CRISIL
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Getting charged

Two and three-wheelers to spearhead electric vehicle adoption

Executive summary

India has committed to facilitating adoption of electric vehicles (EVs) so that they account for 30% of all new vehicle sales by 2030, in line with the global trend.

But is the ecosystem charged up to make that big leap?

An analysis by CRISIL Research shows that while the second instalment of the government's policy – Faster Adoption and Manufacturing of Electric Vehicles in India (FAME II) – and numerous efficiency and emission regulations have created the policy push for EVs, they will hit the roads slower than envisaged over the next five years.

What's more, adoption will vary across segments, with e-two- and three-wheelers continuing to hold pole position.

That's because the enabling ecosystem, so critical for the successful adoption of EVs in India, is not quite in place yet, while vehicle manufacturers have been slow to provide the supply-side push too. India is behind on the key global growth drivers for EV sales: battery prices and manufacturing, demand incentives and the charging infrastructure.

Unlike countries that manufacture lithium ion batteries and, hence, enjoy a cost advantage, battery prices in India continue to be at a premium. Hence, despite demand incentives, the cost of acquisition and operations of EVs will remain unfavourable for many vehicle categories, thereby constraining demand for the next five years.

The constraints on the supply side are that original equipment manufacturers (OEMs) are still grappling with a chicken-and-egg conundrum: will battery capacity come up at scale first and help reduce EV costs, or will EV volumes have to grow first. As a result, consumers do not have enough models to choose from as yet, and the public charging infrastructure is still to fall in place.

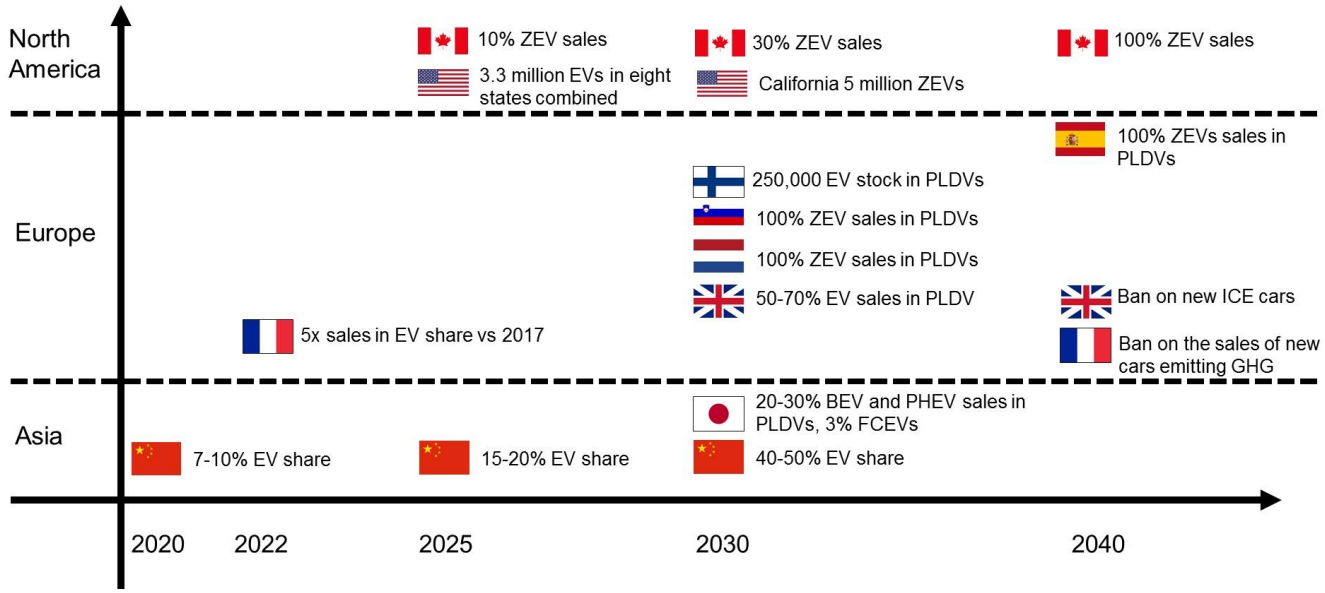
Therefore, execution of the government's EV policy roadmap – which encompasses everything from demand incentives to battery manufacturing capacity to charging infrastructure – holds the key to faster adoption of EVs in India. In the immediate term, the government could do well to action the phased manufacturing plan (PMP) to drive down battery prices and accelerate the development of the charging infrastructure.

CRISIL Research estimates that e-two- and three-wheelers, which already enjoy better cost economics compared with their internal combustion engine (ICE) counterparts, will continue to zoom ahead. By fiscal 2024, EV penetration is expected to improve to 12-17% of new vehicle sales for e-two-wheelers and a whopping 43-48% for e-autos. However, offtake of passenger cars for personal mobility will be subdued given poor cost economics and the lack of demand incentives under FAME II, though cab fleets will move up a gear. As for public mobility, while the cost economics will remain unfavourable for e-buses, government subsidies will ensure that they hit the road and set the ball – or shall we say, wheels – rolling. Hence, CRISIL Research believes that the gradual adoption of EVs will provide component manufacturers enough time to realign their operations over the next five years even as the low penetration levels will cushion the eventual reduction in service revenues for dealers.

The new rage in mobility

The future is electric, goes the refrain in the global automobile industry today. As the following diagram shows, many developed countries have set ambitious targets for adoption of EVs and even developing ones are fast waking up to the possibilities.

The road ahead: Developed nations and China set EV goals



Note: ZEV – Zero-emissions vehicle, PLDV - passenger light-duty vehicle, PHEV - plug-in hybrid vehicle, BEV – Battery electric vehicles, GHG – Greenhouse gas, ICE – Internal combustion engine

Source: IEA, CRISIL Research

As a member of the global forum, the Clean Energy Ministerial's EV30@30 campaign, India, too, has laid out an ambitious target of EVs accounting for 30% of new vehicle sales by 2030.

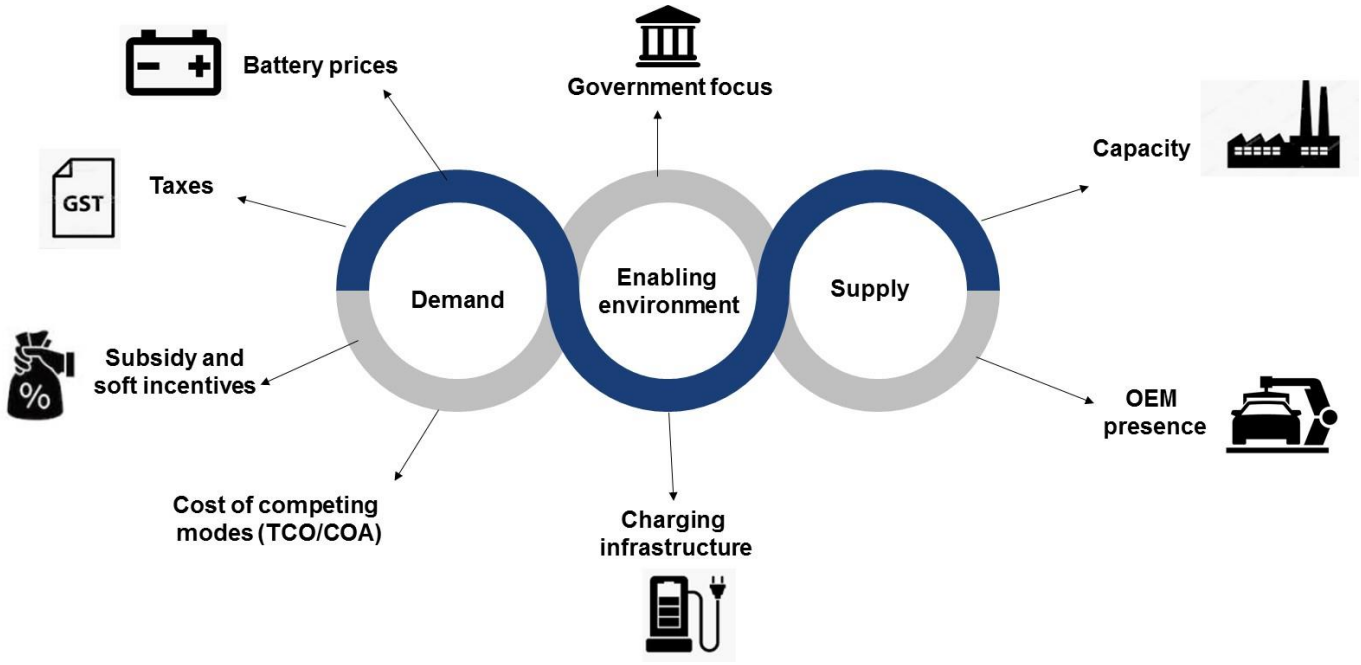
But while the policy has been switched on, is the sector energised enough and will consumers make the shift from ICE vehicles to EVs anytime soon? That is the big question before the industry today.

In India, EV adoption slow to catch up

A CRISIL Research study shows EV adoption is slowly on the rise in India and across automobile segments. However, barring two- and three-wheelers, EV penetration is expected to remain under 5% of new vehicle sales in the five years through fiscal 2024.

The study looked at the growth drivers, such as battery costs and government subsidies, as also the enabling environment in terms of the charging infrastructure and analysed the cost of acquisition (COA) and total cost of operation (TCO) of EVs compared with existing ICE vehicles across two- and three-wheeler, passenger car, light commercial vehicle and bus segments.

Framework of the study



Two- and three-wheelers to lead the charge

CRISIL Research believes two- and three-wheelers will be early adopters of EVs over the next five years because of better cost economics. This is despite the stringent requirements imposed under FAME II and the removal of subsidies on lead acid-powered e-two-wheelers.

EV penetration in FY2024

Vehicle Segment	EV Penetration	
	FY19	FY24 P
	0.1% (~3,600)	3-5% (1,76,000)
	0.6% (~126,000)	12-17% (35,00,000)
	0.5% (~500)	2-4% (~4,500)
LCV	0% (~100)	3-5% (~24,000)
E-auto	0.01% (~700)	43-48% (3,70,000)
E-rickshaw	(~4,50,000)	100% (8,75,000)

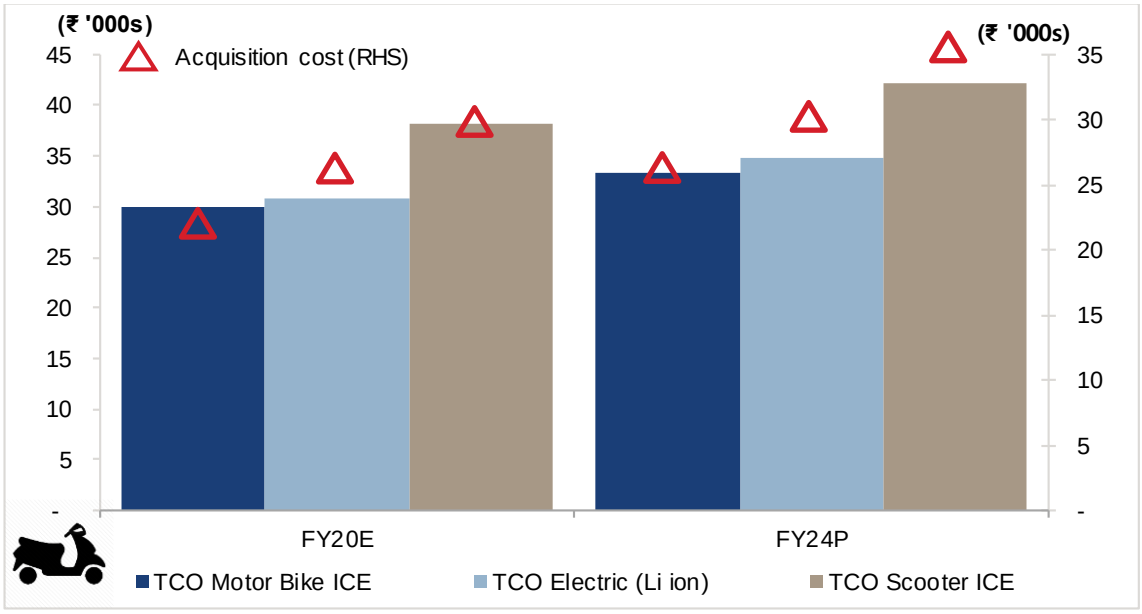
Source: CRISIL Research.

Note: Numbers in bracket are absolute volumes and % indicates penetration level

E-rickshaw are electric battery powered, four seater, low speed (speed limited to 25kmph) three wheelers while e-autos are three seater higher speed (typical maximum speed of ~60 kmph) three wheelers

Indeed, e-scooters are cheaper to operate compared with ICE scooters, while e-autos beat their ICE competitors on both acquisition and running costs. E-scooters, though, are less dependent than e-autos on public charging infrastructure, which is still limited in India.

E-scooters cheaper than ICE scooters but bikes more economical

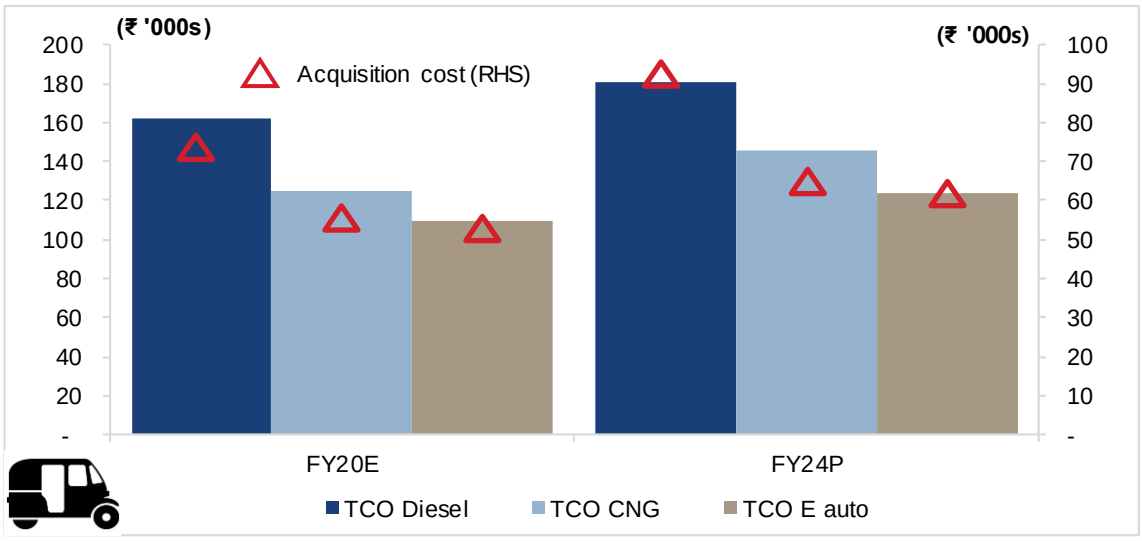


Source: CRISIL Research

Note: TCO Electric (Li ion) represents total cost of ownership for an E-Scooter

TCO - total cost of operation (includes EMI, depreciated battery replacement cost, fuel cost and annual permits); COA - cost of acquisition (includes down payment, registration charges and other one-time charges)

E-autos cheaper to own and operate



Source: CRISIL Research

Note: TCO - total cost of operation (includes EMI, depreciated battery replacement cost, fuel cost and annual permits); COA - cost of acquisition (includes down payment, registration charges and other one-time charges)

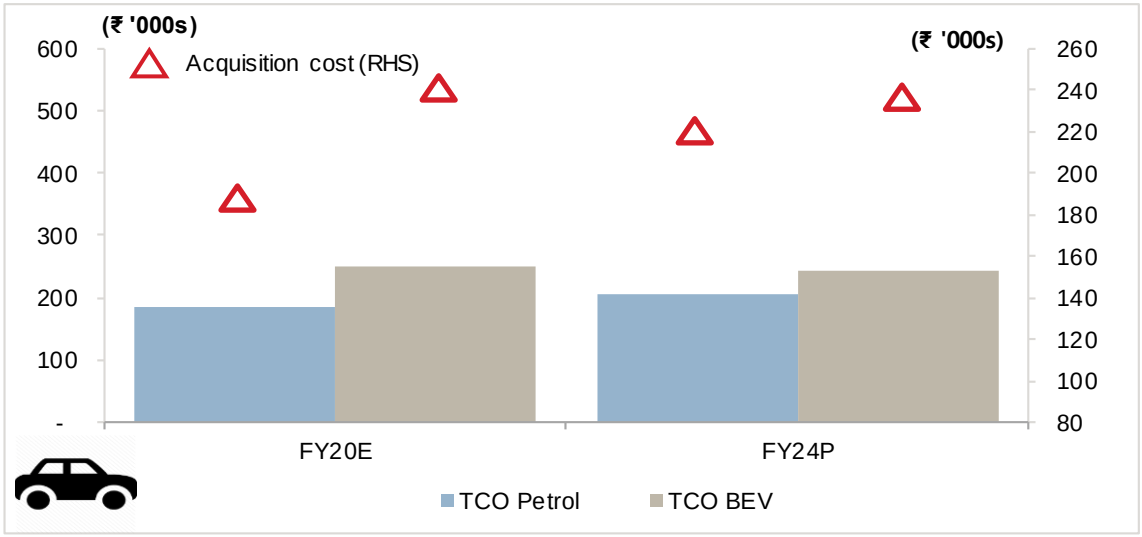
However, as of the first quarter of fiscal 2020, only five two-wheeler OEMs were eligible for subsidies on battery size under the FAME II policy due to stringent FAME-II elligibility criteria. This increased to seven in November 2019 vs. eighteen OEMs that were elligible for the erstwhile FAME I incentive. Hence, supply will play a key role in determining two-wheeler sales. The top five e-two-wheeler players in India are expected to increase their capacity from 0.4 million units in fiscal 2020 to over 3 million units by fiscal 2024.

Meanwhile, the incumbent OEMs are launching e-autos at a rapid pace. Also, e-rickshaws are not only replacing cycle rickshaws but could also emerge as a low-cost alternative to e-autos as e-rickshaw costs ~30% lower than e-auto.

Personal cars to remain in the slow lane

High COA and TCO will continue to deter adoption of EVs for personal mobility, as the FAME II policy offers no subsidies for these vehicles.

Personal cars: Low annual running hinders EV adoption

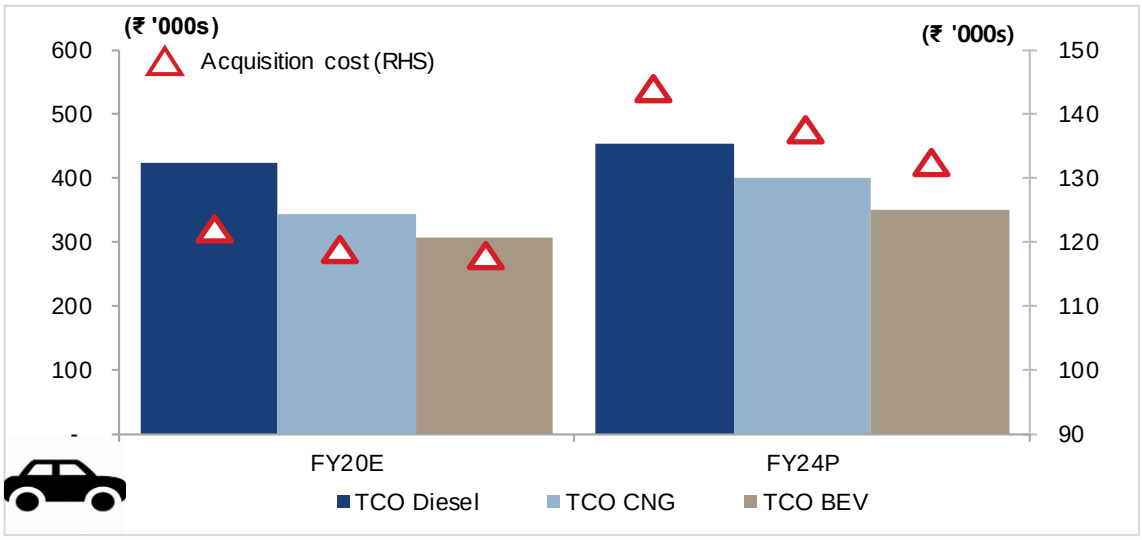


Source: CRISIL Research

Note: TCO - total cost of operation (includes EMI, depreciated battery replacement cost, fuel cost and annual permits); COA - cost of acquisition (includes down payment, registration charges and other one-time charges)

However, cab aggregators, who are eligible for subsidies and whose higher annual running will improve affordability, will spearhead the switch to EVs.

Higher annual running of cab aggregators to aid EV adoption



Source: CRISIL Research

Note: TCO - total cost of operations (includes EMI, depreciated battery replacement cost, fuel cost and annual permits); COA - cost of acquisition (includes down payment, registration charges and other one-time charges)

Take a look at the cost economics. Assuming a power cost of Rs 6 per kWh to charge a 16 kWh battery that gives a range of ~130 km, we arrive at a cost of Rs 0.7 per km for an EV compared with Rs 4 per km for a diesel vehicle with a mileage of ~17 km per litre.

Thus, an EV saves Rs 3.3 per km that it runs. A cab aggregator, which runs ~50,000 km a year, can save about Rs 1.65 lakh a year as against only Rs 35,000 for a personal car running ~10,000 km a year. Thus, cab aggregators can easily recoup the Rs 2-3 lakh higher cost of acquisition by their higher running.

Given this, OEMs are tying up with cab aggregators or launching their own cab aggregators to propel EV sales. It must be noted though that the subsidy is only available on cars that cost less than Rs 15 lakh and which have a minimum range of 140 km and maximum speed of 70 km.

That said, lack of sufficient public charging infrastructure will pose a challenge for EV adoption by cab aggregators.

Subsidies to drive e-bus sales

While Indian commercial vehicle manufacturers have been slow to roll out electric small commercial vehicles (SCVs) off the shop floor, state transport undertakings (STUs), which account for 13% of all bus sales in the country, are starting to drive e-buses on Indian roads with the help of subsidies.

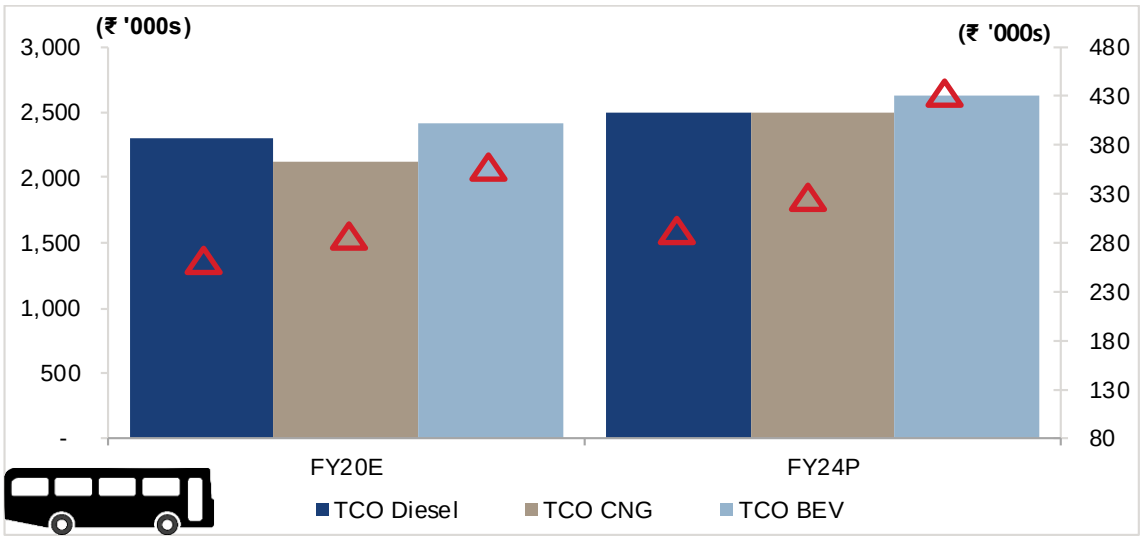
To be sure, e-buses offer unfavourable cost economics because of their higher upfront costs. Besides, there are operational challenges such as charging and concerns over the life and servicing of batteries.

To overcome these, FAME II has specified that the demand subsidy will only be given to buses sold under public private partnership under Operation and Maintenance of Electric Bus (OPEX) model. Under this model, the OEM takes the risk of operating the e-bus and gets a pre-decided revenue per km. Since there is no upfront cost for the STU, the model enables them to accelerate their pace of procurement.

This ties in with India's commitment to reduce its greenhouse gas emissions to 33-35% below its 2005 levels by 2030 under the Paris Climate Convention. In fact, India is home to seven of the top 10 polluting cities in the world. Moreover, as per a study by 'The Energy and Resiurces Insititute (TERI) and the Automotive Research Association of India (ARAI), share of vehicular pollution in PM2.5 and PM10 in Delhi stands between 17-30% and 15-25% respectively.

As of 2018, China had an estimated 421,000 e-buses, aided by subsidies, as against India's 600 (*Source: International Energy Agency, CRISIL Research*).

Buses: Subsidies will drive EV adoption for STUs



Source: CRISIL Research

Note: TCO - total cost of operations (includes EMI, depreciated battery replacement cost, fuel cost and annual permits); COA - cost of acquisition (includes down payment, registration charges and other one-time charges)

Initially, e-buses will be driven primarily by intra-city STUs since charging infrastructure will be a roadblock.

As for heavy goods-carrying commercial vehicles, LNG is likely to emerge as an alternative to ICE vehicles in this segment.

EV penetration in India is thus constrained by a host of demand, supply and policy growth drivers in the short to medium term.

The report card

Vehicle Segment	Factors determining EV adoption					
	Demand		Enabling Environment		Supply	
	TCO	COA	Dependence on public charging	Government Focus	Large OEM presence	Capacity
Personal						
Cab aggregator						
Two Wheeler						
Bus						
LCV						
E-auto						
E-rickshaw						

Favourable Neutral Scope for improvement

Source: CRISIL Research

Note: As there is no comparable ICE vehicle for e-rickshaw, TCO and COA analysis for e-rickshaw have been left blank. However, e-rickshaw shows better TCO and COA as compared to an e-auto

Growth drivers

Globally, EV sales have logged 57% CAGR in the past five years. But be it in Norway, which has the highest penetration of EVs in the world, or China, which is the largest market for EVs, or the US, the maker of the world's top-selling EV, the Tesla Model 3, three factors have driven the adoption of EVs: battery costs, demand incentives or subsidies and taxes, and charging infrastructure.

How far along the road is India in building this enabling ecosystem?

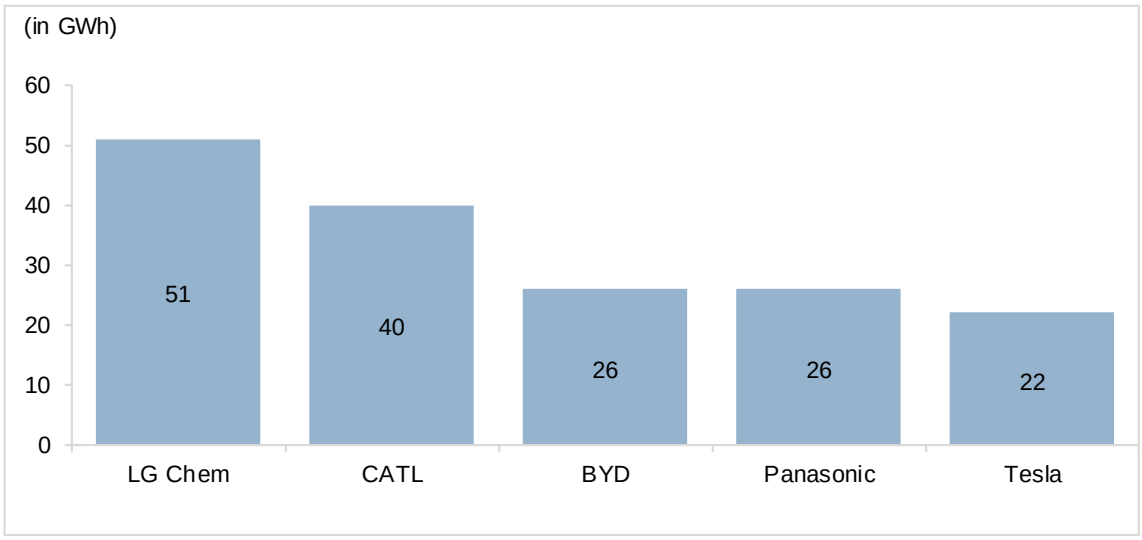
Battery costs expected to fall in next five years.

The lithium ion battery (pack), which is made up of lithium ion cells, accounts for 33-38% of the ex-showroom price (without incentive) of an EV, on average, which has a significant bearing on the cost of ownership.

The biggest lithium ion manufacturing capacities are in China. Even South Korean as well as Japanese manufacturers have their facilities there.

China controls large lithium and cobalt mineral resources at home and in Africa. India, on the other hand, has no significant deposits of these key battery elements and is dependent on battery imports – and on global players to evolve and refine battery technology, too.

Top five battery manufacturers by capacity



Source: Benchmark Minerals as of January 2019

Note: Benchmark Minerals is a Price Report Agency (PRA) which provides prices, data and advisory services in the lithium ion battery and electric vehicle (EV) supply chain

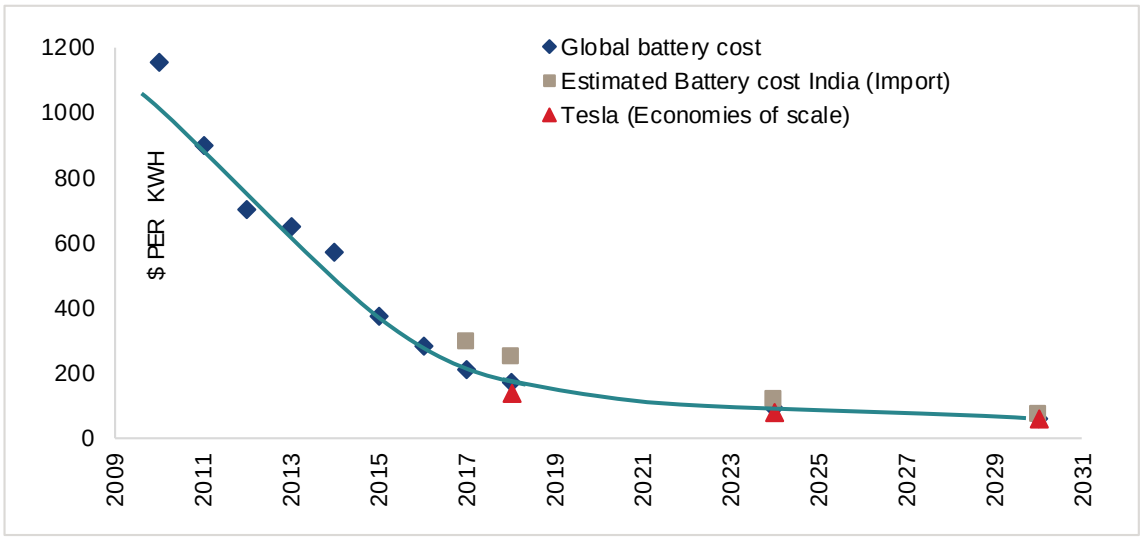
LG Chem is a subsidiary of LG Corporation in the chemical industry. CATL (Contemporary Amperex Technology Co. Ltd) is a Chinese company that is into manufacturing of lithium-ion batteries for electric vehicles and energy storage systems. BYD Co Ltd is a Chinese manufacturer of automobiles, battery-powered bicycles, buses, forklifts, rechargeable batteries, trucks etc. Panasonic is a Japanese multinational electronics corporation. Tesla, Inc., is an American automotive and energy company.

EVs are essentially a business of scale. Existing global battery overcapacity is expected to lead to competition, thereby bringing down battery prices. This, along with higher EV volumes, will enable OEMs to reduce EV prices, further accelerating EV sales.

Based on announcements, global lithium ion battery manufacturing capacity will log a 35% CAGR between 2020 and 2023.

CRISIL Research expects landed lithium ion battery costs in India to drop from currently $230 per kWh to $143/kWh by fiscal 2024. Till then, volume offtake will remain slow as lower battery prices will be the key factor that will spur EV adoption in the country.

Battery cost in India at ~$230/kWh as of fiscal 2020



Source: Bloomberg NEF, SIAM, Tesla, CRISIL Research

Localisation, the need of the hour: On its part, the government is seeking to reduce import dependence and increase localisation of EV batteries through the phased manufacturing programme (PMP), which is valid till 2024.

This incentivises companies to set up integrated battery and cell giga factories (battery production capacity upward of one gigawatt-hour (GWh))-- one gigawatt is equal to 1,000 megawatt -- for manufacturing and assembling lithium batteries in the country.

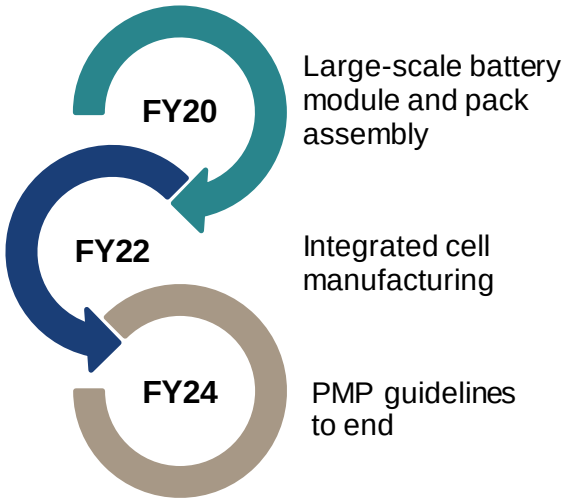
Countries with giga factories, such as China and South Korea, are known to have battery costs that are around 20-30% lower than the global average.

In fact, there are three levels of localisation that can be acheived:

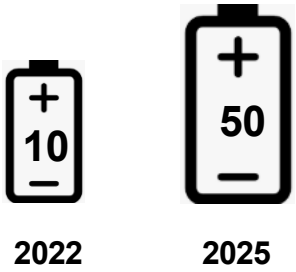
1. Import lithum ion battery pack (No localisation)
2. Import lithium ion cells and assemble the lithium ion battery in India
3. Import lithium ion battery elements (lithium, cobalt, nickel, manganeses, separators) and assemble cells in India itself

PMP envisages to achieve battery pack assembly by FY20 and cell manufacturing by FY22.

Roadmap of PMP execution



Cell capacity required (in GWh)



Source: Niti Aayog

Under the PMP, the government is expected to issue tenders inviting companies to set up 50 GWh battery manufacturing base over the next five years at a proposed investment of $50 billion. To support this, the government is expected to offer subsidies and duty cuts, and lower minimum alternate tax. Successful bidders will have to set up production facilities by 2022 and can apply for incentives until 2030.

Execution is important, though. Since the cost of a battery pack (assembly of cells) is 1.4 times the cost of a battery cell in the case of a 20 kWh battery pack, localisation will be key in reducing the import bill on lithium ion batteries and, hence, in driving down battery costs further in India.

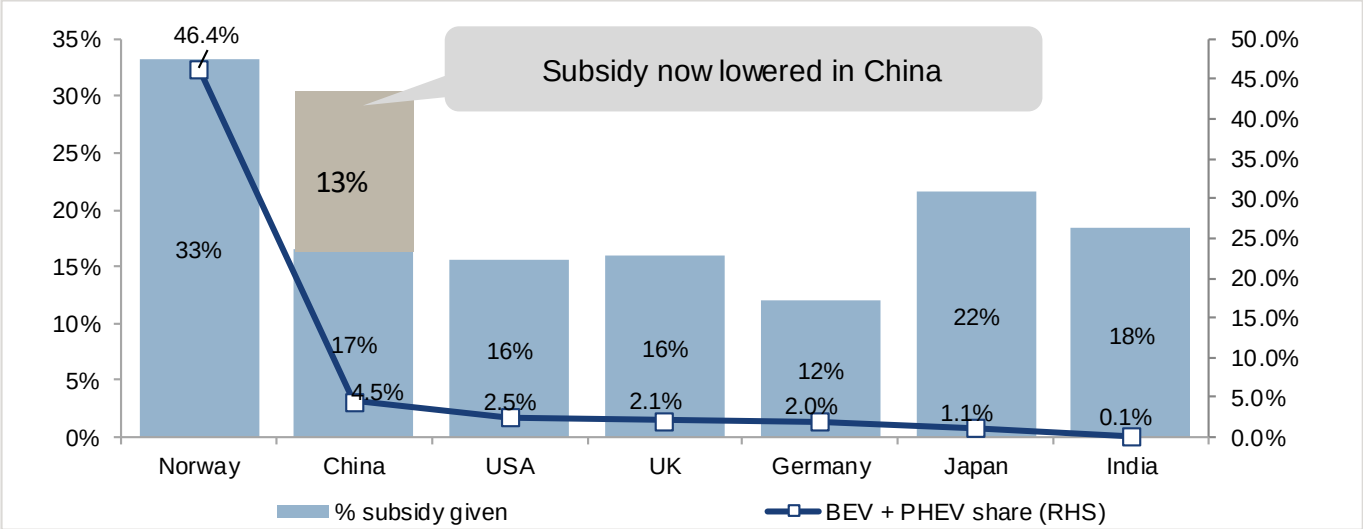
Incentives in place, but yet to spur demand

High demand subsidies and tax incentives have driven EV penetration in countries such as China and Norway.

In Norway, for instance, a whopping 46% of new vehicle sales came from battery EVs (BEVs) and plug-in hybrid EVs (PHEV) in 2018 (see chart) as the country offers substantial tax and other concessions to EVs. Although subsidies have now come down in China, it was this initial thrust that has turned it into the largest EV market with a stock of 2.3 million BEVs and PHEVs as of 2018.

In comparison, subsidies for EVs in India are much lower, which has affected the COA, and constrained sales.

Demand incentive has a high correlation with EV penetration



Note: % subsidy is expressed as % of vehicle price

Source: CRISIL Research

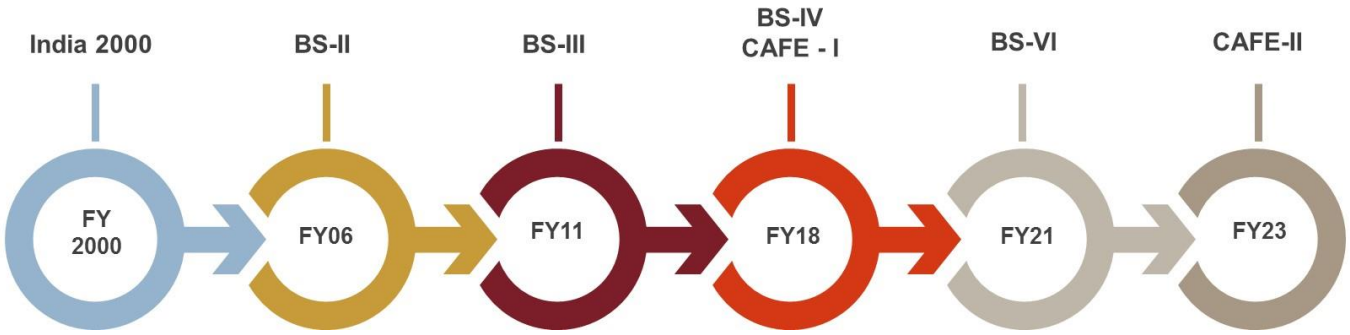
The policy spur: The government has pressed the pedal on the policy front. After introducing several new regulations relating to safety and insurance over the past two years, it has now turned its attention to emission norms.

Immediately on the cards is the shift to the new Bharat Stage VI emission norms from April 1, 2020. CRISIL Research believes this will result in a 5-7% increase on average in prices of ICE vehicles, which will help improve the comparative viability of EVs.

On the tax front too, the government has reduced the goods and services tax (GST) on EVs to 5% from 12%, as against an unfavourable 28% GST plus cesses on personal cars.

Besides, more regulations are on the anvil. These include the next phase of the Corporate Average Fuel Efficiency (CAFE) standards for regulating the sales-volume weighted average carbon dioxide emissions of every auto manufacturer and the Real Driving Emissions (RDE) test, which will measure the pollutants emitted by cars while being driven on the road.

With a host of regulations for ICE vehicles, the viability of EVs to improve



Source: CRISIL Reseach

All these regulations – and the resulting price increases – thus make the case for a shift to alternative fuel options such as EVs.

Policy implementation holds the key: In terms of its specific EV policy, the government intends to spend Rs 10,000 crore over the next three years under FAME II. The focus has shifted from subsidising upfront costs under FAME I to promoting a more holistic growth of the EV industry, including aggregating demand by encouraging EVs in public transport, providing for charging infrastructure and R&D on EV technologies, and also pushing for greater indigenisation.

Under FAME II, subsidies are only available for advanced batteries and strict performance indicators with e-buses getting the most subsidies.

Eligibility criteria for FAME – II demand subsidy									
	Demand only to Advanced batteries	Regenerative breaking	Minimum range	Energy consumption efficiency	Max speed	Minimum acceleration	Maximum ex-factory price	Impact	Outlook
			km	kWh/100km	kmph	m/s/s	Rs lacs		
E-Two Wheeler	NF	NF	80	<7	40	0.65	1.5	Only few models eligible for subsidy post FAME norms E-2W sales dipped as a result	
E-rickshaw	NF	N	80	<8	NA	NA	5	No major impact as they were not getting subsidies owing to not being registered	
E-auto	N	N	80	<10	40	0.65	5	Positive impact due to new vehicle category creation	
e-4W (L<4m)	N	N	140	<15	70	1.04	15	Ex factory price of 15 lacs to impact premium EV launches, thereby impacting demand	
e-4W (L>4m)	N	N	140	<20	70	1.04	15		
e-4W (LCV/ Stage carriage/Maxi cabs)	N	N	100	<30	50	1.04	15	Transparent framework to ensure that more subsidies can be efficiently given compared to FAME I	

Not favourable | Neutral | Favourable

Source: CRISIL Research

In addition, Delhi and Uttar Pradesh, and some southern states are giving EVs a push by evolving their own incentives and policies to promote EV sales and manufacturing. All the same, the execution of these policies will be key in accelerating the pace of EV adoption.

Which is the greenest state in India?

The rollout of EVs in India will depend as much on demand and supply incentives from the central government as from the states.

CRISIL Research's assessment reveals that the southern states, as also Maharashtra in the west, have taken a lead in developing an EV policy framework and formulating attractive incentives to promote manufacturing. In the north, Uttar Pradesh, Delhi and Uttarakhand are charged up on the segment, but for the most part, many key western, central and northern states are still to hit the road.

The early-mover green states have spelt out their eligibility criteria and incentives for EVs and plans for charging infrastructure.

Early-mover states: How they stack up?

State	EV target	Eligibility criteria	Incentives	Charging infra plan
Maharashtra				
Uttarakhand				
Karnataka				
Kerala				
Telangana				
Delhi				

Favourable Neutral Scope for improvement

Note: Several other states have formulated draft EV policies that are yet to be finalised.

Among the states, Karnataka's EV policy for 2017-2022 has set an ambitious target of EVs accounting for 100% of new three-wheeler and LCV sales by 2022. In addition, the state has allocated Rs 100 crore for EV start-ups. It also aims to incentivise 100 fast-charging stations in Bengaluru. The plan is to have over 1,000 hubs to facilitate EV charging, battery swapping and shared mobility by the end of the policy period.

Similarly, Delhi's EV policy for 2018-2023 has set a target for battery EVs or BEVs to account for 25% of new vehicle registrations by 2023. It also intends to make 50% of the public transport bus fleet zero emission by 2023.

Maharashtra and Telangana are also focusing on promoting EVs for public transportation. Maharashtra is targeting EVs for public transport in five cities – Thane, Nagpur, Nashik, Aurangabad, Pune and Mumbai. However, it has imposed limits on EV subsidies for buyers in that only the first 1 lakh EVs – 70,000 two-wheelers, 20,000 three-wheelers and 10,000 passenger cars – are eligible for subsidies in the 2018-2023 policy period.

For Telangana, the target is that e-buses should account for 25% of new bus sales for intra-city, inter-city and inter-state movement by 2022 with a goal of 100% by 2030. In addition, the state intends to have battery-operated shuttle services at all Hyderabad metro stations for last-mile connectivity.

Uttarakhand has not stipulated any EV targets or eligibility criteria or even a charging infrastructure plan. However, it intends to offer term loans of Rs 10-50 crore to micro, small and medium enterprises for manufacturing EVs.

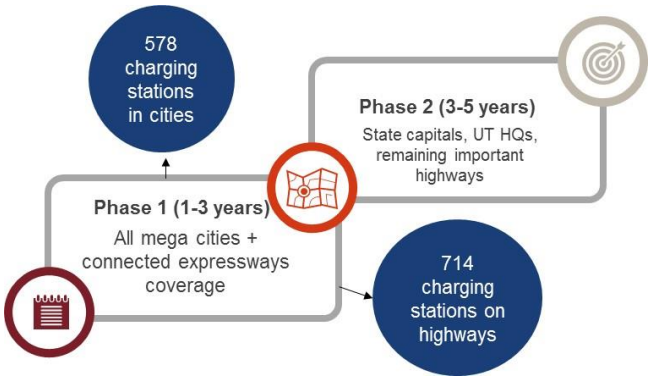
In addition, all the states are providing numerous tax exemptions for EVs over ICE vehicles.

Charging infrastructure in the works

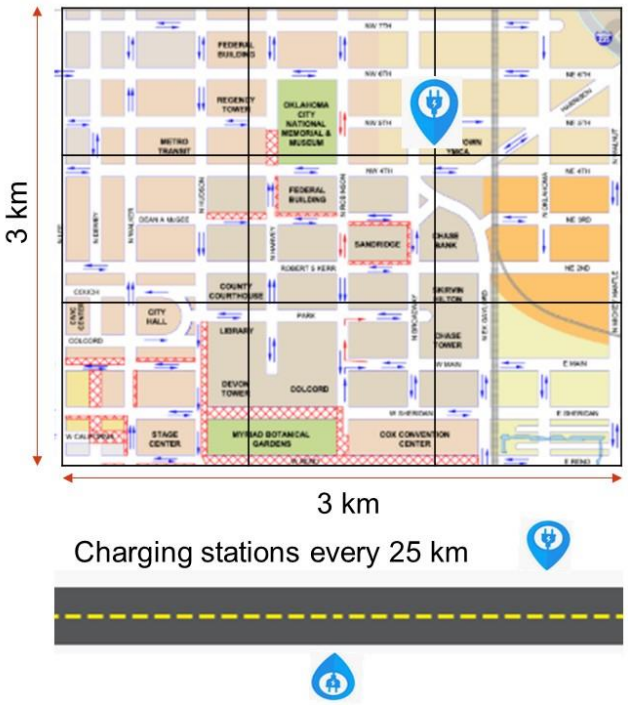
The battery charging infrastructure is another key speed-breaker for EV sales since consumers hesitate to shift from ICE vehicles to EVs on account of range anxiety.

Globally, home charging accounts for the highest share of EV charging points, but this may not be feasible in India. CRISIL Research expects vehicle segments with lower need of public charging, such as two-wheelers, to shift to EVs first. For the rest, charging infrastructure will drive adoption.

EV charging infrastructure priority phases



At least one charging station every 3 x 3 km grid



Source: CRISIL Research

Based on the specifications of the government's charging infrastructure policy, CRISIL Research expects 578 public charging stations to be set up across mega cities and 714 stations on major expressways and highways in Phase 1 (fiscal 2022). (This excludes captive charging facilities set up by cab aggregators or e-rickshaw fleets.) At the moment, apart from some private companies and multinationals, a few leading public sector oil and gas and power companies are exploring the possibility of setting up charging stations across India. But these are early days yet.

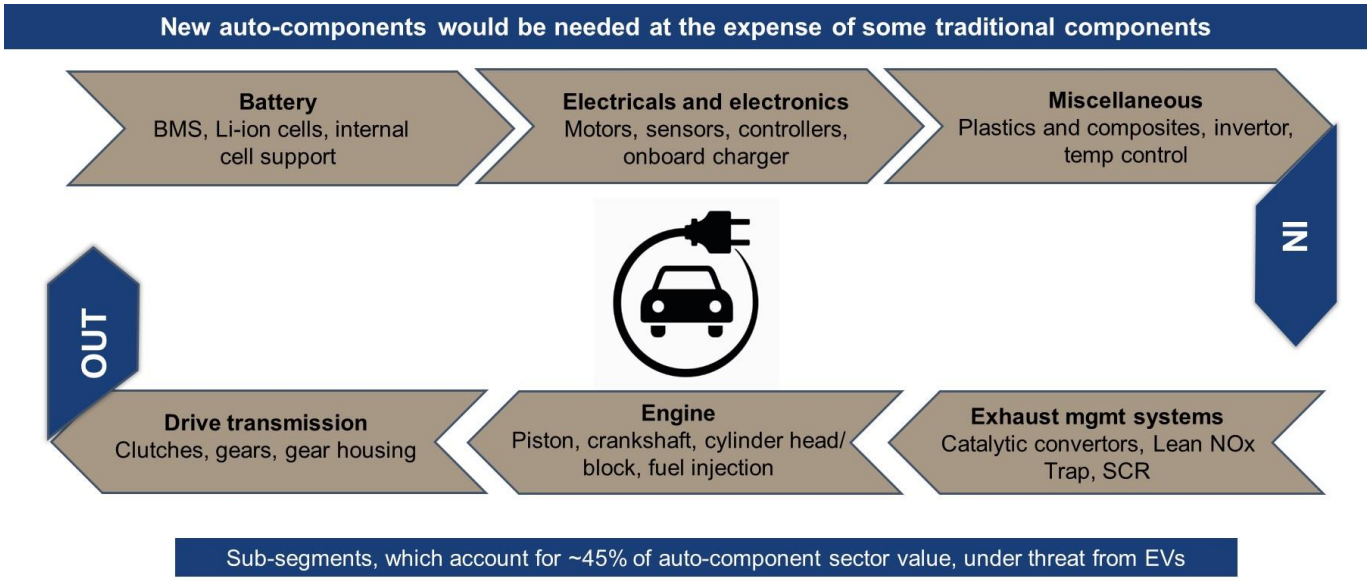
India will deploy both the CHAdeMO and Combined Charging System (CCS) fast-charging technologies – adopted by Japanese and European OEMs, respectively – apart from the existing Bharat Standard, at its public EV charging stations.

Will EVs hurt incumbent auto-component makers?

Across the country, OEMs, auto-ancillary companies and vehicle dealerships have expressed their apprehensions over the advent of EVs and their impact on business.

EVs will require some new auto-components such as batteries, electricals and electronic equipment such as motors and sensors, apart from plastics and composites. But these will be at the expense of traditional components that account for around 45% of the auto-components sector by value, such as drive transmissions, engine parts and exhaust management systems.

<5% of the automotive component revenue to get impacted in FY24 due to EV adoption

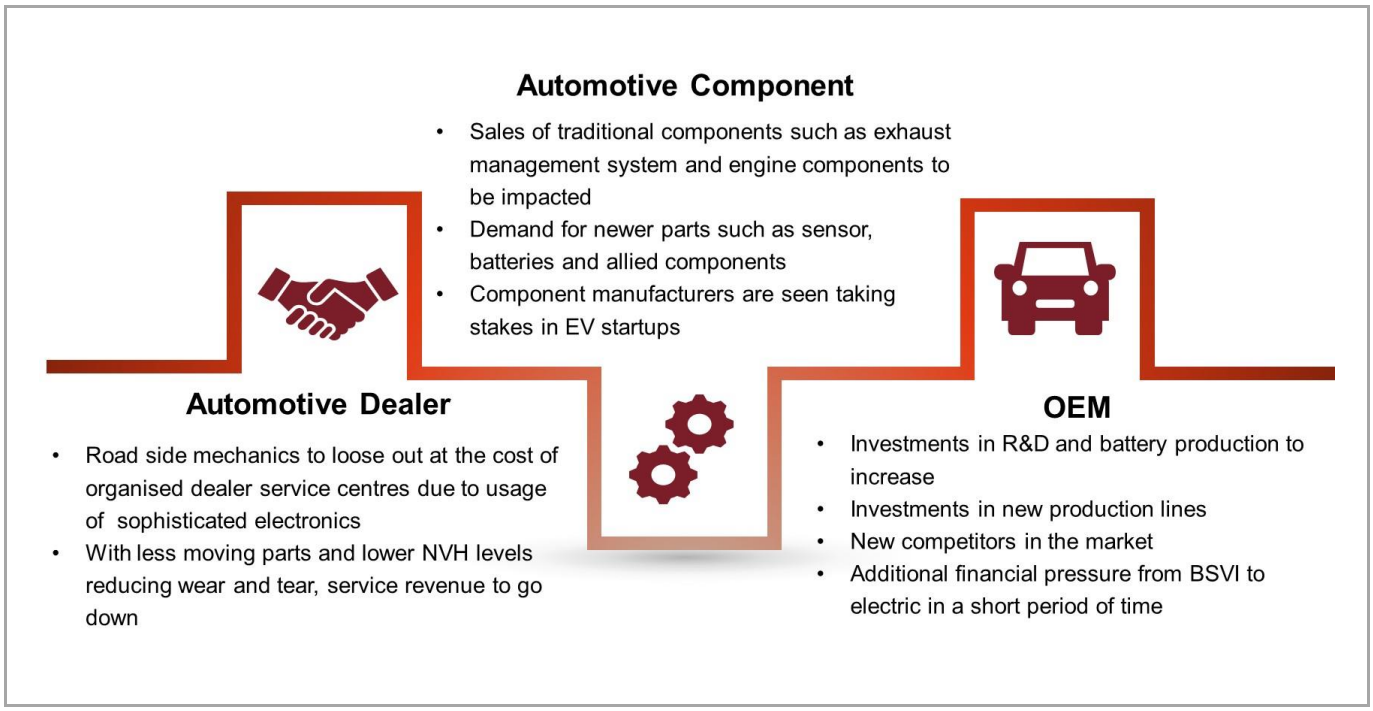


Source: CRISIL Research

CRISIL Research's projections of EV adoption across vehicle classes through fiscal 2024 suggest sales of traditional auto-components will be hit by a modest 3% in value terms by fiscal 2024. The gradual adoption of EVs will thus provide component manufacturers enough time to realign their operations over the next five years.

As for dealers, while the use of sophisticated electronics in EVs will tilt the balance in favour of organised service centres over road-side mechanics, on the whole, their service revenues, which account for a sizeable portion of their total revenues, will go down since fewer moving parts and lower NVH (noise, vibration and harshness) levels in EVs will ensure lower wear and tear of EVs. However, CRISIL Research believes that the impact on dealers will not be significant over the next five years as it will be cushioned by the low penetration levels, especially of personal electric cars, in India albeit this will increase as EV penetration levels rise eventually.

Impact of EVs on various stakeholders



Source: CRISIL Research

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It has delivered independent opinions, actionable insights, and efficient solutions to over 100,000 customers.

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CRISIL Research is India's largest independent integrated research house. We provide insights, opinion and analysis on the Indian economy, industry, capital markets and companies. We also conduct training programs to financial sector professionals on a wide array of technical issues. We are India's most credible provider of economy and industry research. Our industry research covers 86 sectors and is known for its rich insights and perspectives. Our analysis is supported by inputs from our large network sources, including industry experts, industry associations and trade channels. We play a key role in India's fixed income markets. We are the largest provider of valuation of fixed income securities to the mutual fund, insurance and banking industries in the country. We are also the sole provider of debt and hybrid indices to India's mutual fund and life insurance industries. We pioneered independent equity research in India, and are today the country's largest independent equity research house. Our defining trait is the ability to convert information and data into expert judgments and forecasts with complete objectivity. We leverage our deep understanding of the macro-economy and our extensive sector coverage to provide unique insights on micro-macro and cross-sectoral linkages. Our talent pool comprises economists, sector experts, company analysts and information management specialists

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