State Of EV Charging

GLOBAL AND INDIAN LANDSCAPE

Climate Angels

India's Largest Early Stage Climate Focused Angel Fund

Hosted & Sponsored by-

massive earth foundation

Massive Mobility

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ABOUT CLIMATE ANGELS

Climate Angels is a SEBI regulated Cat-1 Angel fund focused on creating a sustainable future by exclusively investing in companies working on Pollution Reduction and Climate Change. We invest in startups working on Agriculture, Clean Mobility, Water, Waste, and Built Environment (Clean & sustainable cities). In the last 15 months, we have invested in 12 companies and are looking to invest in 20+ companies in the next 18 months.

Portfolio Companies

MATTER

PRAAN®

Digital Paani

ElectricPe

solar square

EM EMOTORAD RIDE THE ELECTRIC REVOLUTION

BECO

Revfin
Smartest, Fastest Electric Vehicle Loans

SHERU TEZZ

Notable Investors investing through Climate Angels


Tejinderpal Miglani
Indiabulls


Nipun Sahni
Apollo Global


Phanindra Sama
Redbus


Sandeep Patel
Nepra


Vijay Shekhar Sharma
Paytm


Paula Mariwala
Aureolis Ventures


Pravin Gandhi
Seed Fund


Neha Mudaliar
GGGI


Ashish Goel
UrbanLadder


Saurabh Chawla
GMR Infrastructure

ABOUT MASSIVE MOBILITY

Massive Mobility is a leading Energy-tech company formed in 2019, which is revolutionising the EV charging landscape with its comprehensive solutions.

BRANDS UNDER MASSIVE MOBILITY

1C EV Charging is committed to developing India's largest and most affordable smart EV charging network.

Zecat offers you the unique opportunity to take home the EV of your choice with incredible lease and loan options

Bhamo.in is a multi-brand online marketplace for both used and new EV 3-wheelers.

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INTRODUCTION

ABOUT THE SECTOR

The EV charging infrastructure sector is at the core of the electric vehicle revolution. With governments worldwide setting ambitious climate targets and automakers committing to an electric future, the demand for reliable and accessible charging infrastructure is rapidly increasing. This sector is essential to enabling a large-scale shift to electric mobility, creating a support system that allows EVs to become a mainstream mode of transport.

The growth in EV adoption has created a need for diverse charging networks that cover everything from urban centers to highways. As the sector expands, it includes various players, from technology companies developing advanced charging solutions to municipalities integrating EV stations into public infrastructure. This infrastructure development is critical to solving logistical challenges, such as ensuring efficient charging times and creating a network that can handle growing energy demand.

Charging infrastructure is transforming both the automotive and energy sectors by connecting electric mobility with clean energy sources. With ongoing advancements, the sector is setting new standards in interoperability, grid management, and user experience, aiming to make EV charging as seamless as refueling a traditional vehicle. This shift represents a critical step toward reducing emissions and achieving a sustainable transportation ecosystem that benefits cities, businesses, and consumers alike.

ELECTRIC MOBILITY INVESTMENTS: GLOBAL

ELECTRIC MOBILITY INVESTMENTS: GLOBAL

KEY STATS

12,626
Companies

435
Acquisitions

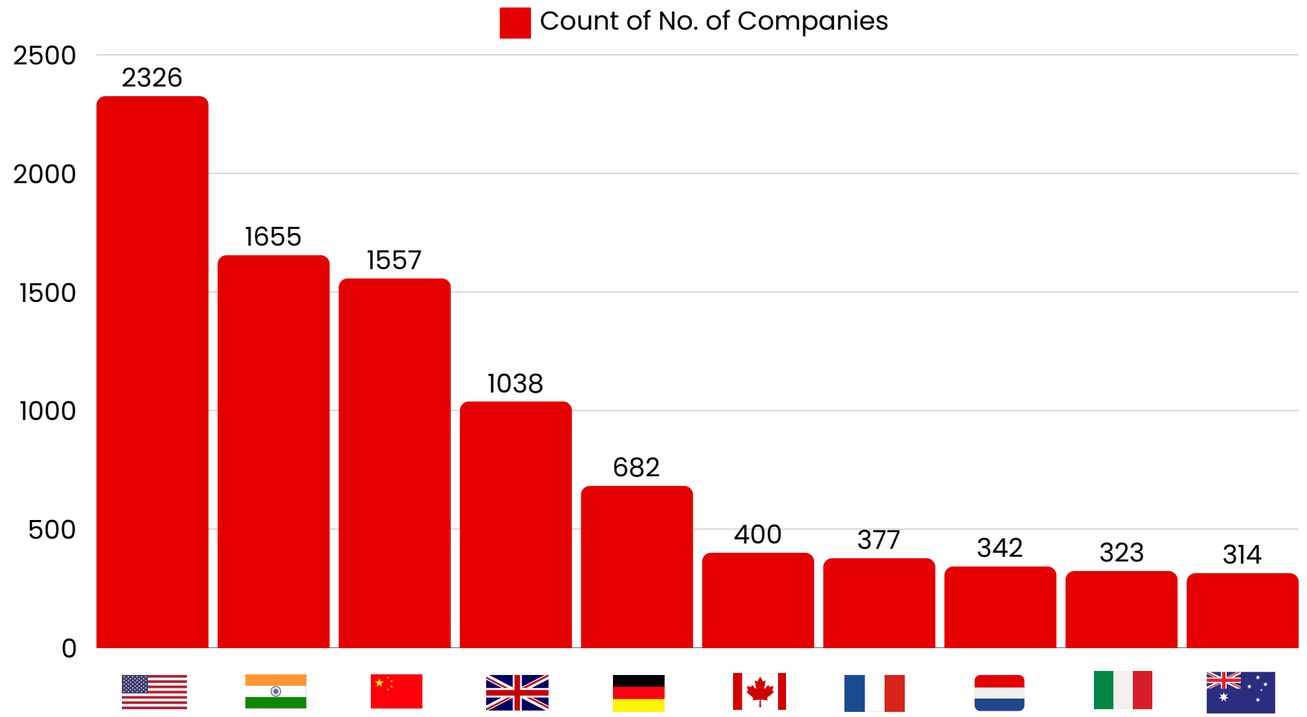
$179B
Total Funding

$47.9B
Funding in last 2 years

45
Active Unicorns

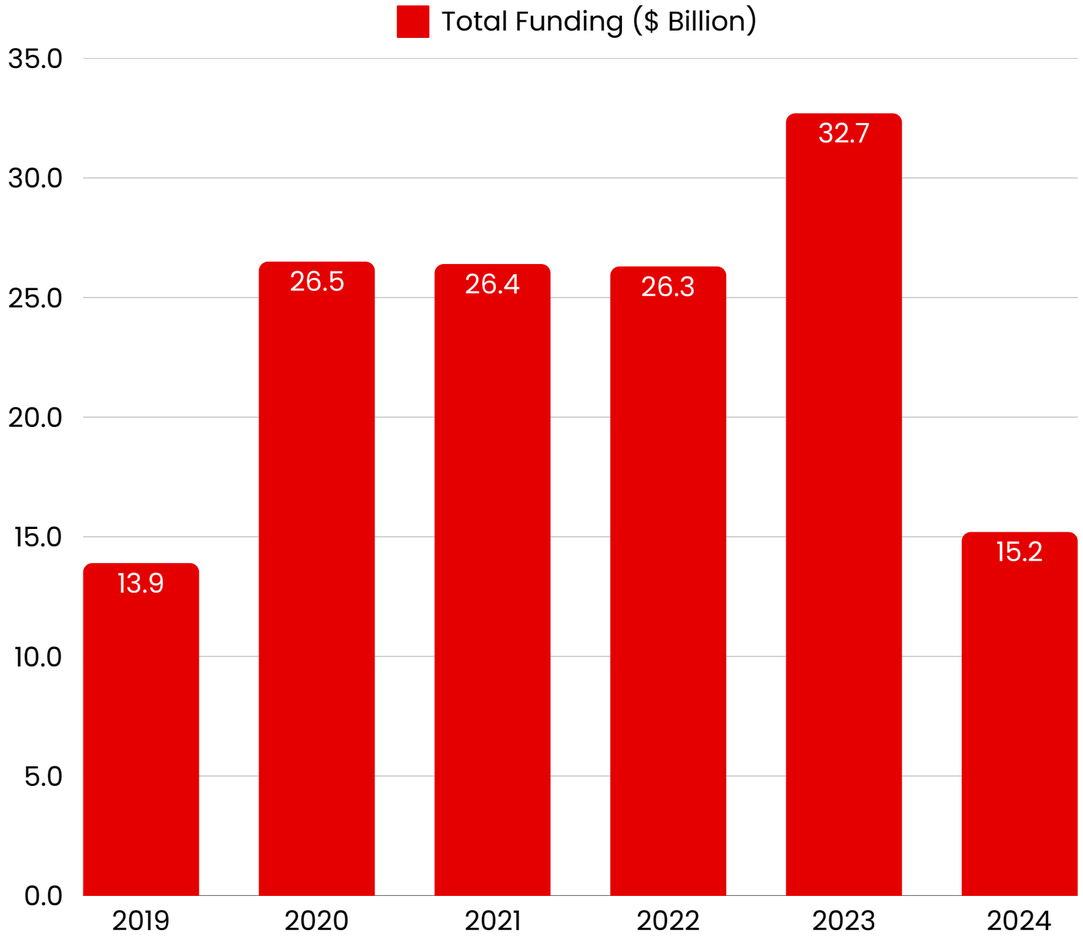
177
IPOs

TOP GEOGRAPHIES



Source: Tracxn

ELECTRIC MOBILITY INVESTMENTS: GLOBAL



The chart depicts the year-over-year (YoY) investment trends in global electric mobility from 2019 to 2024, measured in billions of dollars.

It highlights a substantial growth in funding from 2019 to 2023, with a notable peak of **$32.7 billion in 2023**. However, a significant decline of ~50% was observed in 2024 compared to the previous year. Despite this, the overall investment in electric mobility has seen a significant uptick since the late 2010s.

The investment in electric mobility has fallen, but less in proportion to overall drop in fundings which is a clear indication of the growing interest in electric vehicles and other modes of sustainable transportation.

The drop in electric mobility investments was due to overall funding drop but the future of this sector will witness increased investments with new innovations.

Source: Tracxn

ELECTRIC MOBILITY INVESTMENTS: INDIA

ELECTRIC MOBILITY INVESTMENTS: INDIA

Key Stats

1658
Companies

21
Acquisitions

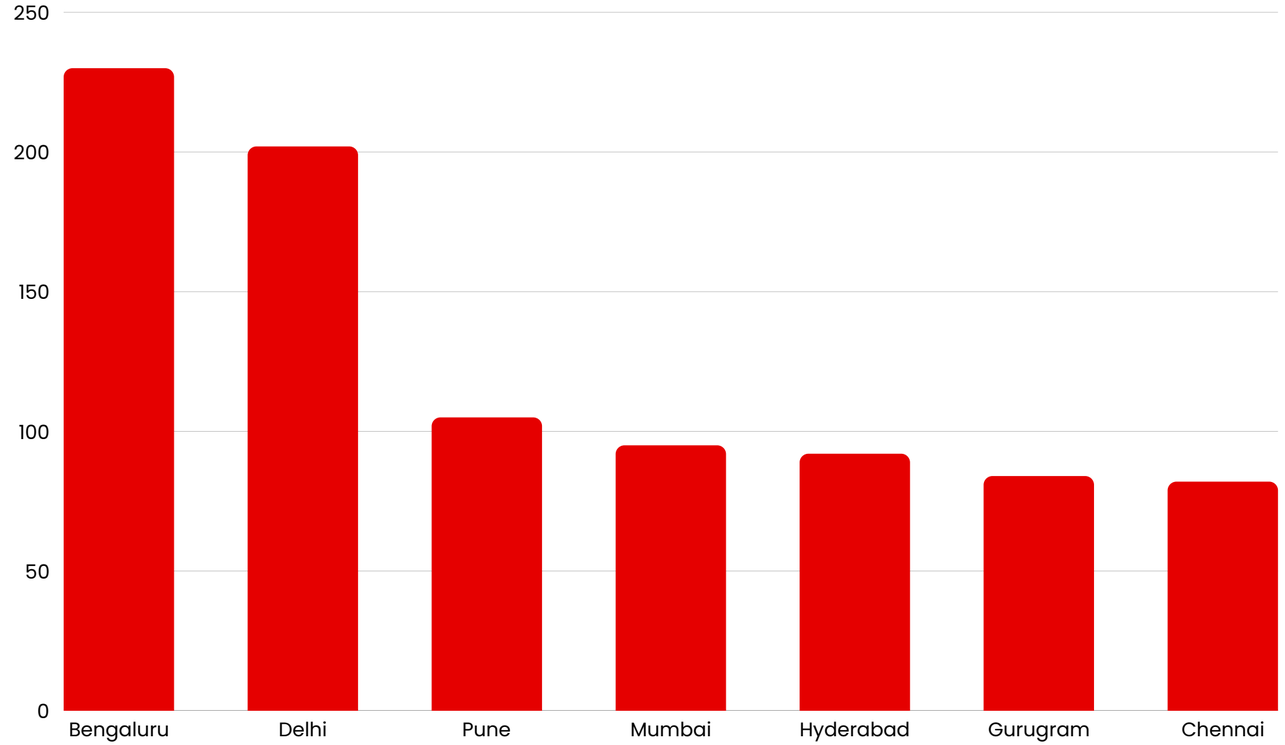
$7.21B
Total Funding

$4.32B
Funding in last 2 years

376
Funded Companies

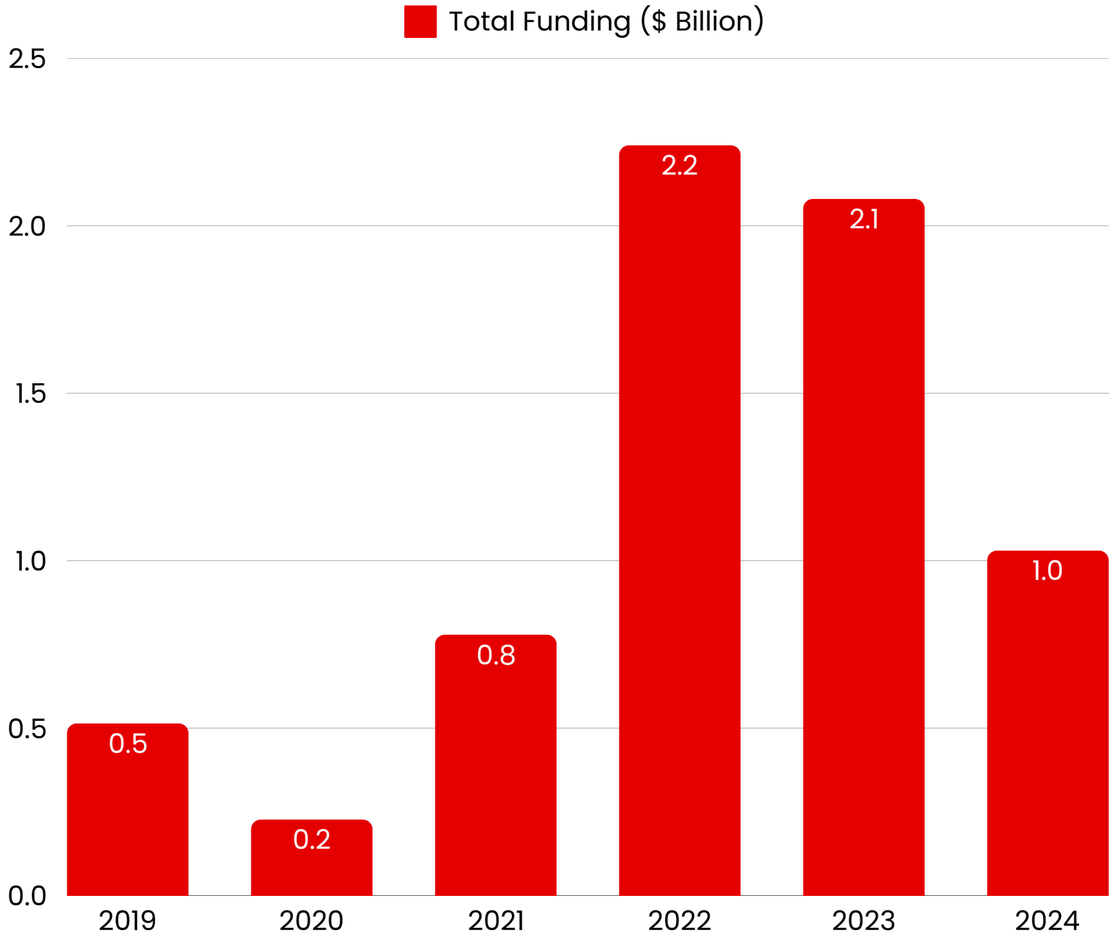
8
IPOs

Top Cities



Source: Tracxn

ELECTRIC MOBILITY FUNDING: INDIA



Source: Tracxn

The data reveals the dynamic nature of investments in India’s electric mobility sector, with notable fluctuations over the past few years.

While 2020 saw a dip due to the pandemic, there was a **strong recovery in 2021 and 2022** reaching a whooping **USD 2.2 Billion**, driven by increasing demand for electric vehicles and supportive government policies.

The slight decline in 2023 and the projected dip in 2024 could indicate a natural market correction after the previous surge, but overall, the sector remains promising with continued interest from investors.

This trend highlights the growing confidence in electric mobility as a key part of India’s sustainable future.

BIGGEST INDIAN ELECTRIC MOBILITY DEALS 2023-24

Electric Vehicles

OLA ELECTRIC
oben ELECTRIC
ATHER
River
EULER
BAAZ
ALTIGREEN DRIVE ELECTRIC
AMPERE
TI INDIA
ZYPP
DELTA AUTOMOTIVE
RAPTEE
BOUNCE infinity
ASTRO MOTORS
SIMPLE
ULTRAVIOLETTE

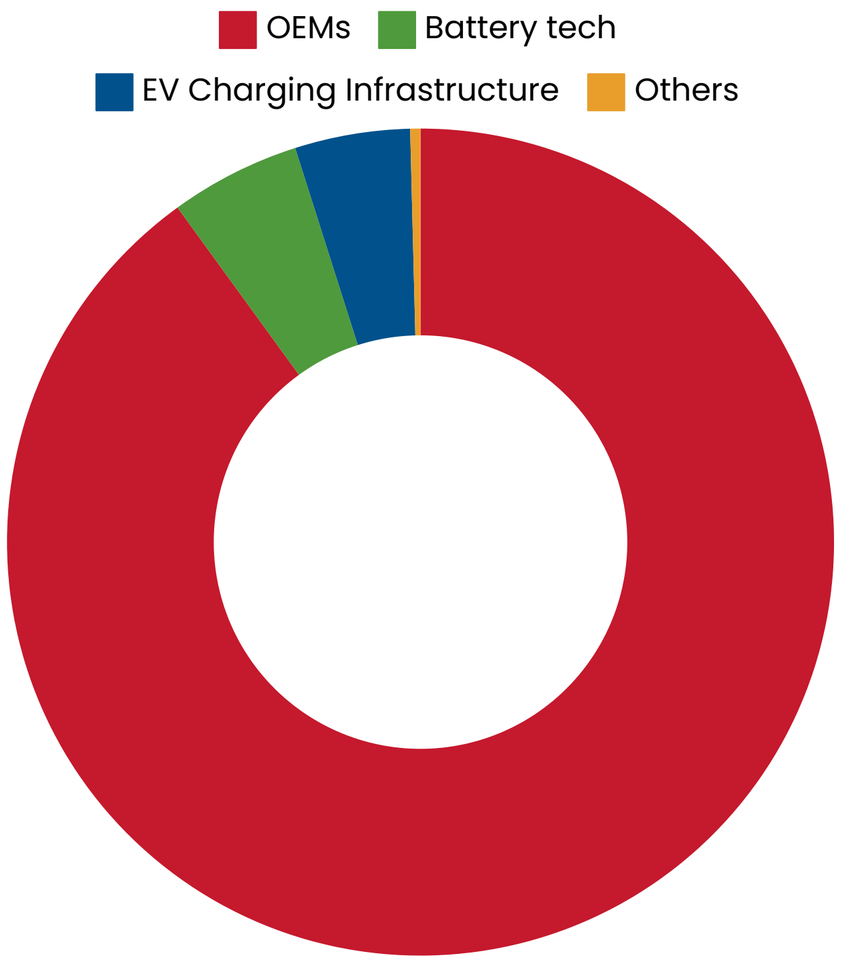
Battery Tech & Charging Infrastructure

RACE energy
LOG9
BOLT.EARTH
kazam
statiq
BatterySmart
CHARGE ZONE POWERING THE FUTURE
êxponent

Others

ohm mobility
BLU SMART MOBILITY
ElectricPe
REVOH
MUFIN
Revfin
Smartest, Fastest Electric Vehicle Loans
VECMOCON TECHNOLOGIES

ELECTRIC MOBILITY FUNDING SPLIT: INDIA



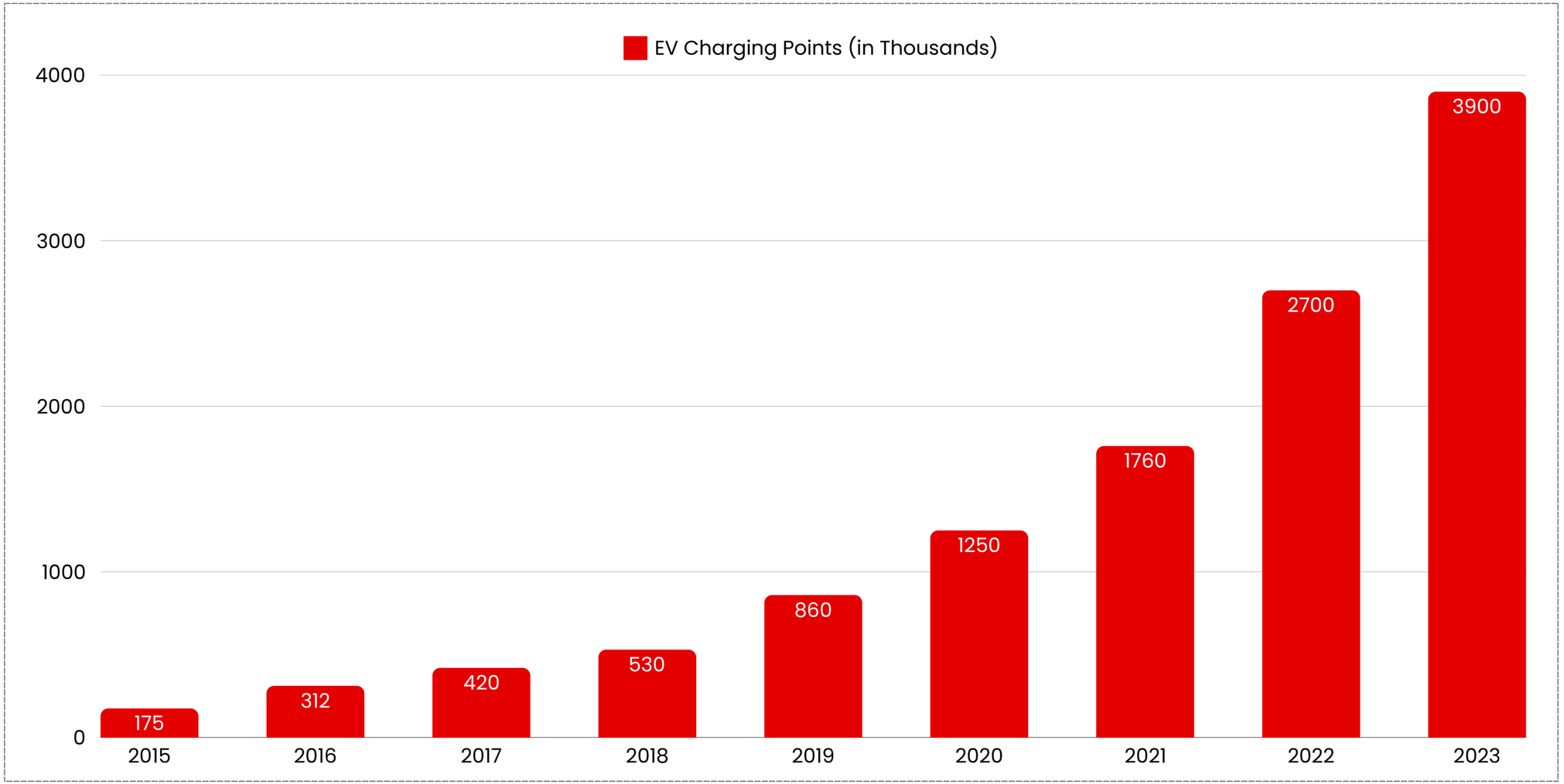
Indian EV startups have raised a total of close to $5 Bn since 2015, with OEMs leading the show so far.

However, a closer look at the current funding activities in the sector reveals that EV OEMs, once the lure of the Indian funding carnival, no longer look lucrative to investors. According to Inc42, over **41% of deals in the industry have been lapped up by non-OEMs in 2023.**

Investment in battery technology was less than 10% of the total which considering the fact that batteries account for about 30-40% of an electric vehicle's cost indicated that significant research and development can still be carried out in the sector.

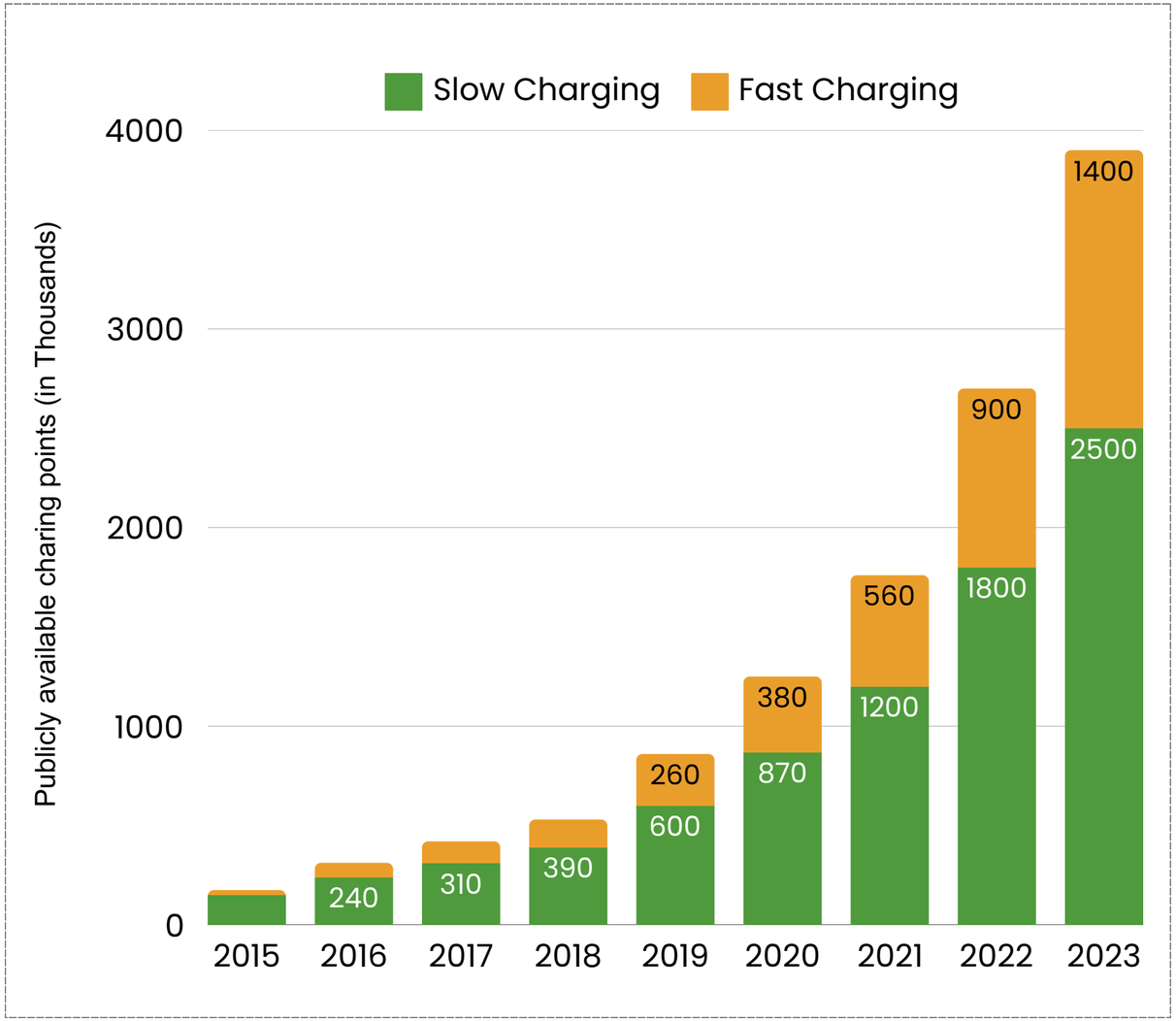
EV CHARGING INFRASTRUCTURE: GLOBAL

EV CHARGING STATIONS: GLOBAL COUNT



Source: IEA

EV CHARGING STATIONS SPLIT



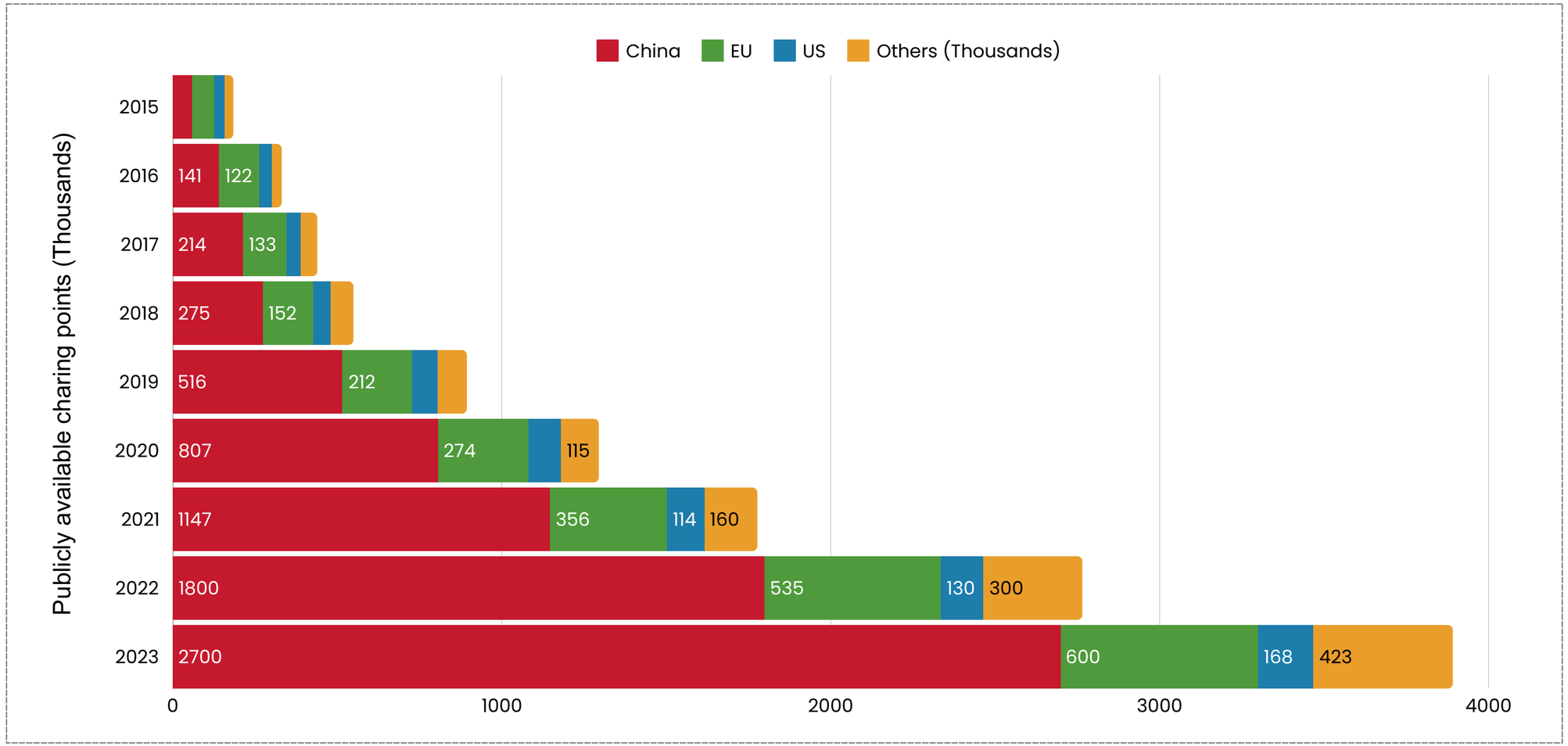
Source: IEA

As the adoption of EVs continues to grow, the infrastructure supporting them is expanding rapidly. Over the years, there has been a clear upward trend in both categories, reflecting the increasing adoption of EVs and the corresponding need for strong charging infrastructure worldwide.

In 2015, the total charging points were modest. However, since then fast charging began to grow significantly alongside slow charging, marking a pivotal moment in EV infrastructure development. By 2023, the growth became exponential, with **2.5 million slow charging points and 1.4 million fast charging points.**

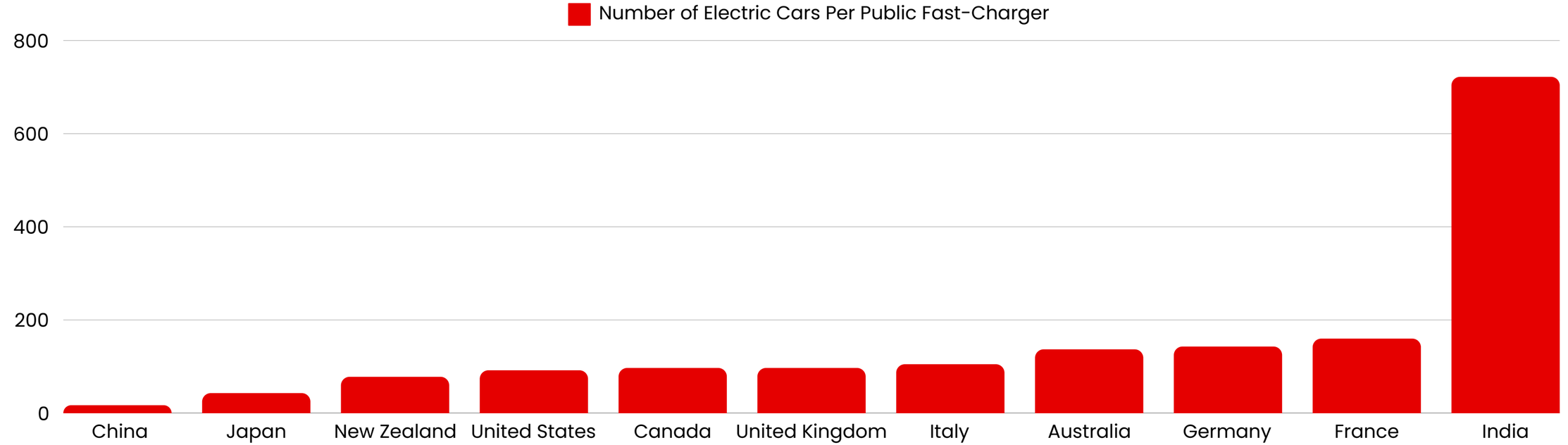
This rapid growth underscores the shift towards fast-charging technology, which enables quicker EV charging, catering to the demands of EV owners and fleet operators.

EV CHARGING STATIONS GLOBAL COUNT (By Country)



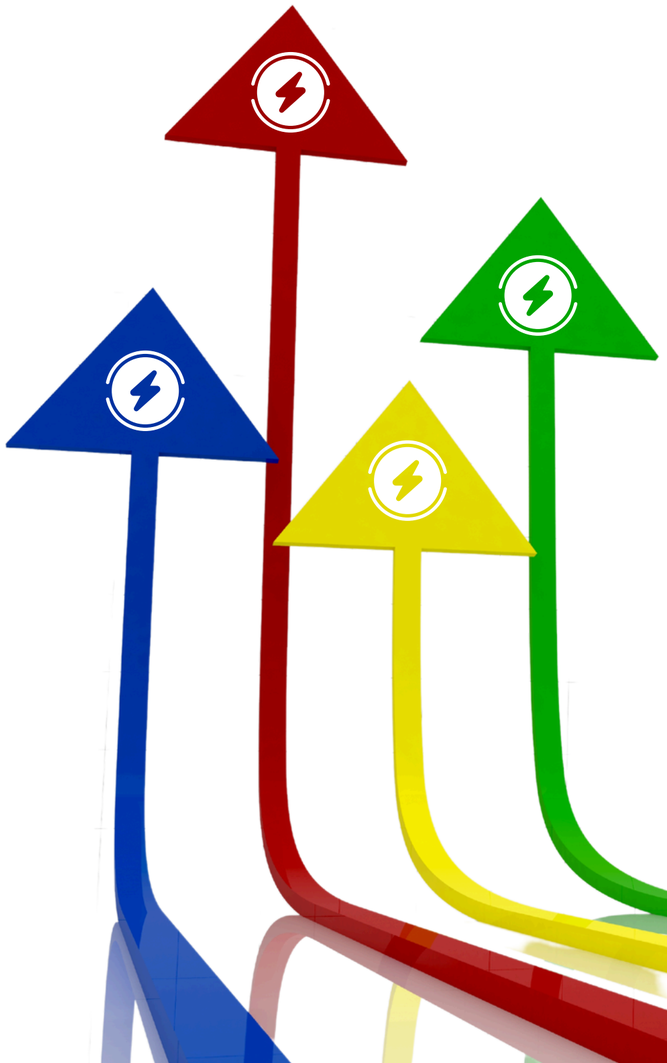
Publicly installed light-duty vehicle charging points
Source: IEA

CHARGING POINTS DENSITY MAJOR CITIES



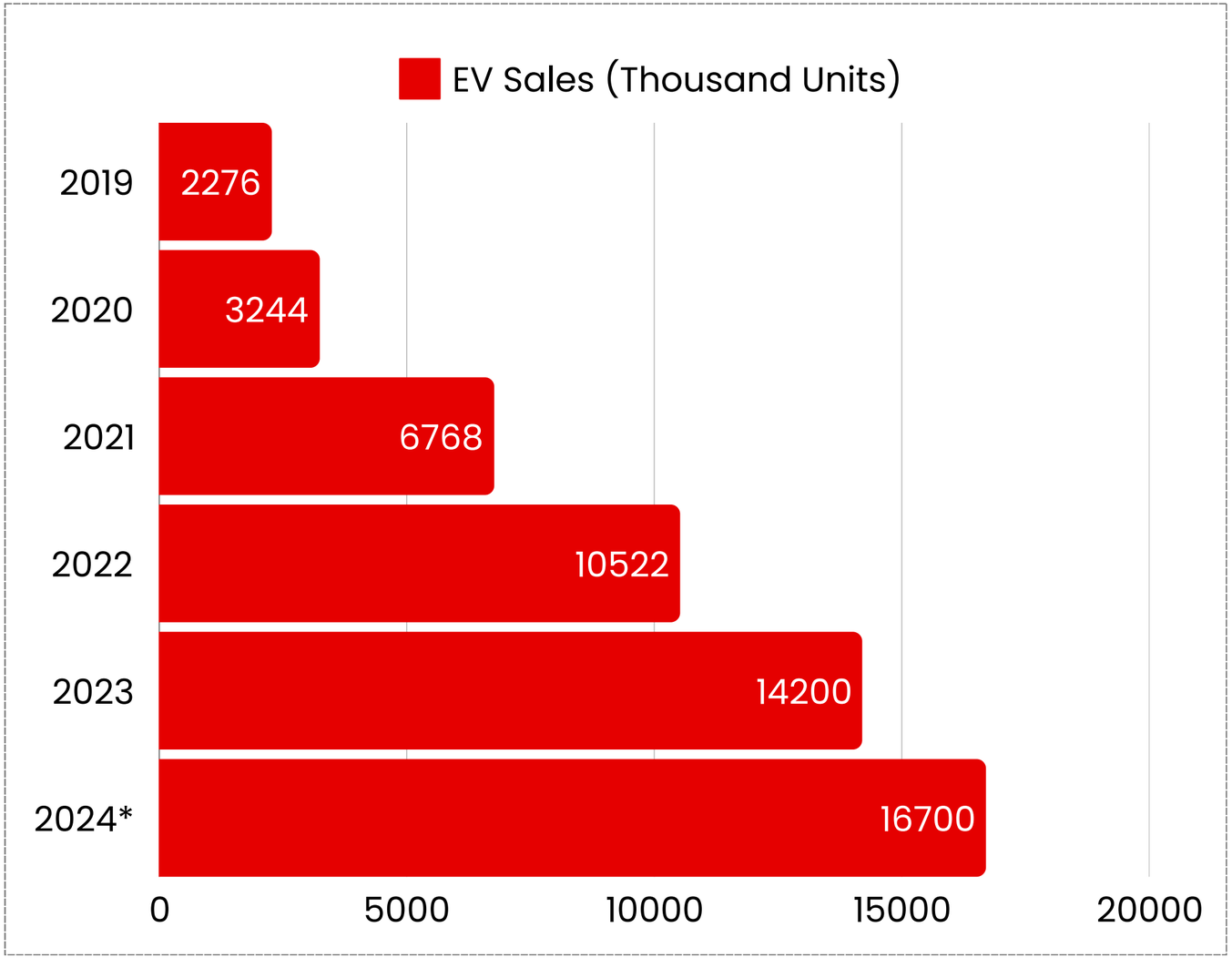
The chart compares the number of electric cars per public fast-charger across various countries. India has the highest ratio, highlighting a significant gap between the number of EVs and available charging stations. This imbalance could lead to charging bottlenecks and slow down electric vehicle adoption. In contrast, countries like China, Japan, and New Zealand have a more balanced ratio, indicating better access to charging infrastructure for EV owners. To support the growth of electric vehicles, especially in countries like India, it is essential to expand public charging infrastructure to provide convenient and reliable charging options for electric car owners.

Source: Sustainability by Numbers



EV SALES: GLOBAL

GLOBAL EV SALES YEAR ON YEAR



Worldwide sales of electric and plug-in hybrid vehicles (PHEVs) rose a healthy 31% in 2023, but that was down from 60% in 2022, according to market research firm Rho Motion.

Battery electric vehicles (BEVs) accounted for 9.5-million of the **14.2 million EVs sold around the world in 2023**, with PHEVs accounting for the balance.

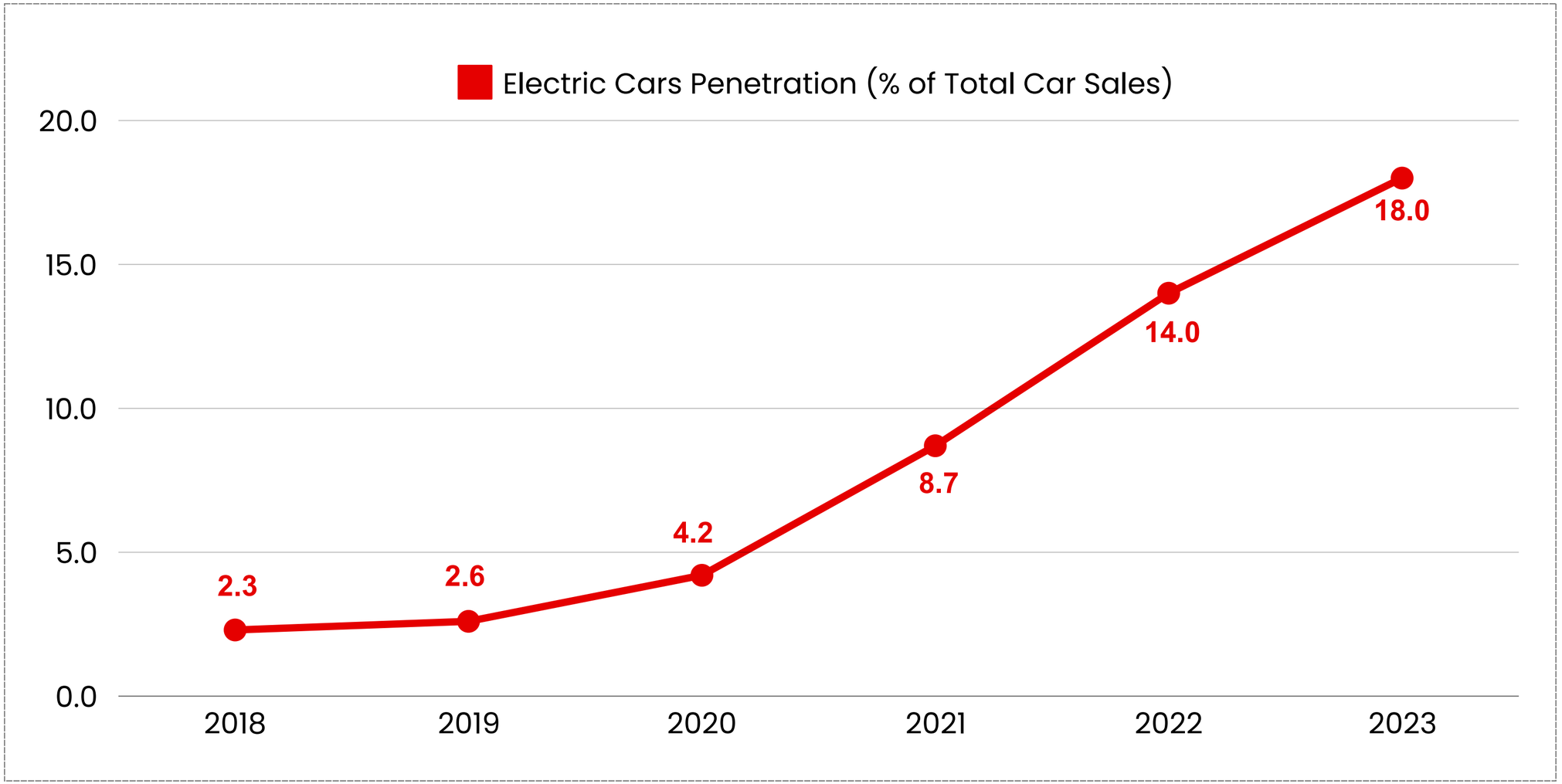
After years of accelerating growth, some automakers are concerned electric car sales in Europe and elsewhere could be heading for slowing demand as drivers wait for better, smaller and cheaper models that are two to three years down the road.

Last year BEV sales grew 50% in the US and Canada, and by 27% and 15% in Europe and China respectively.

Source: EVVOLUMES

*As of October 2024

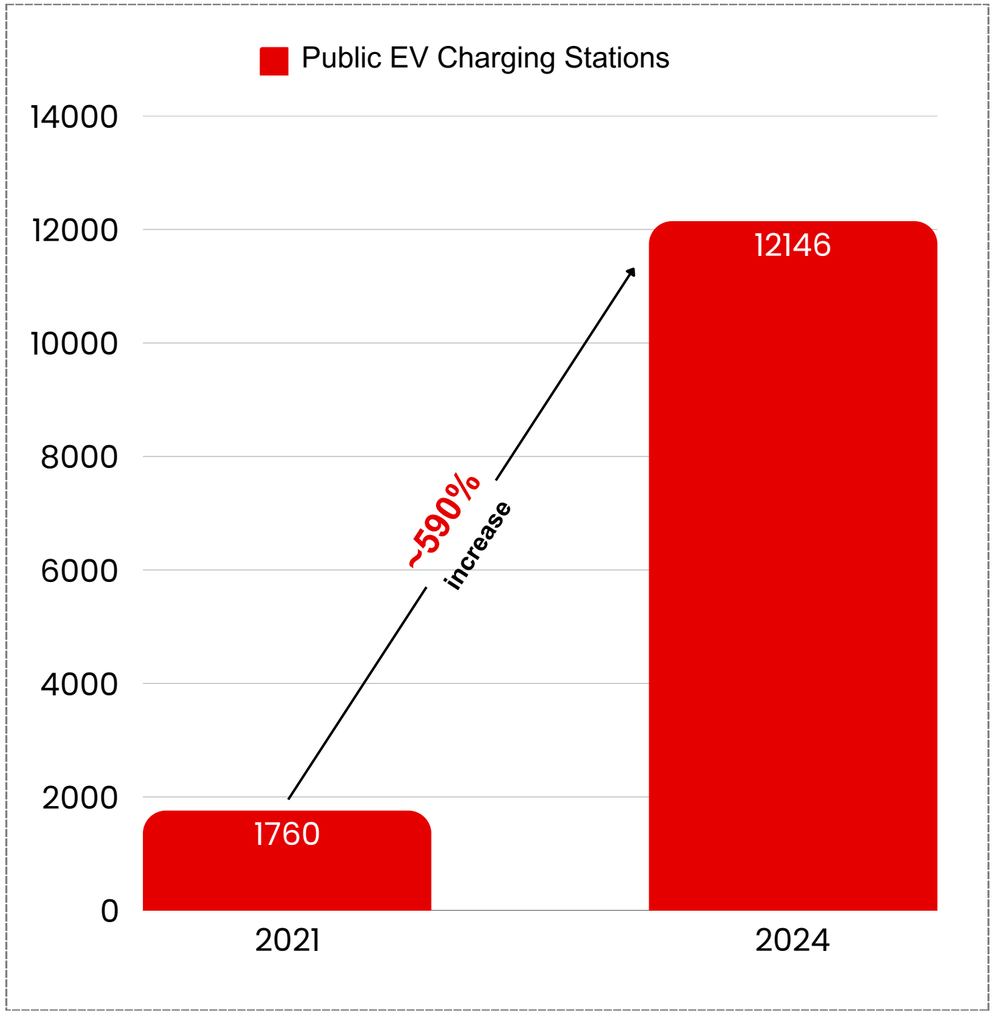
E-CARS PENETRATION OVER THE YEARS: GLOBAL



Source: IEA

EV CHARGING INFRASTRUCTURE: INDIA

PUBLIC EV CHARGER COUNT: INDIA



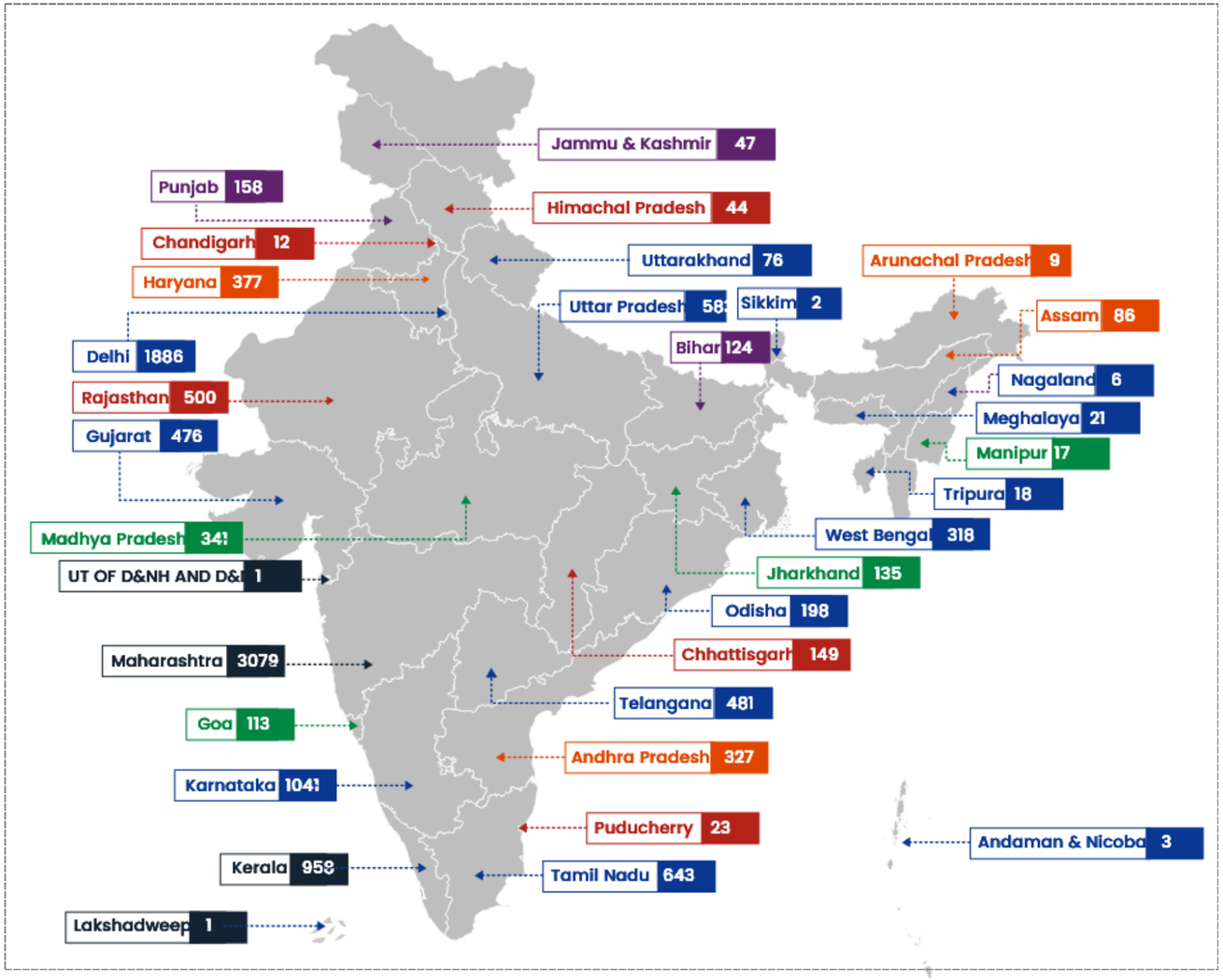
Source: Bureau of Energy Efficiency (BEE)

India had 12,146 public EV charging stations as of October 2024, serving approximately 2.4 million EVs.

In July 2022, Alvarez and Marsal, a global professional services firm, reported that the ideal EV/public charger ratio globally is 6-20 EVs per charger, while India's estimated ratio was 135. The report highlighted that China and the Netherlands had a ratio of 6, and the US had 19 in 2022. Bridging this gap would require approximately 46,000 more charging stations in India to meet the global ideal ratio.

However, infrastructure challenges persist. A survey conducted by Massive Mobility Private Limited found that out of 2,200 listed chargers in Delhi-NCR, only about 250 are functional. The others were either absent, or non-operational. This highlights the need to expand and ensure reliable charging infrastructure.

CUMULATIVE CHARGING STATIONS: INDIA



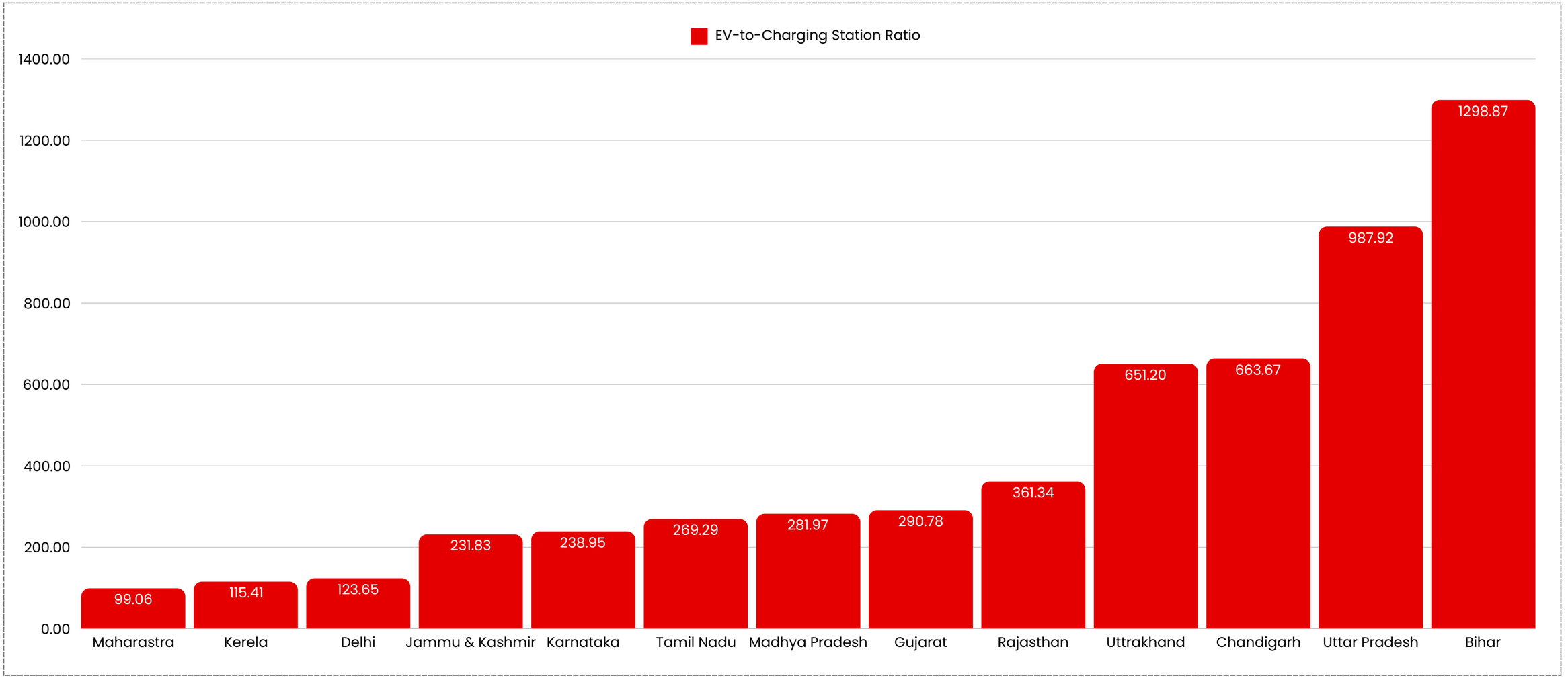
Source: Bureau of Energy Efficiency (BEE)

As per ministry of power there are **12,146 public charging stations and 84 charge point operators across India** as of February 2, 2024.

Maharashtra has emerged as the frontrunner in supporting electric vehicles (EVs), with 3,079 public charging stations - the highest in the country, statistics from the Bureau of Energy Efficiency (BEE), under the Union ministry of power, show. Delhi follows closely behind, with 1,886 charging stations, while Karnataka boasts of 1,041. Tamil Nadu, Uttar Pradesh, and Telangana have 643, 582, and 481 charging stations, respectively.

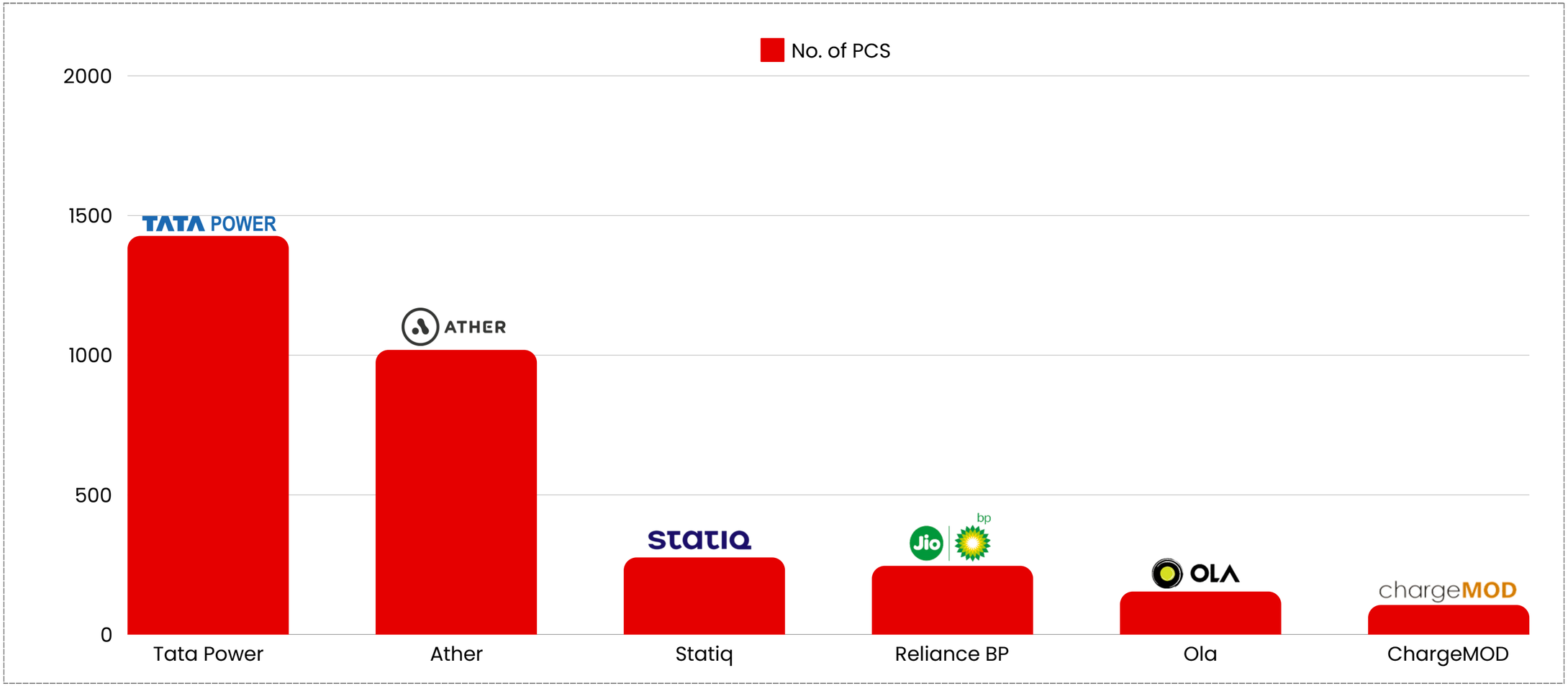
Across the country, there are **26.8 lakh EVs**, out of the 34.59 crore vehicles. Uttar Pradesh leads the EV count with 5.4 lakh, followed by Maharashtra with 2.8 lakh, Karnataka with 2.3 lakh, Delhi with 2.2 lakh, and Tamil Nadu with 1.6 lakh.

EV-TO-CHARGING STATION RATIO: STATE WISE



Based on state-wise details of electric vehicles as on 03.08.2023
Source: Public Information Bureau

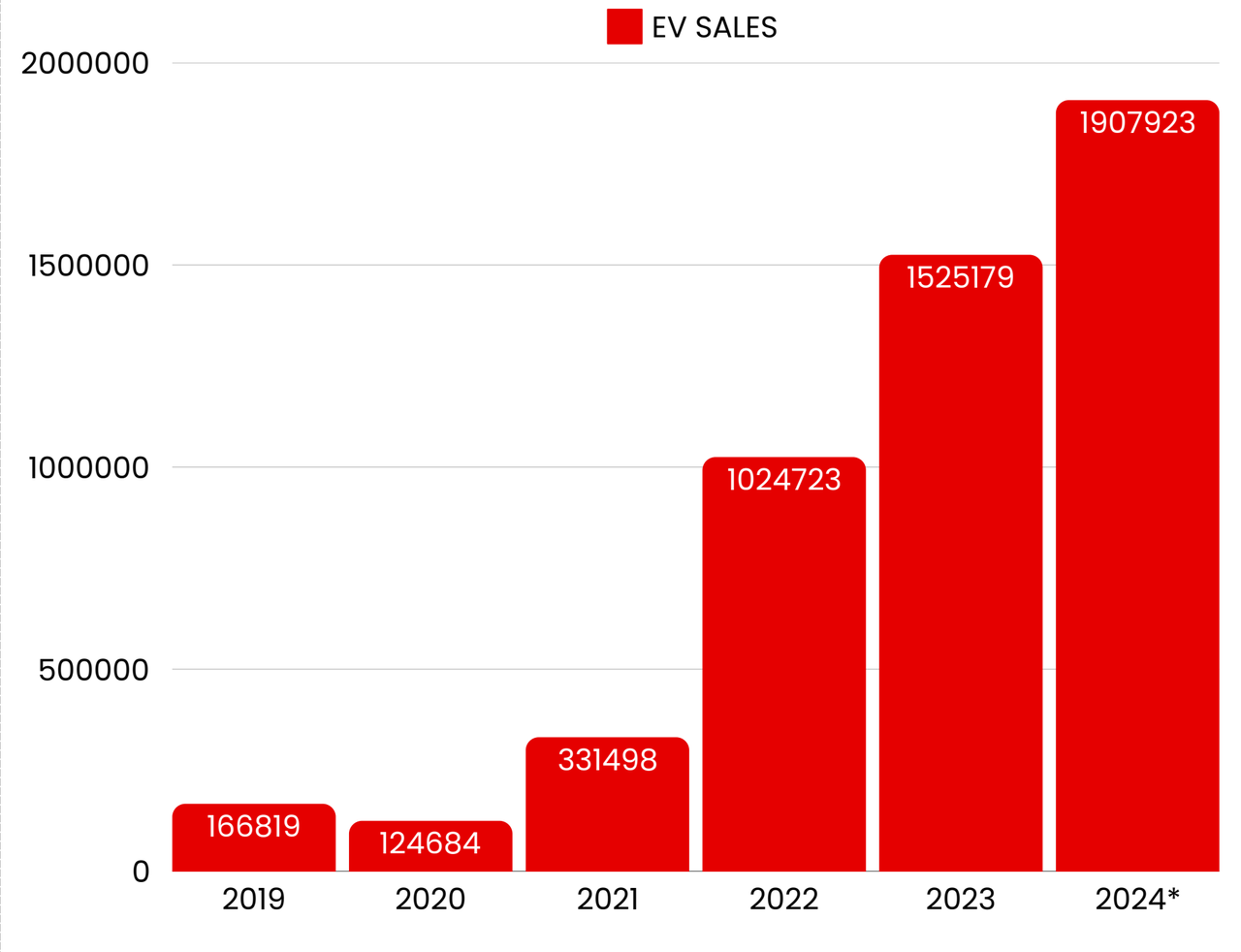
CHARGING STATION DISTRIBUTION IN INDIA (By Company)



Source: Bureau of Energy Efficiency, Ministry of Power

EV SALES: INDIA

ELECTRIC VEHICLE SALES: INDIA

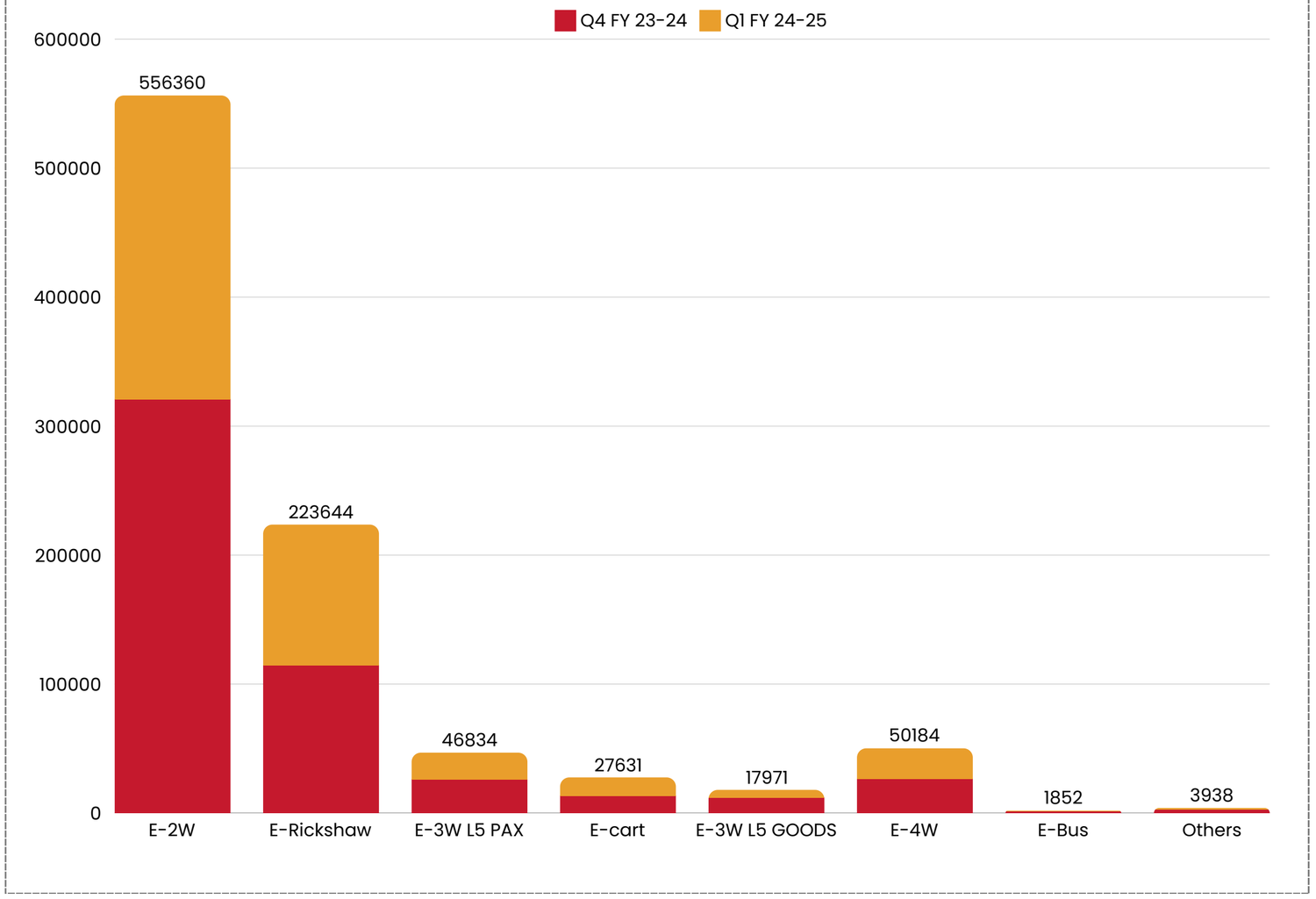


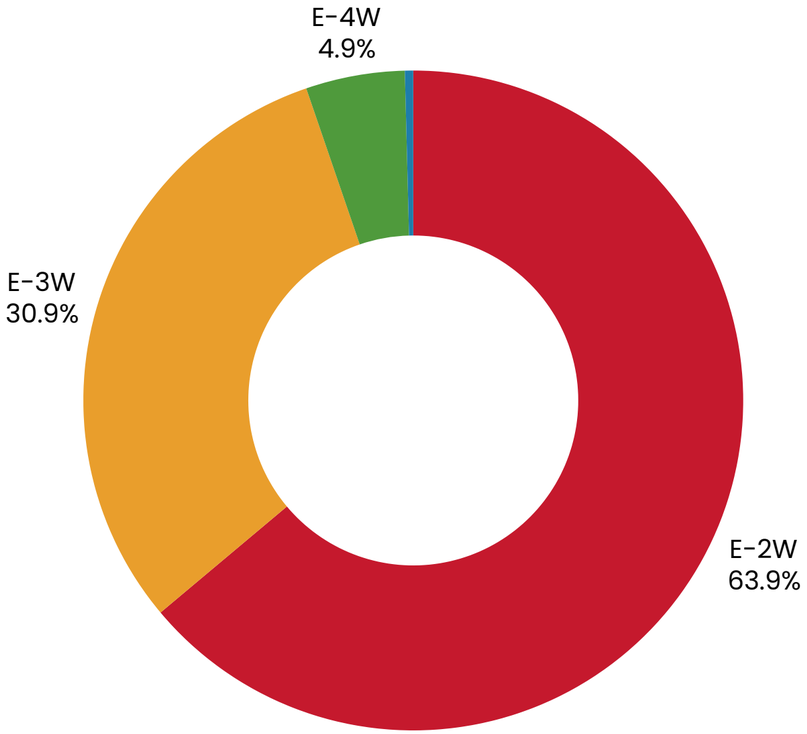
As of October 2024, India's electric vehicle sales reached a milestone of **1,907,923 units**, marking a substantial rise from the previous year. This growth is expected to accelerate further with the upcoming FAME III initiative, which aims to introduce new incentives to the EV sector. Sales trends have shown fluctuating demand, beginning with 154,152 units in November 2023, peaking at 213,063 units in March 2024, and briefly dipping to 115,898 units in April before hitting an all-time high of 217,716 units in October 2024.

In terms of vehicle categories, **two- and three-wheelers dominated, representing 94% of total sales** in the first 10 months of 2024. E2-wheelers accounted for 59.20%, while E3-wheelers held a 35.25% share. Electric cars and SUVs contributed 5% of sales, while electric buses and commercial vehicles represented a modest 0.54%. The top EV-selling states were Uttar Pradesh, Maharashtra, Karnataka, Tamil Nadu, and Rajasthan, underscoring regional adoption. With EV penetration climbing to 7.71%, up from 6.47% in 2023, India is steadily advancing toward an electric mobility future.

Source: Vahan
*As of October 2024

MARKET SHARE FOR TYPES OF EVs SOLD

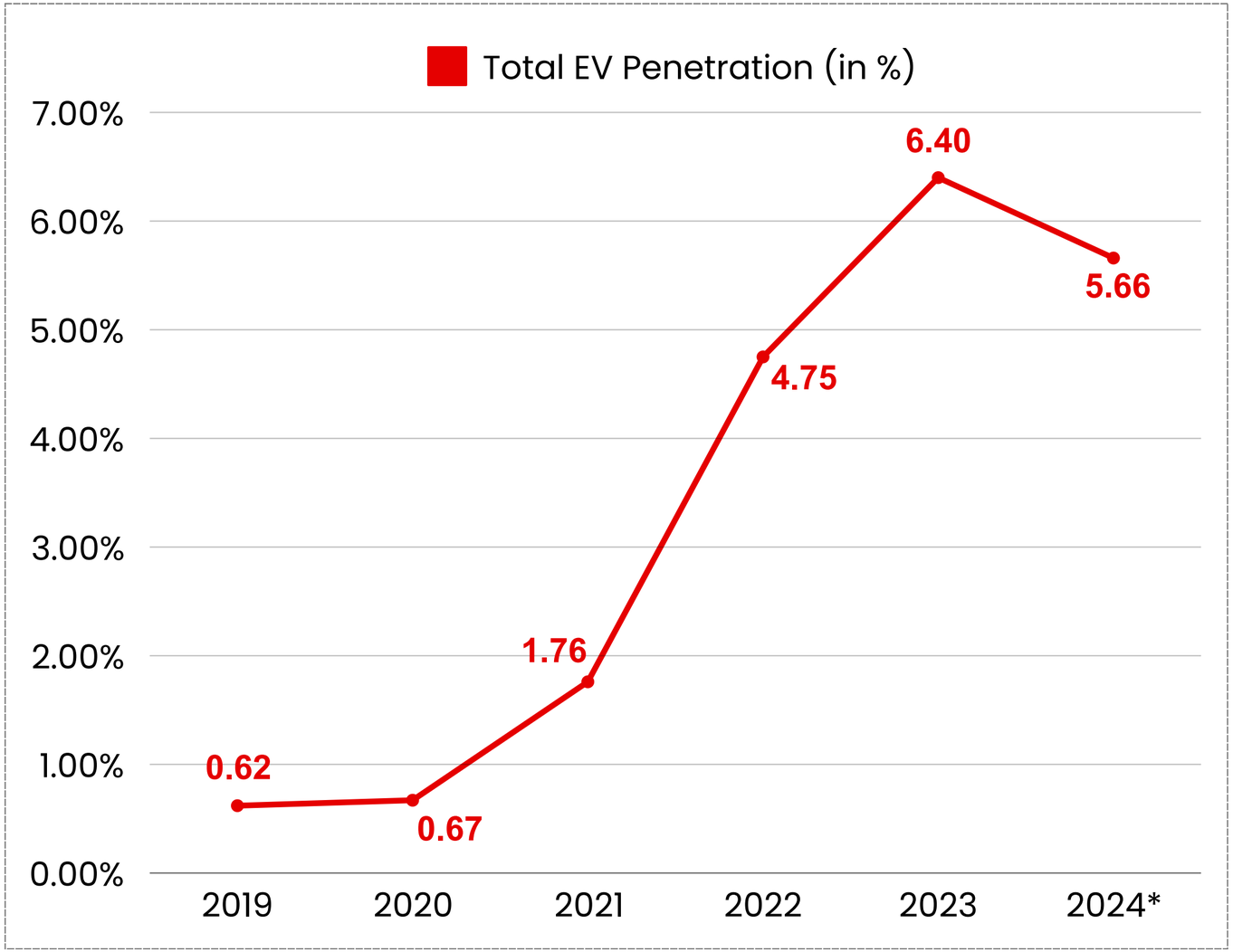




E-2Ws are dominating the EV market in India

Source: Vahan

EV PENETRATION OVER THE YEARS

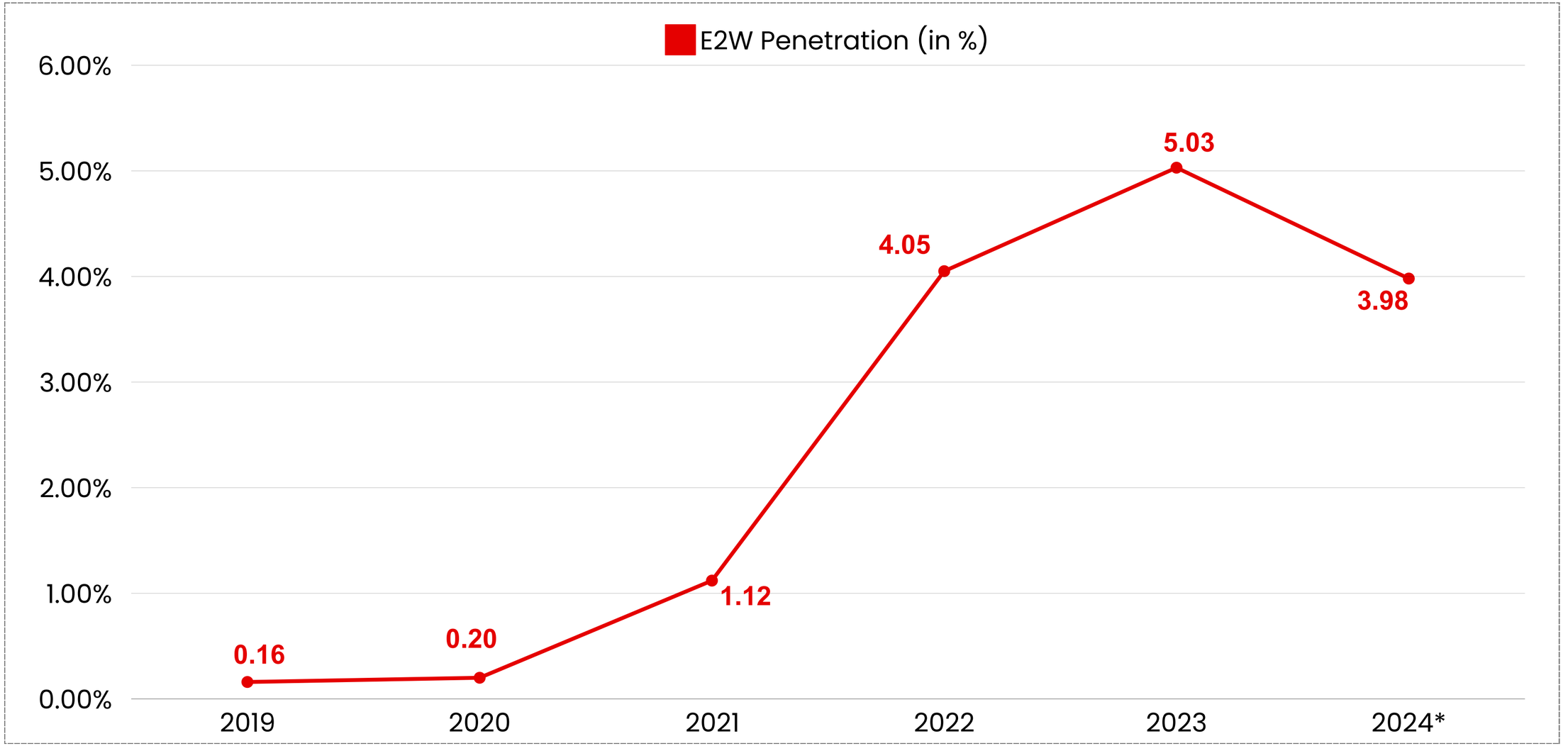


Source: Vahan

The data on total EV penetration in India highlights a significant upward trajectory from 2019 to 2023, reflecting growing adoption of electric vehicles in the country and demonstrating increased consumer awareness, favorable government policies, and infrastructure development. However, the slight dip projected for 2024 could indicate a temporary market correction, possibly due to supply chain challenges, policy transitions, or shifts in consumer behavior.

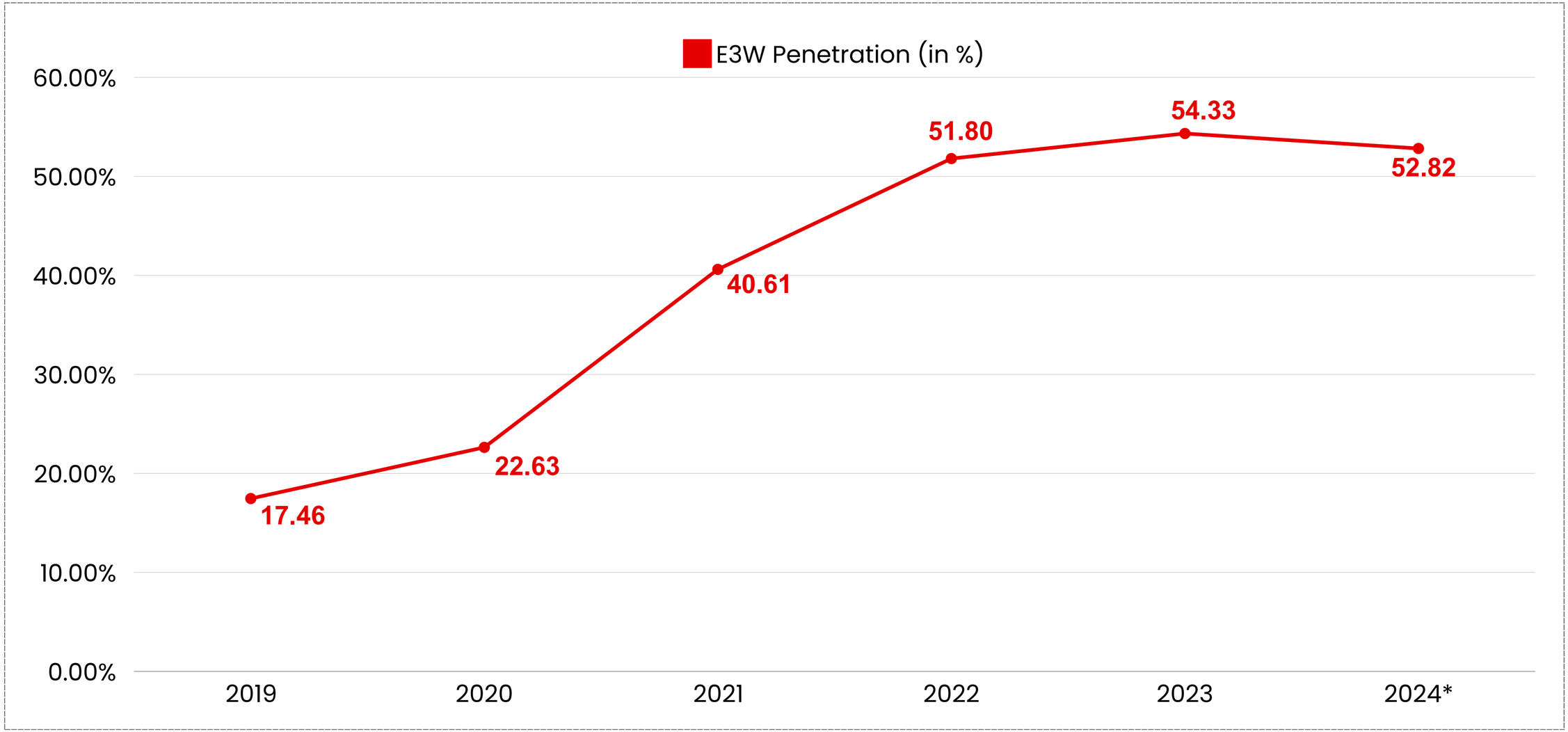
Despite this fluctuation, the long-term trend suggests that India is progressing towards a sustainable mobility future, driven by a stronger focus on reducing carbon emissions. This trend underscores the need for continued investment in charging infrastructure and policy incentives to maintain and accelerate this momentum.

EV PENETRATION OVER THE YEARS



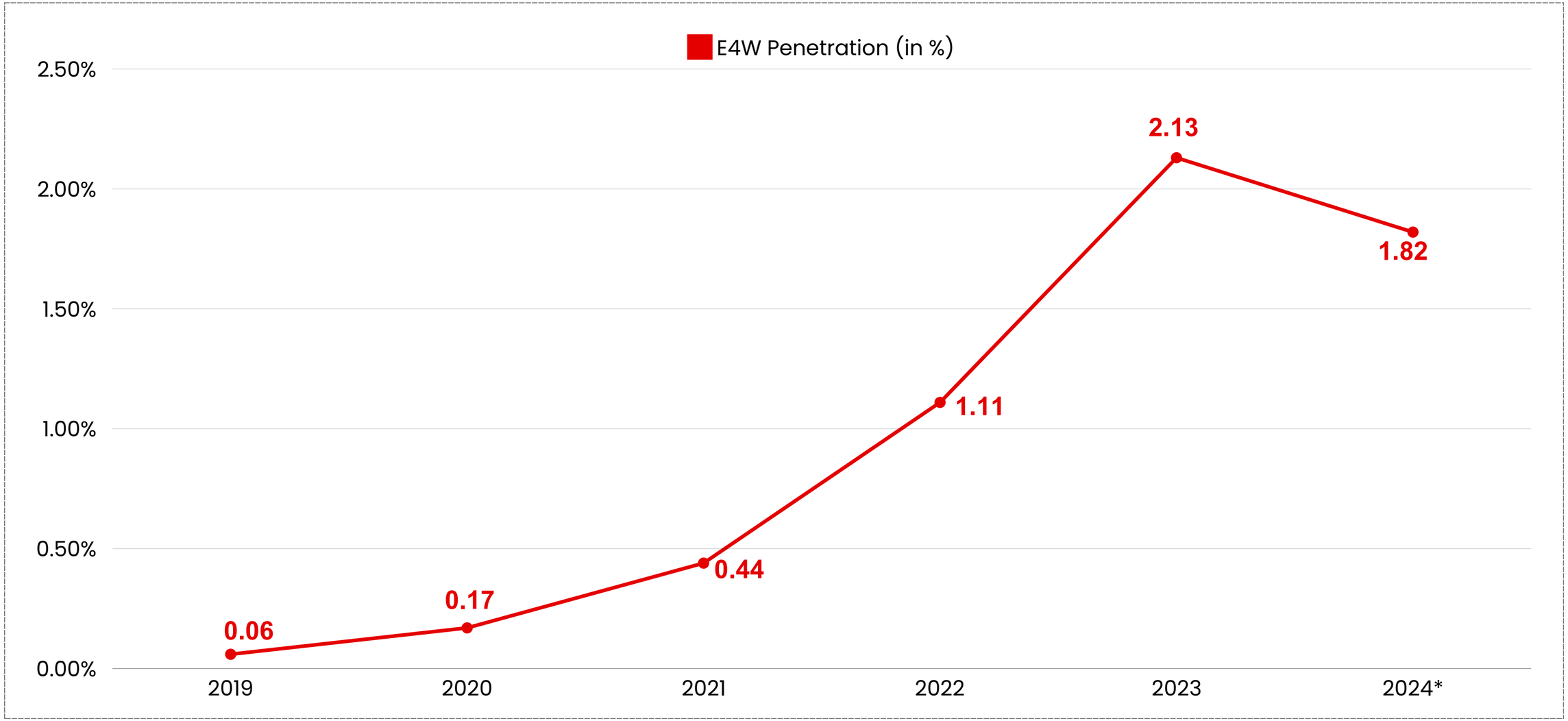
Source: Vahan

EV PENETRATION OVER THE YEARS



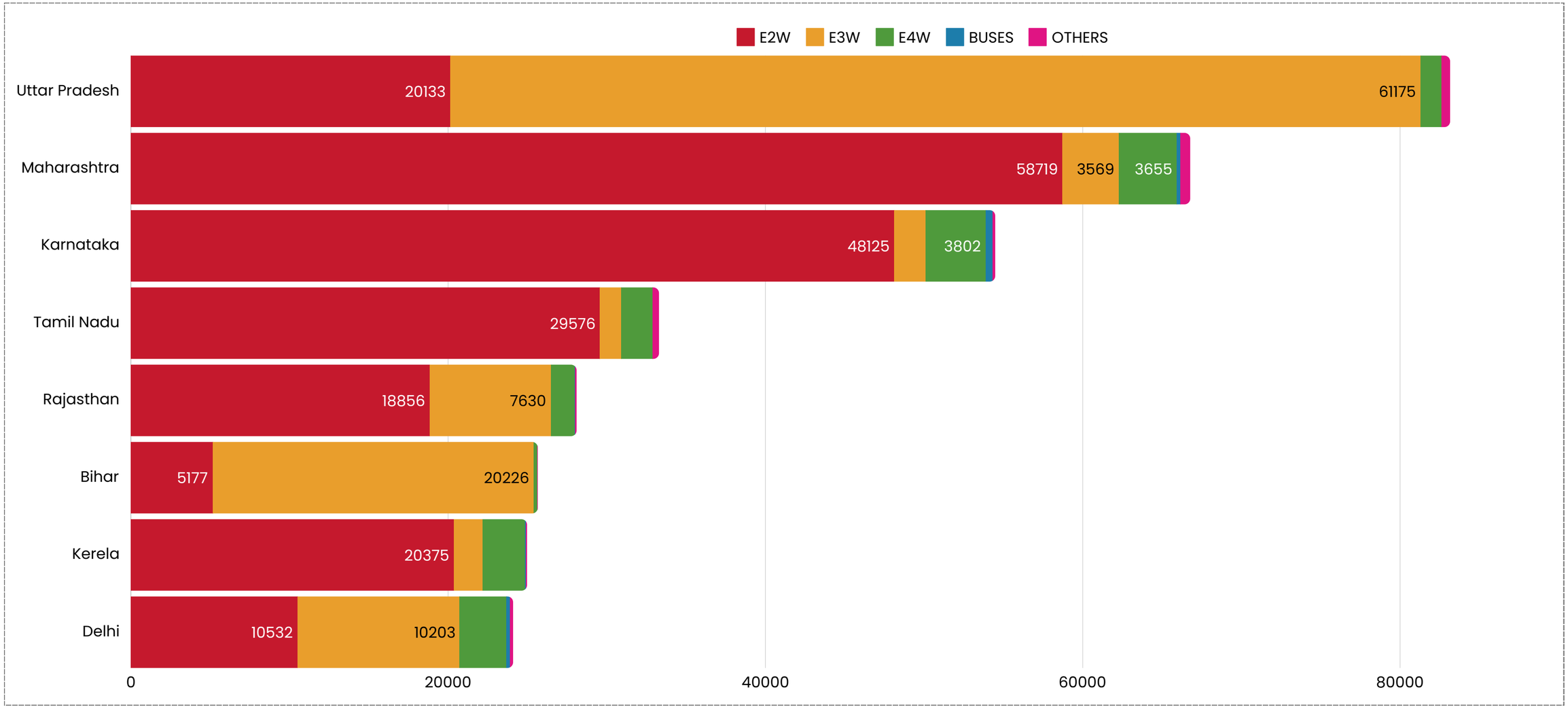
Source: Vahan

EV PENETRATION OVER THE YEARS

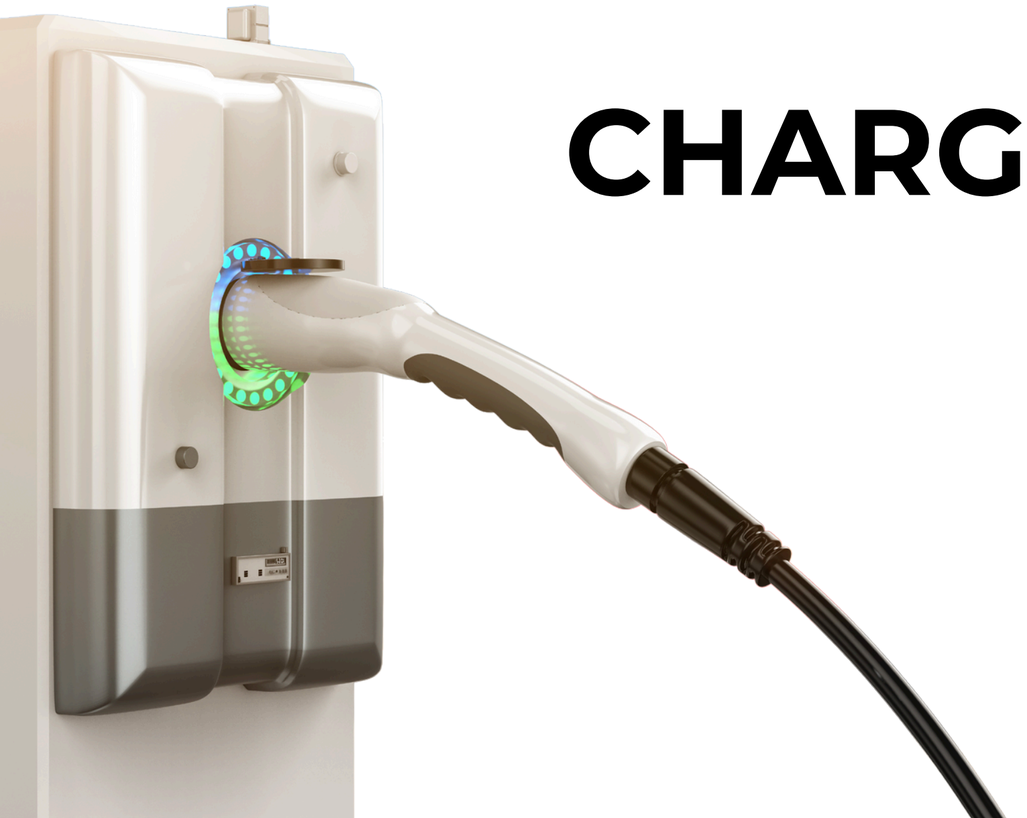


Source: Vahan

EV SALES BY TOP STATES FOR Q4 FY 23-24

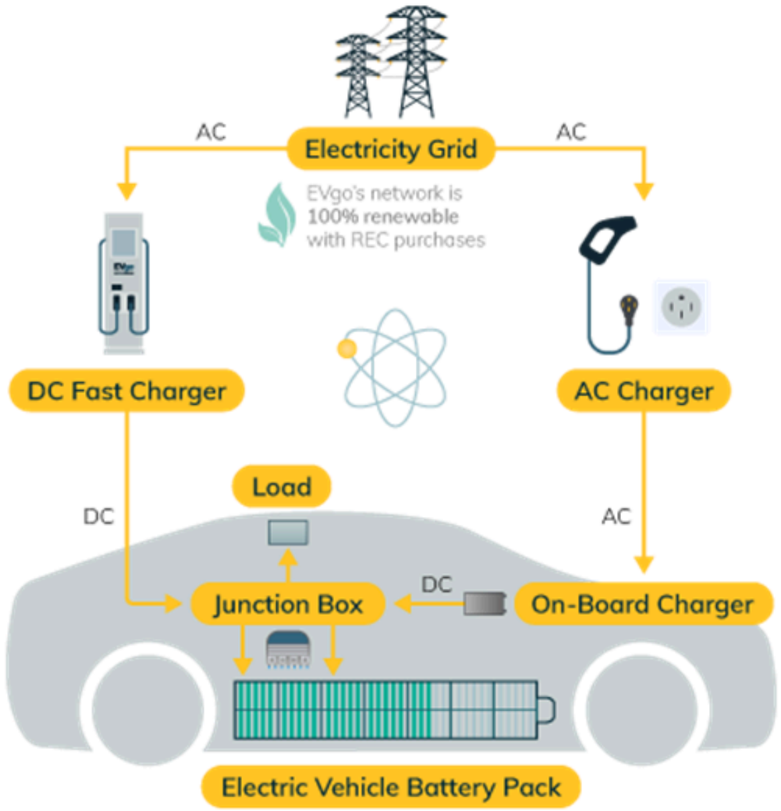


Source: EVreporter Q4 FY2023-24 report, Vahan and Telengana Open data portal.



DIFFERENT CHARGING TECHNOLOGIES

HOW DOES EV CHARGING WORK?



EV chargers can be classified as AC or DC Chargers.

A normal car battery only stores power as DC. Thus, power needs to be converted from AC into DC either inside or outside the car.

For AC charging, AC is converted to DC inside the car using an onboard converter, thereby slowing down the process.

In DC charger, AC from the gird is converted to DC inside the charger. Thus, it can feed power directly into the car's battery by-passing the OBC, making it faster than AC charging.

DIFFERENCE BETWEEN FAST AND SLOW CHARGERS

SLOW CHARGERS

- A slow charger is typically defined as an EV charger that operates at a rate of 3.3kW to 7.4kW.
- Slow charging can take up to 12 hours to achieve a full charge but it is good for the battery life.
- These slow chargers are inexpensive and are widely used for private charging in households and RWAs.

One of the biggest drawbacks of slow charger is the fact that it takes a lot of time to charge electric vehicles, especially the electric-cars or 4-wheelers.

FAST CHARGERS

- Fast charging for electric vehicles involves charging the battery at a rate of 15 kW or higher.
- Fast charging can charge the battery up to 80% in 30-60 minutes, depending on the charging station and battery size.
- Fast charging is more expensive and generates more heat, which can reduce the battery's lifespan if used frequently. However, it can be convenient for long-distance travel and provide a quick charge when needed.

DIFFERENCE BETWEEN AC AND DC CHARGERS

AC CHARGERS

- Supplies alternating current to the EV's onboard charger, which then converts it into direct current to charge the battery.
- Typically slower because the onboard charger in EVs has limited power handling capacity (e.g., 3-22 kW for most vehicles).
- Requires less complex and cheaper infrastructure, making it more suitable for home, workplace, and public slow-charging stations.
- Generally more economical, both in terms of installation and operational costs.

DC CHARGERS

- Supplies direct current directly to the EV's battery, bypassing the onboard charger.
- Much faster, as it provides high-power output (up to 350 kW or more) directly to the battery.
- Requires expensive and complex infrastructure, often found at dedicated fast-charging stations along highways or urban hubs.
- Higher installation and operational costs due to advanced technology and high power output.

WHAT FACTORS AFFECT EV CHARGING SPEED?

THE VEHICLE

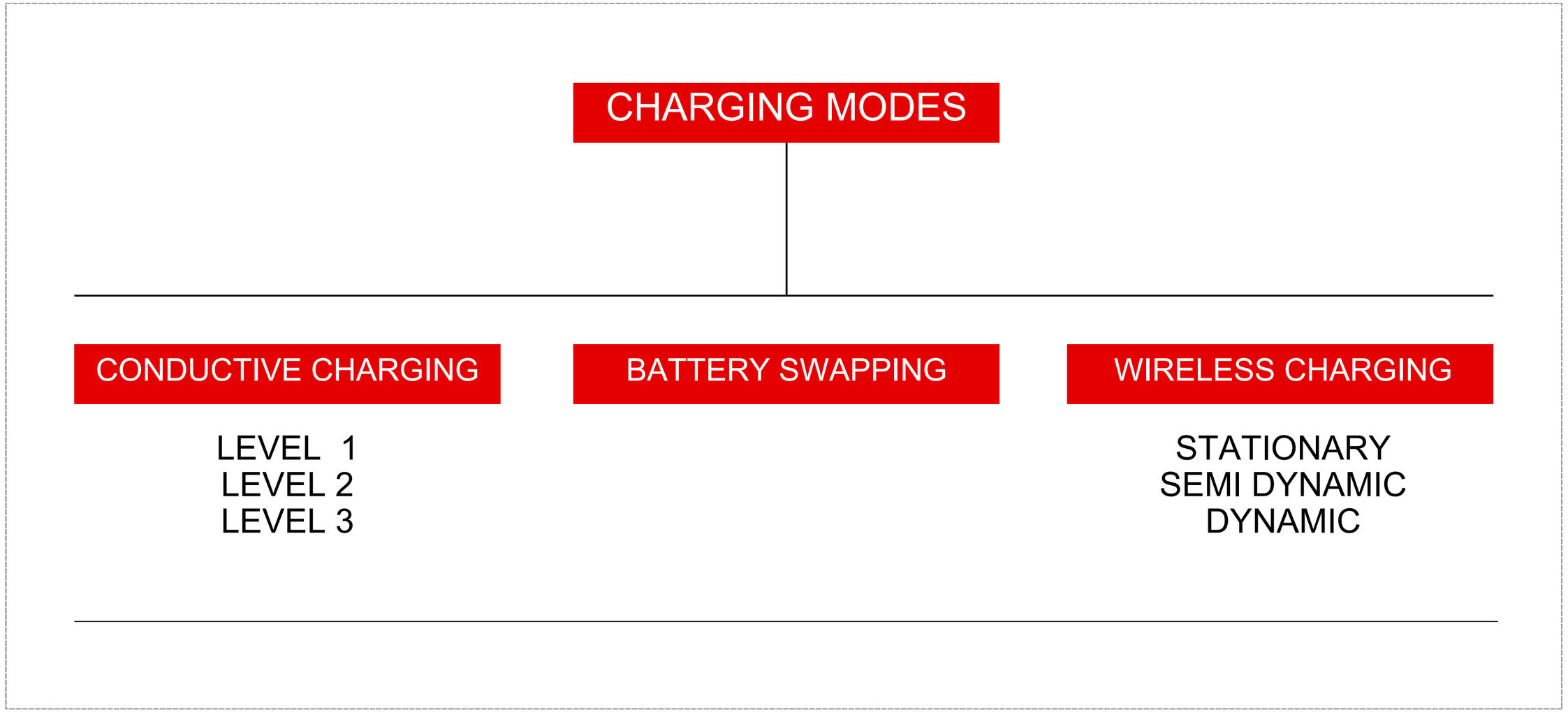
Different vehicle manufacturers design different batteries. And because the battery is usually the single most expensive component of the vehicle, it’s in everyone’s best interest to maximize the battery’s longevity, health, and safety.

As a result, when a vehicle charges, the Battery Management System or the BMS of the vehicle considers a multitude of factors and then communicates with the charging device to decide the voltage and current it can accept - the product of which determines the charge rate in a way that maximizes the longevity of the vehicle.

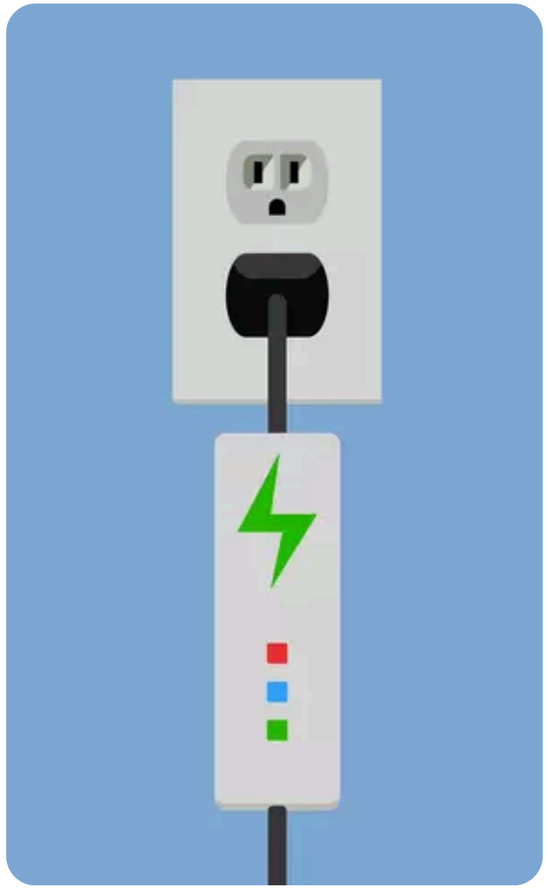
ATMOSPHERIC

Electric vehicle batteries don't like to be too hot or too cold. The charging of a battery generates heat (check your mobile phone when it’s charging), and the battery management system will protect a battery from overheating, so when the battery gets too hot the battery management system will slow down charging (and if the ambient temperature is high or you've been driving your EV for a long time then this might happen earlier as the battery temperature is already elevated).

CHARGING MODES FOR ELECTRIC VEHICLES



LEVEL ONE CHARGERS



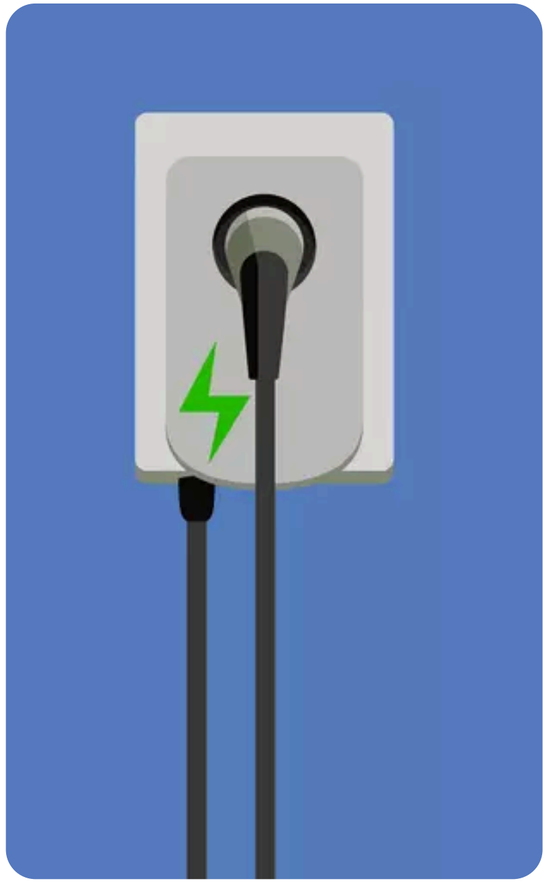
- AC Charging
- Household Outlet
- Unsafe

L1 chargers are portable charging devices typically provided with the purchase of an electric vehicle. They can be plugged directly into a standard electrical outlet and offer a power output ranging from 1.3 kW to 3 kW.

L1 charging primarily occurs in residential settings.

The cost of using an L1 charger depends entirely on the cost of electricity at the charging location as the chargers are usually included in the EV purchase.

LEVEL 2 CHARGERS



- AC Charging
- In-cable control and protection

L2 chargers are relatively faster than L1 Chargers they require nearly 8 hours to fully charge an EV. They operate at a potential of 240V, and have a power output ranging from 3.3 kW to 22 kW of AC power.

L2 charging primarily occurs in public settings such as workspaces, grocery stores, public parking garages, hotels, and shopping malls.

The cost of using an L2 charger varies broadly while some providers operate them free of charge others charge a slightly heftier price tag compared to L1 chargers.

LEVEL 3 CHARGERS

- DC Charging
- Public and Commerical

Level 3 uses DC power to charge electric vehicles. Level 3 charging is the fastest type of charging available and can recharge an EV at a rate of 5 to 30 KM of range per minute.

It is used by charging stations. It requires high voltage and power, so it is not installed at home and it generates more stress (electrical loads) on the power grid. It is commercially installed across highways, hotels, and shopping complexes.

It is available only as an off-board charger because the charging power is high and may exceed 100 kW. Its installation and operating cost are high.

CHARGING MODES FOR ELECTRIC VEHICLES

PARAMETERS	LEVEL 1 (AC)	LEVEL 2 (AC)	LEVEL 3 (DC)
Voltage (V)	240	380-400	200-1000
Power (kW)	1 to 3.3 kW	3.3 to 22 kW	Up to 400 kW
Type of Vehicle	4w, 3w, 2w	4w, 3w, 2w	4w

Source: EVehicle Info

CHARGERS FOR 2W/3W

TYPE 7

- The Bureau of Indian Standards (BIS) has recognised the country's first combined charging standard for light electric vehicles (LEVs).
- The new standard, is based on Ather Energy's charging connector, and is the world's first charging standard that combines AC and DC charging.
- Operating at AC: Up to 480V, DC: Up to 500V

TYPE 6

- Also called as (IEC 62196 -6) connector, this standard is also backed by the Bharat Charge Alliance.
- Primarily designed for DC charging of electric scooters.
- Operating voltage up to 120 V DC and rated current up to 100 A.

CHARGERS FOR 2W/3W

SB-50

- SB50 Anderson connector is commonly used in Battery Packs.
- It is a high current connector commonly used to charge EV.
- The SB50 is rated up to 600V DC or AC.

SB-75X

- Primarily for high-power DC charging of electric vehicles.
- High-voltage, high-current connector with two pins and a latching mechanism.
- Majorly used in 3 wheelers in India

CHARGERS FOR 2W/3W

Chogori

- It is widely used in EV charging infrastructure for light EVs in India, offering strong and reliable performance.
- Supports Fast Charging with power ratings ranging from 15kW to 30kW, making it ideal for e-rickshaws and small EV fleets.
- Offers high resistance to environmental factors, including water and dust (IP65+ rated).

CHARGERS FOR 4W

CCS-2

- Combined Charging System (CCS) charging sockets use shared communications pins to combine AC and DC inlets.
- It communicates between an electric car and the charging system via a PLC (Power Line Communication).
- It can transfer up to 350 kW.
- CCS 2 is widely used in 4 wheelers and buses in India.

GB/T

- GB/T connectors are used in Bharat DC-001 chargers.
- The GB/T standard allows for charging power of up to 15kw.
- The power source used by GB/T connectors are DC power.
- CAN Protocol is utilized to make communication between the electric car and the charging system

CHARGERS FOR 4W

TYPE 2

- The IEC 62196 Type 2 connector is used India in for charging heavy electric 4 wheelers.
- This connector can support both single phase as well as the 3 phase AC slow charging.
- Power rating ranges from 7.4kw -22kw and can carry 3 phase current.

CHAdeMO

- Popular standard for DC fast charging, primarily used for electric cars in Japan and other parts of the world.
- Can deliver up to 50kW of power, enabling rapid charging for compatible EVs, with newer versions supporting even higher outputs.
- CHAdeMO supports Vehicle-to-Grid (V2G) and Vehicle-to-Home (V2H) technology, allowing energy to flow both into and out of the EV battery

CHARGERS FOR 4W

NAAC

- NAAC (North American Automotive Charging), commonly known as the CCS1 connector, is widely used in North America for fast-charging EVs.
- Supports power levels ranging from 50 kW to 350 kW, suitable for rapid charging of electric cars and heavy-duty EVs.
- Integrates AC and DC charging pins, offering versatility and compatibility with both slow and fast charging stations.

NACS

- North American Charging Standard, known for its sleek, lightweight build, ensuring ease of use and compatibility with modern EV designs.
- Delivers up to 1 MW of power, making it suitable for ultra-fast charging of EVs, including heavy-duty applications.
- Leading EV manufacturers, including Tesla, have adopted the NACS connector for its efficiency & interoperability across charging networks.

INDIA ESTABLISHES WORLD'S FIRST CHARGING STANDARD FOR 2W AND 3W EV ADOPTION GOALS

THIS STANDARD PAVES THE WAY FOR WHAT COULD BECOME THE GLOBAL CHARGING CONNECTOR BENCHMARK FOR LEV'S

In Picture : Ather's Type 7 connector. As per new standard, ISI7017 (Part 2 / Sec 7): 2023, cleared by BIS in October 2023

NITI Aayog, the Department of Science and Technology, ARAI, EV manufacturers, and the Bureau of Indian Standards have developed a world-first charging connector standard for light electric vehicles (EVs), including both AC and DC types. This initiative, designed in India, has the potential to become a global benchmark for light EVs.

Currently, Indian EV makers like Ola Electric, Ather Energy, and Ultraviolette Automotive use different charging standards, similar to how iPhones and Android phones once used different charging ports. This variation in EV charging standards creates challenges for public charging stations and increases range anxiety. Unlike electric cars, light EVs have unique charging needs, and using large, expensive 4W connectors is not feasible.

The new standard addresses this by combining both AC and DC connectors into a single solution. However, it does not mandate a uniform connector across all EV models, which still poses a challenge for widespread adoption, especially for four-wheelers, cargo trucks, and buses. A combined charging standard is already widely used in Europe due to its ability to work across various vehicle types and charging stations.

NEW INNOVATIONS

EXPONENT ENERGY'S NON STANDARD CHARGER

WHAT THE COMPANY DOES?

Exponent Energy is changing how electric vehicles (EVs) work in India. Exponent Energy have come up with a way to deliver 15-minute rapid charging for electric vehicles. Their technology relies on a combination of its proprietary battery pack and charging infrastructure to achieve such a feat.These batteries can fit different vehicles and future technologies. They team up with existing gas stations and vehicle makers to grow their network fast.

EXPONENT ENERGY'S TECHNOLOGY

The e^pack

It is their proprietary battery pack which can be fully charged in 15 minutes at their e^pump. They use affordable LFP cells. Their proprietary battery management system (BMS) optimizes the charging process, enabling the 15-minute rapid charging without compromising battery life or safety. The 15 minute charging will only work with their charger.

The e^pump

This advanced station leverages the proprietary battery back design to enable fast charging. By offloading cooling to the e^pump, the ePack can be charged at higher rates without exceeding safe temperature limits.

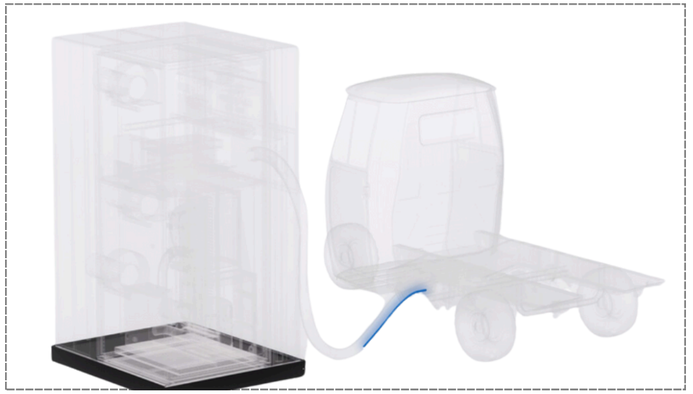
EXPONENT ENERGY'S TECHNOLOGY

The e^plug

This proprietary connector facilitates efficient transfer of data and power between the e^pump and the e^pack. The e^plug incorporates robust safety features, including high-voltage isolation and emergency disconnect mechanisms.
Their connector can handle upto 600A of current.

Off-board Thermal Management System

Unlike traditional EVs with bulky on-board cooling systems, Exponent employs an offboard thermal management system. While charging, their e^pump cools the e^pack by pumping refrigerated water through the e^plug.



BATTERY SWAPPING

Battery swapping technology allows EV users to quickly replace their depleted batteries with fully charged ones at a swapping station.

When contrasted with conventional approaches to charging battery swapping offers numerous advantages including:

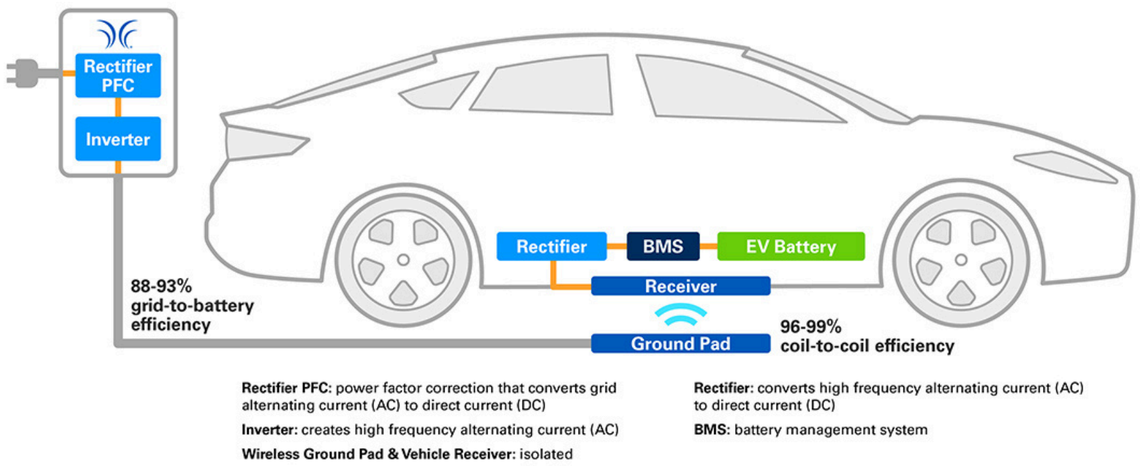
Increased Convenience: Swapping can save time compared to traditional charging methods, which can take several hours to fully charge a vehicle's battery.

Reduction in Range Anxiety: Swapping can also address the issue of range anxiety, as drivers can quickly and easily replace their depleted battery with a fully charged one on the go at a swapping station.

NOTABLE EV SWAPPING NETWORKS IN INDIA

COMPANY	FUNDING ($ MILLLION)	LATEST ROUND	FOUNDING YEAR
SUN MOBILITY	$84	SERIES C	2016
chargeup -----Bharat's Largest Battery Swapping Network-----	$71	SERIES A	2018
VOLTUP SMART SWAPPING NETWORK	NA	NA	2019
BatterySmart	$41	VENTURE DEBT	2019
BOUNCE infinity	$ 20 M	SERIES C	2014

WIRELESS CHARGING



This method is still in the research & development stage. In this method, the electric vehicle battery is charged without the use of a charging chord just by parking (placing) the vehicle at a predetermined location. It has two main parts one is called the transmitter (ground assembly) located underneath the road surface and the other one is the receiver (vehicle assembly) built into the vehicle body. The power is transferred through electromagnetic flux from transmitter to receiver.

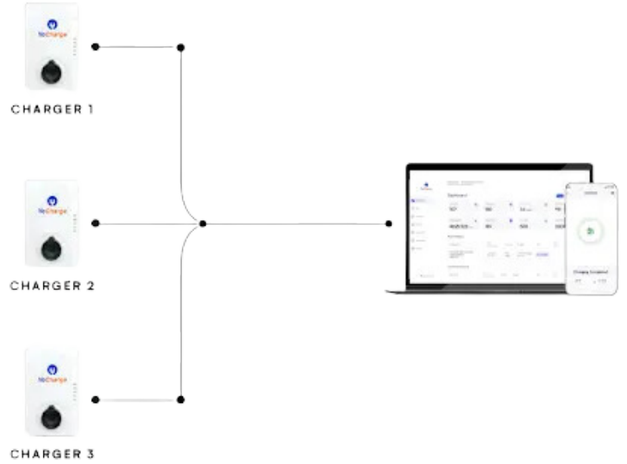
- Wireless charging for EVs is categorized into stationary, semi-dynamic, and dynamic charging systems.
- Stationary Wireless charging is similar to a plug-in charger where EV is parked at a charging pad.
- Semi Dynamic systems can be installed at bus stops, taxi stops, and traffic lights to provide short-term charging in a dynamic environment.
- Dynamic wireless power transfer systems charge the battery when vehicles are on moving on the road. Dynamic Wireless Charging gives unlimited range to EVs and no fear of range anxiety for drivers.
- It is estimated that most wireless charging devices will operate at approximately 92%, ±2% efficiency while wired charging has 96%, ±2% efficiency.

EV CHARGING MANAGEMENT SYSTEM

CHARGING MANAGEMENT SYSTEM

WHAT IS EV CHARGING MANAGEMENT

A Charging Management System or Software (CMS) is a centralized management tool which helps optimize the efficiency of all EV charge points from one central hub. It provides historical & real-time data of each charging point and the charging network as a whole. It also allows companies to easily add new charging stations and manage station groups remotely. In simpler terms, it is a management tool that allows administrators to oversee all aspects of a charging network's operation.

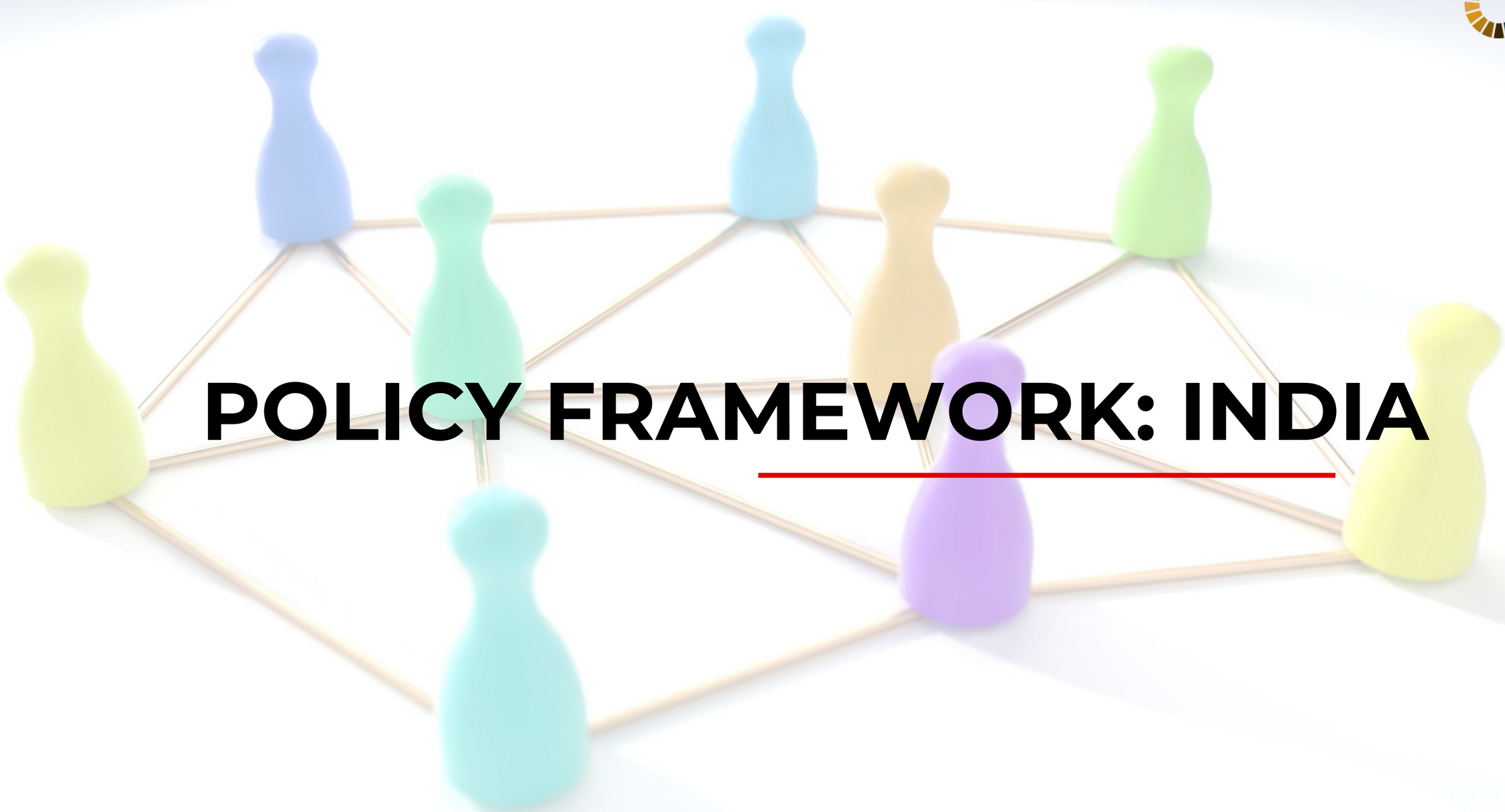


FUNCTIONS AND FEATURE

It offers real-time monitoring of chargers, tracking energy consumption and session status while enabling remote control to start, stop, or adjust charging processes. Integrated user management streamlines authentication, billing, and payment processing through multiple methods, ensuring a seamless experience for customers. Advanced load management prevents grid overload and optimizes energy distribution, while error detection and reporting minimize downtime. Additionally, EV CMS supports scalability, interoperability across charger models and protocols, and data analytics for actionable insights into usage, performance, and revenue trends.

NOTABLE CMS PROVIDING COMPANIES IN INDIA

COMPANY	FOUNDING YEAR	BASED
statiq	2020	Gurugram, Haryana
YoCharge	2018	Udaipur, Rajasthan
kazam	2020	Koramangala, Bengaluru
telio EV	2021	Hyderabad, Telangana
1C	2023	Gurugram, Haryana



POLICY FRAMEWORK: INDIA

EV POLICIES EVOLUTION TIMELINE

PM Electric Drive Revolution in Innovative Vehicle Enhancement (PM E-Drive)

2024

- Focus on expediting EV adoption through demand incentives and creation of charging infrastructure
- Total outlay of Rs. 10,900 crore for a period of 2 years

Electric Mobility Promotion Scheme

2024

- Announced as an interim scheme to extend benefits post expiry of FAME II.
- Total outlay increased to Rs. 778 crore in July 2024; offered demand incentives

Production-Linked Incentive (PLI) Scheme

2021

- PLI Schemes for the automobile and auto component Industry; budgetary outlay of Rs. 25,938 crore
- PLI scheme for Advanced Cell Chemistry (ACC) battery manufacturing; outlay of Rs. 18,100 crore

FAME-II Scheme

2019-24

- Launched in April 2019 initially for a period of 3 years (extended by 2 years till March 2024)
- Total outlay of Rs. 11,500 crore (enhanced from initial Rs. 10,000 crore)

Source: Press Information Bureau, Govt of India, ICRA Research

EV POLICIES EVOLUTION TIMELINE

FAME-I Scheme

2015-18

- Launched in April 2015, by the Department of Heavy Industry
- Total outlay of Rs. 795 crore for demand incentives

National Electric Mobility Mission Plan 2020

2013

- Mission plan formed to promote adoption of electric and hybrid vehicle sales

Alternate Fuel for Surface Transportation Program

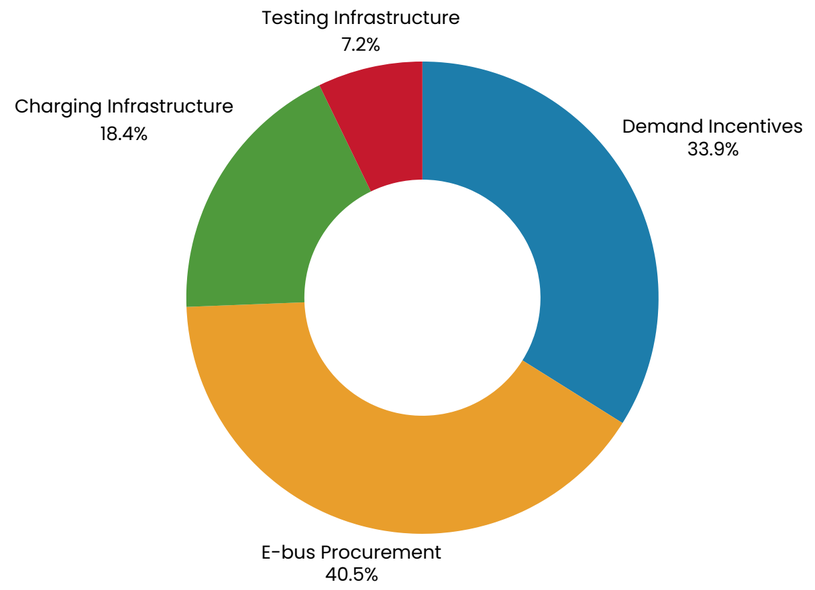
2010-12

- Implemented by Ministry of New and Renewable Energy
- Total outlay was Rs. 95 crore

Source: Press Information Bureau, Govt of India, ICRA Research

PM E-DRIVE SCHEME

Through the PM e-Drive scheme, the Government of India is once again employing a comprehensive strategy to foster the growth of the EV ecosystem. In addition to providing demand incentives to reduce acquisition costs, the focus remains on electrifying mass transportation and expanding charging and testing infrastructure. The scheme also prioritizes building domestic manufacturing capacity and reinforcing the EV supply chain. To qualify for benefits, manufacturers must comply with a phased manufacturing program, which sets standards for domestic value addition.



Investment Allocation under PM E-Drive scheme

- ~₹3,679 crore for incentives on electric two-wheelers, three-wheelers, ambulances, trucks, and other EVs (not for electric cars).
- ~₹500 crore each for promoting electric ambulances and trucks (incentives for those with a scrapping certificate).
- ~₹4,391 crore to support electric buses, with priority for cities/states that scrap old buses.
- ₹2,000 crore for setting up public EV charging stations to ease range anxiety.
- ~₹780 crore to upgrade testing facilities under the Ministry of Heavy Industries.

Source: Press Information Bureau, Govt of India, ICRA Research

ELECTRIC MOBILITY PROMOTION SCHEME (EMPS)

The Electric Mobility Promotion Scheme (EMPS) 2024, launched by India's Ministry of Heavy Industry, initially allocated **₹500 crore** for a four-month period from April 1 to July 31, 2024. This scheme was later extended by two months until September 30, 2024, with **an increased budget of ₹778 crore**. EMPS 2024 focused on accelerating the adoption of electric two-wheelers (e-2W) and three-wheelers (e-3W), including registered e-rickshaws and e-carts, to advance green mobility and strengthen the EV manufacturing ecosystem in India.

EMPS-2024 (Electric Mobility Promotion Scheme) is being subsumed under the PM E-DRIVE scheme.

Vehicle Segment	Max No. of Vehicles to be supported	Total fund support from MHI
e-2W	500080	500.08 Cr
e-3W	13590	33.97 Cr
e-3W L5	47119	235.60 Cr

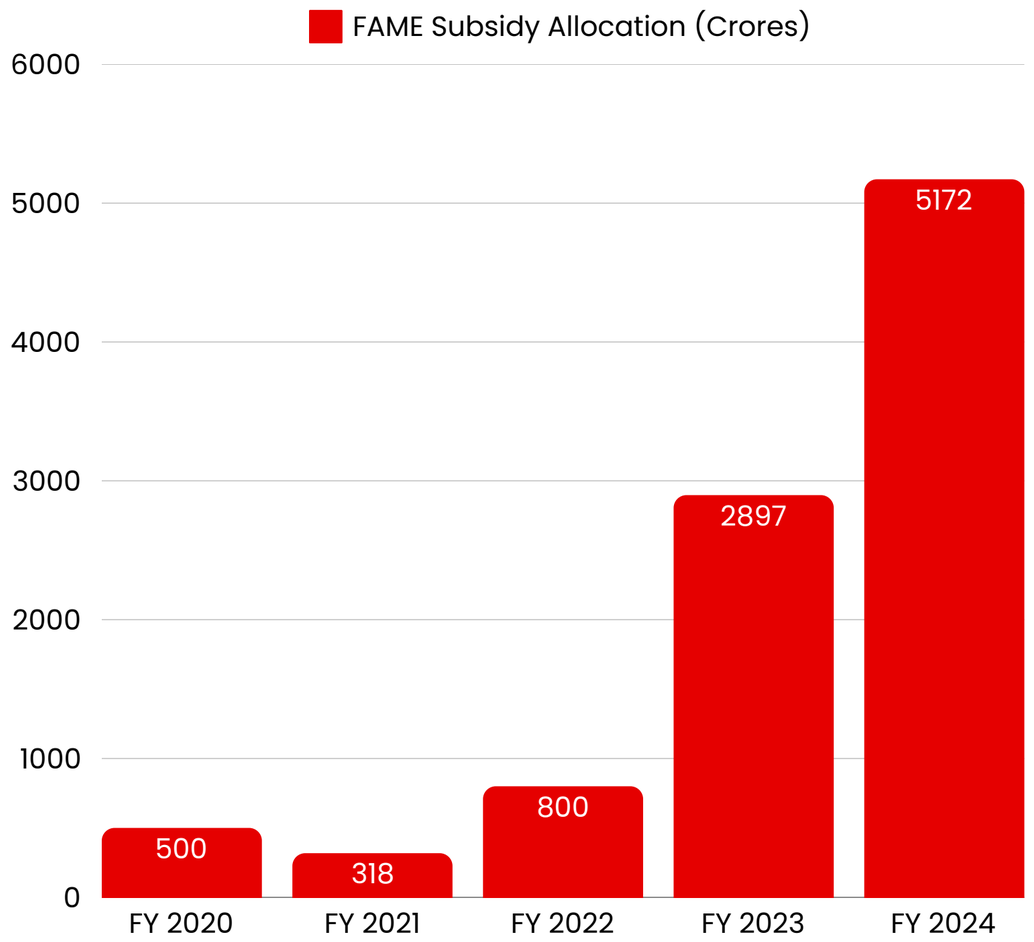
Eligible EV categories

a) Two Wheelers (Electric) (e-2W)

b) Three-wheeler (Electric) including registered e-rickshaws & e-carts and L5 (e-3W)

Source: Ministry of Heavy Industries, GOI

FAME SCHEME



The Faster Adoption and Manufacturing of Electric Vehicles (FAME) scheme was launched in April 2015 under the National Electric Mobility Mission to promote electric and hybrid vehicles in India by offering financial incentives to buyers. The scheme's first phase, FAME I, ran for four years until 2019 and focused on building awareness and encouraging the initial adoption of EVs.

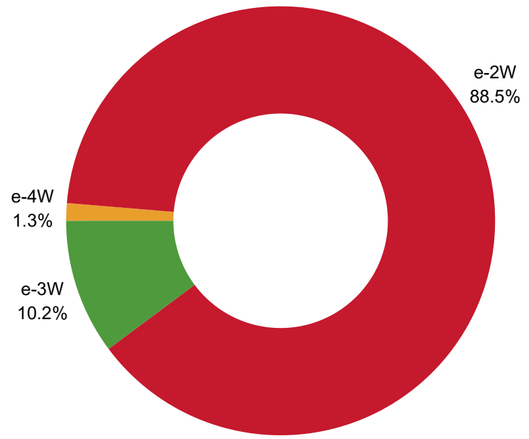
FAME II, the second phase of the scheme, extended these efforts with a specific focus on public and shared transportation. It was designed as a three-year program to subsidize the purchase of EVs across different categories, aiming to electrify **7,000 buses, 500,000 three-wheelers, 55,000 passenger cars, and 1 million two-wheelers.** In addition to vehicle subsidies, FAME II allocated funding to expand the EV charging infrastructure, ensuring adequate support for the growing EV ecosystem. This phase marked a significant push towards cleaner mobility solutions and reducing vehicular emissions in India.

FAME II

The FAME II scheme, with a **budget outlay of Rs 10,000 crore**, was introduced in 2019 for a period of three years. The scheme was targeted to support 7,000 e-buses, 5 lakh e-3 Wheelers, 55,000 e-passenger cars and 10 lakh e-two wheelers. Later another Rs 1500 crore was allotted for the scheme.

The budgeted allocation for FAME II was Rs 5,171.97 crore in the year 2023-24.

The Ministry of Heavy Industry has said that the entire budgeted allocation under FAME II was used up in the first three years, beginning from 2019-20, falling marginally in 2022-23, but in 2023-24, there was a huge gap.



As of 30th March, a total of **15,42,452 electric vehicles** have been subsidized under the FAME II scheme, aimed at accelerating EV adoption in India. This includes **13,64,929 electric two-wheelers** (e-2Ws), **1,57,171 electric three-wheelers** (e-3Ws), and **20,352 electric four-wheelers** (e-4Ws).

Tata Motors has emerged as the largest beneficiary in the e-3W and e-4W categories, leveraging the subsidies to scale its electric vehicle production. Ola Electric leads in the e-2W segment, driven by its popular electric scooters. Altogether, **221 EV models have benefitted under the scheme**.

Source: The Economic Times

PLI SCHEME

Union Cabinet approved the PLI-Auto Scheme on 15.09.2021 with budgetary **outlay of Rupee 25,938 crore for a period of 5 years** (FY2022-23 to FY2026-27). The PLI scheme for electric vehicles is aimed at promoting domestic manufacturing and reducing the country's dependence on imports of EV components.

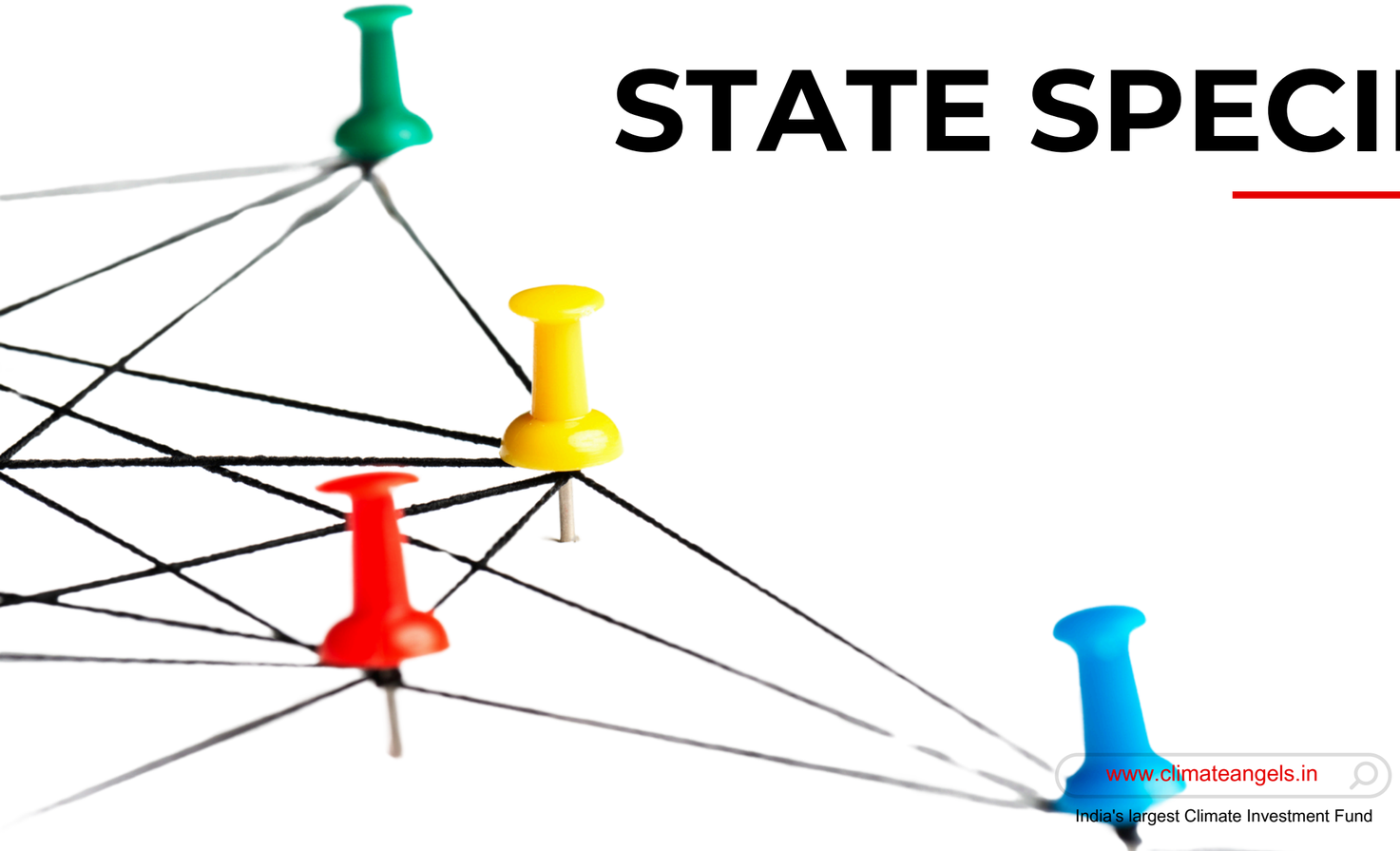
Under the PLI scheme, manufacturers of advanced chemistry cell (ACC) batteries and EV components can receive incentives worth up to **~Rs. 18,000 crore**.

The PLI scheme for EVs also aims to establish a robust charging infrastructure network. The scheme has proposed the **development of 2700 charging stations** in metro cities, other million-plus cities, smart cities, and cities of hilly states across the country.

PLI Applications of Indian Automobile Manufacturers

Company	Application	Approval
Mahindra and Mahindra	23	16
Tata Motors	27	15
Bajaj Auto	13	13
Ola Electric	5	4
TVS Motors	5	2
Eicher	1	0

Source: The Economic Times



STATE SPECIFIC POLICIES

STATE SPECIFIC POLICIES: DELHI

NEW DELHI EV POLICY

The Delhi EV Policy aims to drastically reduce vehicular air pollution in the city and create a thriving ecosystem for electric vehicles. By the end of 2024, the government aims to have 25% of all new vehicles sold in Delhi to be electric.

The policy adopts a combination of fiscal and non-fiscal incentives to ensure demand generation for EVs, which includes purchase incentives, scrapping incentives, interest waivers, road-tax waivers, green-registration plates, license-fee waivers, and single-window clearances. The policy also supports battery-swapping systems and envisions job creation as a key outcome, aiming to promote skill development in the EV supply chain and create jobs such as EV drivers, auto-mechanics, and charging station operating staff.

Funding for demand incentives is generated through measures such as pollution cess, road tax, congestion tax, and environment compensation charge. While battery-swapping systems present challenges, the policy aims to ensure practical and commercial use of the technology. The Delhi EV Policy has been regarded as one of the most progressive policies globally and serves as a model for other cities and governments to adopt to reduce air pollution and promote EV adoption.

STATE SPECIFIC POLICIES: DELHI

DATE OF NOTIFICATION: 07 AUGUST 2020

VALIDITY PERIOD: EXPIRED ON DEC 31, 2023; EXPECTED* TO EXTEND TILL MARCH 2025

- The primary objective of the Delhi Electric Vehicle Policy, 2020 is to establish Delhi as India's EV capital and accelerate EV adoption across vehicle segments, especially in the mass category of two wheelers, public/shared transport vehicles, and goods carriers.
- The policy shall seek to drive rapid adoption of Battery Electric Vehicles (BEVs) so that they contribute to 25% of all new vehicle registrations by 2024 and bring about a material improvement in Delhi's environment by bringing down emissions from the transport sector.
- The Policy will also seek to put in place measures to support the creation of jobs in driving, selling, financing, servicing and charging of Electric Vehicles.

*As per TOI Notification, dated October 03, 2024

STATE SPECIFIC POLICIES: DELHI

DEMAND INCENTIVES

Electric Two-wheelers

- Purchase incentive of INR5,000 / kWh of battery capacity, maximum up to INR 30,000 / vehicle
- Scrapping incentive up to INR5,000 / ICE 2-wheeler
- Delivery service providers to convert 50% of their 2-wheeler fleet to electric by 31st March 2023 and 100% by 31st March 2025

Electric auto

- Purchase incentive of INR30,000 / vehicle
- Interest subvention of 5% on loans for purchase of e-auto
- Scrapping incentive up to INR7,500 / ICE auto rickshaw

e-Cart/e-Rickshaw

- Purchase incentive of INR30,000 / e-rickshaw or e-cart / individual
- Interest subvention of 5% on loans and / or hire purchase for e-rickshaw or e-cart with advanced battery

Electric Goods Carrier

- All new stage carriage buses fleet shall be at least 50% electric and 1,000 pure e-buses by 2020
- Purchase incentive of INR30,000 / vehicle for first 10,000 e-goods carrier to be registered in Delhi
- Interest subvention of 5% on loans and /or hire purchase
- Scrapping incentive of INR7,500 / ICE goods carrier

Electric Four-wheelers

- Purchase incentive of INR10,000 / kWh of battery capacity (up to INR1,50,000) to first 1,000 e-cars

Across all vehicle categories

- Road tax and registration fees to be waived for all electric vehicle

STATE SPECIFIC POLICIES: DELHI

MILESTONES

The policies' success so far was recorded in a report titled Accelerating Electric Mobility in Delhi: Journey and Insights from Implementing the Delhi Electric Vehicles Policy published by the Delhi Government as:

- Overall, in 2023, Delhi registered a total of 6,57,312 vehicles out of which 73,610 were electric. Nearly INR 94 crore purchase incentives have been disbursed to incentivize over 34,000 vehicles, with all EVs receiving road tax and registration fee exemption.

- A record 19.5% of vehicles sold in the city in December 2023 were electric, the highest reported in any state till date, overall EV sales accounted of 11% of total vehicles sales in 2023.

- The steady growth in EVs in Delhi is supported by 2,452 public charging points and 234 battery swapping stations, indicating 28x growth since the policy was launched in August 2020. The accelerated expansion of charging points helped Delhi achieve an EV-to-public-charger ratio of 25:1, which is comparable with that of cities such as Oslo and Helsinki. But Delhi has only achieved 9.67% of its charging infrastructure target of 30,000 charging stations by 2024.

STATE SPECIFIC POLICIES: GUJARAT

GUJARAT STATE EV POLICY

The Gujarat State Electric Vehicle Policy 2021 includes a comprehensive four-year plan with a budget of Rs 870 crore to offer incentives and subsidies to new buyers of electric vehicles across all segments and those investing in the development of EV infrastructure. Under the policy, subsidies will be provided for the purchase of 200,000 electric vehicles, including 110,000 e-two-wheelers, 70,000 e-three-wheelers, and 20,000 e-four-wheelers. Gujarat's incentives of Rs 10,000 per kWh of battery capacity are the highest offered by any state in India, with the total subsidy capped at Rs 20,000 for electric scooters and motorcycles, Rs 50,000 for e-rickshaws, and Rs 1.5 lakh for electric cars and SUVs. The state will also waive off the registration fee for buyers of electric vehicles.

Gujarat aims to add 250 more charging stations to the existing 278 across the state, bringing the total number to 528. Fuel pumps across the state will be permitted to set up EV charging stations, and those who establish the first 250 commercial public charging stations will be eligible for a 25% capital subsidy on equipment/machinery, limited to Rs 10 lakh per station. Furthermore, the state will waive off electricity duty for EV charging stations for the duration of the policy. Gujarat's policy is a significant step towards promoting and encouraging the use of electric vehicles and infrastructure development, providing attractive incentives to both buyers and infrastructure investors.

STATE SPECIFIC POLICIES: GUJARAT

DATE OF NOTIFICATION: 23 JUNE 2021

VALIDITY PERIOD: 4 YEARS COMMENCING FROM 1ST JULY 2021

- To transition the state's transportation sector towards electric mobility.
- To make Gujarat a manufacturing hub for electric vehicles and ancillary equipment.
- To encourage start-ups and investment in the field of electric mobility and associated support sectors such as data analytics and information technology.
- To improve the quality of the environment by reducing air pollution.
- Adoption targets:
  - 2-Wheelers - 1,10,000
  - 3-Wheelers - 70,000
  - 4-Wheelers - 20,000

STATE SPECIFIC POLICIES: GUJARAT

DEMAND INCENTIVES

Incentives for all types of electric vehicles shall be based on the electric vehicle battery capacity (i.e energy content measured in kWh) and subject to maximum ex-factory price and maximum battery capacity

- 2 wheeler - 2 kWh - INR10,000/- per kWh for a maximum ex-factory price of INR1,50,000
- 3 wheeler - 5 kWh - INR10,000/- per kWh for a maximum ex-factory price of INR5,00,000
- 4 wheeler - 15 kWh - INR10,000/- per kWh for a maximum ex-factory price of INR15,00,000

Subsidy to EV user will be disbursed directly to the EV user via DBT mode.

SUPPLY INCENTIVES

All provisions of the Gujarat Industrial Policy-2020, subsequent applicable policies and government resolutions shall be applicable to parties intending to set up or upgrade their facilities for manufacturing in the EV sector.

STATE SPECIFIC POLICIES: KARNATAKA

CLIMATE ANGELS

KARNATAKA STATE EV POLICY

The state government of Karnataka has set forth an electric vehicle policy aimed at establishing the state as a prime location for electric vehicle production. The policy aims to capitalize on available opportunities and sustained development. To achieve this vision, the policy has four key objectives.

Firstly, the policy aims to attract investments in electric vehicle manufacturing, making Karnataka the preferred location for such investments.

Secondly, the policy intends to secure investments worth Rs. 31,000 crore and create 55,000 job opportunities in both the supply and demand sides.

Thirdly, the policy aims to facilitate a smooth transition from traditional internal combustion engine (ICE) vehicles to electric vehicles.

Total number of EVs on road in Karnataka crossed 250,000 in 2023.

STATE SPECIFIC POLICIES: KARNATAKA

DATE OF NOTIFICATION: 25 SEPTEMBER 2020

VALIDITY PERIOD: 5 YEARS FROM THE DATE OF ISSUE OF RELEVANT GOVERNMENT RESOLUTION

- To maintain the lead share of Karnataka as a preferred destination for attracting investments in manufacture of Electric Vehicles.
- To attract investments of INR31,000 crore and create employment opportunities to 55,000 persons both from supply & demand side.
- To create a conducive environment for transition to Electric Vehicle environment from Internal Combustion (IC) engines.
- To provide opportunities for developing R&D in Electric Mobility.

STATE SPECIFIC POLICIES: KARNATAKA

DEMAND INCENTIVES

Private Transport

- e-2W, EV taxis to be encouraged
- Existing auto-rickshaws to be encouraged to move towards EVs
- 100% electrification in auto-rickshaws, cab aggregators, corporate fleets, and school buses/vans by the year 2030

Public Transport

- Road Transport Corporations to introduce 1,000 EVs by year 2022
- Introduction of EV services (on pilot basis) on select routes to & from International Airport

Goods Transport

- e- 3W / e-4W mini goods vehicle to achieve 100% electrification by year 2030
- Encourage adoption of e-2W for e-commerce and delivery companies in Bengaluru and achieve 100% electric fleet by year 2030

STATE SPECIFIC POLICIES: KARNATAKA

SUPPLY INCENTIVES

Investment promotion subsidy

- Micro - 25% value of fixed assets (VFA) - up to INR15,00,000
- Small - 20% VFA - up to INR40,00,000
- Medium - up to INR50,00,000; Investment subsidy (EV cell/ battery/ module manufacturing) : 20% VFA - first 2 units

Capital subsidy for Effluent Treatment Plant (ETP)

- MSME - 50% - up to INR50,00,000
- Large/Mega/Super mega - 50% - up to INR 2 crore

STATE SPECIFIC POLICIES: UTTAR PRADESH

POLICY OVERVIEW

The State Government of UP in India aims to become a global hub for electric mobility development and manufacturing. Their goals include transitioning to an eco-friendly transportation system, targeting 100% transition of government vehicles to EV by 2030, developing charging/battery swapping infrastructure, attracting EV manufacturers, and promoting research and innovation in non-ICE-based automobiles, battery technology, fuel cell technologies, and EV electronics.

For any EV purchased and registered in UP within 3 years of policy notification, a 100% subsidy will be provided. Additionally, for EVs manufactured, purchased, and registered in the 4th and 5th year of the policy period, a 100% subsidy will be available.

As an incentive for early buyers, purchase subsidies will be provided through dealers for a period of 1 year from the date of notification. The subsidy rates for different EV segments are as follows: a) 2-W EV: 15% of ex-factory cost up to Rs. 5000 per vehicle, subject to a maximum budget of Rs. 100 crore for a maximum of 2 lakh EVs. b) 3-wheeler EV: 15% of ex-factory cost up to Rs. 12000 per vehicle, subject to a maximum budget of Rs. 60 crore for a maximum of 50,000 EVs. c) 4-wheeler EV: 15% of ex-factory cost up to Rs. 1 lakh per vehicle, subject to a maximum budget of Rs. 250 crore for a maximum of 25,000 EVs. d) E-buses (non-governmental): 15% of ex-factory cost up to Rs. 20 lakh per vehicle, subject to a maximum budget of Rs. 80 crore for a maximum of 400 e-buses. e) E-goods carriers: 10% of ex-factory cost up to Rs. 1 lakh per vehicle, subject to a maximum budget of Rs. 10 crore for a maximum of 1000 e-goods carriers.

STATE SPECIFIC POLICIES: UTTAR PRADESH

BACKGROUND

Uttar Pradesh, the most populous state in India, is leading the nation's efforts to reduce pollution and move towards electric vehicles (EVs). As of July 2022, the state had over 337,000 EVs on its roads, the highest number in the country. Uttar Pradesh has held the highest share in EV sales in India in 2021, with the number of units sold across all segments reaching 66,701.

To ensure the success of the EV market, UP is working on building a robust charging infrastructure. The state has sanctioned 207 charging stations under FAME II, which are being installed in nine cities, including Noida, Lucknow, Varanasi, Prayagraj, Kanpur, Aligarh, Saharanpur, Bareilly, and Jhansi. Furthermore, more charging stations are expected to be installed along the expressways in the state. The state government is also promoting the use of EVs in public transportation. Electric buses have been launched on select routes in prominent cities, including Lucknow and Kanpur, on a public-private partnership (PPP) model, and charging stations are being developed on these routes as well.

UP is one of the largest beneficiaries of FAME 1 & 2 schemes. The state's support for EVs is further evident in the launch of the Electric Vehicle Manufacturing and Mobility Policy in August 2019 and a New Electric Vehicle Manufacturing & Mobility Policy in 2022, adapting to current trends and needs.

STATE SPECIFIC POLICIES: UTTAR PRADESH

DATE OF NOTIFICATION: 14 OCTOBER 2022

VALIDITY PERIOD: 5 YEARS FROM THE DATE OF ISSUE OF RELEVANT GOVERNMENT RESOLUTION

- Make UP a global hub for electric mobility development and manufacturing
- Enable transition to eco-friendly transportation system particularly in cities
- Enable investments for development of charging/ battery swapping infrastructure
- Attract manufacturers across the EV ecosystem to the state to setup their manufacturing units and supply to a global market
- Promote research and innovations in non-ICE based automobiles, battery technology, fuel cell technologies and EV electronics

STATE SPECIFIC POLICIES: UTTAR PRADESH

DEMAND INCENTIVES

- The State Government shall target 100% transition of Govt vehicles (for official use) to EV by year 2030
- State Government shall promote retro-fitted EVs in the State with certified technology (ARAI/ ICAI or any other)
- Registration and road tax exemption to buyers
- Registration Fees & Road Tax exemption to buyers
  - 100% on any EV purchased & registered in UP over a period of 3 years from policy notification
  - 100% on any EV manufactured, purchased & registered in UP in the 4th & 5th year of policy period
- Purchase Subsidy Scheme (one time) valid for 1 year from date of notification specifically done for this subsidy scheme at following rates in defined segments –
  - **2 Wheeler:** 15% of ex-factory cost up to INR5,000/vehicle subject to max. budget outlay of INR100,00,00,000 for a maximum of 2,00,000 vehicles
  - **3 Wheeler:** 15% of ex-factory cost upto INR12,000/vehicle subject to max. budget outlay of INR60,00,00,000 for a maximum of 50,000 vehicles
  - **4 Wheeler** : 15% of ex-factory cost up to INR 1,00,000/vehicle subject to max. budget outlay of INR250,00,00,000 to maximum of 25,000 vehicles
- **Buses** (Non-Govt, i.e. School buses, ambulances, etc.): 15% of ex-factory cost upto INR20 lakh per vehicle subject to max. budget outlay of INR80 crore to max. of 400 E-Buses
- **Goods Carriers:** 10% of ex-factory cost upto Rs 1,00,000 per vehicle subject to max. budget outlay of INR10 crore to max. of 1,000 E-Goods Carriers

STATE SPECIFIC POLICIES: UTTAR PRADESH

SUPPLY INCENTIVES

Capital subsidy to be provided as follows:

- Integrated EV Project is investing INR3,000 crore or more- 30% on eligible investment over a period of 20 years, subject to a maximum of INR1,000 crore per project for first 2 projects.
- Ultra Mega Battery investing INR1,500 crore or more and minimum production capacity of 1 GWh - 30% on eligible investment over a period of 20 years, subject to a maximum of 1,000 crore per project for the first 2 projects
- Mega EV project investing INR500 crore or more - 20% on eligible investment over a period of 10 years, subject to a maximum of INR500 crore per project for the first 5 projects.
- Mega EV battery project investing INR300 crore or more - 20% on eligible investment for a period of 10 years, subject to a maximum of INR500 crore per project for the first 5 projects.
- Large EV projects with investment of more than MSME but less than Mega EV/ Battery category - 18% on eligible investment, subject to a maximum of INR90 crore per project over a period of 10 years.
- MSME projects with investment as per GoI MSME Act 2020 - 10% on eligible investment, subject to max Rs 5 Cr per project over a period of 2 years.

Stamp duty reimbursement as follows:

- 100% to Integrated EV Project & Ultra Mega Battery project.100% in Poorvanchal & Bundelkhand region, 75% in Madhyanchal & Paschimanchal (except GHZ & GBN district) and 50% in GBN & GHZ district to Mega/ Large/ MSME projects
- Quality certification charges reimbursement (one time) @ 50% of fees paid for obtaining certification upto max INR10 lakhs per unit to Large and MSME EV/ Battery projects.

STATE SPECIFIC POLICIES: MAHARASHTRA

MAHARASHTRA EV POLICY

Maharashtra was one of the first states in the country to design and notify an EV policy. Maharashtra's first EV policy was released in February 2018. To accelerate EV sales and stimulate manufacturing in the state, Maharashtra has updated its EV Policy on 27 July 2021. The new policy aims to capitalize on the recent policy and technology developments and further the state's EV ambition. The policy provides strong demand side incentives to the purchasers of EV in the state.

The objectives of the policy are as follows:

- In the six targeted urban agglomerations in the state, achieve 25% electrification of public transport and last-mile delivery vehicles by 2025.
- Convert 15% of Maharashtra State Road Transport Corporation's (MSRTC) existing bus fleet to electric.
- Make Maharashtra the country's top producer of BEVs in India, in terms of annual production capacity.
- Target establishment of at least one Gigafactory for the manufacturing of advanced chemistry cell (ACC) batteries in the state.
- Promote research and development (R&D), innovation, and skill development across the EV ecosystem in the state.

STATE SPECIFIC POLICIES: MAHARASHTRA

DATE OF NOTIFICATION: 23 JULY 2021

VALIDITY PERIOD: 4 YEARS FROM THE DATE OF ISSUE OF RELEVANT GOVERNMENT RESOLUTION

- Adoption of at least 10% EVs by 2025
- Achieve 25% electrification of public transport and last mile delivery by 2025
- 15% of MSRTC’s existing bus fleet to electric
- Make Maharashtra top producer of EVs in annual production capacity
- One Gigafactory for manufacturing of advanced chemistry cell (ACC) batteries
- Promote research and development (R&D), innovation, and skill development across the EV ecosystem in the state

STATE SPECIFIC POLICIES: MAHARASHTRA

POLICY TARGETS

Parameter	Electrification Targets
All vehicles	10% (All), 10% (2W), 20% (3W), 5% (4W)
Charging Infra	By 2025, city-wise targets of public and semi-public charging stations are, as listed below Greater Mumbai UA – 1500 Pune UA – 500 Nagpur UA – 150 Nashik UA – 100 Aurangabad UA – 75 Amravati – 30 Solapur – 20
Government Fleet	Starting April 2022, all new govt. vehicles (owned/leased) operating within the major cities to be electric.

STATE SPECIFIC POLICIES: MAHARASHTRA

DEMAND INCENTIVES

Electric Two-wheelers

- E-2Ws (L1 & L2) are incentivised for INR5,000/kwh (maximum INR10,000) for the first 1,00,000 vehicles.

Electric Three-wheelers

- E-3W autos (L5M) are incentivised for INR5,000/kwh (maximum INR30,000) for the first 15,000 vehicles.
- E-3W goods carriers (commercial) are incentivised for INR5,000/kwh (maximum INR30,000) for the first 10,000 vehicles.

Electric Four-wheelers

- E-4W cars (M1) are incentivised for INR5,000/kwh (maximum INR1,50,000) for the first 10,000 vehicles.
- E-4W goods carrier (N1) are incentivised for INR5,000/kwh (maximum INR1,00,000) for the first 10,000 vehicles.

SUPPLY INCENTIVES

All the benefits under ‘D+’ category of mega projects/other categories will be provided to EV industries irrespective of location of manufacturing unit in the state.

STATE SPECIFIC POLICIES: RAJASTHAN

POLICY

The Rajasthan Electric Vehicle Policy-2022 was notified by the State Government on August 31, 2022. The policy will be in effect for five years beginning September 1, 2022. The government approved the proposed one-time contribution for the purchase of electric vehicles as well as an additional budget provision of Rs 40 crore for reimbursement of State Goods and Services Tax under this new policy.

The objectives of the policy include:

- To support the adoption of Electric Vehicles in both personal mobility and public transport segments.
- To enable the creation of a robust network of Electric Vehicle charging stations & battery swapping stations catering to all types of Electric Vehicles with focus on clean energy sources.
- To foster research & development and skill development in the State's electric mobility space.
- To promote the manufacturing of electric vehicles and batteries in the State by providing appropriate incentives under RIPS- 2019

STATE SPECIFIC POLICIES: RAJASTHAN

POLICY TARGETS

Parameter	Electrification Targets
E2W	15% Electric Vehicle share in new vehicle registrations
E3W	30% Electric Vehicle share in new vehicle registrations
E4W	5% Electric Vehicle share in new vehicle registrations
E Buses	Phased transition to e Buses used in routes connecting priority cities
Manufacturing	Manufacturing target of 35 Lakh unit per year in the next 5 years.

STATE SPECIFIC POLICIES: RAJASTHAN

DATE OF NOTIFICATION: 31 AUGUST 2022

VALIDITY PERIOD: 5 YEARS FROM THE DATE OF NOTIFICATION

The objectives of the policy include:

- To support the adoption of Electric Vehicles in both personal mobility and public transport segments.
- To enable the creation of a robust network of Electric Vehicle charging stations & battery swapping stations catering to all types of Electric Vehicles with focus on clean energy sources.
- To foster research & development and skill development in the State's electric mobility space.
- To promote the manufacturing of electric vehicles and batteries in the State by providing appropriate incentives under RIPS- 2019

STATE SPECIFIC POLICIES: RAJASTHAN

DEMAND INCENTIVES

- Incentives provided under the policy are as follows:
  - **2 wheeler** - 1,00,000 vehicles to get subsidy between INR2,000 - INR10,000, depending on fixed or swappable battery.
  - **3 wheeler** - 25,000 e-rickshaws and 25,000 e-auto/e-good vehicles to get benefit between INR4,000 - INR10,000, depending on fixed/swappable battery; 3,000 retrofit vehicles to get INR10,000 per vehicle.
  - **4 wheeler** - 1,000 personal, 1,000 commercial and 2,000 maxi cab/e-carriers to receive benefit between INR30,000-INR50,000; 2,000 vehicles opting for retrofit to get INR15,000 per vehicle.
- SGST reimbursement to all categories of vehicles
- Exemption from Motor Vehicle Tax and Green Tax
- Permits for carrying passengers/goods not needed

STATE SPECIFIC POLICIES: RAJASTHAN

SUPPLY INCENTIVES

- SGST reimbursement on charging station equipment for fixed number of stations
- 100% reimbursement on fast charging/swapping stations up to a maximum of INR5,00,000 on actual cost basis.
- 5% interest subsidy or 20% capital subsidy for charging station.
- Charging points at residences / offices permitted through existing electricity connection
- Allow power purchase for public charging stations through open access.
- Land allotment at 50% concessional rate for first 500 renewable energy-based charging stations installed with 5 years after policy commencement
- Capital subsidy equivalent to 20% of investment made in EVSE, maximum upto INR4 lakhs
- Development of mobile application for public charging stations

STATE SPECIFIC POLICIES: TELANGANA

POLICY OVERVIEW

This policy aims to reduce the overall cost of mobility by promoting the use of electric vehicles in public transportation systems and private 2, 3 and 4-wheelers, as well as in light commercial vehicles and shared transportation. It also seeks to promote the transition of the state's energy dependence from imported and unreliable fossil fuels to domestically produced and cost-effective renewable energy.

This policy highlights the state's ambition to become the preferred destination for the electric vehicle industry, including the manufacturing of EV components. It also aims to establish Telangana's presence in the EV and Employee Self-Service (ESS) sectors, with the goal of attracting investments worth USD 4 billion and creating employment opportunities for 1,20,000 individuals by 2030.

This policy also aims to increase the adoption of EVs by promoting initiatives that create a demand for battery storage solutions.

Lastly, the policy seeks to promote the recycling and reuse of batteries used in electric vehicles. The EV policy introduced by Telangana aims to position the state as a global center for research and development in the electric vehicle sector.

STATE SPECIFIC POLICIES: TELANGANA

DATE OF NOTIFICATION: 30 OCTOBER 2020

VALIDITY PERIOD: 10 YEARS FROM THE DATE OF ISSUE OF RELEVANT GOVERNMENT RESOLUTION

- Reduce cost of mobility by increased adoption of electric vehicles
- Attract investment in EV and Energy Storage worth INR29,000 crores and provide employment to 1,20,000 people by 2030
- Making Telangana a preferred destination for Electric Vehicles, ESS and componnet manufacturing
- Support creation of EV charging infrastructure and create market for viable EV charging business
- Promote recycle and cascading of batteries
- Develop State as global center for cutting-edge research and innovation in EV and battery technologies
- Create demand of EVs by providing incentives

STATE SPECIFIC POLICIES: TELANGANA

DEMAND INCENTIVES

Electric 2-wheelers

- 100% road tax and registration fee exemption for first 2,00,000 e-2Ws purchased and registered in Telangana Electric 3-wheeler auto-rickshawauto-rickshawthe
- 100% road tax and registration fee exemption for first 20,000 e-3Ws purchased and registered in Telangana
- Retrofit incentive up to INR15,000 / vehicle for first 5,000 3-seater auto rickshaw
- Encourage Financing Institutions to provide a hire-purchase scheme at discounted interest rates Electric private goods carrier vehicles
- 100% road tax and registration fee exemption for first 10,000 electric 3-wheeler goods carrier and electric private goods carrier purchased and registered in Telangana Commercial electric 4-wheelers & private electric 4-wheelers
- 100% road tax and registration fee exemption for first 5,000 e-4W purchased and registered in Telangana
- 100% road tax and registration fee exemption for first 5,000 private e-4Ws purchased and registered in Telangana Electric Buses
- 100% road tax and registration fee exemption for first 500 e-buses
- Encourage State Transport Units to purchase e-buses
- Battery operated feeder shuttle services at all Hyderabad Metro Stations for last mile connectivity Tractors
- 100% road tax and registration fee exemption for electric tractors purchased and registered in Telangana

STATE SPECIFIC POLICIES: TELANGANA

SUPPLY INCENTIVES

- Capital Investment Subsidy: 20% of investment capped at INR30 Crore for Mega Enterprises.
- Interest Subvention: 5.25% for 5 years capped at INR5 Crore.
- Transportation Subsidy: 60% with 10% reduction YoY - for 5 years; capped at INR5 Crore.
- Lease rental assistance, assistance in patent filing, reimbursement of quality certification costs, cleaner production cost reimbursement, exhibition cost reimbursements, and skill development assistance.
- Urban mining of rare materials and cell/ battery recycling shall be incentivised on par with EV & ancillary manufacturing.

STATE SPECIFIC POLICIES: TAMIL NADU

TAMIL NADU EV POLICY

The Tamil Nadu Government plans on attracting investments worth Rs. 50,000 crore in EV manufacturing, generating 1.5 lakh new jobs, and establishing a strong EV ecosystem in the State.

The policy has four main objectives:

- To make Tamil Nadu the preferred destination for EV manufacturing in South-East Asia by building a robust infrastructure and industrial ecosystem that attracts manufacturing units, and by creating indigenous EV manufacturing value chains.
- To accelerate the adoption of EVs in Tamil Nadu by offering special demand incentives to early adopters of electric vehicles and by developing charging infrastructure with favorable power tariffs through public and private measures.
- To enhance the development of the EV ecosystem in Tamil Nadu by creating industry-academia linkages to generate a skilled workforce pool for EVs, promoting R&D and innovation in automotive and shared mobility, and encouraging the recycling industry to develop a circular economy in the State.
- To develop EV cities in Tamil Nadu, promoting Chennai, Coimbatore, Tiruchirappalli, Madurai, Salem, and Tirunelveli as pilot cities for implementing e-mobility solutions and electrifying commercial and public transport fleets.

STATE SPECIFIC POLICIES: TAMIL NADU

INCENTIVES FOR EV PURCHASE

Category	Maximum Incentive	Number of Vehicles per year
E Cycles	20% of cost upto 5,000	6,000
E2W	30,000	6,000
E3W	40,000	15,000
E4W	150,000	3,000
E Buses	1,000,000	300

STATE SPECIFIC POLICIES: TAMIL NADU

INCENTIVES FOR CHARGING INFRA

The government aims to promote the growth of public charging stations for electric vehicles in Tamil Nadu by offering various incentives.

The government plans to revise demand and energy tariffs, subject to approval from the Tamil Nadu Electricity Regulatory Commission. As part of this, there will be a 75% reduction in existing demand charges for the first 2 years, followed by a 50% reduction for the next 2 years. Moreover, energy charges will be cut by 50% between 8 AM and 4 PM to encourage charging during non-peak hours and promote renewable energy usage for EV charging.

Firms that establish public charging stations in compliance with the Ministry of Power's guidelines and standards will be eligible for a 25% subsidy on the cost involved in purchasing equipment and machinery during the policy period.

Additionally, the first 50 private charging stations established in Tamil Nadu will be eligible for a capital subsidy of 25%, up to Rs. 10,00,000 on the cost involved in the purchase of equipment and machinery during the policy period.

STATE SPECIFIC POLICIES: TAMIL NADU

INCENTIVES FOR SWAPPING AND RETROFITTING

Public Battery Swapping Station Incentives -

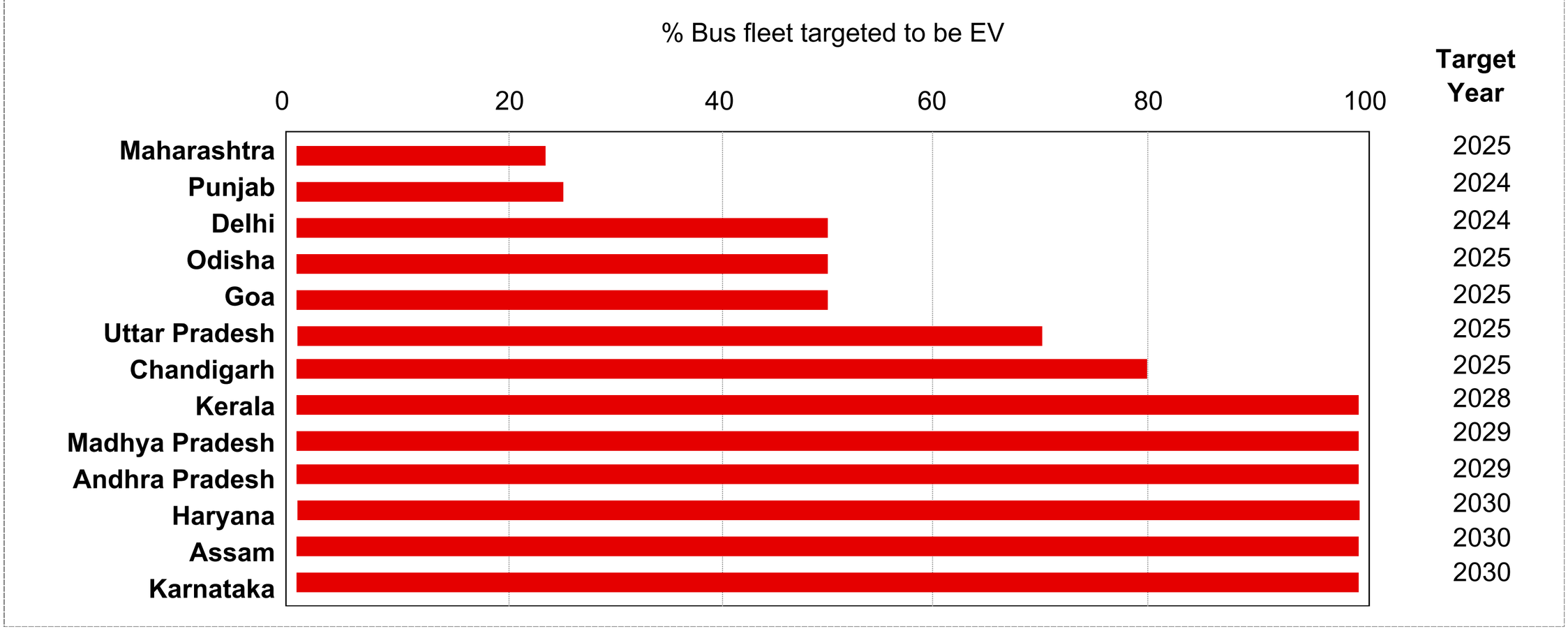
To encourage the establishment of public battery swapping stations in Tamil Nadu, the first 200 stations will receive a capital subsidy of 25% on the equipment and machinery cost, with a limit of Rs. 2 lakh per station.

Incentives for Retrofitting and Remanufacturing -

The government will also provide incentives for commercial vehicles that retrofit their existing internal combustion engine (ICE) vehicles and convert them into electric vehicles (EVs). Retrofitted vehicles that comply with the Automotive Research Association of India (ARAI) standards will be eligible for incentives until December 31, 2025.

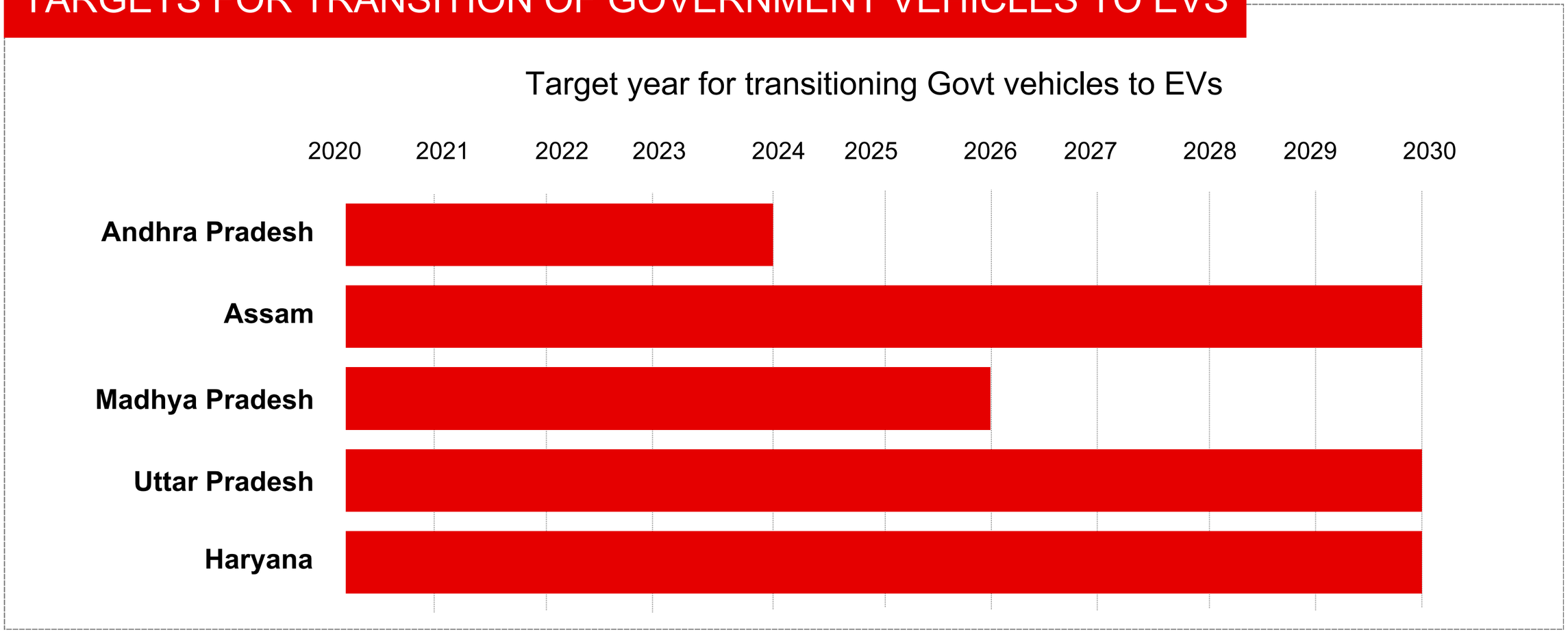
NOTABLE TARGETS

TARGETS FOR BUS FLEETS TO BE CONVERTED TO EVS



NOTABLE TARGETS

TARGETS FOR TRANSITION OF GOVERNMENT VEHICLES TO EVS



YEAR-END REVIEW 2024

- PM Electric Drive Revolution in Innovative Vehicle Enhancement (PM E-DRIVE) Scheme with an outlay of ₹10,900 crore was notified on 29th September, 2024. It is a two-year scheme which aims to support electric vehicles including e-2W, e-3W, e-Trucks, e-buses, e-Ambulances, EV public charging stations and upgradation of testing agencies

- PM e-Bus Sewa-Payment Security Mechanism (PSM) Scheme notified on 28th October, 2024, has an outlay of ₹3,435.33 crore and aims to support deployment of more than 38,000 electric buses. The objective of scheme is to provide payment security to e-bus operators in case of default by Public Transport Authorities (PTAs).

- Scheme for Promotion of Manufacturing of Electric Passenger Cars in India (SPMEPCI) was notified on 15th March, 2024 to promote the manufacturing of electric cars in India. This requires applicants to invest a minimum of ₹4150 crore and to achieve a minimum DVA of 25% at the end of the third year and DVA of 50% at the end of the fifth year.

- Ministry of Power has issued guidelines and standards for EV Charging Infrastructure titled, "Guidelines for Installation and Operation of Electric Vehicle Charging Infrastructure-2024" on 17th September 2024. These revised guidelines outline standards and protocols to create a connected & interoperable EV charging infrastructure network in the country. These guidelines also facilitate electricity connections for EV charging stations

- Ministry of Finance has reduced GST on EVs from 12% to 5%.

NOTABLE EV CHARGING COMPANIES: GLOBAL

NOTABLE COMPANIES OVERVIEW

Company	TGOOD 特来电
Founding Year	2014
CEO	Yongguang Guo
Website	https://www.crunchbase.com/organization/teld-new-energy
Description	Teld New Energy provides a charging system for electric vehicle groups. The charging system has a modular design, and the drawer-type AC and DC charging modules can be flexibly configured according to needs. Easy maintenance, convenient expansion, less one-time investment.

NOTABLE COMPANIES OVERVIEW

Company	
Founding Year	2000
CEO	Dongqing Cai
Website	https://www.crunchbase.com/organization/aulton-new-energy
Description	Aulton New Energy is an energy service platform that focuses on the battery swap business, including core battery swap technology research and development, commercial operation of swap stations, urban distributed energy storage, and battery life cycle management.

NOTABLE COMPANIES OVERVIEW

Company	Star Charge®
Founding Year	2018
CEO	Di Wang
Website	https://www.starcharge.com/#/
Description	Star Charge focuses on the R&D and manufacturing of new energy vehicle charging equipment, the development and expansion of smart cloud platform, as well as the business transaction of entire energy chain.

NOTABLE COMPANIES OVERVIEW

Company	SPAN
Founding Year	2018
CEO	Arch Rao
Website	https://www.span.io/
Description	Span Drive is sold as an accessory to Span Panel, an energy optimization device. Span Drive is a Level 2+ charger supplying 48 amps (11.52 kW) of power and is compatible with all EVs. Using Span Drive EVs can gain up to 41 miles in charge per hour. It claims to be the cleanest way to charging electric vehicles at home while also achieving energy independence.

NOTABLE COMPANIES OVERVIEW

Company	chargepoint
Founding Year	2007
CEO	Pasquale Romano
Website	https://www.chargepoint.com
Description	ChargePoint operates the largest online network of independently owned EV charging stations. It offers a convenient and hassle-free solution for electric vehicle drivers to charge their vehicles at hundreds of thousands of locations across North America and Europe (across 14 countries). By simply signing up for a single ChargePoint account, EV drivers can access a vast network of charging stations. Using ChargePoint's network over 5 Billion electric miles have been traveled and 1M tons of GHG emissions have been avoided.

NOTABLE COMPANIES OVERVIEW

Company	gogoro
Founding Year	2011
CEO	Horace Luke
Website	https://www.gogoro.com/
Description	Gogoro is a Taiwanese company that has developed a battery-swapping network for electric two-wheel scooters, mopeds, and motorcycles which involves battery-swapping. Additionally, the company designs and manufactures its own line of electric scooters and provides vehicle innovations to partner companies such as Yamaha, Hero, Aeonmotor, eReady, PGO, and eMOVING. In addition, Gogoro operates a ride-sharing service called GoShare, which is available in Taiwan and on Ishigaki Island in Japan.

NOTABLE COMPANIES OVERVIEW

Company	NIO
Founding Year	2014
CEO	William Li
Website	https://www.nio.com/
Description	NIO is a Chinese multinational automobile manufacturer, headquartered in Shanghai that specializes in the design and development of electric vehicles. In addition to conventional charging stations, the company also develops battery-swapping stations as an alternative for its vehicles.

NOTABLE EV CHARGING COMPANIES: INDIA

TOP MOBILITY FUNDING ROUNDS: INDIA

COMPANY	LATEST FUNDING	LATEST ROUND	FOUNDING YEAR
OLA ELECTRIC	$ 385 B	Series E	2017
ATHER	$ 109 M	Series F	2013
BOUNCE infinity	$ 20 M	Series C	2014
AMPERE	$ 220 M	Series B	2008
BatterySmart	$ 33 M	Pre-Series B	2019
EULER	$ 14.4 M	Series C	2018
LOG9 PIONEERING RESPONSIBLE ENERGY	$ 40 M	Series B	2015

NOTABLE COMPANIES OVERVIEW

Company	CHARGE ZONE®
Founding Year	2018
CEO	Kartikey Hariyani
Website	https://chargezone.com/
Description	SaaS-based provider of EV charging solutions for station operators. The platform provides find real-time charging station charge spot status, reservations, location information, and navigation to the destination of the EV driver. The mobile application is available for Android and iOS users.

NOTABLE COMPANIES OVERVIEW

Company	êxponent
Founding Year	2020
CEO	Arun Vinayak
Website	https://www.exponent.energy/
Description	Developer of lithium-ion-based fast-charging batteries for electric vehicles. The company offers an e-pack, a battery pack, an e-pump, a charging system, and many more. It also provides solutions to charge the e-pack in fifteen minutes with its e-pump charging station.

NOTABLE COMPANIES OVERVIEW

Company	statiq
Founding Year	2019
CEO	Akshit Bansal
Website	https://www.statiq.in/
Description	Company offers electric vehicle charging station networks. Its smartphone application allows customers to find local charging stations and schedule a space. Its charging stations can be found in places like workplace parking lots, shopping malls, residential unit parking lots, and restaurant parking lots.

NOTABLE COMPANIES OVERVIEW

Company	MASSIVE MOBILITY
Founding Year	2019
CEO	Shailesh Vickram Singh
Website	https://massivemobility.in/
Description	Massive Mobility is a leading innovator focused on accelerating electric vehicle adoption in India by developing advanced technologies and creating a strong EV charging infrastructure while focusing on lowering the cost of ownership for these solutions.

NOTABLE COMPANIES OVERVIEW

Company	BatterySmart
Founding Year	2019
CEO	Pulkit Khurana
Website	https://www.batterysmart.in/
Description	Developer of battery-swapping station network for electric vehicles. It is a network of battery swapping stations providing Li-ion batteries on a pay-per-use basis for the drivers of three-wheeled electric rickshaws and two-wheelers. It offers a mobile application for users to find charging stations and for partners to manage the charging station operations. Its mobile app is available for Android and iOS platforms.

NOTABLE COMPANIES OVERVIEW

Company	LOG9 PIONEERING RESPONSIBLE ENERGY
Founding Year	2015
CEO	Akshay Singhal
Website	https://www.log9materials.com/
Description	This company produces battery packs using a combination of graphene and aluminum, enabling rapid charging. Their focus is on developing sustainable energy storage solutions for a range of applications, including electric vehicle battery packs. In addition, they offer options for short-term power backup and large-scale energy storage on the grid.

TAKEAWAY FOR STAKEHOLDERS

INVESTORS

INSIGHTS

- The EV sector is rapidly maturing, but regional nuances and technological gaps provide abundant opportunities for long-term value creation.
- The shift from vehicles (OEMs) to ecosystem enablers (batteries, software, infrastructure) signals a change in where returns may be maximized.

STRATEGIC TAKEAWAYS

- Shifting focus toward battery technologies like solid-state batteries and recycling solutions may help capitalize on emerging trends that promise scalability and profitability.
- Exploring startups that tackle India-specific challenges, such as affordable rural EV charging or battery swapping for fleets, could unlock untapped markets.
- Supporting grid-independent charging solutions powered by renewable energy may provide a sustainable edge in both urban and underserved regions.

GOVERNMENTS AND POLICYMAKERS

INSIGHTS

- Strong policy frameworks and incentives have catalyzed adoption but lack consistency across states and regions.
- Infrastructure gaps (charging density, functional reliability) are key deterrents to meeting long-term EV goals.

STRATEGIC TAKEAWAYS

- Simplifying and standardizing charging infrastructure requirements, such as universal connectors, may help reduce costs and accelerate EV adoption.
- Offering enhanced subsidies for public transport electrification or last-mile delivery fleets could significantly lower emissions while boosting adoption.
- Developing skill-development initiatives tailored to EV jobs, like battery assembly or charging station operations, may help create employment opportunities and sector expertise.

EV BUSINESSES AND STARTUPS

INSIGHTS

- The market is shifting from high-margin early adopters to cost-conscious mass consumers, especially in emerging economies.
- Technology gaps (e.g., charging inefficiencies, lack of universal connectors) present opportunities for competitive differentiation.

STRATEGIC TAKEAWAYS

- Focusing on scalable, modular solutions like battery swapping or hybrid renewable charging hubs may address both urban and rural EV needs effectively.
- Improving charging reliability and uptime may help businesses stand out in a fragmented market, driving consumer trust and adoption.
- Collaborating with governments and OEMs to align with evolving regulations and demands may ensure long-term growth opportunities in fleet electrification.

AUTO OEMS (VEHICLE MANUFACTURERS)

INSIGHTS

- OEMs are facing shrinking margins due to increased competition and the commoditization of EVs, especially in the two-wheeler segment.
- Battery technology and partnerships with infrastructure providers are becoming critical differentiators.

STRATEGIC TAKEAWAYS

- Collaborating with battery manufacturers for innovations like second-life applications may secure supply chains and reduce long-term costs.
- Designing EV models with affordability and durability in mind could help cater to emerging markets where cost sensitivity drives purchasing decisions.
- Developing integrated platforms for tracking vehicle performance, charging schedules, and maintenance may enhance the customer experience and build loyalty.

CHARGING POINT OPERATORS (CPOS)

INSIGHTS

- Reliable and accessible charging is critical for EV adoption, but operational inefficiencies and low density remain challenges.
- Fast charging and energy management systems are emerging as critical differentiators.

STRATEGIC TAKEAWAYS

- Strategically expanding charging networks in high-demand areas, such as highways and urban centers, may ensure higher utilization and ROI.
- Integrating renewable energy sources into charging hubs could help reduce operational costs while meeting sustainability goals.
- Offering features like dynamic pricing and real-time charger availability updates might enhance the overall user experience.

FLEET OPERATORS AND LOGISTICS PROVIDERS

INSIGHTS

- Electrifying fleets offers cost savings over the lifecycle of vehicles, but upfront costs and lack of reliable charging deter mass adoption.
- Fleet operators require charging solutions tailored for operational efficiency.

STRATEGIC TAKEAWAYS

- Considering battery swapping and depot-level charging solutions may help reduce downtime and improve fleet efficiency.
- Partnering with CPOs for dedicated charging access could ensure seamless operations in high-demand zones.
- Leveraging telematics to optimize routes and reduce energy consumption might help improve cost efficiency and operational performance.

ENERGY COMPANIES AND UTILITIES

INSIGHTS

- EVs will place significant demand on grids, requiring utilities to rethink load management and integrate renewable energy sources.
- Utilities can play a key role in powering and partnering with CPOs for seamless grid integration.

STRATEGIC TAKEAWAYS

- Investing in smart grid technologies and load management systems may help prepare for increased electricity demand from EVs.
- Collaborating with CPOs and governments on renewable-powered charging stations might align with sustainability goals while reducing grid strain.
- Supporting V2G (Vehicle-to-Grid) solutions may help position EVs as a resource for energy storage and peak load balancing.

KEY FUTURE NARRATIVES FOR EV SECTOR

Consumer Shift: The EV market is moving from early adopters to mass-market consumers, driving the need for affordable models, faster-charging technology, and accessible second-hand markets. This transition presents opportunities for innovations like battery refurbishing, resale networks, and EV-focused maintenance services, enabling broader adoption and aftermarket growth.

Energy and Infrastructure Synergy: The future of EV infrastructure lies in integrating renewable energy systems, with battery swapping, Vehicle-to-Grid (V2G) technology, and advanced grid resilience at the core. These solutions will create a smooth energy loop, reducing dependence on fossil fuels and enabling a sustainable and efficient energy-transport ecosystem.

Standardization Race: Fragmented EV markets are pushing the need for standardized technologies, such as India's Type-6 connector. Achieving interoperability across EV brands and charging networks will lower costs, simplify infrastructure expansion, and establish India as a global leader in setting EV standards.

Decentralized Charging Models: Decentralized charging hubs powered by renewable energy or battery storage offer an efficient solution for rural and underserved areas. These models reduce grid dependency, accelerate EV infrastructure growth, and provide a sustainable pathway for broad-based EV adoption.

CONTRIBUTOR

Shailesh Vickram Singh

Founder

Shailesh has 20 years of experience with 11 years in Venture Capital investing and 9 years in Operations with strong domain knowledge of consumer internet, technology and manufacturing space.

Rohit Kasar

Investment Analyst

Rohit completed his B. Tech. in Civil Engineering from Symbiosis Institute of Technology, and worked with Climate Angels as an investment analyst.

Mahi Jain

Analyst

Mahi graduated from Delhi University's Hansraj College in 2021 and had worked with Climate Angels for over a year.

Malvika Sharma

Investment Analyst

Malvika completed her Bachelor of Management Studies from Delhi University’s Shaheed Sukhdev College of Business Studies, and has been looking after the investment due diligence for the company.

PANEL DISCUSSION

DISTINGUISHED PANELISTS

MODERATOR

Shailesh Vickram Singh

Founder & CEO,
GoMassive Earth Network

Priyans Murarka

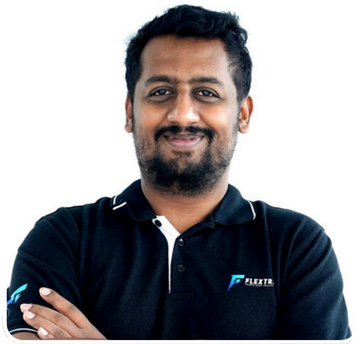
Founder, ExpWithEVs.in

Vasudha Madhavan

Founder & CEO, Ostara Advisors

Sumedh Agarwal

Director, Smart & Resilient Power & Mobility, AEEE



Ameen Khan

Founder & CEO,
Flextron

Akhil Jayaprakash

Founder & CEO, Pulse Energy

Chaitanya Kanuri

Associate Director E-Mobility, WRI

Seshadri Raghavan

Program Lead Sustainable Mobility, CEEW

DISCUSSION TRANSCRIPT

Shailesh Vickram Singh:
Thanks, everyone, for joining today. Today, we are releasing the State of EV Report on the state of charging in India.
We have a very diverse panel today, including experts from policy organizations like WRI and CEEW, investment banker Vasudha, and two founders, Akhil and Ameen, who bring expertise in hardware and software design. Before we begin, it would be great if everyone could give a brief two-line introduction about themselves.
Let's start with you, Chaitanya.

Chaitanya Kanuri:
Hi, I'm Chaitanya. I lead the EV mobility work at WRI India. We work on various aspects of sustainability, including urban transport and development. Within urban transport, we focus on electric mobility as a key pathway to decarbonizing India's transport sector.
On the EV charging front, our work spans national policy engagement with organizations like the Ministry of Power and NITI Aayog, as well as collaborations with DISCOMs, state modal authorities, and public utilities on spatial planning and business modeling for charging infrastructure in cities and along highways.
Happy to be here.

Shailesh Vickram Singh:
Thanks, Chaitanya. Let's move to Vasudha.

Vasudha Madhavan:
Hi, everyone. I'm Vasudha, an investment banker with over 22 years of experience. For the last decade, I've been running my independent firm, Ostara Advisors. We were the first to focus on electric mobility back in 2016-17 and have worked on notable deals

DISCUSSION TRANSCRIPT

in India, such as the acquisition of Ampere Vehicles by Greaves Cotton, India's first M&A in the electric two-wheeler space.
We've helped companies across the EV ecosystem, including OEMs, battery management systems, efficiency devices, and fleets, to raise early- and growth-stage capital. We also work on broader decarbonization projects and have brought several global investors into India. I'm based in Bangalore.

Shailesh Vickram Singh:
Thanks, Vasudha. Moving on, we have Ameen, who runs an interesting startup called Flextron EV. Ameen, over to you.

Ameen (Flextron EV):
Hello, everyone. My name is Ameen, and I'm the co-founder and CEO of Flextron. Flextron is an EV charging technology company manufacturing chargers like 3.3 kW and 7.5 kW models. We have over 15,000 chargers installed across the country through various CPOs.
Our core focus is on rapid charging technology, enabling EVs to charge in about 10 minutes. We bring extensive experience in the charging infrastructure space, particularly in hardware supply chains, and are currently focusing on building charging infrastructure and fast-charging batteries for last-mile delivery and gig workers.

Shailesh Vickram Singh:
Great, Ameen. Next, we have Priyans, who runs a popular blog called "Experience with EVs." He brings a customer-focused perspective. Priyans, over to you.

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Priyans M:
Thank you, Shailesh, for inviting me. As mentioned, I run a blog called eXp with EVs, where I document experiences of driving EVs across the country. Beyond that, I've also been tracking infrastructure growth in India, particularly CCS2 and Type 2 chargers, for over two years. I've been compiling data and insights to inform the public and the industry about what's happening in the EV space.

Shailesh Vickram Singh:
Thanks, Priyans. Now, we have Sheshadri joining us from the US. A quick introduction, please.

Seshadri Raghavan:
Thank you, Shailesh, and thanks to Climate Angels for having me. I'm Sheshadri Raghavan, a program lead at the Council on Energy, Environment, and Water (CEEW). I work on various EV transition topics, ranging from user behavior to broader decarbonization efforts. I'm excited to be here and to learn from this esteemed panel.

Shailesh Vickram Singh:
Thank you, Shishadri. Finally, we have Sumedh Agarwal, Director at IEEE. Sumedh, over to you.

Sumedh Agarwal:
Good afternoon and good evening, everyone. I'm Sumedh, and I've been working in the development sector for over a decade. At IEEE, a nonprofit research-based organization, I lead the mobility practice, focusing on energy efficiency as a key lever for sustainable development. Decarbonization is central to our mission, and we fully support the electrification of the transport sector as a way to reduce emissions. I'm looking forward to learning from the panel and sharing our experiences.

DISCUSSION TRANSCRIPT

Shailesh Vickram Singh:
Thanks, Sumedh. Let’s jump straight into the discussion.
A bigger question on everyone’s mind when it comes to EVs is about charging. Whenever we discuss EVs, the first thing that comes up is charging infrastructure. You approach the government, and they say, "We are working on building it." You speak to CPOs, and the utilization rates are extremely low—barely even in single digits. I met one large company whose utilization rate was only 0.5%.
Sumedh, why do you think this is happening?

Sumedh Agarwal:
Shailesh, there are three key challenges I would summarize as law, land, and legal.
Firstly, land is always an issue when it comes to selecting locations. Rents are typically very high, which makes it difficult to create a viable business model. Secondly, there are legal delays, such as obtaining approvals from utility sectors or accessing subsidies, which can be a significant roadblock. Finally, there are issues related to regulations or policies that sometimes hinder long-term investment and stability for new entrants.
This creates a complex system where the challenges are not just about EVs but also extend to the overall EV infrastructure. These aspects collectively discourage new players from entering the market or staying invested for the long term.

Shailesh Vickram Singh:
So, we’ve discussed law, land and legal issues—very interesting points. Chaitanya, you’ve been closely working with governments and are deeply involved in the development and formulation of EV policies. What are your views?

DISCUSSION TRANSCRIPT

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Chaitanya Kanuri (WRI):

Thanks, Shailesh. Honestly, it's hard to know where to start—there are so many factors at play.

First, as you mentioned, land and legal challenges are significant. The absence of a single-window clearance system slows down the setup of chargers.

On the supply side, a lot of players entered the charging infrastructure market because they saw it as a long-term opportunity. They weren't expecting immediate profits; instead, they wanted to establish first-mover dominance in anticipation of the EV market's growth. Additionally, the low entry barriers—thanks to de-licensing—allowed many charging operators to emerge, which was good for proliferation but also led to fragmentation in the ecosystem.

We've seen a mix of small, fly-by-night operators and big players enter the market. Over time, consolidation is happening, but this fragmentation has created challenges for EV users. It's not uncommon to hear complaints about needing multiple apps—sometimes as many as 30—just to complete a long-distance journey by piecing together different charging networks. This inefficiency impacts utilization rates.

On the demand side, India's vast geography and fragmented market mean that rolling out a cohesive charging infrastructure is a significant challenge. Public charging infrastructure has primarily been concentrated in cities, with highway charging only starting to gain traction in the past couple of years. This lack of highway charging facilities, especially for four-wheelers, has been a psychological barrier for potential EV buyers, who are accustomed to the convenience of fuel pumps everywhere.

Another issue is the mismatch between where charging stations are located and where they're needed. Many initial installations were placed where land was readily available—often in peripheral or industrial areas—rather than in high-demand, high-traffic commercial zones where land is scarce. This mismatch further reinforces the perception that charging infrastructure is insufficient.

In essence, the situation is complex and multifaceted, with truth on all sides.

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Shailesh Vickram Singh:
Interesting. So, you're saying there's charging infrastructure, but profitability and margins are limited. Let me now bring in Akhil from Pulse Energy, a startup addressing these issues. Akhil, you have a tough position here, considering the paradox where everyone's investing in charging, yet CPOs are struggling. Could you introduce yourself and share your thoughts on this paradox?

Akhil Jayaprakash:
Thank you, Shailesh, and thanks to Clem Tangel for having me here.
I'm Akhil, one of the co-founders of Pulse Energy. Over the past five years, I've had the opportunity to work with many of the panelists here. Our business focuses on helping fleet operators access multiple charging networks through our platform.
Today, fleets and commercial vehicles are the biggest consumers of public chargers in India. As Chaitanya mentioned, the fragmentation of charging networks forces users to juggle multiple apps, which we help solve. It's a small but significant problem, as it impacts utilization, accessibility, and the overall user experience.
When I think about the paradox, I see two key trends. One is that Indians are value seekers—we naturally gravitate toward chargers offering the lowest rates. This behavior is consistent across fleets and retail customers. For instance, we manage charging for BESCOM, which offers rates as low as ₹6.70 per unit.

Shailesh Vickram Singh:
So, what's their decision regarding this?

Akhil Jayaprakash:
The rates are extremely high. I get complaints that, while the utilization is good, the issue is whether they're making money.

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The rates are often set at cost—just the electricity cost without any GST. The approach is not profit-driven; these operators are treating it as a government-funded project. They're focused on providing the lowest rates possible, but the problem is, even with high utilization, they're not generating profit. Plus, there are lines at these charging stations, which adds to the frustration.

Shailesh Vickram Singh:
In Malaysia, would you say utilization is above 50% or below 50%?

Akhil Jayaprakash:
I wouldn't be able to answer that. That's best for BESCOM to clarify.

Shailesh Vickram Singh:
I want to understand what is meant by good utilization.

Akhil Jayaprakash:
Think of it as decent utilization. You can actually file an RTI to get the exact data. I'm not authorized to disclose that.
Just to close the loop on this, utilization levels vary. Some public chargers in cities like Mumbai, Delhi, Hyderabad, and Bangalore show good utilization—around 125% for certain chargers. However, on highways, the utilization rates are generally lower.

Shailesh Vickram Singh:
Yes, got it. So, that's happening. You're suggesting that instead of installing a DC charger, we could use a battery charger and deploy it for on-demand charging. Ameen what are your views in this regard?

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Ameen Khan:
Right, I think if you're using battery-integrated DC chargers to charge electric vehicles, there are some fundamental challenges. It makes sense if it's integrated with, say, solar or if you're able to store or borrow energy at a lower cost and sell it at a higher cost.
But where it becomes tricky is within the supply chain. As Akhil mentioned earlier, margins are very thin. If a CPO has to install a charger, consider the stakeholders in the supply chain: you have the manufacturer, the financier, the CPO who manages the software, and the landlord. Each of them needs a share of the ₹8–12 per unit you sell.
Breaking even on these chargers becomes extremely difficult if you're investing in the charger and then also need to invest in an additional grid-to-grid connection, which costs ₹2–3 lakhs. However, if you're able to store energy without requiring another grid-to-grid setup and sell the electricity at a higher cost, then breaking even and building a sustainable model becomes more feasible.
That said, we're noticing grid availability becoming a growing challenge as the ecosystem expands. In cities like Bangalore, there's real estate and capital available, but grid availability is often missing, and this is becoming a significant bottleneck.

Shailesh Vickram Singh:
So, Sheshadri, I'm coming to you. Since you've been advising many governments, do you think this grid availability issue is becoming a major problem?

Seshadri Raghavan:
The grid issue is multifaceted. First, there's a lack of data on ground realities, like demand curves and utilization patterns. This black-box scenario complicates effective planning. Second, there's a lack of coordinated planning between supply and demand, as panelists have pointed out, driven by factors like land availability and costs.

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Currently, the EV transition in India is primarily driven by two-wheelers and three-wheelers. These vehicles operate on AC charging and don't heavily burden the grid. At most, they require minor reinforcements like upgraded MCBs. However, the challenges escalate when we shift to DC fast charging, particularly for four-wheelers and buses.

For four-wheelers, concentrated in metros and premium areas, the bottleneck lies in accessing the required voltage and current levels. Grid challenges can be divided into two parts: onsite infrastructure, like transformers or substations, and upstream infrastructure, such as high-tension lines. Both involve significant costs and time investments.

In rural or highway settings, the challenges amplify due to sparse demand and the high cost of upgrading grid infrastructure. For instance, even with two-wheelers and three-wheelers, some hotspots are creating strain. Anecdotally, in Delhi, e-bus drivers have been advised to space out their charging, but many still charge during their lunch breaks, causing localized strain.

If we aim to accelerate the EV transition and expand beyond two- and three-wheelers, which currently only make a minor dent in crude oil imports and GHG emissions, we must address these grid constraints systematically. However, moving forward, the focus must shift to higher-impact vehicles like buses, trucks, and four-wheelers, as these segments are the real game changers.

Shailesh Vickram Singh:

The endgame lies in buses, trucks, and cars. We'll circle back to the bus discussion later since that's a different challenge altogether. But let's now explore the core challenges from the perspective of users who rely on public infrastructure. Priyans?

Priyans M:

Let's break down the problem:

1. Two-Wheelers: Most users charge their vehicles at home. These are primarily city-driven vehicles that don't rely heavily on public charging infrastructure.

DISCUSSION TRANSCRIPT

1. Three-Wheelers & Light Commercial Vehicles (LCVs): These vehicles are typically used for fixed circuits or point-to-point operations, also relying on private or captive charging setups rather than public infrastructure.
2. Four-Wheelers & Buses: This is where public infrastructure becomes critical. Unlike service operators managing their own e-bus charging, four-wheeler users face a fragmented ecosystem with too many players.

There's also a significant data gap. For example, I have over 100 charging apps on my phone, but none of them consolidate information effectively. However, public charging infrastructure is improving. Since September 2022, CCS2 and Type 2 public chargers have grown tenfold in India.

To illustrate, I've driven the Delhi-Mumbai route nine times. Initially, I had to take detours via cities like Ahmedabad and Udaipur due to limited charging options. Now, with improved infrastructure, I can use the Delhi-Mumbai Expressway, albeit with some reliance on off-expressway chargers. This improvement has already cut my travel time by 3–3.5 hours. Once the expressway is fully operational and equipped with reliable chargers, travel times will reduce further.

This gradual evolution of public charging infrastructure shows promise, but we're still far from optimal. We need coordinated efforts to close gaps, especially for high-demand areas and long-haul routes.

Shailesh Vickram Singh:

Understood. I see your point about shifts in infrastructure and demand patterns. Let's move toward discussing this from an investment and growth perspective.

Vasudha Madhavan (Ostara Advisors):

Looking at the EV sector, I want to address two aspects:

1. Global Trends in EV Investments: Globally, we've seen a decline in EV sector investments. This has raised concerns about whether India might follow the same trend.

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However, India's unique market dynamics—dominated by two-wheelers and three-wheelers—differ from markets primarily driven by passenger vehicles or luxury EVs.

2. Mismatch Between Demand and Supply: The core of the challenge lies in aligning demand and supply. The EV charging ecosystem's current anxiety stems from the shift in expectations. With ICE vehicles, you never worry about finding fuel stations; they're ubiquitous. Transitioning to EVs introduces the need to plan ahead, find chargers, and manage range anxiety.

This mismatch between where demand is concentrated and where charging infrastructure is available exacerbates the problem. Addressing this will be key to alleviating concerns and fostering smoother adoption.

India's EV market has strong growth potential, but ensuring infrastructure development keeps pace with increasing vehicle adoption is critical. This balance will dictate how effectively the sector scales and attracts continued investment.

I think most of the points have been covered about why the infrastructure exists and all that. But essentially, it all comes down to where the demand is and where the supply is. Right now, part of the anxiety is because we're used to having fuel stations available whenever and wherever we need them. That tension doesn't exist with ICE vehicles. The transition to EVs, however, brings this tension because you suddenly have to find where the charging station is.

The way the EV industry has grown in the last several years has been use-case-specific. Two-wheelers used for deliveries have grown at one pace, three-wheelers for last-mile transport at another, and buses at their own cadence. Charging networks also need to integrate with these use cases, but the slower growth of charging infrastructure compared to vehicles has created a mismatch.

Over the next few years, I think this mismatch will start getting ironed out. For instance, more EVs will be in apartment complexes, and societies are already installing local chargers. Each use case will begin to address its own challenges. Right now, the paradox exists because we're in the early stages of adoption.

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From an investment perspective, I often have conversations with investors looking at Series A and above. Almost every meeting includes discussions about preferences, trends, and where they're looking to invest. Over the past three years, more than a billion dollars have been raised annually in the EV sector.

In 2021, for example, we saw significant deals like the TPG Rise investment in Tata Motors, which alone accounted for a billion dollars. But, on average, a large share of funding—50-60%—has gone to OEMs. Charging infrastructure, on the other hand, has received only a small portion. For instance, only about 3% of last year's funding went into the charging space.

The main issue for equity investors is this paradox of low utilization rates for chargers. Investors question the timeline for higher utilization that would justify returns on their capital, which typically has a 3-7 year horizon. This mismatch between perceived timelines and expectations has held back significant investment in charging infrastructure.

Shailesh Vickram Singh:

You're saying people expect utilization, but it's not happening, so they hesitate to come in. Looking at the EV ecosystem broadly—OEMs, hardware, software, battery swapping, and charging—where do you think the pressure will be in the next 18 months?

Vasudha Madhavan:

Speaking broadly, investors are less focused on hardware unless there's a high level of differentiation, like unique technology developed by the company. OEMs and software solutions generally attract more interest.

In India, purely software-based businesses are rare because there's always some hardware or offline element involved. While software is attractive to investors, the broader ecosystem has challenges due to the offline nature of EV infrastructure, which impacts scalability and funding decisions.

DISCUSSION TRANSCRIPT

Shailesh Vickram Singh:
In India, you can't really build a purely software business.

Vasudha Madhavan (Ostara Advisors):
I agree. The software aspect might seem attractive to investors, but scalability often becomes a question, right?

Shailesh Vickram Singh:
When you say scalability, do you mean the market isn't large enough for software solutions?

Vasudha Madhavan (Ostara Advisors):
Exactly. The market is not perceived as very large. For instance, consider a company that provides transportation services, not just EVs but a mix of EVs and ICE vehicles. They might have fantastic AI-based software to optimize rides and trips, and they offer it as a SaaS solution to enterprises. While this sounds great, the market for such solutions is much smaller compared to actually operating and filling those trips.
In the Indian market specifically, enterprise customers or the average end consumer aren’t typically willing to pay for software solutions. It’s very challenging. Akil also mentioned Bescom, which is great work, but in terms of scalability and ROI, it’s tough to match investor expectations with what the industry can deliver.
This creates a paradox. Investors want to focus only on software because of its perceived scalability and asset-light nature, but the reality is that the EV ecosystem often requires a mix of software and hardware. Both sides—investors and industry players—need to find a middle ground and be okay with some level of hardware involvement to make things work.

DISCUSSION TRANSCRIPT

Shailesh Vickram Singh:
Sorry to interrupt here.

Vasudha Madhavan (Ostara Advisors):
Sure, go ahead.

Shailesh Vickram Singh:
Akhil, considering what was just discussed, do you think it's possible to build a hundred-million-dollar revenue company purely through a software play in the EV charging space?

Akhil Jayaprakash:
In India? No, to be very honest. Globally? Yes, it's possible. Here's the thing: investors need to consider the market dynamics. Ultimately, the market size in India is tied to consumption, which in turn depends on vehicle sales.
We've seen government projections of 30 million to 50 million EVs by 2030, but I don't think that's realistic. There's already a slowdown happening. If vehicle sales reduce at a macro level, overall consumption will decline as well.
This impacts hardware charger companies too. There's a limit to how much hardware you can push into the market. At some point, saturation will set in. People aren't going to buy a lakh chargers every year. Eventually, sales will stabilize, and we'll see a stagnant phase.

Shailesh Vickram Singh:
We're already noticing a drop, right? There's a clear decline.

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Akhil Jayaprakash:
Exactly. We're not going to hit those 30-50 million EV targets in the next five years. That reduction trickles down to fewer chargers being set up, less energy being consumed, and ultimately less value that can be extracted through software solutions.
So, when looking at the Indian market, it really boils down to the number of vehicles and users. Without that critical mass, a purely software-driven approach struggles to achieve scale.

Shailesh Vickram Singh:
Ameen, you're focusing on hardware, such as batteries and other components. Do you think it's possible to build a 100-million-dollar company in India, or do you agree with Akhil that we need to think about building for the global market? And if that's the case, how do we account for the challenges related to exporting, compliance, and quality standards?

Ameen Khan:
I believe it's possible to build a 100-million-dollar company in hardware within India, especially considering the market growth. For example, electric motor controllers and EV chargers are seeing a significant rise in demand. However, when you look at the hardware supply chain in India, about 80% of it is sourced from China and Taiwan, and there's a lack of innovation in our local supply chains.
One key challenge in the EV charging infrastructure space is that while the external parts of chargers are often made locally, the internal hardware is still largely imported. This has stunted innovation.
If we want to build a successful 100-million-dollar company in this space, I believe it could come from a charging manufacturer or an OEM that not only serves the Indian market but also exports globally.

Shailesh Vickram Singh:

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Sumedh, what do you think? We have three policy experts here. Do we always blame the vehicles, the institutions, or manufacturers for not innovating, or is it that the policies themselves are heading in the wrong direction? If you look at the graph on the screen, you can see that after hitting 5%, there's suddenly been a drop to 3.9% for 2024. What's your take on the policy side of things?

Sumedh Agarwal:
That's a good question. There are a few things to consider here. Firstly, the EV market in India has always had low penetration. The heroes of the EV sector have mostly been in tier-2 cities, especially with two-wheelers and three-wheelers, where we have more space. But as urbanization increases, there are new challenges. Personal mobility is rising, and more people are living in nuclear families, which means we're seeing a rise in rented apartments.
This creates issues when it comes to setting up fixed charging stations, especially in rented properties where landlords aren't willing to install charging infrastructure. There's also a lack of designated parking spaces for EVs in many places.
Now, on the policy side, India's approach has been supportive. When compared to China, where the EV market is heavily subsidized, India's policies have been more about driving demand and supply. However, there's still a lot of innovation that needs to happen in terms of creating new ecosystems. For example, battery swapping and developing solutions to increase penetration in the four-wheeler sector, as growth right now is largely in the two-wheeler and three-wheeler markets.

Shailesh Vickram Singh:
I think this point you raised about policy is critical. What I want to ask Seshadri now is, do you think the progress we've made is due to policy or despite it? I've got a chart here, and while the data shows some correlation, we can't assume causation. What do you think – is the current trend happening because of policy or despite it

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Seshadri Raghavan:
Okay, I'll play the diplomat here. I'll refer to the previous comment on being bottom-up. Let's say we're not focusing on two-wheelers. We largely don’t need much public EV charging infrastructure, as a regular socket with sufficient protection should be enough.
As for policy and the correlation-causation angle, it's a philosophical discussion. Rather than focusing on whether there is correlation or causation, there is enough global evidence to suggest that policies tend to go hand-in-hand with EV adoption. Especially when talking about four-wheelers, there is some association between EVs and EV infrastructure.

Shailesh Vickram Singh:
That makes sense. Let me add two points here. First, most of the adoption in India, especially for two-wheelers, has been driven by affordable batteries, with little reliance on subsidies. Second, once FAME subsidies were phased out, vehicle prices dropped. But now, companies like Hero Electric and Okinawa, which heavily depended on subsidies, have practically disappeared from the market. So, my question is, are the policies really helping, or have they allowed players who weren't necessarily focused on building quality vehicles to enter the space, take advantage of the subsidies, and build up the market? What's your take?

Chaitanya Kanuri (WRI):
I don’t think there's any question that subsidies drive EV growth, especially at the beginning, when there was a significant price gap between EVs and ICE vehicles. The market was almost non-existent, and economies of scale hadn’t yet come into play. Subsidies were essential for kickstarting the market, and they continue to be important, especially for certain segments like two-wheelers, which remain quite niche. The real question is how to use subsidies judiciously. Yes, if you throw enough money at anything, people will buy it. But the goal is to ensure that the money is spent effectively. As someone pointed out earlier, Okinawa and Hero Electric faced issues with localization, which affected their eligibility for subsidies.

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Over time, these players will likely be weeded out if they don't meet the required standards. I don’t think this is a policy issue.

Shailesh Vickram Singh:
Great. So, I’ll play the devil's advocate here and raise a big question. We’re seeing maximum adoption in three-wheelers, but we don’t have a standardized approach. We’re the only country that uses three different standards as one, right? No other country does that. We have Type 6, Type 7, and other types coming up. So, what are the challenges we’re facing here?

Chaitanya Kanuri (WRI):
What is your take? And that's multiple standards.

Shailesh Vickram Singh:
Yes, you can have multiple standards, but the point is that you have Chademo, American standards, and even others, and you don’t have one unified standard. If there are five standards, the industry won’t come together. So, why are we struggling to have a single standard?

Chaitanya Kanuri (WRI):
It’s really a matter of excitement again.

Shailesh Vickram Singh:
The question remains: What we know is fairly clear, it’s just one—Type 6, Type 7. Why is it so complicated?

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Chaitanya Kanuri (WRI):
Well, I'm sure there are others who could speak to this as well.

Shailesh Vickram Singh:
Okay, I'll let you share your two cents, and then I'll let others weigh in.

Chaitanya Kanuri (WRI):
There are a couple of reasons for this. Firstly, as someone mentioned, most two-wheelers are charged at home. When charging is done at home, there's no pressing need to worry about standardizing connectors to meet international standards. High-quality standards or internationally certified connectors are expensive, and adding them would increase the cost of the vehicle. Two-wheelers are extremely price-sensitive.
And it's not just about charging connectors. For example, consider the batteries—they often don't have high-grade battery management systems (BMS) or advanced thermal cooling systems, especially for two-wheelers. All these are optimized to reduce costs. Moreover, the lack of standardization hasn't really been a pain point for consumers in the two-wheeler space. Most two-wheelers come with a portable charging cable, so as long as the socket on the wall is standardized, it suffices.

Shailesh Vickram Singh:
Yeah, that's a different perspective. We'll come back to that. But I get the point. Let me pause here.
So, Ameen, as a manufacturer, do you think the lack of a standard is a real issue? For example, what Chaitanya is saying suggests it's not a big concern for two-wheelers—it doesn't seem to bother anyone too much.

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Ameen:
I agree with Chaitanya that when charging happens at home, standardization doesn't matter much to users. Standardization becomes important, for instance, in four-wheelers—if you have CCS2, you can publicly charge anywhere.
For public charging, standardization is key because it offers a value proposition. For example, I might use a Chigori or an SBS connector with my battery pack, but as long as I can plug it into a socket at home, it's fine. However, when offering fast charging services or building public infrastructure, the customer expects standardization. They want to be able to charge their vehicle at any station, like an Ather or a Tata Power station.
So, for public charging stations, standardization is crucial. But for home charging, it's less of an issue. What Chaitanya is saying is correct—standardization might not be critical for two-wheelers.

Shailesh Vickram Singh:
We're a little short on time, so I'd like to get as many perspectives as possible.
Vasudha, as a banker, do you see any of the companies you work with struggling with standardization issues? Do you think this is a significant challenge?

Vasudha Madhavan (Ostara Advisors):
We've worked selectively in this space, and while we've observed changes, I don't think standardization across vehicle types is a significant issue on a large scale.
The priority should be building scalable businesses within each segment. The Indian market has a unique dynamic—it's possible to create large and attractive full-stack businesses even by focusing on just one or two use cases. That's the main challenge and opportunity here.

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Priyans M:
From what I've seen, standards don't seem to be a major challenge. As an end user, my perspective is more focused on four-wheelers. Thankfully, in the four-wheeler space, everyone has adopted CCS2.
Initially, there were a few outliers using different standards, but even fleet operators have now switched to CCS2. So in this segment, OEMs or regulatory bodies deserve credit for bringing in and enforcing standardization.

Shailesh Vickram Singh:
Got it. Thanks for sharing your perspectives.
As we're nearing the end of this session, I'd like to pose a slightly different question. Between AC 22 kW fast charging and DC 30 kW fast charging, why haven't we leaned more towards AC 22 kW charging?
It's significantly cheaper—an AC 22 kW charger costs just about ₹56,000. It doesn't require any specialized equipment, there are no significant safety concerns, and it can provide around 150 kilometers of range in an hour. So where are we stuck?
I'll start with you, Ameen—what are your thoughts on this, particularly from the perspective of operational costs?

Ameen Khan:
Right. So, in most buildings today, if you want to provide a 22-kilowatt AC charging option, you'll likely face challenges with the power allotment. For example, in a typical residential or commercial building, you might have a total allotment of just 24 kilowatts.
If you aim to offer 22 kilowatts to your customers, you'll still need to request a grid upgrade to accommodate that load.

Shailesh Vickram Singh:
One second, one second. Why would you need an upgrade?

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If you already have three-phase power, the system should provide sufficient capacity. For instance, if I'm getting seven kilowatts per phase, with three phases, I already have 21 kilowatts, right?
In large building complexes with three-phase energy systems, you typically have around 32 kilowatts of power available. Isn't that standard?

Ameen Khan:
Right, that could be true for large buildings. But the key question is: how many of these buildings can consistently provide a dedicated 22 kilowatts for EV charging?

Shailesh Vickram Singh:
That's a fair point.

Ameen Khan:
The second issue is the cost. While a 22-kilowatt charger might cost ₹40,000 to ₹50,000, making it easier for the end consumer, the cost implications for OEMs are significant.
For example, the differential cost of an onboard charger—whether it's a 3.3-kilowatt or a 7.5-kilowatt charger—can be as high as ₹45,000. This cost difference impacts the overall feasibility of deploying higher-capacity chargers.

Shailesh Vickram Singh:
But if you're comparing the costs, for a 7-kilowatt onboard charger, it's ₹45,000. Meanwhile, a 22-kilowatt onboard charger costs ₹1.5 lakh.

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Ameen Khan:
Okay, ₹1.2 lakh. Is that the difference?

Shailesh Vickram Singh:
So, everybody is around 7.4 kilowatt chargers now. Let's say we move from 7.4 kilowatts to 22 kilowatts.

Ameen Khan:
What's the delta? For the OEM itself, the hardware cost will increase by about ₹1 lakh, but it will reduce costs for the customer eventually. However, when an Indian consumer is buying a car, if there's a price difference of ₹75,000, they'll typically opt for the cheaper option.

Shailesh Vickram Singh:
But when someone is buying an MG car priced at ₹27 lakh, the cost difference should be manageable. The real issue lies in the DC charger pricing. DC chargers are around ₹5 lakh, while an AC charger costs just ₹15,000. I'm just playing devil's advocate here.

Ameen Khan:
As a consumer, if I opt for a 22-kilowatt car, my first question would be: how many places actually offer 22-kilowatt AC charging?
As Priyant mentioned, 7.5 kilowatts is widely available. So, if I have only five locations with 22-kilowatt chargers but 30 locations with 7.5-kilowatt chargers, I'd choose 7.5 kilowatts at a lower cost for both the OEM and the vehicle.

Shailesh Vickram Singh:
Let me reframe this. Let's say the government provides a subsidy for 22-kilowatt chargers—₹50,000 per charger, for example.

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Would it make more sense to subsidize AC chargers instead of DC chargers?
Chaitanya and Seshadri, what's your take on this? If subsidies go toward OVC (Onboard Vehicle Chargers) instead of DC chargers, what will drive better adoption?

Chaitanya Kanuri (WRI):
Subsidizing OVC chargers benefits the OEM directly.

Shailesh Vickram Singh:
True, but subsidies for DC chargers also go to the OEM indirectly. Amin, let me simplify the question. If there's no cost increase and both systems cost the same, what's better for the market: a 22-kilowatt AC system or a 30-kilowatt DC system?

Sumedh Agarwal:
I'd like to add something here.

Ameen Khan:
Sure, go ahead.

Sumedh Agarwal:
From the grid's perspective, a sudden bump from high-load grid charging is a significant challenge. Grids aren't designed to handle such spikes, especially with other devices drawing power simultaneously.

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This creates a heavy load issue. Additionally, in India, scalability depends on affordability.
If there's a substantial cost difference, it won't be practical. Therefore, opting for an AC system over DC is more viable.
AC charging adds value because DC systems cause sudden surges that strain the distribution system, which isn't ideal from a grid perspective.

Ameen Khan:
I agree with Sumedh that for personal use, an AC charger makes more sense. However, when there's no grid availability in a building, spending ₹4–5 lakhs on a grid upgrade to set up 22-kilowatt charging becomes a consideration.
Even with this setup, charging takes about 1.5 hours.
On the other hand, DC charging can significantly reduce charging time.
While we focus on what's best for the grid, consumers prioritize saving time and money. Ultimately, value creation for them revolves around these two factors.

Shailesh Vickram Singh:
Alright. So, coming back to Priyans..

Priyans M:
Honestly, I don't care if it's a 22-kilowatt AC charger or a 30-kilowatt DC charger. The point is that if I can get 150 kilometers of range in one hour, how my car charges doesn't matter to me. From a charging point service perspective, it's often cheaper to deploy 30-kilowatt DC chargers. The key advantage is that they're not dependent on the car's onboard charging capability. Right now, in the market, many cars don't even come with 22-kilowatt onboard chargers (OBCs).

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Shailesh Vickram Singh:
Yes, and without 22-kilowatt OBCs, the possibilities for utilizing those chargers are limited.

Priyans M:
Exactly. And another point that's often overlooked is that upgrading the existing charger hardware to support higher capacities adds to the cost.
For example, back in February 2023, I was in Hyderabad and spent nearly four hours charging my MG ZS EV with a 50-kilowatt-hour battery pack at a 15-kilowatt DC charger.
I was charging from 0 to 100%, and it took significant time.
This shows that low-capacity DC chargers are still prevalent.
The advantage with DC is lower conversion losses because DC power goes directly to the battery.
With AC chargers, you need to convert the current, which results in efficiency losses.

Shailesh Vickram Singh:
Good point. Ameen, would you like to add to the conversion.

Ameen Khan:
Essentially, a DC charger takes AC current, converts it to DC, and supplies it directly to the battery.
If you're using a 22-kilowatt AC charger, the car's onboard charger (OBC) performs the same AC-to-DC conversion.
The efficiency depends on the quality of hardware—whether it's the rectifiers in the OBC or the charger itself.

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Shailesh Vickram Singh:
Got it. Chaitanya, do you have anything you'd like to add?

Chaitanya Kanuri (WRI):
I think the comparison between DC 30 and AC 22 kilowatts isn't entirely fair because today we can charge at much faster rates.
Building on what Priyansh said, if you're looking at fast charging for consumers, we need to wait for OEMs to adopt 22-kilowatt AC chargers. Even then, AC is primarily seen as something for home charging.
When charging outside, consumers prefer faster options, and DC chargers can deliver faster and faster rates as battery charging technologies improve.
For home charging, upgrading transformers becomes an issue. For example, a typical 3BHK home has a 10-kilowatt connection. Adding two 22-kilowatt chargers would blow past that limit and require upgrading the home's power connection, which is logistically challenging.
From an OEM perspective, 22-kilowatt AC chargers are viable for community or personal charging in specific use cases, such as large campuses. However, DC charging will remain dominant for public charging due to its speed and scalability. Today, DC chargers are advancing well beyond 30 kilowatts.

Shailesh Vickram Singh:
Understood. We're almost out of time, but this has been an interesting discussion. There's an active chat with many great insights.
As we wrap up, does anyone have any final comments on what it takes to start with EV charging?
We've prepared a 132-page report on this topic, and we'll share it with everyone after the webinar. Let's start with Chaitanya.

Chaitanya Kanuri (WRI):

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For EV charging to take off, we need to better understand utilization patterns and design use-case-specific solutions.
One strategy, especially in cities, is to focus on how fleets move. Fleet operators should be the first adopters for charging point operators (CPOs), with residual retail customers being an added bonus. This ensures viability for chargers.
It's also important to right-size charging networks. For example, previous estimates suggested 50% of three-wheelers would use public charging. However, in smaller cities, many three-wheeler drivers charge at home, reducing public charging demand.
We need to account for these patterns to build appropriate public charging infrastructure.

Shailesh Vickram Singh:
Thanks, Chaitanya.

Sumedh Agarwal:
So, I think there are two three things. One is like India is a unique market and it's have its own development challenges. One thing for urban cities, I see we have to focus on first my last mile and the public transport. So whatever the solutions which can help us to reach the public stations, public metro stations and we have very established charging stations there will definitely help urban cities to unclog themselves as well as take things forward. For the urban areas or semi urban sorry for the rural areas or semi urban areas, I see I mean two things. One is we should have fleets which like e-commerce fleets. If we can focus on them, we can focus on the use cases which have food chains, which can be taken care forward with public charging stations or private charging stations, definitely it at value. And the last point I wanted to make was that all the public charging stations, high-grade public charging stations, high-grade public charging stations, there can be DC, that can be AC, but for whom less AC charging stations will definitely be something which we have to promote and take.

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Shailesh Vickram Singh:
Yeah. All right. Thank you for any of your view.

Seshadri Raghavan:
On EV, so let me be at some point we have to face out of these subsidy-reliant approach. The only way to make that possible is to also look at the financial sustainability of charging infrastructure, and this requires, I think, I don't want to call it chicken and egg, but I would like to also. At to check in as we as point the right sizing the battery will sort of cascade into searching the how the infrastructure rollout happens. The manifest process we see in terms of fragmentation I don't want to call it fragmentation I would call it somewhere between chaos and a little bit you know very fast very fast to move I would say right sizing the the battery would be a much important angle to look at though we are talking about infrastructure people tend to overestimate their requirements for long distance travel we don't we cannot size the infrastructure for the tail end of the distribution trap is few days a year we have to look at the median and the nominal and some sort of say without the subsidies whether before go we cannot entirely drop the subsidies but the question of AC DC even with the DC there are so many levels possible for the time being we should have the the foresight should be is that what sort of a future infrastructure we want and that should dictate the level pieces we put place today so that we are like you know building up the pieces because we cannot just you know we have to measure twice and cut once that apparently seems to be you know they're learning on the go I would say because you subsidies have to a certain point and let's prioritize the police including the government police as well which includes the public transit those will be that are okay at some point come back to the truck that's when we are let's say and who will is to an extent that's when the full question of what do we do for highway charging infrastructure whether we go the subsidy route or whether we go the you know captive captive consumer role so I think we we have to give another three to five years for this thing to shake out for clear technology I also anticipate a lot of consolidation, all these small spot players, think there is going to be a lot of market consolidation, acquisition, the future will be much clearer as to which direction are we going like this question of bigger battery versus more charges. I think this will need some more time to shake out when we have like an inform answer that will be my closing comment on this.

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Shailesh Vickram Singh:
Thank you. Okay, thanks. Thank you. Vasudha?

Vasudha Madhavan (Ostara Advisors):
Yeah, sorry, I was on mute. No, I mean, I really feel that we need that consolidation of, you know, from a consumer perspective, we need a one view of the charging station, which I think everyone from Google to players in the industry are working on that. I think that will really be a game changer. Ultimately, whatever we say on policy or funding, everything is dependent on customer utilization, you know, greater customer adoption. So while policy has had its own sort of sent down, you can say that broadly the direction is forward and, you know, upward. So we really need to be able to catalyze more equity into the space. Need to, you know, be sensitive to customer needs and see how we can build solutions aimed directly and specifically on customer needs and then use that to drive in more equity into the space and then kind of grow step by step from there. So yeah, that would be my comment.

Shailesh Vickram Singh:
Okay, thanks. Thanks. Ameen?

Ameen Khan:
I mean, right, I think personal charging, I think this will always AC's AC chargers is going to grow drastically, the 3.3 and the 7.5 for home charging. For DC charging, I believe that the dashboard operators need to realize that a charger, deploying a public charger sounds quite fancy. And you want to give access to a consumer. But on a business standpoint, you know, charger break events today with finances and play take about good two and a half to three years. And these break events only happen based on the amount of electricity a DC charger actually dispenses.

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I think like I agree with what's having a single view that'll increase utilization on these chargers and help them break even and bringing this together could become a model where you have normal investors invest into charging infrastructure knowing that they'll get profitable after a point in time and let it all and you know have it organically grow because subsidies can only help you till and it's right.

Shailesh Vickram Singh:
Got it. And so Priyans?

Priyans M:
Yeah. Oh, yeah. I would say that subsidies need not be given CPOs. Subsidies need not be given to OEMs to increase their old basis. If subsidies have to be given, they have to be given to DISCOMs to ensure that power is reliably available to ensure that there is if for example in the comments there is there is there was one piece where we were like in Gujarat you can get 100 kilowatt It connection very easily other states can't do that very interesting very interesting so if this comms are given that kind of subsidy it means that OEMs or CPOs who already have private money private capital they want to invest in the hardware they want to set up the chargers and if I see 120 kilowatt chargers on the expressway I want to travel more or similarly someone wants to set up a fleet operation that's in Rajasthan or in Jodpur they know that they can get 120 kilowatt chargers very easily so you know that the downtime is lower so that is that is how I think if there is subsidies to be played it should be played out in this way.

Shailesh Vickram Singh:
So that's very interesting comment you made. Now, I would like to invite Sudhir Nayak. Are you there?

Sudhir Nayak:
Yes. I am here.

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Shailesh Vickram Singh:
Yeah, I'm here. Yeah, so Sudhir, founder of Sunfuel, they put EV chargers at very particular locations. So thanks, Sudhirya, and you are very, very active. So I said, why not Sudhir give some comment as a CPO and share your experience? Yeah, happy to hear your views.

Sudhir Nayak:
Awesome. So most charging is happening at home. Everyone understands that. Every car comes with that 7 kilowatt wall box, which people have been installing, and eventually humanity has always found ways to augment infrastructure, be it undersea cables for the internet or building stations when we transitioned from horse carts to cars. But we will find ways to augment our grid and have that charger, which comes along with our laptop charger, to get installed somewhere and do home charging, you know, in the near future, I do believe.
But having said that, the DC charging game on the highway, which is the most important piece of this puzzle, needs to be solved. One can't do it without the OEMs, because one, they are the biggest beneficiaries of a good charging infrastructure. Anywhere in the world where there is scaled up and high-quality charging infrastructure, it is OEM-backed, like Tesla chargers or Electrify America, which is a Volkswagen company, or Ionity, which is a conglomerate of Volkswagen, BMW, and Mercedes.
So in India, also, the charging player who wins gets the OEM skin in the game and has a last-mover advantage, which means moving last with the biggest chargers. Yes, so like business, we have the first-mover advantage, but there is the last-mover advantage as well. Think about the last smartphone; Facebook was the last social network. So the player who moves in with the biggest and the best chargers, when the dust has settled, is going to win, especially the one who can, you know, get the OEMs involved. Those are my two cents on this.

Shailesh Vickram Singh:
So, very nice, I think very, very good insights. I totally agree.

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Shailesh Vickram Singh:
I think getting a 100 LT connection is the biggest challenge, right, for any CPU you ask, and the same way he said the problem is the market will be decided by the guys who will enter last. So, probably, we'll take a note of that. Thanks a lot to all of you for sparing one and a half hours for this session, really appreciate that, and I hope we all learned a lot from this thing. We'll share the report also by the end of today, and once again, thanks a lot. Have a good day, thank you. Thanks. Bye-bye.

Priyans M:
Bye-bye.

Seshadri Raghavan:
Thank you. Bye-bye.

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