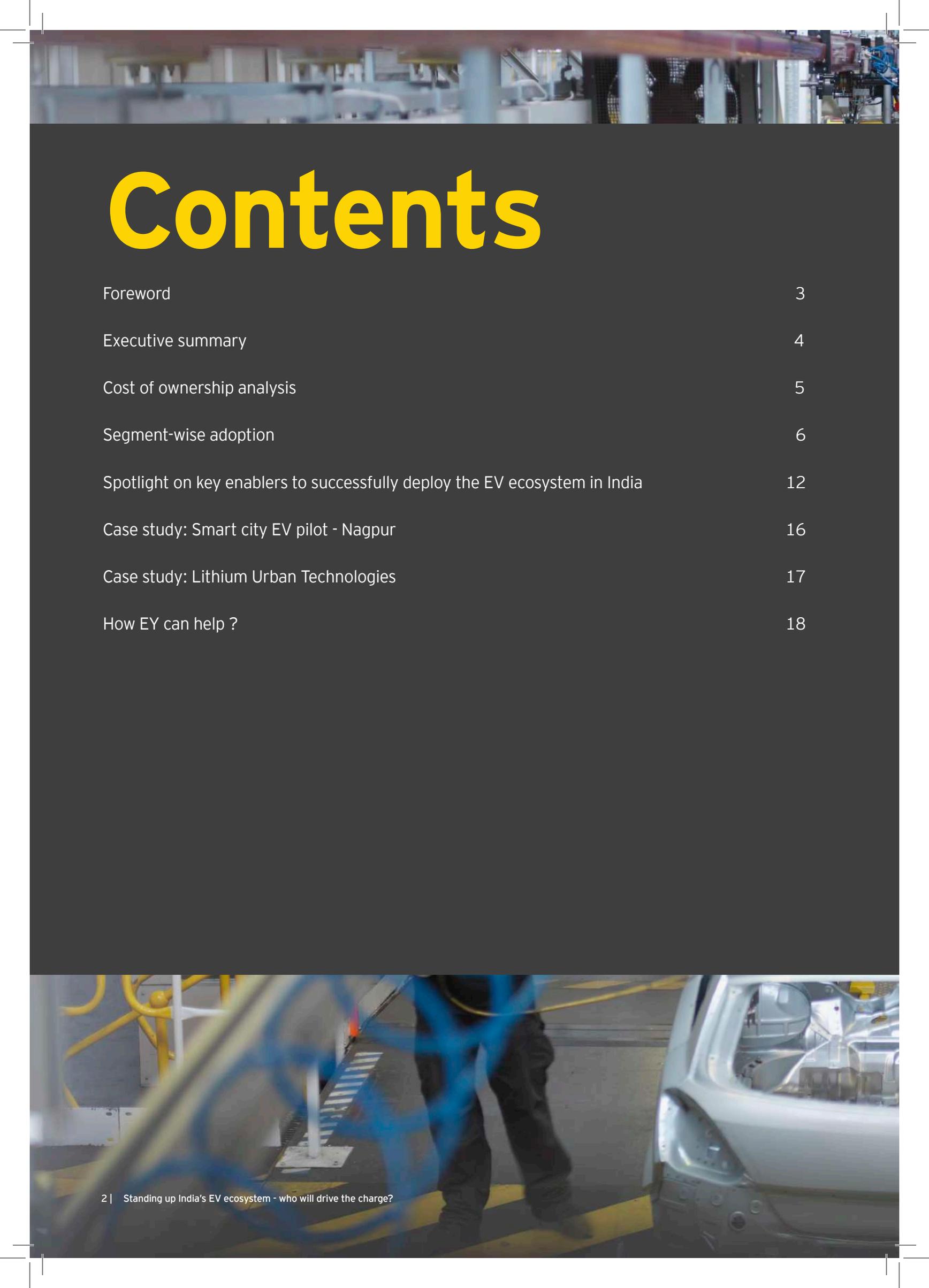




**Standing up India's EV
ecosystem - who will
drive the charge?**

EY

Building a better
working world



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Foreword

The global automotive industry is at the cusp of a paradigm shift from internal combustion engine vehicles to zero emission vehicles owing to the stringent regulatory interventions by Governments worldwide as a result of depleting air quality and greenhouse gas emissions.

India, too, is actively exploring cost effective and viable solutions to the problem of poor air quality in a number of its cities as well as reducing its excessive dependence on oil imports. The country has announced a significant shift to an all electric fleet by 2030, which necessitates attention and action by automakers, suppliers (including battery manufacturers), dealers and utility players alike. As various stakeholders look to understand the implications of this transition and re-align their businesses with the Governments agenda, there are several questions that need to be answered:

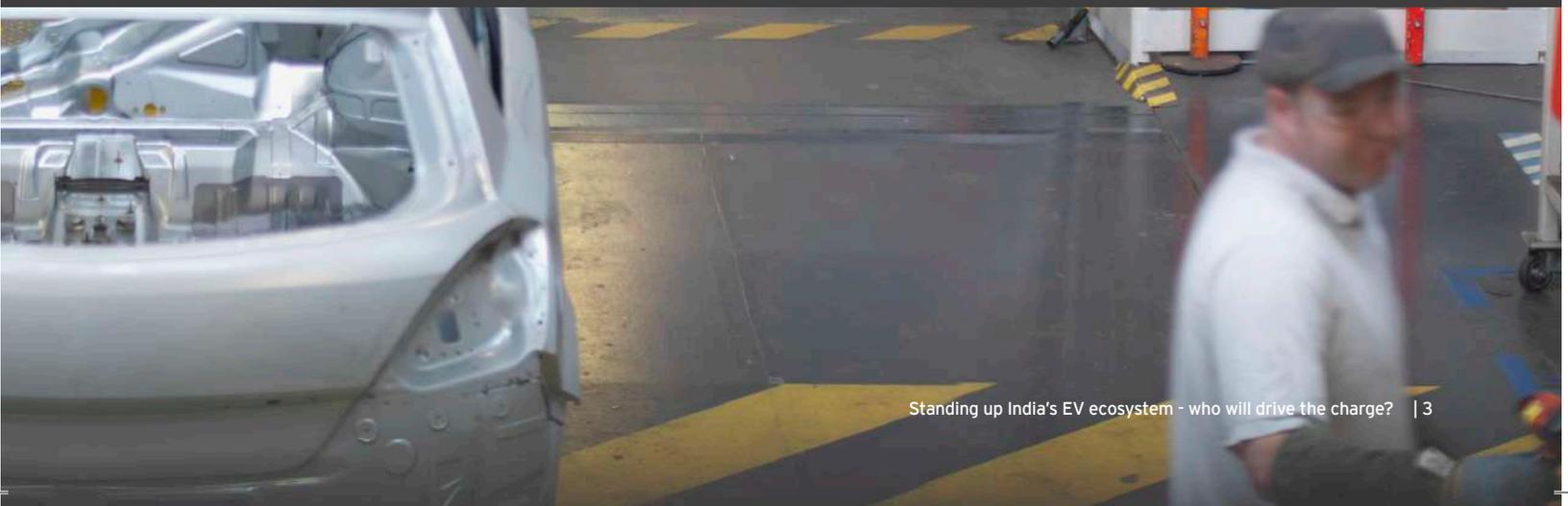
- ▶ How would the current industry ecosystem change as a result of the electrification drive by the Government?
- ▶ Which vehicle segments are likely to lead the drive toward electrification?
- ▶ How will the charging infrastructure evolve and what charging models would be the most suitable in the Indian context?



Rakesh Batra

Automotive and Transportation
Leader, EY India

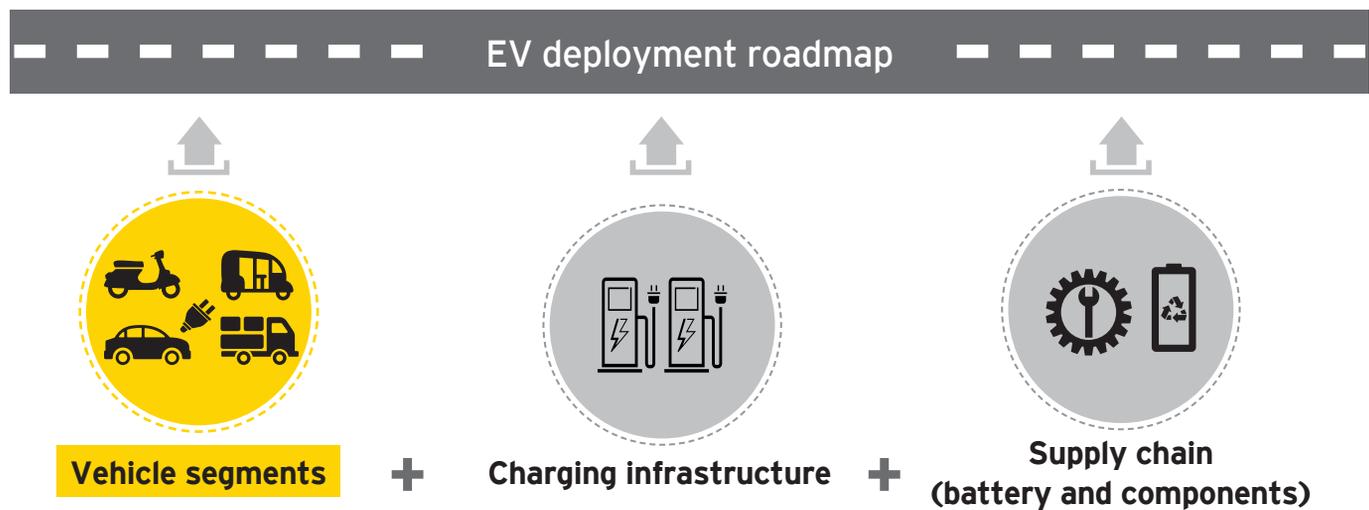
This study, one of our point of views in a series of reports, looks to answer a few of these questions by providing a deep-dive into the foreseeable future of EV adoption across various vehicle segments in India.



Executive summary

Electric vehicles (EVs) on the horizon

The report aims to provide a vehicle deployment roadmap and discuss how EV adoption is likely to take place across vehicle segments. Alongside our research, we conducted interviews with government officials and senior industry executives while analyzing the pattern of EV adoption across vehicle segments. The report lays out an action plan and considerations for the industry stakeholders as key takeaways.



Key findings

1 The transition to EVs is necessary for the Indian automotive industry to continue to retain its foothold and gain additional ground as the world shifts its axis towards EVs.

2 In terms of adoption in the country, we believe that two-wheeler (2W) fleets and three-wheelers (3Ws) would be the first off the block, followed by intra-city buses, corporate cabs and government fleet. Private cars and commercial vehicles, particularly medium and heavy commercial vehicles (M&HCVs), are likely to take some time for adoption.

3 In terms of charging infrastructure, a mix of plug-in charging and battery swapping models has to be carefully deployed based on the dynamics of various vehicle segments.

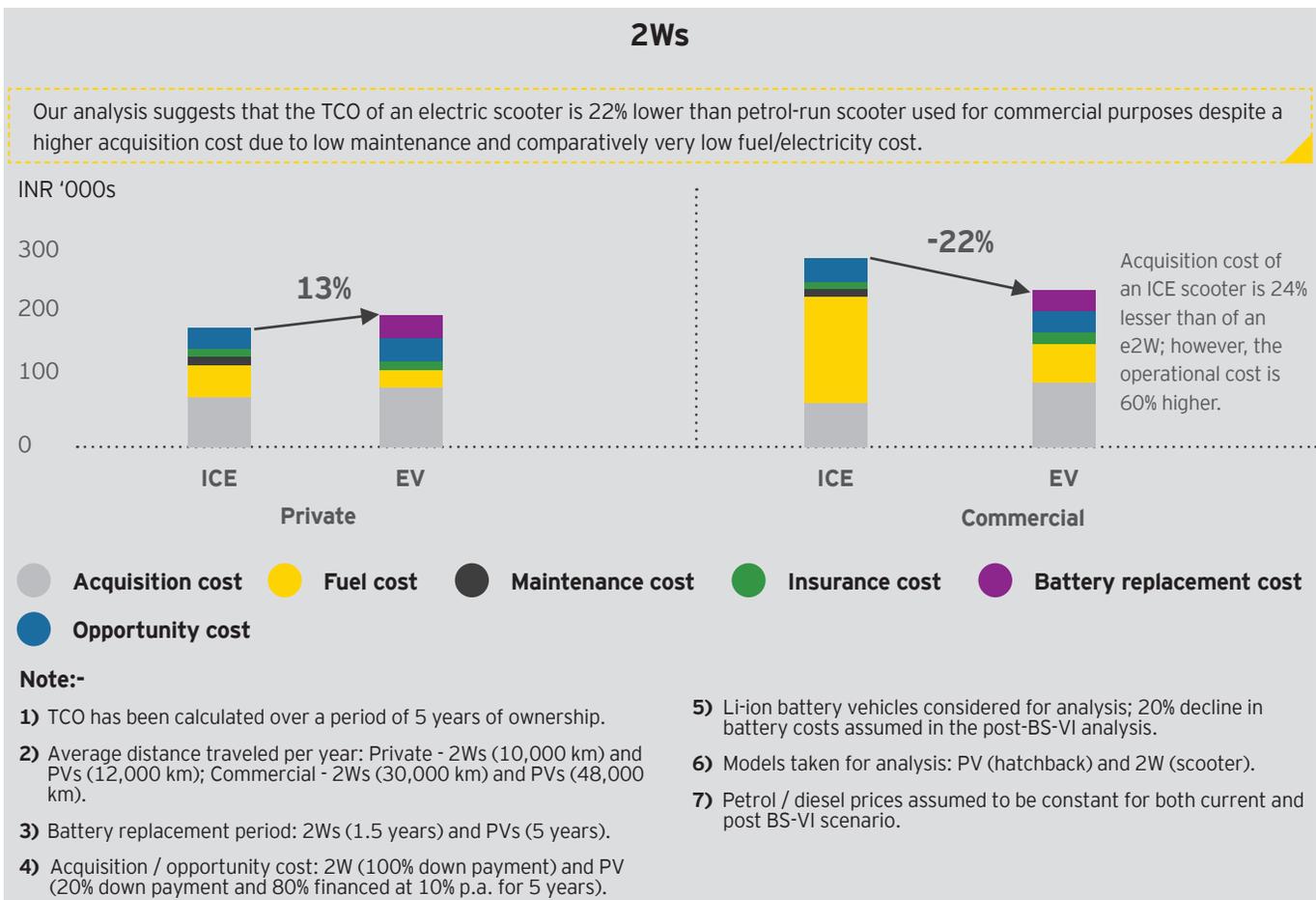
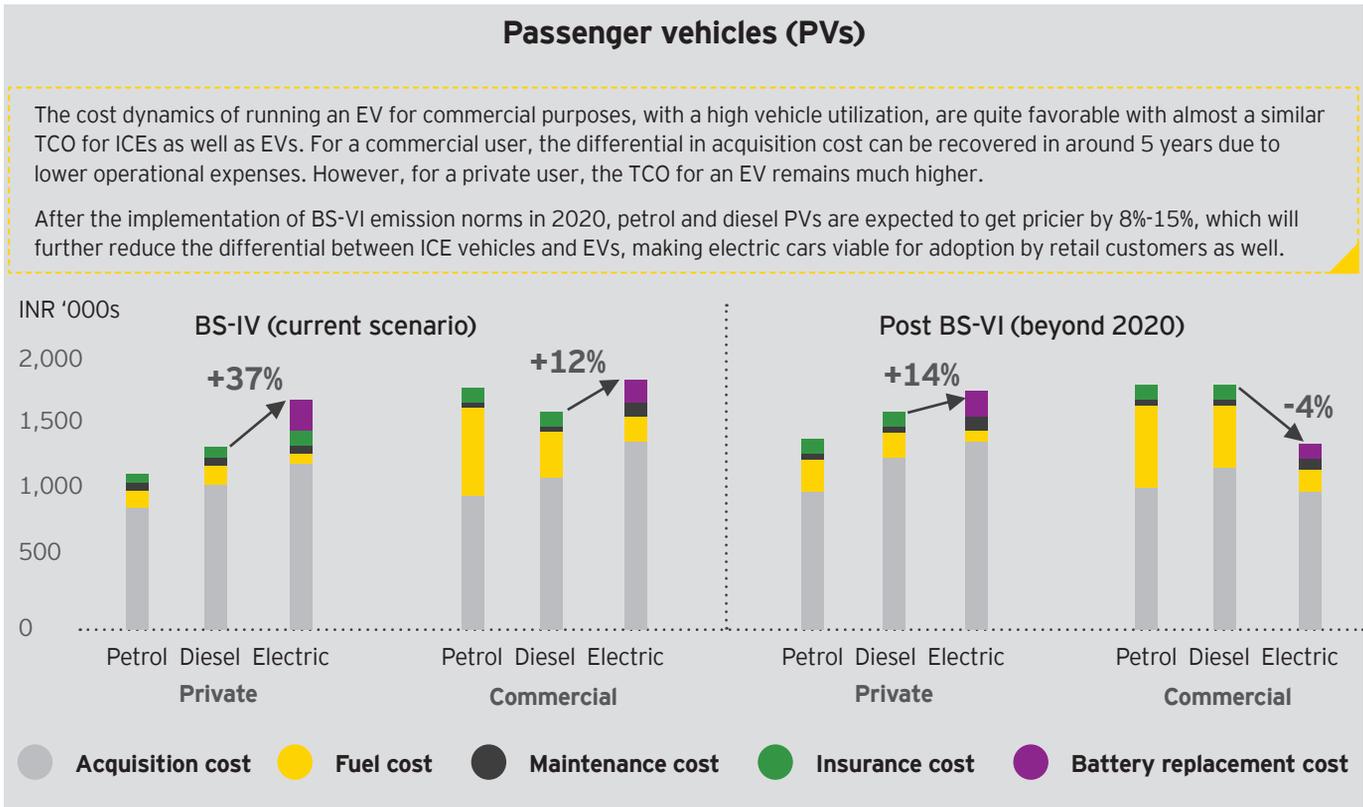
4 Regulatory support would play a key role in EV adoption. A combination of both fiscal and non-fiscal incentives is critical in the medium term.

A total cost of ownership (TCO) perspective:

- 5**
- ▶ For passenger car fleets, the TCO remains comparable, even at present, post BS-VI implementation, the cost dynamics would shift significantly in favor of EVs. This is likely to result in ease of transition for private users as well.
 - ▶ For 2W fleets, the TCO of EVs is lower than of the ICE counterparts.

6 Globally, we are witnessing outsiders to the traditional automotive industry leading the charge, securing higher valuations than their much well entrenched traditional rivals. Automakers need to act fast and join the EV revolution in order to stay relevant.

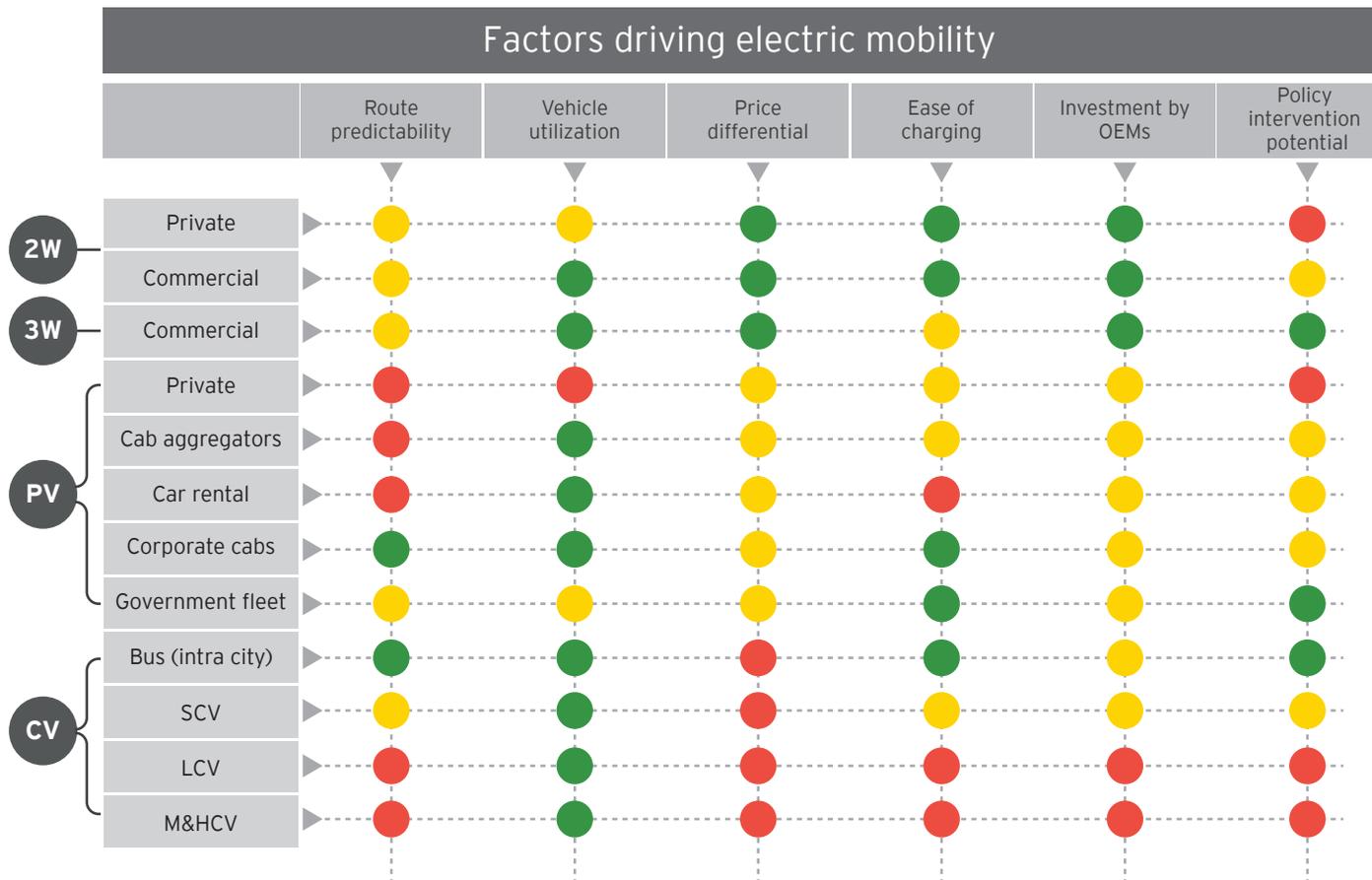
Cost of ownership analysis: By 2020, operating cost for most EVs are expected to compensate for the high acquisition cost



Source: EY analysis

Segment-wise adoption: A varied pace of electrification is expected across vehicle segments driven by specific user groups

We have analyzed the market readiness of vehicle segments by assessing them on various factors driving electrification. A summary analysis is provided below:



3W: Three-wheeler; CV: Commercial vehicle; SCV: Small commercial vehicle; LCV: Light commercial vehicle.

● Favorable ● Neutral ● Unfavorable

 2Ws	 3Ws	 PVs	 CVs
<p>2Ws are expected to be one of the early adopters of electrification. High vehicle utilization and easy home or workplace charging would drive the uptake in the commercial 2W segment.</p>	<p>3Ws are expected to be one of the early adopters of electric mobility given e-rickshaws have a head-start in this space due to their low running cost and emergence of independent assemblers.</p>	<p>High vehicle utilization, route predictability and workplace charging would help corporate PV fleets take off earlier than private cars. Retail customers are expected to go for EVs only once battery prices come down and EVs achieve economies of scale.</p>	<p>Intra-city buses are likely to be electrified early, driven by the support provided by government-run transport undertakings, route predictability and ease of charging at bus depots. SCVs and LCVs are likely to be early adopters in the truck segment.</p>

Source: EY analysis

2Ws: Given the ease of charging, this segment represents the highest potential for penetration, even for areas with minimal charging network

An end-to-end ecosystem (right from in-house manufacturing to setting up charging infrastructure) being created by start-ups is likely to accelerate the adoption of e2Ws.

2W is the largest segment in the Indian automotive industry representing ~80% of Indian automotive sales in FY17 (17.6m units). Owing to the vastness of this segment, we believe it has a huge potential to promote emission-free mobility in the country.

The e2W segment has already demonstrated its potential in 2011-12, when e2Ws clocked sales of 90,000 units. However, the sales saw a dip in the following years with a withdrawal of subsidies by the Ministry of New & Renewable Energy (MNRE), with sales of only 25,000 units in 2016.

The following aspects would help drive e-mobility in this segment:

- ▶ Over 2 million petrol-run 2Ws with a long daily run engaged in courier services
- ▶ Intra-city travels (maximum of around 100-150 km a day)
- ▶ Ease of charging: Can be easily charged on a standard residential/ workplace plug point

	E-bike	Petrol-run bike
Range (km)	70-120	300-450
Price (INR '000s)	90-125	75-120

Embracing the EV technology, a slew of start-ups are looking to drive electric mobility in this segment. Traditional OEMs are also making strategic investments into these companies.

Not only manufacturing e-bikes or e-scooters, these companies are looking at various other aspects of electric mobility as well:

- ▶ **Developing charging infrastructure:** Partnering with cafes, restaurants, malls and apartment complexes to build infrastructure at regular distances in various cities to address the issue of range anxiety
- ▶ **In-house technology:** Developing most technologies and processes in-house in the absence of local supplier network
- ▶ **Training vendors** to become EV grade suppliers
- ▶ **Investment-light distribution:** Resorting to innovative delivery models with door-step delivery and service

There is a significant opportunity that lies within the commercial segment of 2Ws, such as delivery bikes, which have high daily run and easy access to charging infrastructure

200 million

Stock of e2Ws in China as of 2016

A strong policy push has led China to become the largest market of e2Ws.

- ▶ China, in 1999, designated certain e2Ws as bicycles, making their licensing and registration redundant.
- ▶ Major cities restricted the ownership and use of gasoline motorcycles in their urban cores.



Source: SIAM, SMEV, China Bicycle Association, EY analysis

3Ws: Given the head start of the e-rickshaw segment, a mild push by the Government could drive a nation-wide adoption

Considering the lack of essential public transport for last-mile connectivity, e-rickshaws could play a critical role while giving the necessary boost to vehicle electrification in the country.

India has emerged as one of the biggest 3W markets, with a total sales of 0.6 million units in FY17. 3Ws are widely used in India as an affordable means of public and goods transportation over short-to-medium distances.

The segment is witnessing an influx of e-rickshaws, with some estimates putting their numbers around 1 million. This wide scale adoption can be attributed to:

- ▶ The market is characterized by inexpensive and non-standardized component imports that are assembled locally.
- ▶ The absence of strict enforcement of regulations and the unorganized nature of the segment dominated by informal lending and contracting.
- ▶ Increased inclination of consumers toward e-rickshaws as they are faster than manually pulled rickshaws and offer cheaper commute than traditional 3Ws.

While these vehicles are re-shaping the last-mile connectivity, this segment continues to grapple with its own set of challenges, which include:



Design and battery

- ▶ Use of lead-acid batteries, which need to be replaced within 7-8 months
- ▶ Cost-sensitivity of the segment, which makes Li-ion batteries commercially unviable and warrants a much higher scale for adoption
- ▶ Current design of e-rickshaws doesn't possess the required vehicle strength and often fail on safety standards



Charging

- ▶ Unavailability of fixed e-rickshaw stands and charging points
- ▶ Sub-standard charging equipment
- ▶ Electricity theft for charging



Regulatory and compliance

- ▶ Licenses issued without testing the driving skills and lack of driver training
- ▶ Absence of safety and compliance standards, municipal and spatial planning
- ▶ Registration norms not being followed by majority of e-rickshaws plying on the road



Financing

- ▶ High interest rate charged by unorganized lenders/stringent payment terms given the unorganized nature of the segment
- ▶ Buyers' inclination toward cheaper products, posing threat to safety

E-rickshaws could play an important role toward integrated urban mobility, offering last-mile connectivity, provided significant steps to ensure their merited expansion are undertaken. A recommended series of steps would be:

- ▶ Integrate e-rickshaws in city-based mobility plans
- ▶ Make safety and prototype tests mandatory

- ▶ Define area of operation; ascertain limit to the maximum number of e-rickshaws per zone; provide designated parking places as well as charging facilities
- ▶ Relax the rate of interest of loans from various financial institutions

**INR200 -
INR 400
per day**

Typical earnings of an e-rickshaw operator, set to go up as the industry gets organized

A critical factor that would further drive this growth is improvement in the earning ability of the operator as the market gets organized.

As the market evolves, the margins of middlemen such as the charging network operators (often through illegal means) and financiers (who charge interest rates as high as 40%) are likely to come down and the wafer-thin margins of the end operators would go up.

Source: SIAM, Interviews with industry executives, EY analysis

PVs: PV fleets are expected to adopt EVs early, while retail customers are likely to wait for a better value proposition

India is the fifth largest car market in the world with over 3.0 million cars sold in FY17. The market offers a significant growth potential given the car density stands at 34 cars per 1,000 individuals. Electric car sales, however, have continued to be very low and constituted merely 0.1% of the PV sales in FY17.

To understand the responsiveness of PV segment to electrification, we have studied several user groups such as corporate cabs, government fleets and private cars.

Corporate fleets, which have a defined route and operations in a limited geography, top our list while private cars score the lowest on ease of electrification.

PV fleets are likely to be more willing to adopt EVs as the vehicle running costs (which are lesser for an EV) are one of the major influencers in purchase decisions.

With respect to electrification of **government fleet**, the procurement process of 10,000 EVs and 4,000 chargers have already been initiated through Energy Efficiency Services Limited (EESL) that will provide the initial build-up of EV parc and an impetus to local manufacturing. It will help provide some scale and improve the confidence toward the adoption of EVs.

On the other hand, electrifying **rental cars** is likely to take some more time given the average trip length of a rental car is longer with lesser predictable routes. This would require a network of fast DC chargers on the main traffic arteries and national highways, which will essentially take some time to set up.

Retail customers are likely to be the last in line to adopt EVs, given the concerns around high sticker price and an overall viability gap. Some barriers and plausible solutions to achieve electrification in this segment are as follows:

Range anxiety due to occasional inter-city travel and unpredictable routes for a retail customer

- ▶ OEMs need to offer better products with improved range
- ▶ A widespread network of charging stations

High acquisition cost of the vehicle, which is of paramount importance to a retail customer:

- ▶ Likely decrease in battery prices over the next few years to bring the EV cost down
- ▶ Costs to further reduce as OEMs achieve manufacturing scale
- ▶ Prices of conventional vehicles likely to go up with the implementation of BS-VI emission norms in 2020

Lack of awareness:

- ▶ More demonstration projects including EV pilots and national outreach programs through social media
- ▶ Pilot programs by state governments/OEMs

Utilization of a shared vehicle is 25%-30% as compared to only 4%-5% of a private use vehicle.

Car sharing and a shift from vehicle ownership to access are likely to significantly push EV penetration.

Source: SIAM, LMC Automotive, Analyst reports, EY analysis



CVs - Buses: Electrification of buses allows for an opportunity to showcase a plausible deployment of EVs in the Indian context

We believe that the intra-city bus segment is more market ready than others because of shorter trip length, route predictability and ease of charging at bus depots.

A majority of transportation needs in India are met by private vehicles, leading to an increase in congestion and carbon emissions. The Government is expectedly laying greater emphasis on usage of public vehicles for sustainable transport. The carbon footprint can be further reduced through a switch to EVs.

We are already witnessing a few e-bus pilots by state run transport units (SRTUs) – Navi Mumbai, Himachal Pradesh and Bengaluru – with a few more in the pipeline - Chandigarh, Telengana and Gurgaon.

The industry, however, remains divided on the readiness of electrification of this segment. One school of thought believes it to be the driver of electric mobility in India while the other finds it to be one of the most difficult segments to electrify.

“The government should initially target to electrify public fleet such as buses to benefit from the economies of the scale as well as to instil confidence in the minds of general public”

Founder, Charging Infrastructure start-up

“Buses seem to be very difficult to electrify as the cost differential is very high unless OEMs manufacture all key components locally in India”

CXO, Cab aggregator start-up

The segment is also witnessing a growing interest of domestic as well as foreign OEMs. As a result, a number of products are being introduced in the country. Additionally, the Government is exploring ways to address one of the biggest hurdles – high cost of e-buses (due to larger batteries). It plans to work with automakers to reduce the battery size of intra-city buses from 300 kWh to 50 kWh.

For a large-scale sustainable rollout of fleets of e-buses, there is a need to formulate a city-based approach. We have provided a few considerations below for a large-scale roll-out of e-buses.

Integrate e-buses in smart-city agenda

- ▶ Run a pilot in smart cities for a few years, jointly funded by Central and state Government to ensure sustainability of the model

Identify strategic locations to set up charging points

- ▶ Install charging points at major bus depots.
- ▶ Roll out pilot of fast charging (5-10 mins) and battery swapping stations at prominent bus stops
- ▶ Move to PPP model for charging infrastructure deployment in the long run

Government support to establish agreements between SRTUs and OEMs

- ▶ Consider agreements between SRTUs and OEMs for acquisition of battery-less e-buses, because a typical electric bus costs upward of 2.5x of a conventional bus

Source: Interviews with industry executives, EY analysis



CVs - Goods carriers: SCVs and LCVs are likely to be early adopters, eventually propelling electrification in the M&HCV segment

The costs of electric M&HCV and the required infrastructure are likely to come down as sales of electric SCVs and LCVs increase, leading to improved commercial viability for M&HCVs as well

Road transportation accounts for a majority (around 60%) of goods transportation in the country. As a result, CVs represent a huge market (annual sales of ~700,000 units in FY17, likely to reach 2.0 - 3.9 million units by 2026, as per the Automotive Mission Plan) and offer a significant opportunity for electrification.

The demand for fuel-efficient trucks is expected to increase further with India's plan to leapfrog to BS-VI emission norms in 2020. This could provide a thrust toward the adoption of electric trucks in India as ICE trucks are likely to get costlier by up to 20%, leading to a convergence in prices of diesel-powered and e-trucks.

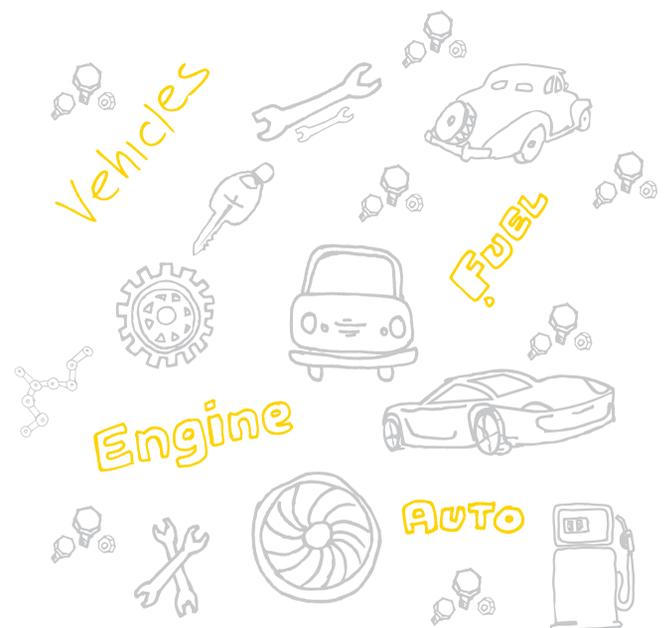
6-8 years → Estimated payback period of an electric truck due to gradually decreasing battery costs as compared to 3-4 years for a diesel truck.

Segment	SCVs	LCVs	MCVs	HCVs
Average daily run (km)	50 - 200	50 - 300	300 - 500	300 - 1000
Payload capacity	Low	Low	Medium	High

There are niche user groups/applications within the SCV and LCV segments that could see early adoption with potential government push and supporting infrastructure development. Some of the potential applications include postal delivery vans and urban delivery vans/trucks. These vehicles have low average daily run and some route predictability, which can be served by current/upcoming product offerings.

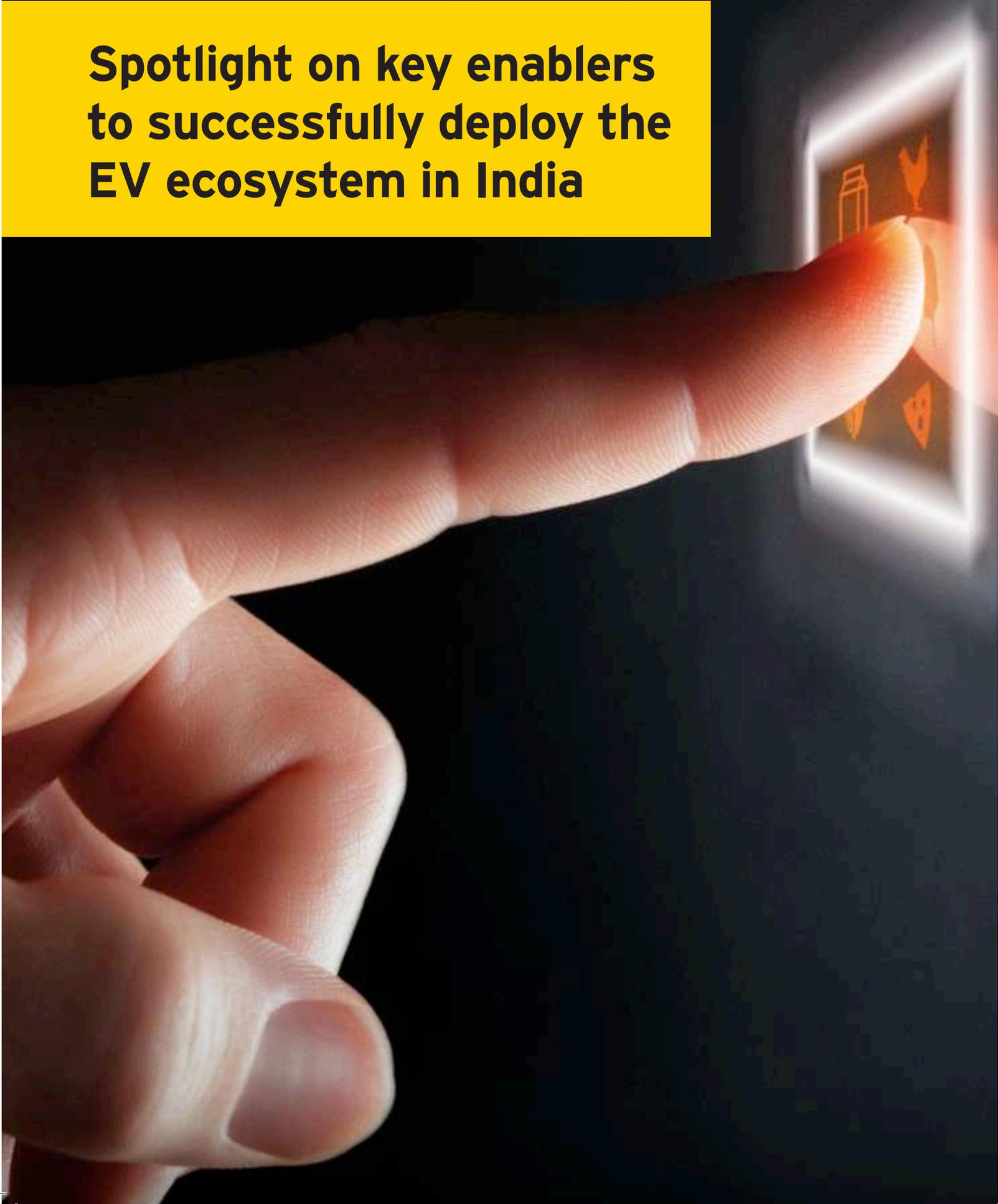
Unlike SCVs and LCVs, the arrival of electric M&HCVs-Goods carriers (7.5t and above) in India is further out as the current range does not meet the requirement of average daily run of these vehicles. Additionally, the nature of their operations is also inter-city, which necessitates a widespread network of charging infrastructure on main highways that currently is not in place.

The potential for a switch to EVs remains high due to the high vehicle utilization in the CV segment. However, high battery capacity requirements due to higher payload and uncertainties around decline in residual value with rapid battery technology improvements might act as a deterrent to adoption.



Source: SIAM, AMP, Pipper Jiffaray, EY analysis

**Spotlight on key enablers
to successfully deploy the
EV ecosystem in India**

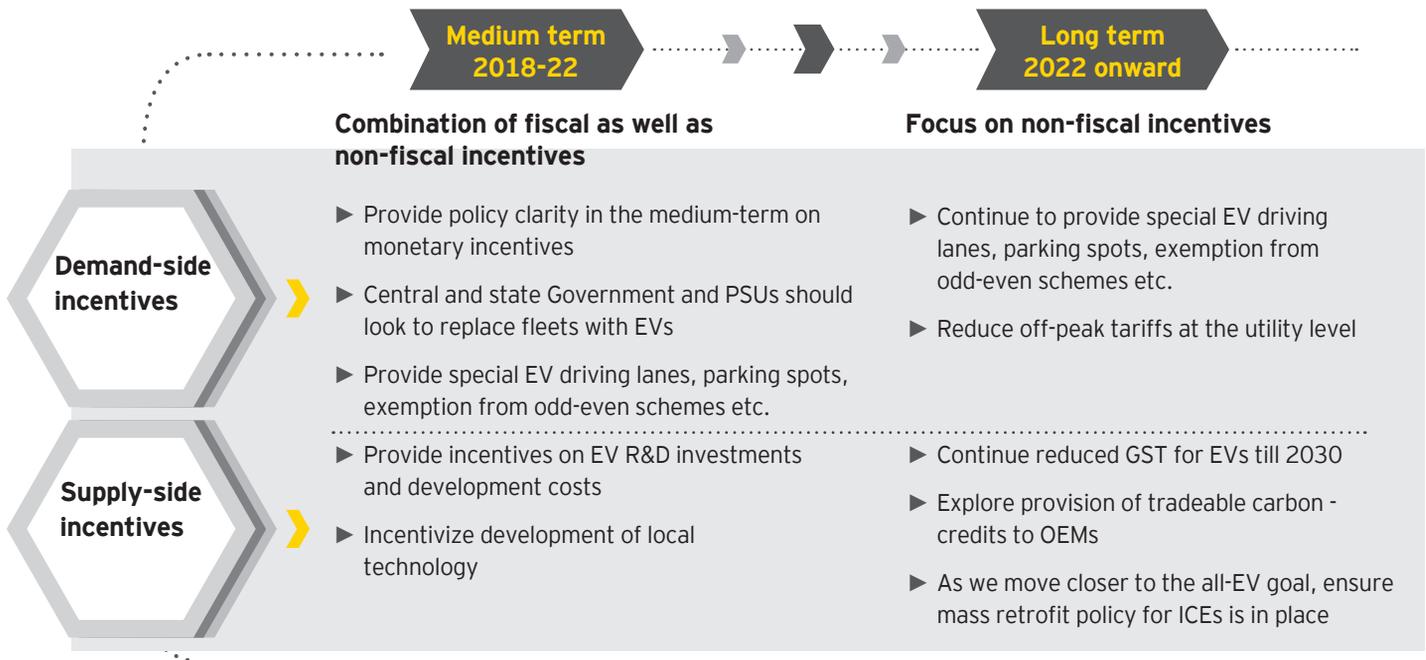


Role of regulators: There is a need for a long-term policy framework that allows for continuity and attracts desired investments required for EV deployment

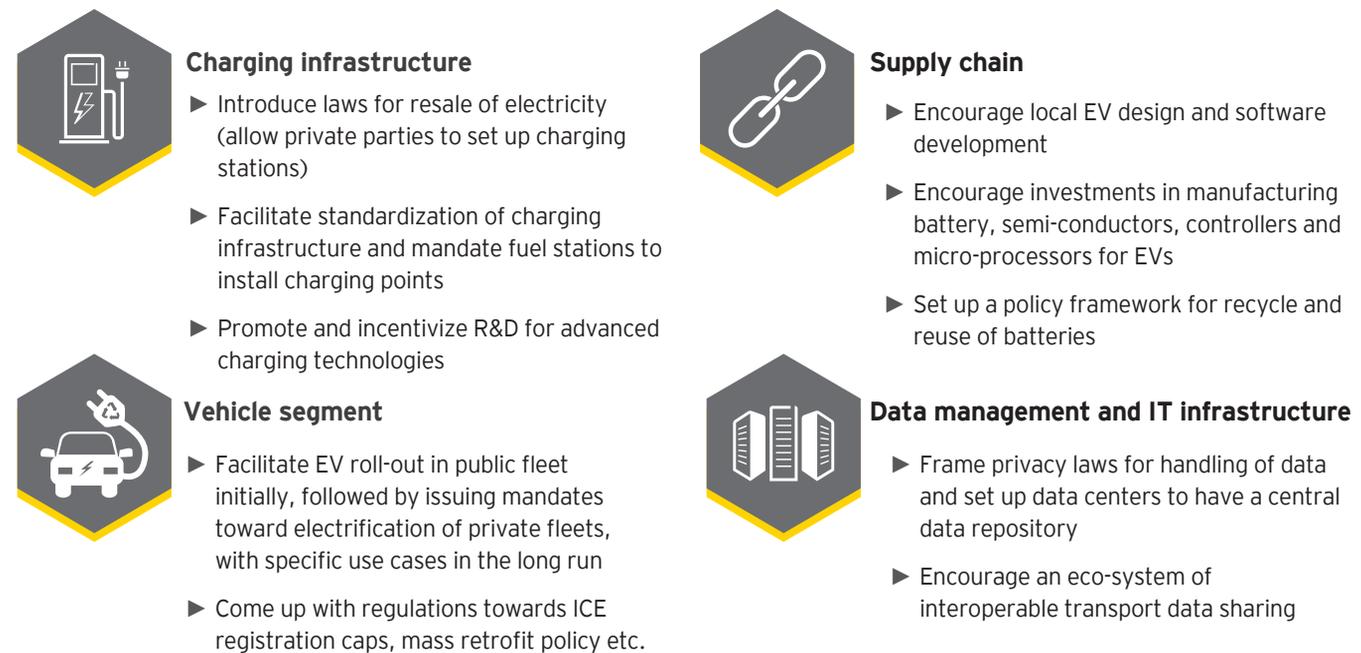
Following the Government's announcement of complete vehicle electrification by 2030, we can see pioneering efforts of different stakeholders in this direction. The increased traction and the nascent state of the EV industry necessitate the requirement of the Government's handholding, at least in the short to medium term.

The Government could potentially explore a two-phased policy clearly stating the time-frame and magnitude of incentives.

We recommend a focus on both fiscal and non-fiscal incentives in the short run and, in order to make the ecosystem self-sustaining, a shift to only non-fiscal benefits in the long-run.



There is also a need to make amendments in the current regulations and to introduce new regulations across the ecosystem.



EV sales in Norway reached as much as 42% of the total cars registered in the country in June 2017. The country's EV incentives are helping maintain a 10 times higher rate of adoption than most countries. This includes exemption from value added tax (VAT) and purchase tax, which averages 43% of the cost of a vehicle. Also, EVs are exempted from road charges, with dedicated bus lanes for EVs, free electricity and free parking at numerous charge points as well as municipal spaces across the country.

Source: EY analysis

EV supply chain: The absence of an EV supply chain in the country demands an urgent investment in R&D and local manufacturing capabilities

The transformation from ICE vehicles to EVs has significant implications for the existing automotive industry supply chain. An EV is relatively simpler to build with only 20 moving parts against ~2,000 in an ICE vehicle.

The growth of EVs will lead to profound changes across the automotive value chain, including technology, manufacturing systems, ownership models, distribution and aftermarket support. This would cause a significant decrease in addressable market for vehicle repairs/ service and would require them to build new capabilities.

From the perspective of component suppliers, large automotive suppliers are likely to adapt to the dramatic changes; however, small players could be hit the hardest from this disruption.

The existing suppliers will not only have to deal with the transition, but also face severe competition from the new entrants in the industry such as technology companies and battery producers.

Impact on major auto-components

Negative impact		Neutral		Positive impact	
Engine parts		Steering systems		Electric motors	
Clutch		Seats		Batteries	
Radiators		Brake lining		Inverters Wiring harnesses	
Gears		Leaf springs		Microprocessors	
Shock Absorbers		Controllers			

- ▶ **OEMs likely to lose some control in the EV value chain:** EVs are less complex to manufacture as compared to ICE vehicles with far fewer moving components and the battery constituting more than 50% of the value of vehicle. This would result in a dilution of control for the OEMs.
- ▶ **Significant changes in component manufacturers' portfolios:** Existing powertrain-related suppliers would lose markets, making them significantly smaller in an all-EV scenario. Whereas new opportunities lie in EV parts such as battery, motors, controllers and microprocessors.
- ▶ **Lack of battery manufacturing capabilities in the country to lead to more partnerships and collaborations:** As EVs gain traction in India, OEMs need to look to secure access to Li-ion reserves and R&D capabilities to manufacture batteries indigenously. Hence, a number of foreign collaborations, partnerships and consortiums between OEMs, battery producers and suppliers could be expected.

Implications

- ▶ OEMs need to reinvent their business to focus on building relationships with battery and electric/electronics component suppliers and also explore opportunities for in-house battery manufacturing.
- ▶ Given the ease of manufacturing of EVs combined with a larger trend of increased vehicle sharing, there is a risk of vehicles getting commoditized and thus an increased focus on OEM brand differentiation would be required.
- ▶ Component manufacturers need to re-align their product portfolios as the industry transitions to EVs.
- ▶ Given EVs are a cross-sector play, new sources of value creation will need to be discovered and the pecking order of the industry participants will get redrawn.

Source: EY analysis

EV charging infrastructure: There is an urgent need to offer flexible charging infrastructure for different vehicle segments to drive adoption of EVs

Charging infrastructure is the most crucial enabler in the entire EV value chain. Based on experience from multiple countries, and surveys by think tanks, the limited availability of charging infrastructure, including a lack of adequate business and financing models, is considered to be one of the biggest obstacles to the widespread adoption of EVs by customers, who still suffer from "range anxiety."

The Indian Government has been exploring different charging models keeping in mind the local conditions to kick-start faster deployment of electric vehicles in the country.

The three key roadblocks associated with EVs are as follows:

- ▶ High capital cost of batteries
- ▶ Charging time on the stations compared to refuelling diesel/petrol
- ▶ Range anxiety

As a result, battery swapping has emerged as a feasible solution for public fleets including e-buses, and e3Ws (rickshaws and autos).

Category	Segment	Short term (2018-19)	Medium term (2020-22)
2Ws	Private		
	Commercial		
3Ws	Commercial		
PVs	Private		
	Commercial		
CVs - Buses	Commercial		

Personalized charging
 Public charging
 Battery swapping

Source: EY analysis

Case study : Smart city EV pilot – Nagpur

The government of Maharashtra launched India's first multi-modal EV pilot in Nagpur in May 2017. The project is being run by the Municipal Corporation of Nagpur in collaboration with private players. Its salient features include:

- ▶ Initial investment of INR200 million (estimated) toward EVs and charging infrastructure

- ▶ Network of 10 fast chargers (initially) created across three strategic locations
- ▶ Waiver of VAT (formerly), road tax and registration of EVs by the state government
- ▶ End-to-end project deployment in less than 3 months

Key components of the Nagpur EV pilot

Vehicles deployed	Charging infrastructure
Around 200 EVs deployed across Nagpur	Public charging stations spread across the city (fixed distance gap)
OEMs involved: BYD, Kinetic, Mahindra Electric, Tata Motors and TVS	Battery swapping stations set up for 3Ws
Category of vehicles: <ul style="list-style-type: none">▶ 100 cars▶ 100 e-rickshaws▶ 2-3 buses	<ul style="list-style-type: none">▶ Single point, multiple chargers▶ All EVs come back to base for charging

Key findings

Outcomes

1. Overall, the operating cost for passenger cars reduced by **50%**
 1. At **less than INR2/km**, the running costs are much lower than of a diesel or a petrol car
 2. It takes **approximately 14 units of electricity** for a full charge, on which the car runs about 100 km
2. **Faster recharge:** A super charger takes about 1 hour and 15 minutes to charge an electric car. The pilot made it very clear that there is certainly a strong need to bring down the charging time.

Challenges

1. **Range:** Currently the vehicle range is around 100 km for passenger cars, while the desired range is around 200 km. High ambient temperatures, especially around the afternoon, further reduced the range to 85-90 km per charge.
2. **Charging:** A dedicated transformer and transmission line was set up for the pilot. However, power cuts and fluctuations posed challenges. Grid condition needs to be improved for better and continuous charging.
3. **Limited vehicle options:** Currently, there are very limited products available in the market to choose from.

The Nagpur pilot is a good example of collaboration between the Government and industry to facilitate the commercial deployment of EVs in India. We expect the Government to replicate this in other clusters to help develop the EV ecosystem in other parts of the country.

Source: Interviews with industry executives, EY analysis

Case study: Lithium Urban Technologies - India's first 100% EV-based commercial fleet operator

Commencing operations in mid-2015, Lithium has pioneered a new concept in the country's urban mobility by demonstrating EVs' commercial and operational viability in fleet operations.

- ▶ The company currently caters to the corporate employee transport sector in Bengaluru and Delhi with an all-EV fleet. It plans to commence operations in Chennai, Pune, Hyderabad and Mumbai during FY18.
- ▶ Lithium has built an analytics platform that enhances vehicle and charger productivity, resulting in 10%-30% reduction in transportation costs for its clients.
- ▶ The company managed to set up its own city-wide captive charging stations overcoming the challenge of a non-existent EV ecosystem.
- ▶ Lithium has been chosen by the Government of India to build 60 public DC fast charging stations across the National Capital Region.

At a glance...



100% electric fleet of ~ **400 EVs**



EBITDA positive within **10 months** and cash positive within **25 months** of operations



Partnered with **800+** drivers



Clocked in excess of **20+ million km**



Vehicles run **250-300 km** per day



Abated **7000+ MT** of CO₂ emissions to date

The company's core philosophy of **"Sweat the Car and Not the Driver"** ensures a sound working environment for its drivers along with financial inclusion and social mobility (with career path options).

"Reimagining How We Commute - Clean, Distributed, Shared, Connected"
Sanjay Krishnan, Co-founder & CEO, Lithium

"Delivering Tomorrow's Transportation, Today"
Joy Nandi, Head NCR, Lithium Urban Tech

How EY can help?

Key considerations for stakeholders:

Vehicle manufacturers	Component suppliers	Utilities	Mobility providers
<ul style="list-style-type: none"> ▶ Develop and operationalize a future of mobility strategy to position the business in the evolving market landscape ▶ Re-design the organizational structure to include new businesses such as vehicle/battery leasing through captive arms ▶ Explore niche markets and use cases that are more amenable to EV adoption 	<ul style="list-style-type: none"> ▶ Re-align business model in view of changing powertrain requirements ▶ Explore tie-ups/ collaborations to penetrate the EV market ▶ Assess opportunities in localization of manufacturing operations ▶ Battery manufacturers to tie-up with charging operators for battery swapping 	<ul style="list-style-type: none"> ▶ Develop smart grid capabilities such as smart metering and Vehicle to Grid charging ▶ Offer special time-of-use rates for charging ▶ Explore innovative business models such as pay per use ▶ Set up independent line for charging stations 	<ul style="list-style-type: none"> ▶ Identify business models and specific use cases where EVs could offer better value proposition over ICE vehicles ▶ Target cities as customer: Align current vehicle portfolio to include EVs to match city-specific mobility needs ▶ Explore alliances/ partnerships with other stakeholders

Why EY in electric mobility?



Global footprint

- ▶ We are leading global-scale providers of business performance consulting services to the automotive industry
- ▶ We serve 100% of the automotive companies included in the 2016 Fortune Global 1000
- ▶ 13,000+ automotive and transportation professionals covering the globe



Launched successful mobility services in market with clients

We have hands-on experience establishing live mobility services in global markets based on our proven delivery model

- ▶ Launched on-demand mobility services based on parking, ride sharing, vehicle postal delivery and dynamic taxi services
- ▶ A deep understanding of business model innovation, creating new models in response to disruption
- ▶ Experience in bringing the best of our global network and start-up community to accelerate mobility development



Ability to define and validate where the value is

We have helped multiple clients to develop their mobility businesses to maximise the value potential, delivering the following:

- ▶ A portfolio approach that can drive improved return on Innovation Investment (ROI)
- ▶ Business models with economics that are grounded in best practice and calibrated based on in-market testing
- ▶ Options for how to scale-up and monetize mobility businesses



Building a mobility ecosystem

We have hands on experience of building mobility ecosystems, understanding what is needed for this. Our experience and approach will accelerate:

- ▶ Exploiting the synergies and linkages between mobility, journey and beyond, especially through data
- ▶ Creating the partnerships needed to succeed, with both start-ups and other corporates
- ▶ Creating "city as customer" value propositions to ensure mobility works with and for its choice of municipalities



Ability to create a repeatable innovation approach

We have helped embed innovation techniques into multiple clients from other industries. We can create the necessary organization as a "living" construct with repeatable approaches to: funding, partnerships, talent and ways of working, data and technology, IP and innovation process

EY contacts

Rakesh Batra

India Automotive & Transportation Leader
+91 124 671 4532
rakesh.batra@in.ey.com

Randall J Miller

Global Automotive & Transportation Leader
+1 313 628 8642
randall.miller@ey.com

Somesh Kumar

India Power and Utilities Leader
+91 11 66718270
Somesh.Kumar@in.ey.com

Anil Valsan

Global Automotive & Transportation Lead Analyst
+44 20 7951 6879
avalsan@uk.ey.com

Shuvendu Bose

Executive Director, Power and Utilities
+ 91 124 671 4083
shuvendu.bose@in.ey.com

Regan Grant

Global Automotive & Transportation Marketing Leader
+1 313 628 8974
regan.grant@ey.com

Som Kapoor

India Automotive Retail Leader
+91 124 671 4603
som.kapoor@in.ey.com

Kanv Garg

Director, Power and Utilities
+ 91 124 443 5779
kanv.garg@in.ey.com

Gaurav Batra

Associate Director, EY Knowledge
+91 124 470 1245
gaurav.batra3@in.ey.com

Shikhar Gupta

Manager, EY Knowledge
+ 91 124 470 1233
shikhar.gupta@in.ey.com

Anuj Chandna

Manager, EY Knowledge
+91 124 470 1282
anuj.chandna@in.ey.com

Contributors: Tanvi Madaan



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