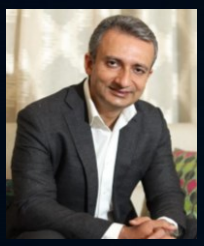
KPMG

Confederation of Indian Industry

Enabling infrastructure changes through policies for growth of EVs

Message from Chairman, CII Delhi



Mr Jaideep Ahuja
Chairman, CII Delhi State and
Managing Director & CEO, Ahuja
Residency Pvt Ltd

The transition to electric mobility represents a pivotal shift towards a cleaner, more sustainable future. As one of the most populous and dynamic regions in India, Delhi has the potential to lead this transformation and set an example for the nation. The Confederation of Indian Industry (CII) Delhi State is deeply committed to championing the growth of the Electric Vehicle (EV) sector, recognizing its vital role in addressing urban mobility challenges, reducing emissions, and fostering economic growth.

CII Delhi is working closely with industry stakeholders, policymakers, and innovators to position the city as the EV Capital of India. Through advocacy for supportive policies, development of EV infrastructure, and promotion of technological advancements, we aim to create an ecosystem that accelerates EV adoption. Key focus areas include encouraging investment in charging networks, fostering collaboration between the public and private sectors, and enabling skill development to support the burgeoning EV workforce.

The vision is to develop a future-ready mobility system for Delhi that prioritizes environmental sustainability while creating new opportunities in manufacturing, services, and innovation. With collaborative efforts, Delhi holds the potential to become a benchmark city for electric mobility in India, setting an example for other regions to emulate.

As we progress, we invite all stakeholders to join us in shaping this exciting future. Together, we can build a cleaner, greener Delhi that leads the way in sustainable urban transportation.

Executive summary

India's economy is projected to surpass USD 5 trillion[1] from its current USD 3.7 trillion within the next three years, making it the world's third-largest economy. This growth will be driven by various sectors, including the automotive industry. However, the increase in vehicles on Indian roads could lead to a higher oil import bill and increased CO2 emissions from traditional internal combustion engine vehicles.

Electric Vehicles (EVs) offer a promising solution to these challenges and align with India's COP26 commitment to transition to 100 percent zero-emission vehicles by 2040. Over the past four to five years, EV adoption in India has accelerated, with total electric vehicle sales reaching 1.2 million[2] and achieving 5 percent market penetration in FY24.

Countries with significant EV penetration, such as Norway, Sweden, China, Germany, and the United Kingdom, have benefited from factors like policy support, total cost of ownership parity, a robust start-up ecosystem, and access to technology. While India has made strides in these areas, substantial progress in developing EV infrastructure is still needed. Focusing on various aspects of infrastructure will further boost EV penetration and mark this decade as a transformative period for mobility in India.

The four primary infrastructure areas to focus on are:

1. Physical Infrastructure:
   - Developing a denser and more distributed charging ecosystem.
   - Establishing battery recycling facilities.
2. Power Infrastructure:
   - Managing the increasing power demand and improving the quality of power supply.
   - Integrating renewable energy sources to support EV charging.
3. Economic Infrastructure:
   - Ensuring access to low-cost capital for EV buyers.
   - Efficient taxation structure across EV value chain.
   - Supporting innovative vehicle ownership business models.
4. Social Infrastructure:
   - Educating and enhancing the capabilities of various stakeholders.
   - Raising public awareness about the benefits of EVs.

Right policy support and faster decision-making can help in fostering collaborations across stakeholders in the EV ecosystem including government bodies, private enterprises, and international partners which shall drive innovation and investment, requisite for development of infrastructure that keeps pace with the growing demand for EVs. Only then, India can significantly advance its EV adoption, reduce its oil import bill, and lower CO2 emissions, contributing to a more sustainable future.

1. India to become USD 4 trillion economy in FY25, The Economic Times, May 2024
2. Indian auto industry poised to reach USD 300 Billion by 2026, The Economic Times, April 2024


Charger

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India's EV decade

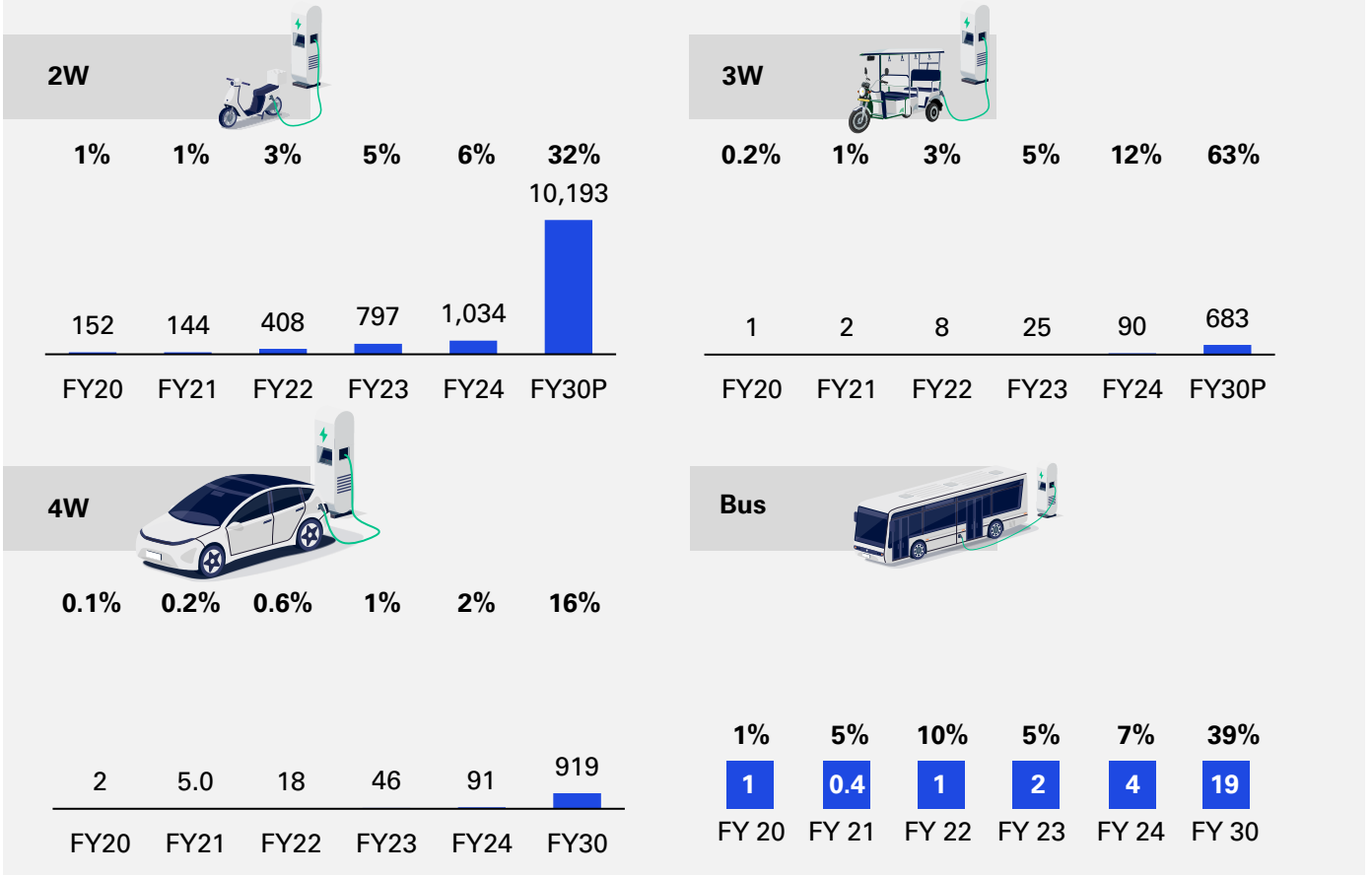
A decade of transition in mobility

Indian economy is on path to surpass the USD 5 tn mark in just three years from USD 3.7 tn at present and emerge as the third largest economy. India took over 15 years to achieve the USD 1 tn mark post 1991 liberalization and seven years each to achieve the USD 2 tn and the USD 3 tn mark[1]. This renewed growth and path to economic dominance is synonymous with the Indian Automotive Industry. India is currently the largest manufacturer of two wheelers and fourth largest manufacturer of passenger vehicles, with over 21 mn units and over 4 mn units produced annually[2].

While Automotive Industry is the testament of India's economic growth, the proliferation of vehicles on Indian roads has resulted in burgeoning of the import bill as well as the CO2 emissions. India's oil import bill has been consistently around USD 100 bn over the last three years[3]. Road transportation today accounts for over 12% of India's total CO2 emissions, with 0.2 t CO2 per capita contribution[4]. So far, lightweighting initiatives from supply side along with regulatory mandates on fuel efficiency and ethanol blending have been the key mitigating levers. However, Electric Vehicles (EVs) present the permanent solution, given India's economy wide net-zero targets and commitment to COP26 for 100% transition towards zero emission vehicles by 2040[5].

In last four to five years, EVs in India have witnessed rapid adoption. The total electric vehicle sales reached 1.2 mn mark and achieved 5% penetration[a] in FY24. Further, multiple vehicle categories are beginning to reach high single digit penetration this year[6]. Many factors such as policy support, total cost of ownership parity, start-up ecosystem, and technology access are aiding the growth. In addition, India has set the ambitious target of 30% penetration[a] by 2030 as part of EV30@30 campaign[7].

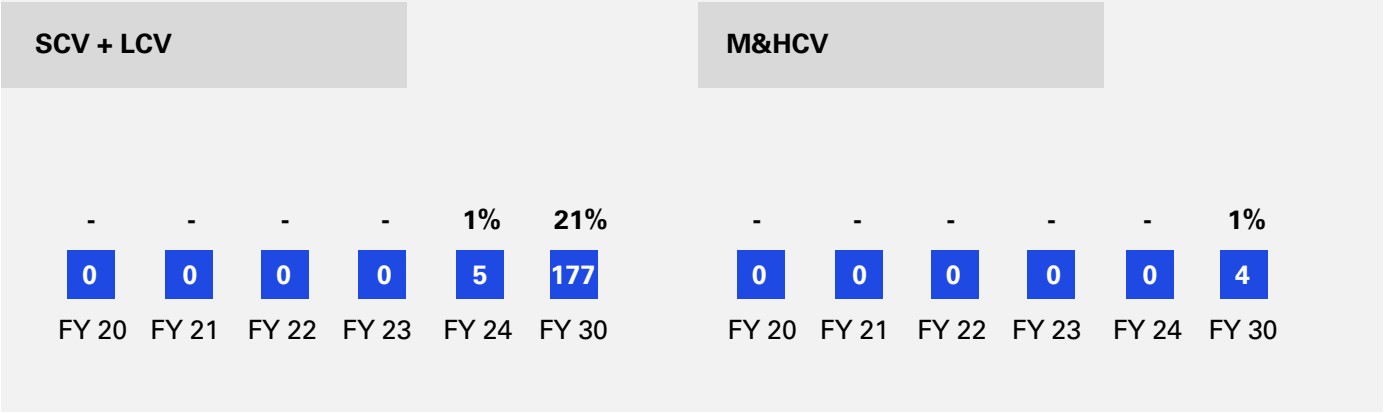
Fig. 1.1 Historical and target EV sales ('000 units and penetration in %)[6]



Note: a. Refers to total electric vehicle sales against total vehicle sales across all categories

1. India to become USD 4 trillion economy in FY25, The Economic Times, May 2024
2. Indian auto industry poised to reach USD 300 Billion by 2026, The Economic Times, April 2024
3. India's oil import bill could swell to USD 101-104 bn in FY25, The Economic Times, April 2024
4. Towards decarbonizing transport, Agora Verkehrswende and NITI Aayog, July 2023
5. India needs Zero Emission Vehicle mandate, Down to Earth, September 2023
6. KPMG Analysis
7. NITI Aayog convenes India's electric mobility enablers under G20 presidency, PIB, July 2023

Fig. 1.1 Historical and target EV sales ('000 units and penetration in %)[1]



The growth of Indian EV market is currently being aided by four key factors:

- **Policy support:** Faster Adoption and Manufacturing of Electric Vehicles (FAME) Scheme successfully incentivized the demand-side, particularly in 2W category. The scheme provided upfront reduction in the purchasing cost to customers and the reduction was then reimbursed to OEMs. The scheme was implemented for five years beginning April 2019 and INR ~7,000 Cr have been re-imbursed to OEMs till March 20242. A new Scheme - PM E-Drive launched in September 2024 has now replaced FAME Scheme. This scheme has planned outlay of INR 10,900 Cr for next two years, including demand incentives for electric 2W, 3W, buses, etc., development of charging infrastructure, and upgradation of testing facilities. Further, two additional measures are also incentivizing the demand-side:
  - GST reduction from 18% to 5% on both electric vehicles and chargers in 2019[3].
  - Ministry of Road Transport and Highways (MoRTH) advisory to states on minimizing the road tax on EVs in 2019, thereafter multiple states completely exempted the road tax[3].

Fig. 1.2 FAME Scheme outlay from April 2019 to March 2024[2]

EV category	Incentive paid (INR Cr)
2W	4,376
3W	846
4W	399
Bus[a]	1,322

- **Total Cost of Ownership (TCO) parity:** While policy support has helped in lowering the EVs upfront cost, EVs today have become affordable compared to ICE vehicles when evaluated in TCO terms. This means lower operating costs, costs related to deploying, using, or retiring the vehicle, over its lifetime. Further, higher daily usage and increasing fuel prices are also strengthening the EV case.

Fig. 1.3 TCO comparison (INR Lacs) between EVs and ICE vehicles[4]

2W			3W		
ICE TCO	EV TCO	Savings	ICE TCO	EV TCO	Savings
3.7	2.1 (40-50 Kms)[b]	43%	14	10 (60-70 kms)[b]	27%

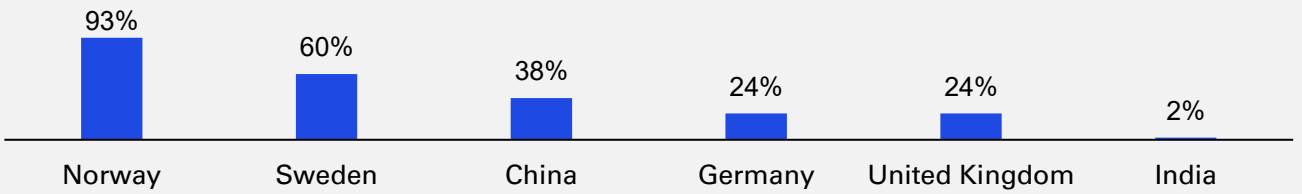
4W			Bus		
ICE TCO	EV TCO	Savings	ICE TCO	EV TCO	Savings
22 (CNG)	21 (170 Kms)[b]	5%	510	440 (127 Kms)[b]	13%

Note: a. Subsidy amount released to State Transport Units b. Minimum Kms required to be travelled per day

1. KPMG Analysis
2. Subsidy to electric vehicle manufacturers under FAME Scheme, PIB, July 2024
3. Evaluation of electric vehicles policy, Lok Sabha Committee of Estimates, March 2023
4. Technology at the forefront of electric vehicles, KPMG India and CII, April 2023

- **Start-up ecosystem:** There are approx. 400 start-ups in India across the EV value chain, including OEMs, fleet operators, battery producers, battery re-cyclers, charge point operators, and financing/ insurance providers[1]. Many start-ups are gaining relevance due to their ability to adapt as per regulatory mandates, evolve with customer feedback, or commercialize newer technologies.
- **Technology access:** Multiple auto-components suppliers have developed capability to manufacture battery pack, battery management system, on-board and off-board charger, and power electronics such as DC-DC converter, bus bar, and power distribution unit. Recent deals activity also points towards increasing technology access. Multiple traditional auto-components suppliers have opted for targeted and smaller bolt-on acquisitions of start-ups to acquire technical and design capabilities required for manufacturing EV components[2].

Fig. 1.4 Share of new cars sold that are electric, 2023[3,a]



Similar growth factors have been witnessed in countries such as Norway, Sweden, China, Germany, and United Kingdom. All these countries have achieved sizeable EV penetration in the recent past. It is evident that India has done well on policy support, TCO parity, start-up ecosystem, and technology access. Learnings from these countries suggest, India is yet to make substantial progress in developing EV Infrastructure. The renewed focus on different aspects of infrastructure required will further propel the EV penetration and make this a decade of transition in mobility for India.

Note: a. Electric cars include fully battery-electric and plug-in hybrids

1. E-Amrit NITI Aayog website accessed in August 2024
2. Auto industry sees 24 deals at USD 357 in Q4 2023, The Sunday Guardian, April 2024
3. Tracking global data on electric vehicles, Our World in Data, April 2024

Fig. 1.5 Infrastructure related focus areas for EV growth in India[1]

Physical infrastructure	Common standards for charger connectors	Right locations for new charging stations	Upfront cost reduction in setting up stations	Li-ion battery recycling capacity build-up
Power infrastructure	Augmentation of distribution assets	On-grid solar charging stations	Green Energy Open Access Rules, 2022 adoption	
Economic infrastructure	Parity in GST structure	Affordable financing		
Social infrastructure	Trainings and skill development	Marketing campaigns	Supporting incentives	

1. KPMG Analysis

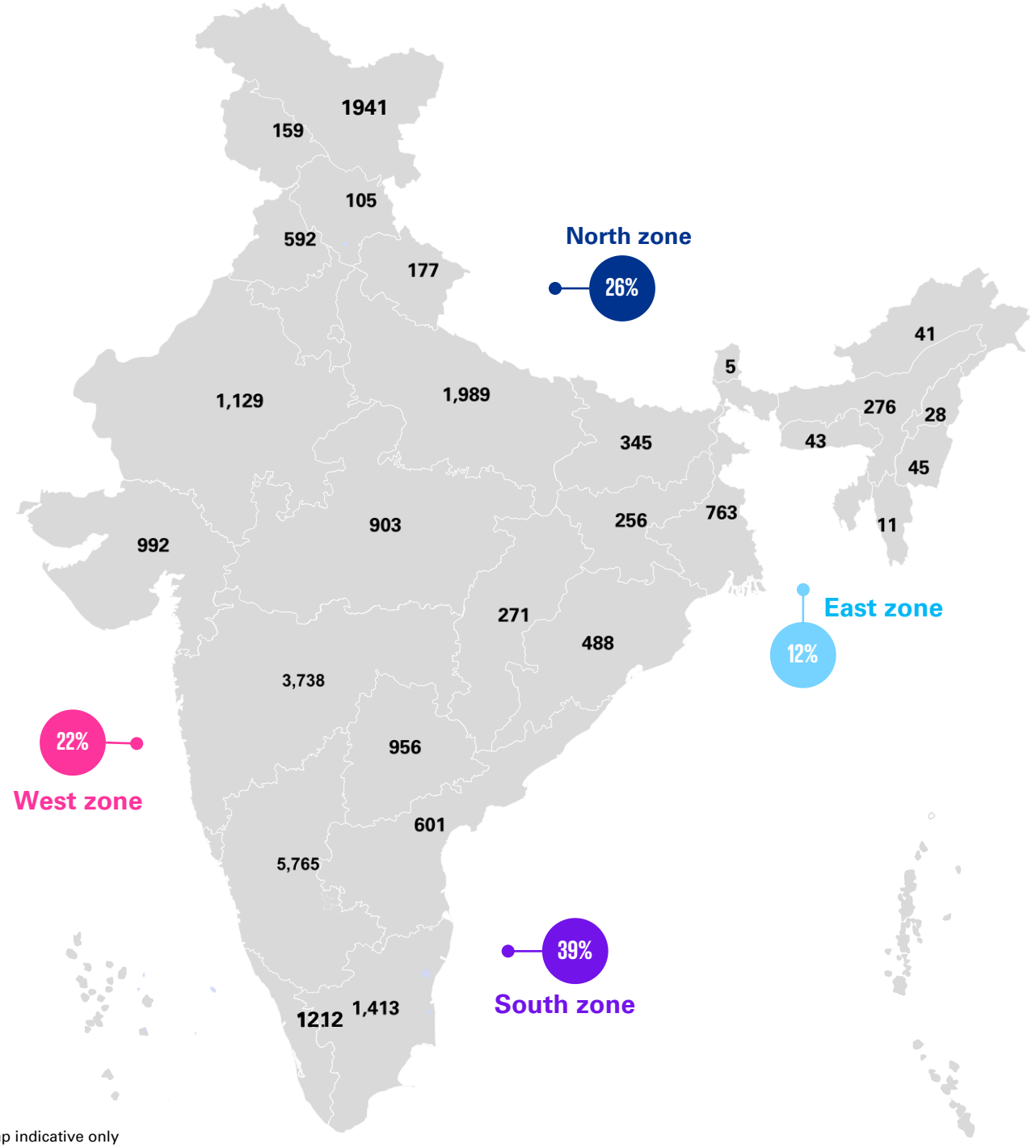
02 a

Physical infrastructure

Need for faster decision making

The EV charging infrastructure has gained momentum over the last 2-3 years with increasing private participation and government policies. There are currently c.25k registered public chargers in India. The distribution of these chargers are uneven with major concentration in large cities/ metros and that too within the confines of the city limits

Fig. 2.1 Registered public stations in India[1]

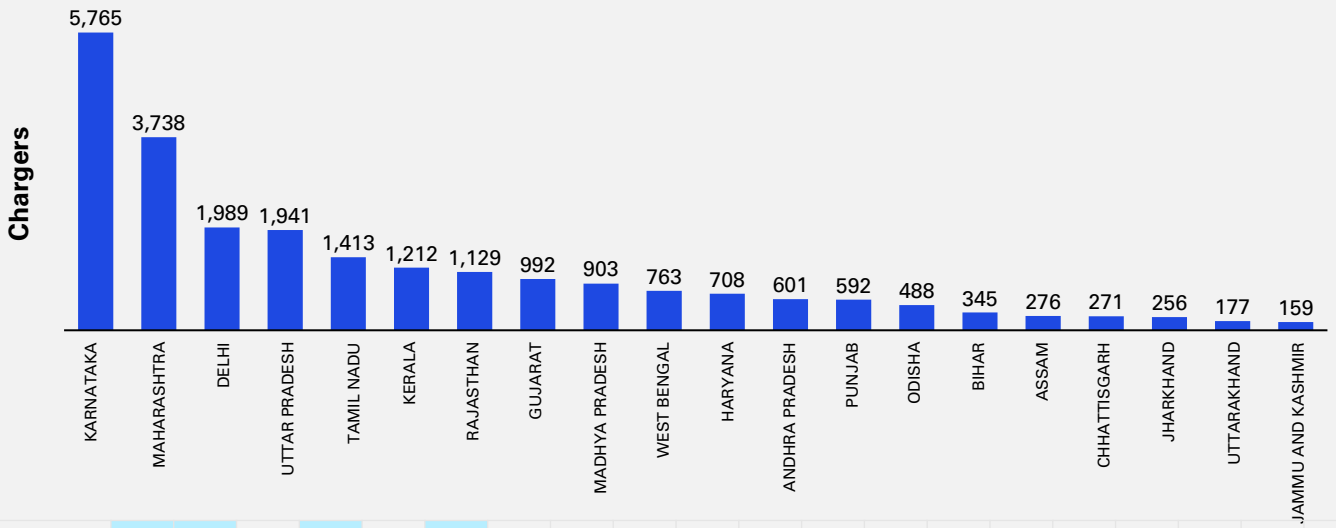


*Map indicative only

Of the top 20 states/ UTs with more than c.50k PV sales (1), Top 4 states/ UTs with highest EV penetration have more than c.1000 charging stations indicating the criticality of charging infra to support EV penetration.

1. Bureau of Energy Efficiency, Ministry of Power
2. Vahaan Dashboard website accessed in August 2024
3. KPMG Analysis

Fig. 2.2 Registered public stations in India[1,2,3]



Penetration	4.3%	3.0%	1.3%	4.3%	2.5%	5.3%	2.5%	2.0%	1.1%	2.7%	1.0%	2.0%	0.7%	2.3%	0.9%	0.4%	2.9%	0.8%	1.0%	0.3%
Rank	3	4	12	2	7	1	8	10	13	6	14	11	18	9	16	19	5	17	15	20

Globally as well, countries such as Norway and China have seen faster adoption of EVs with better charging infrastructure[4,5]

Norway Case Study

- Norway started providing 100% subsidy for public charger installation in 2009-10
- By 2015, Norway had 10,000 charging stations
- Currently, Norway comprises 1% of EU's population, however, has 8% of EU's public charging stations
- Public charger availability along with favorable EV policies has led to EV penetration of >70% in Norway

China Case Study

- China has a Charger to EV ratio (1:7); which is the currently the best
- Government subsidies for construction and preferential utility rates for charging operators; allow for faster breakeven for the charging operator
- China has 16% EV 4W penetration, highest amongst major economies

- An analysis by World Bank indicates that investing in charging infrastructure is 4x more effective in EV adoption than providing EV purchase subsidies
- Subsidies and favorable policies for EV chargers have driven public installations

1. Bureau of Energy Efficiency, Ministry of Power
2. Vahaan Dashboard website accessed in August 2024
3. KPMG Analysis
4. Charging infrastructure experiences in Norway - the worlds most advanced EV market, EVS30 Symposium
5. Trends in charging infrastructure, IEA
6. If you build it, they will come: Lessons from the first electric vehicles, World Bank, December 2021

Therefore, charging infrastructure is foundational to the EV market and its development in India needs to keep pace with the EV adoption. India has c.10 4W EVs per charging station at present, mostly concentrated within the confines of select cities and having limited presence on expressways or highways. While there is no optimal ratio when countries with sizable EV penetration are evaluated, as this ratio depends on local factors – EVs category mix, vehicle running patterns, quality of roads, terrain, etc. It is recommended that this ratio needs to be maintained at less than 20 EVs per charging station (EU proposed the Alternate Fuel Infrastructure Directive (AFID) in 2014 and recommended a long-term target EV : Charge point of 10:1) and spread uniformly between cities as well as highways and expressways[1,4].

There are two key reasons for the slow development of charging infrastructure thus far:

- **Unfavorable unit economics:** Charging stations require significant investment. It is estimated that INR 15 - 20 Lacs are required for setting-up a 60 KW charging station with two charging guns[2]. This includes cost of equipment plus upstream infrastructure like transformer and electricity connection and excludes cost related to real estate and civil works. At the same time, Charge Point Operators (CPOs) are witnessing average utilization in low single digit, which restricts the revenue generation. High investment and low utilization result in unfavorable unit economics for CPOs, deterring them from rapid expansion.
- **Non-standardization of chargers:** Charger connectors used to charge EVs are market driven. As a result, six different connectors are commonly witnessed at charging stations. The earliest charging stations established in major cities had Bharat DC-001 standard and this was in line with EVs being launched at that time. The passenger EV OEMs afterwards shifted to Combined Charging System (CCS) standard, while Bharat DC-001 standard is still primary standard among cargo EV OEMs. The 2W and 3W EV OEMs continue to produce models with different standards. At the same time, CPOs established stations with charging guns of multiple combinations, including the standards which are not relevant to EVs being sold, example being CHArgedeMOve (CHAdeMo). All this mismatch has led to some hardware incompatibility between OEMs and CPOs, adversely affecting utilization rate across charging stations as well as experience of EV owners as they have no guarantee if a specific charging station will have the required connector for their EV.
- Further, unavailability of a unified platform to identify and access charging stations across CPOs aggravates the experience of EV owners.

Fig. 2.3 List of charger connectors prevalent in India[3]

Charger type	#	Charger connectors	Rated output voltage	EV category
Fast	1	Combined Charging System (CCS) (min 50 kW)	200 - 750 or higher	4W
	2	CHArgedeMOve (CHAdeMO) (min 50 kW)	200 - 500 or higher	4W
	3	Type-2 AC (min 22 kW)	380 - 415	4W, 3W, 2W
Slow	4	Bharat DC-001 (15 kW)	48	4W, 3W, 2W
	5	Bharat DC-001 (15 kW)	72 or higher	4W
	6	Bharat AC-001 (10 kW)	230	4W, 3W, 2W

1. KPMG Analysis
2. Why India's EV charging infra is a mess, Fortune India, September 2023
3. Amendment in the revised consolidated guidelines and standards regarding charging infrastructure for electric vehicles, Ministry of Power Government of India, April 2023
4. Directive 2014/94/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 October 2014 on the deployment of alternative fuels infrastructure, Official Journal of the European Union

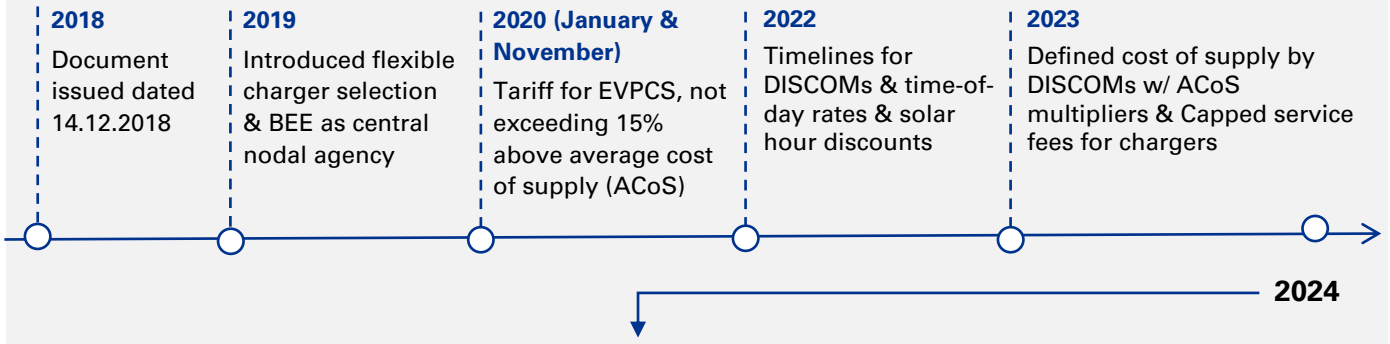
Central and various State Government officials are taking concerted efforts to address the challenges faced by members of EV charging ecosystem.

Central Government laid out public charging infrastructure guidelines in December 2018 and has come up with 6th revision in June 2024 to increase charger footprint across the country and increase adoption of EVs

There are seven key focus areas covered in the guidelines[1,2,3]:

- **Land parcel via revenue sharing model:**
  - Government or public entities to provide land at subsidized rates to private operators.
  - Land-owning agency to get a share of revenue for a 10-year period based on electricity consumed
- **Low Electricity Cost:**
  - Tariff for supply of electricity to EV Charging Station not to exceed 'Average Cost of Supply (ACoS)' till March 2028
  - Distribution licensee to charge 0.7x ACoS during solar hours (9am to 4pm) and 1.3x ACoS in non-solar hours until March 2028
- **Minimum density of Charging Station:**
  - Mandate of at least 1 charging station in 1 km x 1 km grid in urban areas & every 20 kms for highways by 2030
  - Charging stations at every 100 km for long-range and heavy-duty vehicles like buses & trucks
- **Electricity connection timelines**
  - CPOs can apply for electricity connections under specific timelines
  - Connection to be provided within 7 days for metros and within 30 days for rural areas
- **Service charges for EV charging stations**
  - Ceiling has been introduced on CPO's service charges, capping it to INR 3-4 for AC chargers and INR 11-13 for DC chargers. This limit is applicable till March 2028.
- **Technical Specifications**
  - Standardized open communication protocols to be used, such as the Open Charge Point Protocol (OCPP).
  - This would enable real-time monitoring, booking & payment options for consistent user-friendly experience
- **Public EV Charging Station database**
  - Bureau of Energy Efficiency (BEE) to create and maintain a national online database
  - Create web portal, Mobile application of all Public charging stations

Fig. 2.4 Timeline of Charging infrastructure guideline



Bureau of Energy Efficiency (BEE) June 28, 2024 issued the revised Guidelines (6th Revision post December, 2018) and Standards for Electric Vehicle Charging Infrastructure

1. Bureau of Energy Efficiency, Ministry of Power
2. Press Information Bureau
3. KPMG Analysis

Several state government have come up with policies to offer:

- Capital subsidies on charger equipment and installation cost
- Preferential electricity tariffs to CPOs
- Tax rebates
- Facilitate land allocation

Fig. 2.5 State Governments EV charging Infrastructure policy[1,2]

State Govt. EV Charging Infrastructure policy

Punjab (FY28)

- Technology agnostic approach for battery swapping and charging points

Subsidy of INR 3000/CP for first 8k level 1 light EV AC CPs and INR 10k/ CP for first 2000 DC CPs

Favorable electricity tariff

Delhi (FY25)

100% grant for charging equipment (up to ₹6,000/ charging point) for first 30,000 private charging points

100% SGST on DC fast chargers

Gujarat (FY25)

25% capital subsidy on 250 commercial PCS

EV charging w/ existing connection & tariff

Maharashtra (FY25)

- 2,400 chargers in 6 major cities & 50 PCS / Mn. population

50% capital subsidy on 500 fast and 60% for first 15k slow chargers

Favorable electricity tariff

Karnataka (FY25)

25% capital subsidy on DC fast chargers on the first 100 for 2W/3W, first 50 for cars and first 50 for buses & Zero wheeling charges for EV charging stations

Kerala

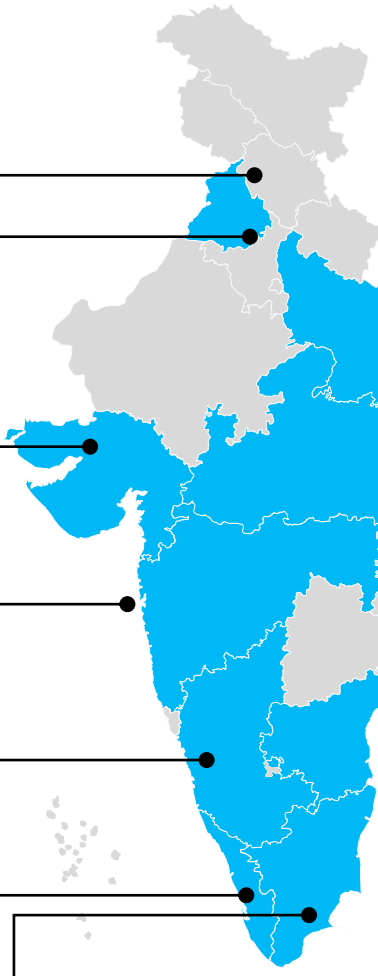
25% capital subsidy on first 100 fast chargers and first 300 slow chargers

Priority electricity connection to public charging stations

Tamil Nadu (FY28)

Green tariff gives additional 10% over the HT category's respective tariffs.

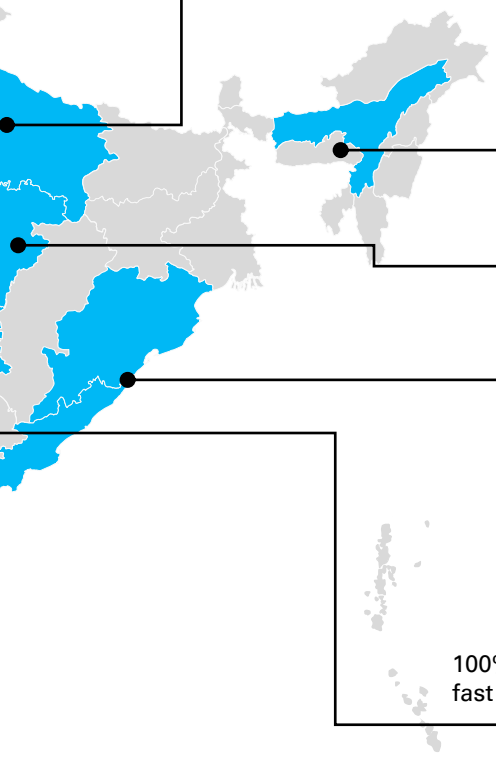
Reduction of Energy charges by 50% between 8 AM to 4 PM : charging during non-peak hours



*Map indicative only

Note: Capital investment subsidies are subject to case-by-case basis, typically allocated in initial phases of state policies on a time-bound or first-come, first-served basis and subject to budget allocation and fund availability at local level.

1. State Government websites
2. KPMG Analysis



Uttar Pradesh (FY30)

Govt. to facilitate land to service providers for EVCS

- Mandatory charging infrastructure at Commercial and residential complexes

20% capital subsidy on upto INR 10 lakhs for 2000 charging stations

Assam (FY26)

100% electricity duty exemption for EVCS

25% capital subsidy up to 10 lakhs for first 500 stations

Madya Pradesh (FY26)

- Energy Operators (EOs) to be granted fixed capital subsidy

25% capital subsidy on the first 300 stations (small), first 100 stations (medium) and 100 stations (large)

Odisha (FY26)

25% capital subsidy for the first 500 charging stations

Grant of INR 5,000 for the first 20,000 private charging points

Andhra Pradesh (FY25)

100% SGST on DC fast chargers

- Public charging stations at Govt. commercial, parking spaces

DC chargers: 25% subsidy of equipment value & 25% capital investment for swapping stations

*Map indicative only

There is need for two key initiatives to support the development of charging infrastructure:

- **Standardization and right location:** It is estimated that 7-15% utilization is sufficient to achieve the viability for a charging station, factoring in aspects such as location and target vehicle mix[1]. While the utilization will increase from current low single digit with the growth in EV sales, this process can be further aided by:
  - Establishing common standards for connectors across vehicle categories. Delay in establishing such standards is preventing interoperability. Interoperability will allow existing charging stations to serve more EVs and help achieve higher utilization. This standardization will also improve the experience of EV owners and address their range anxiety to an extent.
  - Selecting right locations for new charging stations. The need for more charging stations is primarily concentrated in select urban centers, highways, and expressways. The guidelines from Government on charging infrastructure allow public entities to provide land to CPOs[2]. Besides this, there is a need to identify which land parcels of public entities will be suitable for setting-up charging stations and ensure utilization required for viability. As example, DISCOMs can evaluate their land housing substations in urban centers[3]; NHAI can evaluate land parcels near toll plazas at highways or expressways; and transport authorities can evaluate land at inter-state bus terminals, airports, etc. to enable charging facility for visitors, cabs, e-buses, etc. In addition, there is need to enable single window clearance and online / transparent approval for setting up CPO especially for highways and expressways.
  - Allowing private e-bus operators access to state transport undertaking depots for parking and charging basis pay per use model. Currently, private operators park buses on the roadside due to unavailability of overnight parking facilities. This cannot work in case of e-buses as they need to charge overnight for the next trip. Hence, such access is key to enable electrification in buses, given private sector accounts for over 80% of buses in the country[4].
- **Upfront cost reduction:** Public entities are allowed to provide land to CPOs on a revenue sharing model, through a bidding process with floor price of INR 1/kWh payment for land use[2]. This is a significant step in addressing unfavorable unit economics of charging stations. The unit economics can be further improved for CPOs if public entities can bear the cost of preparing the upstream infrastructure like transformer and electricity connection at the identified locations, particularly at highways or expressways where the cost to be incurred for such infrastructure will be significantly higher compared to locations in urban centers.

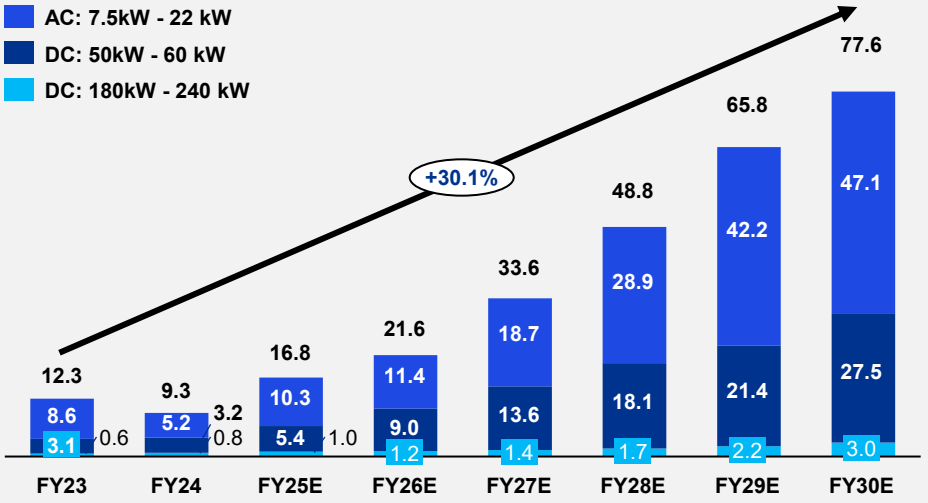
1. KPMG Analysis
2. Revised consolidated guidelines and standards for charging infrastructure, Ministry of Power, January 2022
3. EV perspectives of DISCOMs and stakeholders, Shakti Sustainable Energy Foundation and The Energy Resources Institute, May 2020
4. Electric mobility market assessment, business model, and action plan in India, The World Bank, June 2022

- Further, in addition to centralized database for EV chargers, there is a need for a unified app aggregating charging station data across CPOs available in the market. This will ensure
  - better access for customers
  - competitive charging fees
  - improved charger uptime
  - level playing field for upcoming CPOs in terms of visibility

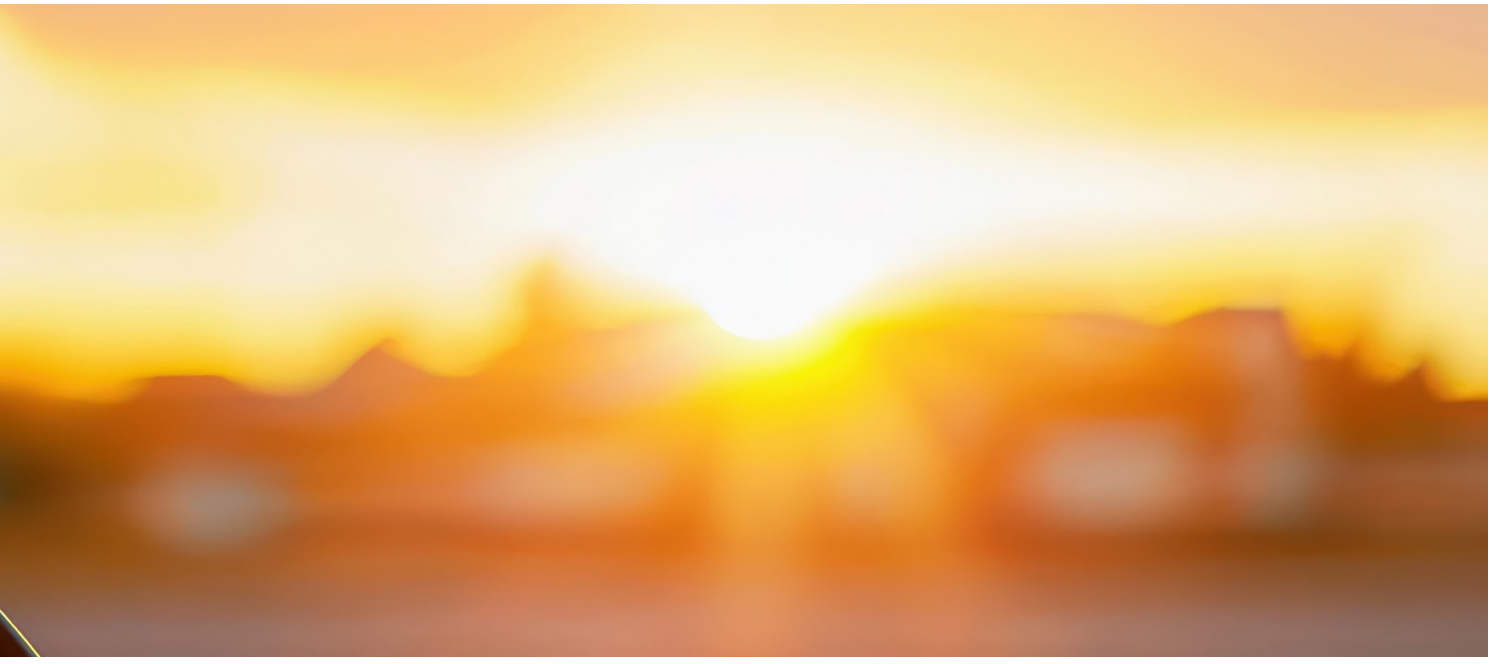
Overall, there is need for faster decision making in these directions to expand EV charging infrastructure in line with aspired EV penetration levels.

Annual deployment of public EV chargers are expected to increase to c.75k by FY30 to fulfill the requirement of EVs that shall ply on the road during the same time.

Fig. 2.6 Expected annual public charger deployment[1]



Charger	Vehicle
AC: 7.5 – 22 kW	• e4W • eLCV
DC: 50 – 60 kW	• e4W • eLCV
DC: 180 – 240 kW	• eBus



02 b

Physical infrastructure

Need for capacity build-up

The majority of 34,36,000 EVs on Indian roads have been in use from last three years[1,a]. This means li-ion batteries in these EVs still have five to eight years to reach their end of life, considering their average life span of five to eight years[2,4]. Thereafter, the volume of retired or spent li-ion batteries is expected to explode as EVs become mainstream. The disposal of such batteries in landfills can pose hazards to environment as well as human health. Some of these batteries can be re-conditioned for second life uses such as grid energy storage and others can be recycled to re-cover valuable metals such as lithium, cobalt, nickel, etc. as these metals constitute 50-60% of battery cost[2]. Most of these metals are not mined in India and their supply would help decrease import dependency of new cathode active material manufacturers and battery cell manufacturers which are in process of establishing their units in India.

Currently, there are few battery recyclers in India, having the total recycling capacity of 44 Kt or 2 GWh[3]. The li-ion batteries from EVs are expected to generate recycling volume of approx. 11 - 15 GWh by 2030[4]. This means battery recycling capacity needs to increase rapidly to manage the forthcoming surge of retired or spent li-ion batteries. Further, the minerals extracted from recycling could help meet c.10% of total mineral demand in 2030.

Fig. 2.7 Recycle potential (GWh) and quantity of material extracted (MT)[4,b]

Quantity of minerals extracted from 1 kWh of battery by chemistries (kg)

Mineral	NMC	LFP	LCO
Lithium	0.18	0.17	0.12
Cobalt	0.18	-	0.88
Nickel	0.59	-	-
Manganese	0.18	-	-
Copper	0.65	0.95	0.65
Titanium	-	-	-
Aluminium	1.12	1.64	1.00
Other materials	3.00	5.94	3.24

FY30			% met from recycling
Lithium (Li)	=	c. 1,500 MT	10%
Cobalt (Co)	=	c. 3,200 MT	15%
Nickel (Ni)	=	c. 2,650 MT	8%
Manganese (Mn)	=	c. 700 MT	8%
Copper (Cu)	=	c. 7,000 MT	10%
Titanium (Ti)	=	c. 3,000 MT	8%
Aluminum (Al)	=	c. 11,500 MT	10%
Other materials	=	c. 33,000 MT	10%

Note: a. Sales summation of EVs (including e-buses) from CY14 to CY23 b. Battery chemistries shown include NMC (Lithium Nickel Manganese Cobalt), LFP (lithium iron phosphate), and LCO (Lithium Cobalt Oxide)

1. Vahaan Dashboard website accessed in August 2024
2. Recycling of EV batteries in India: What opportunity lies ahead?, Center for Study of Science, Technology and Policy, November 2021
3. Is India ready to recycle millions of end-of-life EV batteries? The Economic Times, August 2024
4. KPMG Analysis

The battery recycling capacity build-up can be supported in following ways:

Battery recycling is a capital-intensive business, requiring INR 1 - 1.5 lac for 1 t of capacity3. Awareness about current schemes, including capital subsidy of 25% for a new recycler and import duty reimbursement on capital equipment, needs to be increased.

Government needs to identify industrial zones closer to EV demand hubs across states and invite businesses for setting-up new recycling units with assurance of single window clearance.

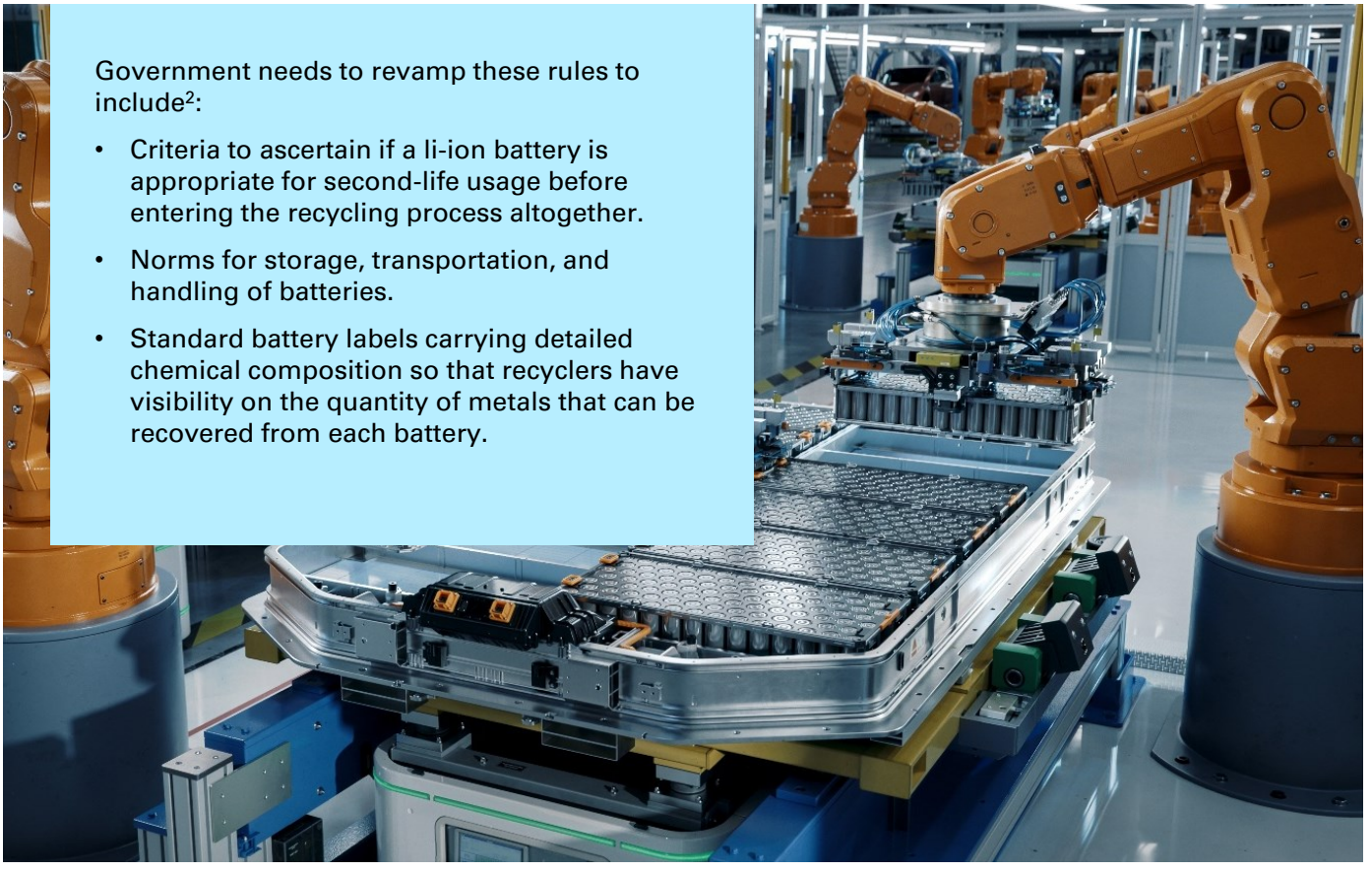
The Battery Waste Management Rules mandate Extended Producer Responsibility (EPR) for battery producers to collect li-ion batteries either directly or via third parties, ensure recycling via authorized recyclers, and use recycled material in production.

Fig. 2.8 Recycled material use mandate for battery producers[1]

	FY28	FY29	FY30	FY31 onwards
Minimum % of recycled material in the total dry weight of battery	5%	10%	15%	20%

Government needs to revamp these rules to include[2]:

- Criteria to ascertain if a li-ion battery is appropriate for second-life usage before entering the recycling process altogether.
- Norms for storage, transportation, and handling of batteries.
- Standard battery labels carrying detailed chemical composition so that recyclers have visibility on the quantity of metals that can be recovered from each battery.



1. Battery Waste Management (Amendment) Rules, 2024, Ministry of Environment, Forest, and Climate Change, March 2024
2. Battery recycling rules need to be revamped to make process more efficient and economic, Down To Earth, November 2023

03

Power infrastructure

Need for augmentation and green energy

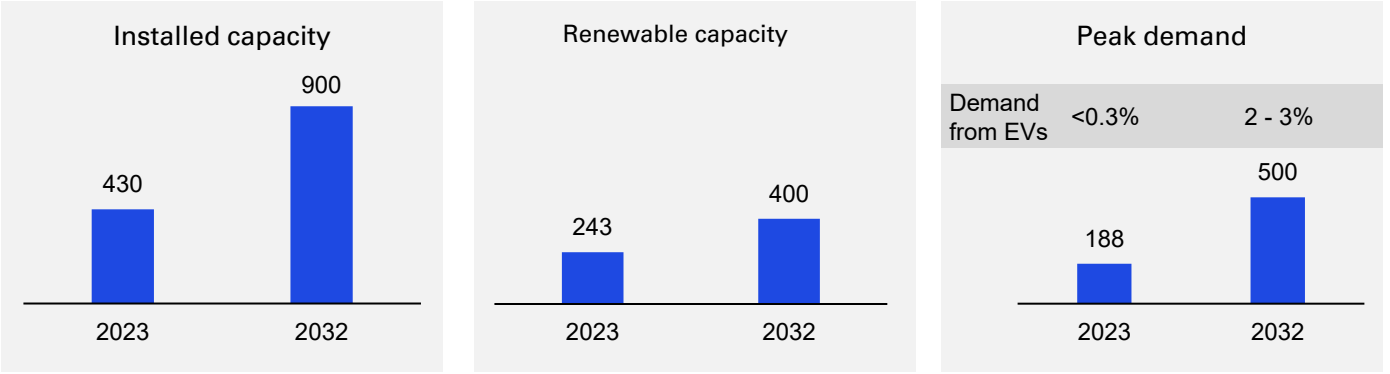
India currently has installed power capacity of approx. 430 GW. In the recent past, Government has taken multiple steps to revamp the power infrastructure[1]:

Operational improvements: This includes unification of grid, developing renewable energy parks, and reduction in aggregate technical and commercial losses.

Capacity addition: Currently, 156 GW capacity is under construction, and it is anticipated that in total 470 GW capacity will be added by 2032.

While capacity addition is underway, the electricity demand is also expected to witness sharp growth. India's peak demand is estimated to reach 370 GW by 2030 from 243 GW at present[2]. However, there is comfortable buffer between the installed capacity and demand. Further, it is estimated that 5 - 8 GW electricity would be required for charging EVs in 30% penetration scenario. This demand accounts for only 1 - 2% of total demand in 2030[3]. Therefore, it can be concluded that any sudden increase in the electricity demand due to EVs can be easily met.

Fig. 3.1 Current and projected power capacity (GW) and peak demand (GW)[1,2,3]



The concern with respect to EVs electricity demand is driven by increasing focus on developing charging stations with fast chargers, targeting 4W EVs.

- Sudden and simultaneous charging across such stations may cause technical challenges such as phase imbalances and issues related to power quality, voltage fluctuations, harmonics, etc. in the distribution networks[4].
- These technical challenges affect distribution assets such as transformers, capacitors, etc. DISCOMs will have to study the roll-out of public charging infrastructure in urban centers to identify which wards requires augmentation of distribution infrastructure with smart grid technologies/ storage solutions.

The electricity that is currently being used to charge EVs is derived from both renewable and non-renewable sources. It is also evident that non-renewable energy sources such as coal, lignite, gas, etc. will continue to be key source of electricity generation for the foreseeable future, considering current and planned renewable capacity. This also means that mobility in India is partly transitioning from petrol or diesel to coal, lignite, gas, etc.

- There is need to promote the development of on-grid solar charging stations.
- The adoption of renewable energy can be facilitated by the Green Energy Open Access Rules, 2022 at least among industrial and commercial consumers[5]. Its adoption across states, including application among fleet owners operating captive charging stations would further promote green mobility in India.

1. 28.8 GW power capacity added during March 2022 to December 2023, Ministry of Power, February 2024
2. India's power capacity expansion to 900 GW, ET Energy World, January 2024
3. KPMG Analysis
4. EV perspectives of DISCOMs and stakeholders, Shakti Sustainable Energy Foundation and The Energy Resources Institute, May 2020
5. Green Energy Open Access: Empowering Consumers With Clean Electricity, ET Energy World, March 2024

04

Economic infrastructure

Need for parity and affordability

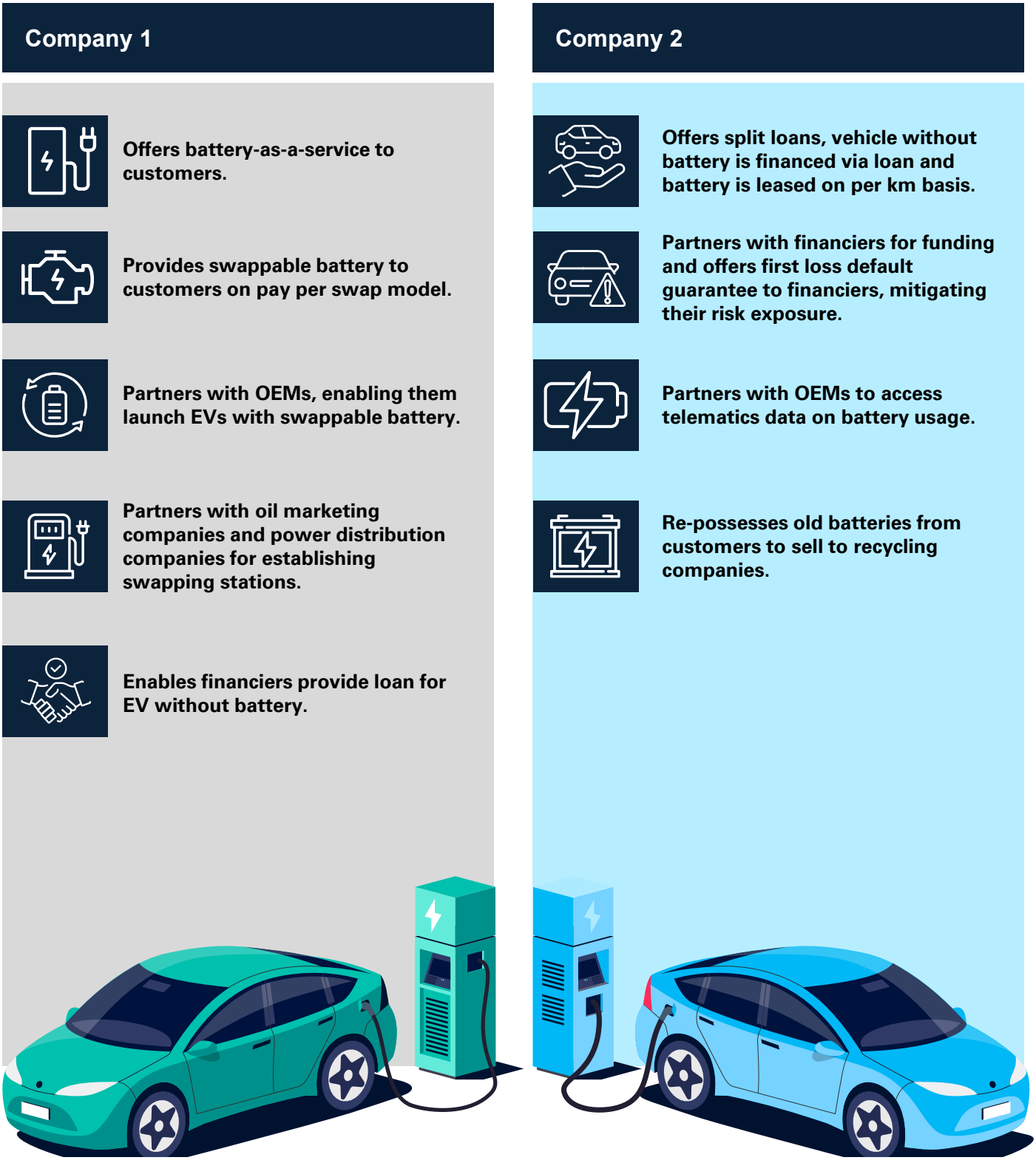
Taxation and financing are key influencers in the large-scale adoption of EVs. While there is inverted duty structure at present in EVs, there are also limited and unfavorable financing options available in case of EVs when compared to ICE vehicles. Hence, there is need for two key initiatives:

- **Parity in GST structure:** GST on EV components currently ranges between 18 to 28% whereas it is 5% for EVs[1]. The consistent 5% GST structure across EV components and EVs will help address three key issues:
  - The disparity in input and output tax is resulting in working capital blockage for OEMs, as they have to wait for obtaining refund for additional tax paid as per input tax credit under GST[2,3].
  - Current structure inadvertently disincentives battery-as-a-service and battery leasing businesses, given they have to pay 18% GST for standalone battery compared to 5% for battery with EV[4].
  - Replacement batteries become costlier for EV owners.
- **Affordable financing:** The current EV financing is primarily driven by few NBFCs, with some participation from banks. In addition to this, the loan terms available on EVs are not on-par when compared to loan terms available on ICE vehicles. EV owners are currently paying significantly higher initial down-payment due to 30-45% higher upfront cost with respect to comparative ICE models and 10-25% lower loan-to-value offered5. EMI burden is also higher due to 10-24 months shorter loan duration and 1-8% higher interest rate[5]. Government can encourage affordable financing by:
  - Adding EVs to priority sector lending list for banks[6]. Public sector banks can first take lead in helping PSUs transition their fleets to EVs. This will allow public banks necessary exposure before venturing into EV financing.
  - Promoting partnerships between financiers and new-age companies.
    - Financiers currently face difficulty in underwriting loans because EV resale market is yet to develop. Further, they have limited knowledge of battery technology, which accounts for 40-50% of EV cost[4], as well as impact of vehicle running pattern, temperature, and quality of road on the battery life.
    - New-age companies are involved in leasing battery or offering battery-as-a-service to customers. Partnerships with companies can help financiers de-link the battery cost from the EV cost. This would mitigate asset risk for financiers and also improve loan terms for the customers.
  - Supporting new-age companies involved in battery-as-a-service and battery leasing with favorable taxation as well as relaxed investment norms.

Note: a. Sales summation 4W EVs (including e-buses) from CY14 to CY23

1. EV charging stations operational across the country, PIB, February 2024
2. Vahaan Dashboard website accessed in August 2024
3. KPMG Analysis
4. Why India's EV charging infra is a mess, Fortune India, September 2023
5. Amendment in the revised consolidated guidelines and standards regarding charging infrastructure for electric vehicles, Ministry of Power Government of India, April 2023

Fig. 4.1 Business model of new-age companies helping to enable affordable financing[1]



1. KPMG Analysis

05

Social infrastructure

Need for right skills and perception

The transition to EVs is altering the automotive value chain:

- **Components manufacturing:** With new EV focused OEMs entering the market and traditional OEMs launching new EV models, the component's requirements are shifting. As an example, the powertrain of ICE vehicles requires engine, transmission, driveshaft, emission control, and exhaust system, while the powertrain of EVs requires battery pack, electric motor, and other components such as charger, converter, battery management system, and thermal management system[1].
- **After sales:** Elements such as repair and replacement will continue to be relevant, but the required frequency of these elements is lower in case of EVs. In addition, the technical know-how needed for servicing EVs is also higher due to the involvement of electronics driven components.
- **New entrants:** There are multiple new entrants to the value chain, including cathode active material manufactures, battery cell manufacturers, battery recyclers, power distribution companies, charging equipment suppliers, charge point operators, etc.

Considering these shifts, it is important to ensure that there are limited job losses by enabling transition towards new type of job opportunities. Hence, there is need for targeted trainings and skill development with respect to:

- **Operations and maintenance:** There is need to educate fleet drivers about best practices such as optimal battery charge levels, servicing required, avoiding deep discharge, and much more. There is also a need to educate traditional mechanics on how to repair and service EVs and EV charging stations[2].
  - Government can include EV related questions in the written test or give training on EV best practices during driving skills test, while issuing the driving license.
  - Government can reskill mechanics by including EV specific course as part of Jan Shikshan Sansthan Scheme.
- **Manufacturing:** OEMs and components manufacturers are addressing the skill gaps via on-the job training for their shopfloor workers, line engineers, and plant managers. Internal skill development is both expensive and requires time investment of up to six months.
  - Government can include EV specific courses across Industrial Training Institutes (ITIs) and incentivize the first-time hiring of students completing these courses.
  - It can also incentivize companies offering short-and-long-term internships in related areas.
- **R&D:** There is need to ensure talent development for niche jobs, with focus on R&D. This requires revamping engineering curriculums to include courses on battery technologies, battery chemicals, battery recycling, and much more.
  - Government can mandate universities for required course development and inclusions.
  - Allocation of budget by government universities on EV technologies

The perception with respect to EVs among public also requires enhancement. There is need to address concerns with respect to difference in cost of EVs and ICE vehicles, scope of re-sale in EVs, safety of batteries during summers, and much more. Government can leverage two key enablers:

- **Marketing Campaigns**: In 2021, Government had launched "Go-electric campaign" to educate public on EVs[3]. Similar initiatives or efforts are needed on sustained basis. They could highlight testimonials of EV owners and their travel to far-off locations via EVs, or introduce a website featuring benefits of using EVs, charging stations map, and virtual training on how to use charging stations.
- **Supporting incentives**: Countries with sizable EV penetration have actively offered supporting incentives, in addition to fiscal incentives, to influence new vehicle buyers' decision towards EVs. Some of the key examples include free parking, dedicated parking spots for EVs in busy locations, and toll tax exemption. Government can advise local authorities across states to consider similar incentives.

1. EV powertrain components, EV Reporter, October 2019
2. Investor perspectives on accelerating growth in the Indian EV ecosystem, Invest India and International Institute for Sustainable Development, August 2022
3. valuation of electric vehicles policy, Lok Sabha Committee of Estimates, March 2023

06

Way forward

Need for further policy changes

Learnings from the countries which have achieved significant EV penetration in the recent past suggest that EV infrastructure is crucial for EV adoption. This is also evident in India, where top four states with highest EV penetration i.e. Karnataka, Maharashtra, Delhi, and Kerala have more than 1,000 public charging stations. This clearly highlights the criticality of charging infrastructure. In addition, the World Bank also suggests that focus on infrastructure is 4x more effective in driving EV adoption compared to demand-side incentives. Therefore, there is need to enable the development of charging infrastructure through policy changes. This development also needs to be supported with simultaneous focus on other aspects of infrastructure which include power, economic, and social infrastructure.

This report highlights the policy related changes required across different aspects of infrastructure with an objective to further propel EV penetration:

- Physical infrastructure:
  - Establishing common standards for charger connectors across vehicle categories to enable interoperability
  - Enabling single window clearance and online / transparent approval for setting up CPO especially for highways and expressways
  - Allowing private e-bus operators access to state transport undertaking depots for parking and charging basis pay per use model
  - Making unit economics more favorable for CPOs by encouraging public entities to provide upstream infrastructure like transformer and electricity connection on apex rather than upfront cost
  - Building battery recycling capacity by increasing awareness about current schemes and identifying zones closer to EV hubs for setting-up new recycling units
  - Revamping Battery Waste Management Rules to include norms for storage, transportation, and handling of batteries along with standardisation of battery labels.
- Power infrastructure:
  - Augmenting distribution infrastructure in line with roll-out of public charging infrastructure for better load balancing and improving quality of power. Implementation of smart grid technologies and enhancing energy storage solutions can ensure stable power availability.
  - Promoting use of renewable energy sources with support to development of on-grid solar charging stations and encouraging states to adopt Green Energy Open Access Rules, 2022.
- Economic infrastructure:
  - Ensuring parity in GST structure for EV components and EVs
  - Adding EVs to priority sector lending list for banks
  - Supporting new-age companies involved in alternate vehicle ownership models such as battery-as-a-service/ battery leasing with favorable taxation as well as relaxed investment norms.
- Social infrastructure:
  - Educating and enhancing the capabilities of various stakeholders.
    - Adding EV topics in the test and training curriculum as part of driving license issuance
    - Reskilling mechanics by including EV specific course as part of skill development programs such as Jan Shikshan Sansthan Scheme
    - Adding EV specific courses across Industrial Training Institutes (ITIs) and incentivizing the first time hiring of students completing these courses
    - Incentivizing companies offering short and long-term internships in above areas
  - Investing in research for advanced EV technologies.
    - Mandating universities to revamp engineering curriculums to include courses on battery technologies, battery chemicals, battery recycling, etc.
    - Allocation of budget by government universities on EV technologies
  - Introducing marketing campaigns for use of EVs and providing supporting incentives such as toll exemption and free/reserved parking spots to EV owners.

Acknowledgements

We are sincerely grateful to the following people from the ecosystem who have helped in the preparation of this report.

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- Willson Anand
- Govinda Bhuwalka

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Printed in India. (017_THL1124_KP)