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NITI Aayog

Unlocking a $200 Billion Opportunity :
— Electric Vehicles in India —

UNLOCKING A $200 BILLION OPPORTUNITY : ELECTRIC VEHICLES IN INDIA

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Unlocking a $200 Billion Opportunity :

— Electric Vehicles in India —

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India has made far reaching commitments at International Fora to reduce its GHG emissions significantly by 2030 and to reach net zero level by 2070. It is indeed a bold decision for a rapidly growing developing country to willingly join the global community in the fight against climate change.

Transport is a significant contributor to climate change, being responsible for almost 15% of greenhouse gas emissions in India. This share is likely to grow further due to urbanisation and rapid economic development, resulting in greater use of motorized modes of transportation. It is in this context that transitioning to electric vehicles will enable the transport demand to be met with reduced emissions. This will also help reduce India's dependence on imported petroleum fuels as also significantly reduce air pollution in major cities.

I congratulate the team at NITI Aayog, and its partners, for having put together this report with innovative suggestions which will help accelerate adoption of electric vehicles in India. I hope these recommendations will be taken forward by different ministries of Government of India, State Governments and industry associations.

(Rajiv Gauba)

New Delhi
August, 2025

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FOREWORD

India has decided to promote electric mobility with a view to reduce its dependence on imported petroleum fuels, reduce air pollution in the major urban areas of the country, as also reduce Green House Gas emissions that will help meet its climate commitments.

2. While electric vehicles have been around for quite some time, they have had limited success primarily due to the low energy density and the high cost of batteries. Over time, battery prices have fallen significantly, and the energy density of batteries has also improved. This has made electric vehicles a much more feasible option, especially for vehicles that are intensively used over the day. Further, the increased concern about climate change has built a stronger case for transitioning to electric vehicles.

3. It is in this background that India set up the National Mission on Transformative Mobility and Battery Storage to drive the adoption of electric vehicles in the country. It has set a target of 30% EV penetration by 2030. By the end of 2024 it had reached a penetration level of only about 7.6%. Clearly a stronger push is necessary to take it to 30% by 2030. Recognizing the need to accelerate this journey, NITI Aayog undertook extensive stakeholder consultations to identify barriers and discover high-impact enablers for scaling EV adoption. Engaging with original equipment manufacturers (OEMs), think tanks, industry associations, and state governments, the process surfaced critical insights into the challenges constraining EV growth and the pathways to unlock its full potential.

4. To consolidate these findings, NITI Aayog has prepared this report titled **"Unlocking a $200 Billion Opportunity: Electric Vehicles in India."** This report offers a timely and comprehensive review of current challenges, alongside actionable recommendations to fast-track the EV transition in India. At its core, the report makes a compelling case for shifting from an incentive-led to a mandate-driven approach. It calls for focused efforts on high impact segments such as electric buses, e-trucks, urban freight vehicles, and two-wheelers—areas that offer the greatest potential in terms of fuel savings, emission reductions, and public benefit. By adopting these measures in a cohesive and integrated manner, India can not only realize its vision of achieving 30% EV penetration by 2030—unlocking a USD 200 billion opportunity while generating millions of jobs, promoting energy security, and advancing its global leadership in clean mobility —but also fulfil its climate commitments. Such a transition also offers an excellent opportunity for India to become a global leader in electric vehicles as well as other components of the electric mobility ecosystem.

Dated: 21st July, 2025

[B.V.R. Subrahmanyam]

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Foreword

India's drive towards electric mobility started in 2015, when it set up the national mission on electric mobility and also adopted the FAME scheme to financially support the procurement of electric vehicles. Its objective in transitioning towards the electric mobility has been largely driven by the rising import bill for petroleum fuels, the increasing air pollution in its cities, and the need to reduce greenhouse gas emissions from the transport sector.

In the last 10 years India has done well with the number of electric vehicles sold having gone up from just 50,000 in 2016 to over two million in 2024. Motorised two wheelers and three wheelers have done particularly well, with about 1.9 million of them being sold in 2024. India is 2nd only to China in this segment. There has been some progress in electric buses and electric cars, but electric trucks have yet to pick up.

India's drive towards electric mobility needs to be strategic in identifying the appropriate vehicle segments that would give it the best value for the money spent. It also needs to be strategic in locating charging stations in a manner that ensures good alignment between their locations and the needs of electric vehicle owners. In terms of vehicle segments, while trucks and buses constitute only 4% of India's vehicle fleet, they are responsible for nearly 50% of the emissions. As such they are a natural choice for faster conversion to electric. Further, motorised two-wheeler constitutes about 75% of the vehicle fleet and, therefore, constitute another segment of the vehicle fleet that needs to be converted to electric. Focusing attention on these vehicles would help India gain the benefits that it is looking for.

The report contains several useful recommendations that would help India move rapidly towards its goal of a 30% electric vehicle penetration by 2030. It provides a very useful road map that the different agencies of the national and state governments, industry associations and other stakeholders would do well to adopt.

O.P. Agarwal

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Foreword

India's mobility sector is undergoing a structural metamorphosis. What was once viewed as a marginal shift in automotive technology is now shaping up to be a foundational pillar of our climate strategy, industrial policy, and urban vision. At the heart of this transformation lies Electric Mobility—no longer a futuristic aspiration, but an unfolding national priority.

NITI Aayog has consistently pushed the agenda—from framing early-stage policies and pilots to aligning cross-sectoral stakeholders and shaping market-enabling ecosystems. Today, the challenge before us is not just about accelerating EV adoption, but doing so in a way that maximizes domestic value addition, strengthens supply chains, democratizes access to clean transport, and fosters innovation across the board. The bigger national aim is to transform India into a global manufacturing hub for EVs. This could only be possible if we promote e-mobility with scale, speed and stability.

The Report, ***'Unlocking a $200 Billion Opportunity: Electric Vehicles in India,'*** presents a bold yet grounded blueprint for this mission. It is not merely a statement of ambition—it is a carefully constructed strategic map that identifies levers of change across financing, infrastructure, technology, and governance. It recognizes that India's EV transition must be inclusive, economically viable, and anchored in both global competitiveness and local resilience.

Now, our job is to operationalize this vision. This means going beyond pilot projects to scalable implementation. It means reimagining public-private collaborations, deploying catalytic capital, fostering deeper R&D linkages, and creating a seamless user experience for the end consumer. It also means building institutional and human capacity across state and local levels to manage this transition dynamically.

We hope this Report serves as a guiding document for policymakers, industry players, investors, and civil society actors alike. The time to act is now—and the window of opportunity, while promising, is finite. Let us move decisively and collectively to make India's electric mobility journey a global benchmark.

(Sudhendu J. Sinha)

ACKNOWLEDGEMENTS

This report was prepared by a team comprising:

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भारत सरकार
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EXECUTIVE SUMMARY

India has decided to aggressively move towards electric mobility. The key objectives are:

- Reduced dependence on imported fuel
- Increased share of renewable energy by leveraging the storage capacity of EV batteries
- Reduced Greenhouse Gases (GHG) emissions
- Improved air quality
- Improved Plant Load Factor (PLF) of electricity generating plants
- Becoming a leader in a rapidly growing global market

India seeks to attain a 30% share of electric vehicles, in the total vehicles sold, by 2030. Sale of EVs in India went up from 50,000 in 2016 to 2.08 million in 2024 as against global EV sales having risen from 918,000 in 2016 to 18.78 million in 2024. Thus, India's transition has been slow to start, but it is picking up. India's EV penetration was only about one-fifth of the global penetration in 2020, but has picked up to over two-fifth of the global penetration in 2024. It continues to show an increasing trend, though relatively slow. Statistics show that:

1. Adoption of EV has been increasing in India but has been slower than the pace in some of the leading countries like the US, EU and China.
2. India is doing well with electric two-wheelers and electric-three wheelers. With regard to electric buses, it has made some progress but with electric cars it has been slow. Long haul electric trucks have virtually not taken off.
3. India has progressed to only about 7.6 % of the sales in 2024 being electric, which is far behind its target of 30% by 2030. Thus, it has taken nearly 10 years to reach a penetration level of 7.6% and now needs to increase this share by over 22% in the next 5 years alone.

This calls for measures to give a stronger push to the transition. Several consultation meetings highlighted the following challenges:

1. Challenges of financing vehicles, especially electric buses and electric trucks
2. Inadequacy of charging facilities on one hand and low utilization of existing public charging facilities on the other
3. Lack of adequate awareness regarding EV performance among public and private stakeholders
4. Inadequate data and regulatory gaps hinder evidence-based decision making

Based on the consultations and certain unique features of the Indian context, several approaches have been suggested to accelerate the transition. These are as follows:

1. Moving from incentives to mandates/disincentives, as incentives have done what they could and a further push requires more strong signals through regulation
2. Focus on a subset of the vehicle fleet, based on the potential benefits from transitioning such vehicles to electric and the ease of providing the required eco-system for them
3. Focus on saturation in limited geographies rather than on an even distribution across the country as saturation brings visible impact and attracts interest in replication

4. Enabling finance for e-Buses and e-Trucks as these have posed a problem, yet are being the most important segment
5. Focus on services delivered rather than assets procured so that benefits flow only from the delivery of services and not for inadequately used assets
6. Shifting capital costs to operating costs to help tide over the problem of high capital costs not being affordable
7. Scaling R&D on new battery technologies to secure lower battery prices, higher energy density and reduced dependence of imported rare earth minerals
8. Strategic scaling of charging infrastructure after due assessment of their viability at different locations
9. Enhance awareness and information systems to improve evidence-based decision making

Based on these approaches, the following actions have been recommended:

1. Moving from incentives to mandates

a. Announce a clear policy, with target timelines, for Zero Emission Vehicle (ZEV) adoption

b. Design a progressively more stringent plan for mandating the production and purchase of EVs and disincentivising the continued use/production of ICE vehicles

c. Have a mechanism for effective implementation

d. Expand Corporate Avergae Fuel Efficiency (CAFÉ) norms to a wider segment of vehicles

2. Saturation instead of thin distribution

a. Design and start a saturation program to support 5 cities over 5 years

b. Have entities in States to manage this program

c. Scale up to 20 cities and then to 100 cities

3. Enable financing for e-Buses and e-Trucks

a. Create a pooled fund with contributions from the public budget and multilateral development banks for providing lower interest loan for the procurement of e-buses and e-trucks

b. Design and launch an appropriate scheme to channel the funds

4. Scale up research for new battery technologies

a. Set up an academia-industry-government partnership for accelerating research on new battery chemistries

5. Strategic scaling of charging infrastructure

a. Identify 20 high density corridors for e-Bus and e-Truck operations and commission a study to identify strategic locations for charging hubs based on current haltage patterns on these corridors

b. Arrange for viability studies and coordinate all the approvals required for private charge point operators to invest in setting up the facilities

c. Establish nodal agencies in each state, on the lines of EVe in Singapore, to facilitate and enable more charging stations to be established.

d. Explore TOD pricing to enable easier approval of connections and improve the PLF of generating plants

e. Have a unified app that gives information on location of charging stations, allows booking of charging slots and enables payments

f. Explore provision of special EV power lines (EVPL)

6. Shifting capital costs to operating costs

a. Nurture the establishment of a battery leasing industry to reduce capital cost of an EV

b. Support the establishment of a battery passport system that contains details to assess the health of a battery

c. Nurture the establishment of truck and bus leasing industries to make it easier for small owners to acquire electric trucks and buses

7. Enhance awareness and information availability

a. Design and manage the awareness building program

b. Assess data and information needs by different stakeholders and nurture the creation of a comprehensive information system

To kickstart the entire effort of accelerating the adoption of EVs, the following four actions have been recommended as the immediate next steps:

1. Develop a clear policy, with targets and timelines, for transitioning to electric mobility.
2. Develop a clear program of increasingly stringent regulations that mandate the transition to EV within specified time frames.
3. Design a new program to saturate 5 cities with 100% e-Buses, e-Paratransit and e-freight vehicles in urban areas.
4. Design and operationalise a blended fund that helps bring down the cost of capital for e-Trucks and e-Buses


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BACKGROUND

India has decided to aggressively move towards electric mobility with a view to benefit from:

- Reduced dependency on imported fuel
- Increased share of renewable energy by leveraging the storage capacity of EV batteries
- Reduced Greenhouse Gas (GHG) emissions
- Improved air quality
- Improved Plant Load Factor (PLF) of electricity generating plants
- Becoming a leader in a rapidly growing global market

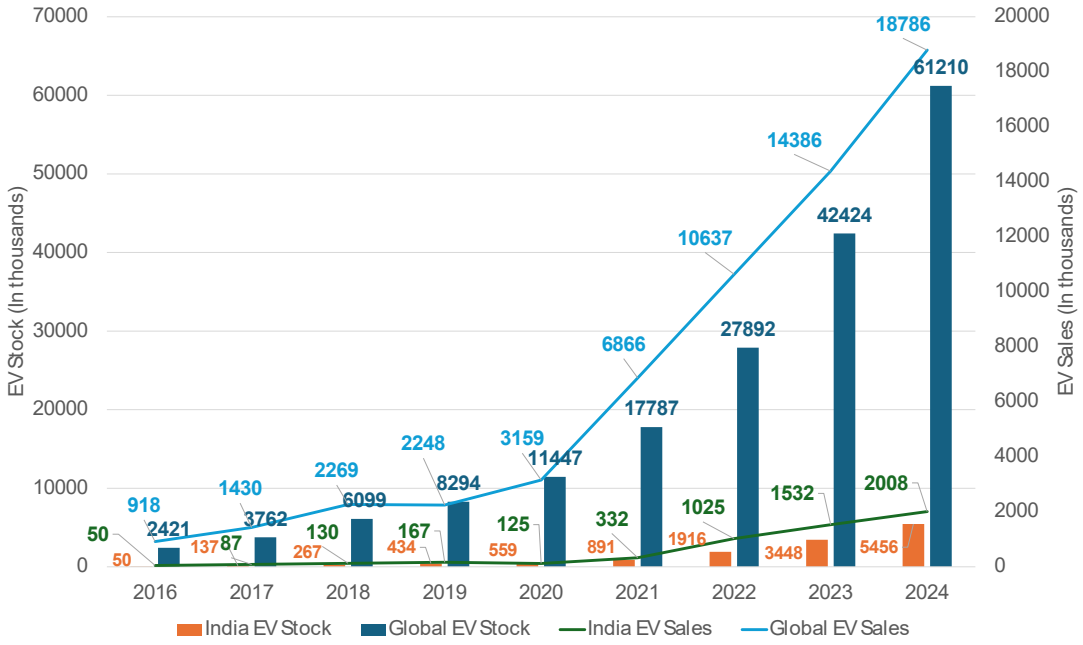
It seeks to attain a 30% share of electric vehicles, in the total vehicles sold, by 2030. In order to achieve this ambition, it has set up a National Mission on Electric Mobility and has also introduced specific schemes aimed at providing financial support to further the adoption of electric vehicles. The first of these schemes was the Faster Adoption and Manufacturing of Electric Vehicles (FAME – 1). This was in operation from 2015 to 2019 and had an allocation of ₹895 crores. This was followed by a more ambitious FAME – 2, which was in operation from 2019 to 2024 and had an allocation of ₹11,500 crores. This has then been followed by an equally ambitious programme known as the PM e-Drive, which has been launched on 2024 and will be operational till 2026. It has an allocation of ₹10,900 crores.

This report seeks to assess how far India has progressed on the strength of the initiatives taken so far, identify current barriers / challenges and present a way forward to accelerate the pace in the years ahead.

GLOBAL AND INDIAN SCENARIO

Global EV sales rose from 918,000 in 2016 to 18.78 million in 2024, contributing to an exponential increase in the total EV stock, reaching approximately 61.21 million vehicles in 2024 as may be seen in Figure 1 below.

Figure 1: EV Sales and EV Stock over the years (Global and India)

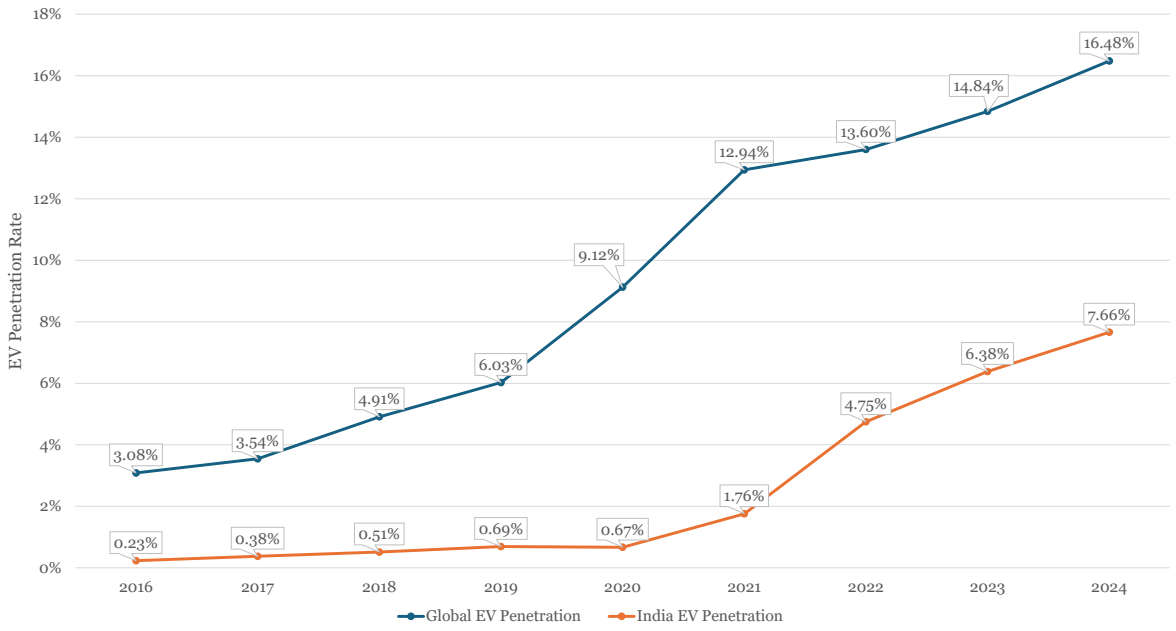


Source: 1) IEA Global EV Data Explorer for global data, 2) VAHAN Portal for India data

The same figure also shows that the sale of EVs in India went up from 50,000 in 2016 to 2.08 million in 2024 taking the total EV stock in the country to 5.45 million in 2024. Further, the total stock on EVs in India stood at around 9% of the global stock. EV sales in India were around 11% of the global sales in 2024.

Figure 2 below shows that the EV penetration rate[1] in 2024 stood at 16.48% globally but was only 7.66% in India. This is against India's target of reaching a 30% penetration rate in 2030.

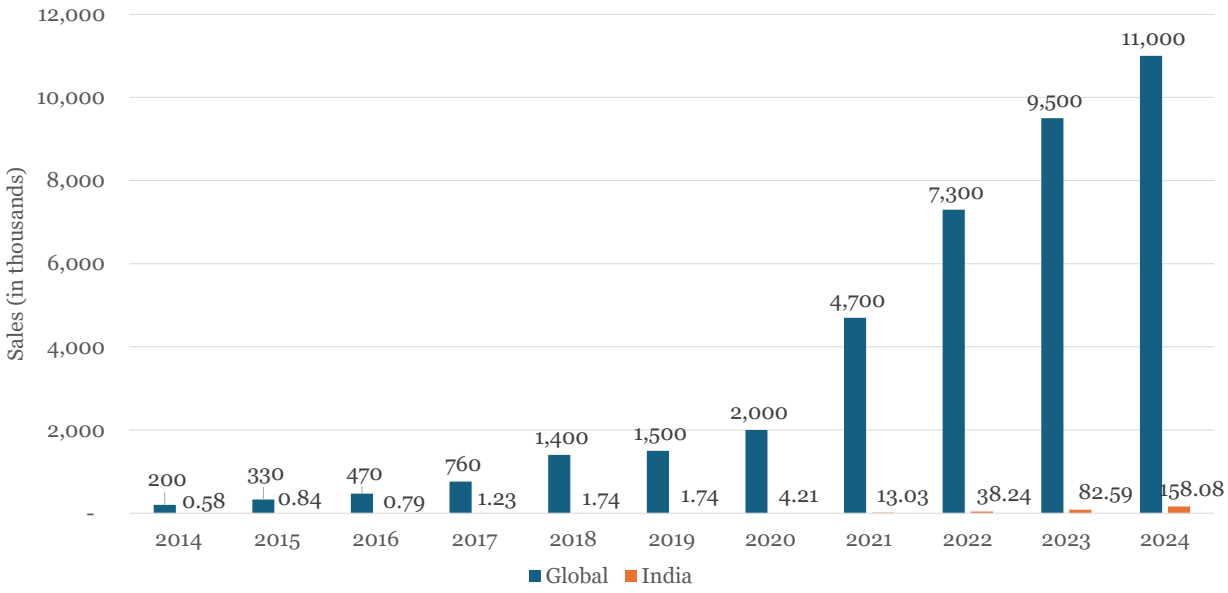
Figure 2: EV Penetration Rate – Global & India



Source: 1) IEA Global EV Data Explorer for global data, 2) VAHAN Portal for India data

Figures 3, 4 and 5 below give the annual sale of e-cars, e-buses and e-trucks globally and in India.

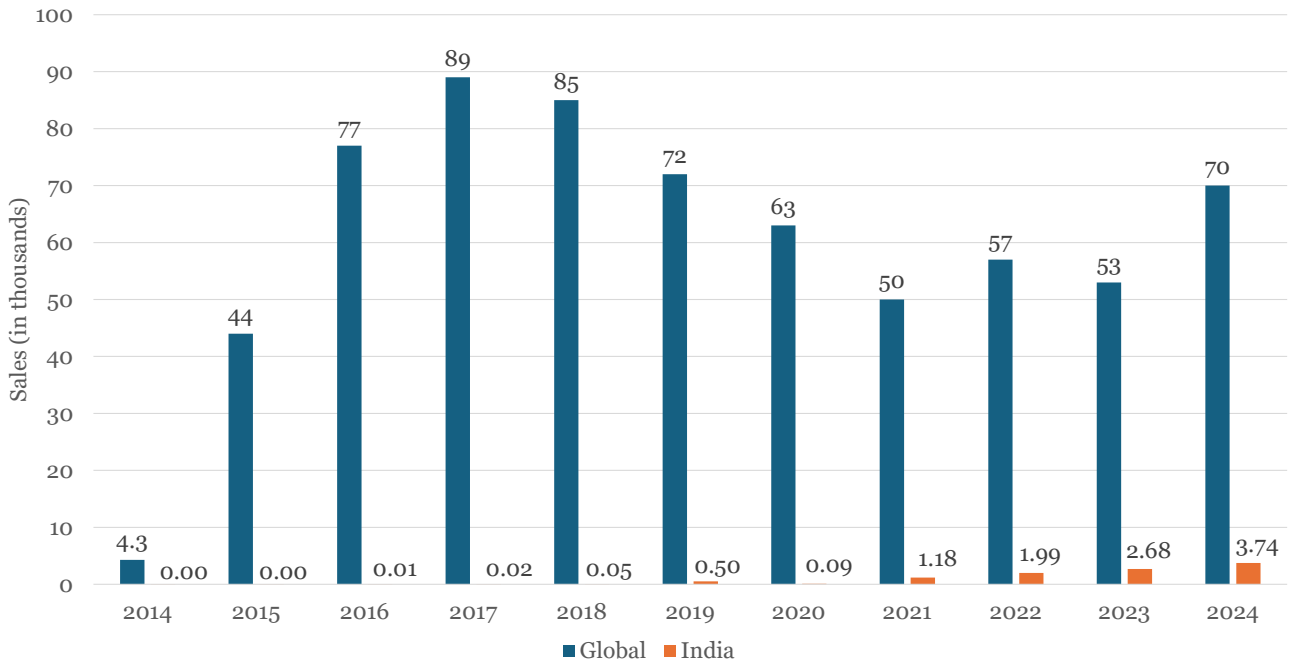
Figure 3: E-4W Sales over the years (Global and India)



Source: 1) IEA Global EV Data Explorer for global data, 2) VAHAN Portal for India data

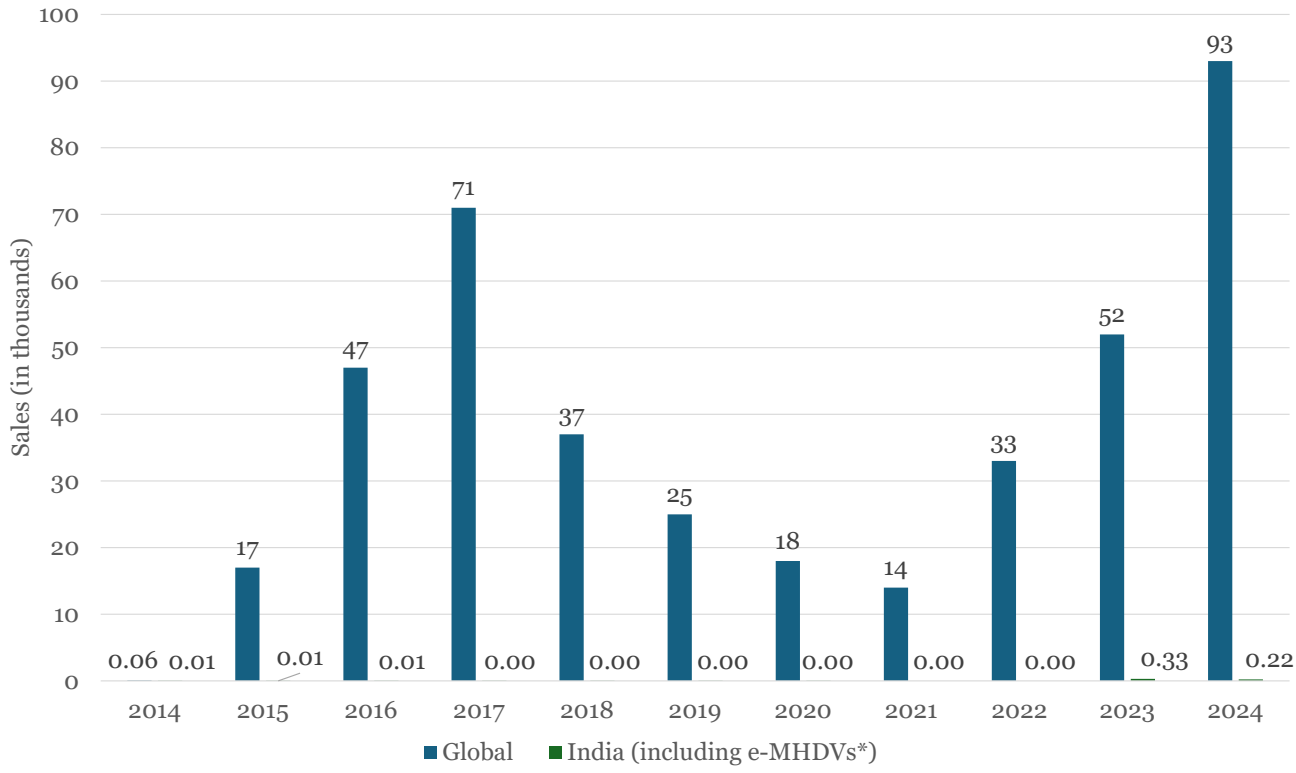
1 Share of EV sold out of total vehicles sold

Figure 4: E-Bus Sales over the years (Global and India)



Source: 1) IEA Global EV Data Explorer for global data, 2) VAHAN Portal for India data

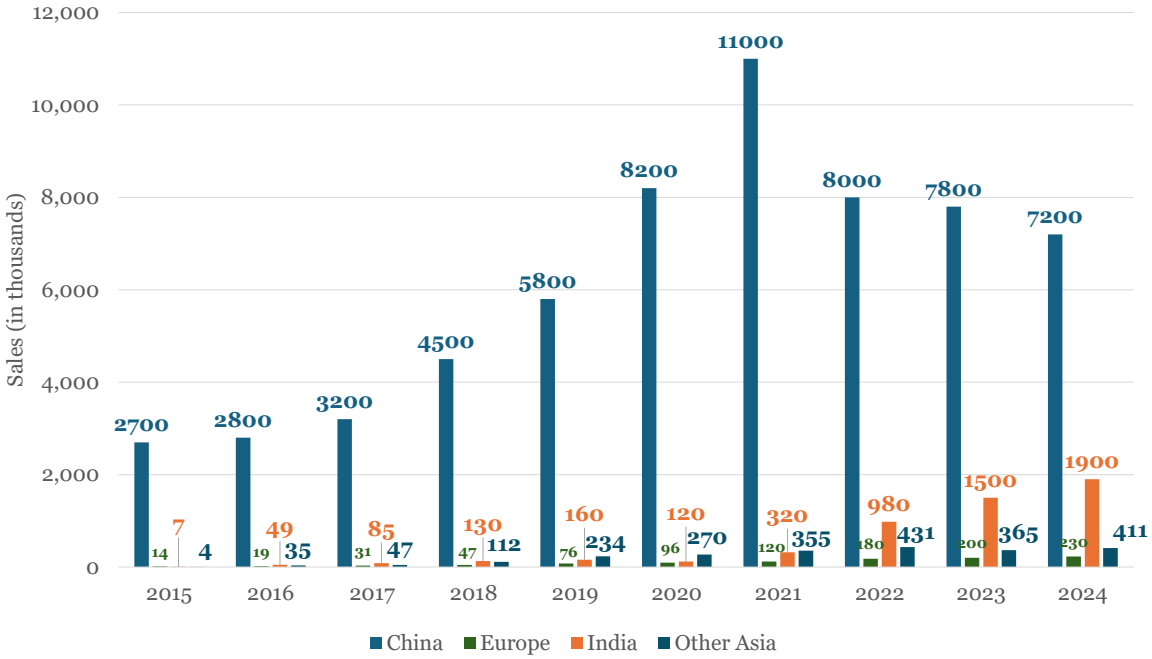
Figure 5: E-Truck Sales over the years (Global and India)



Source: 1) IEA Global EV Data Explorer for global data, 2) VAHAN Portal for India data

Figure 6 below shows the sales of electric 2/3 wheelers in the major 2/3 wheeler markets.

Figure 6: Electric 2/3 wheeler Sales over the years (main 2/3 wheeler markets)

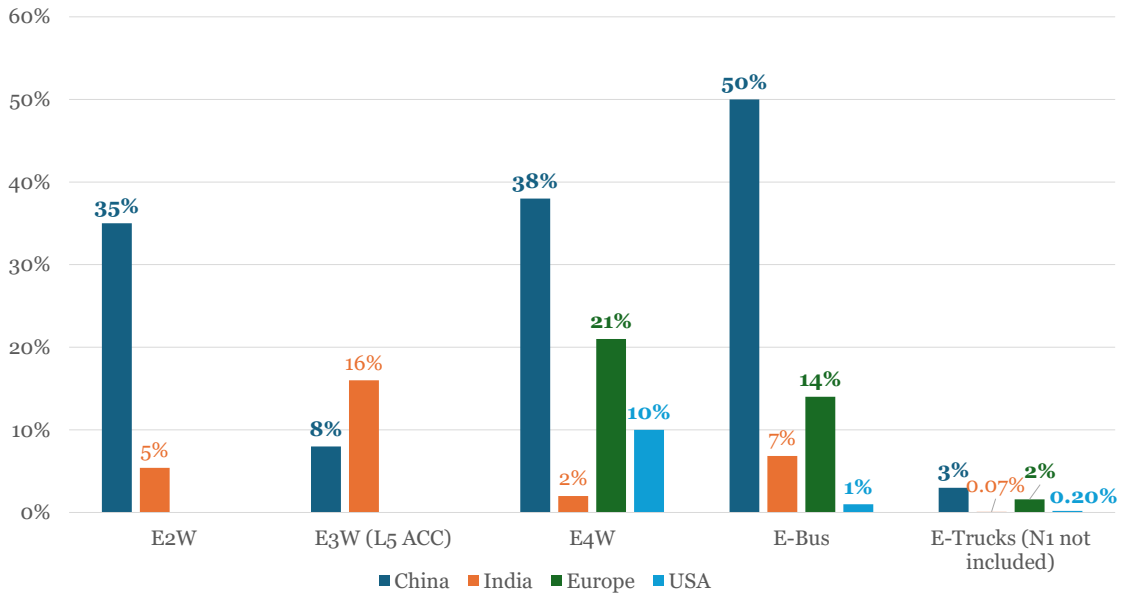


Source: 1) IEA Global EV Data Explorer for international data, 2) VAHAN Portal for India data

These figures show that while there is reasonable progress in the sale of electric buses, the progress on electric cars and electric trucks has been weak compared to the global scenario. In the case of electric 2/3 wheelers, India has done well even when compare to the leading 2/3-wheeler markets, namely China, EU and the other Asian countries, as seen from Figure 6.

Thus, India's transition has been slow to start, but it is picking up. India's EV penetration was only about one-fifth of the global penetration in 2020, but has picked up to over two-fifth of the global penetration in 2024. It continues to show an increasing trend, though relatively slow.

Figure 7: EV penetration rate across China, India, Europe & US in different vehicle segments in 2023[2]



Source: 1) IEA Global EV Data Explorer for international data, 2) VAHAN Portal for India data

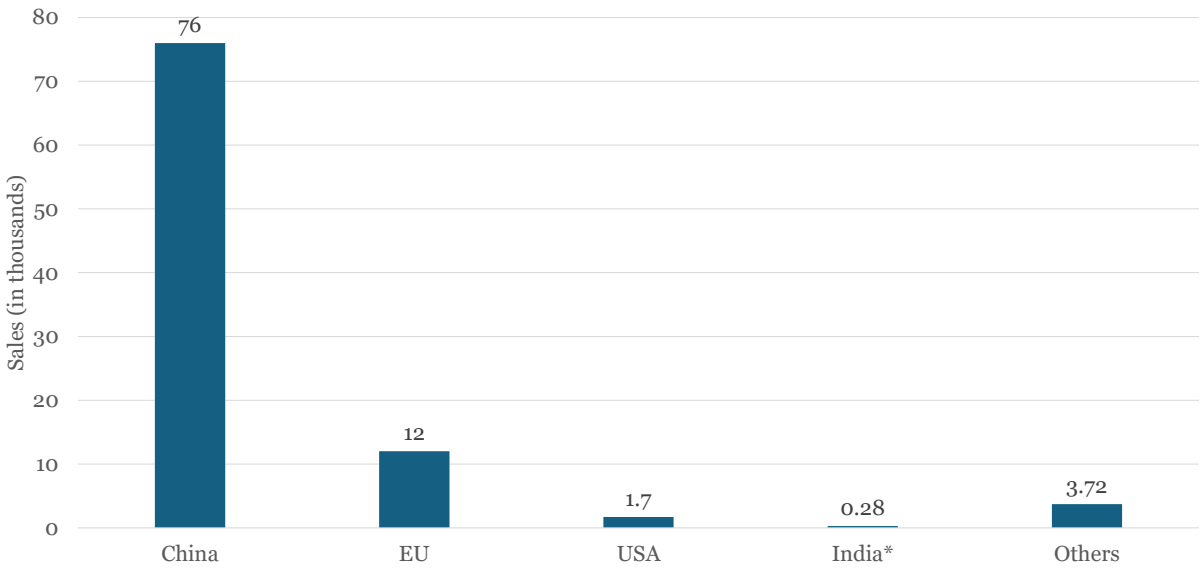
2 Global Penetration data for 2024 is not available for comparison, hence 2023 data has been showcased

If compard to the EV penetration in India with that in the US, EU and China for different types of vehicles (Figure 7), it can be seen that India has done fairly well in the 2-wheeler and bus segments, but has been slow in e-cars and electric trucks. It is a leader in the electric 3-wheelers segment. China is the leader in all categories, except 3-wheelers.

As far as electric trucks are concerned, this has been very slow. Out of 8,34,578 trucks sold in India in 2024, only 6,220 were electric. 95% of these (5940) were of less than 3.5 tonne capacity. These are generally used for carrying short haul freight, largely in urban areas. In fact, several countries do not count trucks of less than 3.5 ton capacity in the category of trucks, given their usage pattern. Only 280 of these electric trucks sold in India in 2024 were of more than 3.5 ton capacity, which are used for longer hauls.

The longer haul trucks are an important component of the road transport system as they emit over 34% of the CO_2 from the transport sector, despite constituting only 3% of the total vehicle fleet[3]. A significant dent in the reduction of GHG from road transport will not be possible without transitioning long haul trucks to electric. Figure 8 below gives the sale of such long haul trucks (above 3.5 tonne capacity) globally. As seen from this, China has been the dominant market for such long haul electric trucks as well, whereas India has had an minimal contribution, as seen in Figure 8 below.

Figure 8: Global Sale of e-Trucks in 2024 (above 3.5 tonne capacity)



Source: 1) IEA Global EV Data Explorer for international data, 2) VAHAN Portal for India data

Thus, key points that emerge from the above analysis are the following:

1. Adoption of EV has been increasing in India but has been slower than the pace in some of the leading countries like the US, EU and China.
2. India is doing well with electric two-wheelers and electric three-wheelers. With regard to electric buses, it has made some progress but with electric cars it has been slow. Long haul electric trucks have virtually not taken off.
3. The country has progressed to only about 7.6% of the sales in 2024 being electric, which is far behind its target of 30% by 2030. Thus, it has taken nearly 10 years to reach a penetration level of 7.6% and now needs to increase this share by over 22% in the next 5 years alone.

3 Office of the Principal Scientific Advisor to the Government of India (May 2025): India's Priority Corridors for Zero-Emission Trucking

Clearly, there is a need for a major step up in the pace of transition from ICE vehicles to electric. This will require a significant thrust.

CONSULTATION MEETINGS AT NITI AAYOG

With a view to understand the current challenges in transitioning to electric vehicles and get innovative suggestions to achieve the goal of a 30% share of EVs by 2030, NITI Aayog had organised a series of consultation meetings, with different stakeholders. The stakeholders consulted were the following:

- Electric 2/3 wheeler manufacturers
- Electric cars manufacturers
- Electric truck and bus manufacturers
- Charging equipment and battery manufacturers
- Charge point operators and electricity distribution companies
- Bus, truck and fleet vehicle operators
- Financial institutions

A summary of the points highlighted during these meetings is between Annexures **A1 – A7**.

KEY POINTS THAT EMERGED

While several challenges to EV adoption were pointed out, the following seem to be the major issues requiring attention. Corresponding suggestions to address these are provided in Boxes 1 to 7 of the report:

1. **Challenges of financing vehicles, especially electric buses and electric trucks, due to several risks perceived by financial institutions.** The main challenge is that the truck and bus ownership is highly fragmented with most of the owners being small players. Since electric trucks and buses cost about two to three times as much as their ICE equivalent, the higher amounts of loan and equity make it difficult for the small players to shift to electric buses and trucks. Financial institutions are also uncertain about the ability of small players to service the higher EMI. The near absence of reliable e-Truck and e-Bus performance data makes it more difficult for them to take lending decisions.

BOX 1

FINANCING ISSUES EMERGING FROM THE HIGH CAPITAL COST OF ELECTRIC VEHICLES

- Increasing loan tenures for e-trucks and e-buses
- Priority sector lending for e-trucks and e-buses
- Create a blended finance mechanism to reduce cost of capital for e-trucks and e-buses
- Formation of committee of bankers - To develop standardised vehicle valuation frameworks, similar to Germany
- Toll relaxations for e-trucks and e-buses

BOX 2

VEHICLE-CENTRIC ISSUES EMERGING FROM HIGH COST & WEIGHT OF BATTERIES

- Adding 5% load in the capacity of e-trucks
- Deducting battery weight from the load capacity of e-trucks
- Reduce capital costs through battery leasing and/or vehicle leasing
- Exempting e-trucks from entry restrictions into cities during the day
- Capture EV data and establish an EV system performance database
- Battery passport system to be established to better assess residual value of a battery
- Requirement to scrap Electric Vehicles at 15 years to be removed
- Leverage existing permit-free regulations for EV buses to remove administrative hurdles and accelerate adoption
- VAHAN Database - Challenges exist in tracking and planning the EV transition, as Vahan's database needs improvement to accurately reflect Battery-Operated Vehicles (BOVs) or diesel buses

2. **Inadequacy of charging facilities on one hand and low utilisation of existing public charging facilities on the other.** This challenge seems to arise due to the following reasons:

   a. **There have been problems in getting upstream power supply connections** from power distribution companies and there are significant differences in the fee structures both for getting the connections as also in the tariff structures for the electricity supplied.

BOX 3

POWER SUPPLY ISSUES EMERGING FROM WEAK COORDINATION IN ENSURING ADEQUATE AVAILABILITY OF CHARGING

- Standardised guidelines relating to HT vs LT connection for public charging stations
- Reducing fixed charge for public charging stations
- According open access to renewable energy systems
- Installing smart meters to enable time of day (TOD) pricing
- Reducing quantum of deposits required by DISCOMS from charge point operator.
- Charge point operator to be allowed to treat their deposits as assets in their books
- Ensuring more reliable power availability for charging stations
- Capacity standards to be laid down for public charging stations
- EV grids to be planned for in the longer term in major cities

   b. **Many Resident Welfare Associations (RWAs) perceive a safety risk** with charging stations and so do not permit their establishment in the housing colonies.

BOX 4

BUILDING ISSUES EMERGING FROM THE NEED TO ADDRESS SAFETY CONCERNS

- Permitting charging facilities in building basements after laying down safety regulations
- Building byelaws to be suitably amended to permit EV charging in basements, subject to safety regulations that should be laid down

c. **Cost of charging at public charging stations** is much higher than the cost of home charging, due to the margins needed by the charge point operators, the absence of subsidies, and the fact that such charging is liable to pay 18% GST.

d. **There are difficulties in securing land,** both within cities and on highways.

e. **Many of the public charging facilities are poorly utilised,** leading to a serious problem of viability.

f. **DISCOMs, ULBs, transport departments, and state nodal agencies rarely collaborate effectively,** leading to planning gaps and slow infrastructure rollout.

g. **The absence of an integrated app** that allows locating the nearest charging station, booking charging time and paying for charging makes charging EVs inconvenient.

BOX 5

PUBLIC CHARGING ISSUES EMERGING FROM THE NEED TO BETTER ALIGN CHARGING LOCATIONS WITH TRAVEL PATTERNS AND ENHANCING CONVENIENCE

- Charging stations to be given infrastructure status
- Levying GST @ 5% for EV charging
- Adopting PPP models for setting up charging stations
- Hot spot charging hubs instead of an even distribution of few chargers to instill confidence in the EV charging network
- Unified App - A one stop unified app like UPI is required to streamline and better manage the EV ecosystem.

3. **Lack of adequate awareness regarding EV performance among public and private stakeholders,** including financiers, is limiting EV adoption rates. Some of the specific examples given related to the following:

a. **National and state-level awareness efforts are fragmented** or non-existent, highlighting the lack of public education campaigns.

b. **The TCO benefits are unclear to users,** as many consumers only see the higher capital costs but do not recognise the savings during use, compared to ICE vehicles.

c. **Different states offer different kinds of incentives** such as exemption for permits of lower tax rates, to encourage EV adoption. However, the range of these is often confusing, thereby hampering adoption.

d. **Persistent misconceptions** like fire safety, battery degradation, range anxiety and resale anxiety continue to suppress buyer interest.

BOX 6

ISSUES TOWARDS ATMANIRBHARTA EMERGING FROM THE NEED TO REDUCE IMPORT DEPENDENCE ON CRITICAL MATERIALS

- R&D for new battery technologies better suited to the Indian context
- R&D for rare earth free motors and other drive train components

4. Inadequate data and regulatory gaps hinder evidence based decision making

a. VAHAN data does not accurately capture data on different categories of electric vehicles, making policy design, subsidy targeting, and progress monitoring difficult.

b. Absence of unique battery IDs weakens tracking, resale, and recycling ecosystems, hindering battery lifecycle transparency and market trust.

BOX 7

EARLY REGULATORY MANDATES EMERGING FROM THE POSSIBILITY OF LEVERAGING LOW HANGING FRUIT

- All airports, railway stations, malls and large parking complexes to provide 10% EV charger equipped parking slots
- Parking fee for EVs to be half of the fee for ICE vehicles
- Transport departments to lay down dates from which permits will only be issued for electric 3-wheelers, electric 4-wheeler taxis and electric urban freight vehicles

UNIQUENESS OF THE INDIAN CONTEXT

Approaches to accelerating the adoption of electric vehicles in India need to be grounded in the Indian context. Therefore, it is important to first recognise the uniquess of the Indian context, so that the rationale for the recommendations can be better understood. The following seem to be unique features of the Indian context, which calls for a somewhat different approach from that adopted in the developed countries:

- While 75% of Indian vehicles are two-wheelers, only 13% of these vehicles are cars. Since some of these cars are used as taxis and fleet vehicles, the share of personal cars will be even lower. Hence, measuring progress in the transition to electric mobility by only looking at cars, as done in developed countries, would not be the right metric in a country dominated by two-wheelers[4].
- 98% of the vehicle fleet comprises either small vehicles (2-wheelers or small cars) or public transport or goods vehicles. Only 2% of the vehicles are larger cars costing more than INR 10 lakhs.
- Travel distances are relatively small with only about 15% of the trips in urban areas being more than 10 kilometres. 54% of the trips are within the 0-10 km range and 31% involve virtually no motorised travel (Census 2011).
- Out of 2.3 million buses in India, only 0.14 million, i.e. barely 6%, are with state owned transport entities. The rest are with private operators, many of whom are small owners.
- 80% of the truck owners are also small owners with a fleet of less than five trucks. Large corporate of trucks owners are very few.
- Three-wheelers constitute an important component of the para transit system and are very popular as they cost only marginally more than public buses but are a lot more convenient.
- The Indian consumer is extremely cost conscious, often looking at fuel economy in making purchase decisions. The high capital cost of an electric vehicle is a serious concern for them. Only 2% of the vehicle fleet comprises cars costing more than INR 10 lakhs. In developed countries most cars cost more than this.

RECOMMENDATIONS

In this section several recommendations have been made to give a stronger push to the adoption of electric vehicles in the country. These have been based on the challenges highlighted during the stakeholder meetings organised by the NITI Aayog, the uniqueness of the Indian context, and analysis of trends in India and internationally. This section has been divided into two components - the first relates to the recommended "**approach**" and the second relates to the recommended "**actions**". The recommended actions have been further broken up into sub-actions wherever needed. Thereafter the recommendations have been grouped into short-term, medium-term and long-term actions. This is followed by grouping the actions into those requiring attention by central government agencies, by state government agencies, and by industry bodies.

4 In this context it is important to note that two-wheelers are of two types i.e. Motorcycles and scooters. A larger share of the two-wheelers or motorcycles which tend to be faster and commonly used by the younger generation. However, when it comes to electric two-wheelers there is any hardly electric motorcycle in the market, most of them being electric scooters. Perhaps the emergence of electric motorcycles could speed up the transition of two-wheelers into electric two -wheelers.

RECOMMENDED APPROACH

Broadly the following approaches are suggested:

1. Moving from incentives to mandates/ disincentives
2. Focus on a subset of the vehicle fleet, based on the potential benefits from transitioning such vehicles to electric and the ease of providing the required eco-system for them
3. Focus on saturation in limited geographies rather than on an even distribution across the country
4. Enabling finance for e-buses and e-trucks
5. Focus on services delivered rather than assets procured
6. Shifting capital costs to operating costs
7. Scaling R&D on new battery technologies
8. Strategic scaling of charging infrastructure
9. Enhance awareness and information systems

Each of these approaches is further explained in the sections that follow.

Incentives to mandates/disincentives

Policies that would nudge a transition to electric vehicles can broadly be classified into incentives or mandates/disincentives. They can be further classified into demand side actions and supply side actions. Examples of each of these are presented in figure 9 below:

Figure 9: Examples of incentives and mandates

Demand Side Incentives • **Vehicle purchase subsidies** • **Reduced registration fees for electric vehicles** • **Lower GST on electric vehicles** • **Reduced Electricity charges**	**Demand Side Mandates** • **Certain share of the fleet to be zero emission vehicles** • **Stringent vehicle emissions standards** • **Higher registration fee for ICE** • **Higher taxes on ICE fuels**
Supply Side Incentives • **Production Linked Incentives** • **Reduced import duty on key components** • **Enhanced rates of depreciation**	**Supply Side Mandates** • **Certain share of the production to be of ZEVs** • **Setting stringent emission standards for all vehicles manufactured** • **Higher input price for ICE vehicles**

So far, the focus has largely been on providing incentives, both on the supply side and the demand side, to encourage a shift to electric vehicles. Thus, under the FAME program subsidies are provided for the purchase of vehicles and setting up charging infrastructure.

Besides, OEMs receive benefits under the ongoing Production Linked Incentive (PLI) scheme. While over ₹40,000 crores have been spent by way of incentives over the last 10 years, it has only reached a level where 7.6% of annual vehicle sales are electric. It is evident that continuation of incentives alone may not help reach the target of 30% EV sales in the next five years. As such it is time to give a stronger push for the shift by introducing some gentle mandates and disincentives which will help signal the required direction more firmly. These could be over and above the incentives that currently prevail.

To avoid any strong backlash, the mandates could be limited to only a certain segment of the vehicle fleet and need not be extremely stringent to begin with. Apart from pushing a certain segment towards EV, they would signal a strong direction and nudge speedier action. They should become progressively more stringent, and have wider application with time. The mandates could be on a certain segment of vehicles like public transport buses, para transit vehicles, government vehicles, and the rapidly increasing number of urban freight vehicles. These are fewer in number and would be easier to manage, besides offering higher public benefits. Limiting mandates and disincentives to such vehicles to begin with may not attract opposition but would at the same time, signal the future direction for all. In fact, in early 2000, Delhi had mandated conversion of all buses and paratransit vehicles to CNG. So this kind of mandate is not new in India.

A note on the types of mandates introduced in different countries is in *Annexure B.* In addition *Annexure C* presents the efforts made and the results of these efforts in Vietnam.

Focus on a sub-set of the vehicle fleet

Different types of vehicles have different use patterns. As a result, the potential benefits from their transition to electric also vary. Further, based on their use patterns, the spatial distribution of charging facilities has various requirments. It is easier to provide several charging points at concentrated locations than to do so in a thinly spread manner across a city or region. Similarly, benefits from transitioning vehicles to electric accrue based on how intensively they are used. Therefore, priority should be accorded to transitioning vehicles that cover a larger number of vehicle kilometre in a day and those which do not require a widely distributed network of charging infrastructure.

In this context, Table 1 below highlights the extent of benefits from each type of vehicles and also the ease of providing charging facilities.

Table 1: Benefits and ease of supporting infrastructure for different types of vehicles

Vehicle type	Daily usage pattern	Number of vehicles	Emissions reduction potential per vehicle	Locational need for charging stations	Priority
Personal 2-wheelers	Low	Very high	Low	Largely at home	High
2W delivery vehicles	Moderate	Low	Moderate	Captive	Moderate
4 W personal cars	Low	Low	Low	Widely distributed network needed	Low
3/4 wheeler paratransit	Medium	Low	Medium/High	Largely at concentrated locations	Medium

Vehicle type	Daily usage pattern	Number of vehicles	Emissions reduction potential per vehicle	Locational need for charging stations	Priority
Buses	High	Low	High	Captive	Very high
Urban freight vehicles	High	Medium	High	Largely at concentrated locations	High
Highway trucks	Very high	Low	Very high	Largely at concentrated locations	Very high

The table above would indicate that buses, trucks, para transit vehicles and urban freight vehicles would be the right ones to prioritise as they are used over longer distances each day and the need for charging facilities is at relatively concentrated locations. Personal two wheelers would also be a good case, primarily because they are very high in number and mostly charge at home. Personal cars would come lower down in the priority primarily because they compose a relatively small share of the vehicle fleet in the country and daily usage is also relatively low. As against this they need a wide distribution of charging facilities which is difficult to provide in the short run[5]. A note on the nature of charging infrastructure for different types of vehicles is in *Annexure D.*

Highway trucks and buses are particularly important segment to transition to electric as they travel long distances in a day and require charging facilities at concentrated locations along highways. In fact, they constitute only 4% of the total vehicle fleet but are responsible for more than 50% of the emissions. Thus, they offer a high potential for emission reduction with relatively less effort.

Focus on saturation rather than even distribution

Instead of distributing scarce resources thinly across multiple geographies, it would be better to focus attention on limited geographies at a time. The impact from a more comprehensive transition is more visible and better placed to attract enthusiasm for replication. This has also added benefit of enabling learning from scale in terms of changes needed in managing the grid, designing route networks, crew and vehicle scheduling, etc. These learnings will not only be very useful for successful replication but also a more effective way of improving air quality in any area.

In this context, China's initial efforts (over 15 years ago) started with the "10 cities 1000 vehicles" program, which invited 10 cities to procure 1000 vehicles each. China has, of course, progressed a long way since then. But this shows that focussed attention to fewer geographies is a good approach to attract attention for replication.

Hence a good initiative to prompt faster transition would be to pick 5 cities where 100 percent of the buses, para transit fleet and urban freight vehicles can become electric in the next 5 years. This can then be scaled up to 20 cities in 10 years.

In this context, a note on a possible approach to 100% saturation in 5 cities is in *Annexure E.*

5 In this context, India's situation is very different from many countries in the developed world where cars are a large share of the vehicular fleet and trip lengths are also high. As seen in the section on India's uniqueness, cars are only 13% of our fleet and most trip lengths are less than 10 kms.

BOX 8

CHINA'S "10 CITIES, 1000 VEHICLES" PROGRAM (2009)[6]

Launched in 2009 by four key ministries of the Chinese government, the **"10 Cities, 1000 Vehicles"** program was a flagship initiative aimed at kickstarting the adoption of electric vehicles (EVs) in China through public sector deployment. The program began with **10 pilot cities,** each tasked with deploying **at least 1,000 new energy vehicles (NEVs),** including battery electric, hybrid, and fuel cell vehicles, primarily in **public fleets** such as buses, taxis, and government vehicles.

This demand-side initiative provided **central government subsidies** to offset the higher costs of EVs and encouraged local governments to develop supportive policies and charging infrastructure. Over time, the program expanded beyond the initial 10 cities, eventually covering over 25 cities across China.

This initiative played a pivotal role in **catalysing China's EV industry**, fostering domestic manufacturers, advancing battery technologies, and establishing a foundation for the country's current global leadership in e-mobility.

Enabling Finance for Electric Buses and Trucks

Trucks represent 3% of the total vehicle fleet but contribute to 34% of the CO_2 emissions and 53% of PM emissions. Similarly, buses constitute less than 1% of the total vehicles but contribute to about 15% of total CO_2 emissions. Thus, trucks and buses constitute a miniscule 4% of the total vehicle fleet but contribute to more than half of the CO_2 and PM emissions.

Since these vehicles constitute a small share of the total vehicle fleet and yet emit a very high share of the emissions it will be important to prioritise them in the subset of vehicles to be transitioned to electric. However, financing these vehicles has been a challenge, as financial institutions perceive these as risky investments. A comprehensive approach is, therefore, necessary to reduce the level of risk for financial institutions. Such a comprehensive approach would possibly encompass:

- Reducing the extent of empty haulage by nudging start ups to develop a platform that provides data on possible return cargo[7]
- Providing some portion of the funds through low-cost financial support using a blended finance mechanism, as being done through SBI for solar panels
- Nudging the insurance industry to develop a partial risk guarantee mechanism that government could support
- Encouraging SIAM or another private entity start up to develop a data platform that captures EV performance data to inform financial institutions and other stakeholders
- Bring electric trucks and electric buses into the priority sector lending so that financial institutions are nudged to lend more generously for this

A separate note on possible pooled fund to support financing for electric trucks and buses is in *Annexure F.*

6 Christopher Marquis, H. Z. (2013). China's Quest to Adopt Electric Vehicles. Stanford Social Innovation Review.

7 It is understood that some such platforms already exist but may need some recognition so that they get supported in compiling the required information.

Focus on services delivered instead of assets procured

Another approach being recommended is to provide incentives for services delivered rather than for the assets procured. The financial support under the FAME program, has largely focused on subsidising assets. Thus, the capital cost of vehicles has been subsidised instead of the number of kilometres run by such vehicles, and charging assets have been subsidised instead of the charging service provided by them. This kind of arrangement runs the risk of subsidies being extended to poorly utilised assets. It will be more appropriate to move towards a system where the financial support is extended to the service provided rather than to the assets procured. A good example of this was in the aggregated procurement of electric buses by five large cities, through the "Grand Challenge" process. The subsidy was provided for every kilometre of service rather than in subsidising the cost of the vehicle itself. The PM e-Bus Sewa scheme also does the same. This approach could be adopted for charging as well by subsidising the electricity consumed by an EV rather than for procuring the charging asset or setting up the charging point.

Shifting Capital Costs to Operating Costs

The capital cost of electric vehicles compared to their ICE counterparts has been a major barrier for transitioning to electric vehicles. In particular this is a serious barrier in the case of electric trucks and electric buses where the capital costs are often two to three times that of an ICE vehicle. Besides small owners are unable to afford the higher levels of equity, and financial institutions are reluctant to provide the higher amounts of debt required for such purchases. Mechanisms that would help shift the capital cost towards higher operating cost may make initial purchase decisions more favourable and make financing a lot easier. In this context the following two mechanisms can be considered.

a) Decoupling the battery from the vehicle

Batteries constitute almost 40 % of the capital cost of an EV. Decoupling the cost of the battery from the cost of the vehicle will help in reducing the capital cost of the vehicle, even if it increases the operating cost. This will give greater confidence to vehicle owners and financiers as the capital cost comes down. However, this will require a completely new kind of battery leasing eco system to evolve, wherein vehicle owners lease batteries and pay on a monthly basis, or on a per-km of use basis instead of paying a high capital cost.

During the stakeholder meetings, ideas also came up about having a battery Aadhar /passport that could track the performance of individual batteries on a continuous basis. This will help understand the current health of a battery and thereby make its monetary value more transparent. A Battery Aadhar pilot is also being planned under the leadership of the Department of Science and Technology in India[8]. However, this will need time to evolve. An expert group could be constituted to help identify specific needs and suggest actions that Government could take to nudge the evolution of such as system.

This kind of model did exist in India for LPG cylinders and so is not new. However, a similar model for batteries will have to be a lot more complex and sophisticated compared to LPG cylinders.

8 The Department of Science and Technology (DST) is currently working with a consortia of partners (Tata Motors, Tata Elexi, Tata Auto Component, Nunam, Lohum, IIT Kharagpur, & WRI India) to test the use cases for a battery aadhaar through a pilot scale project. A demo of the battery aadhar was showcased in the Battery Summit on June 2035 in New Delhi.

A short note on the concept of a Battery Passport is in *Annexure G* and a short note on leasing vehicles and on Battery as a Service (BaaS) is in *Annexure H.*

b) Leasing electric trucks and buses

Given that the capital cost of trucks and buses is unaffordable to small owners, nurturing the development of a leasing industry for these vehicles would go a long way in easing the situation. Large leasing companies will be better placed to procure these vehicles leveraging economies of scale and also maintaining them in a more cost effective manner. They would be at a better position to negotiate with financial institutions who in turn may have greater comfort in lending to such larger entities. These leasing agencies could then provide vehicles to small bus and truck owners on a monthly lease fee. In fact, vehicle manufacturers themselves would be good leasing agencies, though this will mean a significant shift in their business model.

Scaling up R&D on new battery technologies

Current battery technologies, which use lithium, nickel and cobalt, have a relatively low energy density. Getting a reasonable amount of energy stored in them to meet transportation needs, make them heavy and expensive. Another concern for India is the import dependence of these minerals.

Considerable research is already taking place around the world on identifying new battery technologies, primarily using sodium, which is more abundantly available. It is understood that some of this research has also been initiated in India, but is scattered and largely at the preliminary stage. It has not yet matured to a level at which industry would be willing to pick it up for commercialisation. It would be necessary to focus attention on this to improve the energy density of batteries, reduce their costs and reduce the import dependence of such a strategic item for EV. In fact, it could also help India become a global leader if it moves fast enough.

BOX 9

INDUSTRY – ACADEMIA – GOVERNMENT COLLABORATION

Academia often generates early-stage innovations (TRL 1–4) while industry requires mature technology (TRL 7+) before adoption. Governments across the world have created programs, mechanisms and infrastructure to bridge this gap. For example, the UK's Advanced Propulsion Centre (APC) explicitly funds projects at TRL 6–7 - bridging the gap between working prototype and commercialisation.[9] The APC's Technology Developer Accelerator Programme (TDAP) has supported 120 startups, catalysing over £300 million in private investment in zero-emission automotive tech.[10] Similarly, the UK's Faraday Battery Challenge (part of UKRI – a fund that is backed by £2.6 billion of public money, with £3 billion in matched funding from the private sector) invested £610 million in battery R&D and created the UK Battery Industrialisation Centre (UKBIC), a £204 million pilot facility that enables companies to scale lab prototypes to production. UKBIC provides manufacturing scale-up at the scale that product innovations need to move to industrial production", effectively bridging lab research to commercial battery manufacturing.[11]

In the United States, national labs and agencies play a similar role. For instance, the Department of Energy (DOE) funded PNNL's Grid Storage Launchpad (GSL) – a 93,000 ft² facility that combines all phases of battery development under one roof.[12] GSL houses materials research labs, cell prototyping lines and 100 kW-scale testing bays, giving industry and academics the opportunity to explore new battery chemistries under realistic grid conditions, thus reducing the time, risk, and cost of moving new technologies toward commercial readiness.

India has begun similar efforts. The Department of Science & Technology (DST) launched the EVolutionS program, targeting EV startups: it invites proposals from teams with lab-proven tech (TRL 3–4) and funds them through incubation to reach TRL 6–8 with pilot demos and validation.[13] The MeitY–MHI Joint EV Call (Oct 2024) likewise funds indigenous EV subsystems (motors, chargers, BMS, etc.) developed in collaboration between researchers, startups and industry. Projects are expected to deliver TRL 7+ prototypes ready for commercialisation.[14] At the national level, India's new ₹1 trillion R&D&I fund (announced FY25) will channel massive grants into strategic sectors, including batteries and electric mobility.[15] By adopting a similar integrated approach as the UK, backed by the new RDI fund and tied to India's EV manufacturing objectives, innovations can be pushed past TRL 4–7 into products and new manufacturing lines. The result will be a vibrant EV sector with home-grown battery and drivetrain technologies ready for market.

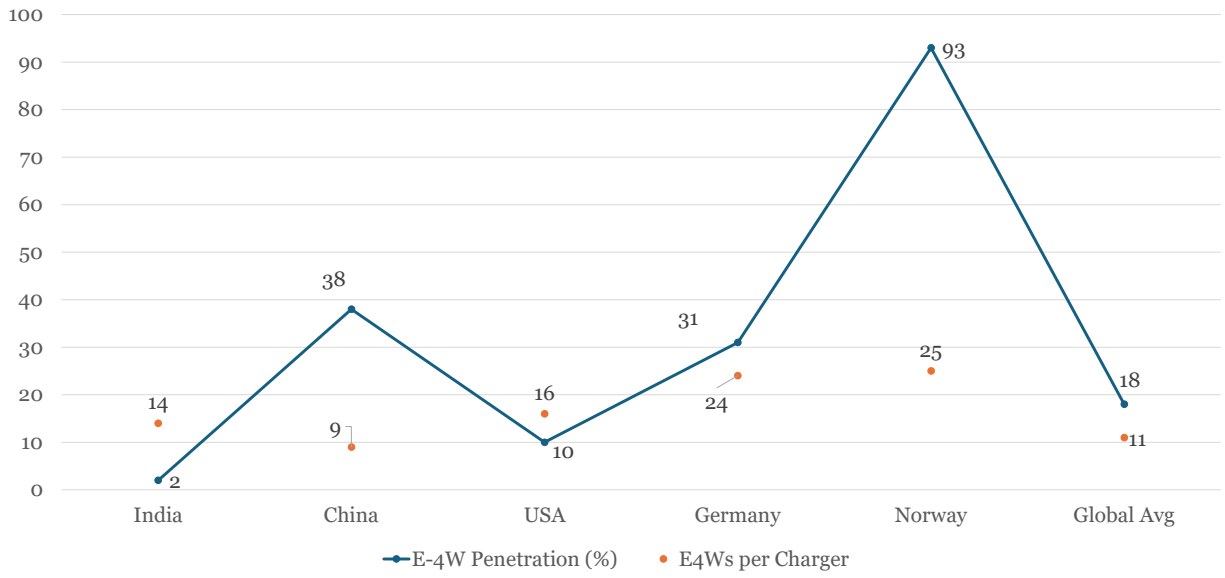
Strategic scaling of charging infrastructure

Electric vehicles and their charging facilities present a classic chicken and egg situation. Inadequate charging infrastructure constrains the purchase of electric vehicles and an inadequate number of electric vehicles adversely impacts the viability of charging facilities. The big question is "which comes first – charging or EV?"

9 apcuk.co.uk
10 theengineer.co.uk
11 ukri.org
12 pnnl.gov
13 dst.gov.in
14 pib.gov.in
15 angelone.in

The relationship between the extent of charging station availability and the level of EV penetration may be seen from figure 10 below. This shows the number of electric cars per charging station in select countries vs the extent of EV penetration in that country.

Figure 10: Charging infrastructure availability Vs 4W EV penetration (2024)



Source: 1) IEA Global EV Data Explorer for global data, 2) CPO consultation for India

As may be seen from this, China with only 9 cars per charging station (meaning a relatively high availability of charging stations) has a relatively high level of EV penetration. This is also the situation in the US and Germany. This would appear to be logical situation, as easier charging would make it easier for consumers to buy EVs. However, Norway with 25 cars per charging station (meaning a relatively poor availability of charging infrastructure compared to many others) has a 93% EV penetration. The possible reason for this counter-intuitive situation in Norway is the early adoption of zero emission vehicle mandates and the setting of ambitious goals. Thinking on EVs had started in Norway as early as in 1994. In 2017 itself they had adopted a national goal of all new passenger cars sold in 2025 being zero emission (electric or hydrogen).

In India there are 14 cars per charging station, meaning the availability of charging facilities is not bad compared to some of the other countries. Only China seems to be in a more favourable position with a better availability of charging facilities. Yet, there is a low penetration of electric cars in India compared to the other countries.

One explanation for this could be the low share of cars in India's vehicle fleet. Apart from this it could also be reflective of how charging stations have been located in different cities. An evenly spread geographical distribution of charging stations may not necessarily be the best strategy. Locating charging stations based on the vehicle movement patterns would perhaps be a better strategy. A geographically uniform distribution runs the risk of some charging stations being overloaded and others being underutilised.

Apart from this, setting up charging facilities requires considerable interaction with multiple public agencies. Power distribution companies, local municipal bodies and those who own the land have to come together. Interaction with financial institutions is also important. However, all of this is often difficult. Besides a systematic analysis of the appropriate locations for charging stations requires professional analysis of the likely demand at each

location based on travel patterns within each geography. Often several approvals are also required before charging facilities can be set up.

It therefore seems necessary to look at a more strategic scaling of charging infrastructure . In this context, having an agency that facilitates a strategic decision on locations suitable for charging stations and also manages the aggregated procurement of connections and service providers will be useful. Singapore has adopted good model by setting up an organisation called EVe in 2022, under their Land Transport Authority. The role of the EVe is to facilitate the establishment of charging stations, by coordinating with all the relevant agencies and undertaking the professional analysis required. A separate note on scaling up EV charging infrastructure and on the EVe in Singapore is in *Annexure I.*

Strategic scaling of charging infrastructure along highways will require identification of locations where long haul trucks and buses stop in their current movement patterns, whether for meals, or for any checking at inter-state borders, or for any other reasons. These would be ideal locations for charging hubs as they will obviate the need for any additional halts for such buses and trucks. 50 priority corridors are understood to have already been identified by the office of the Principal Scientific Advisor and could be used as a starting point for shortlisting. A list of these is in *Annexure J.*

Scaling the availability of charging infrastructure will also need streamlining of the process of sanctioning power connections by the distribution companies and some uniformity in the fees and tariffs. Concerns about the ability to meet the power demand, especially during peak times will have to be dealt with by innovative methods like time of day (TOD) pricing of electricity, an separate power lines (EVPL) for electric vehicle charging. TOD pricing also helps power generating stations by shifting demand from peak periods to off peak periods, thereby improving their plant load factor (PLF).

Given the climate concerns and the limited availability of storage for solar and wind power, it will be worth exploring mechanisms that connect the battery in EVs to the power grid. This not only leverages additional storage but also makes EVs profitable investments as income from supplying to the grid can supplement revenues for the EV owner.

Enhancing awareness and expanding information systems

Many misconceptions continue to prevail about the dangers of EVs, thereby constraining adoption. During the stakeholder meetings, it was informed that many RWAs are unwilling to allow charging facilities in their areas as they are believed to catch fire easily. Further, many vehicle owners are unaware of the potential cost savings of EVs and are discouraged by the higher capital cost of these vehicles. Lower operating costs are not taken into account in making purchase decisions. A strong awareness building program is therefore needed to clear the misconceptions that exist.

Apart from this, the need for developing convenience digital application that provide a range of information to EV owners will go a long way in supporting the transition. Examples of some information often needed relates to locating the nearest charging stations, booking charging slots and even paying for the electricity consumed. As an example, ChargeMap, an app in Europe, provides real-time charging station data, user reviews, and is integrated with navigation systems. It also aggregates data from multiple charging networks for interoperability.

A short note on the data that needs to be collected and shared is in *Annexure K.*

RECOMMENDED ACTIONS

Each of the approaches highlighted above will require several actions that will enable their implementation. These are presented in Table 2 below, which also highlights the appropriate timelines for having them taken up in and the appropriate agencies to lead the effort for each:

Table 2: Actions needed against each approach presented above

Within one year ● Within 1 to 5 years ● Within 5 to 10 years ●

S. No.	Approach	Actions	Timeline	Action by
1	**Moving from incentives to mandates**	Announce a clear policy, with target timelines for Zero Emission Vehicle (ZEV) adoption	●	MHI/ MoRTH
		Design a progressively more stringent plan for mandating the production and purchase of EVs and disincentivising the continued use/ production of ICE vehicles **See BOX 7**	●	MHI / MoRTH
		Have a mechanism for effective implementation	●	MHI, MoRTH
		Expand CAFÉ norms to a wider segment of vehicles	●	MoP
2	**Saturation instead of thin distribution**	Design and start a saturation program to support 5 cities over 5 years	●	MHI, MoRTH, MoHUA
		Have entities in States to manage this program	●	State Governments
		Initiate Design and Planning to scale up for 20 cities	●	MHI, MoRTH, MoHUA
		Initiate Design and Planning to scale up for 100 cities	●	MHI, MoRTH, MoHUA
3	**Enable financing for e-buses and e-trucks**	Create a pooled fund with contributions from the public budget and multilateral development banks for providing lower interest loan for the procurement of e-buses and e-trucks by small operators and thereby bring down the total cost of capital for such procurement **See BOX 1**	●	DFS MHI
		Design and launch an appropriate scheme to channel the funds	●	DFS MHI

S. No.	Approach	Actions	Timeline	Action by
4	**Scale up research for new battery technologies**	Set up an academia-industry-government partnership for accelerating research on new battery chemistries **See BOX 6**	🟠	DST
5	**Strategic scaling of charging in-frastructure**	Organise national workshops with state governments on the challenges faced in scaling up electric mobility **See BOX 4**	🔵	NITI Aayog
		Identify 20 high density corridors for eBus and eTruck operations and commission a study to identify strategic locations for charging hubs based on current haltage patterns on these corridors **See BOX 5**	🔵	MoRTH MHI
		Arrange for viability studies and coordinate all the approvals required for private charge point operators to invest in setting up the facilities **See BOX 3**	🔵	MoRTH MHI
		Establish nodal agencies in each state, on the lines of EVe in Singapore, to facilitate and enable more charging stations to be established	🟠	MoP, States
		Explore TOD pricing to enable easier approval of connections and improve the PLF of generating plants	🟠	MoP
		Have a unified digital application that gives information on location of charging stations, allows booking of charging slots and enables payments **See BOX 5**	🔵	MHI
		Explore provision of special EV power lines (EVPL) **See BOX 3**	🔴	MoP

S. No.	Approach	Actions	Timeline	Action by
6	**Shifting capital costs to operating costs**	Nurture the establishment of a battery leasing industry to reduce capital cost of an EV **See BOX 2**	●	MHI DFS
		Support the establishment of a battery passport system that contains details to assess the health of a battery **See BOX 2**		MHI MoRTH
		Nurture the establishment of e-truck and e-bus leasing industries to make it easier for small owners to acquire electric trucks and buses **See BOX 2**	●	MHI DFS
7	**Enhance awareness and information availability**	Design and manage the awareness building program	●	MHI MoRTH State Govts
		Assess data and information needs by different stakeholders and nurture the creation of a comprehensive information system	●	MoRTH MHI

RESOLVING INTER-AGENCY COORDINATION ISSUES

In addition of the above, action is necessary to resolve several inter-agency coordination gaps that were highlighted during the stakeholder consultations. Many related to delayed approval of power connections by the DISCOMS and high fixed costs levied by them. These adversely impact the viability of the charging stations. There were issues relating to skewed GST rates for the battery and the vehicle as also for charging services. These make it difficult to bring down the capital cost of electric vehicles and also increase the cost of charging at public charging stations. There were issues relating to fast charging vs slow charging. These inter-agency coordination issues need to be resolved.

IMMEDIATE NEXT STEPS

To kickstart the entire effort of accelerating the adoption of EVs, the following five actions would be appear to be the immediate next steps:

1. Develop a clear policy, with targets and timelines, for transitioning to electric mobility.
2. Develop a clear program of increasingly stringent regulations that mandate the transition to EV within specified time frames.
3. Design a new program to saturate 5 cities with 100% e-buses, e-Paratransit and e-freight vehicles in urban areas.
4. Design and operationalise a blended fund that helps bring down the cost of capital for e-trucks and e-buses.
5. Set up an inter-ministerial committee to resolve inter-agency coordination issues speedily.

ANNEXURE A - 1

Suggestions from electric 2/3 wheeler manufacturers

1. Single till approach towards PM E-DRIVE and PLI - So that vehicles covered under one scheme are covered under the other scheme. This shall reinforce priorities and prevent mixed messages to OEM on product development investment, market investment and capacity creation. Quadricycle class which is covered under PLI should also be covered under PM E-DRIVE, and E-rickshaw with advanced chemistry battery which is covered under PM E-DRIVE be covered under PLI.
2. PSL for EV Financing - Upfront high cost of EVs, coupled with charging and parking problems is hindering EV adoption in country. Further, battery replacement cost to decouple higher GST rate.
3. E-permits, Tolls waiver - To ensure 80% penetration, permits/tolls for electric vehicles may be waived off or be applicable throughout India/rates slashed for tolls.
4. Piling up of GST - Cash flow issue due to input GST at 18% and output GST at 5%, which blocks the working capital and input tax gets piled up.
5. Frequent changes in Road taxes - Road taxes are different in different states and fear they will increase. Informed that a window period may be provided if the road taxes are being increased and a surety to the industry that road taxes won't change for at least some period of time.
6. Home Charging for private vehicle not allowed by RWAs/AoAs- Disincentivises the buyer for purchasing EV.
7. Public charging infrastructure not available and if available, not reliable- Disincentivises the buyer for purchasing EV.
8. Expediting approvals for setting up of charging infrastructure instill confidence in EV user and takes out fear of range anxiety.
9. Subsidised public charging- Public charging is almost 4 times expensive as home charging due to 18% GST (no GST on home charging) and hence, subsidised charging may be introduced for public charging.
10. Revision in norms of low speed e2w to make them much better suited for operations in the Indian traffic environment- The potential may be unleashed by the meteoritic rise of quick commerce in India and its use of low speed e2w due to its low-speed operation in tightly defined geographies within dense urban clusters. India has the potential to take global leadership position in low speed e2w as the Chinese model of segregated lanes for low-speed EV is not compatible with most other countries' infrastructure.

ANNEXURE A – 2

Suggestions from electric 4 wheeler manufacturers

1. Mandate for percentage of EV sales - OEMs shall be mandated for a certain percentage of EV sales.
2. Electrification of fleets - Massive impact on CO_2 emission reduction with minimal spending. 7-8% of car sales is in fleet and car price range is below ₹10 lakhs for this segment. Hence, VGF for fleet can be a disruption and bring about a huge change.
3. Price range and models - Desired price range of the market for adoption of EV is 10+/- 3 lakhs. New models within this price and range over 300-500 km are required for higher EV penetration. In this regard, OEMs will have to take the lead and reduce the battery pack cost.
4. PSL for EV Financing - Upfront high cost of EVs, coupled with charging and parking problems is hindering EV adoption in country. Further, battery replacement cost to decouple higher GST rate.
5. Misconceptions for EVs - Misconceptions about range, fire accidents still push back adoption of EV.
6. Reduction in import duty for EV components - Required until the industry reaches scale of manufacturing for localisation and decreasing cost of EV.
7. Scrapping incentives - Consumers to be given incentives in scrapping for purchase of an EV.
8. Home Charging for private vehicle not allowed by RWAs/AoAs - Right to Charge EV to be mandated.
9. Promotion of home and office charging - Public charging is almost 4 times costly and also, fast charging reduces 2000 charging cycles of charging to 600, if used continuously. Hence, fast charging is to be used as only a last mile resort.
10. Hotspots charging rather than distributed charging - Hotspots data of EV are available with OEMs and can be requested by Government to create charging lots (20-30 chargers in a hot spot) instead of distributed charging over 50km (1-2 chargers. This can cover the key highway and expressway networks to instill confidence in EV charging infrastructure network.
11. Subsidies for setting up of sub-station, installation of transformers and setting up of charging infrastructure rather than chargers - Subsidy for chargers will not be materialised until and unless charging infrastructure has been set up.
12. Unified app - A one stop unified app like UPI is required to streamline and better manage the EV ecosystem.

ANNEXURE A-3

Suugestions from electric bus and truck manufacturers

1. Localised Mandates - Introduce use case-specific mandates for buses and trucks to ensure a structured transition to electric mobility.
2. Public Procurement Strategy - Encourage large-scale government procurement of EVs for public transport to drive demand aggregation and economies of scale.
3. Battery Swapping Policy Framework - Develop a clear policy framework to encourage battery swapping stations, reducing downtime for commercial fleets.
4. Permit-Free Regulations - Leverage existing permit-free regulations for EV buses to remove administrative hurdles and accelerate adoption.
5. Toll Rebates & Loan Extensions - Implement toll rebates and extend financing terms to 8-10 years to make EV investments financially viable for businesses.
6. Charging Infrastructure Expansion - Support the establishment of widespread fast-charging infrastructure with government backing to ensure operational feasibility for long-haul and commercial vehicles.
7. Leasing Finance Models - Develop and encourage leasing finance models to reduce the upfront cost barrier and promote fleet adoption.
8. Reverse GST Structure - Address the inverted GST structure affecting EV financing and operations, ensuring financial sustainability.
9. Technology-Linked Incentives - Establish incentives linked to advancements in battery efficiency, charging speed, and range improvement to drive R&D investments.

ANNEXURE A-4

Suggestions from electric vehicle equipment and battery manufacturers

1. Non availability of adequate power timely - Non availability of adequate power at charging station make it non-usable and also, time for obtaining the connection is too long making the business no-viable.
2. Land acquisition - Land acquisition in urban areas is a very costly affair. Government's need to pitch in to provide support in this regard to expand charging infrastructure network.
3. Low utilisation rate of charging infrastructure - Charging infrastructure have single digit utilisation which makes the business non-profitable and hinders big players to enter.
4. RWAs - RWA don't provide NOC for setting up private and community charging despite policies in place.
5. Promotion of charging in malls, work place, etc. - Charging infrastructure to be expanded in public places to instill confidence in the EV users.
6. Subsidised public charging- Public charging is almost 4 times expensive as home charging due to 18% GST (no GST on home charging) and hence, subsidised charging may be introduced for public charging.
7. Inter-operable charging infrastructure - Charging to be made interoperable to ensure they are utilised fully and increase their reliability.
8. Standards and specifications - To be India specific DISCOMs to allow dual output cables from the meter to facilitate public/private charging.
9. Localisation of components of charging infrastructure - Most of the charging infrastructure components are imports and needs to be localised to reduce cost and promote Make in India.
10. Single app - Single app on the lines of UPI to cater to the charging infrastructure needs across India.
11. 1 city 1 operator - To fix responsibility and cater to various problems.
12. Promotion of green EV charging - To reduce load on the DISCOMs at highways and expressways.
13. Collection of material for recycling - Collection is a challenge. As a result, recycling is not achieving pace.
14. Reduction in GST - Reduction in GST for batteries from 18% to 5%.
15. Removal of restrictions - Removal in limits of imports and to promote stockpiling.
16. Data sharing of BMS - Since recycler bears the risk of battery, data sharing to be mandated by Government.

ANNEXURE A-5

Suggestions from Distribution Companies and Charge Point Operators

1. Low utilisation rate of charging infrastructure - Charging infrastructure have single digit utilisation which makes the business non-profitable and hinders big players to enter. Utilisation to increase by expanding charging infrastructure network. Support of various stakeholders required.
2. In addition to high OPEX & CAPEX costs, timely connection is also not given. In fact, in case of connection, there is no adequate power supply - Setting up and operation of charging infrastructure is a very costly affair. Financial models to be explored to reduce the same.
3. Waiving off of fixed demand charges & power tariff issue (State Government & DISCOMs)- MoP has already issued guidelines. Upon success of the sector, these can be re-introduced again and the sector will have no problem paying these charges.
4. Security deposit issue - Security deposit are very high and further, are not returned when connection is not required.
5. Electricity infrastructure Urgent push for upgradation and strengthening of electricity infrastructure along with charging infrastructure.
6. RWAs- RWA don't provide NOC for setting up private and community charging despite policies in place.
7. Single window clearance - At present, various agencies given various NOC required for connection and hence, single window clearance is the need of the hour.
8. 24X7 power on National Highways for buses and trucks for continuous operations.
9. Dedicated power lines and tariff for EV charging i.e. Special EV Power Lines (EVPL) as the standards for electricity distribution do not cover EV charging load.
10. Over loading of grid during peak hours - Energy storage (Solar+BES) to be explored and encouraged.
11. Setting up of sub-station adjacent to charging infrastructure - The per km charges for CPOs are too high and hence, electrical sub-station may be near to the charging infrastructure. Requisite safety guidelines may be explored prior to taking this decision and stakeholder consultations to be done.
12. Ensuring inter-operability and standardisation - To enhance and increase utilisation of charging infrastructure.
13. Land acquisition - Land acquisition in urban areas is a very costly affair. Government need to pitch in to provide support in this regard to expand charging infrastructure network.

ANNEXURE A-6

Suggestions from Financers

1. Treating the chassis and battery of commercial vehicles as separate units - Improve accessibility. Further, both components have different risk weights and separating the same would also help in financing.
2. Corporate fleets face no significant financing issues, the primary concern remains retail users - Clear distinction between passenger and commercial EV financing. Need for special rate of interest for EVs, PSL to Banks and Risk pool arrangement.
3. Higher tenure loans to reduce monthly outflows and promote EV adoption.
4. Financing risk management - Risk pool arrangements could be extended to certain entities to mitigate financing risks.
5. Consumer education - Consumer education is critical since EVs are often a secondary choice for buyers.
6. High up front cost of EV to be reduced - Battery-as-a-Service (BaaS) models and battery-vehicle decoupling to reduce upfront cost. BaaS is not yet a full-service model similar to telecom but has the potential to drive down costs. A tri-party agreement between OEMs, financiers, and battery manufacturers is lacking, as there are no dominant players in the battery manufacturing space.
7. Modification in Clause 14 of the Renewable energy circular - To expand its definition to include EVs, particularly two-wheelers, three-wheelers, light commercial vehicles (LCVs), buses, and trucks.
8. High cost of funding for non-banking financial companies (NBFCs) remains a major challenge.
9. High insurance premiums remain a concern for financing and ownership costs.
10. During re-sale, batteries are replaced with waste batteries - Battery to have unique ID. integrating battery numbers into RCs was suggested as a way to improve transparency and market confidence.
11. EV financing is a high-risk venture, with risk primarily centered on the asset rather than the borrower - Proposed reinstating previous RBI preferences for asset finance NBFCs, which have since been withdrawn restructuring of MSME finance without affecting credit ratings was also recommended.
12. Consortium of banks for EV financing - Consortium of banks to collaborate on creating bankable investments through pooled demand and structuring assured business models for EV financing, thereby ensuring stability and market confidence.
13. Formation of committee of bankers - To develop standardised vehicle valuation frameworks, similar to Germany.

PSL for EVs has yet to be approved by RBI. However, the integration of dense charging infrastructure into national infrastructure planning is a positive step. The Risk Sharing Facility (RSF) fund, launched with Shell, has seen minimal claims, and OEMs are extending warranties while complying with AIS and BIS standards.

ANNEXURE A-7

Suggestions from Bus/Truck Operators

1. Power Enhancement for CPOs - Limited access to charging infrastructure remains a significant barrier to EV adoption & Charge Point Operators (CPOs) lack power enhancement capabilities, delaying infrastructure expansion. Standardisation and interoperability to be promoted.
2. VAHAN Database - Challenges exist in tracking and planning the EV transition, as Vahan's database need improvements to accurately reflect Battery-Operated Vehicles (BOVs) or diesel buses.
3. High capital expenditure (3X higher than ICE trucks) as a major barrier to EV truck adoption - Financing mechanisms to be developed.
4. Closed-loop, long-term contracts to be explored and adopted.
5. As informed in the meeting, EV utilisation rate is 10,000 km/month, compared to 7,000 km/month for diesel trucks, showing a significant advantage in asset utilisation.
6. Variation in electricity pricing - Variation in electricity pricing (₹15/unit from oil companies vs. ₹22/unit commercial rate) needs to be addressed for TCO optimisation. CPO Utilisation remains low despite increased investments, raising concerns about sustainable business models for charging infrastructure providers. Addressing utilisation and pricing challenges will be crucial to ensuring long-term financial viability for CPOs.
7. Fast charging every 100 km would eliminate range limitations, making intercity operations feasible.
8. Supply constraints from OEMs - Supply shortages from manufacturers remain a major constraint, along with the need for fare structure adjustments to ensure financial sustainability. As part of the EV 2.0 policy by GNCTD, all 4W goods transport and garbage collection vehicles must transition to EVs by December 2027 and hence, supply needs to be ensured.
9. PPP model - Importance of a Public-Private Partnership (PPP) model, where manufacturers become operators to ensure financial viability. The operational life of buses may be extended from 12 to 15 years for both ICE and EVs to increase EV adoption.
10. High GST - GST on charging services to be lowered or waived off to reduce commercial EV operational costs and enhance viability.
11. Interoperability of charging infrastructure - Interoperability of charging infrastructure must be ensured to facilitate smoother operations.
12. Capacity building programs for drivers are essential to enable the workforce to adapt to EV technology. At present, there is a shortage of drivers in the ecosystem.
13. Standardisation of registration process - Integrating battery numbers in vehicle registration certificate(RC) to enhance tracking and financing mechanisms.
14. Access to public charging infrastructure of State STUs by private players - Private operators face access challenges at ISBT locations, as many hubs currently do not permit private EV operators, posing a barrier to broader adoption.

ANNEXURE B

Examples of mandates imposed in select countries/states[16]

Country/Government	Period (Years)	Vehicle types
California + 14 states	2017–2026	Light-duty vehicles (35% ZEV in 2026)
California + 12 states	2027–2035	Light-duty vehicles (100% ZEV in 2035)
United Kingdom	2024–2030 (adopted), 2031–2035 (proposed)	Light-duty vehicles (100% ZEV in 2035)
British Columbia, Canada	2020–2025 (adopted), 2026–2035 (proposed)	Light-duty vehicles (100% ZEV in 2035)
Québec, Canada	2017–2035	Light-duty vehicles (100% ZEV in 2035)
Canada	2026–2035	Light-duty vehicles (100% ZEV in 2035)
China	2019–2025	Light-duty vehicles (45% ZEV in 2027)

16 https://theicct.org/publication/aligning-regulations-and-standards-with-zev-targets-sept24/

ANNEXURE C

Incentives to Mandates in Vietnam

Vietnam's electric vehicle (EV) market has experienced explosive growth, expanding nearly 20 times in just three years, reflecting a strong shift toward green transportation. From March to December 2022, an average of 404 EVs were registered each month. In 2023, this number surged to 2,440 vehicles per month, bringing the total for the year to 29,281. By 2024, the growth rate accelerated further, with monthly registrations reaching 6,648 vehicles – 2.7 times higher than the previous year.

Key Policy Levers Driving Vietnam's EV Ecosystem

All policies below are drawn from Decision No. 876/QD-TTg (July 2022) and related legal texts in force as of early 2024.

Demand-Side Incentives

- **Registration-fee exemption** for BEVs (100%) from 1 Mar 2022–1 Mar 2025; followed by 50% concession through Feb 2027.
- **Special excise-tax cut:** BEV rate cut from 15% → 3% (Mar 2022–Feb 2027).
- **Local pilots** (e.g., HCMC): Co-financing schemes covering registration fees, license plates, and preferential loans for low-income households on e-2Ws.

Supply-Side Incentives

- **0% import duty** (2020 - 2024) on raw materials & components for vehicle assembly (Decree 57/2020/ND-CP).
- **Corporate income-tax allowances** & land-lease incentives for "green" auto-industry investments under the national strategy toward 2035.
- **Battery-manufacturing grants**: VinES factory (Ha Tinh), 100000 packs/year Phase 1, expanding to 1000000 packs/year Phase 2.

Non-Fiscal & Enabling Measures

- **Public-fleet procurement pilots**: Mandates to electrify government vehicles, ride-hailing fleets, and municipal buses (design guidelines under MOT action plan).
- **Clear Mandates (Supply & Demand Side)**

Decision 876/QD-TTg Targets

- **By 2040**: End production, assembly & import of fossil-fuel road vehicles for domestic use.
- **By 2050**: 100% of all road vehicles powered by electricity/green energy.
- **Fuel-economy & CO_2 standards** (draft): Roadmap under Law 72/2020 to phase in mandatory consumption or emission limits for ICE 2Ws & PVs.
- **Vehicle-energy labeling**: Mandatory from 2020 (2Ws) and 2015 (PVs), laying groundwork for tightening future performance requirements.

From Incentives to Mandates: Driving Adoption

- Early generous incentives such as zero registration fees and steep excise-tax cuts sparked initial consumer interest and gave manufacturers confidence to invest in local assembly and charging infrastructure. With sales growing, policymakers are now layering in firm mandates (Decision 876's phase-out timelines and forthcoming CO_2/fuel-economy standards). This calibrated shift provides the market certainty needed to accelerate infrastructure roll-out, secure long-term manufacturing plans, and normalise EV ownership, thereby transforming Vietnam's EV transition from nascent subsidy-driven growth into a self-sustaining, mandate-backed trajectory.

ANNEXURE D

Nature of charging infrastructure for different types of vehicles

- 2-wheelers tend to be charged at home, using residential connections, as their batteries are fairly light and can be manually removed. They may not be very intensively used but given the relative ease of charging, they could be an important segment to focus attention on. They also constitute the dominant share of the vehicle fleet in India.
- 3- wheeler batteries are slightly heavier but these vehicles tend to park in clusters at designated spots in a city. This would mean the charging locations for three wheelers need to be limited to only a few clusters where three wheelers typically tend to be parked. Being paratransit vehicles, they cover longer distances in a day than personal vehicles and therefore offer greater benefits in terms of reduced pollution and savings in the import of petroleum fuels.
- Taxis and other 4 wheeled paratransit systems would also tend to park in clusters and would require charging facilities primarily at such clusters. They also travel longer distances than personal vehicles and therefore have larger public benefits.
- Personal cars would either need charging in the residential areas or at workplaces or at other locations where these cars tend to be parked for relatively longer durations. These could be in malls, movie halls, entertainment centres, etc. where people tend to spend several hours. Trying to provide a wide distribution of charging stations across the city may not be the best thing to do at this point as they run the risk of severe under-utilistion. This could happen as we reach higher levels of electric vehicles. Unlike petrol pumps, which cannot be located within housing colonies, charging stations can be located in housing colonies and parking lots. Personal cars do not travel long distances in a day has seen from the data on trip lens in the country and therefore the public benefits will be lower.
- Buses and trucks also tend to park in clusters and would need charging stations either at bus depots or at truck parking clusters / terminals or logistics hubs. They would also need charging facilities on highways at strategically located points, especially those where such trucks and buses stop in any case, for a variety of other reasons. It may not be a good idea to create charging facilities at equal distances on highways as this would enforce an additional halt for charging instead of piggy backing on halts required for other purposes. It would be essential to identify current movement patterns on a set of the most highly used highways and locate charging locations at such points. Buses and trucks tend to travel long distances in a day and offer significant public benefits. Hence even if there are difficulties in creating charging infrastructure for them, especially on highways, they are worth focusing attention on.

ANNEXURE E

100% saturation in 5 cities

The objective is to achieve 100% electric mobility adoption across five designated Indian cities within five years, leveraging infrastructure development, fleet electrification mandates, and targeted financing mechanisms. The challenge would involve inviting proposals from interested cities and shortlisting 5 cities to be supported with an implementation plan for 100% electrification of all transport systems within the city including public, paratransit, and private transport modes within a period of 5 years.

Municipal, and state government vehicle fleets would transition to all-electric operation, with complete phase out of internal combustion engine vehicles by end of 5 years . Commercial operators such as logistics firms, ride-sharing services and corporate shuttles would follow a staggered compliance schedule, culminating in 100% electric procurement by the end of the five-year timeline. Progress would be monitored through a dashboard dedicated towards the smart city, which would track new electric registrations, impose penalties for non-compliance and award tax rebates to early adopters.

Complementary fiscal measures, such as GST exemptions on lease payments, road-tax waivers, and accelerated depreciation, would further reduce total cost of ownership and nudge the logistics service providers to switch to an all-electric fleet. To accelerate deployment of public transport and goods movement vehicles, the State would collaborate with city transit agencies to adopt electric buses.

To incentivise state and city governments, the central government would provide expert technical assistance in master planning for charging infrastructure integration, demand forecasting and tender design, financing mechanisms for low-interest loans, as well as capacity building programs for creating an EV ready workforce. Finally, the top-performing cities would compete for awards from an “EV Excellence Fund,” unlocking additional grants for renewable-energy integration or advanced mobility pilots. This approach should ensure that the partner cities are fully equipped, motivated and empowered to lead India’s electric mobility transition.

The comprehensive learnings gained from this ambitious five-city electrification challenge will serve as a robust blueprint for scaling electric vehicle (EV) adoption across other Indian cities. By meticulously documenting best practices in infrastructure rollout, regulatory frameworks, and stakeholder coordination, the challenge will generate actionable insights into overcoming common barriers such as financing gaps, technology integration, and behavioral change. The phased approach—mandating electrification across municipal, commercial, and private fleets—will yield valuable data on compliance strategies, incentive effectiveness, and operational logistics.

ANNEXURE F

Pooled Fund to Support Financing of Electric Trucks & Buses

Financing rates for diesel trucks/buses are currently at around 10-12%, while their EV counterparts have a considerably higher cost of financing (15-18%). This cost of capital is higher for electric trucks/buses due to lenders' perceived risks, including immature battery technology (e.g., longevity concerns) and operational uncertainties such as unproven maintenance costs or resale value of the battery. This poses a barrier for operators considering purchasing an electric truck/bus.

To address this challenge, a pooled fund could be set up by the Government of India in collaboration with a multilateral development bank to provide a form of concessional finance for e-truck/bus purchases. The goal of this fund would be to bring about parity in the cost of capital for the purchase electric trucks/buses vis a vis diesel trucks/buses.

The pooled fund could operate through a strategic blended finance structure like the ADB-SBI-NABARD solar financing facility. A Government of India grant capital, combined with multilateral institution financing, could be channeled through a designated public sector bank as the implementing agency. This bank could then blend this concessional capital (available at lower than commercial lending rates) with its own commercial financing (at market rates) to create a blended product offering ICE equivalent financing rates to purchasers of e-trucks/buses.

Drawing parallels with the ADB's $240.5 million solar financing facility, where funds were made available to SBI and NABARD at concessional terms through the Clean Technology Fund, this electric vehicle pooled fund would similarly leverage the participating bank's existing distribution network while ensuring that concessional benefits reach the vehicle operators. The implementing bank would manage underwriting, disbursement, and portfolio monitoring while maintaining responsibility for repayment to the multilateral institution, creating a scalable model that minimises implementation complexity while maximising capital efficiency.

Case Study: Concessional Finance for E-trucks

We've assumed an ex-showroom price for the e-truck at Rs 1.5 Crores. The standard debt to equity (70:30) ratio has been considered in this case. The traditional interest rate for e-trucks is assumed to be 18%, against the rate of 12% for diesel trucks. MDB interest rate is taken to be 9%. Our aim is to use a blended finance mechanism that brings down the cost of capital for e-trucks to 12% from 18%.

Cost of Capital Structure			
Source of Capital	Share	Interest Rate	Cost Contribution
Commercial banks	50%	18%	9%
MDB fund	30%	9%	3%
Government funds	20%	0%	0%
Blended cost			12%

On this basis, funds required from different sources for 10,000 e-trucks, and presuming a 70:30 debt-equity ratio, will be as follows:

Total requirement – ₹15,000 crores

- Equity – ₹4500 crores
- Debt – ₹10500 crores

Of which:

- Govt loan – ₹2100 crores
- Commecial loan – ₹5250 crores
- MDB loan – ₹3150 crores

ANNEXURE G

Note on the concept of a Battery passport

Data generated by a battery has 3 distinct layers, each layer is accessible to stakeholders based on their roles within the battery value chain. The layers can be described as follows:

- Public Layer: Accessible via QR code, displaying non-sensitive data (e.g., manufacturer details, carbon footprint, date and origin of manufacturing, etc.).
- Restricted Layer: Available only to regulators and authorised entities, containing technical specifications, recycling data, and ethical sourcing reports.
- Dynamic Layer: Continuously updated with real-time performance metrics with role based access (e.g., state of health, charging cycles).

The operationalisation of a battery passport requires careful planning for data governance, privacy protection, interoperability between different systems, and ensuring compliance with evolving regulatory requirements while maintaining commercial confidentiality.

The battery data can be stored in a centralised or decentralised format, a centralised storage would have to be hosted by an IT service provider as a cloud-services (ITES), while a decentralised approach would use technologies such blockchain, or a digital twin.

A battery passport system is functioning in the EU. A mandatory digital identity is assigned to all electric vehicle batteries. Data is collected throughout the battery's lifecycle by all supply chain actors (miners, refiners, cell/module/pack producers, OEMs, users, recyclers, etc.), with each actor contributing relevant information. The data is stored and managed via a hybrid digital infrastructure using blockchain for immutable records and cloud platforms for dynamic updates, ensuring security, traceability, and interoperability. The overarching goal is to enhance transparency, sustainability, and circularity in the battery value chain, supporting the EU's green objectives.

ANNEXURE H

Vehicle leasing and Battery as a Service (BaaS)

High upfront costs, uncertain technology performance and less favorable loan terms have long held back electric heavy duty trucking in India, particularly among the country's 70 % of truck operators who have a fleet size of five or fewer trucks. Two innovative financing structures: Vehicle leasing and battery as a service (BaaS) offer powerful ways to convert the upfront capital intensive purchase of the vehicles into operating expenses while shifting key risks off small operators' balance sheets.

Some of the key highlights of a leasing model are mentioned below:

1. Packaging vehicle, battery, charging and maintenance into a single, fixed rental contract, eliminate the 70:30 debt to equity hurdle and sidestep the 1–4 % interest rate premium and shorter tenures of standard EV loans.
2. Monthly rentals fully qualify as deductible OPEX, smoothening cash flow and strengthening balance sheet metrics.
3. OEMs or specialised lessors retain residual value risk and handle service interruptions, freeing operators from technical and residual value uncertainties.
4. Financial (capital) leases remain an option for large, creditworthy fleets seeking end of term ownership via bargain purchase clauses and direct subsidy capture.
5. For the fragmented small operator segment, where acquisition costs are 2.5× those of diesel trucks, operational leases that are directly offset by PM E-Drive subsidies, deliver the most scalable, low risk path to rapid electrification.

Battery as a Service (BaaS): Separating battery ownership from the truck itself can cut upfront CAPEX by up to 30–40 %. Under a BaaS contract, third party providers finance, installation and maintenance of the battery pack, and guarantee performance through pay per use or subscription fees. This shifts battery degradation, replacement and second life risks away from the operator, while leveraging centralised battery management systems and swap station networks to minimise downtime. Bundled warranties and performance guarantee further enhance uptime and residual value predictability.

Together, leasing and BaaS unlock lower entry barriers, predictable OPEX, and outsourced technical risk, empowering India's small commercial vehicle operators to electrify their fleets swiftly, without the strain of a heavy upfront investment.

ANNEXURE I

EVe in Singapore

To accelerate deployment of EV chargers to support the EV transition, Singapore established EV-Electric Charging Pte Ltd (EVe) which is a wholly owned subsidiary of Singapore's Land Transport Authority (LTA). EVe's primary role is to ensure seamless deployment, operation and upkeep of charging infrastructure islandwide.[17]

From its inception, EVe has worked closely with Charging Point Operators (CPOs) and government agencies. To keep pace with rising EV adoption, there is a nationwide deployment target of 13,800 public charging points nationwide[18], with nearly half of all Housing & Development Board (HDB) carparks, about 952 sites, now EV ready.[19] These installations include both slow (AC Type 2) chargers for overnight topups and increasingly prevalent fast (DC Combo 2) chargers for fleet and high mileage users, enabling a full charge in roughly one hour compared to six to eight hours on slow chargers.

Key Functions and Responsibilities of EVe

- **Network Planning & Expansion:** The organisation is tasked with expanding Singapore's EV charging network to meet rising demand, with a target to equip all HDB carparks with charging points by 2025. Beyond public car parks, EVe supports charger rollout in nonlanded private residences (NLPRs) through the LTA's EV Common Charger Grant (ECCG). New and significantly refurbished buildings must also provide EV ready electrical capacity and a minimum number of charging points.[20]
- **Orchestrating the Public EV Charging Network:** EVe works closely with Charging Point Operators (CPOs) and government authorities to deploy and upgrade EV charging points across public carparks, including HDB (Housing & Development Board) carparks and other public spaces.
- **Collaborations & Partnerships:** EVe collaborates with various government and non-government organisations to leverage technology for optimising electricity supply and monitoring carbon data. It has appointed a prequalified panel of eight CPOs, via a large scale tender to streamline and scale charging stations across the island.
- **Operationalising and enforcing regulatory and safety standards:** Safety and interoperability are ensured through Singapore's National Public Charging Standards (NPCS). The Electric Vehicles Charging Act (EVCA), mandates that all chargers be certified and registered, operators be licensed, service uptime be maintained, and data be shared with the regulator.

Looking ahead, EVe aims to make every HDB town fully EV ready as part of Singapore's broader ambition of accelerating charging infrastructure by 2030. This multipronged strategy of combining aggressive infrastructure rollout, strategic partnerships, clear regulations and targeted incentives underpins Singapore's vision of a reliable, accessible and sustainable EV charging ecosystem.

17 EVe - Singapore
18 LTA Government - Singapore (EVe)
19 Straitstimes - EVe
20 MOT - Mandates (EV)

ANNEXURE J

List of top 50 highway corridors[21]

S. No.	Corridor	S. No.	Corridor
1	Adilabad-Nagpur	26	Hubballi-Chitradurga
2	Adilabad-Nizamabad-Hyderabad	27	Indore-Bhopal
3	Ahmedabad-Mundra	28	Jaipur-Delhi
4	Ambala-Jalandhar	29	Jaipur-Jodhpur
5	Aurangabad-Pune	30	Jawaharlal Nehru Port (JNPT)/Navi Mumbai-Pune
6	Ballari-Hubballi	31	Jodhpur-Udaipur
7	Bengaluru-Tiruchirappalli	32	Kanpur-Jhansi
8	Bhopal-Jabalpur	33	Kolhapur-Hubballi
9	Bhubaneswar-Balasore	34	Kolkata-Haldia
10	Bhubaneswar-Bhadrak	35	Kota-Indore
11	Bhubaneswar-Brahmapur	36	Madurai-Tiruchirappalli
12	Chandigarh-Ludhiana-Amritsar	37	Mangaluru-Chitradurga
13	Chennai-Bengaluru	38	Mumbai-Nashik
14	Chennai-Ongole	39	Nagpur-Chandrapur
15	Chennai-Villupuram	40	Nagpur-Raipur
16	Coimbatore-Kochi	41	Paradeep-Barbil
17	Coimbatore-Salem	42	Pune-Kolhapur
18	Delhi-Agra	43	Pune-Nashik
19	Delhi-Chandigarh	44	Surat-Vadodara
20	Dhanbad-Kolkata	45	Thiruvananthapuram-Kochi
21	Dhanbad-Ranchi-Jamshedpur	46	Vadodara-Udaipur
22	Gorakhpur-Lucknow	47	Varanasi-Prayagraj
23	Gwalior-Agra	48	Vijayawada-Hyderabad
24	Gwalior-Kota	49	Vijayawada-Visakhapatnam
25	Hosapete-Chitradurga	50	Visakhapatnam-Brahmapur

21 Office of the Principal Scientific Advisor to the Government of India (May, 2025): India's Priority Corridors for Zero-Emission Trucking

ANNEXURE K

Note on data to be collected and shared as part of an information system

To accelerate electric vehicle (EV) adoption, India must also develop robust data sharing frameworks and advanced information systems that enable seamless access, transparency, and interoperability across the EV ecosystem. Some of the key data that must be enabled include:

1. Charging Infrastructure Data: Both static data (station locations, pricing, connector types) and dynamic data (real-time availability, operational status, performance metrics) are essential for planning, user navigation, and efficient utilisation of charging networks. Enabling interoperable data standards such as UEI[22] for public charges can empower private sector companies to develop apps and services that can allow discovery and access of charging infrastructure.
2. Consumer Behavior Insights: Aggregated, anonymised data on charging habits, travel patterns, and preferences help optimise infrastructure placement and service offerings. This type of data can also enable EV operator's insights into vehicle performance and enable them to improve efficiency of their operations.
3. Grid and Energy Data: Data on grid capacity, load management, and integration with renewable sources ensures reliable and efficient charging infrastructure deployment. As EV penetration increases, integration of Vehicle to Grid technologies can also be enabled through such data frameworks.
4. Battery Data: Detailed information on battery state of health (SOH), remaining useful life (RUL), usage history, and environmental exposure is vital for safety, resale, and recycling.

A successful framework requires clear governance on data ownership, privacy, and access rights, along with supportive policies to incentivise digital collaboration and the adoption of common standards and protocols. The government should focus on developing centralised platforms for aggregating and sharing standardised data on charging infrastructure, vehicle registrations, and battery information. These platforms should be accessible to stakeholders and third-party developers, enabling the creation of innovative services—similar to how UPI has enabled multiple payment service providers.

22 https://powermin.gov.in/sites/default/files/webform/notices/Final_Consolidated_EVCI_Guidelines_January_2022_with_ANNEXURES.pdf

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