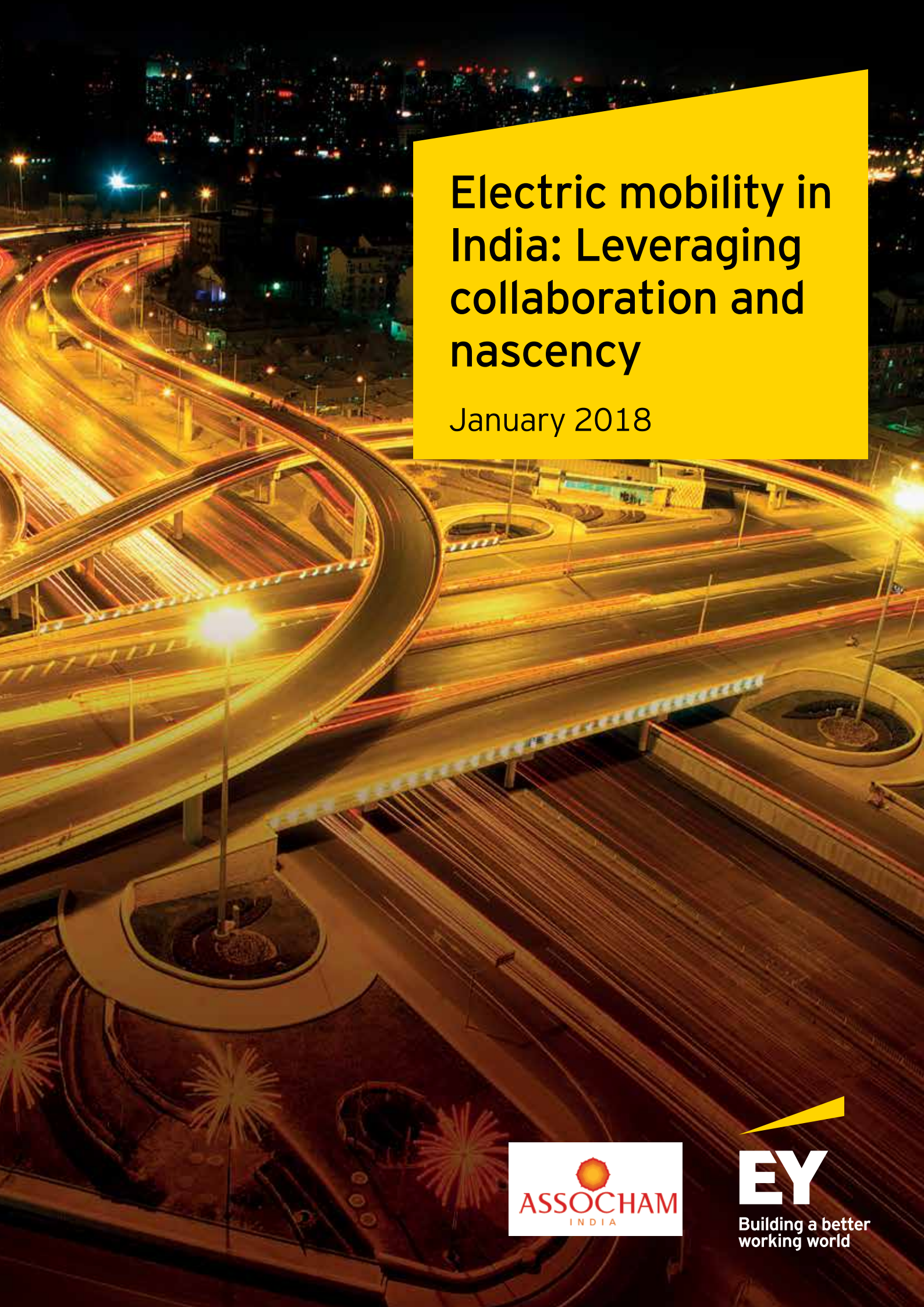


Electric mobility in India: Leveraging collaboration and nascency

January 2018

ASSOCHAM INDIA

EY
Building a better working world

Foreword

The Indian automobile industry is on the cusp of a paradigm shift from internal combustion engine vehicles to zero emission vehicles. This is on account of depleting air quality and rising greenhouse gas emissions. As such, the Indian automobile industry is one of the largest growing markets of the world. Adoption of EV will not only be a stepping stone in designing an intelligent transport infrastructure in India but would also reduce India's excessive dependence on oil imports and curb pollution levels too.

Electrification of mobility is still in nascent stages in India but growth momentum is expected over the next 3–5 years. The growth, however, will depend on multiple factors that would be crucial such as technology development, demand creation, price differentials, charging infrastructure and ease of charging for unhindered transportation.

It is estimated that about 6 million EVs will be launched on Indian road by 2020. As per the Government of India's plan, by 2030 most of the vehicles will be powered by electricity, resulting in a saving of US$60 billion in energy costs and 1 gigatonne of carbon emissions. India thus offers tremendous opportunity for those who are willing to make the first move in this market.

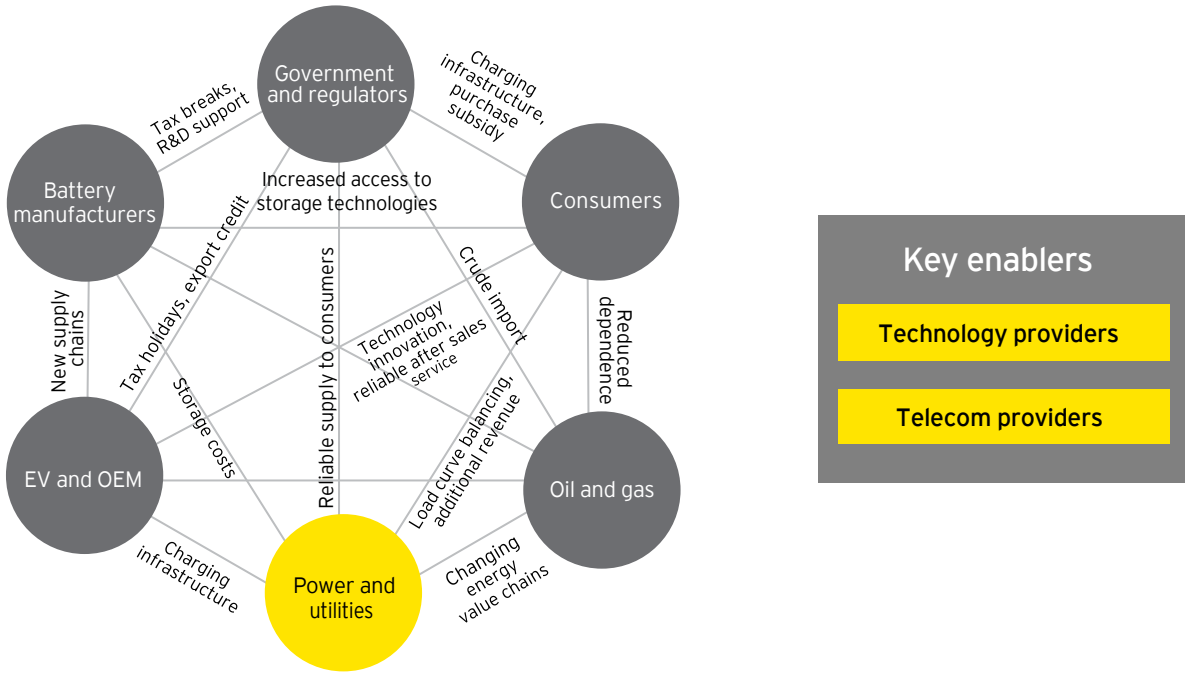
ASSOCHAM will continue to provide a conducive platform for exchange of ideas and technical knowhow and promote business interactions and interaction with the policyakers.

I sincerely thank EY, our knowledge partners, for their efforts in preparing this paper. We hope these will merit the kind consideration of policymakers.

D.S. Rawat
Secretary General, ASSOCHAM

Context

Global mobility is facing huge disruption as stricter emission norms, reducing battery prices and increasing consumer awareness are driving electric vehicle (EV) adoption. In India, while EVs are not yet mainstream, government push and other indications point to a growing momentum. The accelerated and upcoming EV adoption is set to disrupt a variety of stakeholders as it presents a complex program with linkages across the energy, manufacturing, consumers and government sectors.



Source: EY analysis

While the current lack of EV charging infrastructure is potentially the biggest challenge to EV adoption in India, it also presents a tremendous opportunity for those who are willing to make the first move in this market. Market players from different industries will find it difficult to ignore this opportunity as they risk losing out to competitors who could leverage their presence in the EV business. We are already seeing interest from power and utility companies, oil and gas majors, and fleet aggregators in setting up charging infrastructure.

The players will be looking to gain a leadership position by leveraging their scale and balance sheet strength to take on risk and expand their scope of business from being manufacturers to mobility providers. They need to:

Develop and operationalize a future of mobility strategy to position the business in the evolving market landscape

- Consider alternate business models that decouple ownership (vehicle, battery) vs. access
- Explore niche markets and use cases that are more amenable to EV adoption
- Challenge the type of innovation portfolio required – optimize "how to win vs. where to play"
- Collaborate across traditional industry boundaries to create a competitive ecosystem
- Work closely with "city as a customer" – to deliver consumer experience
- Collaborate closely with policymakers on pilot programs to demonstrate viabilit

Going forward, this accelerated move toward EVs will be a stepping-stone in designing an intelligent transport infrastructure in India. The roadmap to the electric mobility vision is based on the growing collaborative economy and the proliferation and success of electric and shared mobility business models.

As urbanization depletes natural resources, EVs and digital technologies such as smart wearables, Internet of Things (IoT) and telematics will take center stage to enable the provision of customizable mobility packages, and different stakeholders will compete for a share of customers' mobility spends. In the long run, India will witness the rise of technology-driven mobility service providers, who will draw Indian consumer toward the idea of "access" from "ownership."

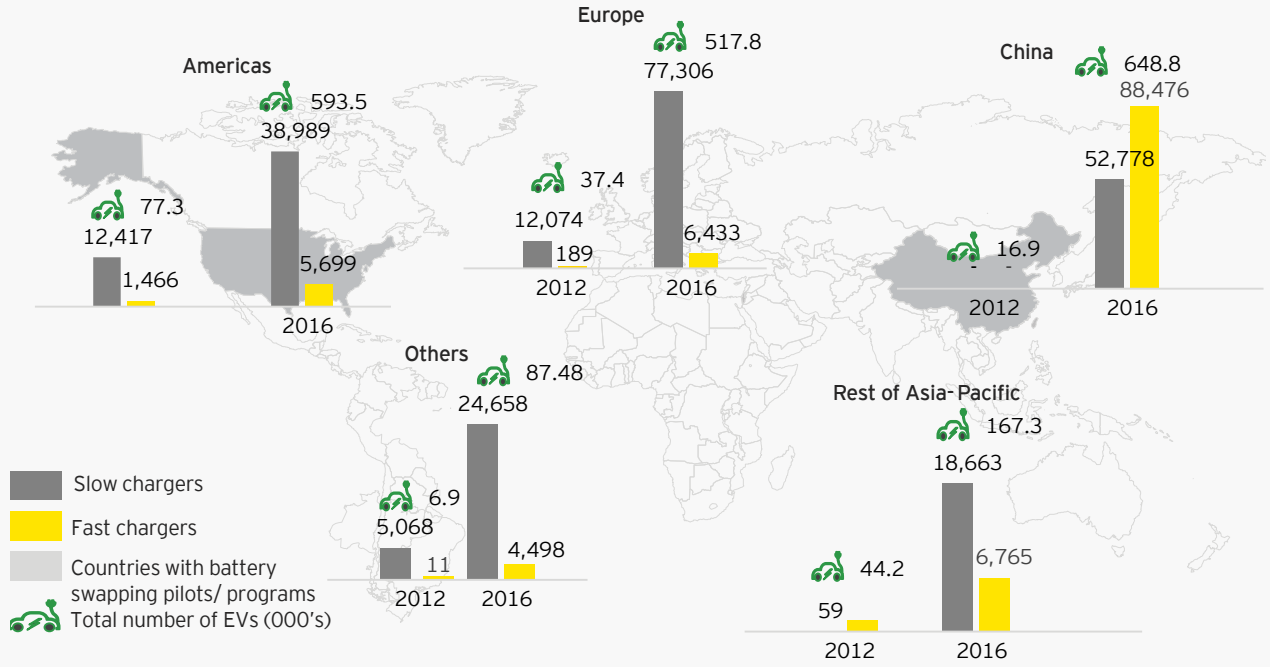
Contents

EV of **landscape** in India

There is a widespread acknowledgment that a game-changing disruption is on the horizon for the global mobility. The industry is at the cusp of a paradigm shift from internal combustion engine (ICE) 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. According to IEA and Bloomberg New Energy Finance, more than 750,000 EVs were sold in 2016, up 37.6% from 2015, and nearly 530 million[2] electric cars will be sold globally by 2040, representing about one-third of the total market for automobiles.

A blossoming EV market is accompanied by a world record number of electric vehicle supply equipment (EVSE) installations, also known as EV charging points. In 2016, the total installed publically accessible chargers grew to 322,265, an increase of 72.2% from 2015. With more than 80,000 installations last year, China has become the global leader in installed charging stations.[3]

Figure 2: EV stock ('000), number of publically available slow and fast chargers in different geographies



Source: EY Analysis, IEA
Note: "Others" include Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Greece, Hungary, Iceland, Italy, Ireland, Latvia, Lichtenstein, Lithuania, Luxemburg, Malta, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Switzerland and Turkey. Countries with battery swapping pilot/programs include US (Tesla), China, Israel (Better Place) and Taiwan (Gogoro)

The growth dependency of EV adoption and charging stations is often described as the chicken and egg problem, i.e., the need for ample EV penetration as a prerequisite for EV charging infrastructure deployment vs. the need for abundant EV charging infrastructure as a prerequisite for EV adoption.

However, recent studies confirm that availability and accessibility of reliable public charging infrastructure must precede dense EV penetration. In the absence of a robust charging infrastructure, EV fleet growth will also be difficult to sustain, as can be seen in the example of California. The region of California leads the US EV adoption, with 269,000[4] sales during 2011–16, representing nearly 48% of total EVs across the US. However, charging infrastructure has not kept pace with the EV growth, with only 12,000 public chargers available in California[5].

1.1 Indian EV market and key trends

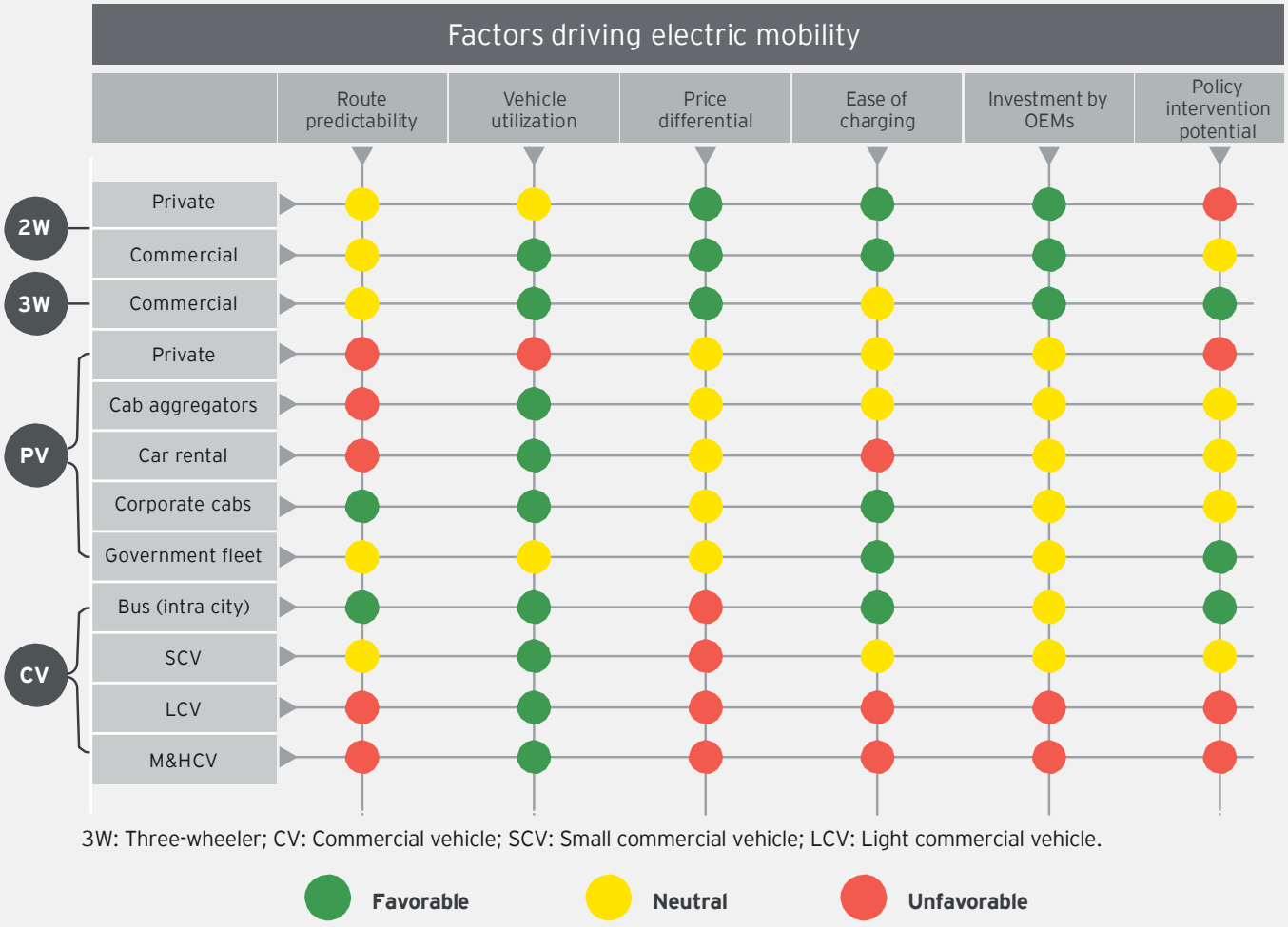
The Indian automobile industry is one of the largest growing markets in the world and contributes highly to the country's manufacturing facilities. Adding to this, the automotive industry in India is expected to improve India's GDP to 25% by 2022 from 15% currently, with the production of EVs being the new talk of the town.

India 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 EV industry is at a nascent stage in India, comprising less than 1% of the total vehicle sales and is dominated by two-wheelers (2Ws) (95%). However, the EV market has the potential to grow significantly in the coming years, as sales are expected to witness high double-digit growth rates annually till 2020.

A varied pace of electrification is expected across different vehicle segments driven by specific user groups in India. The growth will depend on multiple factors that will be crucial to making the market ready for electrification of mobility in India.

A brief summary is provided below:

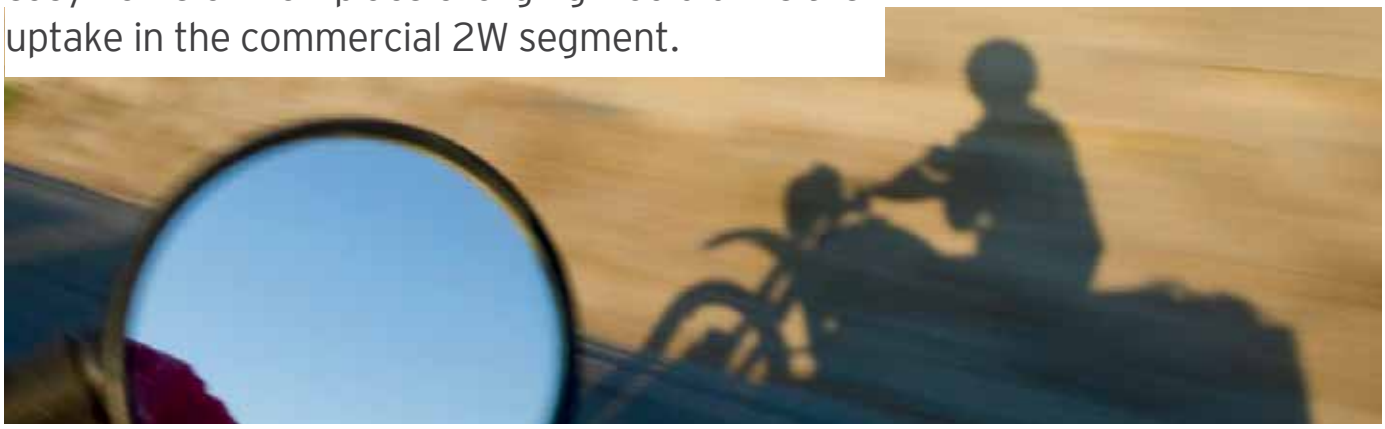
Figure 3: Segment analysis



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

Source: EY analysis, IEA.
For more details, please refer to EY's thought leadership report titled "Standing up India's EV ecosystem - who will drive the charge?"

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.



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

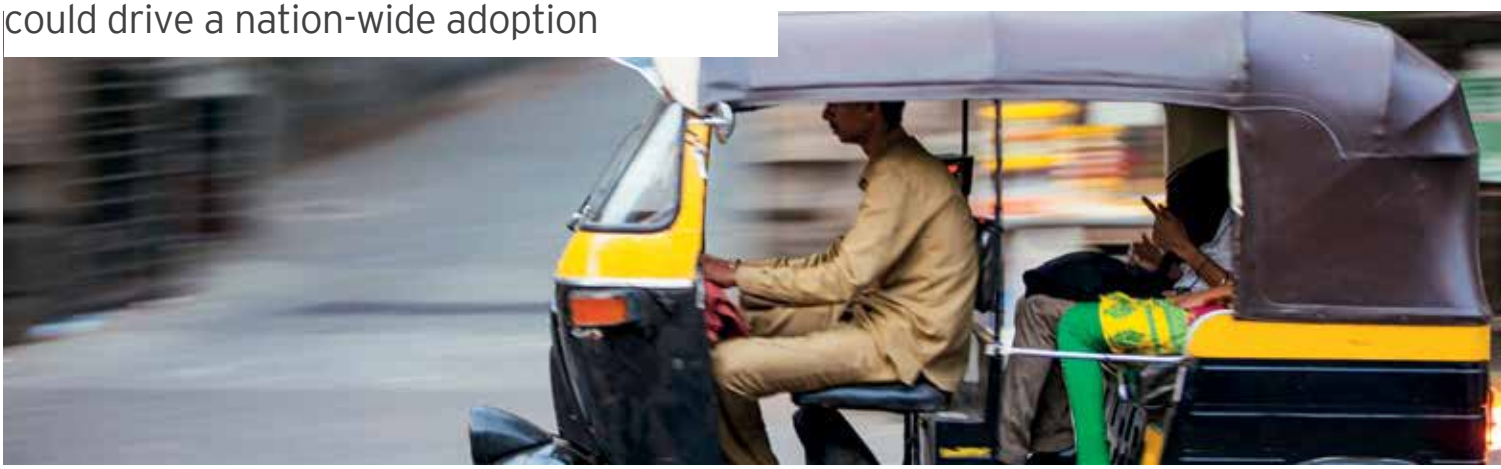
The e2W segment has already demonstrated its potential in 2011–12, when e2Ws clocked sales of 90,000 units. However, the sales saw a dip in the following years with a withdrawal of subsidies by the Ministry of New & Renewable Energy (MNRE), with sales of only 25,000 units in 2016. However, development of an end-to-end ecosystem (right from in-house manufacturing to setting up the charging infrastructure) by emerging start-ups is likely to accelerate the adoption of e2Ws.

2Ws

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

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



India has emerged as one of the biggest 3W markets, with 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 also witnessing an influx of e-rickshaws, with some estimates putting their numbers around 1 million.

3-wheelers (3Ws)

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. However, it will need significant steps to ensure their merited expansion is undertaken:

- Make safety and prototype tests mandatory
- Integrate e-rickshaws in city-based mobility plans
- 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 on loans from various financial institutions

Source: SIAM, SMEV, EY analysis.

For more details, please refer to EY's thought leadership report titled "Standing up India's EV ecosystem - who will drive the charge?"

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.

Private Vehicle

Electric car sales, however, have continued to be very low and constituted merely 0.1% of the PV sales in FY17. The acceptance of EV will depend on multiple drivers such as range, cost and charging infrastructure and will also vary for different PV segments:

- Corporate fleets, which have a defined route and operations in a limited geography, will be the first ones to adopt.
- Cab aggregators/fleets are likely to be more willing to adopt EVs as the vehicle low running costs are one of the major influencers in purchase decisions.
- Retail customers are likely to be the last in line to adopt EVs, given the concerns around range, high acquisition cost and lack of awareness.

Car sharing and a shift from vehicle ownership to access are likely to significantly push EV penetration, as utilization of a shared vehicle is 25%–30% as compared to only 4%–5% of a private use vehicle.

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

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. India is 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, Telangana and Gurgaon.

Commercial Vehicle

- In order to make it successful, the Government is exploring ways to address one of the biggest hurdles – the high cost of e-buses (due to larger batteries). The Government is developing a plan 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 by running a pilot in smart cities, installing charging points at major bus depots and rolling out pilots of fast charging and battery swapping stations.

Source: SIAM, SMEV, EY analysis

For more details, please refer to EY's thought leadership report titled "Standing up India's EV ecosystem - who will drive the charge?"

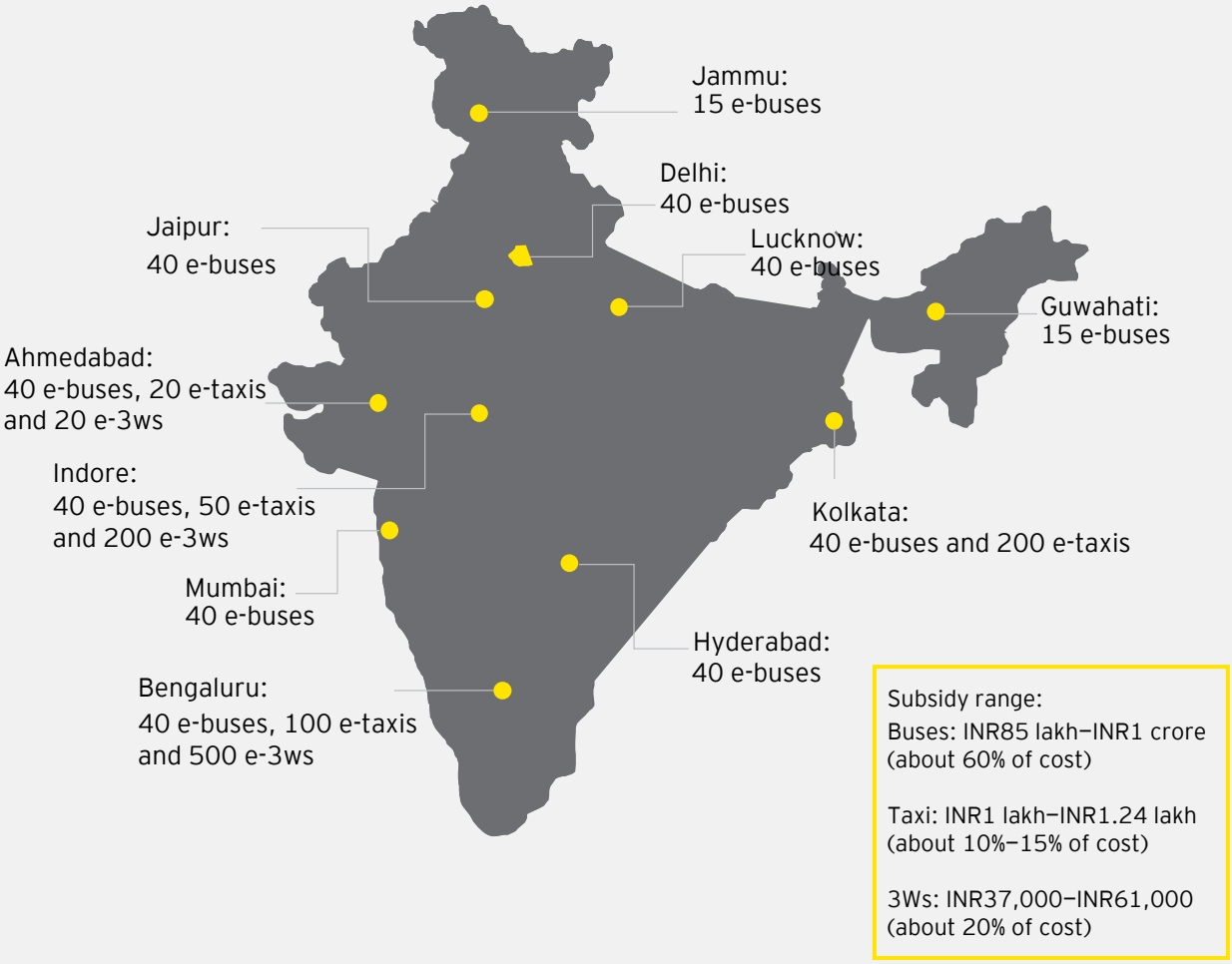
1.2 Central-level policy frameworks on EV adoption in India

Under the National Electric Mobility Mission Plan 2020 (NEMMP), India has set targets to have 6 million EVs on the road by 2020. The Government plans that by 2030 most, if not all, vehicles in India will be powered by electricity, which could aid in saving US$60 billion in energy costs by 2030 and 1 gigatonne of carbon emissions between 2017 and 2030 by adopting more electric and shared vehicles[6].

The Government of India launched its Faster Adoption and Manufacturing of Hybrid and Electric vehicles (FAME) scheme in 2015, which outlines subsidies for EV adoption and has an increased focus on four key areas: technology development, demand creation, pilot projects and charging infrastructure. The FAME scheme is inclined more toward offering consumer incentives rather than incentivizing the R&D, providing incentives in terms of subsidy to different vehicle segments. According to the heavy industries ministry, a total estimated subsidy worth INR14,000 crore will be required for the promotion of EVs and associated charging infrastructure[7].

In April 2018, the Central Government plans to launch FAME II, under which priority will be given to public transport in India and the prime objective will be to roll out a number of electric buses, electric 3Ws and electric shared cabs for multi-modal public transport. The Department of Heavy Industry has announced that the Central Government will subsidy totaling INR437 crore to 11 cities under the FAME II scheme, which includes an INR40 crore subsidy for installation of charging infrastructure[8].

Figure 4: Number of vehicles & amount of incentives to 11 cities under FAME II scheme



Source: EY analysis

Taxation policy: The Central Government has also developed the necessary taxation policy to drive EV adoption. Differential GST for EVs has been implemented by the Government as it is expected to help electric mobility gain momentum.

- Pure EVs have been kept in the 12% tax slab under GST.
- Manufacturers of pure EVs would face an inverted duty structure with major inputs liable to GST at either 18% or 28%.
- Hybrid vehicles have been kept in the same category as luxury cars and will be taxed at the peak rate of 28% plus a cess of 15%.

Focus on charging standards: India needs to create charging infrastructure at a rapid pace as it is the determining factor for the growth of EVs. The major challenges in the establishment of a robust charging network include lack of standardized charging infrastructure specifications and requirement of a distribution license. To solve these issues, DHI had formed a Committee on Standardization of Protocol for EV Charging Infrastructure. The Government is also setting liberal rules for charging stations under which government or private institutions setting up charging infrastructure will not require any electricity retailing license.

Other initiatives: The Indian government is backing the above policies by taking some important initiatives in the EV space. A joint effort by the Indian Government and SIAM named "Project xEV One" has been planned to develop a network of suppliers for building electric and hybrid vehicles. The Government has planned to use EVs in vehicle fleets of government departments/ agencies and has already given Energy Efficiency Services Ltd (EESL), the nodal agency for procuring EVs on behalf of the Indian Government, tenders for 10,000 EVs to Tata Motors and Mahindra.

1.3 State-level policy frameworks on EV adoption in India

Along with the Central Government, various state governments have also started finalizing their EV and EV charging policies. States such as Karnataka, Telangana and Andhra Pradesh are the first movers, coming up with their own policies to promote the EV ecosystem.

State governments also plan to develop charging infrastructure as a commercially viable business venture that will attract private investment. The state policies intend to be in line with the vision of India to be 100% fossil free in road transport. The ecosystem needs to have aligned policies and facilitation by both the Center and states as many components of the ecosystem cover policies that fall under the concurrent list, for example, transport and power, in which both states and the Center have a say.

The Karnataka State Government, in its efforts to become the EV capital of India, approved the state's Electric Vehicle and Energy Storage Policy 2017. The new policy aims to attract investments worth INR31,000 crore and create around 55,000 employment opportunities.

The State Government is looking to set up new EV manufacturing zones, set up charging stations in public and private spaces including airports, railway stations, metro stations, and encourage start-ups to develop business models focused on supporting economic applications for EVs. According to their charging policy document, the Karnataka Government plans to do the following:

1. Come out with standards for battery, charging infrastructure and swapping mechanism to help build interoperable network where different OEMs can participate
2. Provide land on long-lease basis for setting up of EV fast-charging stations and battery swapping infrastructure
3. Electricity Supply Corporations of Karnataka to bring amendments to their policies and allow resale of power to encourage setting up of charging stations
4. Introduce lease/pay-per-use business models with battery-swapping station network in partnership with private players
5. Facilitate the deployment of used EV batteries for solar application, and provide battery disposal infrastructure in PPP

Andhra Pradesh

is looking to put in place an electric-mobility policy by January 2018 and is seeking to attract investments of INR30,000 crore in the EV industry by providing capital subsidies to automakers and charging-equipment manufacturers.

Andhra Pradesh in its proposed policy is looking at waiving off registration and road tax on the sale of EVs. In addition, they will be imposing additional taxes on petrol and diesel vehicles and introducing promotional schemes for women and consumers from vulnerable backgrounds for 2W purchases.

In order to invite investments into the charging infrastructure, the Government has proposed to provide capital subsidy and SGST exemptions for charging infrastructure installations. They also have a plan in place to provide land at concessional rates to charging stations and battery swapping kiosks and are looking to make it mandatory for bus terminals, bus stops, government offices and public parking to have charging stations.

Telangana

has come up with a final draft of a comprehensive EV policy in order to provide incentives to manufacturers and private players in setting up charging stations. Some of the salient features are as follows:

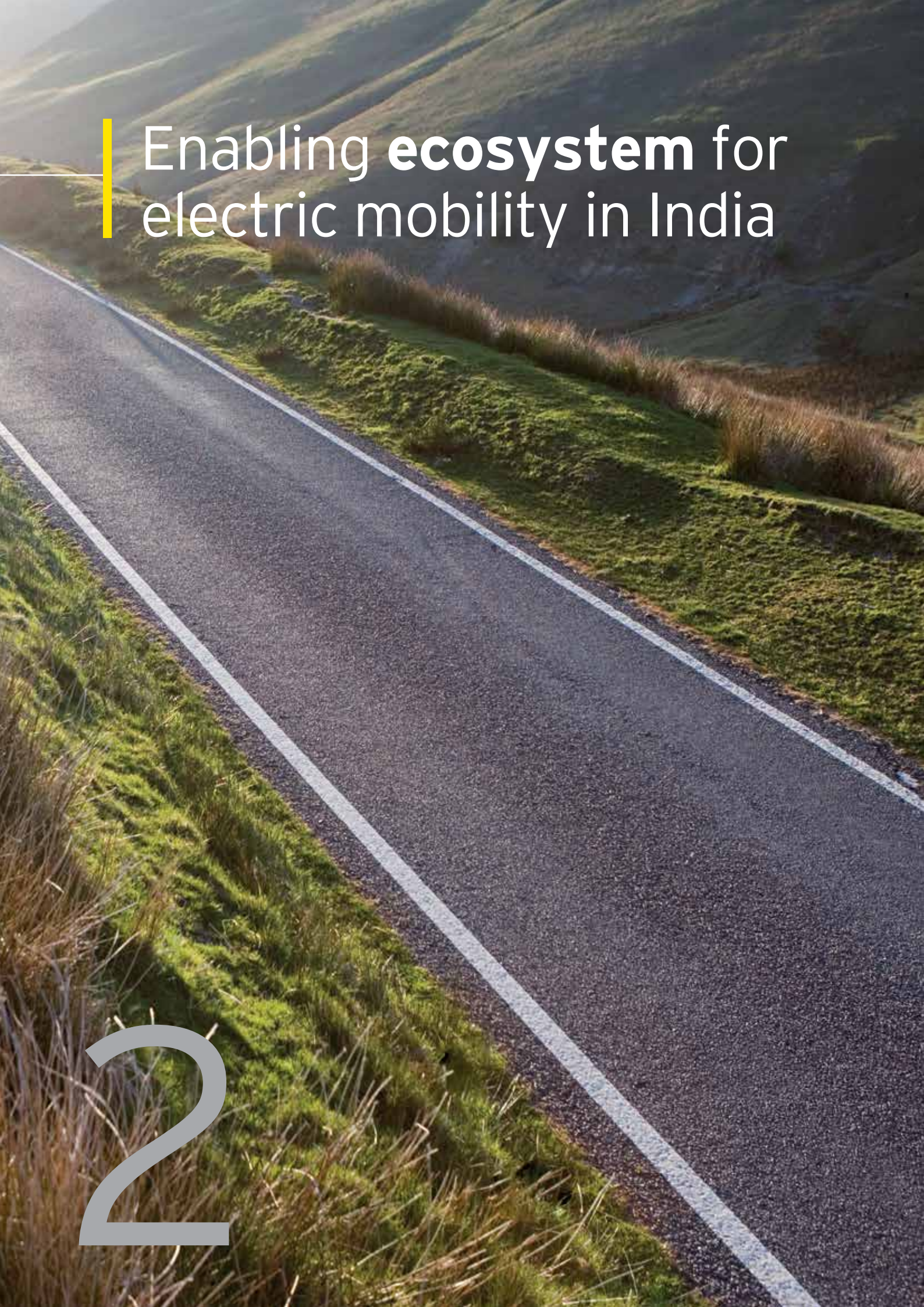
1. It aims to facilitate the development of common standards for setting up EV charging systems and infrastructure.
2. Distribution companies of the state will bring in amendments to their policies to enable setting up of private charging stations and allow resale of power.
3. Land belonging to government agencies within Hyderabad city will be made available to private players on a long-term lease at subsidized rates for setting up charging or swapping stations.
4. Renewable energy will be supplied on preferential basis at special tariffs for EV charging stations with zero connection cost and wheeling charges.
5. The Government will facilitate the deployment of used EV batteries and will provide a battery disposal infrastructure in the PPP model.

Source: EY analysis

1.4 Private sector response to policy frameworks

The electric car segment is yet to take off, with most OEMs launching/planning electric variants of existing models. However, in the electric 2W segment, there is a flurry of entrants who are launching new EV brands. Some of the key initiatives are mentioned below:

Key initiatives	
Ampere	▶ Currently produces electric cycles, scooters, Ampere V 60 scooters and Angel electric motorcycles ▶ Received total funding of US$5.5 million ▶ Also producing Mitra load carriers
Ather	▶ Introduced S340 electric scooter in February 2016 ▶ INR13 million funding raised, which will be used to advance the infrastructure and ecosystem for EVs in the country ▶ Investors include Tiger Global, Sachin and Binny Bansal (Flipkart) and Hero MotoCorp, which pumped in INR205 crore for a 30% stake
Hero Electric	▶ Sold 15,000 units in the first six months of the current fiscal year, double the entire sales of the last year ▶ Aims to reach 100,000 sales by 2020/2021
Mahindra	▶ Currently produces 30,000 e2os/year at the Nashik plant ▶ Invested around INR800 crore on its EV business, including the development of technology ▶ Focusing on electric variants of all existing models but not hybrids ▶ M&M working on new technology that can deliver up to 80KW of power for mid- and high-end cars ▶ M&M planning a new all-electric vehicle with Italian design Pininfarina
Maruti	▶ Toyota and Suzuki have signed an MOU to launch EVs in India by 2020 ▶ Set-up a lithium-ion battery plant in Sanand, Gujarat, in an alliance with Toshiba Corporation and Denso ▶ Launched SHVS technology in models such as the Ciaz and Ertiga and sold over 90,000 units
Spero	▶ Built an e-cycle, which comes with a motorcycle-like accelerator, with an option to paddle or simply accelerate through traffic ▶ Raised INR6.6 million in funding
Tata Motors	▶ Tata to supply the EV variant of its Tigor model to EESL ▶ Electric version of Tata Nano being tested
Tork	▶ Launched India's first premium sporty electric motorcycle christened T6X



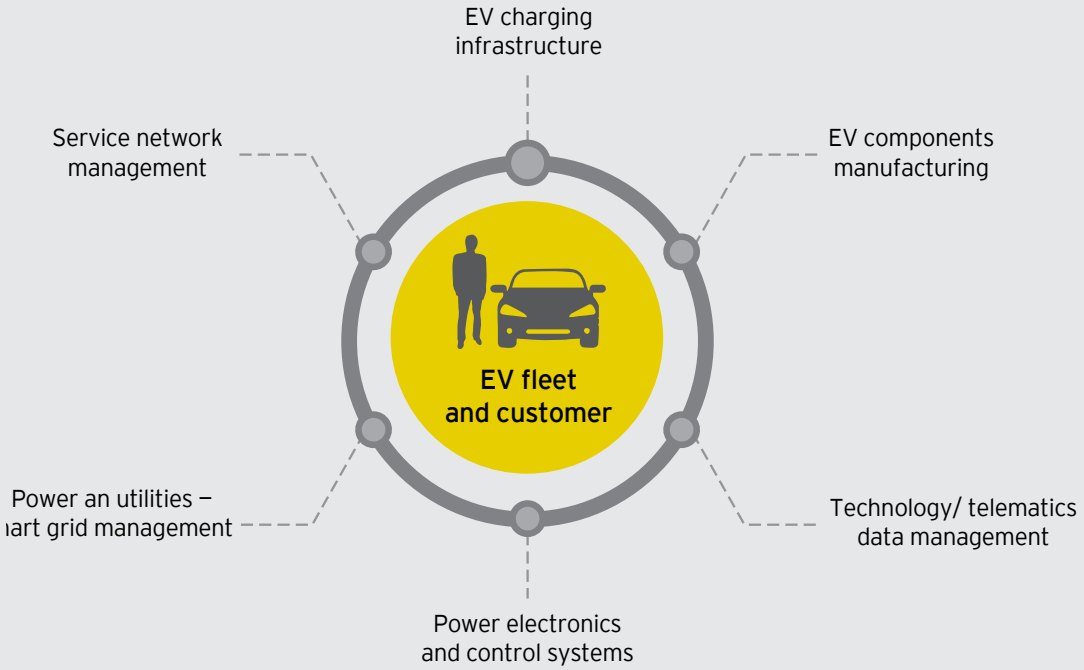
Enabling **ecosystem** for electric mobility in India

2

Technology advances have blurred the line between multiple sectors/stakeholders operating in an EV ecosystem. Electric mobility is increasingly augmented and interconnected by technology interconnections, where both power and information flow in both directions across vehicle and information technology systems.

While EV solutions will vary from market to market – with multiple solutions most likely to drive new customer relationships and service opportunities – a number of new players from multiple sectors are entering the EV value chain, such as equipment manufacturers, software, and networking and consumer electronics companies.

Figure 5: Components of the EV landscape



Source: EY analysis

For the limited purpose and scope of this publication, we are focusing on the following three major themes:

- Charging infrastructure
- EV components manufacturing
- Technology and telematics

In chapter **3, 4, and 5** we will discuss in details on the above themes around the recent developments, major challenges and impact of EV adoption on the system as a whole.

Charging **infrastructure** in India

One of the major barriers to the adoption of EVs is range anxiety. Globally, the proliferation of EVs has taken place with several incentive mechanisms and federal policies such as subsidies, tax breaks and fee bates. But apart from a strong mandate from governments, it is evident that a thriving network of charging infrastructure plays a pivotal role in the proliferation of EVs.

3

3.1 Current penetration of charging stations and proposed pilots

We are already witnessing a divergence of business models for operators of charging infrastructure aimed at the users of private EVs. As of now, India has about 222 charging stations (353 charger units)[9,10]. Recently, EESL floated a tender for 4,500 chargers for installation in Delhi NCR. However, many installations are taking place in the country in pilot scale, offering free charging services to consumers:

Automobile/fleet aggregators

- EV manufacturer Mahindra has entered into an agreement with Gopalan chain of malls to set up charging points.
- Mahindra has invested in setting up charging stations at the Bangalore airport and operates charging stations in Delhi, Bengaluru and Pune.
- OLA has set up 50 charging stations at Nagpur for its EV fleet, including one DC charger.

Utilities

- Tata Power is investing INR6 billion to set up 1,000 charging stations in Delhi, including free stations. Tata Power is also setting up at Mumbai at a regulated tariff to its consumers.
- Fortum has set up a charging station at NBCC's premises and plans to set up about 150 charging stations along with cloud-based solutions and payment gateways.
- NTPC is facilitating the installation of chargers procured by a tender floated by EESL for 4,500 charging points.
- Hero Future Energies plans to launch solar-based charging stations for EVs.

Oil and gas

- Reliance is planning to set up EV charging stations at its petrol pumps.
- OLA also partnered with IOCL to set up India's first ever fast DC charging station at a company owned and operated outlet of IOCL in Nagpur.

Heavy industries

- DHI has expressed interest for city administration to avail subsidy of INR120 crore for 5 to 6 cities, of which INR15 crore shall be provided for installation of charging infrastructure and the rest for the procurement of EVs.

Source: Interviews with industry executives, EY analysis.

Over the last year, the Indian Government has held extensive discussions with many companies, both domestic and foreign, for setting up a charging infrastructure. EESL has hired Exicom to deploy EV chargers in Delhi-NCR under the procurement program. This will include 100 numbers of 3.3 kW AC chargers and 25 numbers of 15 kW DC fast chargers and will be used to charge the Tata Tigor and Mahindra e-Verito cars procured by EESL.

ACME, a charging infrastructure manufacturing firm, helped OLA, a cab aggregator, in setting up charging stations in the first EV pilot in India. Currently, OLA has multiple operating charging stations within Nagpur. In addition to the large stations, which have 5–6 charging points, Ola has also set up swapping stations for 3Ws, with a swapping time of less than 2 minutes.

Despite above initiatives, the pace of investment has been slow due to lack of standardization of charging standards. Going forward, in order to meet the rising demand of charging stations, the Government will have to quickly facilitate standardization of charging infrastructure and mandate fuel stations to install charging points and promote and incentivize R&D for advanced charging technologies.

3.2 Current charging standards and expected developments

The charging infrastructure is being developed in the country keeping in mind the following criteria:

- Affordable on-board and off-board chargers
- Affordable cost per KWh (efficiency) for end users
- Minimum support and investments from the Government in the form of subsidy
- Development of open standards that can be adopted by manufacturers

Policy interventions are inevitable for facilitating the growth of the ecosystem, of which charging infrastructure is a vital component. Some of such regulatory or policy interventions required are as follows:

- Provisions related to standardization and policy for widespread charging infrastructure deployment
- Installation of charging stations in places such as fuel stations, apartments, office and shopping complexes and public parking
- Necessary regulatory amendments or rules to exclude charging of EVs as an activity that involves reselling of power

With regard to public charging stations, there is a need for immediate deployment. AC on-board chargers are available with all EVs produced and sold in India. There is an active effort to develop clear-cut country-wide standards for both slow and fast chargers through TAG, ARAI and NAB.

Solutions that need to be developed for India:

- Specifications of the AC and DC chargers must cater to open standards.
- Standardized communication and billing standards are required.
- There must be energy consumption monitoring, control, metering and storage specifications.

In order to develop a robust information exchange system, communication and billing are major concerns for which standards and mechanisms need to be developed.

Standardization of communication protocols for data exchange:

- Communications between EV and charging stations (EVSE)
- Communications between EVSE and central management system (CMS)
- Grouping of stakeholders such as manufacturers of vehicle, charging stations and batteries as per the functional requirements for the development of a standard communication protocol

Current technology landscape for AC chargers[11] :

AC charging infrastructure available in India	
Type of AC charging	**Hardware requirements**
Public charging EVSEs 230 V, 15 A	IEC 60309* industrial socket with an optional energy meter and RFID prepaid card reader for payment, authentication, monitoring and control
AC fast charging: 3 phase, 415 V, 63A	IEC 61851 Type 2 socket

Current technology landscape for DC chargers

Globally

- Japan: CHAdeMO
- China: GB/T 20234
- Europe: EN 62196¬3
- US: SAE J1772 Combo

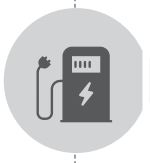
India

- Prevalence of BEVs with lower voltage (48–72 V) drivetrains and high currents
- A large number of xEVs with higher voltage and lower current systems in the market

DC fast charging standards may be split based on voltage (e.g., less than 100VDC and greater than 100V) in order to facilitate safety requirements and interoperability between vehicles and charging stations.

3.3 Allowed business models around resale of power to set up charging infrastructure

Findings of the "Study on Impact of Electric Vehicles on the Grid" by the Forum of Regulators (FOR)[12] outline the business models for charging infrastructure. As per the current regulatory ambit, charging of a vehicle is considered as resell of power. As per the Indian Electricity Act (IEA), 2003, only a distribution licensee or its franchisee can sell power to end consumers. The report suggests the following business models as per the current regulatory ambit.

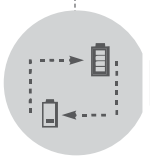


Distribution licensee owned EV charging infrastructure

- The supply of electricity to EV owners is to be done by the distribution licensee.
- The tariff charged to users shall be determined by the SERC as a separate EV charging consumer category.

Distribution licensee franchised EV charging infrastructure

- Utility can authorize a third party (franchisee) or a PPP to install and/or supply electricity on its behalf.
- The franchisee can procure power in bulk and through open access, too, with exemption from the application of cross-subsidy surcharge.
- SERC shall determine the cap on retail price and single point supply tariff for procurement of power in bulk.



Privately owned battery swapping stations

- Utility/Franchisee/Private party can aggregate demand and set up battery charging and swapping stations.
- This service shall not be considered as "resale of power."
- They can procure power in bulk or through open access as per the provisions of IEA, 2003
- The bulk supply tariff shall be determined by SERC.

An alternative to these business models is for EV fleet owners to set up charging stations for their own fleet of buses, e-rickshaw or cars. Doing this will not be categorized as resale of electricity and hence will be a viable option under IEA, 2003 – for example, Tata Motors can set up their charging stations, which will allow charging of only Tata-owned electric buses and cars.

However, to encourage private participation, specific amendments to the Act are being considered to enable players to resell electricity for EV charging without the need for a specific license.

3.4 EV charging investment models and strategies

As the EV penetration picks up, there will be an ever-increasing requirement to have a wide charging infrastructure. While home charging would continue to be the preferred mode for EV charging in the next few years, increasing focus will have to shift toward building public charging infrastructure. Destination chargers (e.g., workplace charging) and parking spaces (with charging ports) will have to be created, as vehicles remain parked there for longer durations and can serve a large base.

Implementing an appropriate EV charging infrastructure does not necessarily mean mandating an outlet at every street corner. It means creating a profitable industry where the economics are profitable and self-sustaining to justify the investment as the market develops. This will depend on understanding the EV charging value chain and developing innovative business models. In the entire value chain, distinct business activities are grouped to develop five potential business strategy variants for different spheres of operations.

Figure 6: EV charging business models

Business strategy	The builder	The maintenance installer	The broker-operator	The grid master	The guadian
Charging insfrastructure sphere	Branded/ un-branded station manufacturer Charging Station retailing	Installation and maintenance services	Smart grid and smart charging interface Metering and billing capability		
OEM sphere			In-vehicle charging info – telematics Mobile/Web portal Network software		Fleet management tools
Utility sphere				Smart grid management	
Customer sphere					Vehicle purchase, operations Battery re-cycling

Source: EY analysis

3.5 Outlook for EV charging infrastructure in India

India suffers on the infrastructure front and mobility solutions are not that fluid, which stalls the growth of charging infrastructure. This directly increases the issue of range anxiety multifold and has a direct impact on the EV adoption. The required need at this point in time is the presence of related support industry and infrastructure as it will help the charging infrastructure thrive.

The Government of India is trying to create an investor-friendly environment to push the adoption of EVs, creation of EV charging infrastructure and launch of various schemes to promote EVs. We expect the Government to take active measures to streamline regulatory challenges and provide further policy impetus to drive uptake of EVs.

Public charging picks up, but home charging will dominate

EVs and the EV ecosystem is still evolving in the Indian context, with home charging emerging as the primary option mainly due to the lack of public charging facilities. We expect the share of public charging to grow; however, home charging would still continue to be the dominant source with a share of nearly 70% in 2030. Overall, the charging models are expected to vary by vehicle category. Both short-term and medium-term overviews of this are given in the table below.

Figure 7: EV charging short term and medium term growth plan

Category	Segment	Short term (2018–19)	Medium term (2020–22)
3Ws (e-rickshaw and e-auto)	Fleet		
e-Buses	Fleet		
Cars (4-wheelers)	Private		
	Fleet		
2W	Private		
	Fleet		

Personalized charging

Public charging

Battery swapping

Source: EY analysis

3.6 Impact of EV charging on the power and utilities value chain

Growing EV penetration is likely to have a varied impact on different players in the power and utilities value chain. An EV with a daily commuting distance of 30–40 km will need an energy of 6-8 KWh, which is equivalent to daily power needs of a small household. Hence, adding one more EV in the neighborhood will create a similar impact on the local electricity network as of one more household metering point. This has presented with unique challenges for electrical utilities, where the shift from fuel to electricity requires an increase in electrical production, and resolve the problem of clustered charging, which can create a localized problem for the grid[13].

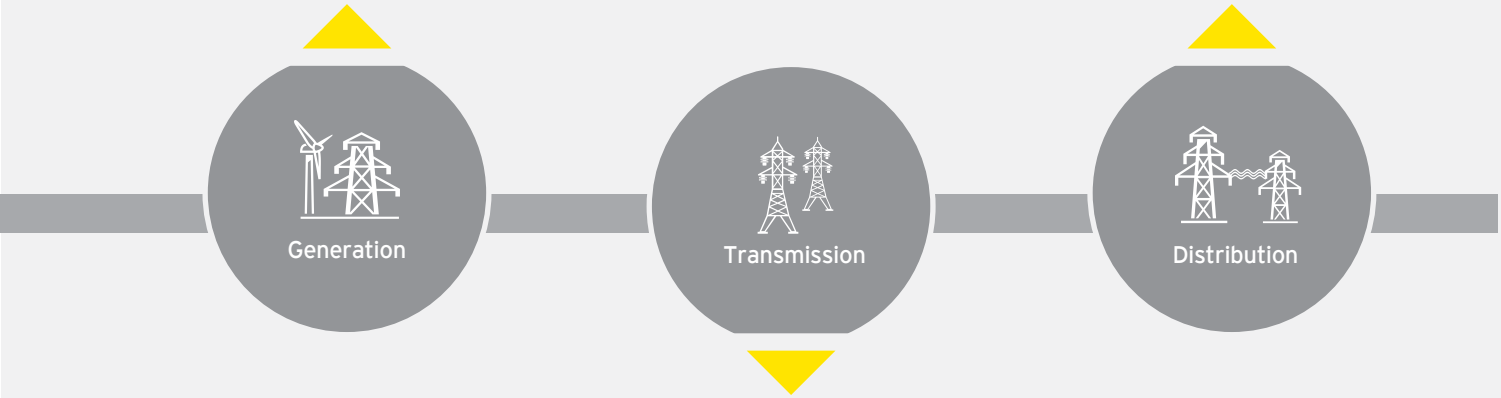
Figure 8: EV charging impact on power sector

Additional electricity demand, primarily in the developing region

41 million EV sales globally by 2040 (35% of new light duty vehicles), will require 2,700 TWh of electricity (11% of 2015 global demand)

Most vulnerable points of failure due to EV fast charging

- Public fast charging – high load on high load commercial transformer
- Residential fast charging – high load on low load residential transformer



EV-grid interaction can cause grid frequency fluctuation in case of sudden load mismatch, leading to an increasing cost and regulatory pressure to ease the integration of distributed energy resources

The risk of overloading local transformers is particularly high during peak hours, when all EV owners in the neighborhood decide to recharge them at the same time. Utilities across the globe are looking to modify customers' demand by offering EV owners discounted rates for charging their vehicles during off-peak hours.

Managed charging, also known as smart or intelligent charging, entails a combination of infrastructure and communication signals sent directly to a vehicle or via a charger to influence the driver's decision on when to charge the car. US utilities such as San Diego Gas & Electric and Southern California Edison are the early adopters and running a pilot featuring special rates encouraging electric car drivers to charge their vehicles when the electricity supply is abundant and the prices are low.

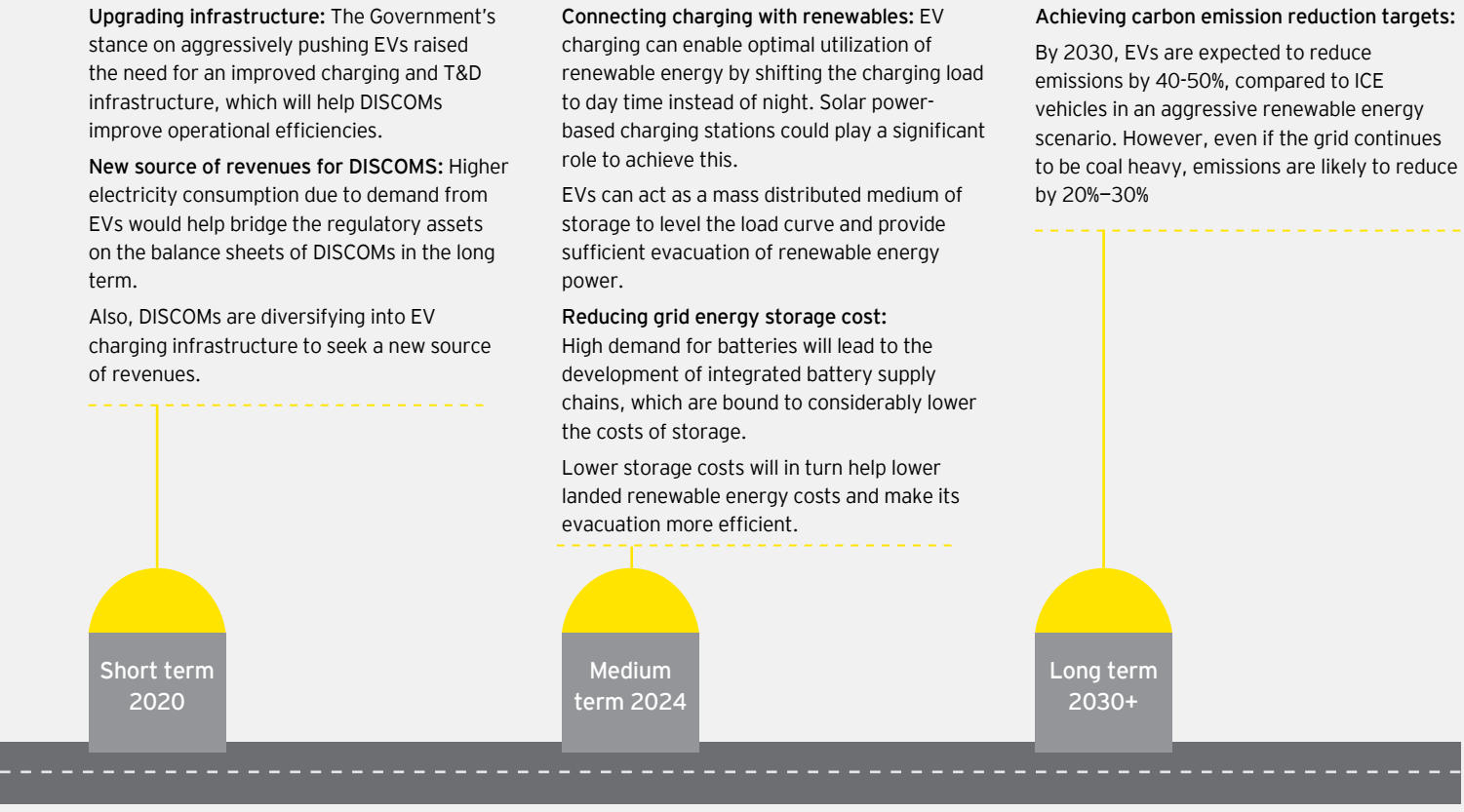
Despite all the above challenges, if handled correctly, EV provides an impactful and beneficial cross-cutting opportunity for power sector stakeholders and can enable transformation to a green and efficient power sector in developing regions such as India.

3.6.1 EVs to provide a boost to India government's power sector goals

The power and utilities sector in India is undergoing rapid transformational developments — reducing dependence on imported coal, rising energy independence with renewables, reducing plant load factors (PLFs) and national grid integration to name a few.

Increasing adoption of EVs across India will be instrumental in transforming the country's power sector. The surge in electricity demand from EVs will help recover the slow demand growth in India. By 2020, the overall electricity demand from EVs is projected to be around 79.9 GWh and is expected to reach 69.6 TWh by 2030. The overall EV demand is expected to help utilities earn an estimated US$11 billion (INR700 billion) in revenue by 2030. The impacts of high EV adoption are expected to start showing positive results within 5–7 years in the power sector, while a few developments will take a bit longer to have a meaningful impact.

Figure 9: Timeline of EV impact on Indian power sector



Source: EY analysis

3.6.2 Challenges currently faced by power distribution companies in providing efficient charging facilities

Poor financial health of DISCOMs: For many decades, DISCOMs were supplying electricity at tariffs far below cost, accumulating massive losses and mounting debts over the years. This led to the launch of UDAY Scheme in 2015, when DISCOMs reported an annual loss of INR600 billion and total accumulated debt of INR3.96 trillion[14 15]. Despite an improvement over the last two years, annual losses still stand at ~INR400 billion, which can continue to restrain DISCOMs from taking any new investment decisions[16 17].

Stressed distribution networks: Many parts of India are still facing power shortage, with 16 states and 2 union territories (UTs) reporting electricity deficits in FY17. Northern, Eastern and Northeastern regions have stressed electricity networks. Increasing adoption of EVs is expected to boost electricity demand, which may put additional strain on the electricity networks and lead to more load shedding and power outages, especially in regions that are already facing deficits[18 19].

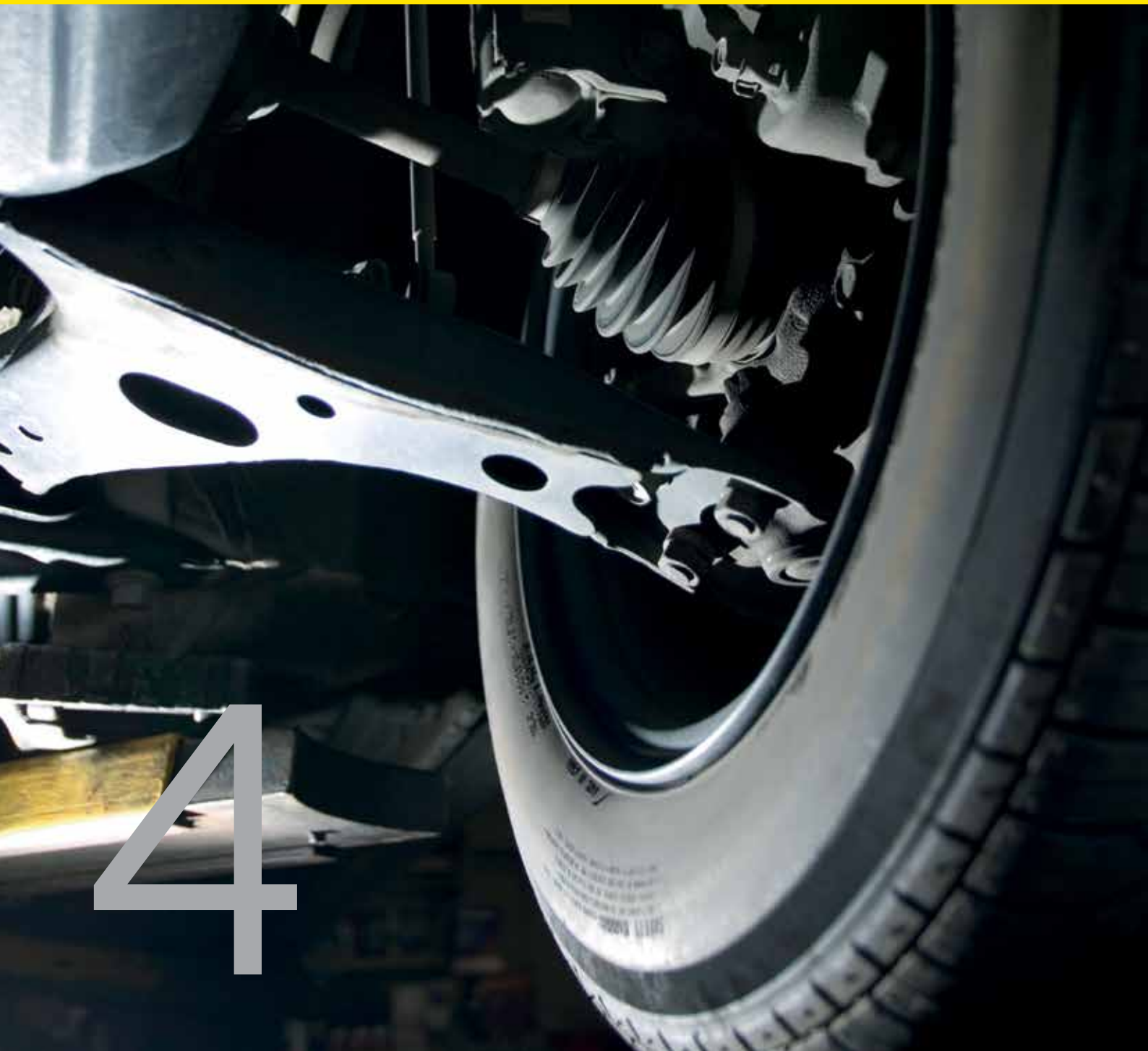
Lack of regulations for charging services: The Government is in discussion to standardize charging infrastructure development in India. Many norms are proposed to standardize the market, but they are still in the planning stage. Additionally, EV charging tariffs are regulated at some locations, while tariffs are not fixed at other locations. There is a growing need for a national regulated rate that can be applicable to all charging stations across India[20 21 22].

Despite these challenges, DISCOMs are entering the EV charging space[23 24 25]

1. **Tata Power is among the few DISCOMs that are exploring this space and have aggressive plans for expansion.**
   - Announced plans to invest INR6 billion to upgrade its power transmission network and install 1,000 charging stations across Delhi
   - Installed its first charging facility in Mumbai in August 2017 and in talks to install more stations in the city
   - Launched two free charging stations for electric 2Ws in North and North West Delhi
2. **Maharashtra-based DISCOMs Brihanmumbai Electric Supply and Transport (BEST) and Maharashtra State Electricity Distribution Company Limited (MSEDCL) are also exploring the option of setting up similar charging stations**

EV ecosystem **manufacturing** in India

One of the major barriers to the adoption of EVs is range anxiety. Globally, the proliferation of EVs has taken place with several incentive mechanisms and federal policies such as subsidies, tax breaks and fee bates. But apart from a strong mandate from governments, it is evident that a thriving network of charging infrastructure plays a pivotal role in the proliferation of EVs.

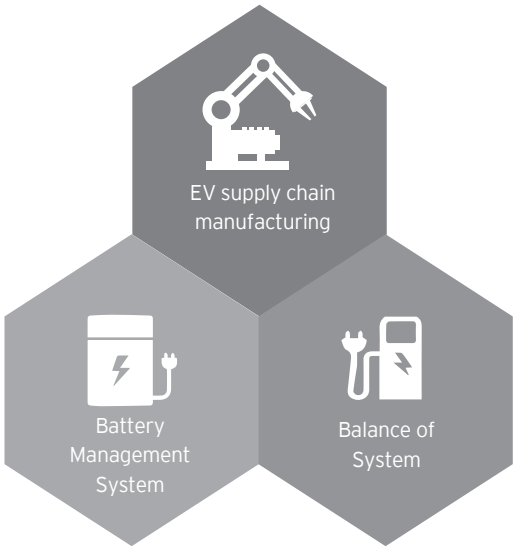


4

The success of India's EV mission depends on the development and proliferation of the domestic manufacturing ecosystem. Despite the Government push, the pace of EV adoption has been slow to pick up and, barring few e-vehicle manufacturers who make e-scooters, e-rickshaws, low-powered e-cars and in-campus EVs, there are not many indigenous component makers in the industry. At present, almost all critical components such as batteries, electric engines, motor controllers, braking systems and electrical differential are imported from China and other developed markets.

To counter that, the Indian Government is looking to strengthen the supply side by establishing an EV manufacturing base backed by strong technology know-how and skill set availability around ancillary manufacturing, battery manufacturing, and charging infrastructure.

Figure 10: EV ecosystem manufacturing



Source: EY analysis

4.1 Current EV supply chain scenario

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.

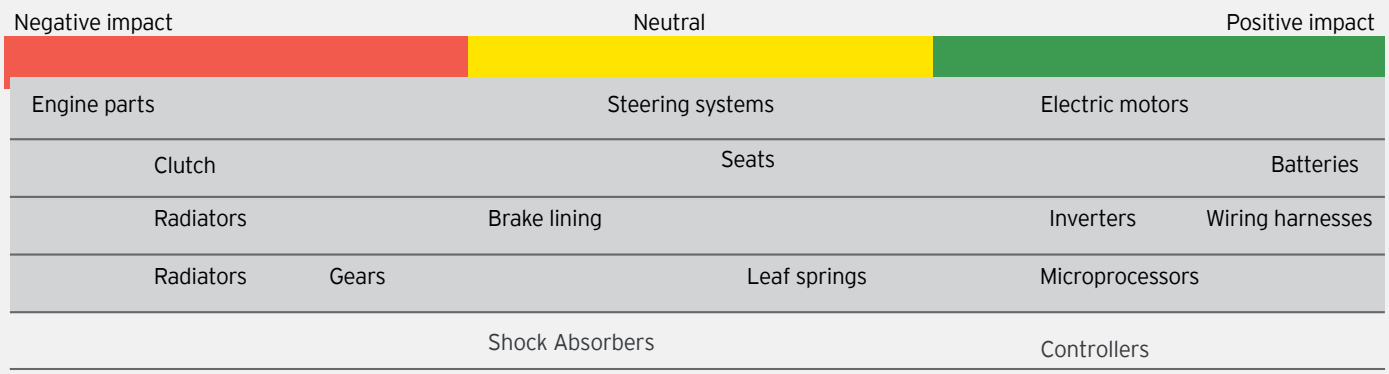
The growth of EVs will lead to profound changes in the automotive value chain, including technology, manufacturing systems, ownership models, distribution and aftermarket support. An EV is relatively simpler to build with only 20 moving parts against ~2,000 in an ICE vehicle. This would cause a significant decrease in the 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 by 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.

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 the 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. New opportunities lie in EV parts such as battery, motors, controllers and microprocessors.

Figure 11: Impact on major auto-components



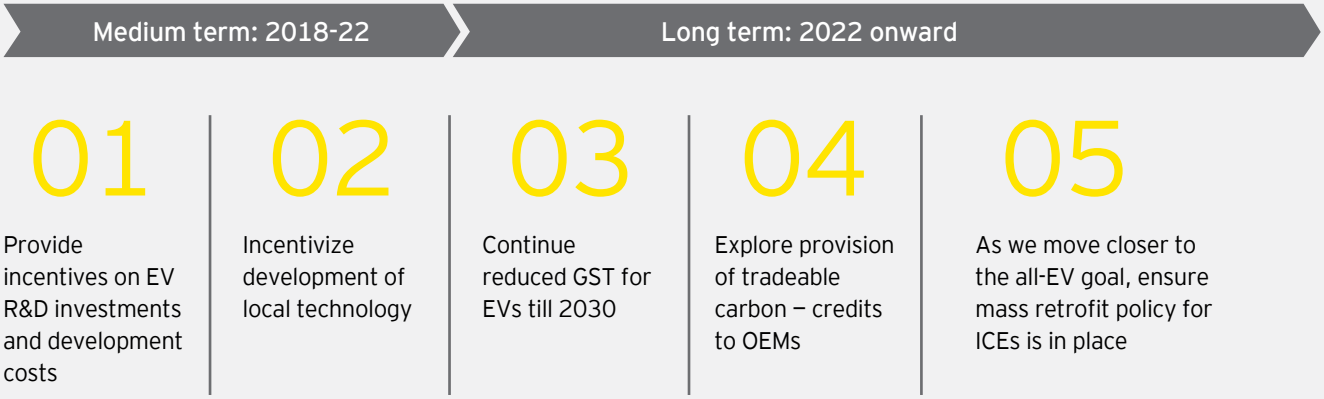
Source: EY analysis

The changes in the manufacturing supply chain will have long-term implications on market leaders and component manufacturers:

- 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.

There is a need for a long-term supply-side incentives that attract desired investments required for EV deployment.

Figure 12: Incentive support to ancillary manufacturers



Source: EY analysis, For more details, please refer to EY's thought leadership report titled "Standing up India's EV ecosystem - who will drive the charge?"

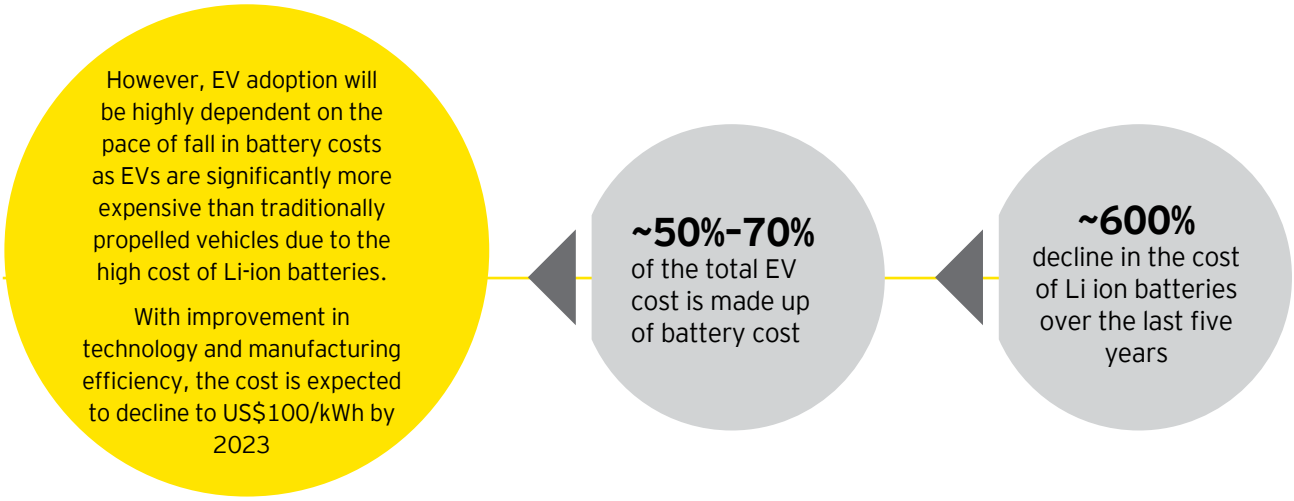
4.2 Battery storage technology

4.2.1 New emerging battery technology and global best practices

As EVs are gaining more and more traction, there is an increased focus on finding and adopting the best battery solution that provides the best energy density for maximum distance coverage. Lithium-ion batteries are currently used in most of today's electric cars, and it is likely that they will remain dominant in the coming future. The growing demand will drive the production capacity of Li-ion battery as it is expected to grow six times by 2020.

The growth in the production capacity will be led by China, with 62% of the Li-ion mass production set to be in China by 2020. Automobile players have been active in ramping up their production capacity, with Tesla expected to add 35 GWh by 2020[26]. Accumotive, a Daimler subsidiary, laid the foundation for a US$550 million plant to expand its annual Li-ion battery production from the current level of 80,000 units to around 320,000[27]. Volkswagen is also looking to invest US$11 billion in the development of a dedicated Li-ion battery factory in Salzgitter[28].

EVs will be requiring 40% of the total battery production (in GWh) in 2020, and the requirement is expected to further grow up to almost 60% by 2024. Estimates indicate that the annual demand for Li-ion batteries from EVs would be 1,293 GWh in 2030, representing an annual growth of 32.49% from the 2015 levels[29].



Researchers are also working on "beyond lithium" projects, and are looking at other technologies that are more efficient in terms of energy density and can replace Li-ion in the long run.

1. **Solid-state** batteries are getting significant attention as they can operate at super capacitor levels to completely charge or discharge in just minutes. Their construction provides several advantages: no electrolyte leaks or fires, extended lifetime, decreased need for bulky and expensive cooling mechanisms and the ability to operate in an extended temperature range between -30°C and 100°C.

2. **Lithium-air batteries** offer far greater energy density – maybe as much as 10 times more. As cathode typically makes up most of the weight in a battery, having one made of air is a major advantage. However, these batteries suffer from poor cycle life and cyclability issues.

Toyota has been focusing on solid-state and Li-air batteries and is reportedly planning to begin releasing plug-in EV utilizing solid-state battery tech in early 2020. Another automotive giant BMW has announced to partner with Solid Power to develop solid-state batteries for use in BMW's future EV models and is targeting to field solid-state batteries in commercial vehicles within 5–10 years.

Source: EY analysis

4.2.2 Locked smart (LS) batteries

There is a need to distinguish Li-ion batteries in EVs from the ones used for other applications, so that different tax-and regulation treatment can be provided if needed. LS batteries are batteries designed to be used with EVs and cannot be used for any other applications. This is especially important when the battery is leased/sold separately from the vehicle.

LS batteries are specially designed smart lithium batteries built to power authorized EVs only. They work with a highly secured encryption algorithm that exchanges a unique key during each use to ensure they are used only by authorized EVs (and no other applications) and authorized charging and swapping stations.

- They cannot be charged except at the authorized charging and swapping stations.
- They cannot be discharged except in the authorized vehicle.

These batteries are programmed with a unique encrypted key to be used for authenticating the specific vehicle and the chargers where such batteries will be charged. These keys are generated in such a manner that they cannot be changed except by authorized personnel. When LS batteries are used by a charging-cum swapping operator, a discharged LS battery can be swapped with another charged locked smart battery. The new swapped LS battery shall be specifically authorized again at the time of swapping to be usable with that specific vehicle only. The returned discharge battery shall go for charging to the bulk charging station.

4.2.3 Battery manufacturing in India

In order to achieve 100% electrification of automobiles by 2030 and beyond, India needs a robust and competitive battery manufacturing supply chain. As per a report by NITI Aayog and Rocky Mountain Institute, India would require to set up a minimum of 20 Gigafactories to produce batteries at an investment of US$100 billion. However, lack of clear long-term policies and technology uncertainty are preventing investments in storage technologies.

In addition, low mineral reserves and absence of major EV battery producers are also deemed as key bottlenecks for the investments in the storage space. As EVs gain traction in India, OEMs are looking to secure access to Li-ion reserves and R&D capabilities to manufacture batteries indigenously.

Going forward, a number of foreign collaborations, partnerships and consortiums between OEMs, battery producers and suppliers could be expected. Japanese player Suzuki has planned to invest INR11.5 billion together with Japanese partners Toshiba and Denso Corp. to set up a Li-Ion battery facility in Gujarat, in which Suzuki will own 50%, Toshiba 40% and Denso 10% of the joint venture[30].

The policy and regulatory framework for battery storage system does not exist at the Central Government level; however, State Governments of Karnataka and Telangana have proposed some policies for battery storage in their EV policy draft.

Battery storage policy of Karnataka

The State targets to set up 5 GWh of EV battery manufacturing capacity. It plans to offer special package of incentives for ultra mega and super mega Li-ion battery manufacturers catering exclusively for EVs and the EV charging or swapping infrastructure.

It aims to facilitate the deployment of used EV batteries for solar application, and will provide battery disposal infrastructure in the PPP model.

It will offer investment subsidy of 20% of the value of fixed assets (VFA) (maximum INR200 million per project) for the first two units in the state.

Battery storage policy of Telangana

The State targets to develop an automotive electronics park and will offer special status and incentives to units manufacturing batteries cells/packs for EVs.

The Government will provide capital subsidy of 35% (cap of INR10 million) and 25% (cap of INR100 million) for the first 10 companies involved in batteries cells/packs for EVs manufacturing.

Battery manufacturing/assembly units will be extended a rebate of 50% of the cost (upper limit of the rebate at INR1.5 million per acre) to the first 10 units.

It aims to deploy a used EV batteries and battery disposal infrastructure model.

Source: State Government websites of Karnataka and Telangana

4.2.4 Battery recycling and disposal: Repurposed EV batteries

EV batteries have a shelf life of less than 10 years and after 8–10 years of usage, they are not considered fully functional to power an EV. However, studies have proven that 70%–80% of the initial battery capacity can be retained and batteries may function for up to 25 years. Such an EV battery can serve the purpose of utility/home storage, reducing overall cost without seriously compromising the storage capacity or quality. A potential cumulative capacity availability of "second use" batteries is expected to be around 1,000 GWh by 2030, at a repurpose rate of 80% and at a replacement timescale of 7 years .

Several global automakers are establishing storage arrays with repurposed EV batteries for remote facilities and data centers, combined with renewable capacity to provide power equivalent to baseload supply.

- BMW was selected by California utility Pacific Gas & Electric to manage a minimum of 100 kW of electric demand using second life Li-ion batteries from Mini E demonstration vehicles.
- An off-grid 85 kWh energy storage system built with 208 repurposed Toyota Camry Hybrid nickel-metal hydride battery packs, along with renewable energy, is being used to power a remote facility.

At present, India does not have any policy framework or mechanism for the battery recycling and second use market. However, in order to achieve its electrified mobility target, reclaiming the materials from old Li-Ion batteries in a certified and sustainable manner should be a huge priority of the Government of India. The Government should focus on the following:

- Using an environmentally friendly method of recycling involves significant investments in infrastructure and technology, and the Government should develop a detailed incentive framework such as investment subsidy for setting up plants, tax holiday and income tax deduction for R&D spend to improve investment environment in this field.
- The battery recycling market should be organized and a mechanism should be developed and promoted where all vehicle suppliers should take back used Li-ion batteries and enable second-use of these batteries before giving them to a suitably certified recycling organization for disposal.

Technology landscape in the EV ecosystem

5

Many new emerging technologies could play a supportive role in making the entire EV charging value chain more efficient and profitable. A number of disruptive startups with new models are expected to come up in these areas.

Digital payments and blockchain

- There is a need to provide a hassle-free payment mechanism, where users will be directly billed using their vehicle's unique identification number, with transactions being secured through a blockchain layer.
- Share&Charge, a decentralized marketplace that connects EV owners with private and public charging stations, has released its mobile app enabling digital payments secured using an Ethereum block-chain[36].

Data analytics

- Data analytics is likely to be a great enabler of improvements in charging services. The analysis based on data sets can be used for anomaly detection and preventive maintenance by helping estimate the present energy consumption and future demand, load on grid during peak demand and recharge pattern.
- ChargePoint, a US-based charging station operator, provides data around charging patterns, charging times, sessions lengths, idle time etc., which can be analyzed using various data analytics tools[37].

Solar-based charging stations

- As India plans to reduce its dependence on oil imports, it is shifting its focus toward solar PV. Using solar-based charging stations for EV will help optimally utilize renewable energy by shifting the charging load to different times of the day depending on overall demand. This would help take off additional load from the grid and ensure energy security apart from being the cleanest fuel.
- A Taiwan based e-scooter manufacturing company has come up with a new initiative where the swapping stations run on solar power[38].

Vehicle-to-grid (V2G) charging

Integrating EV with the grid can provide various benefits as it would provide additional storage device to make the grid more resilient and could also serve as a load-balancing device[39 40].

- A Japanese automobile manufacturer in collaboration with an Italian utility has announced a V2G trial with 100 V2G units.
- A Netherlands-based utility has announced a pilot with a charging solutions provider to explore whether EVs can provide reserve capacity without disturbing the European grid frequency.

However, the success of the above enabling technologies will depend on understanding the communication between different machines. This has resulted in increased focus on adopting new solutions such as tracking vehicle on the move (telematics) and smart transport systems, where automobile manufacturers and technology players are increasingly focusing on providing connectivity between the car and the smartphone while enabling access to the internet in a move to personalize the in-car environment.

5.2 Telematics: A key enabler for EVs

Telematics could play an important role in providing a boost to EVs by providing an anxiety-free EV ownership experience for drivers as well as smartly managing charge of the vehicle. It could support a new generation of intelligent transport solutions by embedding intelligence into vehicles using sensors and chips and help improve communication between different stakeholders (automakers, dealers, mobility providers, power and utility players, technology companies, etc.).

The global telematics market is estimated to grow at a CAGR of 28% between 2017 and 2022 to reach a revenue of more than USD 230 billion by 2022 with more than 100 million new cars having some form of connectivity.

From an India perspective, the growing population of smartphone and falling data costs have resulted in an ever-connected consumer. India now represents second biggest internet user base in the world with around three fourths of users accessing internet through mobile phones. The telematics market in India is still at a nascent stage (at the initial stages of Telematics 3.0), however, multiple connectivity options, changing consumer preferences and low cost data are providing momentum to the market with OEMs introducing new features leveraging connectivity.

Evolution of automotive telematics

Telematics 1.0	► Hands-free calling and screen-based navigation
Telematics 2.0	► Portable navigation and satellite radio
Telematics 3.0	► Introduction of comprehensive connectivity to the vehicle
Telematics 4.0	► Seamless integration of mobility and the web – the biggest opportunity yet

Major Stake holders: Telematics is about cooperation between different stakeholders and developing an integrated product offering

Automotive Industry	Government	Telematics service providers	Insurance Sector
IT Industry	Telecom Sector	Power and Utilities	BPO & Others

Embedding telematics into EVs can enable:

- Lower range anxiety: Telematics solutions can provide the driver with information about the state of charge, the distance that can be covered with the charge remaining, the location of the next charging station, the distance and directions to reach that station, and the availability and booking of that charging station
- Managing the charge of the vehicle: Telematics solutions can facilitate (1) smart charging capability to manage the power used by EVs, such as adjustments in charging based on load, (2) vehicle to grid charging, (3) time of charging (users can charge during off-peak hours when rates are the lowest) and 4) notification to owners when the charging stops or is unplugged.

420 million: Number of estimated mobile internet users in India in June 2017, up from 389 million in 2016

The Indian market is already seeing a growing use of telematics involving multiple services such as navigation, safety and security services (emergency and breakdown calls), fleet/asset management, insurance telematics, etc. We believe that telematics based services are likely to become standard offerings as part of the overall EV package and, in the medium to long run, the focus will increasingly shift toward EV to grid interaction, more sophisticated infotainment solutions, such as live traffic, weather, streaming content and cloud-based applications.

Sources: Internet and Mobile Association of India, Netscribes, Statista, SBD, EY analysis

Bringing it all together toward smart and sustainable **mobility**

The combination of disruptive trends such as sharing economy, vehicle electrification and connected car are likely to transform the Indian automotive industry and present an unimagined mobility experience.

Evolving demographics, urbanization, digitization and collaborative consumption are likely to disrupt the mobility ecosystem. The future urban mobility network will involve vehicles with connectivity and digital technologies enabling the provision of customizable mobility packages, and stakeholders will compete for a share of customers' mobility spend.

In line with what we are witnessing globally, the Indian market is also witnessing proliferation of technology-driven mobility service providers, as the consumer is being drawn towards the idea of "access" from "ownership". The Indian market has witnessed a growth in shared mobility as a result of evolving demographics, rising disposable income and confluence of smartphones and internet penetration, which could help bring in the new age of mobility.

31% of people were residing in Indian Urban areas in 2011, set to go up to 40% & 58% in 2030 & 2050 respectively

10% of miles driven in 2015 estimated to be shared, the number could reach 25% by 2030

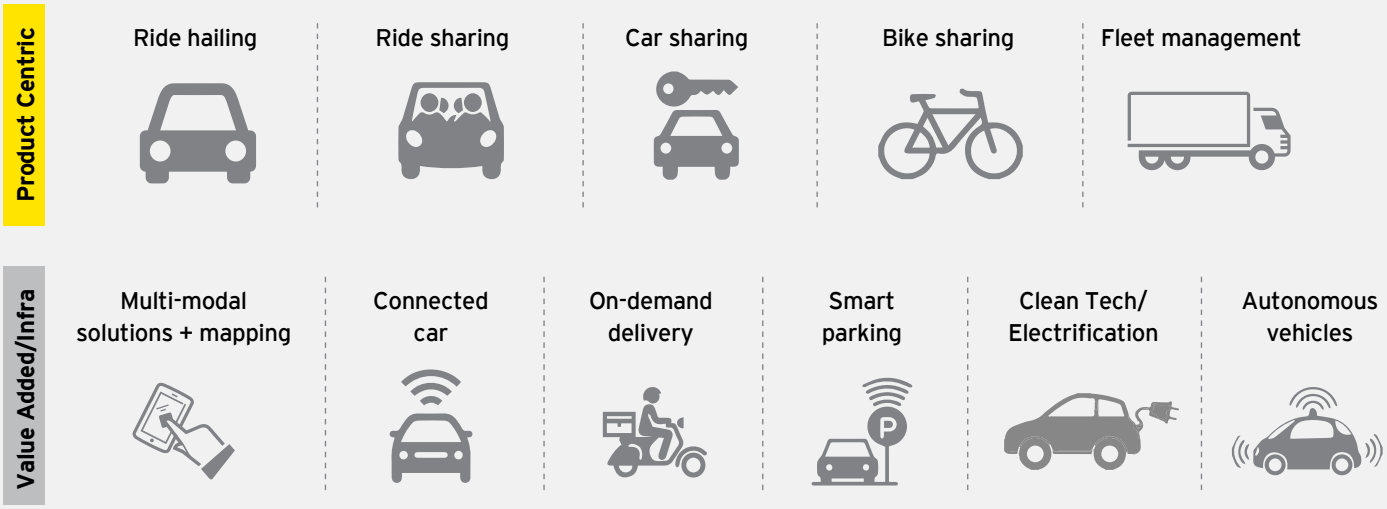
30% of cars in India estimated to be bought as second cars in the household, one of the segments worst hit by car sharing

3.5x Faster replacement rates of a shared vehicle as compared to a private vehicle, which will support vehicle sales to some extent

Source : EY analysis, Census 2011, World Bank, The World's Cities in 2016 - UN Report, Analyst reports

Driven by rising real incomes and low penetration rates (in both car ownership and per capita miles travelled), the Indian mobility market is likely to be one of the fastest growing in the world. However, car ownership is likely to grow since it is a highly aspirational purchase and first time buyers will drive the market, at least, over the next decade or so.

Smart mobility spawning a whole new automotive industry ecosystem

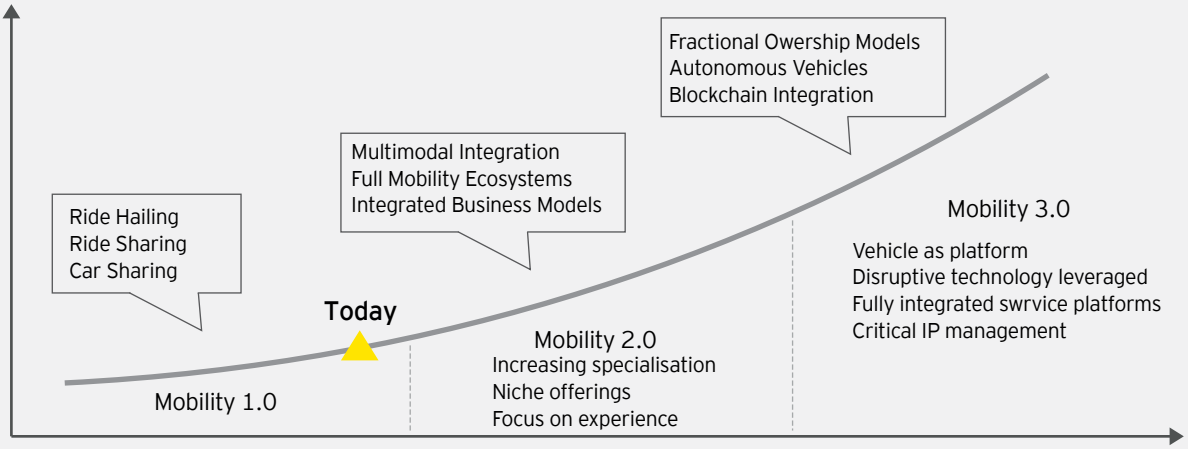


Note: The list of ecosystem services above is non-exhaustive

Sources: EY analysis

At present, the industry is in generation 1.0 and has already implemented ride sharing and ride-hailing models. The adoption of new innovative models and technology advancement will drive the industry into the next generation mobility solutions, where vehicles will be considered as a platform. Smart mobility will also increasingly lead to boundaries blurring in multiple industries such as automotive, insurance, car rentals, logistics, telecoms, energy and media creating a whole new industry ecosystem.

Figure 15: Future projection of smart mobility growth



Source: EY analysis

6.1 Considerations for key stakeholders

Vehicle manufacturer

- 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

Component suppliers

- 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

Utilities

- 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

Mobility providers

- 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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