ELECTRIC MOBILITY

Smart City
MISSION TRANSFORM-NATION

सत्यमेव जयते
Ministry of Housing and Urban Affairs
Government of India

ROCKY MOUNTAIN INSTITUTE

Ministry of Housing and Urban Affairs
Government of India

ABOUT MINISTRY OF HOUSING AND URBAN AFFAIRS (MoHUA)

The Ministry of Housing and Urban Affairs is the apex authority of Government of India to formulate policies, coordinate the activities of various central ministries, state governments and other nodal authorities and monitor programs related to issues of housing and urban affairs in the country. The Smart Cities Mission was launched by the Ministry in 2015 to promote sustainable and inclusive cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and application of 'Smart' Solutions.

ABOUT ROCKY MOUNTAIN INSTITUTE (RMI)

Rocky Mountain Institute (RMI)—an independent nonprofit founded in 1982—transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables. RMI has offices in Basalt and Boulder, Colorado; New York City; Washington, D.C.; and Beijing. RMI has been supporting India's mobility and energy transformation since 2016.

Foreword

HARDEEP S. PURI
Honourable Minister of State
(Independent Charge),
Ministry of Housing and Urban Affairs

With a rapidly growing population and quickly evolving technologies and business models, there is a need to adopt new and fundamentally different pathways to develop a clean, cost-effective, and efficient transportation system to support the diverse needs of citizens. With initiatives like the Smart Cities Mission, Government of India has undertaken one of the most comprehensive planned urbanization programme in the world. Smart Cities represent the exemplars of urban development in India and are poised to lead the country in this transition. We envision Smart Cities to lead the adoption of smart solutions in provision of transportation infrastructure and services and are committed to support them in this endeavor. These capacity-building Policy Framework documents are expected to enable Smart Cities in implementing electric mobility solutions for their cities, and in turn lead the way for the rest of the country.

I congratulate the authors of **"Electric Mobility"** for their outstanding work, as well as for their dedication in helping India build strong, sustainable transportation systems. Let this be the next step in building cleaner, more sustainable, and more modern cities in India.

DURGA SHANKAR MISHRA

Secretary,
Ministry of Housing and Urban Affairs

The capacity-building Policy Framework Documents
are an exciting step in the Smart Cities Mission to make cities more citizen-friendly and sustainable. Since the launch of the Smart Cities Mission in June 2015, the program has made remarkable progress in driving the implementation of impactful projects to support citizen needs. The recommendations outlined in this document are a step on the path towards building the cities of the future, capable of supporting a growing and thriving urban population.

I commend Rocky Mountain Institute on their strong work and insightful recommendations in **"Electric Mobility".** I look forward to seeing the recommendations outlined in these documents put into practice to further improve the health, sustainability, and vibrancy of Indian cities.

KUNAL KUMAR

Joint Secretary (Mission Director Smart Cities), Ministry of Housing and Urban Affairs

The Ministry of Housing and Urban Affairs is committed to supporting the development of sustainable, accessible, efficient, safe, and clean urban transportation systems, and promoting electric mobility is of critical importance to this effort. The capacity-building Policy Framework documents represent a step change in established practices and given the direct influence that the transportation system can have in our lives and environment, we believe it to be an essential change.

It gives me great pleasure to introduce **"Electric Mobility"** as a new capacity-building Policy Framework document to support the development of India's Smart Cities. It emphasizes the importance of transitioning to clean mobility alternatives to create healthier and more livable cities. It gives an overview of electric mobility and provides guidance to enable cities to transition to clean mobility solutions.

ELECTRIC MOBILITY

PART 1: POLICY FRAMEWORK

Smart City
MISSION TRANSFORM-NATION

सत्यमेव जयते
Ministry of Housing and Urban Affairs
Government of India

ROCKY MOUNTAIN INSTITUTE

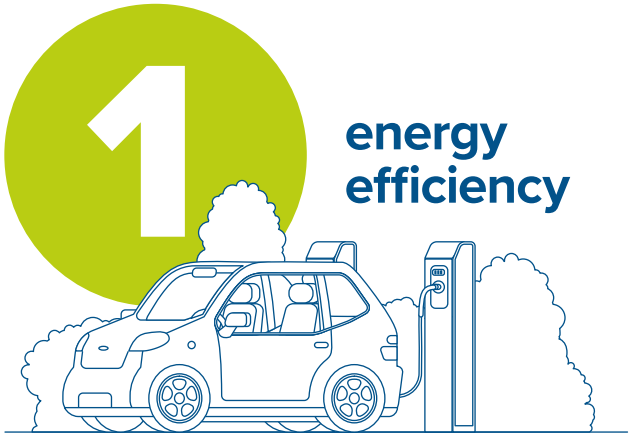
Section outline

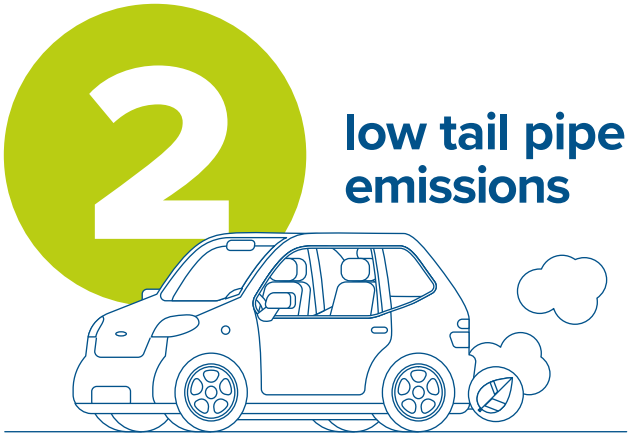
This document introduces city managers to the basics of electric mobility. It presents various components of an electric mobility ecosystem, particularly the different types of electric vehicles (EVs) and charging infrastructure. It orients city managers to the status of EV uptake around the world. The document discusses initiatives to promote electric mobility by national and city governments and other key stakeholders, globally. To enable city managers, introduce or improve uptake of electric mobility in their respective cities, the document provides information on the electric mobility landscape in India with a focus on relevant schemes and policies. For the cities, which are keen to implement and promote electric mobility, it is important for them to understand and measure their progress. This document provides a set of Key Performance Indicators (KPIs) to equip cities to measure their progress and understand the impact of their actions and take necessary corrective course, if required, to meet the transport electrification goals.

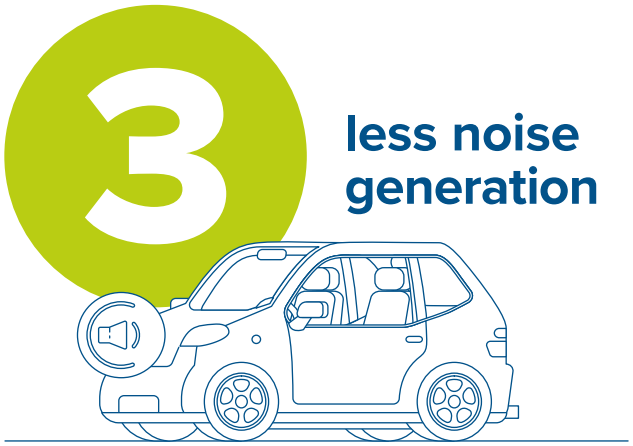
Glossary of terms

EVs	Electric Vehicles
BEVs	Battery Electric Vehicles
PHEVs	Plug-in Hybrid Electric Vehicles
FCEVs	Fuel Cell Electric Vehicles
ZEVs	Zero Emission Vehicles
NEVs	New Energy Vehicles
ICEVs	Internal Combustion Engine Vehicles
OEMs	Original Equipment Manufacturers
KPIs	Key Performance Indicators
EESL	Energy Efficiency Services Limited
MoP	Ministry of Power, Government of India
MoHUA	Ministry of Housing and Urban Affairs, Government of India
MoHIPE	Ministry of Heavy Industries and Public Enterprises, Government of India
DHI	Department of Heavy Industries, MoHIPE
MoEF	Ministry of Environment and Forest, Government of India
MoRTH	Ministry of Road Transport and Highways, Government of India
ULB	Urban Local Body

1.0 Why promote electric mobility?







The world is transitioning to cleaner mobility options with the aim at improving air quality, reducing carbon emissions and reducing dependency on fossil fuels. By their virtue of being energy efficient and clean (zero or significantly lower tailpipe emissions), in comparison to similar Internal Combustion Engine Vehicles (ICEVs), EVs have emerged a popular clean mobility choice and have the potential to reduce carbon emissions and other criteria pollutants. As the EVs are powered fully or partially by batteries, they can also help reduce dependence on imported fossil fuels and address energy security concerns for India.

2.0 What is an electric vehicle?

Electric Vehicles (EVs) use one or more electric motors or traction motors for propulsion. An electric vehicle may source its power from off-vehicle onboard battery, or other sources such as solar panels or electric generators.

Based on the degree of electrification of the propulsion system, the EVs can be classified into[1]:

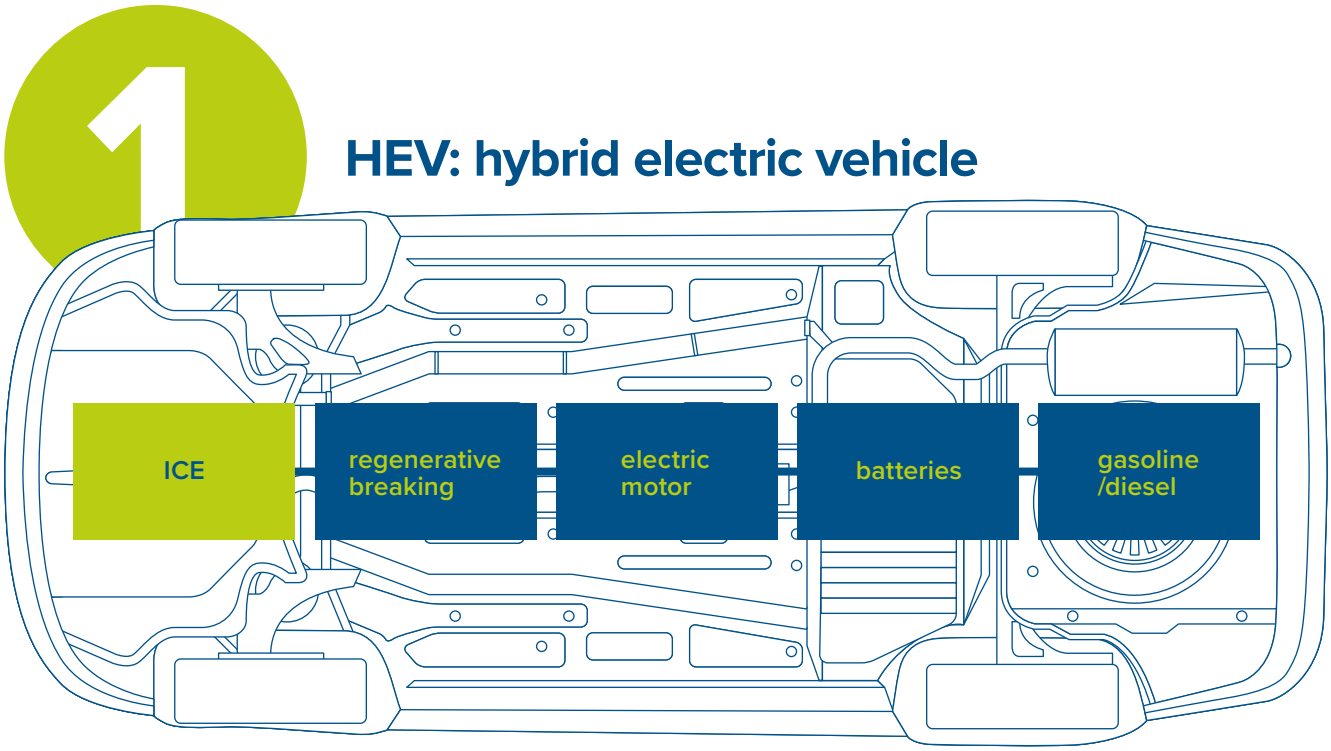


Figure 1

» **Hybrid Electric Vehicle (HEV):** Uses both an electric motor and an internal combustion engine (ICE), which work in tandem to propel the vehicle and lead to higher fuel efficiency. If the battery is used only when the vehicle is started or stopped, for regenerative breaking and limited electric motor assist, it is classified as a mild hybrid. In contrast to this, full hybrids have a full electric launch assist and motor drive.

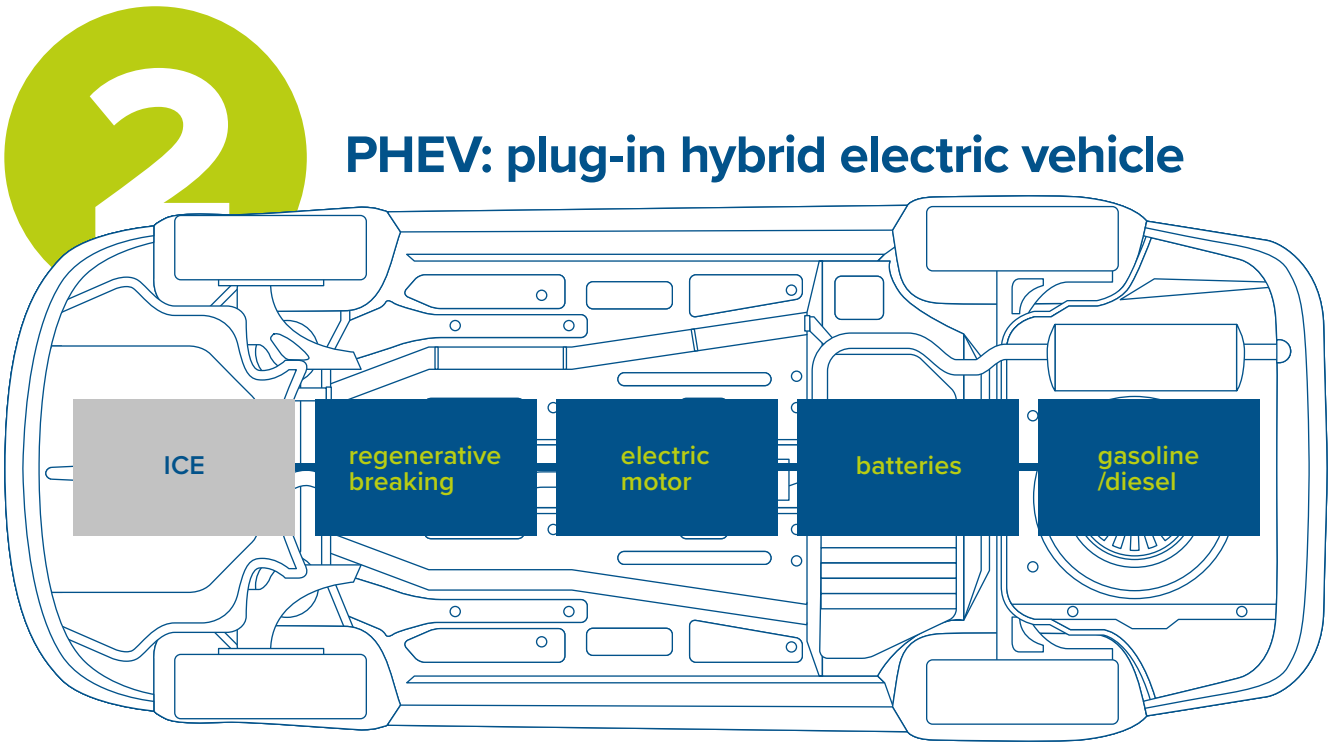


Figure 2

» Plug-in Hybrid Electric Vehicle (PHEV): Shares the characteristics of a conventional vehicle and an all-electric vehicle. It has an internal combustion engine (ICE) powered by conventional or alternative fuels; and the electric motor of an all-electric vehicle, having a plug to connect to the electrical grid.

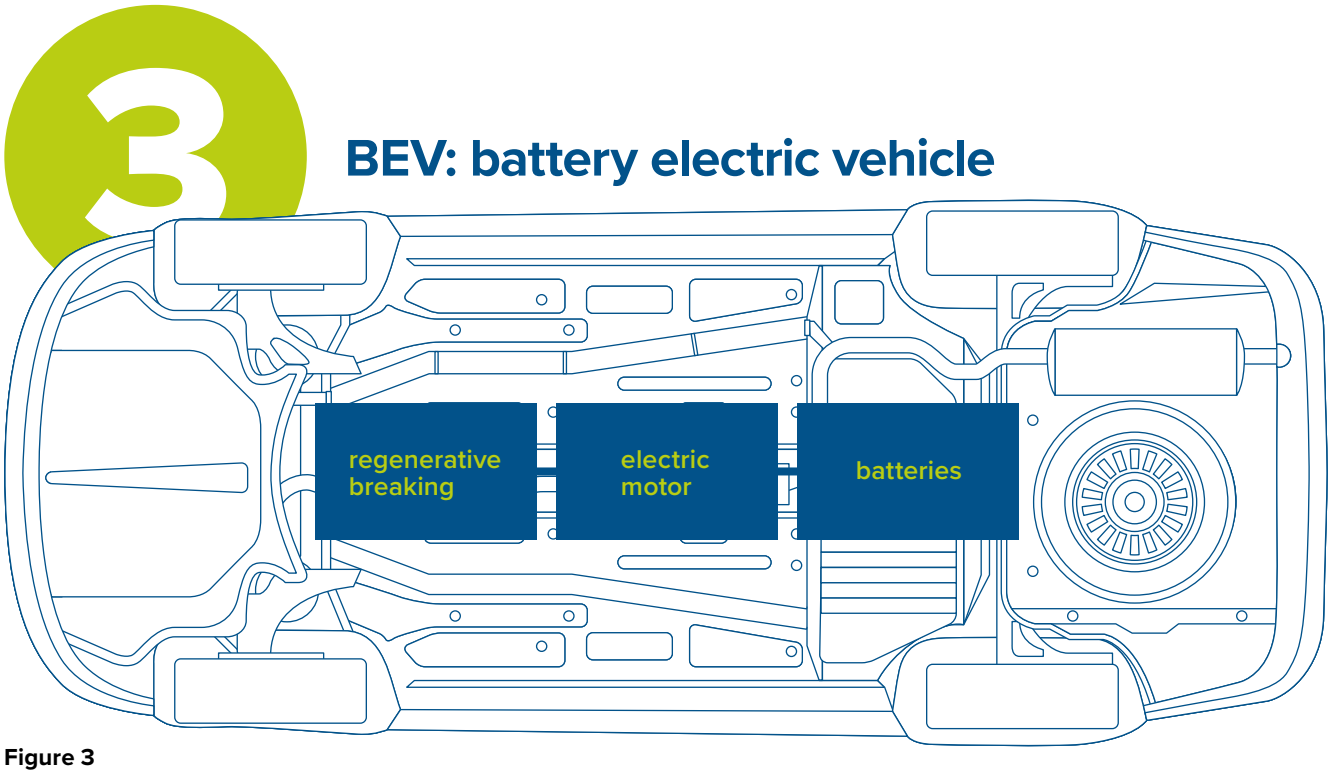


Figure 3

» **Battery Electric Vehicle (BEV):** Uses a relatively large on-board battery to propel the vehicle. The battery being the only source, provides energy for propulsion through an electric traction motor(s) as well as power for all vehicle accessory systems.

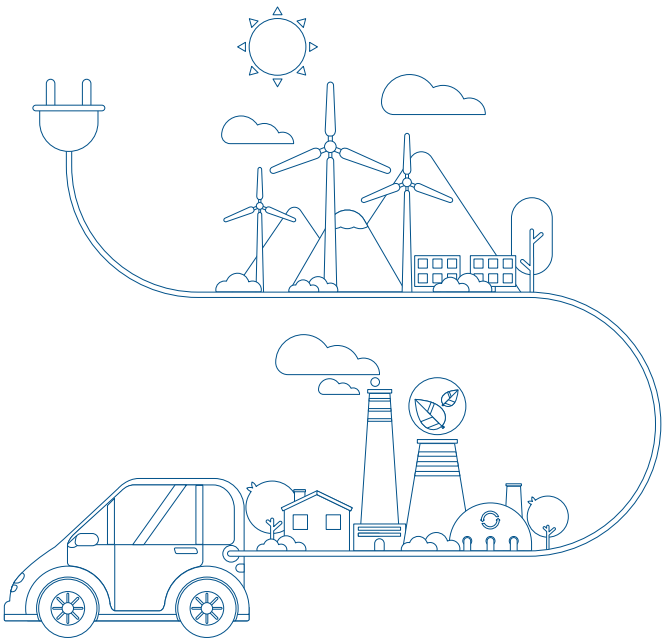
» **Fuel Cell Electrics Vehicle (FCEV)[2]:** A type of electric vehicle which uses a fuel cell, instead of a battery in combination with a battery or supercapacitor power its on-board electric motor. Fuel cells convert fuels directly into electricity via an electrochemical process that does not require combustion.

Electric mobility ecosystem

Implementing electric mobility in cities will require developing an entire ecosystem. Electric mobility brings together two sectors —transport and power, which have conventionally remained standalone. Success of implementing electric mobility will be determined by how efficiently cities are able to integrate these two sectors.

The electric mobility ecosystem includes the government which formulates the guiding policies and regulations, OEMs and suppliers, which design and manufacture vehicles, power and electricity suppliers, which are responsible for electricity generation, transmission and distribution, city-level bodies that can support setting up of charging infrastructure by energy operators/charging solution providers; and end consumers.

There are diverse stakeholders in the electric mobility ecosystem within a city. The end user could be a bus operator, who would need to charge massive batteries in a short time, or it could be a personal vehicle owner who might require charging his/her two-wheeler or a car overnight through an on-street charger or it might be a car ride-sharing provider, who would like the charging to happen rapidly for numerous vehicles simultaneously.



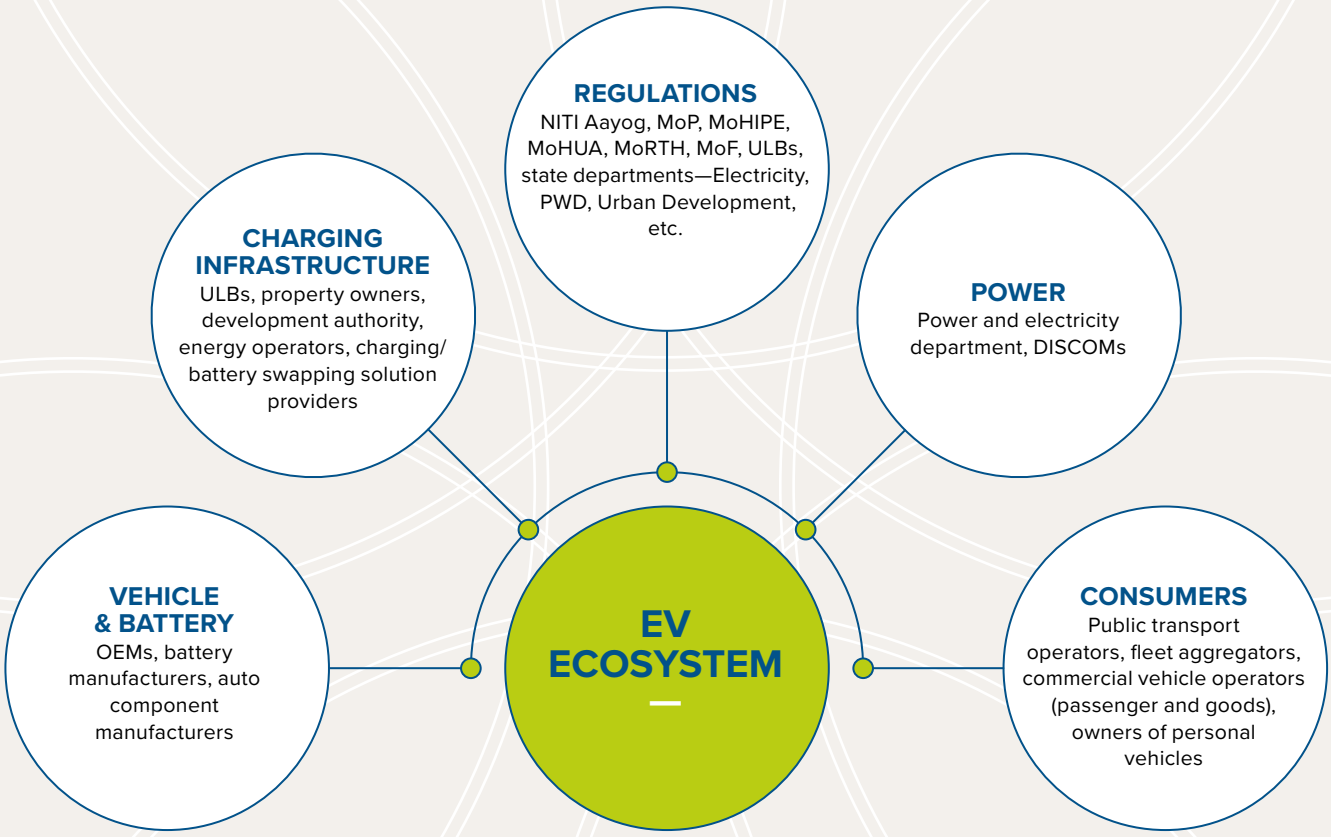


Figure 4: Key stakeholders and components of an EV ecosystem

3.0 What is the global scenario of EV adoption?

As per the estimations made by International Energy Agency (IEA), 2018, globally, the annual sales of new electric cars surpassed 10 lakhs in 2017. The sales of electric buses touched almost 10 lakh and that of two-wheelers, almost 3 crores for the same year (IEA, 2018).

In terms of total EV stock, IEA (2018), estimates more than 30 lakh cars, 3.7 lakh buses and around 25 crore two-wheelers, to be existing globally. Estimates made by Bloomberg New Energy Finance (BNEF, 2017) and ZEV Alliance (2018) also fall within the similar range.

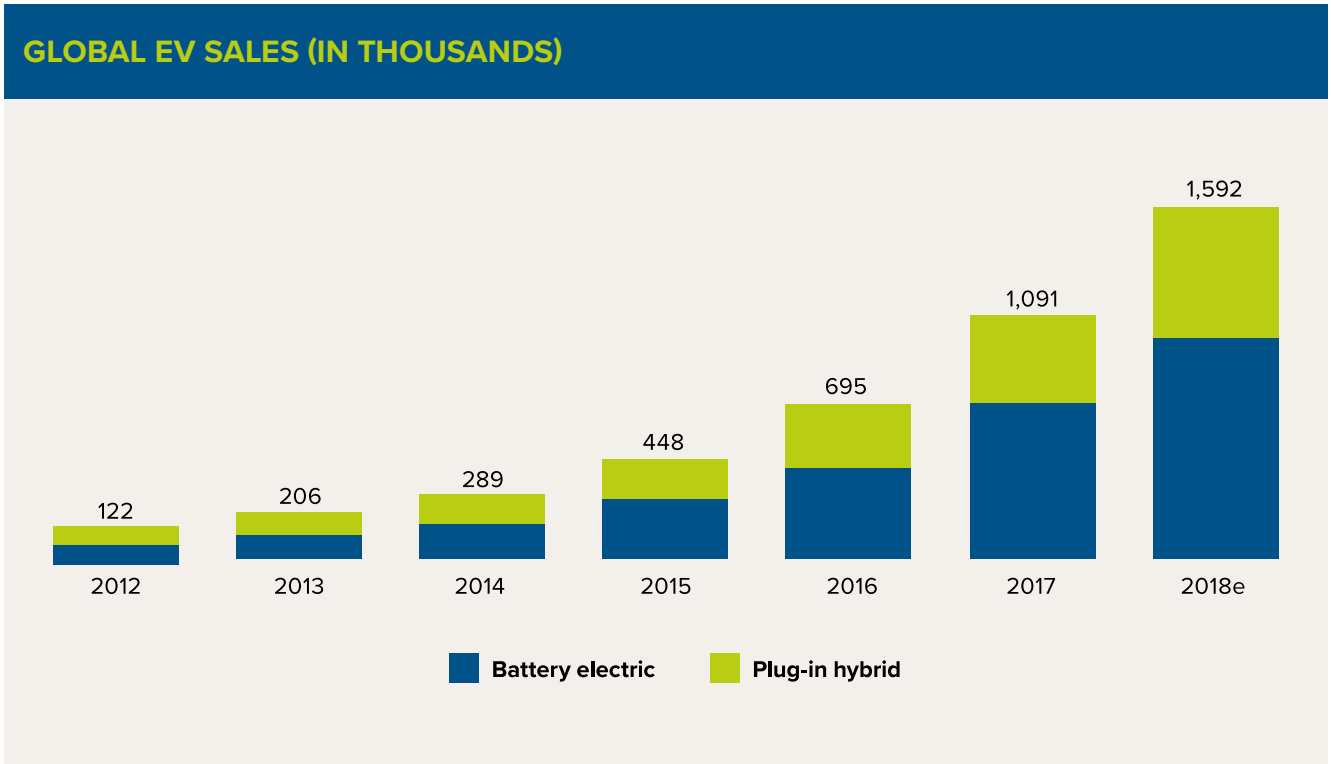


Figure 5: Global passenger EV sales by type as per estimates made by Bloomberg New Energy Finance (2017)
Note: The figure provides only estimated numbers for 2018 (2018e)

GLOBAL EV SALES BY COUNTRY

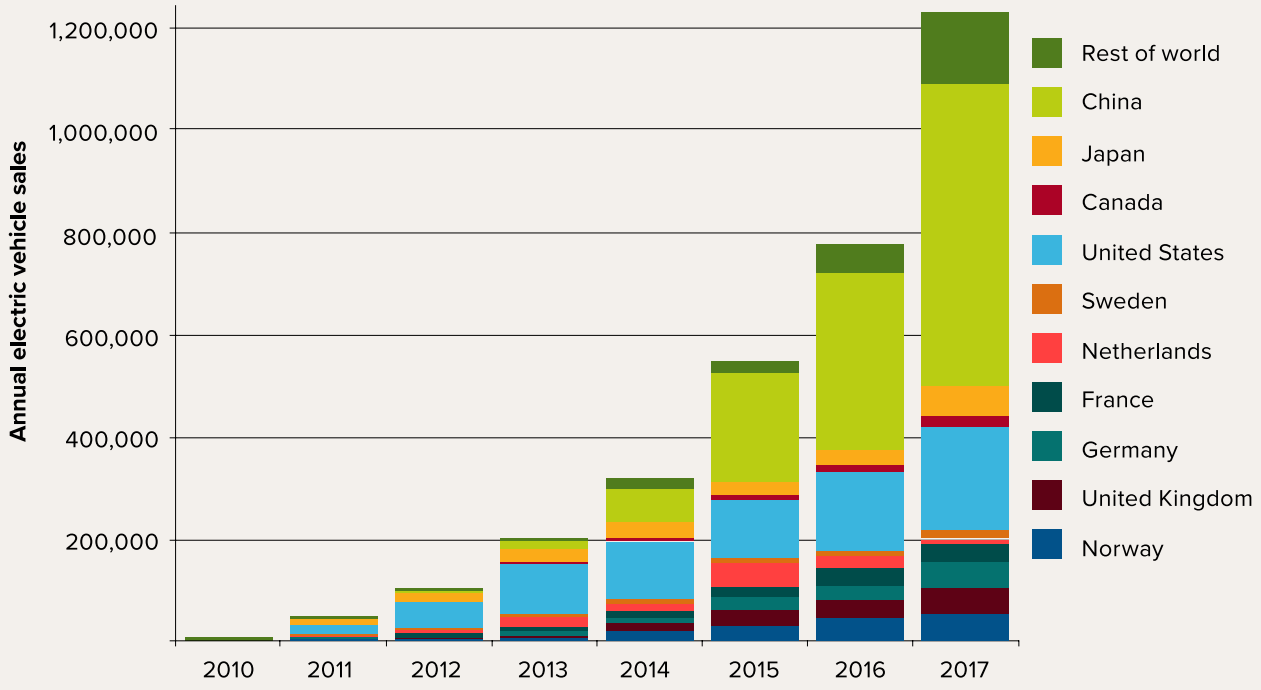


Figure 6: Annual sales of EVs—2010-2017 as per ZEV Alliance (2018)[3] | **Source:** www.forbes.com/sites/energyinnovation/2018/05/30/chinas-all-in-on-electric-vehiclesheres-how-that-will-accelerate-sales-in-other-nations/#9896912e5c1e

4.0 Drivers of electric mobility

Falling battery prices and improvement in battery performance

Cost has been one of the key barriers for the uptake of EVs. With supportive government policies and reduction in battery prices, a significant growth in the EV market is expected. The battery prices, in fact, have witnessed a significant drop; almost 80% in the past seven years (BNEF, 2017). According to BNEF (2017), an average battery pack price was $1,000/kWh in 2010, which reduced to $209/kWh, in 2017. The prices are expected to plummet to $70/kWh by 2030 (BNEF, 2017).

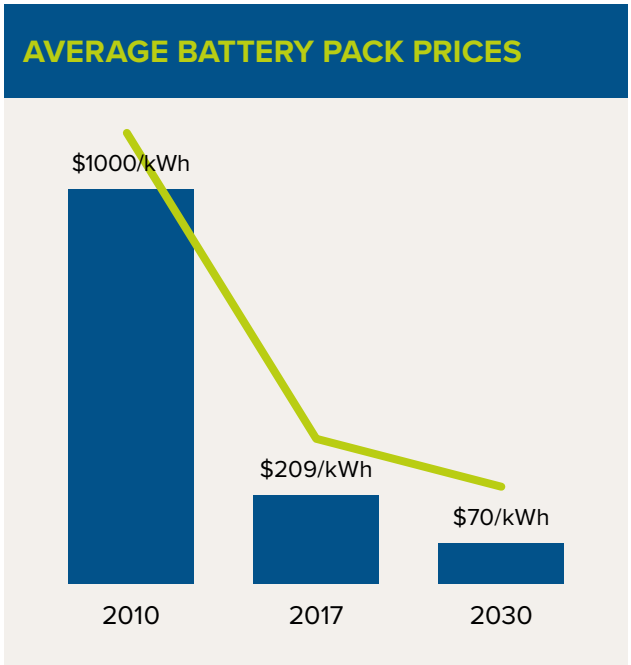


Figure 7 | **Source:** Bloomberg New Energy Finance (2017)

» The battery performance has improved markedly over the years; the average energy density of EV batteries has been improving at around 5–7% per year (BNEF, 2018). «

Government support

Governments around the world have been keen on adopting cleaner modes of transport. There has been extensive support for purchase of EVs, through incentives like purchase subsidy, mandatory EV fleet requirements, strict fuel economy norms, etc.

Action by cities

The growth of EVs is not just driven by national and state level policy support but also aggressive action led by cities. Air quality benefits that EVs offer are becoming a key driver of such action across municipalities, globally.

NATIONAL EV TARGETS SET BY DIFFERENT COUNTRIES FOR 2020–2030	
COUNTRY	**TARGET**
» China	» **New energy vehicle (NEV) mandate:** 12% NEV credit sales of passenger cars by 2020 » **NEV sales share:** 7–10% by 2020, 15–20% by 2025 and 40–50% by 2030
» Finland	» 250,000 EVs by 2030
» Ireland	» 500,000 EVs and 100% EV sales by 2030
» U.S.A.	» **ZEV mandate in ten states:** 22% ZEV credit sales in passenger cars and light-duty trucks by 2025 » 3,300,000 EVs in eight states combined by 2025 » **California:** 1,500,000 ZEVs and 15% of effective sales by 2025 and 5,000,000 ZEVs by 2030
» Korea	» 200,000 EVs in PLDVs by 2020
» Norway	» 100% EV sales in PLDVs, LCVs and urban buses by 2025 » 75% EV sales in long-distance buses and 50% in trucks by 2030

Table 1: National EV targets set by different countries for 2020–2030 | **Note:** NEVs in the Chinese context refers to BEVs, PHEVs and FCEVs; PLDV: passenger light-duty vehicle; LCV: Light commercial vehicle | **Source:** Compiled by IEA (2018)

5.0 Action led by cities

Cities and urban local governments around the world are developing policies to encourage the use of EVs to reduce greenhouse gases, improve air quality and reduce dependence on fossil fuels. EV uptake in 20 global cities, as shown in Figure 8, constitutes about 40% of the world's total EV sales (ICCT, 2017).

The share of EV sales is as high as 36% in Bergen and 33% in Oslo. Cities such as Amsterdam, London, Los Angeles, Oslo, and Beijing have also set targets for adoption of EVs in their respective cities. While Amsterdam is aiming at zero-emission transport by 2025, Oslo is targeting the same but for 2030. New York city is aiming at 20% EV sales share by the same year.

Cities are relying on measures such as restricting movement of ICEVs in certain parts of cities, incentivizing the ownership and use of EVs such as providing purchase subsidy on EVs, and allowing EVs on special lanes, access to free charging, free parking, exemption from toll charges, etc.

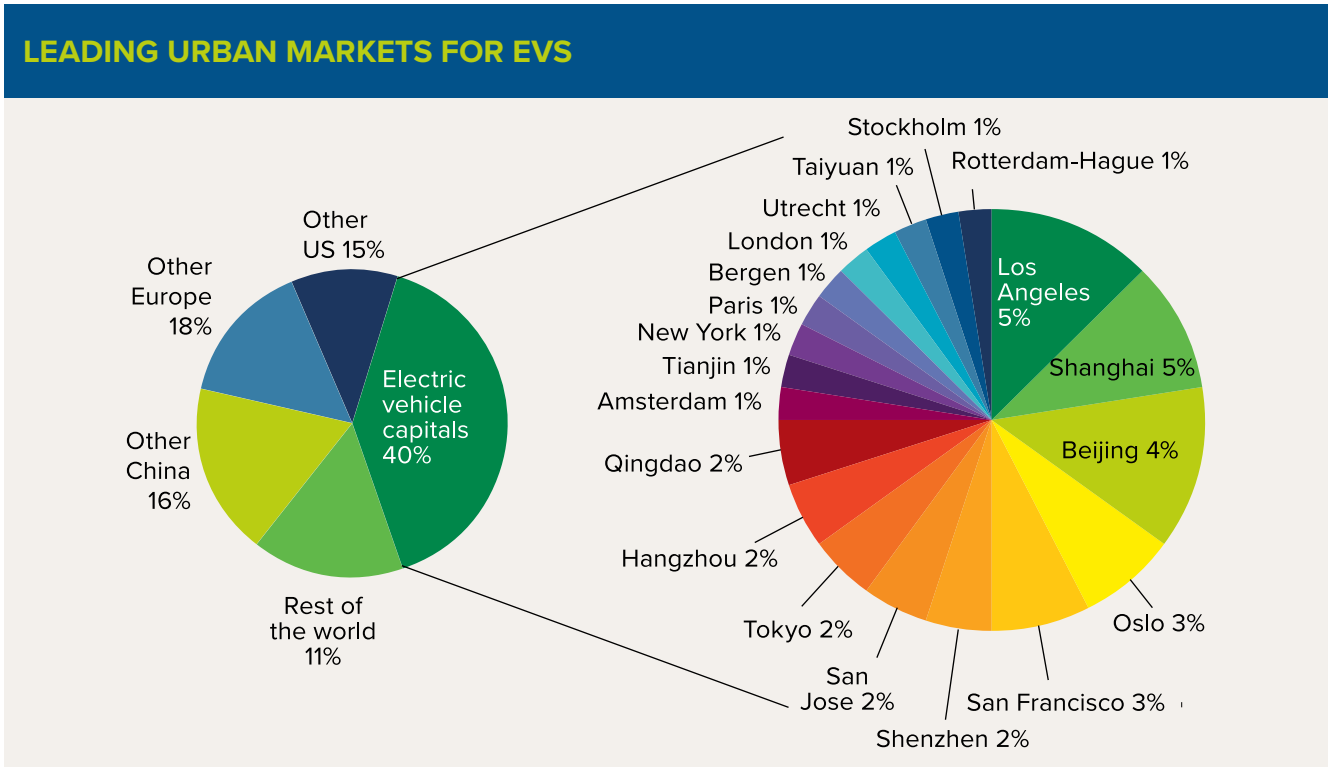


Figure 8: Cumulative EV stock in leading urban markets and other geographies expressed as percentage of global EV stock as in 2016 (estimated values) | **Source:** ICCT (2017)

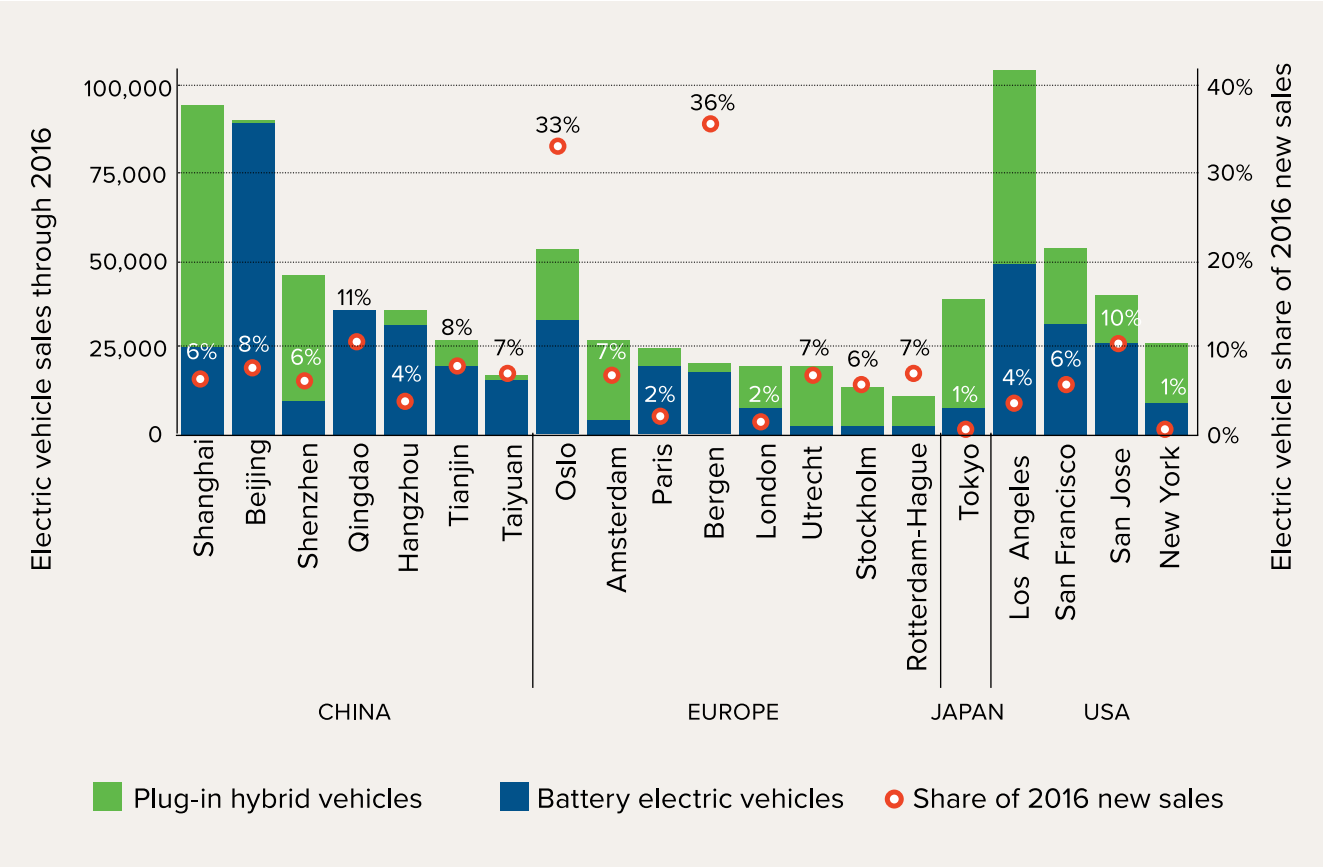


Figure 9: Cumulative EV stock in leading urban markets and other geographies expressed as percentage of global EV stock as in 2016 (estimated values) | **Source:** ICCT (2017)

EV TARGETS ANNOUNCED BY CITIES	
CITY	**TARGET**
Amsterdam	Zero-emissions transport within the city by 2025
London	Procure only zero emission buses from 2025
Los Angeles	10% of vehicle stock electric by 2025; 25% electric by 2035
New York City	20% vehicles sold in the city by 2025 to be EVs Municipal vehicle fleet of 2,000 EVs by 2025
Oslo	Zero-emissions transport within the city by 2030
Shenzhen	120,000 new energy vehicles sold by 2020
Tianjin	30,000 new energy vehicles sold by 2020

Table 2: EV targets announced by cities | **Source:** ICCT (2017), SLOCAT (2018)

6.0 Action led by Original Equipment Manufacturers (OEMs)

Several OEMs have announced targets for the production and sales of EVs; BMW for instance aimat to selling 15–25% EVs of its entire sales by 2025, Honda on the other hand is targeting a massive goal of two-third of its 2030 sales to be EVs. The table provides details of the EV production and sales targets set by some of the leading OEMs, globally.

EV TARGETS ANNOUNCED BY CITIES	
OEM	**ANNOUNCEMENT, AS OF APRIL 2017**
BMW	0.1 million electric car sales in 2017 and 15–25% of the BMW group's sales by 2025
Chevrolet (GM)	30,000 annual electric car sales by 2017
Chinese OEMs	4.52 million annual electric car sales by 2020
Daimler	0.1 million annual electric car sales by 2020
Ford	13 new EV models by 2020
Honda	Two-third of the 2030 sales to be electrified vehicles (including hybrids, PHEVs, BEVs and FCEVs)
Renault-Nissan	1.5 million cumulative sales of electric cars by 2020
Tesla	0.5 million annual electric car sales by 2018 1 million annual electric car sales by 2020
Volkswagen	2–3 million annual electric car sales by 2025
Volvo	1 million cumulative electric car sales by 2025

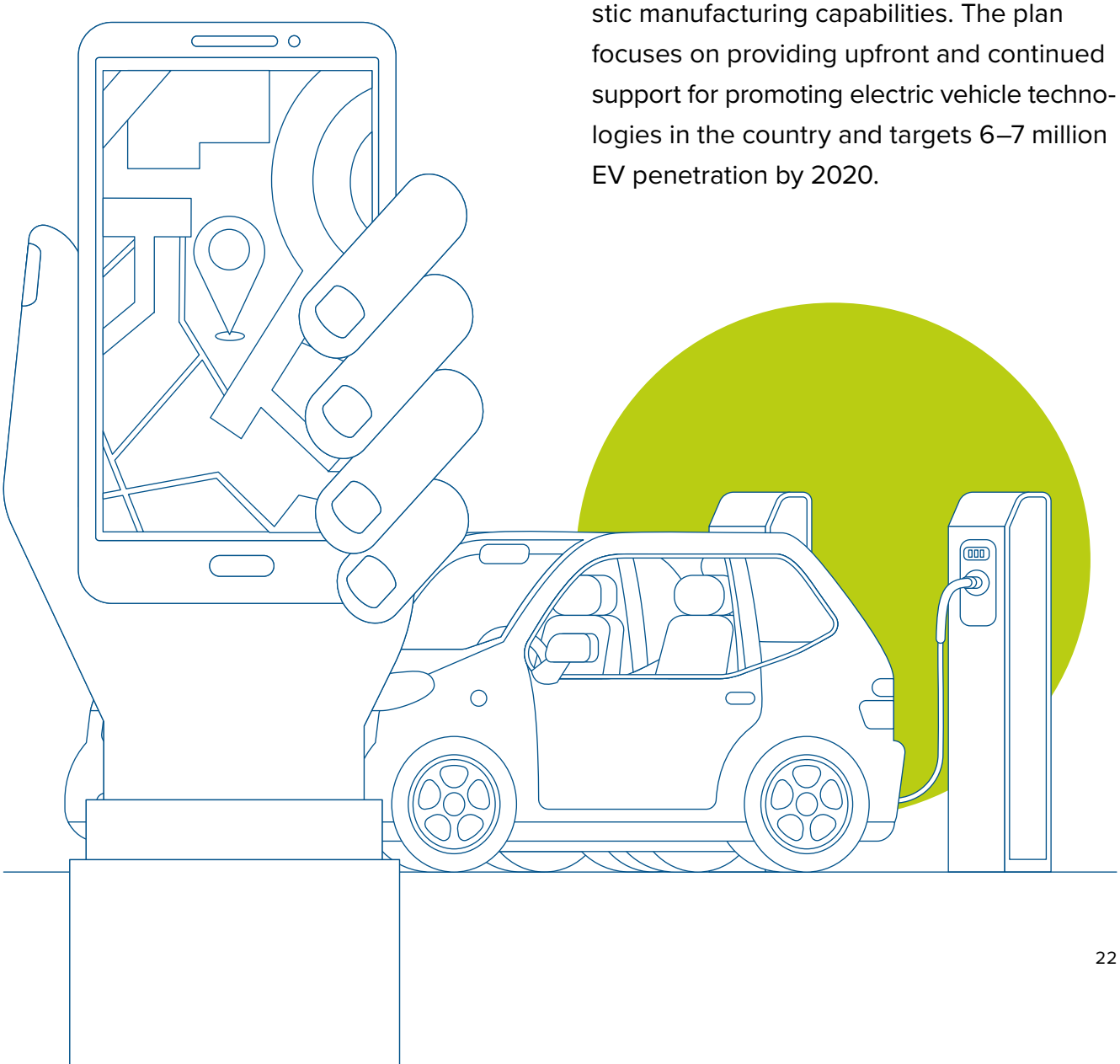
Table 3: Announcements made by different OEMs, as of April 2017 | **Source:** Compiled by IEA, 2017

7.0 Electric mobility in India

Given the massive benefits offered by EVs, India is also turning to EVs as a solution to its transport problems such as fossil fuel dependence, urban air pollution and carbon emissions. India has already mapped its electrification program through adopting the National Electric Mobility Mission Plan 2020 (NEMMP 2020).

National Electric Mobility Mission Plan 2020 (NEMMP 2020)

The NEMMP, 2020 lays down vision and roadmap for EV penetration in India. The plan was adopted by the Government of India in 2013. The plan aims at national energy security, mitigation of adverse impacts of vehicular growth on environment and growth of domestic manufacturing capabilities. The plan focuses on providing upfront and continued support for promoting electric vehicle technologies in the country and targets 6–7 million EV penetration by 2020.



Key interventions proposed under NEMMP 2020

Supply-side incentives: The plan draws up a four-phase approach for building India's EV manufacturing capabilities:

Initial focus on:

- Developing R&D capacities
- Strengthening domestic capabilities
- Initiating localization

Later focus on:

- Creating high capabilities across the value chain, developing indigenized products, sourcing components locally, creating an EV component ecosystem, targeting the export market and investments to enhance capabilities and production plan for exports.

Power and charging infrastructure to build 300–400 charging terminals for buses and for building the overall EV charging infrastructure:

- Estimated investment of 10–20 CR INR
- Estimated requirement of 2–4 MW of extra power generation capacity

The recommendations made under NEMMP have been taken forward by the Government through a scheme called FAME.

» Cities and towns included under the scheme—Smart Cities, metropolitan cities of Delhi, Mumbai, Kolkata, Chennai, Bengaluru, Hyderabad, Ahmedabad, North Eastern cities and cities with over 1 million population «

FAME, India (Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India)

FAME is a demand side incentive scheme under the NEMMP, with a focus on technology development, infrastructure creation and boosting demand through subsidies and pilot projects.

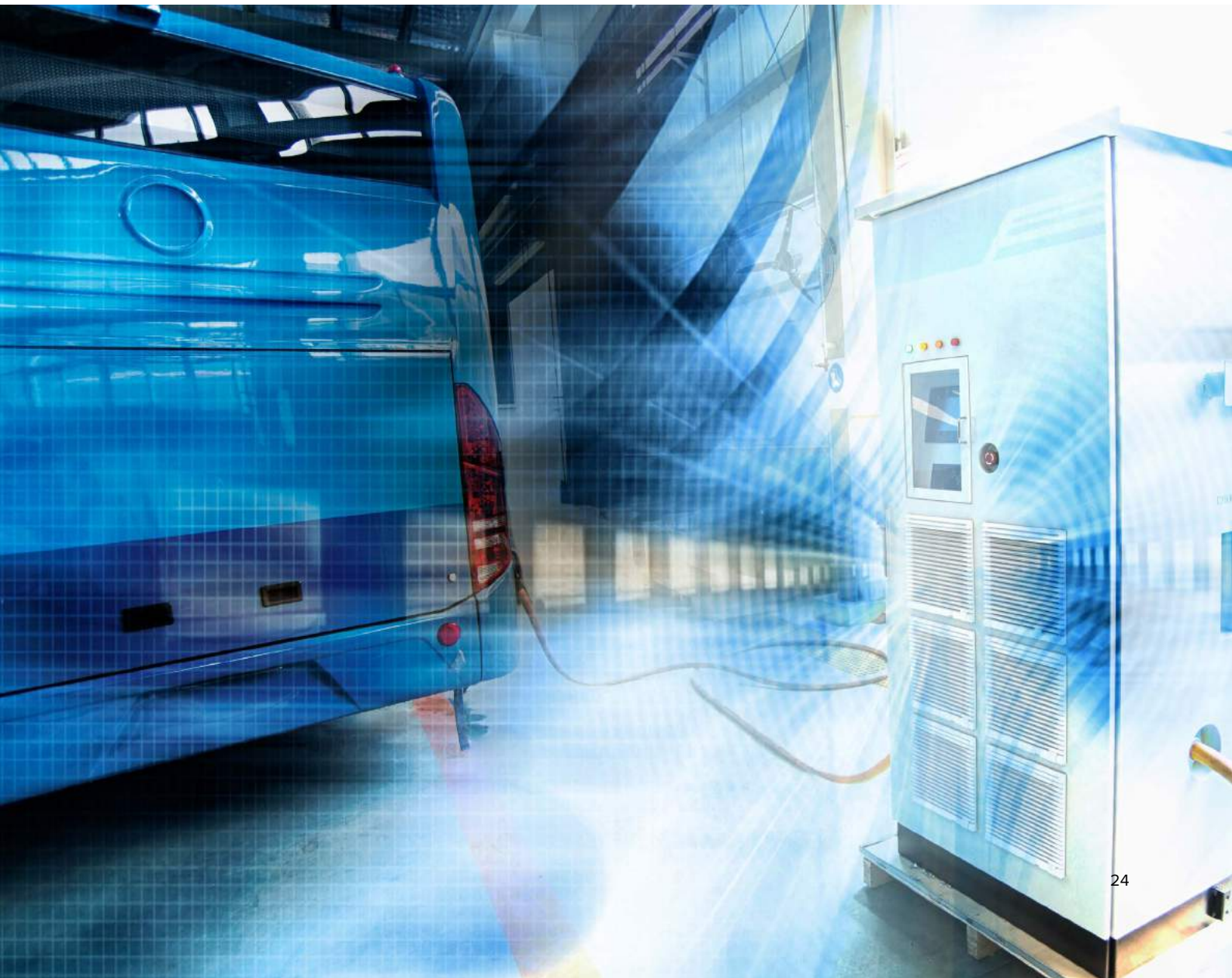
- Implemented since April 2015, extended till 31 March, 2019
- It has an approved outlay of INR 750 million
- Incentives under the scheme are provided in the form of discounts
- The discount amount is about one-third of the difference between the price of an EV and a comparable petrol vehicle
- ~60% of these funds are allocated towards demand incentives

Coverage of the scheme[7]

- Cities and towns included under the scheme—smart cities, metropolitan cities of Delhi, Mumbai, Kolkata, Chennai, Bengaluru, Hyderabad, Ahmedabad, North Eastern cities and cities with more than 1 million population
- Covers all vehicle segments i.e. two, three and four-wheelers, cars, LCVs, buses, etc.

INCENTIVES FOR DIFFERENT VEHICLE SEGMENTS	
VEHICLE SEGMENT	**INCENTIVES (MIN–MAX)**
Scooter	INR 1,800–INR 22,000
Motorcycle	INR 3,500–INR 29,000
Auto-rickshaw	INR 3,300–INR 61,000
Car	INR 11,00–INR 138,000
LCV	INR 17,000–INR 1,87,000
Bus	INR 300,000–INR 660,000

Table 4: Incentives for different vehicle segments




RoWrice
柔记 智能手写本
69
邦
55D
39D
40059-40059


JOIN THE
TREO
e VERITO

Incentives for the Smart Cities

Smart cities can also make use of grant funding being made available to them by the Central Government for EV deployment. Advancing the NEMMP, the Government of India has announced that it will provide financial support of up to 1.05 billion as grant funding to Smart Cities for the purchase of EVs for mass public transport for implementing pilot projects under the FAME program. Only cities with populations greater than 1 million can avail this funding.

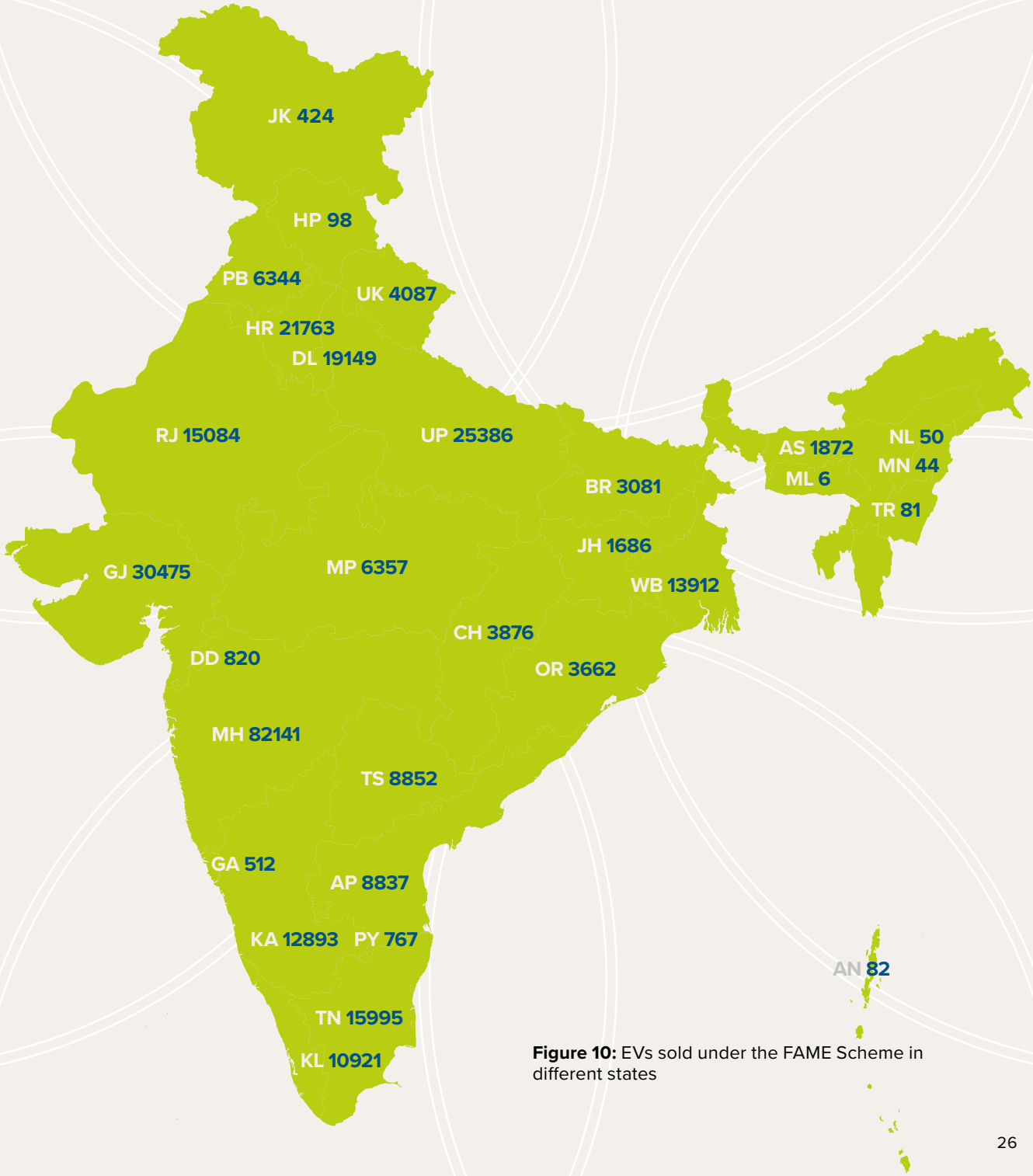


Figure 10: EVs sold under the FAME Scheme in different states

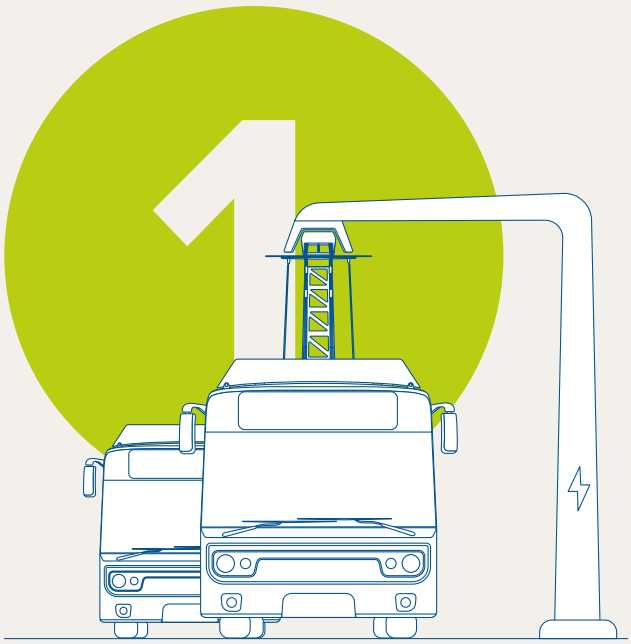
» Implementation of the FAME scheme has led to 77,000 tons of CO_2 emission reduction and 31 million litres of fuel savings—DHI, 2018.[8] «

Key areas of EV funding proposed are[9]:

» The funding support is available only on the composite deployment of electric buses (with a maximum of 100 per city), electric four-wheeler (4-W) passenger cars, and electric three wheelers (3-W)

» The government will also provide financial support towards setting up of charging infrastructure in selected cities with an upper ceiling of INR 150 million per city

» DHI will receive only a consolidated proposal from the city (city size> 1 million eligible). The cities will be responsible for the coordination among city and state level stakeholders such as the state government departments, undertakings, municipal corporations, and public, state transmission utilities, transportation authorities, and 4-W/3-W aggregators, etc.



Financial support for electric buses:

» Electric buses with a minimum of 15% Indian components: 60% of the purchase cost or 10 million

» Electric buses with a minimum of 35% Indian components: 60% of the purchase cost or 15 million

Financial support for electric 4-wheelers:

» Electric 4-W with a length that does not exceed 4m and range of 70km: a grant of INR 76,000

» Electric 4-W with a length that does not exceed 4m and range of 105 km: a grant of INR 1,24,000

» Electric 4-W with a length that exceeds 4m and a range of 70 km: a grant of INR 60,000

» Electric 4-W with a length that exceeds 4m and has a range of 105 km: a grant of INR 1,38,000

Financial support for electric 3-wheelers:

» Electric 3-W with a range of 50 km: a grant of INR 51,000

» Electric 3-W with a range of 80 km: a grant of INR 61,000

» Electric 3-W with a top speed that does not exceed 25km per hour (km/h) and range of 50 km: a grant of INR 37,500

» Electric 3-W with a top speed that is not more than 25km/h and range of 80 km: grant of INR 45,000

Delicensing and standardization of charging infrastructure by GoI

With an aim at accelerating development of charging infrastructure in the country, the Ministry of Power recently delicensed setting up of charging stations for EVs.

The licence requirement had been a major hinderance for market access in setting up charging infrastructure. With delicensing it is expected that a lot of small players will come forward in setting up of EV charging stations. Since it is expected that charging infrastructure will be dominated by large number of small fragmented players, developing standardized protocols for charging stations is important. With an aim at promoting performance and interoperability, the Government has already adopted standard protocols for low and high power AC and DC charging stations in the country.

No licensing requirement to set up charging stations, Ministry of Power[10]

Ministry of Power released a notification on 14 December 2018, stating that charging batteries of EVs through charging stations does not require any license under the Electricity Act.

Standardization of protocol for Charging Infrastructure—Bharat EV Charger AC-001 and Bharat EV Charger DC-001

» Protocol for low power AC & DC charging

stations (for EVs having system voltage less than 100 VDC)

» These standards provide specifications for AC and DC charging for electric vehicles

» For more information on the protocol refer to https://dhi.nic.in/writereaddata/UploadFile/Standardization%20of%20protocol.pdf

Recommendations for high power AC & DC charging stations (for EVs having system voltage over 100 VDC) developed by ARAI

» For the recommendation refer to https://dhi.nic.in/writereaddata/UploadFile/Standardization%20of%20Protocol%20of%20AC63666-2997828194203.pdf

Other initiatives taken up by the Government to promote EVs[11]

Besides providing incentives to the cities and offering demand side incentives to the consumers, there are other steps that the government has taken to provide a thrust to the EV market in the country. Some of these steps/ initiatives have been discussed below.

Reduced GST on purchase of EVs

» Pure BEVs have been placed in a lower GST slab of 12% in comparison to the 28% GST that these vehicles were earlier subject to.

National E-Mobility Programme, MoP

» Implemented by Energy Efficiency Services Limited (a joint venture set up under the Ministry of Power)

National E-Mobility Programme, MoP

» Implemented by Energy Efficiency Services Limited (a joint venture set up under the Ministry of Power)

» Focus on public procurement to facilitate demand creation for EVs in India

» Aim at building bulk procurement and demanding aggregation to procure and deploy electric vehicles to transition the national fleet of government vehicles (about 500,000 cars) to EVs

» The Ministry also announced that it is focusing on creating the charging infrastructure and a policy framework so that by 2030 more than 30% of vehicles in India are electric

Zero-emission corridor, Agra

» Restricts movement of conventional vehicles within a radius of 1.5 km around the Taj Mahal

» Seven-seater electric vans (make: Maximo) are operated by the Agra Development Authority (ADA) for last-mile connectivity (2 km)

Private initiatives

» Fleet aggregator and operator, Ola announced its plans to deploy 5 million e-cars in the next five years

» Uber to explore deployment of Mahindra's e-cars in Delhi and Hyderabad

» Mahindra Electric is providing fast charging support to e-cars deployed by ZoomCar, a car renting company

» Fleet operator and aggregator Meru, and Mahindra Electric announced the launch of a pilot EV fleet in Hyderabad; to be replicated in other cities in India[12]

Bus Pilots[13]

A number of bus pilot projects have also been launched in various Indian cities; some of these are listed below:

» 25 electric buses being launched in Pune, in February 2019

» Electric buses plying in New Town, Kolkata since May 2018

» BYD electric bus trial in Bengaluru by Bengaluru Metropolitan Transport Corporation (BMTC), 2014

» Goldstone-BYD bus trial in Rajkot in 2016

» BYD electric bus trial in Delhi by Delhi Transport Corporation (DTC), 2016

» Goldstone-BYD bus trial by Himachal Road Transport Corporation (HRTC) on Manali-Rohtang Road in 2016; regular e-bus service started in September 2017—25 Goldstone BYD buses in operation

» Ashok Leyland bus trial by HSRTC on Manali-Rohtang Road in 2016

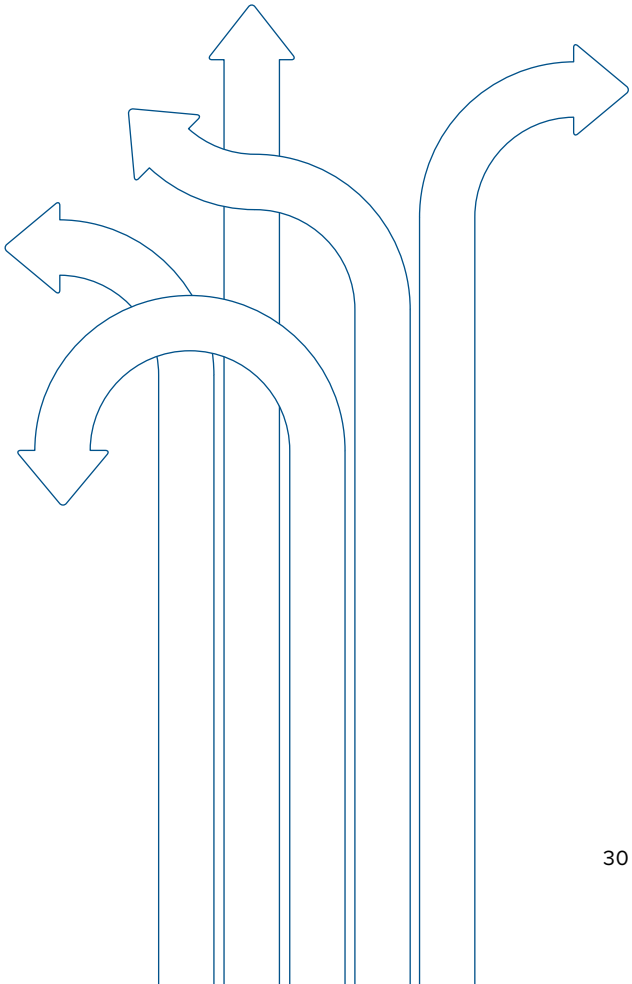
» Tata Motors bus trial in Shimla in 2017

» Tata Motors bus trial in Chandigarh in 2017

» Four Goldstone-BYD buses deployed by Bombay Electric Supply & Transport (BEST), Mumbai in 2017

» Goldstone-BYD bus trial in Goa in 2018

» BYD electric bus trial in Delhi by Delhi Transport Corporation (DTC) in 2016




50

Initiative by the State Governments

Karnataka, Telangana, Maharashtra and Uttar Pradesh have launched their respective state EV Policies to promote manufacturing and adoption of EVs. Delhi also released a draft EV policy in December 2018. It is currently in the stage of finalization. Andhra Pradesh has recently announced its plans and targets for adoption of electric vehicles. The box below provides details on the vision, objective and targets set by each state EV policies.

Andhra Pradesh aims at putting 10 lakh electric vehicles on road by 2024. AP government seeks to:

» Have 10 lakh electric vehicles across all vehicle segments in the state by 2024

» Convert the entire fleet of Andhra Pradesh State Road Transport Corporation into electric

» Convert all government vehicles, including corporations, boards and government ambulances to electric vehicles by 2024

» Install 1 lakh slow and fast EV charging stations by 2024

» Government will stop new registration of ICE cars and wants to make Amaravati, an electric-only city

State Government Policies on Electric Vehicles

Karnataka Electric Vehicle and Energy Storage Policy 2017

Vision:

To make Karnataka, a preferred investment destination for manufacturing of electric vehicles by leveraging advantages and opportunities available for sustained development of this promoting segment

Objectives:

» To maintain lead share of Karnataka as preferred destination for attracting investments in manufacture of electric vehicles

» To attract investment of INR 31,000 CR and create employment opportunities for 55,000 persons both from supply and demand sides

» To create a conducive environment to transit from electric to ICE

» To provide opportunities for R&D in e-mobility

Targets:

» 1000 EV buses in poly period

» 100% three-wheelers/four-wheelers moving goods will be encouraged to transit to electric mobility by 2030

» Incentives for first 100 fast-charging stations

For more details on the policy refer to www.investkarnataka.co.in/assets/downloads/Karnataka-State-Electric-Vehicle-&-Energy-Storage-Policy-2017.pdf

Telangana Electric Vehicle Policy Draft 2017

Vision:
To establish Telangana as the benchmark state in India and a model of international standards for electric vehicle adoption across segments (personal, shared and commercial), supported by a world-class infrastructure and ecosystem

Objectives:
» To attract investments worth 3B USD and create employment for 50,000 persons by 2022 through EV manufacturing and charging infrastructure development

» Provide best-in-class ecosystem and infrastructure to make Telangana the EV hub of India

» Develop a proving ground for viable business models through accelerated demand for EVs

» Promote innovation in EVs and other emerging trends such as autonomous/connected mobility

» Make Telangana state the preferred destination for electric vehicle and component manufacturing

» Create a pool of skilled workforce for the industry

» Create a conducive environment for industry and research institutions to focus on cutting edge research in EV technologies

Targets:
» Telangana State Transport corporation to set a target of 100% electric buses by 2030 for intracity, intercity and interstate transport (key milestones—25% by 2022, 50% by 2025 and 100% by 2030)

» Government will set up first 100 fast charging stations in GHMC and other cities in a phased manner

For more details on the policy refer to www.evpedia.in/wp-content/uploads/2017/11/Telangana-Draft-Electric-Vehicle-Policy-_16_10_2017.pdf

Maharashtra's Electric Vehicle and Related Infrastructure Policy 2018

Vision:
Transforming Maharashtra into a globally competitive state for electric vehicle and component manufacturing and maximize the adoption of EV in Maharashtra

Objectives:
» To develop Maharashtra as the leader in EV manufacturing and use

» To create newer employment opportunity

» To promote export of EV, component, battery, charging infrastructure

» To promote R&D and skill development in EV

» To promote sustainable transportation

Targets:

» Increase number of EV registrations in Maharashtra to 5 lakhs

» To generate an investment of INR 25,000 CR in EV

» To create jobs for 1 lakh people

For more details on the policy refer to www.di.maharashtra.gov.in/_layouts/15/doistaticsite/english/pdf/MaharashtrasElectricalVechiclePolicy.pdf

Uttar Pradesh Electric Vehicles Manufacturing Policy 2018

Vision:

To support the expansion of eco-friendly automobile industry in Uttar Pradesh and open the market for electric vehicles manufacturing, supporting the set targets of GoI

Objectives:

» To establish Uttar Pradesh as the preferred destination for attracting investments in manufacturing of electric vehicles (EV)

» To create employment opportunities, both from supply side and demand side

» To create a conducive environment for shift from Internal Combustion (IC) engines to electric vehicles

» To encourage the use of Hybrid EVs in Uttar Pradesh during the transition phase

» To develop human capital and augment the power capacity to meet the needs of the industry promoting electric mobility in the state

Targets:

» **Public transport:** To promote EVs in public transport, 1000 e-buses will be introduced in the state by 2030; 25% in phase I by 2020, remaining 35% in phase II by 2022 and the rest 40% in phase III by 2030. Further, green routes will be identified by 2020 in GB Nagar, Ghaziabad, Lucknow, Kanpur and Varanasi for 100% EV public transportation

» **Private transport:** State government will encourage electric two-wheeler taxis for short distance mobility and existing auto rickshaws will be encouraged to resort to EV technology. Auto rickshaws, cabs, school buses/vans, etc., will also be targeted to achieve 100% electric mobility by 2030 in five cities—GB Nagar, Ghaziabad, Lucknow, Kanpur and Varanasi

» **Goods transportation:** To promote adaptability of EVs in goods transportation, three-wheelers, four-wheelers. Mini-goods vehicles to be encouraged in GB Nagar, Ghaziabad, Agra, Lucknow, Kanpur, Varanasi and Jhansi

For more details on the policy refer to www.niveshmitra.up.nic.in/Documents/DraftPolicies/Uttar_Pradesh_Electric_Vehicles.pdf

8.0 Considerations while promoting electric mobility

Promotion of EVs need not address concerns related to traffic congestion

Though EVs are being hailed as a solution to very many problems, city managers at this stage, must understand that private automobiles, even when they do not emit or use clean source of energy to power themselves, may not address concerns related to increasing congestion in cities.

» Cities should ensure that in the process of encouraging EVs, promoting electric passenger kilometers rather than private EVs should be the aim. «

This would imply a focus on the electrification of public transport, shared vehicles, fleet vehicles, and other vehicles deployed in high utilization business models.

Cities should aim at powering EVs with clean electricity

While EVs produce significantly lower or no tailpipe emissions, they still contribute to pollution and emissions considering the electricity they consume. While assessing the emission footprint of EVs, one must account for well-to-wheel emissions, which imply including GHGs and air pollutants that are emitted to produce and distribute the energy being used to power the EVs. Wherever feasible, cities should try to make efforts to utilise clean electricity, generated from renewable sources like wind or solar to power EVs to reduce the well-to-wheel emissions.

Deploying charging infrastructure is important

Availability of public charging infrastructure is considered critical to the deployment of EVs. Setting up an optimum density of public chargers will require availability of accessible and affordable locations. It will also require availability of grid and power infrastructure. There are no tried and tested business models for setting up public charging infrastructure in the Indian market and ensuring safety of the charging infrastructure will be crucial for the success of EV adoption.

Other Barriers

Though operating cost of EVs is competitive or even lower as compared to ICEVs, their high acquisition cost remains a key barrier to widespread uptake of EVs. A comparison of different bus technologies shows that the upfront cost of electric buses is more than double that of typical diesel buses.

While capital costs are high, the total cost of ownership of electric buses is already lower than ICE buses in many markets. Cities and governments are taking a number of measures to reduce the upfront cost of EVs, yet bridging the wide gap in EV capital costs will remain a challenge for some time. Hence, cities must collaborate with different stakeholders to explore business models that unlock the operational savings of EVs.

COMPARISON OF DIFFERENT BUS TECHNOLOGIES				
POWER SOURCE	**ELECTRICITY**	**ELECTRICITY + FUEL**	**BUSES**	**3W**
Diesel or CNG	CNG	Diesel	Moderate	Moderate
Power generator	Battery	IC engine + battery	IC engine	IC engine
Upfront costs (INR)	2.6 crores	>3 crores	20–88 lakhs	20–88 lakhs
Fuel efficiency	1.5 kWh/km7	2.75–4km/L8	2–3 km/kg	2–3 km/LG
Fuel tariff	6.95 INR/kWh10	50 INR/L11	40 INR/kg	50 INR/L
Fuel cost	10/km INR	13–17/km INR	13–20/km INR	15–23/km

Table 5: Comparison of different bus technologies | **Source:** CSTEP, 2016, Report on Electric buses in India

9.0 Key Performance Indicators (KPIs)

Beyond understanding opportunities and challenges in the sector, it is important that city managers pursue strategies that can deliver the impact they wish to create. KPIs, in this respect, will equip city managers to measure their progress and understand the impact of various actions.

KPIs can be a useful tool to enable cities measure their progress. The focus here is to list the key indicators that will help understand how the city is performing in a holistic manner in terms of EV uptake.

The subsequent document, 'Evaluation Metrics' will provide a detailed discussion on the following KPIs and ways to measure and utilize them.

Number of EVs in the city:

Parameters

» Buses » Mini buses » Standard

Measure

» Actual numbers/estimated numbers/ qualitative indicators

Data sources

» RTO, fleet operators, fleet operator untions

Number of EVs in the city:

Parameters

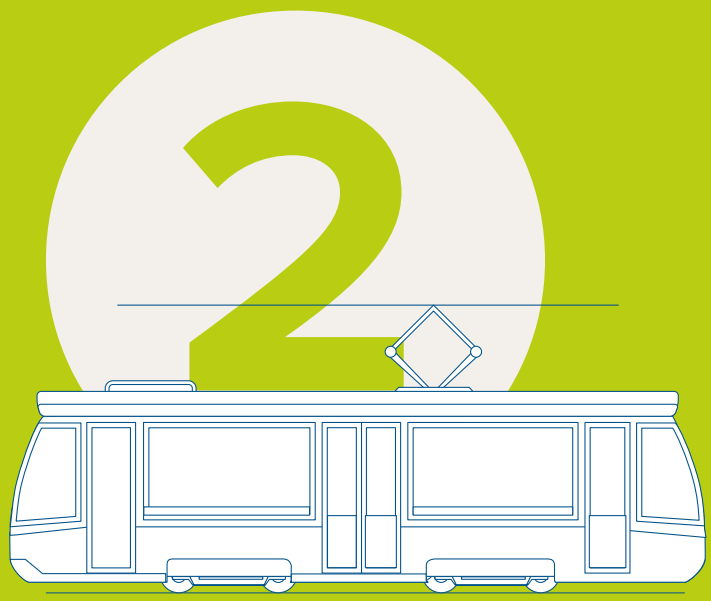
» Rail

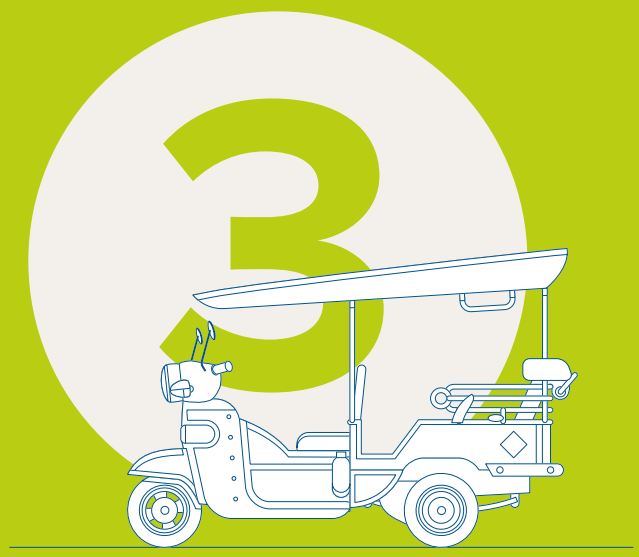
Measure

» Actual numbers/estimated numbers/ qualitative indicators

Data sources

» RTO, fleet operators, fleet operator untions





Number of EVs in the city:

Parameters

» IPT » E-autorickshaw » E-rickshaw

» E-taxis

Measure

» Actual numbers/estimated numbers/ qualitative indicators

Data sources

» RTO, fleet operators, fleet operator untions

Number of EVs in the city:

Parameters

» Personal vehicles » E-cars » LCVs
» E-2-wheelers » E-bicycles

Measure

» Actual numbers/estimated numbers/ qualitative indicators

Data sources

» RTO, fleet operators, fleet operator untions

Number of electric fleet operators:

Parameters

» Buses » Mini buses » Standard

Measure

» Actual numbers/estimated numbers/ qualitative indicators

Data sources

» RTO, fleet operators, fleet operator untions

Number of electric fleet operators:

Parameters

» Rail

Measure

» Actual numbers/estimated numbers/ qualitative indicators

Data sources

» RTO, fleet operators, fleet operator untions

Number of electric fleet operators:

Parameters

» IPT » E-autorickshaw » E-rickshaw » E-taxis

Measure

» Actual numbers/estimated numbers/ qualitative indicators

Data sources

» RTO, fleet operators, fleet operator untions

Electric PKM:

Parameters

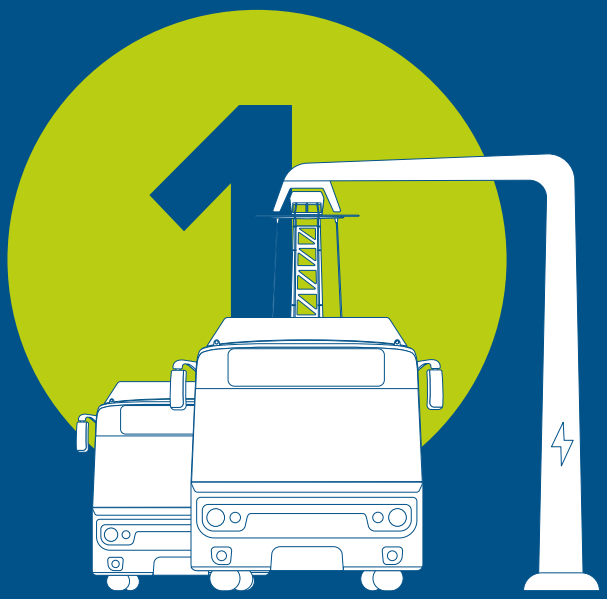
» Buses » Mini buses » Standard

Measure

» Actual numbers/estimated numbers

Data sources

» RTO, fleet operators, fleet operator unions



Electric PKM:

Parameters

» Rail

Measure

» Actual numbers/estimated numbers

Data sources

» RTO, fleet operators, fleet operator unions

Electric PKM:

Parameters

» IPT » E-autorickshaw » E-rickshaw

Measure

» Actual numbers/estimated numbers

Data sources

» RTO, fleet operators, fleet operator unions

Electric PKM:

Parameters

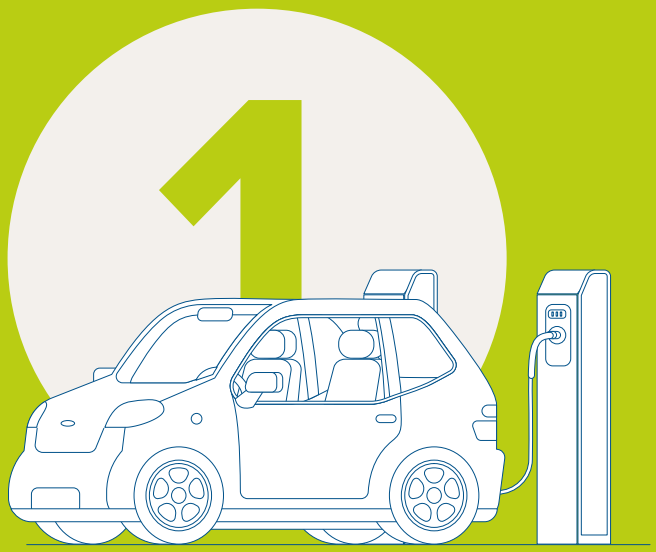
» Personal vehicles » E-cars » LCVs
» E-2-wheelers » E-bicycles

Measure

» Actual numbers/estimated numbers

Data sources

» RTO, fleet operators, fleet operator unions



Number of public EV charging points in the city:

Parameters

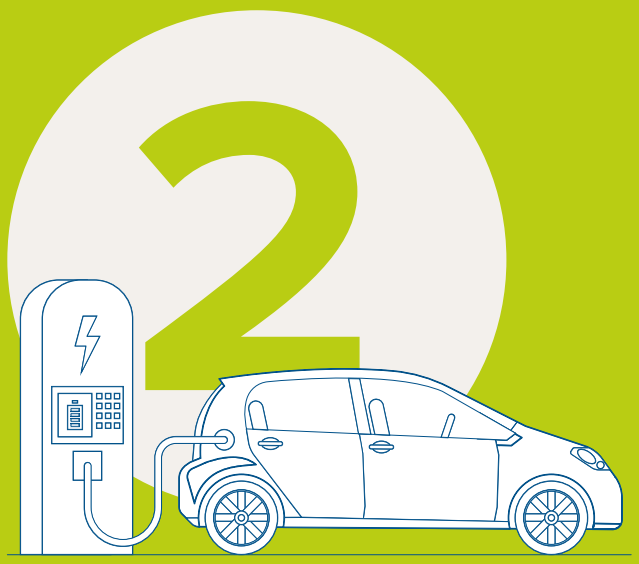
» Level 1

Measure

» Number and location

Data sources

» DISCOM



Number of public EV charging points in the city:

Parameters

» Level 2

Measure

» Number and location

Data sources

» DISCOM

Number of public EV charging points in the city:

Parameters

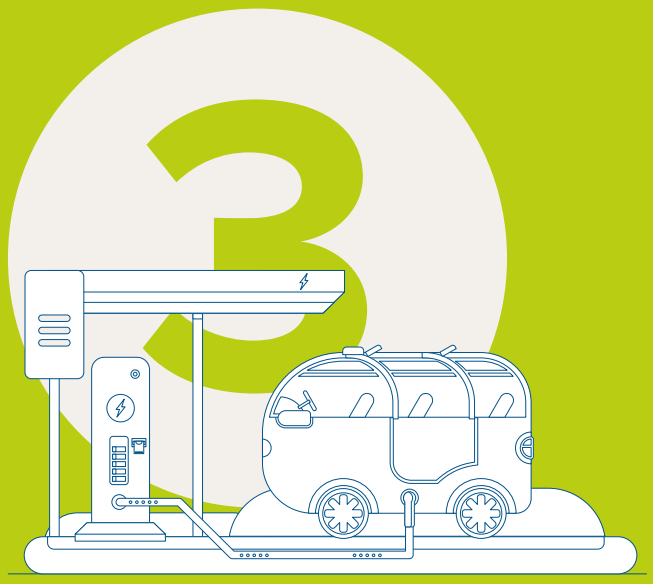
» Level 3

Measure

» Number and location

Data sources

» DISCOM



Investment made on promoting EVs:

Parameters

» Investment on deploying charging infrastructure

» Purchase of EVs

» Deploying monitoring infrastructure such as CCTCs, sensors, etc.

Measure

» Investment made

Data sources

» Municipal body, urban development agency, Department of Transport, Department of Finance, traffic police department

Air quality level:

Parameters

» PM, NO_2, SO_2 levels

Measure

» Air quality levels

Data sources

» Pollution Control Board, Department of Environment

Recognition for e-mobility initiatives:

Parameters

» National

Measure

» Describe

Data sources

» Municipal body, Urban Development Agency, Department of Transportation, Department of Environment, fleet operators

Recognition for e-mobility initiatives:

Parameters

» International

Measure

» Describe

Data sources

» Municipal body, Urban Development Agency, Department of Transportation, Department of Environment, fleet operators

10.0 Way forward

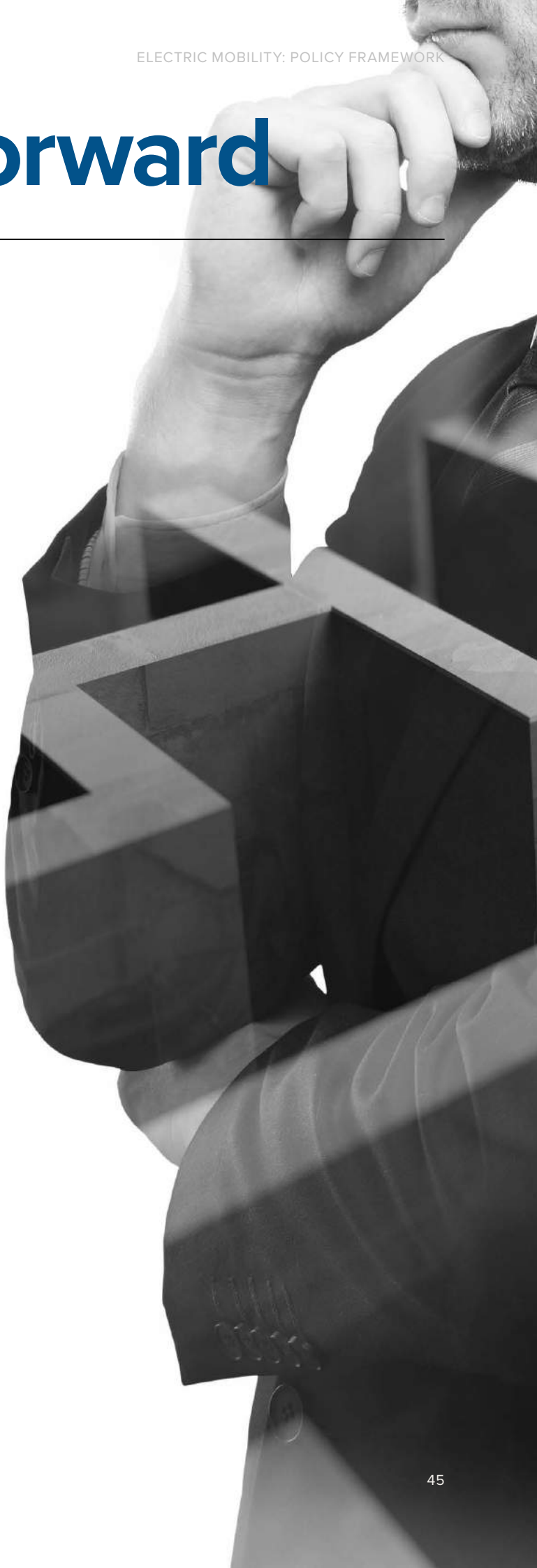
This document provides city managers with an understanding of the electric mobility ecosystem, including information on different types of EV technologies, charging infrastructure and the EV landscape globally and in India. The next document in this series will be a guidebook to help cities implement electric mobility. The document will specifically help the city managers with the following:

» Assessing the current status of cities in terms of EV uptake

» Drawing an institutional framework for planning and implementing e-mobility in cities

» Identifying measures and strategies through which cities will be able to approach/promote electrification in transportation sector

» Suggesting how cities can implement the identified measures and strategies



11.0 Resources

Government policy documents and notifications

Ministry of Heavy Industries and Public Enterprises

» Government policies
https://emobility.araiindia.com/government-policies/

» NEMMP

» Standards
https://emobility.araiindia.com/standards/

» EVs
» HEVs
» Retrofitment standards
» Traction Battery
» Charger standard
» Standard for Pilot Project
» Standardization of protocol for charging infrastructure
https://dhi.nic.in/writereaddata/UploadFile/Standardization%20of%20protocol.pdf

» Notifications
https://emobility.araiindia.com/notifications/

» E-rickshaws
» EVs
» HEVs
» Electric 2-Wheeler Exemption Category (power less than 250W)

» FAME scheme and related notifications
https://fame-india.gov.in/index.aspx

» Link to DST Technology Platform for Electric Mobility (TPEM)
https://dhi.nic.in/UserView/index?mid=2428

Ministry of Power

» Clarification on charging infrastructure for electric vehicles
https://powermin.nic.in/sites/default/files/webform/notices/Clarification_on_charging_infrastructure_for_Electric_Vehicles_with_reference_to_the_provisions_of_the_Electrcity_Act_2003.pdf

» National Automotive Board Portal providing status of FAME scheme and its impact
https://fame-india.gov.in/index.aspx

Documents providing policy direction

» SIAM White paper, 2017
The Indian automotive industry released a white paper proposing a pathway towards all new vehicle sales being all electric by 2047 and 100% of intra-city public transport as all electric by 2030
http://www.siam.in/uploads/filemanager/114SIAMWhitePaperonElectricVehicles.pdf


6c

» Vision document by NITI Aayog & RMI –'India leaps Ahead'
https://niti.gov.in/writereaddata/files/document_publication/RMI_India_Report_web.pdf

Interesting readings

Resources from IEA

» Global EV Outlook 2017
https://webstore.iea.org/global-ev-outlook-2017

» Global EV Outlook 2018
https://webstore.iea.org/global-ev-outlook-2018

» IEA tool: Electric vehicles - Tracking Clean Energy Progress
https://www.iea.org/tcep/transport/evs/

» Other IEA resources available at https://www.iea.org/publications/freepublications/

Resources from Bloomberg New Energy Finance (BNEF)

» Electric vehicle outlook, 2018
https://about.bnef.com/electric-vehicle-outlook/

Resources from RMI

» Enabling the transition to electric mobility in INDIA, FICCI and RMI, 2017
http://ficci.in/spdocument/20975/RMI-Report-20-Nov.pdf

» Battery technology in India: Challenges and Potential (RMI, NITI aayog)

http://niti.gov.in/writereaddata/files/document_publication/India-Energy-Storage-Mission.pdf

» Potential of feebates (a market based policy for rebate and taxation) for Electric Vehicles in India (RMI, NITI Aayog).
http://niti.gov.in/writereaddata/files/document_publication/Valuing_Society_First_Feebates_Policy.pdf

» Transformative mobility solutions, RMI, NITI Aayog, 2017
http://niti.gov.in/writereaddata/files/document_publication/RMI_India_Report_web.pdf

Resources from India Smart Grid Forum (ISGF)

» Implementation plan for electrification of public transportation in Kolkata, October 2017
http://www.indiasmartgrid.org/reports/Report_Implementation%20Plan%20for%20Electrification%20of%20Public%20Transportation%20in%20Kolkata.pdf

» ISGF White Paper on Electric Vehicle Charging Stations Business Models for India
http://www.indiasmartgrid.org/reports/ISGF%20White%20Paper%20-%20EVSE%20Business%20Models%20for%20India.pdf

» ISGF White Paper- Electric Vehicles: A sustainable Solution to Air Pollution in Delhi
http://www.indiasmartgrid.org/reports/ISGF-Electric%20Vehicles%20for%20Delhi-%20Final.pdf

» Other ISGF resources available at http://www.indiasmartgrid.org/resourcecenter.php

Others

» Report on Zero Emission Vehicles (Zevs): Towards A Policy Framework, Niti Aayog and World Energy Council, 2018
https://niti.gov.in/writereaddata/files/document_publication/EV_report.pdf

» Report on Electric Mobility Paradigm Shift: Capturing the opportunities, TERI and Yes Bank, 2018
https://invest-india-revamp-static-files.s3.ap-south-1.amazonaws.com/s3fs-public/Electric%20Mobility%20Paradigm%20Shift_0.pdf

» Report on Electrifying India: building blocks for a sustainable EV ecosystem, E&Y and ASSOCHAM, 2018
https://www.ey.com/Publication/vwLUAssets/ey-electrifying-india-building-blocks-for-a-sustainable-evecosystem/$FILE/ey-electrifying-india-building-blocks-for-a-sustainable-ev-ecosystem.pdf

» Electric Buses in India: Technology, Policy and Benefits, CSTEP and GGGI, 2016
http://www.cstep.in/uploads/default/files/publications/stuff/CSTEP_Electric_Buses_in_India_Report_2016.pdf

» Report on Using vehicle taxation policy to lower transport emissions: An overview for passenger cars in Europe, 2017
https://www.theicct.org/publications/using-vehicle-taxation-policy-lower-transport-emissions

» Information note on the role of trade policy in enabling the global diffusion of electric vehicles, 2018 https://www.ictsd.org/sites/default/files/research/climate_and_energy_-_the_role_of_trade_policy_in_enabling_the_global_diffusion_of_electric_vehicles_final.pdf

Online learning

» Certificate course on Electric vehicles by DIYguru. DIYguru is a skill partner for NITI Aayog Electric Vehicle Mobility Vision 2030. It offers a 30-day Electric Vehicle Certification Course: www.diyguru.org/course/electric-vehicle/

» Coursera offers an online course on the basics of electric mobility instructed by researchers from École des Ponts ParisTech, with a focus on evaluation, analysis and implementation of electric vehicles: www.coursera.org/learn/electric-vehicles-mobility

Additional resources to learn more about electric mobility in cities:

» Clean Vehicles—electric vehicles for cleaner cities; EU-SOLUTIONS Project Online course: https://www.mobility-academy.eu/mod/scorm/view.php?id=1005

» Electric Vehicles and Mobility; Groupe Renault and ParisTech schools Online

course: https://www.mooc-list.com/course/electric-vehicles-and-mobility-coursera

» Charging infrastructure for electric vehicles: What kind? Where? How?; EU-TIDE Project Online course: https://www.mobility-academy.eu/course/view.php?id=12

» Electric Cars: Introduction' Delft University of Technology Online course: https://www.edx.org/course/electric-cars-introduction-0

» Electric Cars: Policy, Delft University of Technology Online course: https://www.mooc-list.com/course/electric-cars-policy-edx

» Electric Cars: Technology, Business, and Policy; Delft University of Technology Online course: https://scholarship-positions.com/blog/free-online-course-electric-cars-technology-business-policy/201709/

» Accelerating Worldwide Plug-in Electric Vehicle Market Development: 5 Policy Interventions; Meeting of the Minds, UC Davis

Webinar: www.meetingoftheminds.org/cal/accelerating-worldwide-plug-in-electric-vehicle-market-development-5-policy-interventions

» Electric Mobility and Development: An Engagement Paper from the World Bank and the International Association of Pub-

lic Transport; The World Bank Report: http://documents.worldbank.org/curated/en/193791543856434540

» Electric Vehicle Capitals of the World; ICCT Report: https://www.theicct.org/publications/EV-capitals-of-the-world-2017

» Electric Vehicles for Smarter Cities: The Future of Energy and Mobility; World Economic ForumReport: http://www3.weforum.org/docs/WEF_2018_%20Electric_For_Smarter_Cities.pdf

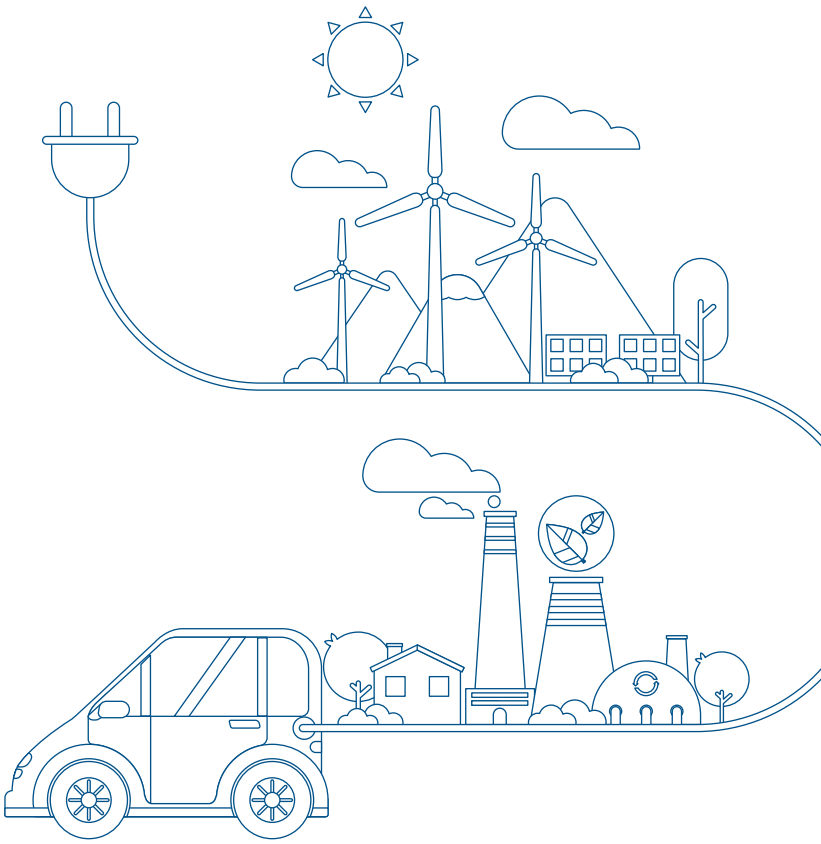
» Enabling Adoption of Electric Mobility in Public Transportation in India; Global Green Growth Institute Case study: http://www.greengrowthknowledge.org/case-studies/enabling-adoption-electric-mobility-public-transportation-india

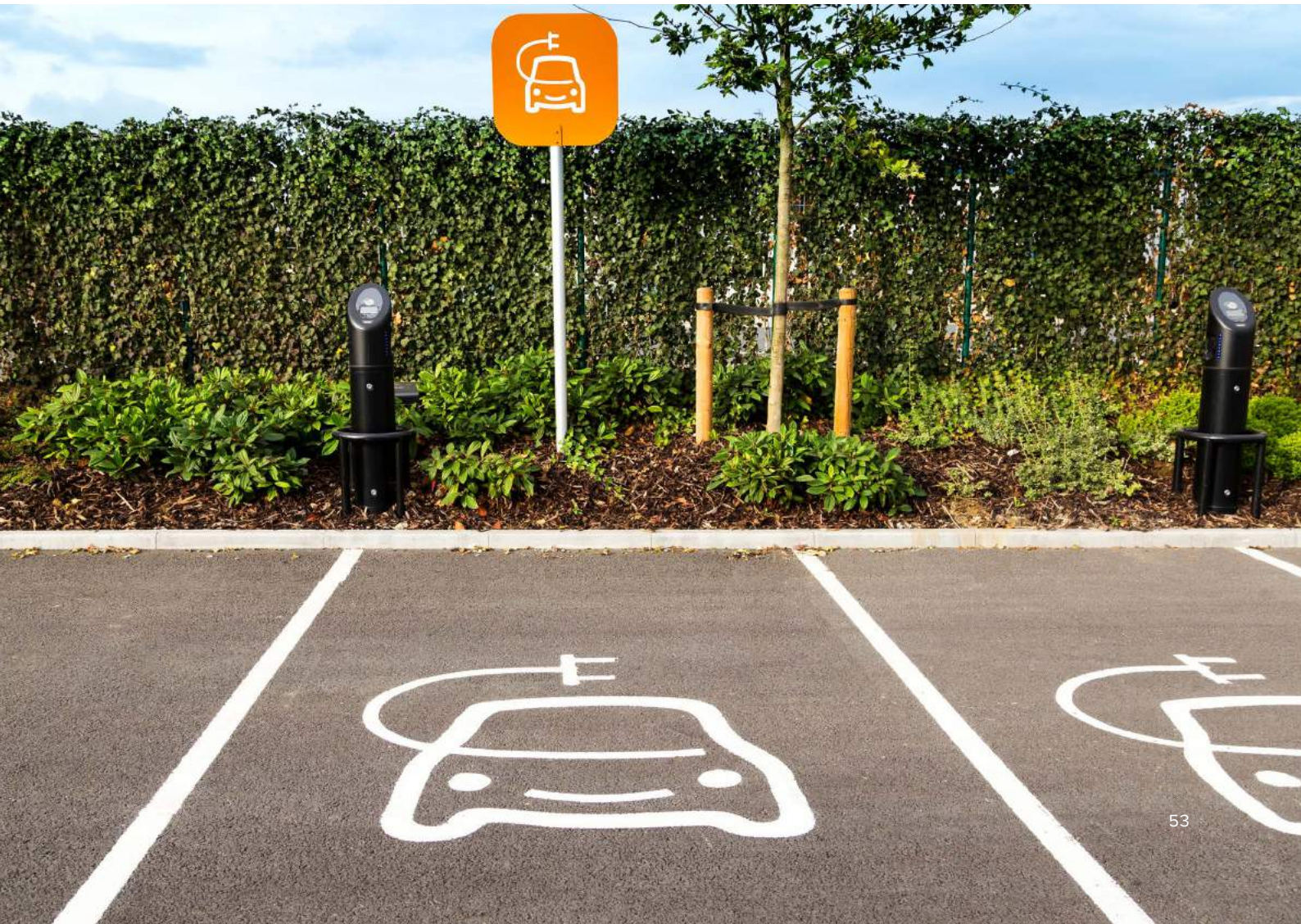
» The future(s) of mobility: How cities can benefit; McKinsey & Company Article: https://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/the-futures-of-mobility-how-cities-can-benefit

» Leaders in Urban Transport Planning Program; The World Bank Workshop series: http://www.worldbank.org/en/topic/transport/brief/leaders-in-urban-transport-planning

» Powering the Future of Urban Mobility; Siemens Report and tools for cities to forecast infrastructure needs with increased EV adoption: www.w3.siemens.com/topics/global/en/intelligent-infrastructure/Pages/future-urban-mobility.aspx

» Principles for Effective Electric Vehicle Design; ICCT Report: https://www.theicct.org/publications/principles-effective-electric-vehicle-incentive-design





12.0 References

1. NEMMP 2020; Stevic, Z. (Ed.). (2012). New Generation of Electric Vehicles. InTech. www.doi.org/10.5772/45641

2. www.cars.kkleads.com/announcements/hybridphevhevbevwhatdoesitallmean

3. Note: FCEVs are not going to be the focus of discussion in this document

4. www.forbes.com/sites/energyinnovation/2018/05/30/chinas-all-in-one-electric-vehicles-heres-how-that-will-accelerate-sales-in-other-nations/#9896912e5c1e

5. www.forbes.com/sites/capitalone/2018/10/24/wholesome-halloween-treats-for-healthy-goblins/#36a58de0b2b5

6. www.about.bnef.com/electric-vehicle-outlook/

7. www.energysage.com/electric-vehicles/advantages-of-evs/evs-environmental-impact/

8. DHI's Notification, available at www.dhi.nic.in/writereaddata/UploadFile/30%20june%202015.PDF

9. NMEM official website; accessed on 3 Oct 2018, www.fame-india.gov.in/index.aspx

10. Mercom India, Nov 2017; www.mercom-india.com/indian-government-smart-city-grants-evs/ and www.livemint.com/Politics/2GS3iKHq6dykzX19BsR9MP/Centre-to-provide-grants-to-cities-buying-electric-vehicles.html; www.auto.economictimes.indiatimes.com/news/industry/govt-to-provide-grants-to-cities-buying-evs-for-mass-transport/61524133

11. www.powermin.nic.in/sites/default/files/webform/notices/Clarification_on_charging_infrastructure_for_Electric_Vehicles_with_reference_to_the_provisions_of_the_Electrcity_Act_2003.pdf

12. NEMMP 2020; 2.3, IEA, 2018 CSTEP, 2016, Report on Electric buses in India: www.gizbot.com/news/electric-vehicles-will-soon-help-india-do-away-from-fossil-fuels-053746.html

13. www.financialexpress.com/auto/car-news/mahindra-e-verito-and-e2o-to-be-part-of-ubers-fleet-in-two-major-cities/945850/

14. www.slocat.net/sites/default/files/e-mobility_overview.pdf

15. www.intelligenttransport.com/transport-articles/67395/electric-buses-fully-electric-fleet-india/

16. www.energysage.com/electric-vehicles/advantages-of-evs/evs-environmental-impact/

ELECTRIC MOBILITY

PART 2: POLICY WORKBOOK

Smart City
MISSION TRANSFORM-NATION

सत्यमेव जयते
Ministry of Housing and Urban Affairs
Government of India

ROCKY MOUNTAIN INSTITUTE

Section outline

As India continues to experience rapid urbanization, managing urban environmental quality will be critical to ensure well-being. Considering severe air quality concerns and rising GHG emissions, clean mobility solutions such as electric mobility are gaining traction in urban centers around the world. Indian cities have been no different. As has been discussed in the framework document, many Indian cities are piloting electric mobility technologies with the aim at further scaling the uptake of this technology.

This document is the second in line among the series of documents under the electric mobility component. The previous framework document presents a knowledge base on India. The current workbook document is designed to support cities in implementing electric mobility solutions. The workbook will introduce various steps required for identifying strategies and implementing plans for promoting electric mobility in respective cities. This document will specifically help city managers in:

- Assessing the current status of their cities in terms of EV uptake
- Drawing institutional framework for planning and implementing e-mobility in their cities
- Identifying measures and strategies through which the city will be able to approach/ promote electrification in transportation sector
- Suggesting how cities can implement the identified measures and strategies

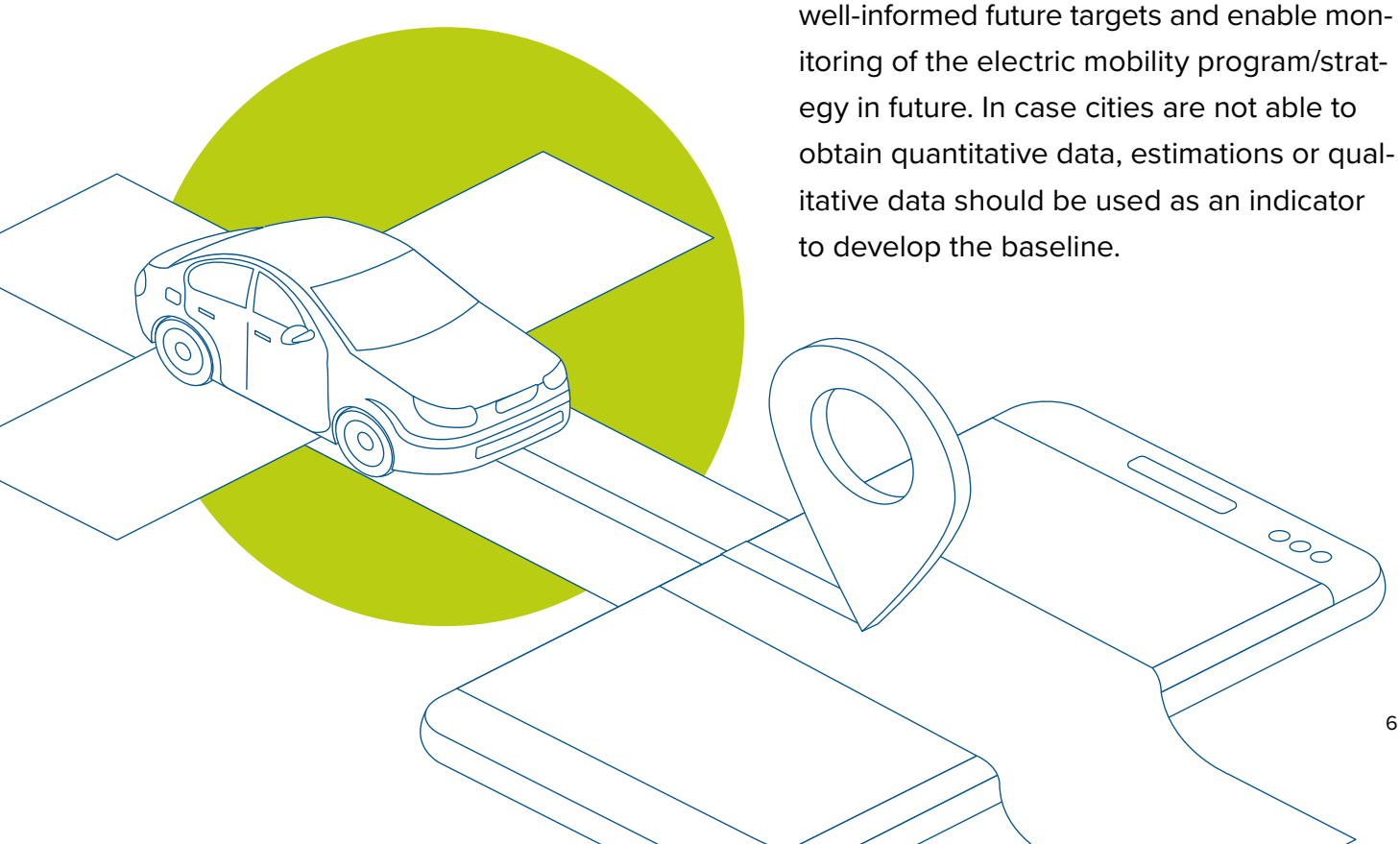
To help assess the aforementioned, the document is structured in the following parts

1.0 Benchmarking current status

The first step towards promoting e-mobility in the city is to understand the current status of the city in terms of EV penetration, charging infrastructure and city-level e-mobility policies /initiatives.

This step will help the city managers assess where the city stands in terms of e-mobility. The city manager is encouraged to measure all the parameters listed in the table to develop a baseline. It may not be possible to collect exact empirical data with respect to each of the suggested parameters. It is, however, suggested that the cities collect as much data as possible.

This will help create a strong baseline, develop well-informed future targets and enable monitoring of the electric mobility program/strategy in future. In case cities are not able to obtain quantitative data, estimations or qualitative data should be used as an indicator to develop the baseline.



Number of EVs in the city:

Parameters

Buses » Mini buses » Standard

Baseline year

» Actual numbers/estimated numbers/operational network length/passenger km

Data sources

» RTO, public transport companies, fleet operators, fleet operator unions, OEMs

Number of EVs in the city:

Parameters

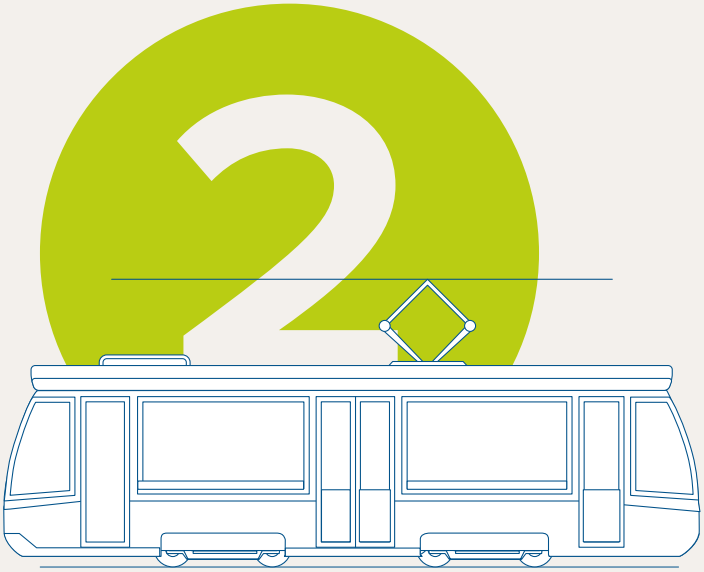
» Rail

Baseline year

» Actual numbers/estimated numbers/operational network length/passenger km

Data sources

» RTO, public transport companies, fleet operators, fleet operator unions, OEMs



Number of EVs in the city:

Parameters

Intermediate public transport » E-rickshaws » E-auto-rickshaws[1] » E-taxis » Any other

Baseline year

» Actual numbers/estimated numbers/operational network length/passenger km

Data sources

» RTO, public transport companies, fleet operators, fleet operator unions, OEMs

Number of EVs in the city:

Parameters

Personal vehicles » E-cars » LCVs
» E-2-wheelers[2]: low speed (below 25kmph)[3] and medium/high speed (above 25kmph)
» E-bicycles[4]

Baseline year

» Actual numbers/estimated numbers/operational network length/passenger km

Data sources

» RTO, public transport companies, fleet operators, fleet operator unions, OEMs

Number of EVs in the city:

Parameters

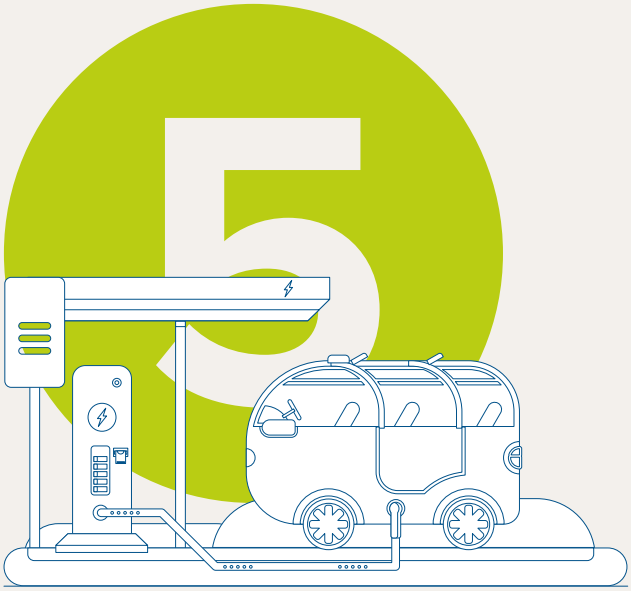
Commercial vehicles » LCVs » HCVs

Baseline year

» Actual numbers/estimated numbers/qualitative indicators

Data sources

» RTO, public transport companies, fleet operators, fleet operator unions, OEMs



Number of EVs in the city:

Parameters

Personal vehicles » E-cars

Baseline year

» Actual numbers/estimated numbers/operational network length/passenger km

Data sources

» RTO, public transport companies, fleet operators, fleet operator unions, OEMs

Number of electric fleet operators:

Parameters

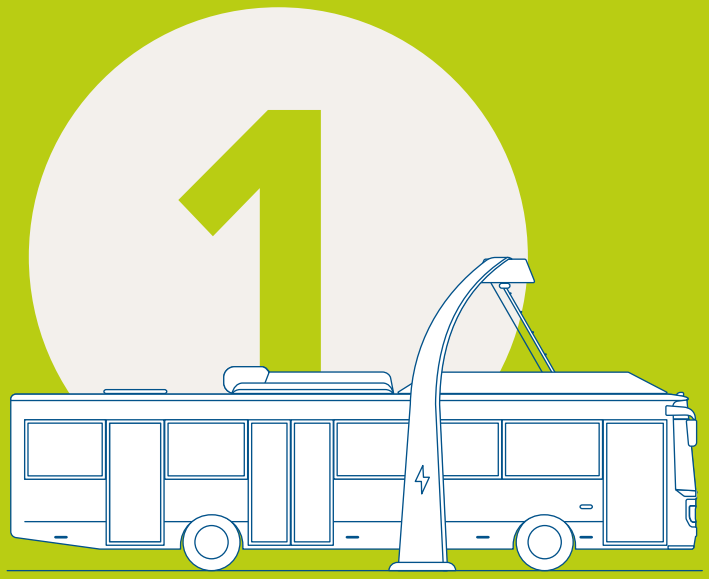
Buses » Mini buses » Standard

Baseline year

» Actual numbers/estimated numbers

Data sources

» RTO, fleet operators, fleet operator unions



Number of electric fleet operators:

Parameters

Intermediate public transport

» E-auto-rickshaws » E-rickshaws

» E-taxis » Any other

Baseline year

» Actual numbers/estimated numbers

Data sources

» RTO, fleet operators, fleet operator unions

Number of electric fleet operators:

Parameters

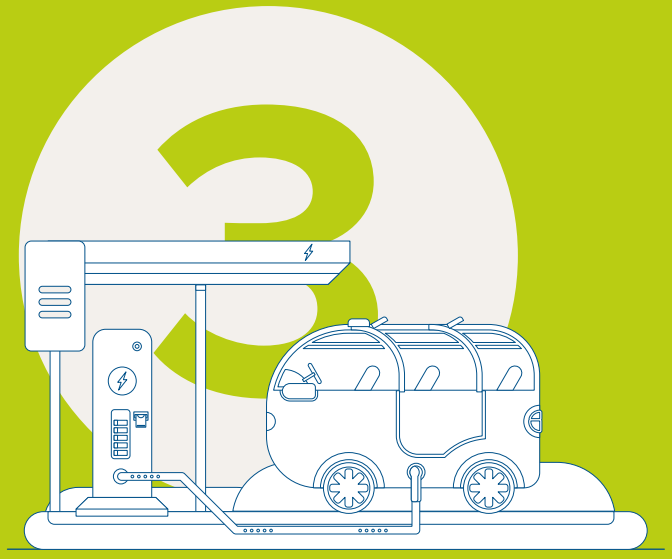
Commercial vehicles » LCVs » HCVs

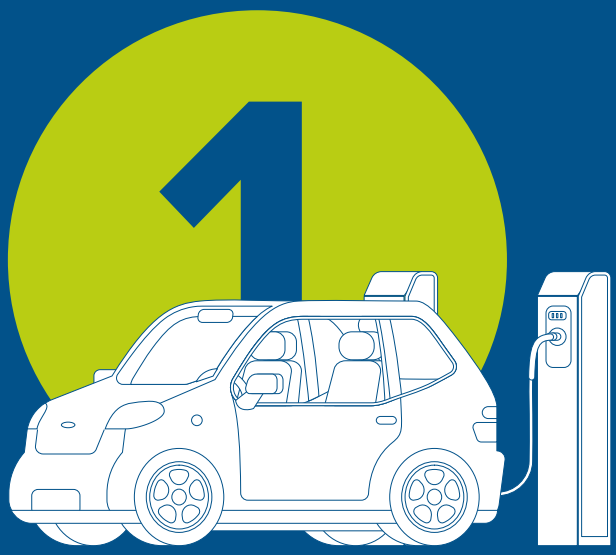
Baseline year

» Actual numbers/estimated numbers

Data sources

» RTO, public transport companies, fleet operators, fleet operator unions, OEMs





Number of public EV charging points in the city:

Parameters

» Level 1

Baseline year

» Number and location

Data sources

» DISCOM, municipality, fleet operators

Number of public EV charging points in the city:

Parameters

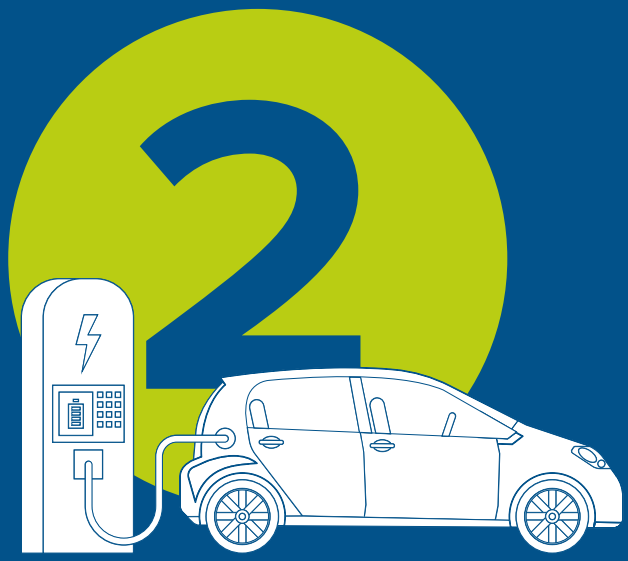
» Level 2

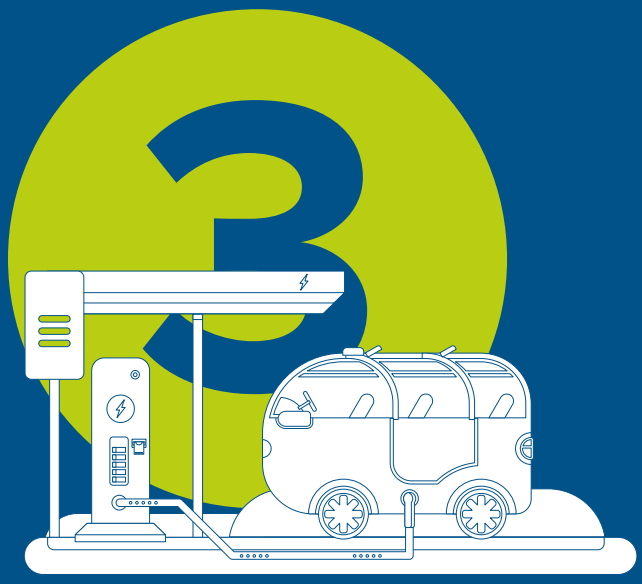
Baseline year

» Number and location

Data sources

» DISCOM, municipality, fleet operators





Number of public EV charging points in the city:

Parameters

» Level 3

Baseline year

» Number and location

Data sources

» DISCOM, municipality, fleet operators

Current policies, regulations, incentives for EVs:

Parameters

» Fiscal—like subsidy, rebates etc. on EVs

Baseline year

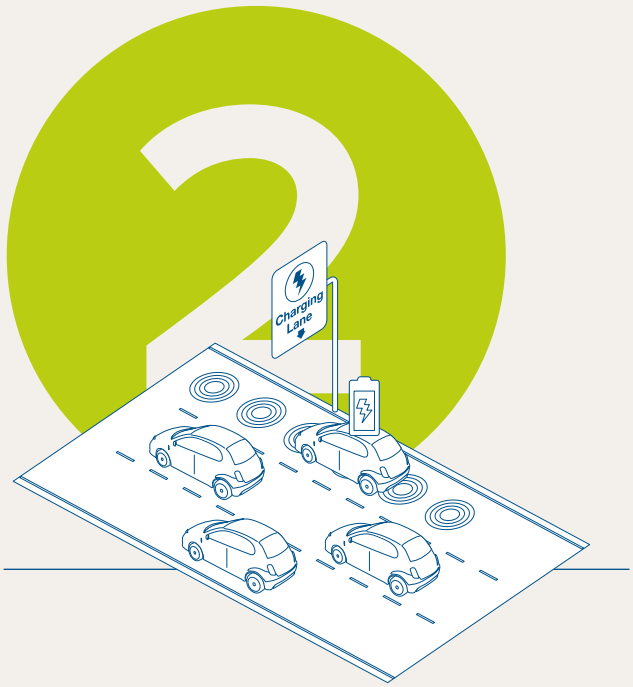
» Central and state incentives available for different categories of EVs

» Any city-level incentive for supporting EVs —provide details of the city—incentive scheme

» Investment made by the city in the scheme since the implementation of it

Data sources

» Department of Transport, Department of Finance, Department of Environment, Public Works Department, Department of Housing, State Nodal Department/Committee, State Electricity Board, City level Electricity Utility Board, Traffic Police Department, municipality, Urban Development Authority, public transport operators, fleet operators, OEMs



Current policies, regulations, incentives for EVs:

Parameters

» Non-fiscal: like low-emission zones, lane priority, parking reservation for EVs etc.

Baseline year

» Details of the schemes

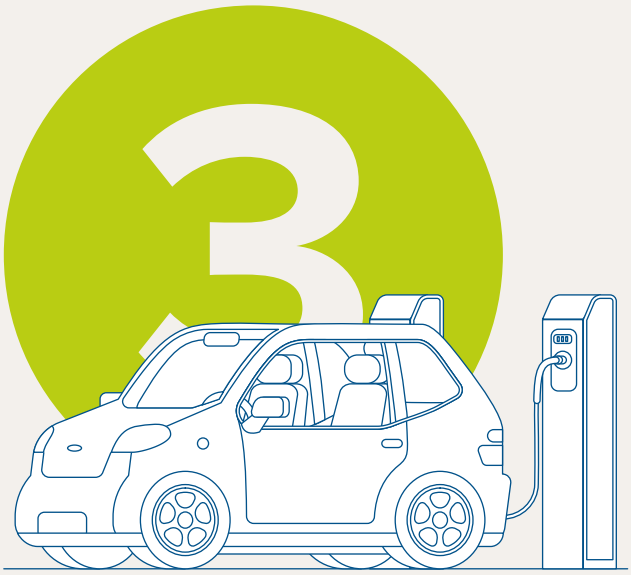
» Location and impact

» Investment made by the city in these schemes

Data sources

» Department of Transport, Department of Finance, Department of Environment, Public Works Department, Department of Housing, State Nodal Department/Committee, State Electricity Board, City level Electricity Utility Board, Traffic Police Department, municipality, Urban Development Authority, public transport operator, fleet operators, OEMs

Current policies, regulations, incentives for EVs:



Parameters

» Charging infrastructure

Baseline year

» Details of the schemes

» Location and impact

» Investment made by the city in these schemes

Data sources

» Department of Transport, Department of Finance, Department of Environment, Public Works Department, Department of Housing, State Nodal Department/Committee, State Electricity Board, City level Electricity Utility Board, Traffic Police Department, municipality, Urban Development Authority, public transport operator, fleet operators, OEMs

Public awareness campaign (PAC):

Parameters

Are there any PACs running in the city to promote EVs?

» Government/private-sector led initiatives

» Other city-led initiatives to promote EVs

Baseline year

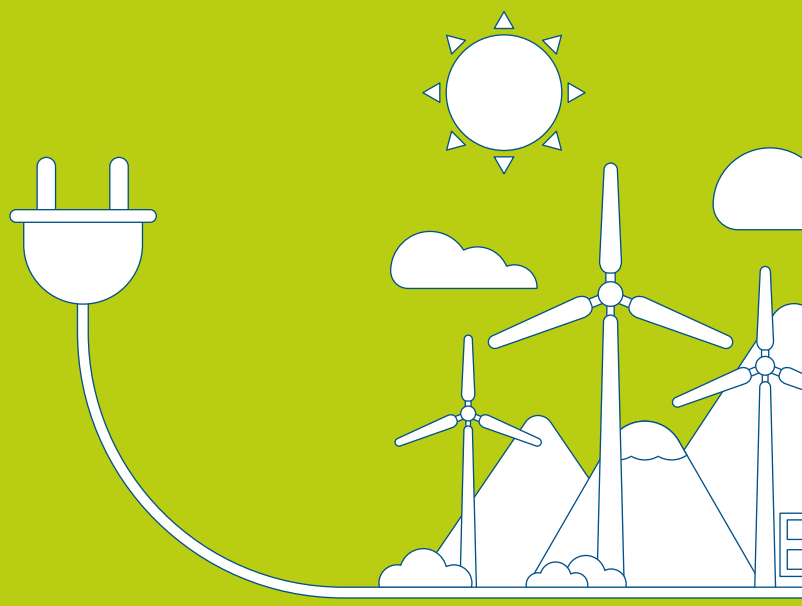
» Details of the campaign

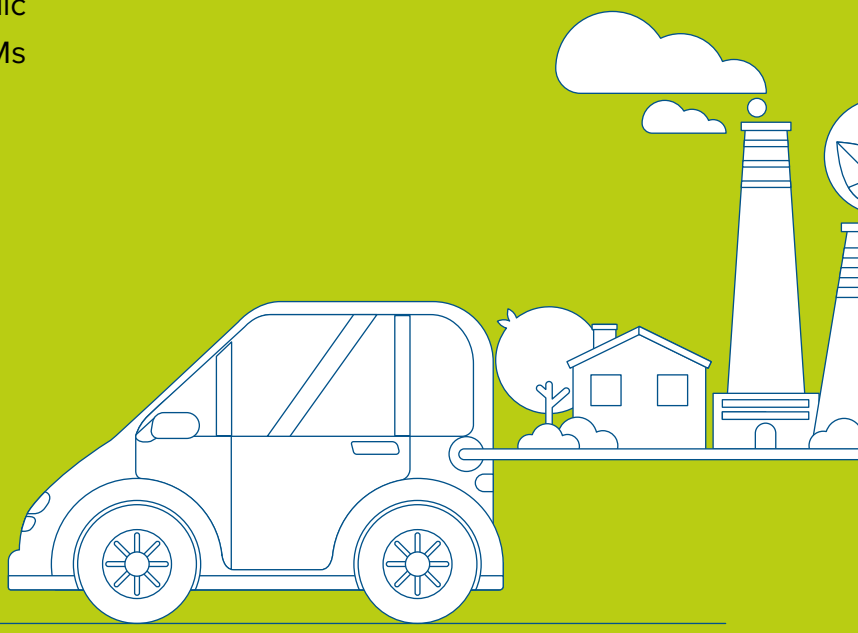
» Impact

» Investment made by the government/ private entity

Data sources

» Department of Transport, Department of Finance, Department of Environment, Public Works Department, Department of Housing, State Nodal Department/Committee, State Electricity Board, City level Electricity Utility Board, Traffic Police Department, municipality, Urban Development Authority, public transport operator, fleet operators, OEMs





2.0 Institutional frameworks for planning & implementing e-mobility

If a nodal body for the purpose of planning, designing and implementing electric mobility has been identified in the city, this body should be the executive and lead body for all functions, roles and initiatives in respect of coordinating the efforts for implementing electric mobility in the city. In case the city does not have an institutional set-up for planning and coordinating the efforts for implementation of e-mobility, it is highly recommended that the city constitutes a body/committee of relevant departments and experts for coordinating city-level efforts for planning, designing and implementing electric mobility.

The government representatives of this body/committee could include officials from the city's municipal agency, Smart City SPV, traffic police, urban development authority, electricity department/DISCOM, public transport corporation, etc. It is suggested that in addition to government officials, the nodal body should also find a mechanism to work with non-government actors in the e-mobility space.

What should be the key roles and functions of the city-level nodal agency?

The city-level nodal agency must work towards implementing and achieving the centre and state-level initiatives and targets for electric mobility, considering the city-level opportunities and barriers. It should accordingly formulate city-level e-mobility strategy and identify projects that the city should be implementing. The agency should also take the responsibility of coordinating project implementation, monitoring and evaluation and review/revision of the e-mobility strategy periodically.

Government representatives

1. Smart City SPV
2. traffic police
3. municipal agency
4. urban development authority
5. electricity department/ DISCOM
6. public transport operators

Non-government representatives

1. EV, automative, power, urban transport experts
2. members of transport unions
3. members of RWAs
4. members of academic/research institutes

Centre

- Providing funds
- Providing technical assistance and capacity building
- Setting national-level targets/norms
- National-level monitoring
- Coordination of state-level efforts

State

- Providing funds
- Providing technical assistance and capacity building
- Setting state-level targets/norms
- State-level monitoring
- Coordination of city-level efforts

City

- Set EV targets for the city
- Formulate projects/strategies/ recommendations
- Project implementation
- Project monitoring and evaluation
- Review/revision of the e-mobility strategy periodically

3.0 Planning for electric mobility in the city

As suggested, the nodal agency should focus on drawing a strategic plan for adopting electric mobility in the city. This plan should focus on medium to long-term strategy to allow the city to undertake a sustained and concerted effort towards promoting e-mobility. In addition, the city would also need to invest in short-term or pilot projects to test and verify the feasibility of different solutions.

This section will help the city identify medium- to long-term objectives and targets for electric mobility; help build medium or long-term growth scenarios for penetration of e-mobility; and also help them identify medium- to long-terms projects.

Step-wise guide to drawing a medium to long-term e-mobility plan/strategy

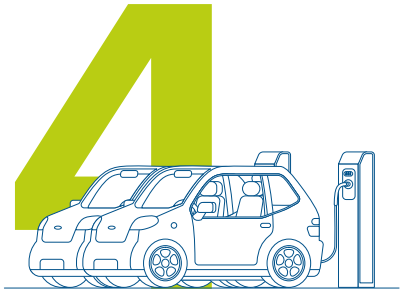
Step 1: Set long-term objectives

It is suggested that the city manager identifies specific objective/s for the city. These objectives should address the ongoing or likely issues that the city might face in the near future. These objectives may be:

Air quality improvement

Least cost intervention

Revenue improvement

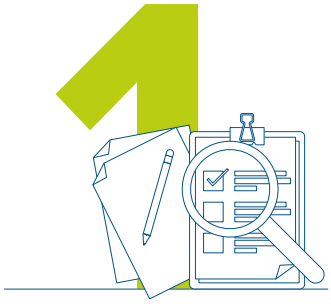


Boost e-mobility industry in the city

Improve mobility choices

Increase ZEV transit use

Step 2: Medium- to long-term strategic objectives



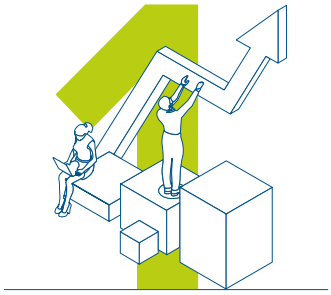
Identify long-term objectives for the city

Set targets and build medium- to long-term growth scenario

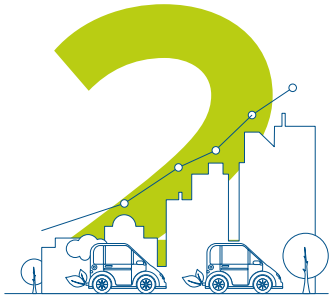
Identify pilot/medium- to long-term projects/ strategies

Step 3: Identify scenarios and set targets for penetration of EVs

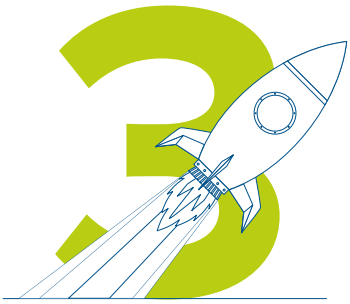
It is suggested that the objective/s be converted to likely scenarios that the city would like to follow to approach electric mobility in the city. These scenarios should be developed considering the objectives, capacity and resources available in the city. These scenarios could be one of the following:



BAU



Optimistic scenario



Aggressive scenario

» **BAU:** In this scenario, the city may decide to follow a growth path for EV uptake on a par with their current growth or aiming at minimal penetration of EVs in the city.

» **Optimistic scenario:** In this scenario, the city may decide to follow a growth path for the uptake of EV on a par with their current growth or aiming at minimal penetration of EVs in the city.

» **Aggressive scenario:** The city may decide to follow an aggressive path for adopting electric mobility and aim at a high penetration of EVs in the city.

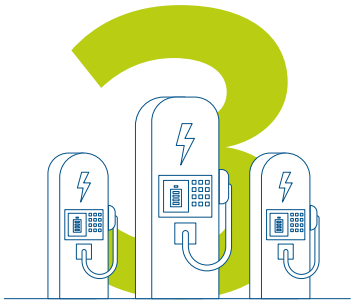
For the above scenarios, it is suggested that the city also identifies targets for EV uptake. It is recommended that the city sets up annual targets for different vehicle segments.

Step 4: Identify strategies and projects

Once the city determines the targets and EV uptake growth scenario, the city manager should identify policies/strategies/instruments to achieve the targeted level of electrification. Electrification in the city could be encouraged using various instruments. These could be:

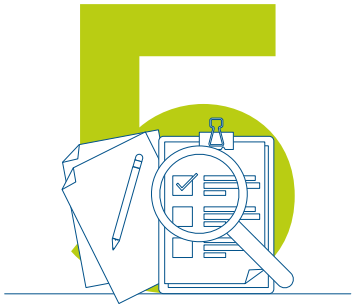
Bringing down the upfront cost of EVs

Bringing down the operating cost of EVs



Incenticizing deployment of charging infrastructure

Incentivizing OEMs to sell EVs and non-fiscal measures



Non-fiscal/regulatory measures

Examples of measure/s that the city manager could deploy have been provided in the following sections.

1

Bringing down the upfront cost of EVs: vehicle purchase incentives, insurance discounts

Stakeholders

» Center, state, municipality and other ULBs

Likely benefits

» Encourage EV adoption

Likely barriers

» Center, state, municipality and other ULBs

Actions for stakeholders

» Design incentive scheme

» Notify relevant authorities such as the department of transport, municipal body, etc. to implement the new policy

» Inform the likely beneficiaries such as the fleet operators, public transport corporation and vehicle owners

---

2

Bringing down the upfront cost of EVs: differentiated tax

Measures

» Tax based on vehicle perfomance such as fuel efficiency

Stakeholders

» Center, state, municipality and other ULBs

Likely benefits

» Encourage EV adoption

Likely barriers

» Tax foregone/loss of likely revenue

Actions for stakeholders

— DO —

3

Bringing down the upfront cost of EVs: feebate

Measures:

» Imposing fees and rebates based on performance of vehicles

Likely benefits

» Revenue neutral

» Encourage EV adoption and discourage ICEVs adoption

Likely barriers

» Acceptability to OEMs

Actions for stakeholders

— DO —

Stakeholders

» Municipal body and other bodies responsible for parking management in the city

Likely benefits

» Encourage use of EV

Likely barriers

» Revenue foregone

Actions for stakeholders

» Draw/amend existing parking policy with a provision of free/discounted parking for EVs

» Notify relevant authorities such as the Department of Transport, traffic police, municipal body, etc., to implement the new policy

» Inform the public

1

Bringing down the operational cost of EVs: dedicated parking for EVs

2

Bringing down the upfront cost of EVs: discounted parking for EVs

Stakeholders

» Municipal body

Likely benefits

» Encourage use of EVs

Likely barriers

» Revenue foregone

Actions for stakeholders

» Draw/amend existing parking policy with a provision of free/discounted parking for EVs

» Notify relevant authorities such as the Department of Transport, traffic police, municipal body, etc., to implement the new policy

» Inform the public

Measures

» Tax based on vehicle perfomance like fuel efficiency

Stakeholders

» Centre, state, municipality and other ULBs

Likely benefits

» Encourage EV adoption

Likely barriers

» Public acceptability

» Difficult to enforce

3

Bringing down the upfront cost of EVs: dedicated parking for EVs

Actions for stakeholders

» Draw/amend existing parking policy with a provision of free/discounted parking for EVs

» Notify relevant authorities such as the Department of Transport, traffic police, municipal body, etc., to implement the new policy

» Inform the public

4

Bringing down the upfront cost of EVs: free charging for EVs

Stakeholders

» Municipal body, DISCOMs, private entities

Likely benefits

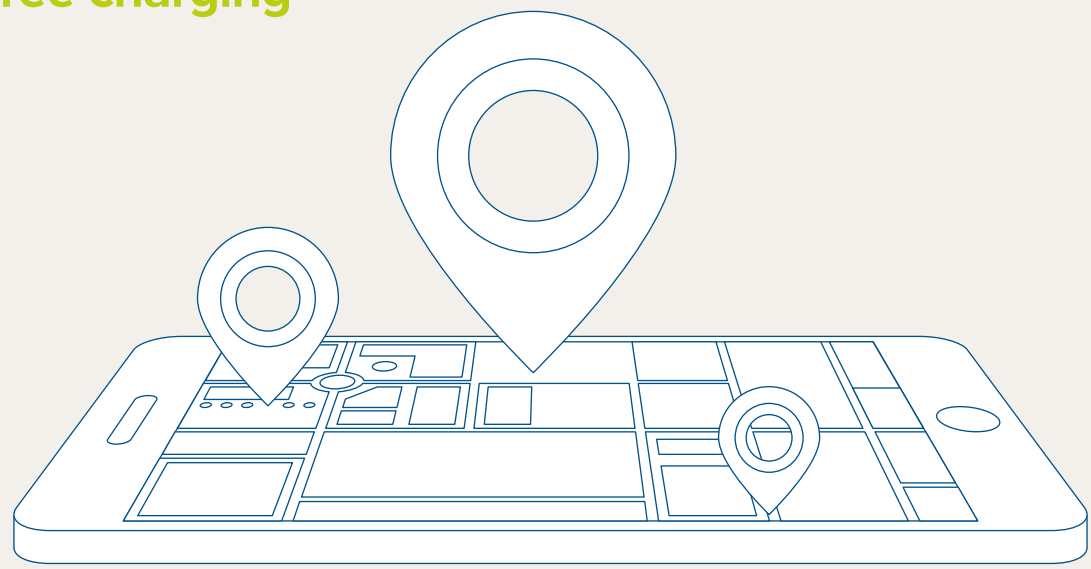
» Encourage use of EVs

Likely barriers

» Revenue foregone

Actions for stakeholders

» Develop a mechanism to implement the scheme with DISCOMs



Stakeholders

» Municipal body, DISCOMs, private actors providing charging solutions

Likely benefits

» Encourage EV adoption

Likely barriers

» Develop a mechanism to implement the scheme with DISCOMs

5

Bringing down the upfront cost of EVs: discounted charging rates for EVs

---

6

Bringing down the upfront cost of EVs: priority lanes for EVs

Stakeholders

» Traffic police, municipal body, PWD

Likely benefits

» Encourage use of EVs

Likely barriers

» Public acceptability

» Difficult to enforce

Actions for stakeholders

» Identify lanes where this scheme could be implemented

» Draw detailed design for implementation of the scheme

» Relevant authorities such as the Department of Transport, traffic police, municipal body, etc., to implement the new policy

» Inform the public

Measures

» Exemption/discount from toll charges

» Exemption/discount from congestion charges

Stakeholders

» Traffic police, municipal body, PWD, toll operator/s

Likely benefits

» Encourage use of EVs

Likely barriers

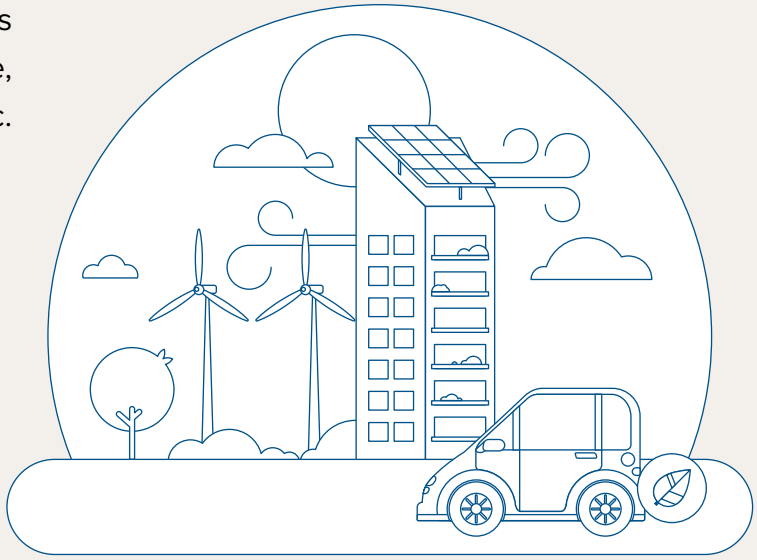
» Revenue foregone

Actions for stakeholders

» Develop a mechanism to implement the scheme with relevant stakeholders such as the Department of Transport, traffic police, toll operator/s, municipal body, etc.

7

Bringing down the upfront cost of EVs: reduced charges on use of infrastructure by EVs



8

Bringing down the upfront cost of EVs: Electric Vehicle Supply Equipment (EVSE) financing

Stakeholders

» OEMs, EVSE manufacturers, private entities

Likely benefits

» Encourage deployment of EV charging infrastructure and hence promote use of EVs

Likely barriers

» Revenue foregone

Actions for stakeholders

» Develop and implement the scheme with the support of OEMs/EVSE manufacturers

1

Incentivizing deployment of charging infrastructure

Measures

» Adopting open standards for vehicle charge points and payment to allow interoperability between charging networks

Stakeholders

» OEMs, EVSE manufacturers, Bureau of Energy Efficiency (BEE), municipal body

Likely benefits

» Encourage deployment of EV charging infrastructure and hence promote the use of EVs

» Encourage private sector participation in deployment of EV charging

Likely barriers

» May be a challenge for OEMs due to

factors such as high cost of shifting to a new technology

Actions for stakeholders

» Adopt standards in consultation with technology experts/OEMs/EVSE manufacturers

---

2

Incentivizing deployment of charging infrastructure

Measures

» Mandating provision of EV charging through building bylaws

Stakeholders

» Municipal body, Urban Development Authority, OEMs, EVSE manufacturers

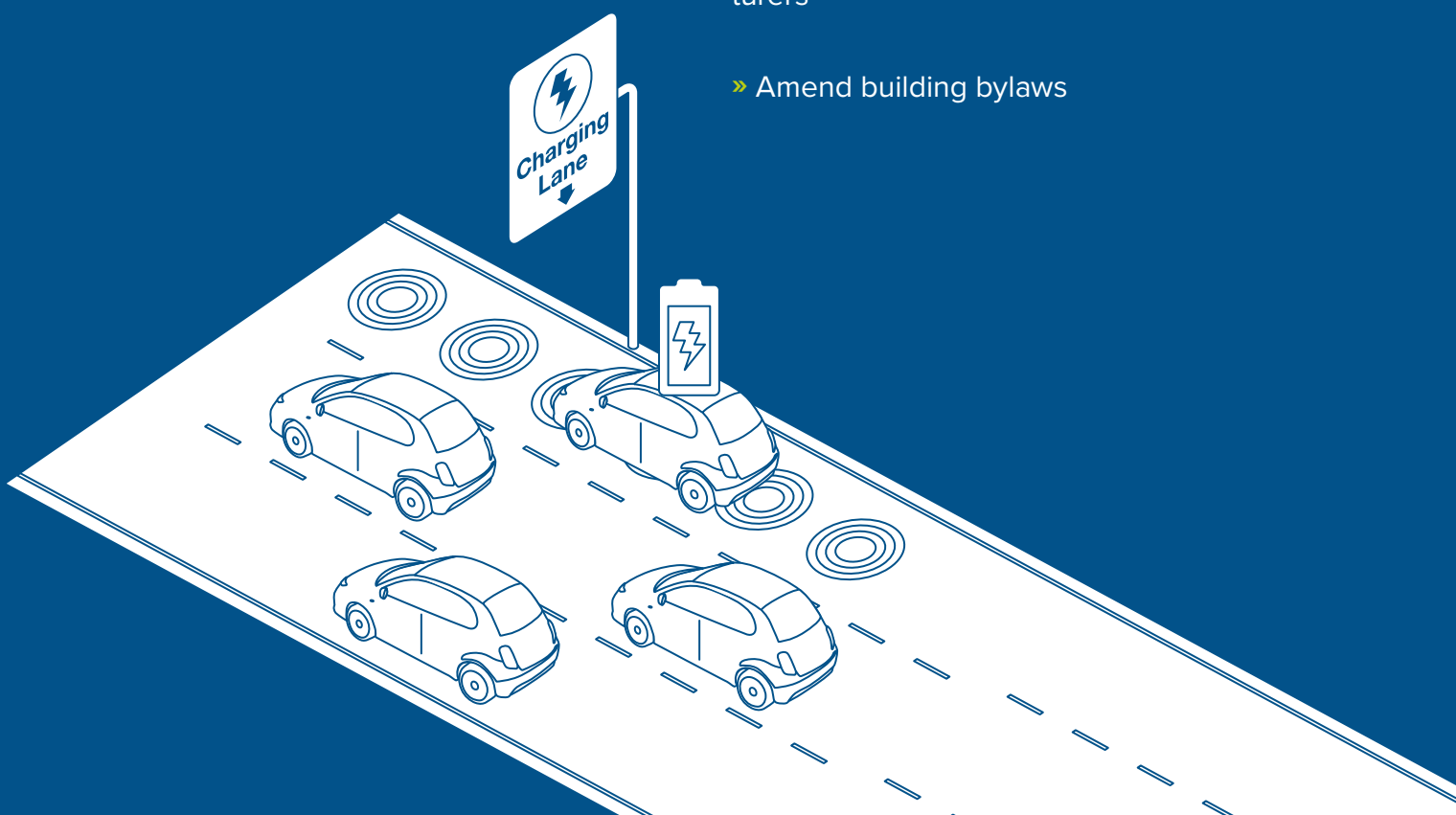
Likely benefits

» Help make buildings become EV-ready and thereby promote use of EVs

Action for stakeholders

» Adopt new standards in consultation with technology experts/OEMs/ EVSE manufacturers

» Amend building bylaws



3

Incentivizing deployment of charging infrastructure

Measures

» Relax regulations to set up EV charging station/s

Stakeholders

» Municipal body, Urban Development Authority, DISCOM

Likely benefits

» Encourage deployment of EV charging infrastructure and hence promote the use of EVs

» Encourage private sector participation in deployment of EV charging infrastructure

Action for stakeholders

» Draw scheme/amend regulations to facilitate easy setting up of EV charging stations

---

4

Incentivizing deployment of charging infrastructure

Measures

» Mandating investment in charging infrastructure through government/private/PPP mechanism

Stakeholders

» Municipal body, Urban Development Authority, DISCOM

Likely benefits

» Result in better EV charging infrastructure in the city and hence promote use of EVs

Action for stakeholders

» Draw scheme in consultation with the Department of Finance at state and city levels

5

Incentivizing deployment of charging infrastructure

Measures

» Providing financial support for setting up of EV charging stations: low interest rate loans and loan guarantees

Stakeholders

» Municipal body, Urban Development Authority, DISCOM

Likely benefits

» Encourage deployment of EV charging infrastructure and hence promote the use of EVs

» Encourage private sector participation in deployment of EV charging infrastructure

Action for stakeholders

» Draw scheme/amend regulations to facilitate easy setting up of EV charging stations

---

6

Incentivizing deployment of charging infrastructure

Measures

» Implement smart charging system

Stakeholders

» DISCOM, municipal body, private entities

Likely benefits

» Encourage use of EVs

Likely barriers

» Technical challenges

Action for stakeholders

» Engage with DISCOMs to undertake shift to smart charging system

1

Incentivizing OEMs to sell EV and non-fiscal measures: ZEV credits explanation

Measures

» OEMs earn credit on sale of EVs; ZEV credits are bankable and saleable

Stakeholders

» State and center: not directly under the city's purview

Likely benefits

» Encourage OEMs to invest in EVs

Likely barriers

» May be expensive

» Need for institutional se-tup to implement it

Actions for stakeholders

» No action for the city

2

Incentivizing OEMs to sell EV and non-fiscal measures: ZEV mandate

Measures

» Mandatory EV sales targets for OEMs

Stakeholders

» State and Centre: not directly under the city's purview

Likely benefits

» Encourage OEMs to invest in EVs

Likely barriers

» Strong commitment from government

Actions for stakeholders

No action for the city

3

Incentivizing OEMs to sell EV and non-fiscal measures: compulsory purchase order

Measures

» Government fleet, fleet operators (mobility as a service)

Stakeholders

» City government departments

Likely benefits

» Encourage OEMs to invest in EVs

Likely barriers

» Financing

Actions for stakeholders

» Identify government departments with fleet requirement

» Plan EV fleet uptake with the identified departments

4

Incentivizing OEMs to sell EV and non-fiscal measures

Measures

» Compulsory electric vehicle fleet for public transport (public and private operators)

Stakeholders

» Public and private fleet operators

Likely benefits

» Encourage OEMs to invest in EVs

Likely barriers

» Opposition from fleet operators

Actions for stakeholders

» Identify fleet operators in the city

» Draw an EV uptake plan and a phase-out plan in consultation with the fleet operators

» Implement plan

1

Incentivizing OEMs to sell EVs and non-fiscal measures: zero emission/low-emission zones

Stakeholders

» Traffic police, Urban Development Authority, municipal authority, public transport operators, technology providers, etc.

Likely benefits

» Significant air quality improvement in the ZE/LE zone

» Congestion reduction

» Revenue generation if fees imposed on entry of ICEVs

» Revived local economy

Likely barriers

» Political and public acceptability

» Difficult to plan and implement

» Requires high investment, especially if the city relies on electronic measures to ensure enforcement

Actions for stakeholders

» Plan and implement the scheme in collaboration with relevant stakeholders such as traffic police, Urban Development Authority, municipal authority, public transport operators, technology providers, etc.

2

Incentivizing OEMs to sell EVs and non-fiscal measures: preferential registration for EVs

Stakeholders

» Transport department

Likely benefits

» Higher preference for EVs than ICEVs among consumers

» Increased penetration of EV fleet

Likely barriers

» Public acceptability

Actions for stakeholders

» Plan and implement the scheme in consultation with the Department of Transport

3

Bringing down the upfront cost of EVs: limiting registration of ICE vehicles

Stakeholders

» Transport department

Likely benefits

» Discourage use of EVs

» Improve user preference for EVs

Likely barriers

» Public acceptability

Actions for stakeholders

» Plan and implement the scheme in consultation with the Department of Transport

4

Incentivizing OEMs to sell EVs and non-fiscal measures: ban on sale of certain categories of ICE vehicles

Stakeholders

» Transport department, municipal body, Urban Development Authority, traffic police

Likely benefits

» Discourage use of ICEs

» Improve user preference for EVs

Likely barriers

» Opposition from public, OEMs

Actions for stakeholders

» Plan and implement the scheme in consultation with the Department of Transport

---

5

Incentivizing OEMs to sell EVs and non-fiscal measures: ban/access restrictions on movement of ICEVs within certain areas/regions

Stakeholders

» Municipal body, Urban Development Authority, traffic police

Likely benefits

» Discourage use of EVs

» Improve user preference for EVs

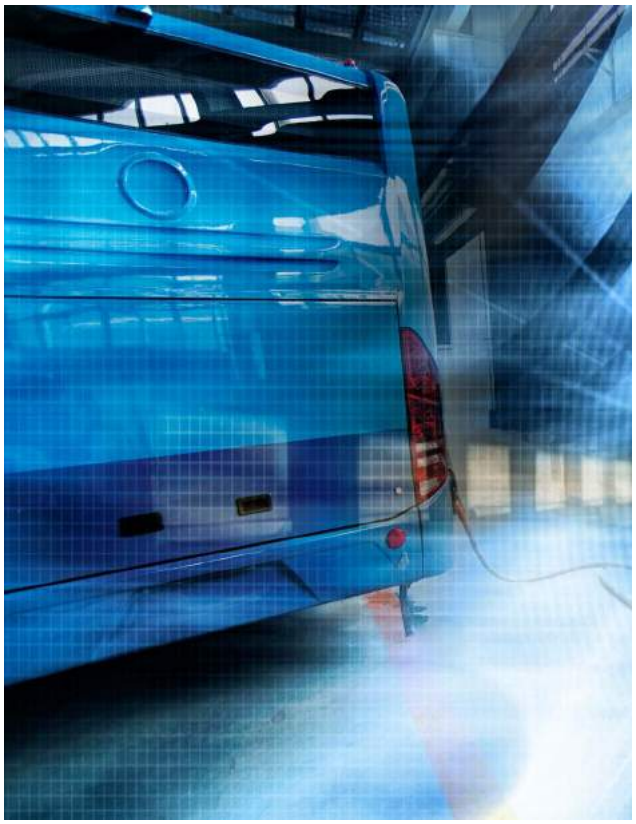
Likely barriers

» Public acceptability

Actions for stakeholders

» Plan and implement the scheme in consultation with the traffic police

Short-term/pilot projects



Actions for stakeholders:

- Plan the scheme
- Assess technology options available in the market
- Get in touch with successful technology providers
- Identify financing options
- Plan for the pilot test, train staff
- Procure e-buses/e-vehicles
- Operation of the e-bus/e-vehicles
- Monitor the performance
- Evaluate the performance
- Based on the evaluation, determine the future plan as to whether to scale up the same technology or test a new one

E-bus operation

Stakeholders:

- Air quality benefit
- Savings for fleet operators

Likely benefits:

- High upfront cost for vehicle purchase
- Lack of technical capability for upkeep and maintenance of e-buses

Likely barriers:

- High upfront cost for vehicle purchase
- Lack of technical capability for upkeep and maintenance of e-buses

EV fleet deployment as first- last-mile solution

Measures:

» e-autorickshaw
» e-rickshaw
» e-taxi
» e-buses (mini buses)

Stakeholders:

» OEMs, public transport, agencies and fleet operator/drivers

Likely benefits:

» Air quality benefit
» Savings for fleet operator

Likely barriers:

» High upfront cost for vehicle purchase
» Lack of technical capability for upkeep and maintenance of e-buses

Actions for stakeholders:

» Plan the scheme
» Assess the technology options available in the market provided by successful technology operators
» Identify financing options
» Plan for the pilot test, train staff
» Procure e-buses/e-vehicles
» Operation of the e-bus/e-vehicles
» Monitor the performance
» Evaluate the performance
» Based on the evaluation, determine the future plan as to whether to scale up the same technology or test a new one

EV sharing schemes

Measures:

» e-cars
» e-scooters
» e-bike

Stakeholders:

» OEMs/EV sharing company

Likely benefits:

» Air quality benefit
» Savings for fleet operators

Likely barriers:

» Air quality benefits
» Congestion reduction
» Improved mobility

Actions for stakeholders:

» Plan the scheme
» Assess the technology options available in the market
» Get in touch with successful technology providers
» Identify financing options
» Plan for the pilot test, train staff
» Procure e-buses/e-vehicles
» Operation of the e-bus/e-vehicles
» Monitor the performance
» Evaluate the performance
» Based on the evaluation, determine the future plan as to whether to scale up the same technology or test a new one

Deployment of public chargers

Stakeholders:

» DISCOMs

Likely benefits:

» Encourage use of EVs

Likely barriers:

» Land availability

Zero/low emission zone

Stakeholders:

» Municipal body, traffic police

Likely benefits:

» Significant air quality improvement in the ZE/LE zone
» Congestion reduction
» Revenue generation if fees imposed on entry of ICEVs
» Revived local economy

Likely barriers:

» Political and public acceptability
» Difficult to plan and implement
» Investment intensive proposition, especially if the city relies on electronic measures to ensure enforcement

Actions for stakeholders:

» Plan and implement the scheme in collaboration with relevant stakeholders such as traffic police, Urban Development Authority, municipal authority, public transport operators, technology providers, etc.

Free EV charging facilities in the city

Stakeholders:

» Municipal body, DISCOMs, private entities

Likely benefits:

» Encourage use of EVs

Likely barriers:

» Revenue foregone

Actions for stakeholders:

» Develop a mechanism to implement the scheme with DISCOMs

Priority lanes for EVs

Stakeholders:

» Traffic police, municipal body, PWD

Likely benefits:

» Encourage use of EVs

Likely barriers:

» Public acceptability
» Difficult to enforce

Actions for stakeholders:

» Develop a mechanism to implement the scheme with relevant stakeholders such as the Department of Transport, traffic police, municipal body, etc.

Exemption from parking charges

Stakeholders:

» Municipal body

Likely benefits:

» Encourage use of EVs

Actions for stakeholders:

» Draw/amend existing parking policy with a provision of free/discounted parking of EVs

» Notify relevant authorities such as the Department of Transport, traffic police to implement the new policy

» Inform the public

Exemption from toll charges

Stakeholders:

» Toll operator/s

Likely benefits:

» Encourage use of EVs

Actions for stakeholders:

» Develop a mechanism to implement the scheme with relevant stakeholders such as the Department of Transport, traffic police, municipal body, etc.

Reserved parking for EVs

Stakeholders:

» Municipal body

Likely benefits:

» Encourage use of EVs

Likely barriers:

» Difficult to enforce

Actions for stakeholders:

— DO —

Public awareness campaign

Measures:

» Website

» Demonstration zones

Stakeholders:

» Municipal body, OEMs

Likely benefits:

» Encourage use of EVs

Actions for stakeholders:

» Plan the awareness campaign and engage with relevant stakeholders such as schools, colleges, etc.

4.0 Project implementation

As India continues to experience rapid urbanization, managing urban environmental quality will be critical to ensure well-being. Considering severe air quality concerns and rising GHG emissions, clean mobility solutions like electric mobility are gaining traction in urban centers around the world. Indian cities have been no different. As has been discussed in the framework document, many Indian cities are piloting electric mobility technologies with the aim at further scaling the uptake of this technology.

This document is second in line among the series of documents under the electric mobility component. The previous framework document presents a knowledge base on India. The current workbook document is designed to support cities in implementing electric mobility solutions. The workbook will introduce various steps required for identifying strategies and implementing plans for promoting electric mobility in respective cities. This document will specifically help the city managers in:

» Assessing the current status of their cities in terms of EV uptake

» Drawing institutional framework for planning and implementing e-mobility in their city

» Identifying measures and strategies through

which the city will be able to approach/ promote electrification in transportation sector

» Suggesting how cities can implement the identified measures and strategies

To help assess the aforementioned, the document is structured in the following parts:

Constituents of the TOR

01 Background and objective

» Provide study context, need and specific objectives

02 Scope

» Conduct baseline study and collect baseline data for the proposed area/corridor

» Prepare Detailed Project Report (DPR) for implementation of the selected strategies, including detailed design plans, infrastructure requirements, pricing schemes, etc.

» Identify institutional barriers and propose an institutional framework for implementation and management of scheme/s

» Ensure coordination between the various government departments and private stakeholders such as the fleet operators

» Review zoning laws and building bylaws to ensure that they support the schemes

» Identify potential issues regarding policy changes and propose possible solutions

» Identify financial requirements for project implementation and suggest funding sources

» Propose a plan for creating public awareness and holding public consultations

» Monitor and evaluate the implementation of schemes and propose periodic revisions

» Obtain public feedback regarding the strategies being implemented

03 Technical qualification

» Consultants/firms having relevant and similar experience or expertise in planning, designing and monitoring e-mobility projects should be invited

ELECTRIC MOBILITY

PART 3: EVALUATION METRICS

Smart City
MISSION TRANSFORM-NATION

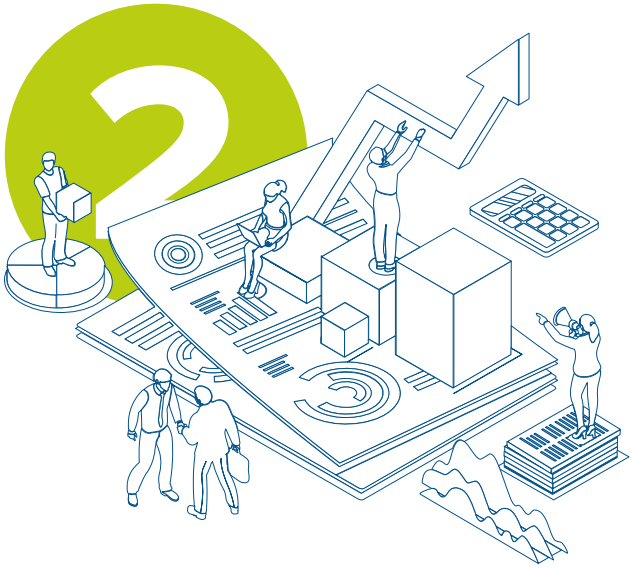
Ministry of Housing and Urban Affairs
Government of India

ROCKY MOUNTAIN INSTITUTE

Measuring progress through KPIs

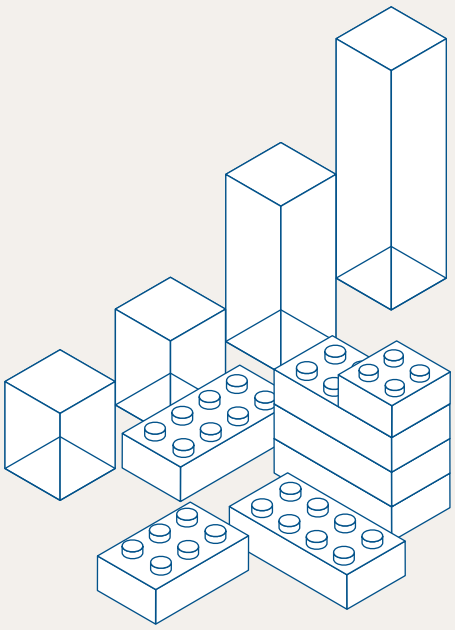
Periodic evaluation is critical to the successful implementation of policies and programs. The evaluation matrix is the third document in line among the series of documents under the electric mobility component. The intent of the earlier documents was to develop capacity of city managers to implement electric mobility in their respective cities. This document is focused on enabling the city managers to evaluate the performance of electric mobility solutions. This document specifically aims at helping the city managers and interested stakeholders in:

Mapping their city's progress with respect to implementation of electric mobility solutions



Undertaking comparison of performance across cities and encouraging regular evaluation and course correction in cities

City managers are encouraged to undertake periodic evaluation and it is recommended that they establish annual targets. Cities should then compare annual performances against annual targets. In case of a lag in achieving the set targets, the city should devise a strategy for course correction and implement the same. The following table suggests the Key Performance Indices (KPIs) that can be used by cities for evaluating their progress and identifying corrective measures to achieve the set objectives and targets for e-mobility.

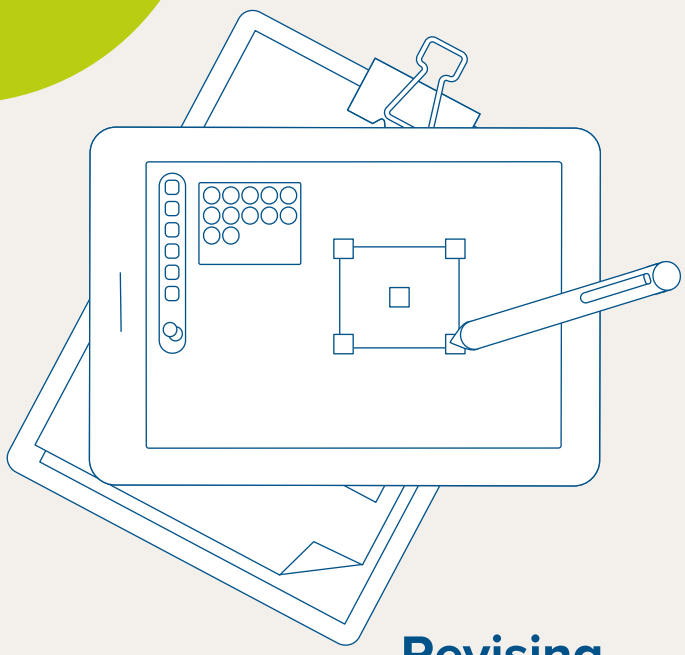


Setting up annual targets

Monitoring annual (actual) growth

Suggested evaluation and monitoring mechanism

Preparing corrective actions



Revising targets in case of lag

Number of EVs in the city:

Parameters

» Buses » Mini buses » Standard

Measure

» Actual numbers/estimated numbers/ qualitative indicators

Data sources

» RTO, fleet operators, fleet operator untions

Number of EVs in the city:

Parameters

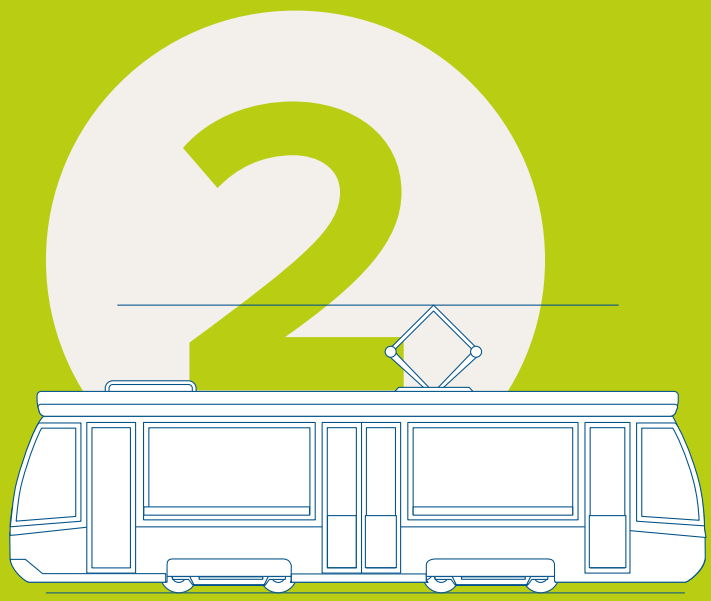
» Rail

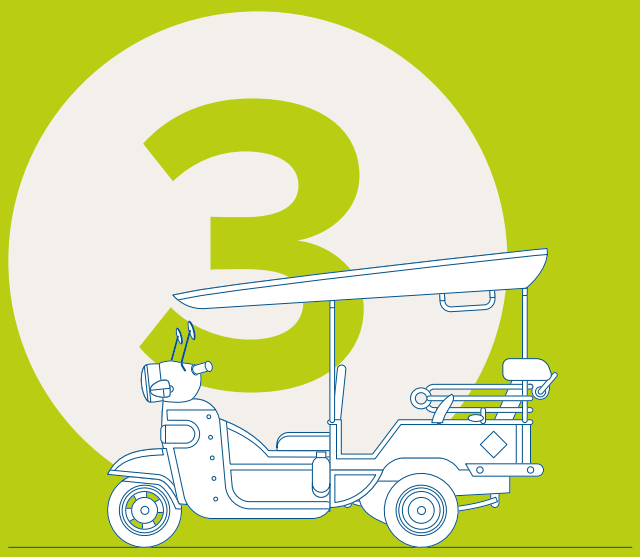
Measure

» Actual numbers/estimated numbers/ qualitative indicators

Data sources

» RTO, fleet operators, fleet operator untions





Number of EVs in the city:

Parameters

» IPT » E-autorickshaw » E-rickshaw

» E-taxis

Measure

» Actual numbers/estimated numbers/ qualitative indicators

Data sources

» RTO, fleet operators, fleet operator untions

Number of EVs in the city:

Parameters

» Personal vehicles » E-cars » LCVs
» E-2-wheelers » E-bicycles

Measure

» Actual numbers/estimated numbers/ qualitative indicators

Data sources

» RTO, fleet operators, fleet operator untions

Number of electric fleet operators:

Parameters

» Buses » Mini buses » Standard

Measure

» Actual numbers/estimated numbers/ qualitative indicators

Data sources

» RTO, fleet operators, fleet operator untions

Number of electric fleet operators:

Parameters

» Rail

Measure

» Actual numbers/estimated numbers/ qualitative indicators

Data sources

» RTO, fleet operators, fleet operator untions

Number of electric fleet operators:

Parameters

» IPT » E-autorickshaw » E-rickshaw » E-taxis

Measure

» Actual numbers/estimated numbers/ qualitative indicators

Data sources

» RTO, fleet operators, fleet operator untions

Electric PKM:

Parameters

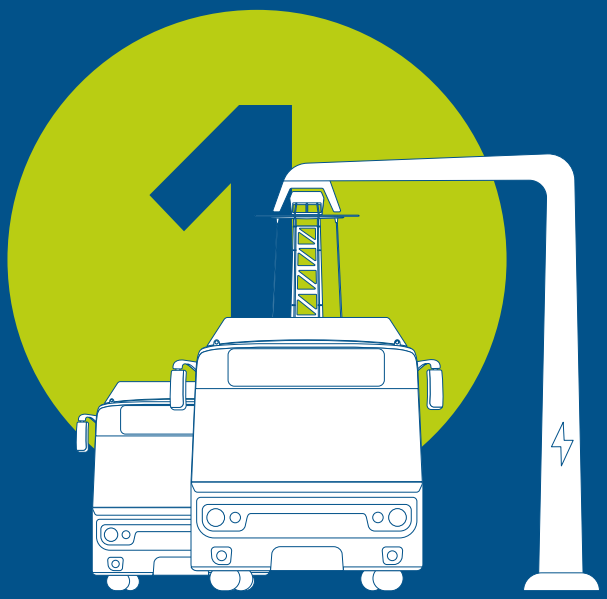
» Buses » Mini buses » Standard

Measure

» Actual numbers/estimated numbers

Data sources

» RTO, fleet operators, fleet operator unions



Electric PKM:

Parameters

» Rail

Measure

» Actual numbers/estimated numbers

Data sources

» RTO, fleet operators, fleet operator unions

Electric PKM:

Parameters

» IPT » E-autorickshaw » E-rickshaw

Measure

» Actual numbers/estimated numbers

Data sources

» RTO, fleet operators, fleet operator unions

Electric PKM:

Parameters

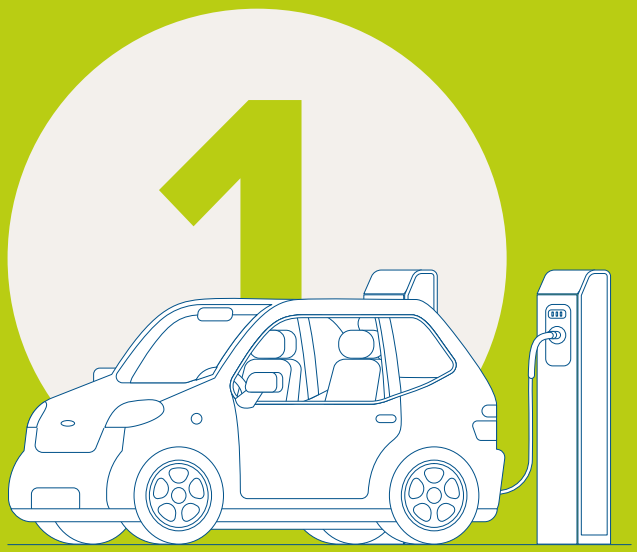
» Personal vehicles » E-cars » LCVs
» E-2-wheelers » E-bicycles

Measure

» Actual numbers/estimated numbers

Data sources

» RTO, fleet operators, fleet operator unions



Number of public EV charging points in the city:

Parameters

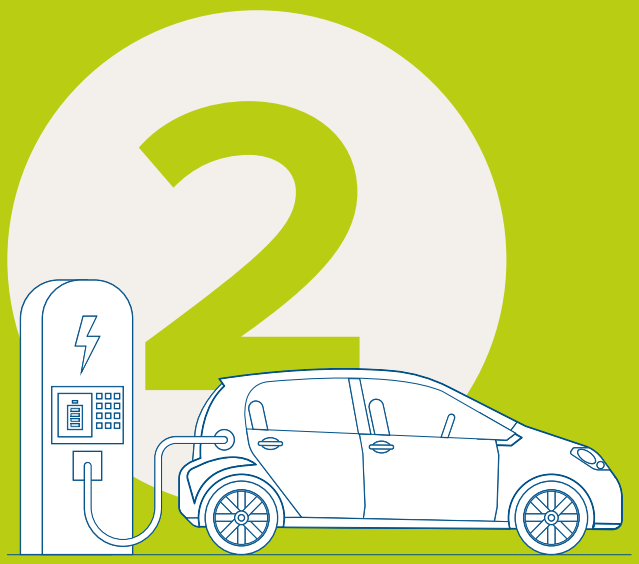
» Level 1

Measure

» Number and location

Data sources

» DISCOM



Number of public EV charging points in the city:

Parameters

» Level 2

Measure

» Number and location

Data sources

» DISCOM

Number of public EV charging points in the city:

Parameters

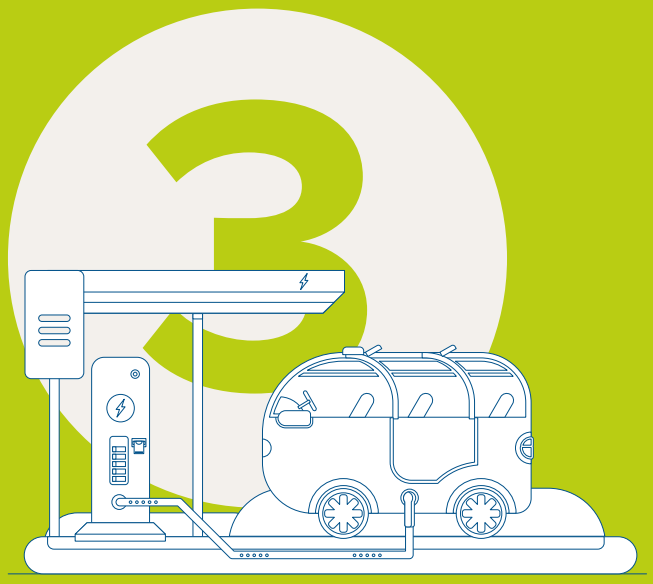
» Level 3

Measure

» Number and location

Data sources

» DISCOM



Investment made on promoting EVs:

Parameters

» Investment on deploying charging infrastructure

» Purchase of EVs

» Deploying monitoring infrastructure such as CCTCs, sensors, etc.

Measure

» Investment made

Data sources

» Municipal body, urban development agency, Department of Transport, Department of Finance, traffic police department

Air quality level:

Parameters

» PM, NO_2, SO_2 levels

Measure

» Air quality levels

Data sources

» Pollution Control Doard, Department of Environment

Recognition for e-mobility initiatives:

Parameters

» National

Measure

» Describe

Data sources

» Municipal body, urban development agency, Department of Transportation, Department of Environment, fleet operators

Recognition for e-mobility initiatives:

Parameters

» International

Measure

» Describe

Data sources

» Municipal body, urban development agency, Department of Transportation, Department of Environment, fleet operators

ELECTRIC MOBILITY

PART 4: BEST PRACTICES

Smart City
MISSION TRANSFORM-NATION

Ministry of Housing and Urban Affairs
Government of India

ROCKY MOUNTAIN INSTITUTE

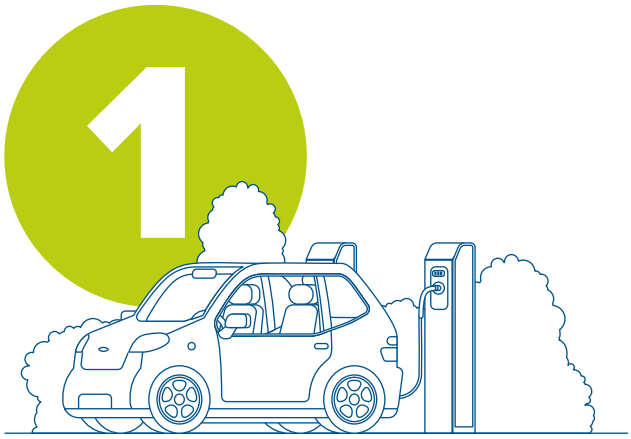
Section outline

The best practices compendium is the fourth and final document under the electric mobility component. It is focused on informing the city managers of measures/policies that have helped cities promote electric mobility. The best practices highlight policies and regulations, business models, institutional frameworks and financial models that enabled cities to increase uptake of electric vehicles.

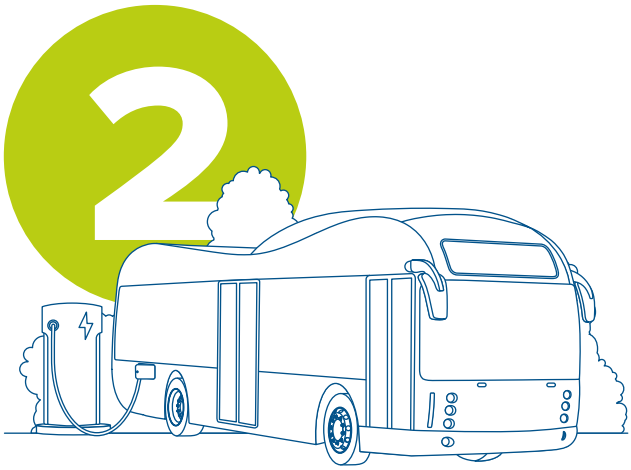
The case studies discussed are in line with the measures/ policies discussed in the workbook document. While the conditions in India are unique, the experience of EV uptake in different parts of the world can provide important learning for EV adoption in India.

1.0 Electric vehicle adoption, Norway

Norway is a world leader in terms of EV market share, with EVs constituting more than 50%. Norway started promoting EVs as a solution to its local air quality concerns and as a means to promote industrial development. Later, however, the shift to electric mobility became integral to larger climate and environmental policies in the country. Norway has set a goal of:



100% EV sales in passenger light duty vehicles, light commercial vehicles and urban buses by 2025



75% EV sales in long-distance buses and 50% in trucks by 2030

Fiscal incentives

EVs are exempted from progressive vehicle registration tax, value added tax, annual road tax and company car tax.

Non-fiscal incentives

Electric vehicles are provided various indirect incentives such as access to free parking, access to bus lanes and free charging at public charging stations.

The fiscal and non-fiscal exemptions convert into substantial savings for the EV users. Operationally, EVs offer a more economic choice than similar ICEVs. Annual charging costs is estimated to be at £264 as compared to an average £1,293 for petrol driven vehicles.[2] In addition, the ICEVs are heavily taxed, at an exorbitant 100%.

Incentives offered to EVs

NEW RULES ALLOW LOCAL AUTHORITIES TO LIMIT THE ACCESS TO ONLY INCLUDE EVS THAT CARRY ONE OR MORE PASSENGERS

FREE MUNICIPAL PARKING

Exemption from 25% VAT on leasing

NO ANNUAL ROAD TAX

Exemption from 25% VAT on purchase

NO PURCHASE/IMPORT TAXES

Parking fee for EVs was introduced locally with an upper limit of maximum 50% of full price

No charges on toll roads

CHARGES WERE INTRODUCED ON FERRIES WITH UPPER LIMIT OF MAXIMUM 50% OF FULL PRICE

50% REDUCED COMPANY CAR TAX

NO PURCHASE/ IMPORT TAXES

Exemption from 25% VAT on purchase

ACCESS TO BUS LANES

50% reduced company car tax

50% reduced company car tax

Company car tax reduction was lowered to 40%

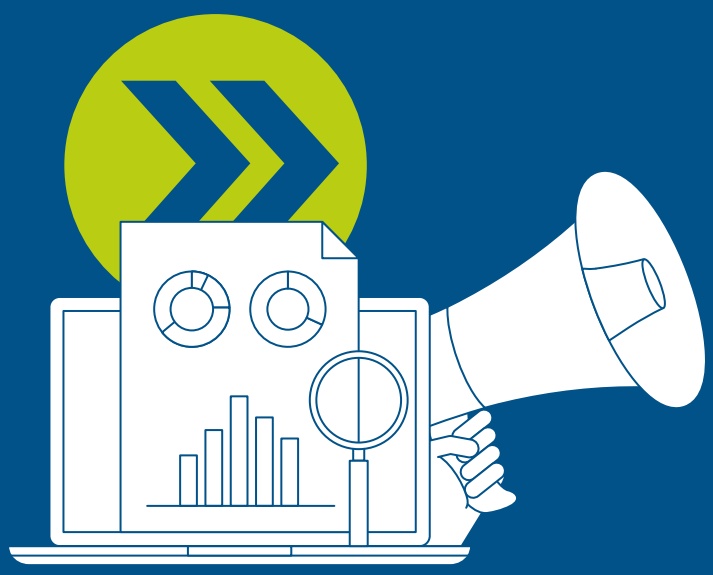
Parking fee for EVs was introduced locally with an upper limit of maximum 50% of full price

ACCESS TO BUS LANES

No annual road tax

Free municipal parking

CHARGES WERE INTRODUCED ON FERRIES WITH UPPER LIMIT OF MAXIMUM 50% OF FULL PRICE



Key takeaways

The success of EV adoption can be attributed to wide range of incentives adopted by the government to reduce the cost of buying and operating EVs. With a network of charging infrastructure in place, the government has also been able to take care of the range anxiety.

—

For more details refer to the webpage on the Norwegian EV policy: www.elbil.no/english/norwegian-ev-policy/

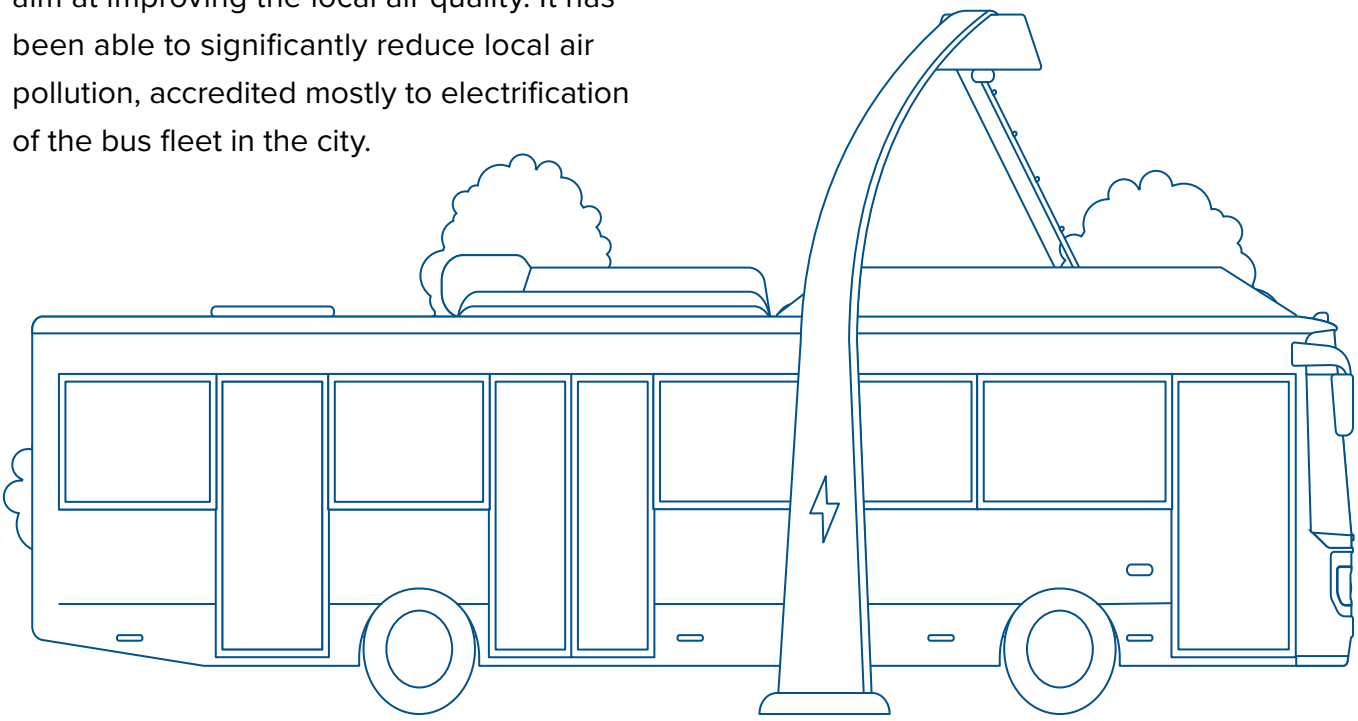
2.0 Electric bus fleet, Shenzhen, China

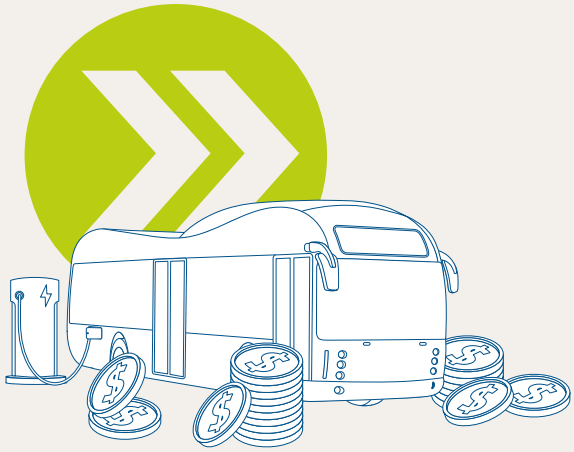
In 1980s, Shenzhen was declared a Special Economic Zone (SEZ). From a small fishing village, it has become a booming metropolis housing around 12 million people. Shenzhen has transformed massively over the years and has also been leading the electric mobility transition in China.

» Shenzhen is the first city in the world to have an entirely electric public bus fleet with more than 16,000 such buses. «

Shenzhen is also in the process of electrifying its entire taxi fleet. The city started the electric mobility transition in 2009 with an aim at improving the local air quality. It has been able to significantly reduce local air pollution, accredited mostly to electrification of the bus fleet in the city.

The shift to electric technology is supported by government incentives aimed at closing the cost gap between ICE and electric buses. A 12 meter e-bus in Shenzhen received a $150,000 government incentive, more than half of the vehicle's price. In order to overcome the barrier of high upfront cost, the city also adopted innovative business models for uptake of e-buses. It employed a cooperative commercial model, which is basically a leasing model facilitated through strategic partnership. Under the model, the local government arranges a financial leasing model for city's bus companies. The state-owned enterprises Potevio New Energy venture and China Southern Grid Ltd. help bring down the acquisition cost of e-buses.





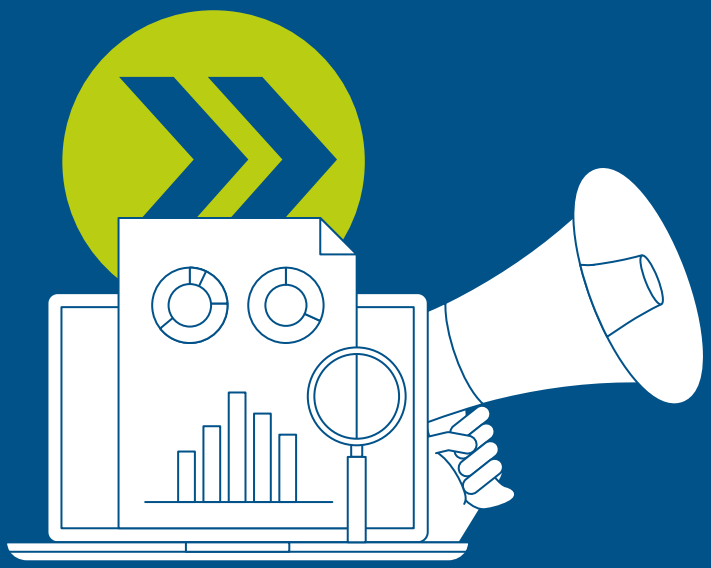
- Cost of e-bus: $320,000
- Central and local government incentives: $160,000 ($80,000 from each)
- Cost of a conventional ICE bus: $80,000

» Shenzhen employed a cooperative commercial model, which is a leasing model facilitated through strategic partnership for the uptake of e-buses. «

Potevio's leasing model reduces the capital cost of a bus by separating the cost of the battery ($56,000). Ownership of the battery remains with Potevio and it leases the battery to Shenzhen Bus Company. Potevio also offers a loan guarantee on the remaining amount of $104,000. With support from the local government and battery manufacturer BYD, Potevio is able to buy batteries at a subsidized price.

In addition, policies such as 'National Electric Vehicle Industry Base' (in 2011–15 five year plan) which mandates the city of Shenzhen to invest USD 7.9–9.4 billion in the EV industry, 'new energy bus and car system standards', 'Shenzhen's new energy bus operation monitoring system standard', have also been contributing towards pushing the uptake of EVs in the city.

The city has also invested in developing charging infrastructure. The city has constructed and integrated more than 100 large-scale public bus charging stations with bus interchange stations. To promote EVs in Shenzhen, the local power utility, China Southern Power Grid Co. Ltd. (CSG), offers a discounted price for charging EVs during the non-peak hours. Shenzhen has capitalised on these incentives and has been able to optimize its costs by following practices such as charging during the off-peak hours to take advantage of low electricity tariff. To improve the financial viability of charging infrastructure, the charging facilities are also open to private car users.



Key takeaways

In Shenzhen, EV deployment is driven by high levels of incentives. Hence, strong government support is required at local and national levels to drive electric mobility.

Shenzhen met its ambitious air quality goals in 2016 and 2017 and has not only demonstrated the economic viability of operating a large electric fleet but also the positive impact that electric mobility can create.

—

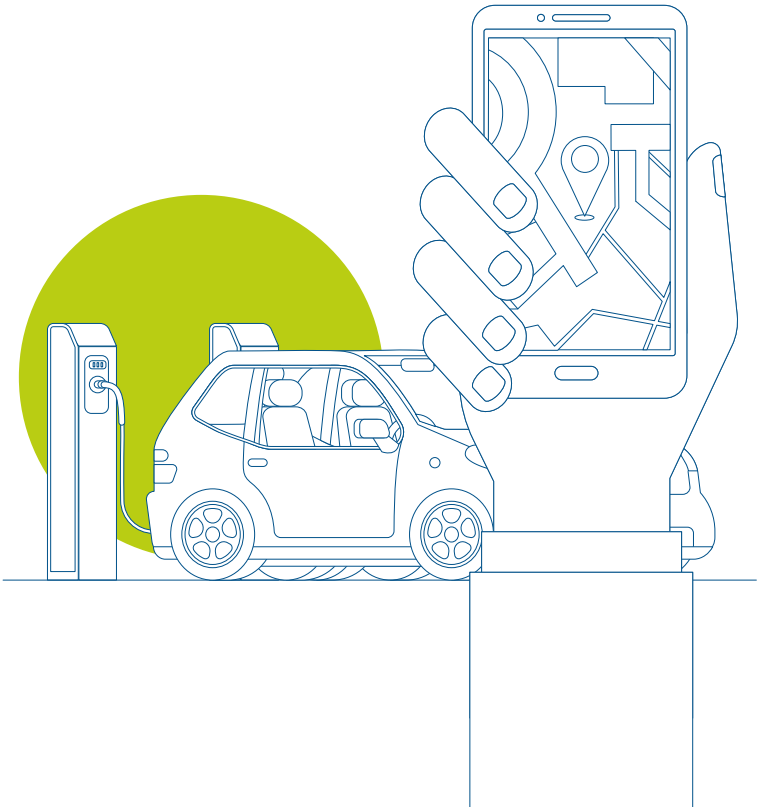
For more details refer to ISGF Report on electric bus revolution of Shenzhen City, China, 2016: www.indiasmartgrid.org/reports/ISGF%20-%20Visit%20to%20Shenzhen%20Eastern%20Bus%20Company%20Ltd%20on%2016th%20April%202018.pdf

WEF web article on Shenzhen just made all its buses electric, and taxis are next, 2018: https://www.weforum.org/agenda/2018/11/shenzhen-just-made-all-its-buses-electric-and-taxis-are-next/

3.0 Electric mobility driven by OEMs, Japan

Japan is aiming at a 20–50% passenger electric vehicle market share by 2020. Japan already has the third largest global stock of EVs and second largest stock of public fast chargers. Japan also has the highest density of fast chargers—0.016 per sq. km. Japan presents an interesting case study on electric vehicles as its market is driven by voluntary involvement by automotive firms.

Japan's progression to electric mobility can be attributed to early investment by the auto industry into electric mobility technology, in addition to policies implemented by the federal government. The average aggregate cost of Passenger Light duty Vehicles (PLDVs) is the lowest in Japan as compared to China, US or anywhere in Europe. Lower EV prices have been the key drivers of EV uptake in the country. A demand for EVs in turn has propelled setting up of charging infrastructure.



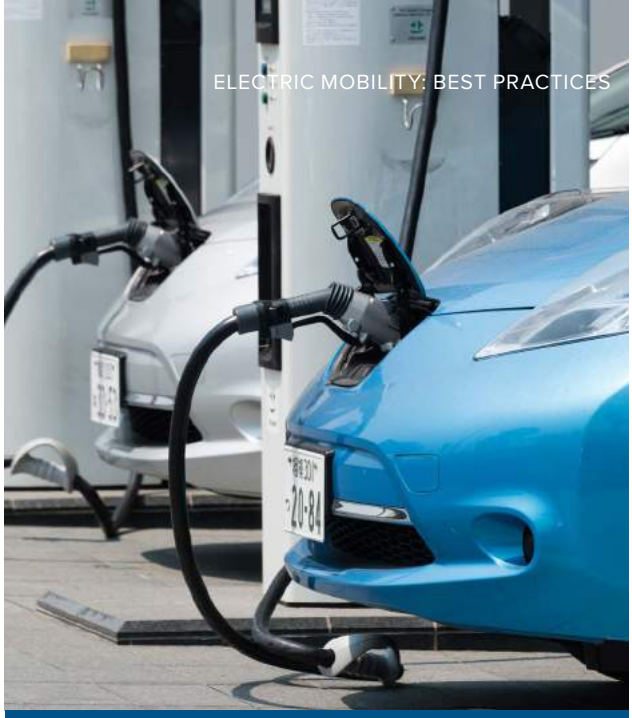
» The government focuses on providing direct consumer incentives, building public charging infrastructure and investing in research and development of EVs. «

Despite, upfront cost not posing a significant barrier, the government still offers a wide variety of incentives to promote the uptake of EVs in Japan. The government focuses on providing direct consumer incentives, building public charging infrastructure and investing in research and development of EVs. In terms of direct consumer benefits, the government has been offering tax exemptions and vehicle subsidies to EVs since 1999.

Vehicles that display 10–20% higher efficiency as compared to Japanese vehicle standards, are eligible for a 5–10% reduction in VAT. Higher fuel efficiency vehicles not only include EVs but also higher efficiency ICEVs. However, from 2009 onwards, the government has been offering 100% VAT exemption to EVs. EVs are also exempted from annual tonnage tax for the first year and can obtain 50% exemption in the second year. The government also offers a financial subsidy of 10,000 Yen on purchase of an eco car (vehicle that met 2015 fuel efficiency standards).

The government has also been making investments on installation of charging stations. The government has fixed a goal of installing two million chargers and 5,000 quick chargers by 2020. The government has been promoting Public-Private Partnership (PPP) wherein automobile manufacturers are encouraged to participate and install charging infrastructure in selected model towns. Today, Japan has more charging stations than petrol fueling stations. The government has also been supporting research and development of EV technology. The New Energy and Industrial Technology Development Organization and R&D programs on vehicle battery such as BES-ITS program have also been beneficial in promoting research on EVs.

» The government offers 100% VAT exemption to EVs, and financial subsidy of 10,000 Yen on purchase of an eco car, among other perks. «



Key takeaways

Governments must support EV uptake through wide variety of policy instruments. Attractive upfront cost remains a key to EV uptake. A network of charging infrastructure is also important to ensure usage of EVs.

—

For more details refer to www.ihsmarkit.com/research-analysis/japanese-automakers-investment-to-develop-advanced-technologies-rises-to-usd256-bil.html

Report on financial innovation in clean mobility, 2018: http://www.eib.org/attachments/pj/access_to_finance_study_on_innovative_road_transport_en.pdf

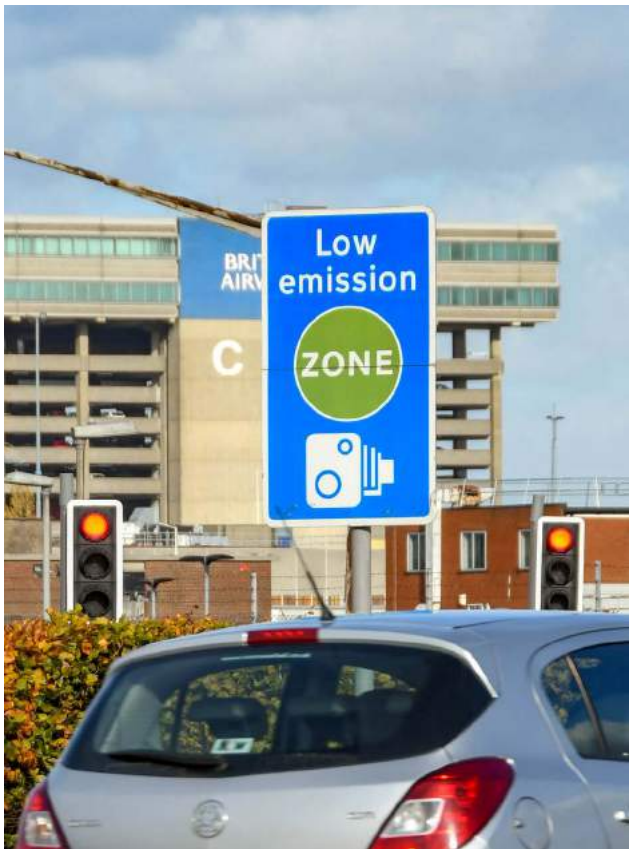
4.0 Ultra Low Emission Zone (ULEZ), London

London has been aggressively pursuing a low-emission policy with an aim at transitioning to zero emission road transport system by 2050. London is in the process of implementing Ultra Low Emission Zone (ULEZ) from 2019 onwards. ULEZ is a traffic management and emission reduction scheme with an aim at improving local urban air quality. ULEZ will be implemented in a phased manner. It will first be implemented within the same area as the current Congestion Charge Zone and will be in place in central London. From 2021 onwards, the ULEZ will include the inner London area.

Most vehicles, including cars and vans will need to meet new, tighter exhaust emission standards (ULEZ standards) or pay a daily charge to travel within the area of the ULEZ.

Towards this effort, the city is aiming at converting its entire taxi fleet and private hire vehicles to zero emission by 2033 and its entire bus fleet by 2037.

The vehicles, which will not adhere to the new emission standards, entering the ULEZ would need to pay a daily charge of:



£12.50
vehicles under 3.5 tons such as cars, motorcycles and vans

£100
vehicles over 3.5 tons (lorries, buses/coaches) which are over 5 tons

» The revenue generated from the T-Charge will be allocated to Transport for London for undertaking clean-up and maintaining a greener transport fleet in London. «

This charge will be an additional one over the weekday congestion charge and the Low Emission Zone (LEZ) charge and will replace the T-Charge (emission surcharge).[4] It is anticipated that such a charge will encourage people to shift to vehicles that meet the new emission standard. The revenue generated from this charge will be allocated to Transport for London (TfL) for undertaking clean-up and maintaining a greener transport fleet and reducing pollution across the transport network in London.

In order to meet the vehicle emission standards of ULEZ, London is already procuring hybrid, electric and hydrogen buses. In terms of private vehicle fleet, the city will allow only electric cars, the newest hybrids, hydrogen vehicles and bikes or e-bikes to operate within the ULEZs. The city is also working towards designing a diesel vehicle scrappage scheme to encourage polluting vehicles get off roads.

To improve the uptake of zero emission vehicles, the government is also investing in setting up of charging and refuelling infrastructure both in London and across the UK. The Mayor has committed to install 1,500 standard charging points across London. £4.5 million of funding from the Office for Low Emission Vehicles (OLEV) has been allocated towards installation of these charging points. The government is also developing a network of rapid chargers with the support of £18 million from TfL capital investment. However, much of this rapid charging network will be reserved for black cabs.

1200
EV registrations: 2012

12000
EV registrations: 2017

10x
growth in EV demand

The sale of EVs has surged in London, especially in the last 4–5 years. There are almost 12,000 EVs registered as of 2017 in London, over ten times as many as in 2012. However, there seems to be a shortfall of charging infrastructure vis-à-vis growing EV demand. In order to bridge the demand gap for charging infrastructure, the government is also offering a grant of up to 75% of the cost of home charging point, up to a maximum saving of £500 to citizens. It is estimated that 60% of Londoners do not have a private parking space and use public streets for parking. To cater to this segment, the government has stipulated that 20% of all new parking spaces created in London must be equipped with charging facility.

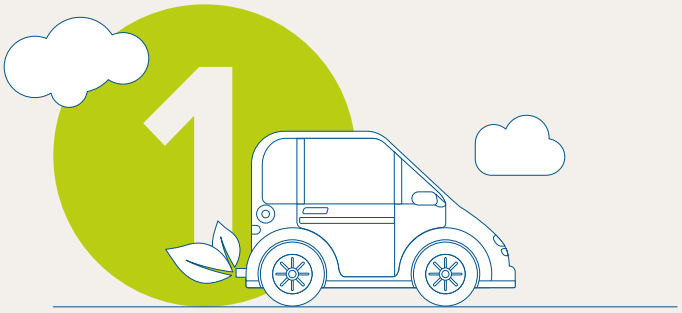
» 20% of all new parking spaces created in London will be equipped with charging facility. «

In order to encourage uptake of zero emission vehicles, the government is also providing financial incentives in the form of grants for plug-in vehicles. The government is offering a grant of up to £4,500 for cars, £1,500 for motorcycles, £8,000 for vans and £7,500 for taxis. Zero-emission capable vehicles are also eligible for an exemption on vehicle tax (VED) or are required to pay a reduced rate depending on their CO_2 emissions, vehicle list price and year of registration. The government also offers a range of tax incentives for business users. Some London boroughs offer free or reduced-charge parking for electric vehicles.

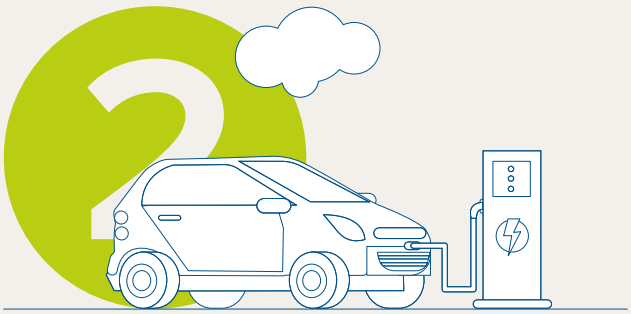
London has been successful in accruing advantages from implementing the low-emission zone in the past. The scheme not only improved the local air quality but also successfully induced a shift towards low-emission vehicles. It is anticipated that the ULEZ scheme will also be equally instrumental in improving the uptake of EVs and improving the air quality and imparting related benefits in London, in the near future.

Zero-emission capable

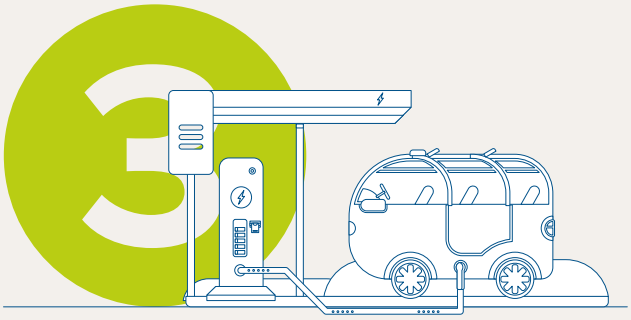
As per TfL, Zero-Emission Capable (ZEC) is the collective term used for vehicles that can operate with zero exhaust emissions. Most car and van manufacturers have ZEC models available, with more due to come to market in the next few years. There are three types of ZEC vehicles:



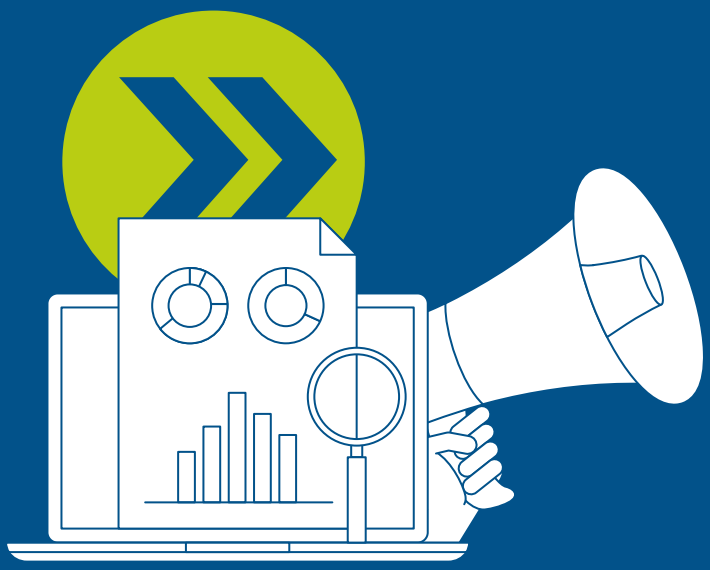
100% pure electric vehicles are powered by a battery which drives the electric motor. They have no exhaust emissions. Battery electric vehicles typically have a range of around 80 miles but some can achieve up to 300 miles



Plug-in hybrid and range-extended electric vehicles also have a conventional diesel or petrol engine, meaning they have a longer range than those with a battery alone



Hydrogen fuel cell electric vehicles have a fuel cell which uses hydrogen to produce electricity which powers the wheels of the vehicle. They typically have a range of around 300 miles



Key takeaways

Regulations such as ULEZ scheme can be an effective instrument to induce shift to cleaner mobility solutions. However, even within such a regulatory environment, benefits such as financial incentives on upfront cost and tax exemption remain important. Also, non-financial policies such as free parking increase the attractiveness of EVs among consumers.

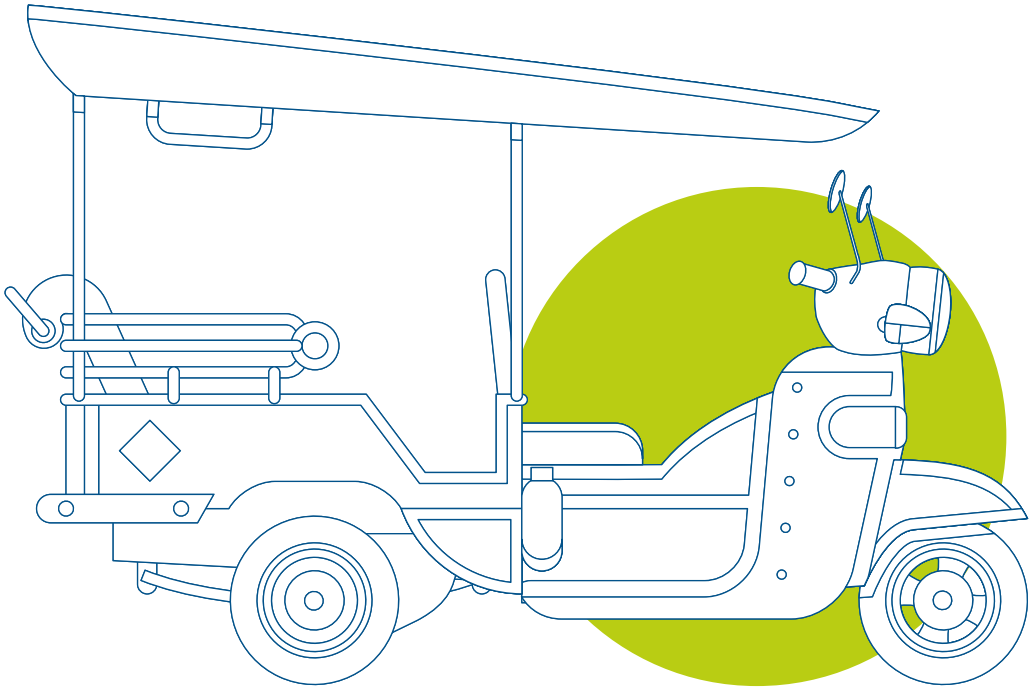
—

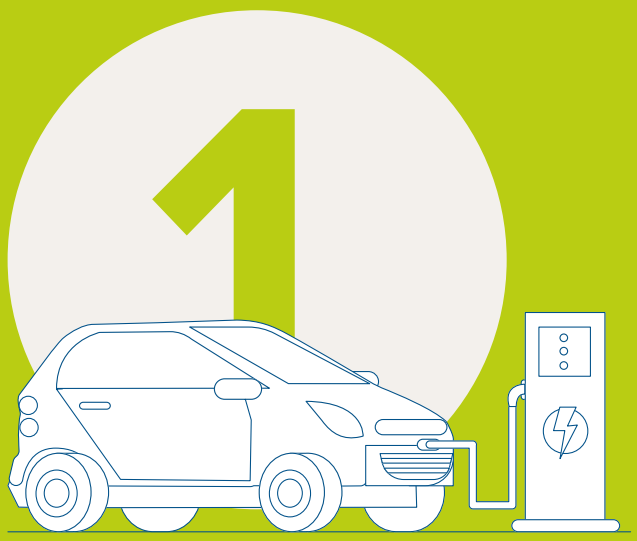
For more details, refer to official website of Transport for London (TfL); https://tfl.gov.uk/modes/driving/ultra-low-emission-zone

5.0 Electric mobility in India: learning from national experiences

India has started focusing on electric mobility much recently as compared to Europe, U.S or China. The electric mobility agenda was mainstreamed with the adoption of the National Electric Mobility Plan (NEMMP) in 2013. The policy laid down vision and road map for EV penetration in the country. The plan has been taken forward through the faster adoption and manufacturing of (hybrid &) electric vehicles in India (FAME) scheme. The FAME scheme has been instrumental in creating demand for EVs in the country, especially in the public transport segment.

FAME facilitates pilot projects for operation of EVs in 11 cities for public transport purposes. The scheme is offering 60% subsidy to buses, 20% to three-wheelers and 10–15% to four-wheelers. Almost 10% of the total subsidy is being budgeted towards installation of charging stations. Beyond NEMMP, there have been a few initiatives to promote e-mobility; these have been described in this section.





» EESL aims at creating a demand for EVs, encouraging local manufacturing facilities and improving technical competencies for the long-term growth of the EV industry. «

EESL Procurement Model

In August 2017, the Energy Efficiency Services Limited (EESL), a joint venture of the public-sector units of the Ministry of Power and the Government of India, floated a tender for procurement of 10,000 electric cars. This effort was aimed at creating demand, providing an impetus for Indian vehicle manufacturers, charging infrastructure companies, fleet operators, service providers, and the industry to gain efficiencies of scale and drive down costs. The tender required an international competitive bidding. Tata Motors and Mahindra & Mahindra won the tender to supply electric cars. A price of INR 11.2 lakh (inclusive of GST) along with a comprehensive 5-year warranty was quoted by TATA Motors. This price was almost 25% below the market price of a similar e-car, which came with a warranty of three years. The procurement was planned in a phased manner. In the first phase, 500 e-cars were to be supplied by November 2017. The procurement was aimed at replacing conventional fuel vehicles across government institutions.

» **Nagpur is the first city in India with an electric fleet of 200 EVs, including taxis, buses, e-rickshaws and e-autos.** «

OLA e-Taxi Pilot, Nagpur

Nagpur is a city with 2.5 million people, located in central India, in the state of Maharashtra. Nagpur has emerged to be one of the front runners in encouraging and adopting electric mobility in the country. It has become India's first city with an electric fleet of 200 electric vehicles, including taxis, buses, e-rickshaw and autos; including 100 of Mahindra's new e20 plus. Ola, a cab aggregator service, invested $8 million for a fleet of 200 electric cars with support from the Softbank and in partnership with Mahindra.

Other initiatives:

As discussed in the Framework Document, a number of bus pilot projects have also been launched in various Indian cities. Some of the key e-bus initiatives have been described in the following section.

Status of sanctioned e-mobility projects

Navi Mumbai Municipal Transport (NMMT)

» NMMT has ordered procurement of Volvo 8400 Hybrid City Bus; 5 of these buses have already been delivered.

—

Mumbai Metropolitan Region Development Authority (MMRDA)

» MMRDA is procuring 25 hybrid buses from Tata Motors (which do not require external charging).

—

BEST Mumbai

» BEST has ordered retrofitment of buses with AV Motors and Impact Automotive Solutions Limited (a subsidiary of KPIT) with funding from its municipal corporation.

» It is also procuring 30-seater six electric feeder buses from BYD-Goldstone.

—

Himachal Road Transport Corporation (HRTC)

» HRTC is operating 25 full electric buses. It is offering exemption from token tax, registration charges and value-added tax (VAT) to all electric vehicles.

—

Bangalore Metropolitan Transport Corporation (BMTC)

» BMTC has submitted a proposal to procure 150 electric buses on PPP model.

—

Thane Municipal Transport (TMT)

» Thane is planning to operate 100 electric buses on PPP model. The private operator will purchase and operate the buses for 10 years on self-selected routes. The fare level of electric and other buses would be same and will be fixed by Metropolitan Transport Authority.

—

Pune Mahanagar Parivahan Mahamandal Ltd. (PMPML)

» Pune has floated a tender of 500 electric buses.

—

West Bengal Housing Infrastructure Development Corporation Ltd.

» Running electric pilot in New Town, Kolkata

Electric bus pilot in New Town, Kolkata

Kolkata is India's seventh most populated metropolis with a population of almost 4.5 million as per the 2011 Census. With an aim at reducing pressure on Central Kolkata, New Town, a satellite town was developed in the Greater Kolkata region. This satellite town has a population of more than 100,000 people. To cater to the mobility needs of New Town, West Bengal Housing Infrastructure Development Corporation Ltd. (WBHIDCO) aimed at developing smart and sustainable public transport solution. With this aim, WBHIDCO has started pilot operation of electric buses. Coal India Limited is supporting WBHICO through offering funding for procuring electric buses under its CSR initiative.

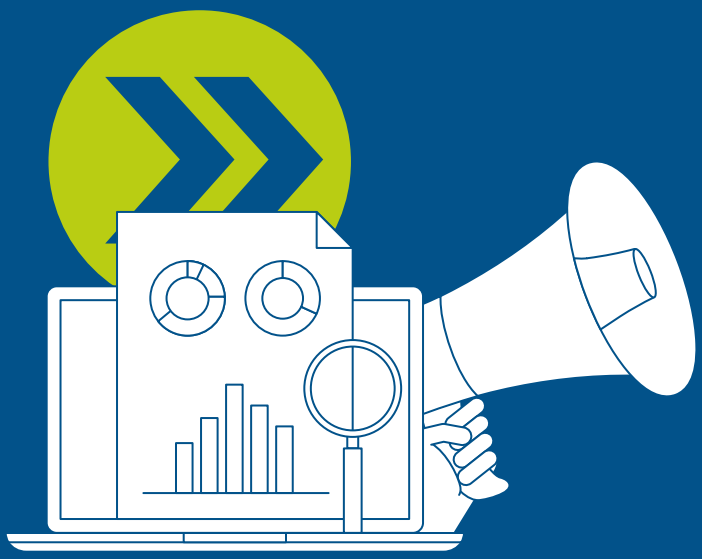
» These buses not only operate with zero tailpipe emissions, but are also noise-free and offer a better riding experience, as they are vibration-free. «

The pilot operations include three 32-seater battery electric buses. These buses are manufactured by Eicher and retrofitted by KPIT to run on electric propulsion. These buses are air-conditioned, equipped with Intelligent Transport System (ITS) and also offer wi-fi connectivity to its passengers. The electric buses have a top speed of 80 kmph. In their daily operation, however, they do not exceed 50 kmph, the usual traffic speed in the area.

The buses have a range of around 180 kmph on a single charge with the air-conditioning working throughout.

The buses can regenerate almost 36% of the power from braking and use only 0.8 electricity unit/km. The buses take six hours to charge completely. The buses are charged at New Kolkata Development Authority (NKDA) bus stand which has a charging station and workshop. There is also a provision for en-route charging at some of the bus stops. The buses are typically charged overnight and operated between 8 a.m. to 12 p.m. and 4 p.m. to 8 p.m. They are again charged between 12 p.m. and 4 p.m. in the daytime. The bus fare is Rs. 10.

WBHICO and CIL are planning to further increase the fleet of electric buses and expand operation of these buses to other parts of Kolkata. As per their estimate, the operation of an electric bus over a year offers benefits equalling diesel savings worth INR 1 million and CO_2 reduction of 42,000 kg. The positive experience of operating electric buses has encouraged the state government to further expand electric mobility and it is planning to add a fleet of electric ferries.



Key takeaways

Bulk purchase models and competitive bidding can be helpful strategies to reduce upfront cost of EVs. Charging infrastructure will be a prerequisite to promoting EVs in Indian cities, particularly in case of commercial operations such as cab services, where the per day vehicle utilization rates are higher.

For more details refer to www.cleantechnica.com/2018/03/10/olas-ev-taxi-pilot-program-india-reportedly-facing-significant-problems/

www.auto.ndtv.com/news/government-officials-reject-using-electric-cars-under-eesl-scheme-1874251

www.india.uitp.org/articles/electric-bus-market-in-india

6.0 Setup of charging infrastructure in cities: Chinese experience

Local policy instruments remain critical to promoting setting up of charging infrastructure in cities. IEA, 2018 identifies four measures through which cities around the world are deploying charging infrastructure. These measures are:

» **Policies:** Setting up targets for installation of charging infrastructure and driving development of such infrastructure

» **Building codes:** Mandatory requirement for installation of electric charging infrastructure for EVs in residential and commercial buildings/areas

» **Financial incentives:** Subsidy on setting up charging points

» **Direct deployment:** Developing parking facilities specifically for EVs, on-street charging facilities and by enabling residents to raise request for charging infrastructure to be installed

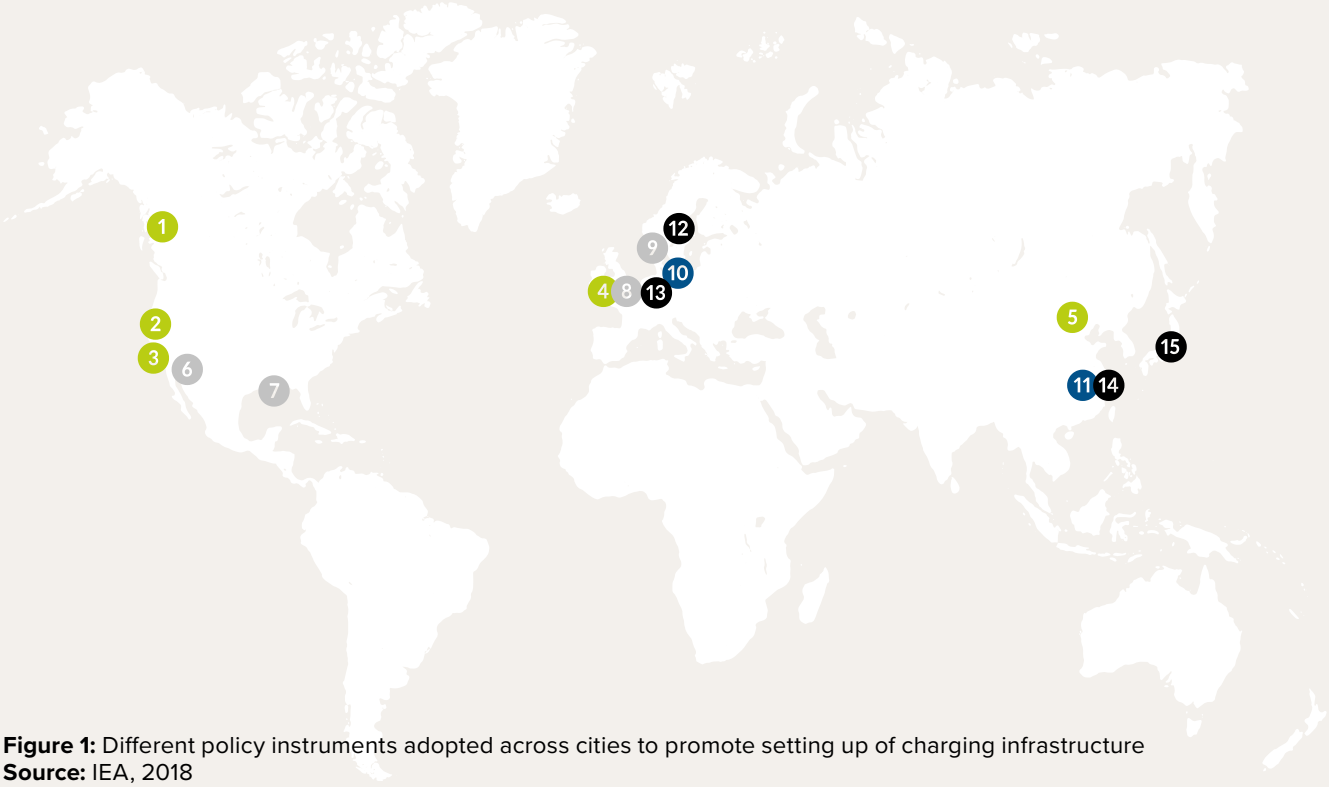


Figure 1: Different policy instruments adopted across cities to promote setting up of charging infrastructure
Source: IEA, 2018

Building codes

1 **Vancouver (Canada):** 20% of the parking stalls in multifamily buildings must be equipped with wire conduits

2 **San Francisco (USA):** 10% of parking spaces in new constructions must have Level 2 chargers

3 **San Jose (USA):** Simplify local charging permitting process

4 **London (UK):** Charging point planning requirements for all new real estate developments

5 **Beijing (China):** 100% of new residential buildings and 15–25% of new commercial buildings required to be fitted with wire conduits

Direct EVSE deployment

6 **Los Angeles (USA):** Deploying charging stations on streetlights

7 **New Orleans (USA):** Residents can apply for permits to install electric vehicle charging stations on the road in front of their homes

8 **London (UK):** Residents can request that charging stations be installed on the road in front of their homes by Ubitricity

9 **Oslo (Norway):** Building two large parking garages for electric vehicles

Target number of charging points to be built

10 **Copenhagen (Denmark):** 500–1000 publicly available charging stations and 5000 semi-public charging stations by 2025

11 **Shanghai (China):** Plan to build 28,000 publicly available and private charging pointsby 2020

Financial incentives

12 **Utrecht & Amsterdam (The Netherlands):** 1000 EUR subsidy for semi-publicly accessible charging points

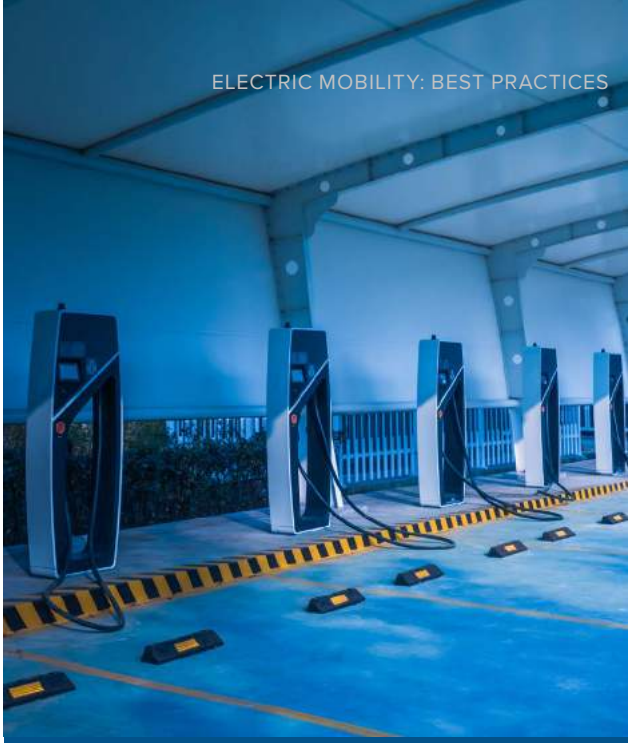
13 **Oslo (Norway):** Grants for up to 60% of installation cost of a charging point

14 **Shanghai (China):** 30% capital subsidy for businesses for charging infrastructure

15 **Tokyo (Japan):** Subsidy of approximately JPY 1.5 million for charging points in condominiums

The case of China is extremely interesting. China rapidly expanded its charging infrastructure, reaching 107,000 public charging outlets by 2016, witnessing an increase of 118% year-on-year (McKinsey, 2017). As per another source, the number of installed charging stations across China stood at 450,000 units in 2017. This included 210,000 public charging stations, up 51% year-on-year (Renewable Energy World, 2018).

In China, the deployment of charging infrastructure is primarily driven by central and state governments and utilities. The government has set up a target of deploying 120,000 fast charging stations and 500,000 total public stations by 2020. The eighty-eight pilot cities for EVs, funded by central government, are required to provide one charging point for every eight EVs. The charging stations are recommended to be set up within a 1 kilometer distance in the city center (ICCT, 2017). Many municipal governments provide funding for local stations, in support with the national utility state grid. The state grid is also setting up fast chargers in the city center and along major intercity corridors (ICCT, 2017).



Key takeaways

Relying on the four identified strategies is expected to help cities deploy charging infrastructure in Indian cities as well.

—

For more details refer to Electric Vehicle Outlook, IEA, 2018; www.webstore.iea.org/global-ev-outlook-2018

White paper on Emerging Best Practices for Electric Vehicle Charging Infrastructure, 2017; www.theicct.org/sites/default/files/publications/EV-charging-best-practices_ICCT-white-paper_04102017_vF.pdf

7.0 Quick case studies

CO_2 emission-based feebate (malus–bonus) system in France

» In France, the government offers substantial direct and indirect incentives to EVs. Direct incentives include purchase subsidy for EVs and subsidy for installation of chargers while indirect benefits range from tax breaks to access to reserved lanes and parking spots

» In addition, France offers an CO_2 emission-based feebate system, which subsidizes electric vehicle purchase while penalizing higher-emission vehicles

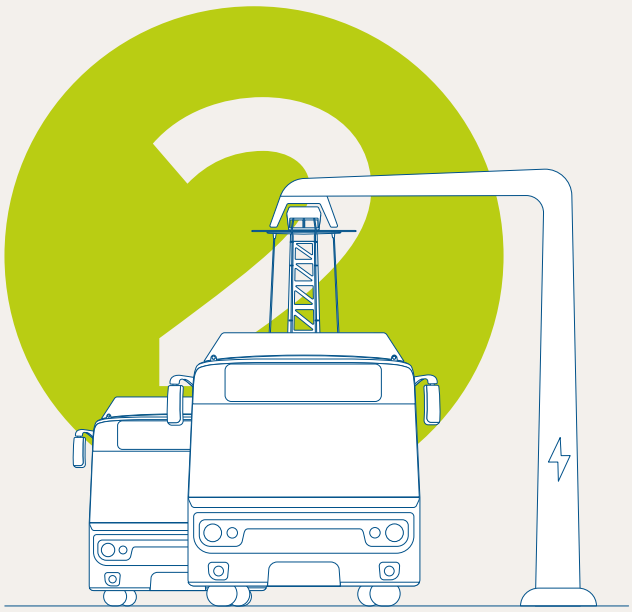
» The feebate system was introduced in 2008 and required a car buyer to either pay a fee (malus) for vehicle with CO_2 emissions above certain level or receive a rebate if the emissions were below certain limits

For more details refer to www.globalfueleconomy.org/transport/gfei/autotool/approaches/ economic_instruments/fee_bate.asp

» Recognizing the benefits of public procurement as an initiator of the electric mobility transition and its potential to contribute to air quality and climate goals, eight major countries signed and launched the Government Fleet Declaration at the Marrakech COP22 in 2016. These eight countries are—Canada, China, France, Japan, Norway, Sweden, United Kingdom and United States

» The countries committed to the target of minimum thresholds of 50% low-emission vehicles for fleet renewals at the national level and 20% for local authorities, both established in 2015, as well as a target of full electrification of new buses by 2025

For more details refer to Global Energy Outlook, IEA, OECD, 2018; www.webstore.iea.org/global-evoutlook-2018



Public procurement programs to stimulate the initial rollout of EVs

Phasing out ICE vehicles to promote higher efficiency vehicles

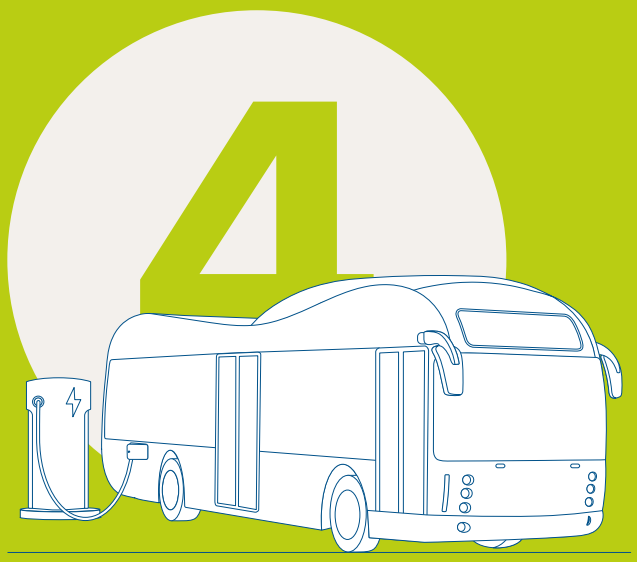
» A number of countries are banning or planning to phase out ICE vehicles to promote the use of higher efficiency and cleaner vehicles. Some of the targets set by countries are:

» **China:** In September 2017, China considered a national ban on the production and sales of ICE cars running on gasoline and diesel. The announcement does not specify details on the timeline of such a ban

» **France & U.K.:** No new ICE vehicle sales after 2040

» **Netherlands:** No new ICE vehicles sold after 2030, phase-out begins 2025

For more details refer to Survey of Global Activity to Phase Out Internal Combustion Engine Vehicles, 2018; www.climateprotection.org/wp-content/uploads/2018/10/Survey-on-Global-Activities-to-Phase-Out-ICE-Vehicles-FINALOct-3-2018.pdf



The ZeEUS project (zero emission urban bus system), European Union (2013–2018)

The ZeEUS project aimed at facilitating the uptake of electric buses.

» It set up ten demonstration sites across ten European cities to monitor and improve upon technical, economic and operational performance of electric city buses.

» The project is expected to aid informed decision-making with respect to procurement and introduction of electric buses as it concludes.

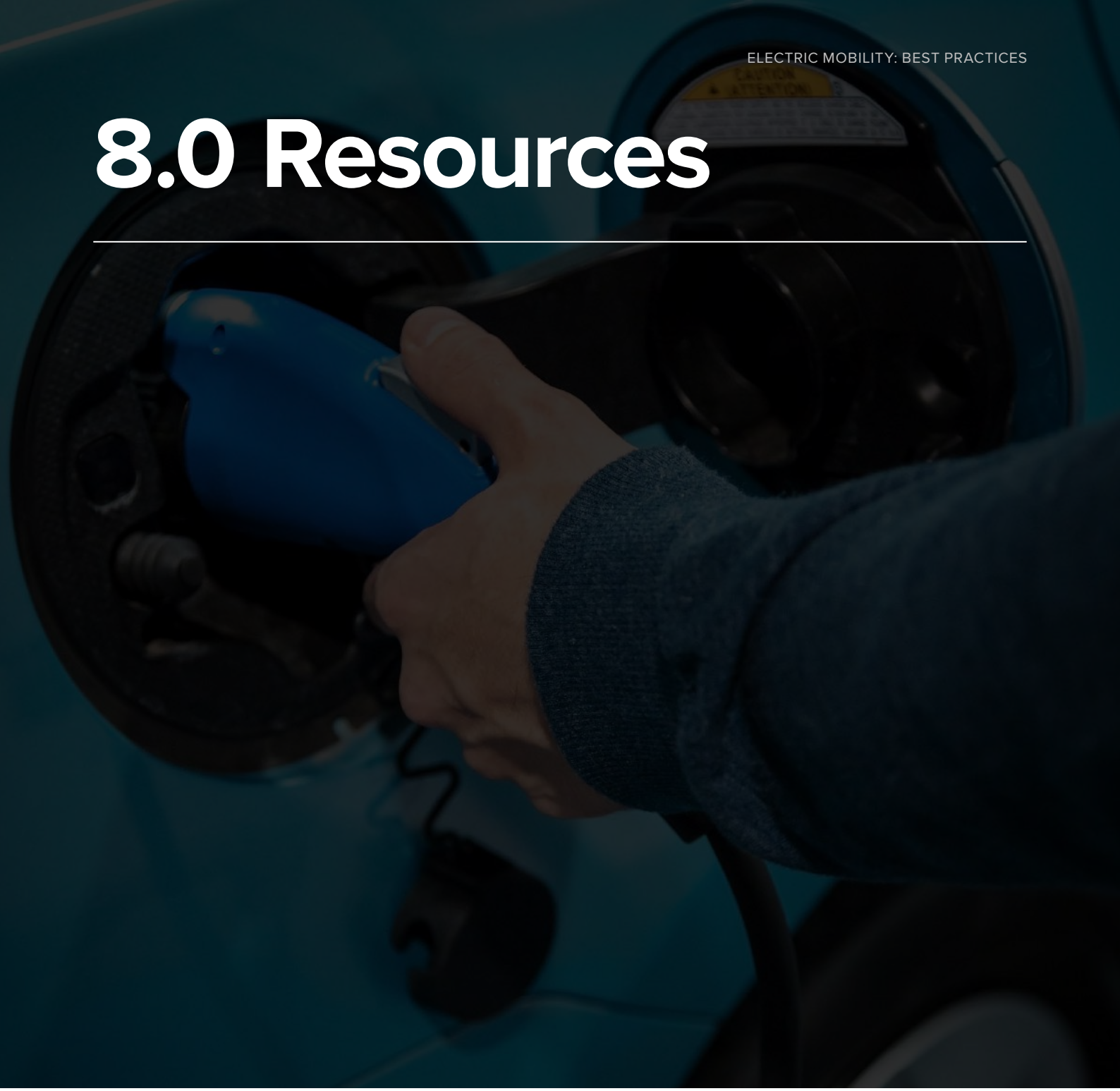
» The project was set up at a budget of € 22.5 M (€ 13.5 M funded) with an aim at decarbonizing the transport sector.

» The ZeEUS project brings together a network of 40 partners, including public transit authorities and operators, vehicle manufacturers, energy providers, academic and research centers, engineering firms and associations.

» The ZeEUS project is closely observing the progress of bus system electrification in Europe. As per the annual report of ZeEUS: An overview of electric buses in Europe, 2016, the number of electric buses increased from twelve to thirty-two between August 2015 and August 2016. Twenty one of these buses were BEVs and eleven PHEVs. The report states that during 2015–16, the electric buses helped save 226,921l of diesel and 519 tons of CO_2 emission.

For more details refer to the annual report of ZeEUS: An overview of electric buses in Europe, 2016; www.zeeus.eu/uploads/publications/documents/zeeus-ebus-report-internet.pdf

8.0 Resources



Case studies

- Global EV Outlook 2017: www.webstore.iea.org/global-ev-outlook-2017
- Global EV Outlook 2018: www.webstore.iea.org/global-ev-outlook-2018
- Report on Electric bus revolution of Shenzhen city in China, India Smart Grid Forum (ISGF), 2018: www.indiasmartgrid.org/reports/ISGF%20-%20Visit%20to%20Shenzhen%20Eastern%20Bus%20Company%20Ltd%20on%2016th%20April%202018.pdf

» Electric Vehicles for Smarter Cities: The Future of Energy and Mobility, World Economic Forum and Bain & Company, 2018: www3.weforum.org/docs/WEF_2018_%20Electric_For_Smarter_Cities.pdf

» Competing and Co-existing Business Models for Electric Vehicles: Lessons from International Case Studies, Claire Weiller, Amy Shang, Andy Neely, Yongjiang Shi, International Journal of Automotive Technology and Management, University of Cambridge, 2015: www.innovation-portal.info/wp-content/uploads/2015-January-Business-Models-for-EV.pdf

» The emergence of electromobility: Comparing technological pathways in France, Germany, China and India, Tilman Altenburg,1,* Eike W. Schamp2 and Ankur Chaudhary3, Science and Public policy, 43(4), 2016, 464–475, Oxford, 2015: www.watermark.silverchair.com

» White paper on Emerging Best Practices for Electric Vehicle Charging Infrastructure, 2017: www.theicct.org/sitesdefault/files/publications/EV-charging-best-practices_ICCT-whitepaper_04102017_vF.pdf

» White paper on Power Play: How are governments spurring the electric vehicle industry, ICCT, 2018: www.theicct.org/sites/default/files/publications/EV_Government_White Paper_20180514.pdf

» Report on International evaluation of public policies for electromobility in urban fleets, 2017: www.theicct.org/publications/international-evaluation-public-policies-electromobility-urbanfleets

» Electric Vehicle Grid Integration in the U.S., Europe, and China Challenges and Choices for Electricity and Transportation Policy, ICCT, 2013: www.theicct.org/sites/default/files/publications/EVpolicies_final_July11.pdf

9.0 References

1. www.elbil.no/english/norwegian-ev-policy/

2. Jones, 2018; www.theguardian.com/money/2018/jul/02/norway-electric-cars-subsidies-fossil-fuel

3. www.wri.org/blog/2018/04/how-did-shenzhen-china-build-world-s-largest-electric-bus-fleet

4. In order to improve urban air quality in London, older vehicles plying within Central London need to pay an extra daily charge, in addition to the Congestion Charge, in case they do not adhere to minimum Euro emission standards. The T-Charge (or the Emissions Surcharge) is applicable in the Congestion Charge zone.


IDEA
BUSINESS

AUTHORS AND ACKNOWLEDGEMENTS

SUGGESTED CITATION

Ministry of Housing and Urban Affairs (MoHUA) and Rocky Mountain Institute (RMI). *Electric Mobility*. 2019

ACKNOWLEDGEMENTS

Authors:
Akshima Ghate
Clay Stranger

Art Director: Vindhya Tripathi
Designer: P. Pallavi Baasri

Editorial Director: Ashpreet Sethi

Image Credits: Shutterstock

CONTACT

For more information, please contact:
RMI: india_contact@rmi.org

The views and opinions expressed in this document are those of the authors and do not necessarily reflect the positions of the institutions or governments. While every effort has been made to verify the data and information contained in this report, any mistakes or omissions are attributed solely to the authors and not to the organizations they represent.