



ELECTRIC VEHICLE GUIDEBOOK FOR INDIAN STATES

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This guidebook aims to assist state-level policymakers in designing well-rounded electric vehicle policies for their states.

ABOUT THIS GUIDEBOOK

State governments play an important role in electric vehicle market development by complementing national actions with policies that fit local conditions. States also act as a bridge between national and city governments.¹ To assist state-level policymakers in designing well-rounded electric vehicle policy packages, this guidebook identifies and summarizes international best practices in promoting electric vehicles.

All suggestions in the guidebook are compiled from reviews of electric vehicle strategies and policies in 32 states or provinces and major cities in India and around the world.² These areas have been highly ambitious in seeking to bring electric vehicles into the mainstream and are leading electric vehicle development efforts in the United States, Canada, Europe, China, Japan, and India by adopting comprehensive policies to increase electric vehicle adoption. This guidebook identifies an effective strategic approach and selects policy actions that can be

applied by state-level governments in India. Specifically, this guidebook:

- Introduces an electric vehicle policy development cycle, which state governments can follow in both electric vehicle promotion and stakeholder integration.
- Details the five components of this policy cycle, which policymakers can use to establish a strong electric vehicle strategy: identifying the electric vehicle development opportunity, understanding the barriers hindering the diffusion of electric mobility, developing an electric vehicle policy package, implementing policies, and evaluating policy outcomes.
- Recommends 83 policy actions to address five market barriers for electric vehicle development.
- Links recommended measures with real-world practices via a case study.

Battery electric vehicles and plug-in hybrid electric vehicles are covered in this guidebook. Fuel cell electric vehicles are not included because the technology and infrastructure for them is at a nascent stage. The content of this guidebook applies to all vehicle segments—private, public, and commercial ownership—and includes two-, three-, and four-wheelers.

¹ India is a member of a multi-governmental forum Electric Vehicle Initiatives (EVI) which launched an EV 30@30 campaign in 2017, setting a goal of achieving 30% new EV sales by 2030 in member countries. To that end, the government of India launched the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (“FAME India”) in March 2015.

² This guidebook summarizes policies proposed or adopted by December 31, 2018. The 32 regions include nine states in the United States: Arizona, California, Colorado, Indiana, Massachusetts, New York, Oregon, Utah, and Washington; three provinces in Canada: British Columbia, Ontario and Quebec; four cities in China: Beijing, Shanghai, Shenzhen, and Xi’an and one province: Zhejiang; five cities in Europe: Amsterdam, London, Oslo, Paris, and Stockholm and one province in Germany: Baden-Württemberg; one city in Japan: Tokyo; and eight states in India: Andhra Pradesh, Delhi, Karnataka, Kerala, Maharashtra, Telangana, Uttar Pradesh and Uttarakhand.



Electric vehicle charging stations are being set up in Bengaluru by BESCOM. (Arun Bhat S)

1 THE ELECTRIC VEHICLE POLICY CYCLE AND STAKEHOLDERS

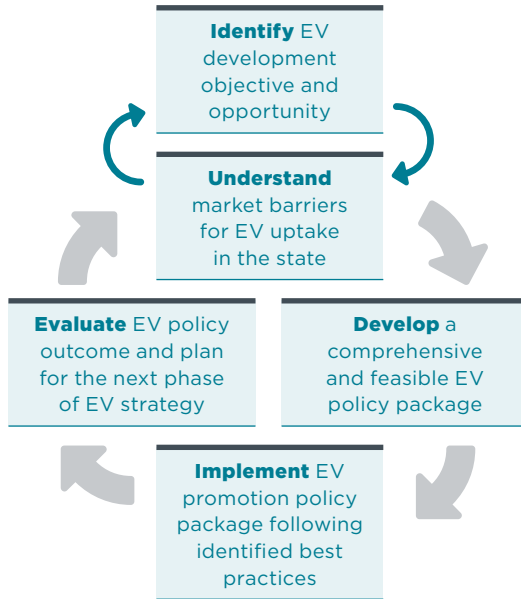


Figure 1. Electric vehicle (EV) policy development cycle

1.1 The policy development cycle

Innovative and dynamic support is required to design and implement an electric vehicle policy that best fits the local context. This guidebook creates an electric vehicle policy development cycle that explains how state-level electric vehicle policies should be drafted, implemented, and assessed. The cycle is designed to incorporate policy opportunities and challenges that we observed in other leading markets. Figure 1 shows the five key components of the policy cycle for promoting electric vehicles.

At the start of the cycle, the state government needs to **identify the electric vehicle development objective and opportunity** and **understand barriers for electric vehicle uptake in the state**. These two components are closely related and prepare policymakers for the rest of the policymaking process. Specifically, policymakers should have a clear vision of the state's electric vehicle development goal and an understanding of the relevant market barriers. The barriers influence how short-term and long-term objectives are set and how the opportunity that exists is assessed. Additionally, establishing the direction of electric vehicle development would narrow down which market barriers the government is likely to face.

Once the government identifies its electric vehicle development objective and understands the relevant

market barriers, it can begin working on **developing a comprehensive and feasible electric vehicle policy package**. When developing the policy package, policymakers should consider which activities will best seize the market opportunities and be comprehensive enough to address market barriers.

Once the policy package is formulated, the state government needs to align and coordinate agencies and stakeholders to **implement the electric vehicle promotion policy package**. For effective implementation, the policy package needs to be specific about activities and clear on responsibilities. This guidebook introduces general principles for implementation and provides references to a number of best practices that have been identified for various policy actions.

Different markets can react differently to the same policy, so **evaluating electric vehicle policy outcomes** in response to an established policy package helps to **enhance plans for the next phase of the electric vehicle strategy**. Evaluating the market's response to the existing policy package supports future policymaking. If the progress of electric vehicle development indicates the need for continued policy support, the next round of electric vehicle development planning will repeat the policymaking cycle as market conditions for electric vehicles change and additional actions are needed.

1.2 The stakeholders involved in policy development

Electric vehicle development is a cross-sector issue, and success requires collaborative efforts from many stakeholders. In states where electric vehicle policy development and implementation have been successful, policy development was often initiated by heads of the state. In California, for example, an executive order by the governor established several electric vehicle goals for the state. The governor's office also led an interagency working group to develop a Zero Emission Vehicle Action Plan that included specific strategies for meeting the milestones established by the executive order.³ It is therefore recommended that the state-level electric vehicle policy development process in India be ideally initiated and monitored from the office of chief minister of the state. Appointing a nodal ministry to develop the policy might result in the policy being crafted too narrowly, and it increases the risk of incomplete implementation.

After the policy development process is initiated, an executive authority should be formed to develop and implement it. The executive authority could be a cell within the office of the chief minister, or an independent body in the form of a committee, a board, or a task force coordinated by the office of the chief minister. Whichever form the executive authority takes, it should represent multiple departments within the state government. Some of these would be the departments of transport, finance, power/energy, industries and commerce, planning, and environment, and the state pollution control board.

3 Governor's Interagency Working Group on Zero-Emission Vehicles, "2013 ZEV Action Plan: A roadmap toward 1.5 million zero-emission vehicles on California roadways by 2025" (February 2013) [http://opr.ca.gov/docs/Governors_Office_ZEV_Action_Plan_\(02-13\).pdf](http://opr.ca.gov/docs/Governors_Office_ZEV_Action_Plan_(02-13).pdf)

This executive authority could also include experts from industry, civil society, and academia to advise the government on best practices. For states in India that have already proposed electric vehicle policies, the nodal agencies that have led policy development are the Department of Transport in Delhi⁴ and Kerala;⁵ the Industries and Commerce Department in Karnataka,⁶ Telangana,⁷ and Andhra Pradesh;⁸ the Industries, Energy, and Labor Department in Maharashtra;⁹ the Directorate of Industries in Uttarakhand;¹⁰ and the Department of Infrastructure and Industrial Development in Uttar Pradesh.¹¹ Although these states chose to appoint nodal agencies to initiate electric vehicle development, these agencies all proposed the formation of a dedicated executive authority to advise the government on policy formulation, oversee policy implementation within the state, and review the progress of policy initiatives. Some

- 4 Government of NCT Delhi, "Draft Delhi Electric Vehicle Policy 2018," November 27, 2018, https://www.transportpolicy.net/wp-content/uploads/2019/10/Delhi_Draft_EV_Policy_20181127.pdf
- 5 Government of Kerala, "The Draft Policy on Electric Vehicles for the State of Kerala," September 29, 2018, https://www.transportpolicy.net/wp-content/uploads/2019/10/Kerala_Draft_EV_Policy_20180929.pdf
- 6 Government of Karnataka, "Karnataka electric vehicle and energy storage policy 2017," September 25, 2017, https://www.transportpolicy.net/wp-content/uploads/2019/10/Karnataka_EV_Policy_20170925.pdf
- 7 Government of Telangana, "Telangana electric vehicle policy - draft 27.09.2017," September 27, 2017, https://www.transportpolicy.net/wp-content/uploads/2019/10/Telangana_EV_Policy_20170927.pdf
- 8 Government of Andhra Pradesh, "Andhra Pradesh Electric Mobility Policy 2018-23," June 8, 2018, https://www.transportpolicy.net/wp-content/uploads/2019/10/Andhra_Pradesh_EV_Policy_20180608.pdf
- 9 Government of Maharashtra, "Maharashtra Electric Vehicle Policy-2018," February 14, 2018, https://www.transportpolicy.net/wp-content/uploads/2019/10/Maharashtra_EV_Policy_20180214.pdf
- 10 Government of Uttarakhand, Uttarakhand Electric Vehicle Manufacturing, E.V. Usage Promotion and Related Services Infrastructure Policy 2018, (2018) https://www.transportpolicy.net/wp-content/uploads/2019/10/Uttarakhand_EV_Policy_20181008.pdf
- 11 Government of Uttar Pradesh, Uttar Pradesh Electric Vehicles Manufacturing Policy 2018, (2018), https://www.transportpolicy.net/wp-content/uploads/2019/10/Uttar_Pradesh_Draft_EV_Policy_2018.pdf

states have empowered this executive authority with decision-making capabilities, and others have limited its role to an advisory one.

Ideally, an executive authority of this kind needs to be empowered enough to take on a variety of responsibilities that range from evaluating long-term political, air quality, and climate goals to assigning agencies to implement policy actions. Depending on the power designated by the government, the executive authority could perform the following roles:

- Assist in electric vehicle development decision-making.
 - » Advise government on defining electric vehicle development goals in connection with socio-economic, air quality, and climate targets.
 - » Support the state government in developing an electric vehicle strategy.
 - » Coordinate interdepartmental and stakeholder collaboration.
- Support the development of an electric vehicle policy package.
 - » Consolidate and facilitate the electric vehicle policymaking process.
 - » Advise government on electric vehicle promotion policies.
 - » Suggest or establish funding and institutional mechanisms to implement the policy package.
- Implement the electric vehicle policy package.
 - » Provide guidance and support for the implementation of electric vehicle policies.
 - » Monitor the policy implementation progress and take on or advise on necessary course-corrective actions.
- Track and evaluate the effectiveness of electric vehicle policies.
 - » Review the effectiveness of the policy.
 - » Review the scope of the policy, such as the definition of an electric vehicle, electric vehicle components, battery, and charging stations.
 - » Advise on or undertake necessary changes and amendments to achieve policy goals.

Even though a state government in India has broad authority, implementing some electric vehicle-related policy actions might not fall under the purview of the state government and its agencies. Some tasks are legally assigned to the national government, and some are administratively feasible only at the city level. Table 1 provides examples of electric vehicle-related policy actions in various supervisory categories and details the levels of government authorized to implement them. All of these policy actions can play a role in spurring electric vehicle development in the state. In cases where the state government does not have the authority, or its authority overlaps with that of the national or city government, the state will need to collaborate with the other levels of government for smooth implementation.

Table 1. Electric vehicle policy authority levels

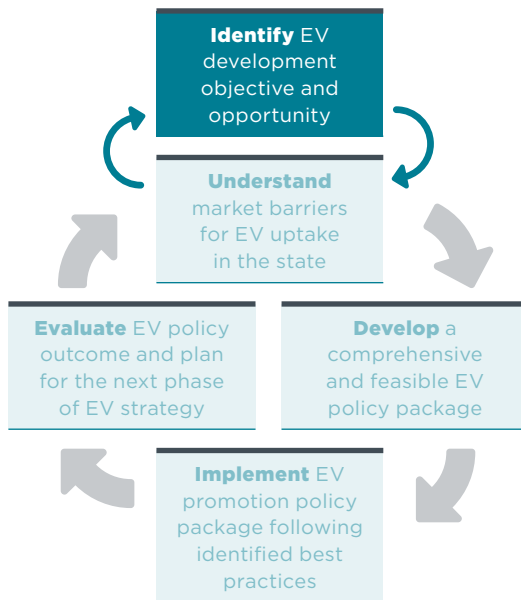
Authorities to implement electric vehicle-related policy actions	Level of authority		
	National	State	City
Financial authority			
Determine electricity price		✓	
Determine road tax, registration fees		✓	
Determine State Goods and Services Tax (SGST) for electric vehicle purchase, electric vehicle supply equipment (EVSE)	✓	✓	
Subsidize EV purchase, infrastructure, electricity, EV manufacturing		✓	
Determine road toll		✓	✓
Determine parking fee			✓
Fund electric vehicle-related promotion, training, research, public events	✓	✓	✓
Determine loan interest, insurance rate		*	
Regulatory authority			
Establish technical standards (vehicle, battery, charging infrastructure)	✓		
Establish zero-emission vehicle (ZEV) mandate for manufacturers	✓	✓	
Determine permit approval process for commercial electric vehicles, charging stations, electric vehicle manufacturing infrastructure		✓	
Promulgate e-rickshaw regulations		✓	✓
Amend building code to incorporate charging infrastructure	✓	✓	✓
Mandate conversion or replacement of fleets		✓	✓
Determine preferential lane access		✓	✓
Require battery recycling and material recovery	✓	✓	✓
Determine usage of land (public places and government offices)			✓
Establish education/certification program at universities	*	*	*
Fleet management			
Control vehicle entrance to the region		✓	✓
Procure fleet for government offices	✓	✓	✓
Issue permit/license for commercial electric vehicle users		✓	✓
Own or manage bus fleet			✓

Note: Sources include various regulations, policy documents, and our own evaluation of government hierarchy.

* Actions the government does not have the authority to conduct, but where it can help facilitate attractive terms or provide subsidies.

2 FIVE COMPONENTS OF AN EFFECTIVE ELECTRIC VEHICLE POLICY CYCLE

This section delineates the five components involved in the electric vehicle policy development cycle and provides guidance for each of them.



2.1 Identify the electric vehicle deployment objective and opportunity

State governments that seek to develop an electric vehicle strategy usually have a pre-existing goal. This might be in terms of absolute sales of electric vehicles, or electric vehicles as a percentage of total vehicle sales. The goal might also be a general description of desired market scale, or of environmental and climate impact.

Once there is a clear goal, what's needed is to identify short- and long-term objectives and opportunities to achieve this goal. It is best to consider the development opportunities from different perspectives. Through policy design, a state could prioritize electrifying certain vehicle groups over others. Vehicle groups could be categorized by vehicle mode, segment, owners, and purpose of use, among others, and the state could focus its electrification efforts on those groups that contribute the most to air pollution, for example. In other cases, the state could focus on vehicle groups that have fast population growth and strong market demand, that the state has more control over, that have good business and investment opportunities, that reflect consumer preference for electric vehicles, and that pertain to social uplift with ready-to-adopt electric technologies. The identification

of these opportunities will influence the direction of the state's electric vehicle policy development.

A state could also give precedence to certain segments over others. Figure 2 shows categories of vehicles, some of which already have electric versions in India and some of which have been electrified in other countries.

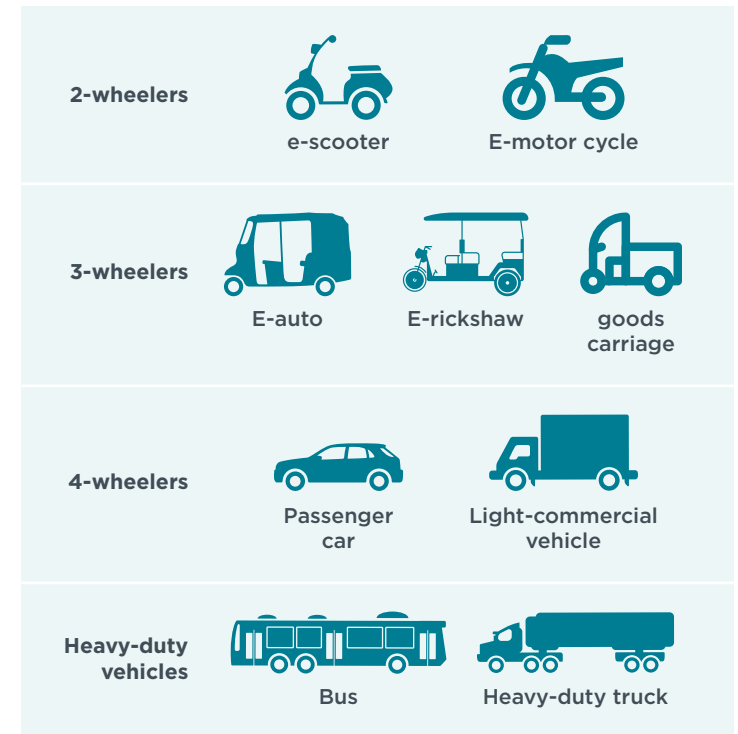


Figure 2. Electric vehicle segments

For two-wheelers, motorcycles and scooters make up the majority of registrations in Indian states. The electric two-wheeler market share was around 0.2% in fiscal year (FY) 2017–2018.¹² Electric three-wheelers are primarily commercial vehicles; these are e-autos, e-rickshaws, and goods carriers. E-rickshaws are popular in tier 1 and tier 2 cities of India, with around 1.5 million of them on the roads of these cities. Three-wheeler goods carriers are used for short-haul deliveries, usually in congested city areas. The four-wheeler market share in India was around 0.02% in FY 2017–2018, with fewer than 10 models available in the passenger car segment. Electric models of light commercial vehicles—pickup trucks of N1 category—are not yet available but are expected to enter the market by early 2020.^{13,14} M2 category vehicles, or vans, meanwhile, have been in the Indian market since 2016. Electric bus deployment has been undertaken by several state governments in India as a part of electric vehicle promotion policy and by the central government through the Faster Adoption and Manufacturing of Electric Vehicles (FAME) initiative.

The state could also give precedence to certain vehicle fleets over others. Vehicle fleets are vehicle groups that are owned or leased and operated by the same party, whether a business, government agency, or other organization. Various fleet types and their descriptions are listed in Table 2. The state could analyze and compare

the development opportunities of different segments and fleets and then determine the direction of its own electric vehicle development strategy. The state could also decide to develop a strategy that applies to all types of electric vehicles and provides equal treatment to them.

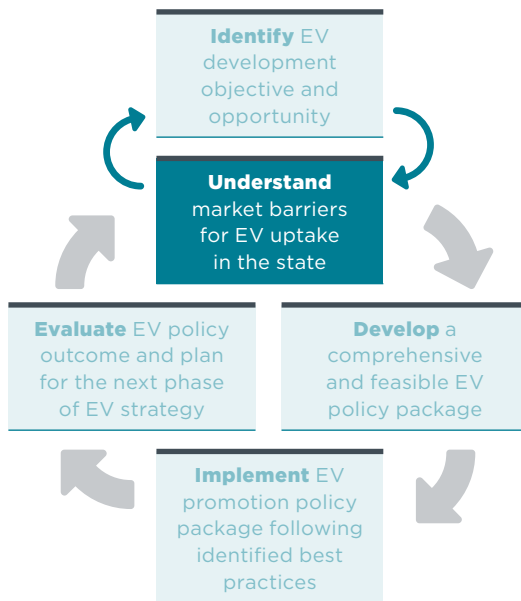
Table 2 Types of vehicle fleets

Type of fleet	Description
Private vehicle	Individual ownership
Commercial vehicle	Taxi service, delivery fleet (logistics/freight), sharing fleet (2-wheelers, 3-wheelers, car sharing/ride hailing services, shuttle services), owned by individuals or businesses
Vehicles for public transportation	Buses used by the general public for daily transportation, owned by state transportation authorities or private entities
Vehicles in public sector fleets	Fleets owned or contracted by public entities such as states, cities, municipalities, and public-sector undertakings; this includes shuttles, ambulances, and other utility fleets such as postal vans and dump trucks.
Vehicles in corporate fleets	Vehicles used by private companies for business and employee transportation

¹² Segment Y India two-wheeler sales database FY 2017-18, <https://www.segmenty.com/>

¹³ N1 category vehicles are commercial vehicles with gross vehicle weight of no more than 3,500 kg.

¹⁴ Malyaban Ghosh, "Tata Motors, Mahindra in race to roll out electric light commercial vehicles," *Livemint*, March 31, 2018, <https://www.livemint.com/Industry/gSVYDvwtv3dk586cXzHQUL/Tata-Motors-Mahindra-in-race-to-roll-out-electric-light-com.html>



2.2 Understand the market barriers for electric vehicle uptake

In examining policy actions that have been adopted to promote electric vehicles around the world, we found that all of the policies were adopted to address five consumer barriers to greater electric vehicle adoption. They are model availability, cost competitiveness, fleet deployment, usage convenience, and consumer understanding. The scale of the challenges varies by market and by fleet, but these barriers are commonly recognized. Therefore, when the state is preparing its electric vehicle development strategy, there are typically five questions related to these barriers that should be studied.

Barrier #1, electric vehicle model availability: Are electric vehicle technologies for sale?

The availability of a range of electric vehicle models across multiple segments and consumer price points is a key factor for the broader adoption of electric vehicles. There is a clear link between electric vehicle model availability and uptake.¹⁵ The top electric vehicle markets had noticeably more electric vehicle models available than other markets. The state could refer to the following indicators while investigating the availability of electric vehicle technologies:

- The total number of available electric models.

¹⁵ Peter Slowik and Nic Lutsey, *The continued transition to electric vehicles in U.S. cities* (ICCT: Washington, DC, 2018), <https://www.theicct.org/publications/continued-EV-transition-us-cities-2018>

- The number of available electric models in each segment at different price points.
- Manufacturers' plans to design and supply electric vehicles in five to 10 years, or one to two product-development cycles.
- Capacity of manufacturers and suppliers to provide electric vehicle technologies and parts.
- Inventories of electric vehicle models at dealerships.

Barrier #2, electric vehicle cost-effectiveness: Are electric vehicle technologies competitive on cost with conventional alternatives?

As electric vehicles are at an early stage of development in India, their market price is higher than conventional gasoline and diesel alternatives. However, as the scale of production increases and battery costs decline, the prices of electric vehicles fall.¹⁶ Evaluating the existing and future cost differences between electric vehicles and conventional vehicles will help the state government determine the amount of monetary incentives needed to make electric vehicles cost-competitive. The state government could consider the following indicators:

- The manufacturing cost of electric vehicles compared with conventional vehicles.
- The total cost of ownership of electric vehicles for five to seven years, depending on the average length of ownership of a new car in India, compared with

¹⁶ *ibid.*

conventional vehicles, including taxes, fees, and operating costs such as fuel and maintenance.

- The total cost of ownership of electric vehicles with all national-level electric vehicle incentives compared with conventional vehicles.
- Expected cost trend of electric vehicles and conventional vehicles in the long term, or five to 10 years.
- Portion of investment committed to electric vehicles by manufacturers over the next five to 10 years.

Barrier #3, electric vehicle deployment across different fleets: Is electric vehicle deployment achievable for different categories?

Even though the total cost of ownership of electric vehicles can be competitive with that of conventional vehicles with government financial support, high upfront costs could act as a major barrier for public and commercial fleet transition. The state government could consider the following when evaluating the challenges that need support from the government:

- The feasibility and challenges of deploying electric vehicles for public transportation, such as buses and taxis.
- The feasibility and challenges of deploying electric vehicles for public use, such as government and corporate fleets.

- The feasibility and challenges of deploying electric vehicles for commercial use.

Barrier #4, convenience and reliability of electric vehicles: Can electric vehicles match conventional alternatives?

Driving range anxiety and time to recharge are among key factors that might prevent mainstream consumers from purchasing electric vehicles. Charging infrastructure increases range confidence, and more electric vehicle users increase demand for infrastructure. As identified in other electric vehicle markets, electric vehicle adoption is linked in complex and multidirectional ways to the availability of various types of charging infrastructure, such as public regular, public fast, and workplace charging. As a benchmark, a study found that in the United States, markets where electric vehicles account for more than 4% of vehicles have at least 300 public charge points per million people—10% to 20% of which are fast charging—and at least 100 workplace charge points per million people.¹⁷ The state government could evaluate the convenience and reliability of electric vehicles using the following measures:

- Survey the availability of existing private and public charging infrastructure.

¹⁷ *ibid.*

- Study feasibility for home and public charging infrastructure using city mobility patterns and grid capacity.
- Study feasibility for home charging infrastructure based on grid capacity and cost of installation.
- Survey manufacturer, utility company, and industry plans for charging infrastructure.
- Analyze charging infrastructure service data.
- Survey consumer perspectives and expectations regarding electric vehicle convenience.

Barrier #5, awareness of electric vehicles: Are EVs understood and considered by potential buyers and operators?

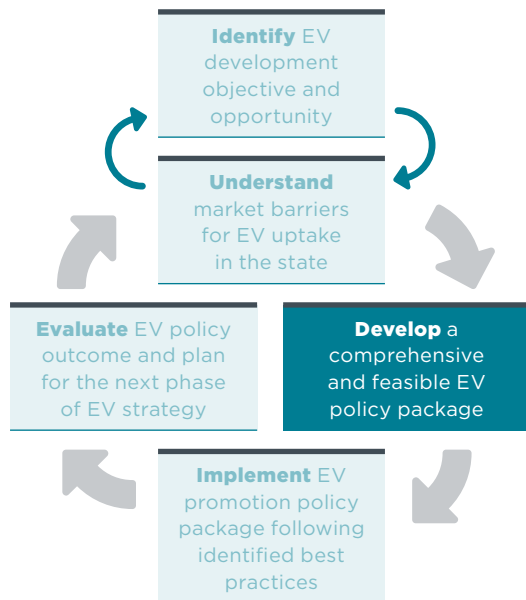
There is a general lack of knowledge and awareness about electric vehicles even in states like California, where there have been several government-sponsored electric vehicle

promotional programs.¹⁸ A literature review showed that consumers with first-hand exposure to electric vehicles have a higher valuation of them and consider them a choice for future purchases.¹⁹ Low consumer awareness of electric vehicles includes lack of familiarity with new technology, lack of knowledge of available incentives and models, misperception about the potential savings from lower fuel and maintenance costs, and lack of awareness regarding the environmental benefits of electric vehicles. The state government could evaluate consumer awareness of electric vehicles through surveys, interviews, and electric vehicle ride-and-drive initiatives, and then synthesize reports on the following indicators:

- Familiarity with availability of the models and electric vehicle incentive programs.
- Understanding of the basic characteristics of electric vehicles and the operation of an electric vehicle.
- Understanding of the operating costs of electric vehicles.
- Interest in purchasing electric vehicles.

18 Kenneth S. Kurani , Nicolette Caperello, and Jennifer TyreeHageman, New car buyers' valuation of zero-emission vehicles: California (California Air Resources Board, 2016). <https://www.arb.ca.gov/research/apr/past/12-332.pdf>

19 Lingzhi Jin and Peter Slowik, *Literature review of electric vehicle consumer awareness and outreach* (ICCT: Washington, DC, 2017), <https://theicct.org/publications/literature-review-electric-vehicle-consumer-awareness-and-outreach>



2.3 Develop a comprehensive electric vehicle policy package

A study that analyzed markets with consistently high electric vehicle sales concluded that a comprehensive policy package, including national- and regional-level policies, is necessary to launch the electric market.²⁰ For state governments, policy actions should be written into a strategic document, such as an “action plan” or “readiness plan,” and it should include multiple players.

First, the selected policy actions in the policy package should target the development objectives and opportunities identified in **Section 2.1** and address the market barriers identified in **Section 2.2**.

In crafting an initial package, the state should also tailor its choices to the local policy, economic, and fleet context. For example, areas with rugged geography would benefit from exempting electric vehicles from tunnel and ferry tolls, and areas with a large vehicle population and heavy congestion would benefit from giving special purchase or usage priority to electric vehicles. The goal is always to adopt policy actions that have the highest potential to benefit the local market. **Section 3** recommends a pool of 83 policy actions to address these five market barriers. States in India can choose from the list to form their electric vehicle policy packages.

Second, with the initial policy package prepared, the state needs to evaluate its comprehensiveness and feasibility. Table 3 provides support for reviewing the policy

actions in a given package and assessing their combined comprehensiveness and feasibility. The table can also be used to examine an existing electric vehicle policy package if a state has already adopted one.

Table 3 asks users to fill in the rows with all policy actions in the proposed or existing policy package following the market barrier categorization in **Section 2.2**. For each action, the users can evaluate the following five parameters. Users will determine their own methodology for evaluation, but methods should be consistent across the table.

- **Fleet coverage:** Check the box if the policy action has direct impact on electric vehicle uptake in one or more types of fleet, including private, public, and commercial.
- **Vehicle coverage:** Check the box if the policy action has a direct impact on electric vehicle uptake in one or more vehicle segments, including two-wheelers, three-wheelers, passenger vehicles, commercial vehicles, and buses.
- **Cost:** Evaluate the potential cost to the state government of implementing the policy action during a certain period of time. Depending on the type of policy, the cost could come from direct financial incentives such as subsidies or tax benefits; government grants or funds; direct infrastructure investment; or administrative, staff, or operation expenses. Sometimes policy actions raise revenue for the state, as is the case with disincentives to conventional vehicle purchase.
- **Government role:** Check the box if the state government or agencies would be responsible for implementing the policy action, including providing funding, supervising implementation, and collaborating with other

²⁰ Dale Hall, Hongyang Cui, and Nic Lutsey, *Electric vehicle capitals: Accelerating the global transition to electric drive* (ICCT: Washington, DC, 2018), <https://www.theicct.org/publications/ev-capitals-of-the-world-2018>

stakeholders such as city-level government, industry, utilities, and financial institutions.

- **Policy priority:** Assign a priority tier for each policy action. This could be done using the criteria given in this

guidebook, or users could develop their own criteria to evaluate the immediacy required in implementation of a particular policy action.

Table 3. Example format for evaluating the comprehensiveness and feasibility of an electric vehicle policy package

	Fleet coverage ^a			Vehicle coverage ^b					Cost	Government role F- Funding S- Supervisory C- Collaborative			Policy priority
	Priv	Pub	Co	2-W	3-W	PV	CV	Bus		F	S	C	
Overcome Barrier 1													
Policy action 1													
Policy action 2													
.....													
Overcome Barrier 2													
Policy action 1													
Policy action 2													
.....													
.....													
.....													

^a Priv=private fleet; Pub=public fleet; Co=commercial fleet; ^b 2-W=two-wheeler; 3-W=three-wheeler; PV=passenger vehicle; CV=commercial vehicle

“Effective implementation of electric vehicle policy actions consists of three elements: initiation of the policy development process from the chief minister’s office, clearly delegated authority to agencies, and properly designed policies for smooth implementation and enforcement.”

To evaluate the comprehensiveness of the policy package, Table 3 can be used to answer the following questions:

- Does the designed policy package cover the priorities the state has identified?
 - » Go through “fleet coverage” and “vehicle coverage” in Table 3 to check whether there are policy actions that target the prioritized fleets or vehicles identified in Section 2.1.
- Does the package include policy actions to address all market barriers that the state has identified?
 - » Go through the policy actions list in Table 3 to check whether there are policy actions to address each market barrier identified in Section 2.2.
- Does the policy package have a good number of prioritized policies that need to be implemented in the near term?
 - » Check the “policy priority” in Table 3 to see whether there are tier 1 policy actions adopted to address each barrier and consider whether these could generate an immediate market reaction and momentum for electric vehicle uptake.

To evaluate the feasibility of the policy package, Table 3 can be used to answer the following questions:

- Does the government have enough resources to support the implementation of the policy package?
 - » Add up the cost to implement all policy actions and compare with the budget level that the government

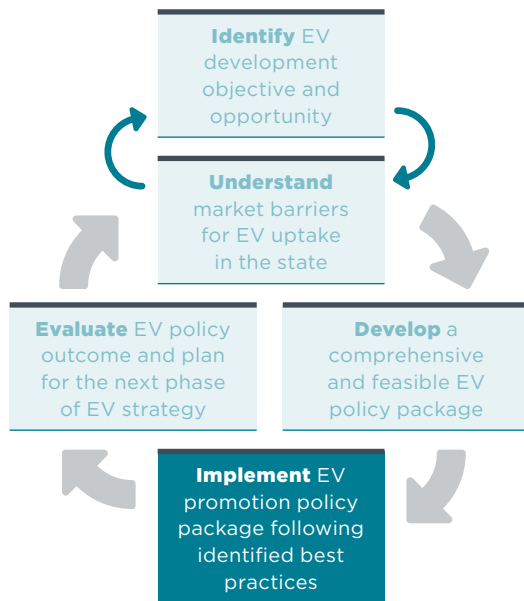
planned. Identify or create additional revenue sources if necessary.

- Does the government have enough authority to carry out its role?
 - » Go through “government role” and make sure the government or nodal agencies have the legal authority and proper level of expertise to implement their roles in all policy actions. Identify the areas for which there is a need to strengthen expertise, if any.

By comparing the policy package specifications with the state’s priorities and market barriers, the state has the opportunity to assess the scope of the plan and fill any gaps with additional policy actions.

By comparing the available government resources required to implement the policy package with available capacity, the state has the opportunity to assess the potential to take on more actions, generate more resources to implement the designed actions, or revise the policy actions. In the case of constraints on budget and resources, the government can consider shedding the tier 2 or tier 3 policies first.

Note that the evaluation needs to be carried out in consultation with multiple stakeholders, and the results will lead to back-and-forth adjustment of the electric vehicle policy package. This analysis will help the state to develop a comprehensive and reliable policy package and identify additional resources needed to effectively implement it.



2.4 Implement electric vehicle policies following best practices

Effective implementation of electric vehicle policy actions consists of three elements: initiation of the policy development process from the chief minister’s office, clearly delegated authority to agencies, and properly designed policies for smooth implementation and enforcement.

Because a policy package usually includes a variety of actions, the implementation of electric vehicle policies is usually assigned to a number of agencies. Besides being clear about which agencies are responsible and the related authority they hold, how the policy is designed is crucial. Precedents show that policy design can influence:

- **Expected outcomes.** The state should choose a combination of mandate- and incentive-based approaches. Mandate-based approaches are advantageous because they provide certainty around the outcome, encourage investors by providing strong signals, and provide flexibility to industry to develop plans to improve upon and achieve targets. However, it is incumbent upon the government to set targets and timelines that are ambitious yet achievable. If a target is set too low, then there is no incentive for companies to exceed it. At the same time, incentive-based approaches help businesses and individuals overcome cost barriers and accelerate the scaling-up of electric vehicle technology. With proper incentive frameworks and funding mechanisms, incentive-based approaches encourage industry competition and innovation. However, these can be costly for the government, and there is uncertainty about the outcomes.

- **The kinds of technologies that are encouraged.** Before 2017, China’s new-energy vehicle subsidy had a number of loopholes in design and enforcement, which led to fraud and inefficiency. China then revised the subsidy design in 2017. With stricter qualification requirements and subsidy accounting methods, the policy is now easier to implement in favor of electric vehicles with advanced technologies.²¹
- **The visibility of policy benefits.** Beginning in 2017, the U.S. state of Colorado modified its electric vehicle financial incentive from tax credits paid at the end of the year to subsidies paid upfront at the point of sale. This made the process simpler and more attractive to consumers. While there are other factors involved in purchasing decisions, electric vehicle sales in Colorado increased by about 50% from 2016 to 2017.²² In 2015, Connecticut introduced a point-of-sale rebate program requiring auto dealers to deduct the rebate amount from the vehicle price as a direct discount. The dealership was then expected to submit the rebate application for the consumer and would receive reimbursement within 10 days after approval. The dealerships are incentivized to go through the whole process by qualifying for a dealer incentive for every eligible vehicle they sell that receives the rebate.²³

21 Hongyang Cui, “Subsidy fraud leads to reforms for China’s EV market,” ICCT staff blog, May 30, 2017 <https://www.theicct.org/blogs/staff/subsidy-fraud-reforms-china-ev-market>

22 Peter Slowik and Nic Lutsey, *The continued transition to electric vehicles in U.S. cities* (ICCT: Washington, DC, 2018), <https://theicct.org/publications/continued-EV-transition-us-cities-2018>

23 Center for Sustainable Energy, “Evaluating the Connecticut Dealer Incentive for Electric Vehicle Sales,” (June 2017), <https://energycenter.org/sites/default/files/docs/nav/research/CT-Dealer-IncentiveEvaluation-CSE-2017.pdf>



Lithium operates electric taxis and buses for corporate clients in Bangalore and Gurgaon.

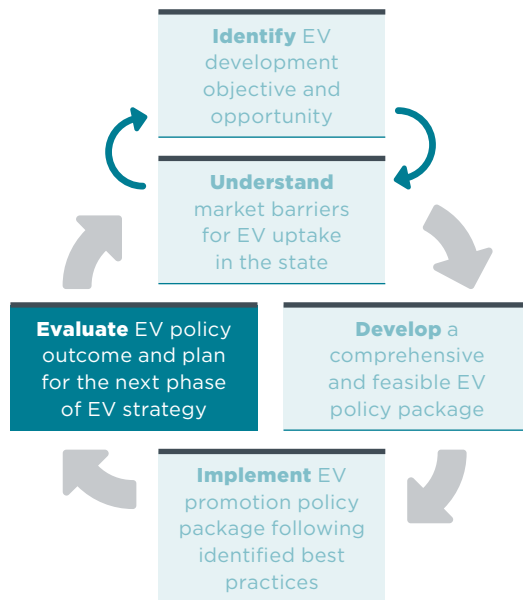
- **Social equity.** Beginning in 2016, California offered increased electric vehicle rebates for low- and moderate-income consumers. The data show a slight uptick in the number of rebates issued in disadvantaged communities from then on.²⁴
- **Enforcement.** Policies that provide priority parking or charging infrastructure at select parking spaces for electric vehicles are much less likely to be effective if there are no penalties such as fees, parking tickets, and towing to discourage combustion-engine vehicles from parking in spaces designated for electric vehicles.²⁵ A failure to enforce such policies would not encourage prospective electric vehicle buyers.
- **Market acceptance.** Events such as electric vehicle ride-and-drives and other opportunities to see, feel, and drive an electric vehicle are likely to be more effective than less-tangible information sources such as municipal websites.²⁶

A number of studies and reports examine the proper design and implementation of various electric vehicle policies. As a reference for policymakers, Annex III lists useful ICCT reviews of best practices and market-specific experiences globally.

24 Peter Slowik and Michael Nicholas, *Expanding access to electric mobility in the United States*, (ICCT: Washington, DC, 2017), <https://www.theicct.org/publications/expanding-access-to-US-electric-mobility>

25 Rick Wolbertus, Maarten Kroesen, Robert van den Hoed, and Caspar G. Chorus, "Policy effects on charging behaviour of electric vehicle owners and on purchase intentions of prospective owners: Natural and stated choice experiments" *Transportation Research Part D Transport and Environment*, 2018, 62, 283-297, <https://doi.org/10.1016/j.trd.2018.03.012>

26 Lingzhi Jin and Peter Slowik, *Literature review of electric vehicle consumer awareness and outreach* (ICCT: Washington, DC, 2017), <https://theicct.org/publications/literature-review-electric-vehicle-consumer-awareness-and-outreach>



2.5 Evaluate policy outcomes and plan for the next steps

While getting electric vehicles into the mainstream market is likely to take more than a decade in most jurisdictions, an electric vehicle policy package usually defines strategy for two to five years. A state government should strategically leave its policy document open for periodic adjustment and plan to evaluate how the market reacts to the policies. The California Zero Emission Vehicle Action Plan is revised every two to three years to keep up with changes in the market and emerging needs and to explore new opportunities. The plan, which details the actions taken, policy goals, and challenges to fulfilling the state’s ambition to get 1.5 million electric vehicles on the road, has been updated twice since it was released in 2013.

In evaluating its policies, the state can look at the uptake status of electric vehicle technologies and the progress made in addressing barriers. Other things to assess are how effectively the money has been spent, equity impacts, and changes in the public’s perception of electric vehicles. Surveys and interviews are important tools for evaluating consumer perception. The California Clean Vehicle Rebate Project carries out extensive consumer surveys and makes results available to the public. These surveys illuminate consumer demographics, factors that influence purchase-related decisions, dealership experiences, and awareness of important information channels. Interviews

and voluntary surveys during public events such as ride-and-drives also help to evaluate consumer perception. The Mass Clean Drive 2017, a state-sponsored test-drive campaign, provided policymakers with insights about how to change consumer receptivity to electric vehicles.

Additionally, a state could host a publicly available electric mobility dashboard that tracks the implementation of high-level policy actions. The dashboard could also include a compilation of leading and lagging indicators of progress made.

If the progress of electric vehicle development indicates a need for continued policy support, the state should go back to the beginning of the decision cycle. This means re-evaluating its electric vehicle development priorities and understanding the barriers for electric vehicle uptake that are present at the new stage. A new policy package could be created in response to lessons learned and the updated market context. Meanwhile, it should be noted that continuity of policy is also important. The significant electric vehicle uptake in Oslo, Norway, is an example of where success was partially attributed to long-term incentives, whereas the U.S. state of Georgia experienced a decline in electric vehicle sales after the expiration of a generous state purchase subsidy in 2014.²⁷ Thus, new and revised policies should reflect not only changes in technology and the market landscape but also maintain some continuity of incentives.

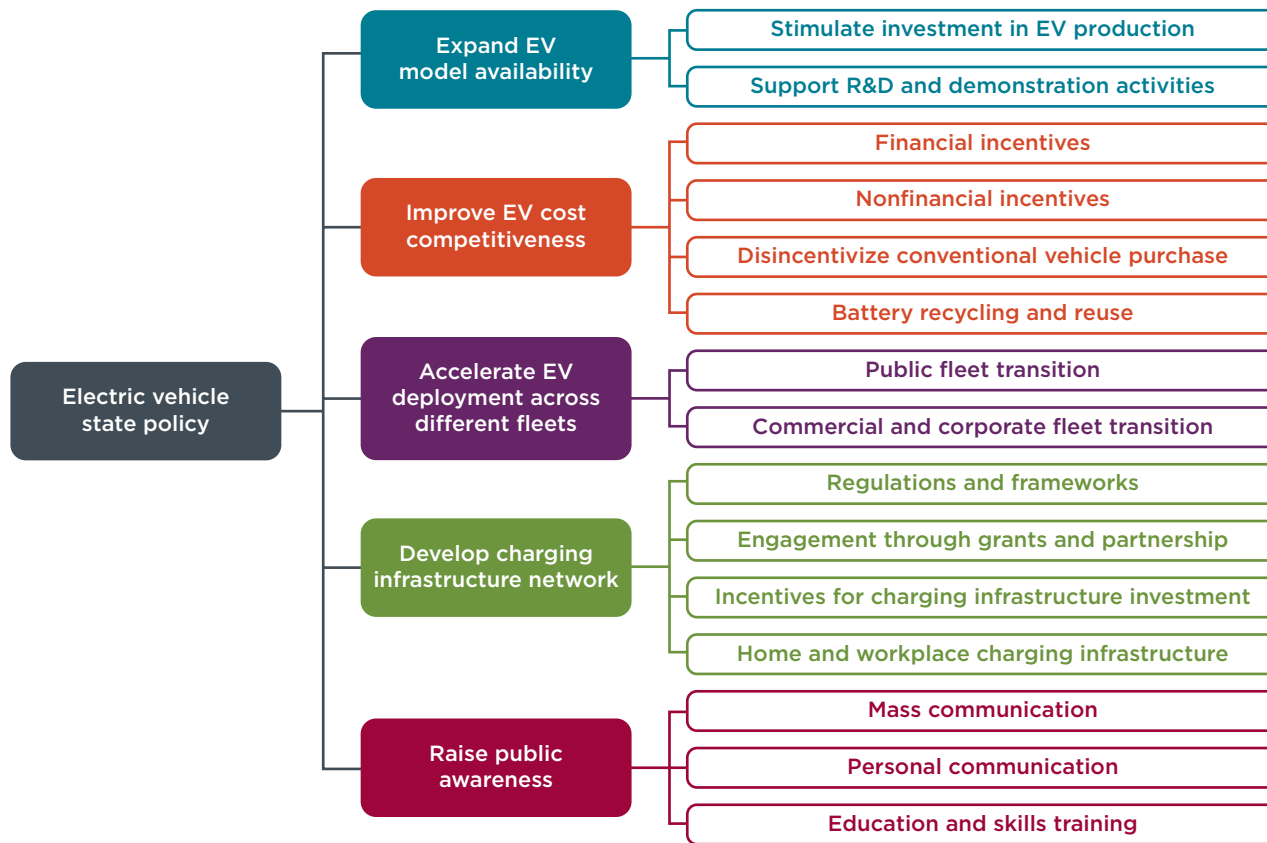
²⁷ Peter Slowik and Nic Lutsey, *Expanding the electric vehicles market in U.S. cities* (ICCT: Washington, DC, 2017), <https://www.theicct.org/publications/expanding-electric-vehicle-market-us-cities>

3 POLICY ACTIONS TO PROMOTE ELECTRIC VEHICLES

State governments around the world have taken a number of actions to address the barriers to electric vehicle market development and to accelerate the transition to electric mobility. This guidebook reviews electric vehicle policies in 32 states or cities around the world and selects 83 policy actions that can be applied to state-level governments in India. This policy list aims to provide

polymakers a reference for developing their own electric vehicle policy packages.

This guidebook identifies strategies to overcome each of the five barriers (Figure 3) and matches them with suitable policy actions from the list of 83. In the case of a policy action with the potential to help take on multiple barriers, that action is linked to the most relevant market barrier.



Additionally, we assign priority tiers to policy actions associated with overcoming each barrier. The rationale behind this is that, with limited resources, the state government has to prioritize items from the extensive list of policy options. In terms of implementation in India, Tier 1 policies have the highest priority and tier 3 policies the lowest. In considering the context, we looked at things like vehicle taxation level, infrastructure development status, and socio-economic scenarios, among other factors. In assigning tiers, we assumed that the policy actions are well-designed and aim to deliver maximum positive impact when implemented. Further, the criteria used to assess the priorities was different for different barriers. An explanation of the criteria used to generate each tier classification is included in Annex II.

We also present the relative frequency of policy adoption. Of the 83 policy actions, the most frequently adopted one appears in 23 out of 32 regional policies. The least frequently adopted policy action was implemented in one region. The policy list below uses four shaded circles ●●●● for adoption frequency above the third quartile, three shaded circles ●●●○ for adoption frequency between the second and third quartiles, two shaded

Figure 3. Strategies to address each electric vehicle market barrier



Ranjan Ray, an architect in Delhi, has put nearly 200,000 km on his E2Os.

circles ●●●● for adoption frequency between the first and second quartiles, and one shaded circle ●●●● for adoption frequency within first quartile.²⁸

The priority tiers and frequency statistics are tools to aid policymakers in considering the 83 policy actions in the context of available resources. The inherent value and effectiveness of policy actions assigned a lower priority tier or a lower frequency rating is in no way discounted. The priority tiers will be re-evaluated in future editions of the guidebook as we collect more comprehensive data from real-world practices in India.

Note that the following strategies are presented with corresponding policy actions. Each policy action consists of a brief description of the action and the role of the state government, an assigned priority tier, the frequency of adoption of the policy in the 32 regions chosen, and one or two examples of deployment of the policy.

²⁸ Out of the 32 regions, first quartile of policy frequency is 3, second quartile of policy frequency is 6, third quartile of policy frequency is 11.

3.1 OVERCOME BARRIER #1 – EXPAND EV MODEL AVAILABILITY

If not enough electric vehicle models are available for sale across different segments of the market with a broad spectrum of specifications and price points, the state can design policies to expand availability and spur manufacturer marketing. Policy actions include measures that stimulate automakers, or original equipment manufacturers (OEMs), to invest in electric vehicles through incentive or mandate programs and those that support and encourage research and development (Table 4).

Table 4 Summary of strategies to expand EV model availability

Strategies	Policy Actions	Priority
Stimulate investment in EV production	Mandate that OEMs produce and sell EVs ●●●○	Tier 1
	Provide financial incentives to set up manufacturing units ●●●○	Tier 2
	Support product/technology marketing ●○○○	Tier 2
Support research, development, and demonstration activities	Support development and demonstration of new technology ●●●●	Tier 1
	Create research hubs and incubation centers ●●●○	Tier 3
	Collaborate with universities ●●●○	Tier 3
	Support the organization of technical events for stakeholders ●●●○	Tier 3
	Create working groups and consortiums to further electric mobility ●○○○	Tier 3

Zero-emission vehicle mandates are at the heart of policies driving early uptake of electric vehicles in key regions.

STIMULATE INVESTMENT IN ELECTRIC VEHICLE PRODUCTION

Governments can stimulate electric vehicle production through mandates or incentive programs. The state pollution control boards (SPCBs) in India, under the Air Act of 1981, have the authority to regulate emissions and issue standards for all categories of automobiles. SPCBs could create mandatory quotas for ZEV sales and require vehicle manufacturers to comply with such requirements. *Mandates* usually assign a certain percentage credit requirement that automobile manufacturers need to fulfill through the sale of electric vehicles. The number of electric vehicle sales required for compliance depends on the total sales of the manufacturer in the state. Typically, credits earned per vehicle depend on the type of electric vehicle, its driving range, and the drivetrain type. Credit requirements become more stringent as the market matures. This policy action has proven to be effective in increasing investment and spurring research and development in electric vehicle technology.²⁹ *Incentive programs* can be designed in different forms to reduce manufacturing, operating, and administrative costs.

- **Mandate that manufacturers produce and sell electric vehicles:** Introduce a program that mandates production and sale of a certain number of electric vehicles, depending on manufacturers' share of conventional vehicle sales in the state. Usually, flexibility mechanisms such as banking and trading of

credits or exemptions for small-volume manufacturers are provided.

- » **California**³⁰ formulated a ZEV program mandating that manufacturers with volumes of more than 4,500 vehicles a year fulfill a credit requirement through sales of electric vehicles. The credit requirement is equal to a set percentage of the overall sales of the manufacturer, and it increases over time.
- **Provide financial incentives to set up manufacturing units:** Encourage businesses to set up electric vehicle and component manufacturing enterprises by providing financial incentives such as subsidies, low-interest or interest-free loans, reimbursement of SGST accrued to the state, stamp duty and land registration charge exemptions or discounts, discounts on power and water tariffs, subsidies for setting up effluent treatment plants, making land and ready-made infrastructure for manufacturing available, and providing benefits such as single-window clearance to streamline the application procedure for manufacturing projects.
- » **Karnataka**³¹ provides financial incentives including subsidies, low-interest loans, SGST reimbursement, discounts on registration charges, stamp duty exemption, and electricity tariff discounts. The state will also make industrial land available in clusters for creating electric vehicle manufacturing zones and provide infrastructure in the form of ready-made flatted factories (i.e., industrial buildings with more than one story) with power, water, and sewage

29 Scott Hardman, Alan Jenn, Jonn Axsen, George Beard, Erik Figenbaum, Sten Karlsson, Daniel Sperling, Frances Sprei, Tom Turrentine, and Bert Witkamp, *Driving the Market for Plug-in Vehicles: Understanding ZEV Mandates*, (UC Davis, International EV Policy Council, August 2018) <https://phev.ucdavis.edu/wp-content/uploads/zev-mandates-policy-guide.pdf>

30 California Air Resources Board, "The Zero Emission Vehicle (ZEV) Regulation-Fact Sheet," (2018), https://ww3.arb.ca.gov/msprog/zevprog/factsheets/zev_regulation_factsheet_082418.pdf

31 Government of Karnataka, "Karnataka electric vehicle and energy storage policy 2017."

treatment plants. This enables businesses to be set up through public-private partnerships (PPPs).

- **Support product and technology marketing:** Offer funding that businesses can use to promote their technology.
 - » **Quebec**³² provides equity funding for market innovative transportation electrification projects.

SUPPORT RESEARCH, DEVELOPMENT, AND DEMONSTRATION ACTIVITIES

Policy actions supporting research and development aim to encourage research by providing funding and subsidies to businesses and appropriate government agencies and by creating working groups and hosting technical events where stakeholders can discuss market barriers and ways to find innovative solutions. Policy actions supporting research, development, and demonstration can be viewed as supply-focused policies aimed at expanding industry growth and building the country's future research and industrial capabilities. These policies are essential in encouraging early adoption of electric vehicle technologies. Also, if properly structured, they could support market creation and cost reduction of segments that receive less attention globally and are more relevant to the Indian context.

- **Create research hubs and incubation centers:** Provide funding for the creation of government-owned research hubs and incubation centers dedicated to research and development of electric vehicle technology. Provide

³² Government of Québec, "Transportation Electrification Plan," (2015), <https://transportselectriques.gouv.qc.ca/wp-content/uploads/CIAO-050-LG2-MTQ-Rapport2016ENV2.1.pdf>

investment subsidies to private actors that set up research facilities and procure equipment for industrial research.

» **Andhra Pradesh**³³ has proposed to provide 5 billion rupees (\$73 million)³⁴ to create a research laboratory dedicated to electric vehicle and smart mobility research.

- **Support development and demonstration of new technology:** Provide funding and facilitate equity partnerships with private players to back development, demonstration, and marketing of innovative products and technology relating to electric vehicles.
 - » **New York**³⁵ provides financial and technical support and facilitates equity partnerships with individuals and private entities by awarding grants for developing new products in transportation electrification.
- **Collaborate with universities:** Provide grants and funding to universities to set up research centers to encourage innovation in electric vehicle technology. Facilitate collaborative research programs between universities and the electric vehicle industry. Facilitate collaboration with international universities to seek expertise in electric vehicle infrastructure development and gain exposure to cutting-edge electric vehicle technologies.

³³ Government of Andhra Pradesh, "Electric Mobility Policy 2018-23," (June 8, 2018), <http://www.cogitasia.com/wp-content/uploads/2019/02/ANDHRA-PRADESH-EV-Policy-Document.pdf>

³⁴ All currency conversions used in this guidebook are as of August 8, 2019.

³⁵ "Electric Vehicle Programs," New York State Energy Research and Development Authority, accessed February 1, 2019, <https://www.nyserda.ny.gov/Researchers-and-Policymakers/Electric-Vehicles/Electric-Vehicle-Programs>

- » **California**³⁶ supported the creation of the Plug-In Hybrid and Electric Vehicle Research Center at the University of California, Davis. The center collaborates closely with California utilities, automakers, and regulators on research aimed at developing a sustainable market for plug-in vehicles.
- **Support the organization of technical events for stakeholders:** Host events to bring together stakeholders such as manufacturers, government entities, research institutes, and utilities to enhance information exchange and cooperation, discuss market barriers, and identify potential solutions.
 - » **Zhejiang province in China**³⁷ hosts a Global Future Mobility Conference every year to promote exchanges and cooperation among stakeholders and encourage the electric vehicle market.
- **Create working groups and consortiums to further electric mobility:** Collaborate with industry veterans to encourage innovation in electric vehicle technology.
 - » **London**³⁸ supported the launch of the Electric Vehicle Energy Taskforce with members from industry and government to expand electric vehicle infrastructure in the city.
 - » **China EV100**,³⁹ a national electric vehicle consortium with representatives from ministry, industry, and academia, plays an important role in supporting China's electric vehicle industry.

36 “Plug-In Hybrid and Electric Vehicle Research Center–About,” UC Davis Institute of Transportation Studies, accessed February 1, 2019, <https://phev.ucdavis.edu/about/>

37 “Zhejiang’s 13th Five Year Development Plan on New Energy Vehicle Industry,” Zhejiang Development and Reform Commission, (2016). <http://m.evpartner.com/news/detail-21813.html>

38 “Electric vehicle energy taskforce,” Low Carbon Vehicle Partnership, accessed 28 March 2019 <https://www.lowcvp.org.uk/projects/electric-vehicle-energy-taskforce.htm>

39 “Annual EV100 Conference 2018,” Sustainable Transport in China, March 5, 2018 <https://www.sustainabletransport.org/archives/5640>

3.2 OVERCOME BARRIER #2 – IMPROVE EV COST COMPETITIVENESS

In response to the cost disadvantage of electric vehicles relative to gasoline- or diesel-powered vehicles, governments in dominant electric vehicle markets have taken measures to make them more cost-competitive and attractive to consumers. These measures include providing financial and nonfinancial incentives, disincentivizing conventional vehicles through taxation, and creating incentives for battery recycling and reuse (Table 5).

Table 5 Summary of strategies to improve EV cost competitiveness

Strategies	Policy Actions	Priority
Financial incentives	Provide purchase subsidies for electric vehicles ●●●●	Tier 1
	Provide exemptions and discounts on road tax, registration fees, and SGST ●●●●	Tier 1
	Exempt parking fees and road tolls ●●●●	Tier 1
	Subsidize and regulate fees for electric vehicle charging ●●●●	Tier 1
	Offer vehicle replacement subsidies ●●●●	Tier 1
	Offer low-interest or interest-free loans ●●●●	Tier 1
	Offer vehicle usage subsidies ●●●●	Tier 1
	Initiate time-of-use tariffs ●●●●	Tier 2
	Introduce congestion pricing ●●●●	Tier 2
	Provide discounts on vehicle insurance and SGST exemptions on insurance premiums ●●●●	Tier 2
	Promote V2G integration ●●●●	Tier 3
Nonfinancial incentives	Provide designated parking ●●●●	Tier 1
	Establish low/zero emission zones ●●●●	Tier 1
	Provide registration and license benefits ●●●●	Tier 1
	Exempt from road access restrictions ●●●●	Tier 2
	Provide preferential lane access ●●●●	Tier 2
	Exempt from pollution under control checks ●●●●	Tier 3
Disincentivize conventional vehicle purchase	Introduce fossil fuel tax/carbon tax to fund EV initiatives ●●●●	Tier 1
	Increase road tax and registration fee for conventional vehicles ●●●●	Tier 1
	Levy parking surcharges ●●●●	Tier 2
Battery recycling and reuse	Incentivize end-of-life recycling ●●●●	Tier 2
	Commercialize battery second-life ●●●●	Tier 3

FINANCIAL INCENTIVES

Financial incentives provide direct monetary benefit to consumers. The monetary benefits are granted in several ways. Some are aimed at reducing upfront purchase costs, and others are aimed at reducing operating costs.

- **Provide retail purchase subsidies for electric vehicles:** The Indian central government scheme FAME provides subsidies for two-wheelers, three-wheelers, light commercial vehicles, and buses at the national level. A state-level purchase subsidy would further bring down the upfront cost of electric vehicles. Providing a purchase subsidy to the consumer directly or through vendors or manufacturers as a discount at the time of purchase can maximize the impact of the subsidy on the consumer's purchase decision. Car leasing companies could be required to pass on the benefits of subsidies to the lessees in the form of reduced monthly payments. In some schemes, the subsidy amount is derived from electric vehicle specifications like driving range, maximum speed, energy efficiency, and rated power. Electric vehicles with better performance parameters can be granted higher subsidies. There are also subsidy schemes designed to provide support for lower-income consumers. These include setting income limits for buyers to qualify or capping the price of vehicles that qualify to avoid subsidizing luxury electric vehicles. Such schemes promote equity in electric vehicle adoption.

» **Connecticut**⁴⁰ offers rebates at the point of sale of as much as \$5,000 for the purchase or lease of electric vehicles, depending on the vehicle's electric range.

- **Provide exemptions and discounts on road tax, registration fees, and SGST:** Road tax and vehicle registration fees are levied by the state at the time of purchase or charged as annual fees. SGST is charged at the time of purchase of any good. SGST can be exempted if vehicles are manufactured and sold within the same state. State governments can incentivize electric vehicle purchase by exempting or providing discounts for electric vehicles.

» **Copenhagen**⁴¹ slashes the registration tax to 40% on electric vehicles from 150% on conventional vehicles.

- **Exempt parking fees and road tolls:** Work with city and municipal authorities to provide discounts and exemptions on parking fees and road tolls for electric vehicles.

» **Oslo**⁴² provides free street parking as well as exemptions from road tolls for electric vehicles. For conventional vehicles, the municipal parking charges could be as much as 59 Norwegian kroner (\$7) an hour and road tolls can be as much as 55 kroner (\$6.30).

- **Subsidize tariff for electric vehicle charging:** Offer subsidized charging for public charging infrastructure

40 Center for Sustainable Energy, "Evaluating the Connecticut Dealer Incentive for Electric Vehicle Sales," (June 2017), <https://energycenter.org/sites/default/files/docs/nav/research/CT-Dealer-IncentiveEvaluation-CSE-2017.pdf>

41 "Denmark-Incentives," European Alternative Fuels Observatory, accessed February 1, 2019, <https://www.eafo.eu/countries/denmark/1730/incentives>

42 Eltis, "Oslo: electric vehicle capital of the world," (December 5, 2014), <http://www.eltis.org/discover/case-studies/oslo-electric-vehicle-capital-world-norway>

owned by city/municipality/utility and regulate tariffs for privately owned charging stations.

- » **Glasgow**⁴³ provided free charging at public charging stations owned by the Glasgow City Council for a period of five years, from 2011 to 2016.
- **Offer vehicle replacement subsidy:** To encourage the early retirement of heavily polluting conventional vehicles and the transition to electric vehicles, offer additional subsidies to consumers. The state could mandate that the subsidy be used only toward the purchase of a new electric vehicle.
 - » **Delhi**⁴⁴ has proposed a scrapping and deregistration incentive of 15,000 rupees (\$211) for two-wheelers. The incentive can be used only as an additional incentive toward the purchase of an electric vehicle in the same financial year as the year of issuance of the deregistration certificate.
- **Offer low-interest or interest-free loans:** Work with financial institutions to introduce new schemes offering cheaper credit to finance electric vehicle purchases. Preferential loans can target various strata of consumers such as commercial electric vehicle buyers, consumers belonging to lower-income groups, corporate fleet owners, or private consumers.
 - » **Scotland**⁴⁵ provides interest-free loans of as much as £35,000 (\$46,000) for private consumers as well as up to £120,000 (\$148,000) for businesses.

43 “Electric Vehicles,” Glasgow City Council, accessed February 1, 2019, <https://glasgow.gov.uk/article/24595/Charge-Place-Glasgow-Frequently-Asked-Questions>

44 Government of NCT Delhi, “Draft Delhi Electric Vehicle Policy 2018.”

45 “Electric Vehicle Loan,” Energy Saving Trust, accessed February 1, 2019, <https://www.energysavingtrust.org.uk/scotland/grants-loans/electric-vehicle-loan>

The scheme is funded by Transport Scotland, a government organization.

- **Offer vehicle usage subsidies:** Provide a fixed amount of subsidy to customers owning electric vehicles. Requiring some proof of usage, such as odometer reading, would make the subsidy more effective.
 - » **Shenzhen**⁴⁶ provides a one-time vehicle usage subsidy equal to 10,000–20,000 yuan (\$1,453–\$2,907) depending on type of electric vehicle and driving range.
- **Initiate time-of-use tariff:** Introduce time-of-use tariffs or dynamic tariffs to lower electricity prices during times of the day when demand is typically lower. In addition to reducing the cost of operating electric vehicles for those who charge when prices are lower, time-of-use tariffs also help in effectively shaping the load profiles of electric vehicle charging stations and the grid in general.
 - » **The California Public Utilities Commission**⁴⁷ directed utilities in the state to introduce time-of-use tariffs. The tariff implemented by Pacific Gas & Electric (PG&E) is dynamic and varies throughout the day, designating 2 p.m.–9 p.m. for peak rates, 7 a.m.–2 p.m. for partial-peak rates, and other hours as off-peak. The difference between peak and off-peak pricing is more than 250%, and between partial-peak and off-peak, around 150%.
- **Introduce congestion pricing:** A congestion price is a fee charged for using certain roads to reduce

46 Hui He, Hongyang Cui, Lingzhi Jin, and Huang Zhou (2018). *Assessment of electric car promotion policies in Chinese cities* (ICCT: Washington, DC, 2018), <https://theicct.org/publications/assessment-electric-car-promotion-policies-chinese-cities>

47 “TOU Rates,” California Public Utilities Commission, accessed February 1, 2019, <http://www.cpuc.ca.gov/General.aspx?id=12194>

congestion. The price varies at different times of the day and is highest during the most congested times. Introducing congestion pricing in urban areas could reduce traffic during peak times and therefore reduce air pollution. Exempting electric vehicles from congestion fees could encourage electric vehicle uptake without jeopardizing pollution-control efforts.

» **Greater London**⁴⁸ exempts most electric vehicles from congestion charges levied for entering the city during weekdays. Conventional vehicles, on the other hand, are charged £11.50 (about \$15).

- **Provide discounts on insurance and SGST exemptions on insurance premiums:** Work with the state insurance

regulatory and development authority and car insurance companies to provide insurance discounts for individually purchased electric vehicles and bulk insurance at discounted rates for commercial electric vehicle fleet owners. Exemption on SGST levied on insurance premiums by the state government would further incentivize electric vehicle purchase.

» **Xi'an**,⁴⁹ the Chinese city, fully subsidizes the first annual premium of mandatory vehicle insurance for electric vehicles.

- **Promote vehicle-to-grid (V2G) integration:** V2G integration involves discharging an electric vehicle's battery into the grid to fulfill short-term energy demand, with payment of monetary benefits to the vehicle owner. Direct state utilities and the electricity regulation commission to introduce regulations and

48 "Congestion Charge," Transport for London, accessed February 1, 2019, <https://tfl.gov.uk/modes/driving/congestion-charge>

49 He et al. *Assessment of electric car promotion policies in Chinese cities*. <https://theicct.org/publications/assessment-electric-car-promotion-policies-chinese-cities>

tariffs concerned with V2G integration. Commission pilot projects demonstrating V2G integration. V2G gives consumers an added incentive to own an electric vehicle.

» **California**⁵⁰ created a V2G system that allows the Los Angeles Air Force Base to use its nontactical plug-in electric vehicle fleet as an ancillary services resource in the wholesale electricity market. The nonprofit California Independent System Operator, the California Energy Commission, and the California Public Utilities Commission worked with the U.S. Department of Defense and Southern California Edison to implement the program.

NONFINANCIAL INCENTIVES

Nonfinancial incentives provide consumers with benefits such as time savings and convenience. Although the incentives are nonmonetary, the benefits afforded through incentives can be quantified to find the equivalent monetary benefit.⁵¹

- **Provide designated parking:** Require designated parking spots for electric vehicles in municipally owned parking lots and at train stations, airports, and commercial parking areas in urban centers.

» **Sacramento**⁵² provides designated parking for electric vehicles in the California city's municipal garages.

50 "Los Angeles Air Force Base Vehicle-to-Grid Demonstration," Vehicle Grid Research at Berkeley Lab, accessed July 2, 2019, <https://vehicle-grid.lbl.gov/project/los-angeles-air-force-base-vehicle-grid>

51 Lingzhi Jin, Stephanie Searle, and Nic Lutsey, *Evaluation of state-level U.S. electric vehicle incentives* (ICCT: Washington, DC, 2014), https://www.theicct.org/sites/default/files/publications/ICCT_state-EV_incentives_20141030.pdf

52 "Electric Vehicle Parking," City of Sacramento, accessed February 1, 2019, <https://www.cityofsacramento.org/Public-Works/Parking-Services/Discount-Programs/Electric-Vehicle>

Parked vehicles can plug in at no additional cost apart from parking rates, and the city provides monthly electric vehicle parking permits at a discounted price.

- **Establish low/zero emission zones:** Create zones where access is restricted only to electric vehicles and vehicles conforming to stringent emission standards. Other vehicles could enter the zone after paying certain fees.
 - » **Paris**⁵³ has a low-emission zone/environmental zone that exempts electric vehicles, light-duty gasoline vehicles conforming to Euro 2 and diesel vehicles meeting Euro 3 and above, and heavy-duty vehicles conforming to Euro IV and above.
- **Provide registration and license benefits:** Exempt electric vehicles from the restricted vehicle registration system for conventional vehicles. Allocate a separate queue at registration for electric vehicle owners to shorten wait time. Create a distinction between the provision of a license for commercial electric vehicle drivers and conventional vehicle drivers, with reduced waiting time and increased periods of license validity for electric vehicle drivers. Empower individual regional transport offices to cap or freeze the registration numbers for internal combustion-powered vehicles.
 - » **Shanghai**⁵⁴ gives preference to electric vehicles for registration and license plates. To reduce road congestion, Shanghai imposes an upper limit on new conventional-fuel vehicle registrations every year, and license plates are given out through auction by paying a fee. The average auction price in 2015 was 80,686

53 “Environmental zone ZPA Paris (Greater Paris) – France,” Crit’Air, accessed February 1, 2019 <https://www.crit-air.fr/nc/en/information-about-the-critair-vignette/french-environmental-zones-zcr/paris-zone-zpa.html>

54 He et al., *Assessment of electric car promotion policies in Chinese cities*.

yuan (\$11,730). There is no cap on new electric vehicle registrations. Electric vehicles are allowed to bypass the auction and obtain a license plate free.

- **Provide preferential lane access:** Designate bus lanes and lanes for high-occupancy vehicles on state highways and city roads. Providing electric vehicles with access to these lanes would make them more desirable to consumers.
 - » **Hawaii**⁵⁵ provides electric vehicles with access to bus lanes and high-occupancy vehicle lanes.
- **Exempt from road access restrictions:** Such restrictions are deployed to reduce vehicle emissions or prevent congestion on roads.
 - » **Beijing**⁵⁶ provides electric vehicles full road access while conventional vehicles are subject to traffic restrictions. Conventional private cars are allowed on the roads for four of the five weekdays. During times of severe air pollution, only half of conventional private cars are allowed to drive, depending on the last digit of the license plate number.
- **Exempt from pollution under control (PUC) checks:** Exempt pure battery electric vehicles from PUC checks and displaying such labels. Allow plug-in hybrid vehicles to be tested less frequently for PUC purposes. Issue green background license plates to ZEVs to make it easy to verify PUC exemption eligibility.
 - » **Washington**⁵⁷ exempts electric vehicles from state emission inspection.

55 “Hawaii Laws and Incentives,” Alternate Fuels Data Center, accessed February 1, 2019, https://afdc.energy.gov/laws/state_summary?state=HI

56 He et al., *Assessment of electric car promotion policies in Chinese cities*.

57 “Washington Laws and Incentives,” Alternate Fuels Data Center, accessed February 1, 2019, https://afdc.energy.gov/laws/state_summary?state=WA

DISINCENTIVIZING CONVENTIONAL VEHICLE PURCHASE

- **Introduce fossil fuel or carbon tax:** Add a fossil fuel tax or carbon tax to the sale of diesel or gasoline fuel to disincentivize purchase of conventional vehicles. The proceeds could help fund the state’s electric vehicle initiatives.
 - » **Delhi**⁵⁸ has proposed to enact a pollution tax on diesel fuel. The funds collected would be allocated to the state EV fund.
- **Increase road tax and registration fees for conventional vehicles:** Alternatively, apply an additional fee on the purchase of conventional vehicles to reduce demand.
 - » **Delhi**⁵⁹ has proposed a higher road tax for diesel and gasoline vehicles.
- **Levy parking surcharges:** Charge an additional fee for parking conventional vehicles in public parking facilities.
 - » **Delhi**⁶⁰ has proposed a parking surcharge for conventional vehicles in public and on-street facilities.

BATTERY RECYCLING AND REUSE

Batteries used in electric vehicles contain expensive materials that are also toxic. Recycling batteries can recover expensive materials while avoiding the environmental cost of disposing of hazardous materials. Electric vehicle batteries at the end of their service life retain 70%–80% of their initial capacity. Used batteries

can be repurposed and reused in stationary storage applications. The reuse of batteries helps to reduce the lifecycle cost of batteries, lowering the cost of electric vehicles and making them more cost-competitive.

- **Incentivize end-of-life battery recycling:** Incentives can take the form of investment subsidies or be based on the remaining capacity of end-of-life batteries purchased for recycling.
 - » **Shenzhen**⁶¹ subsidizes electric vehicle manufacturers or their wholly owned subsidiaries for every battery recycled with 10 yuan (\$1.45) per kilowatt hour (kWh) of battery capacity.
- **Commercialize battery second life:** Collaborate with private players, OEMs and battery manufacturers in developing pilot projects for second-life commercialization. Provide financial incentives to projects demonstrating promising efforts.
 - » **California**⁶² supported a second-life commercialization pilot project by EVgo, a private charging station network, and automobile manufacturer BMW. The project demonstrated a grid-tied public fast-charging system using second-life batteries that helps in insulating the grid from sudden spikes in demand and keeps fast charging affordable.

58 Government of NCT Delhi, “Draft Delhi Electric Vehicle Policy 2018.”

59 Ibid.

60 Ibid.

61 He et al., *Assessment of electric car promotion policies in Chinese cities.*

62 “EVgo Announces Grid-Tied Public Fast Charging System With Second-Life Batteries,” PR Newswire, July 10, 2018, <https://www.prnewswire.com/news-releases/evgo-announces-nations-first-grid-tied-public-fast-charging-system-with-second-life-batteries-300678315.html>

3.3 OVERCOME BARRIER #3 – ACCELERATE EV DEPLOYMENT ACROSS DIFFERENT FLEETS

Fleet transition requires extensive stakeholder cooperation, especially for commercial and corporate-owned fleets. The state government could facilitate electric vehicle procurement by fleets through mandatory transition requirements or by taking market-driven approaches to incentivizing fleet transition (Table 6).

Table 6 Summary of strategies to accelerate EV development across different fleets

Strategies	Policy Actions	Priority
Public fleet transition	Mandate electric vehicle purchase ●●●●	Tier 1
	Mandate phased conversion ●●●○	Tier 1
	Develop government procurement guidelines ●●●●	Tier 2
	Create detailed public fleet operation plans ●●●●	Tier 2
Commercial and corporate fleet transition	Mandate new/upgrade purchase and phased conversion ●●●●	Tier 1
	Provide financing schemes targeting commercial vehicle/fleet owners ●●●●	Tier 1
	Facilitate electric vehicle ride hailing/car sharing programs ●●●●	Tier 1
	Exempt permit fee ●○○○	Tier 1
	Relax permit requirement for commercial electric vehicles ●○○○	Tier 1
	Implement user-incentive schemes for ride sharing ●○○○	Tier 1
	Introduce fleet-based mandates for commercial fleets ●○○○	Tier 1
	Encourage data sharing and interoperability ●●●○	Tier 2
	Provide pick-up benefits ●○○○	Tier 2
	Coordinate financing of operations ●○○○	Tier 2
	Facilitate covenants with business owners ●○○○	Tier 2
	Allocate corporate social responsibility (CSR) spending on fleet electrification ●●●○	Tier 2
Facilitate electric retrofit ●●●○	Tier 3	

PUBLIC FLEET TRANSITION

Electrification of public fleets can be pushed through mandates requiring that new purchases be electric vehicles or by converting existing conventional fleets to electric power. In all cases, it is important to provide the human resources—the employees and drivers of the vehicles—with proper training to operate the electric vehicles safely and correctly.

- **Mandate electric vehicle purchase:** Mandate that all new fleet procurement be electric vehicles. This could be applicable to all government-owned fleets, including buses.
 - » **Guangdong Province**⁶³ requires that all new buses purchased from 2018 on must be battery-electric vehicles (BEVs) or fuel cell electric vehicles.
- **Mandate phased conversion:** Mandate that state and local agencies convert a certain percentage of their fleets to electric power within a specified period of time.
 - » **Shenzhen**⁶⁴ required all buses to be electrified by October 2017.
- **Develop government procurement guidelines:** Establish standardized guidelines to streamline the electric vehicle procurement process and facilitate government purchases.

63 Guangdong Provincial People's Government, "Opinions of the People's Government of Guangdong Province on Accelerating the Innovation and Development of New Energy Automobile Industry [Yuefu [2018] No. 46]" (June 6, 2018), http://zwgk.gd.gov.cn/006939748/201806/t20180613_769686.html

64 http://jtys.sz.gov.cn/zwgk/jtzy/gzdt/gjdt_80994/201712/t20171228_10630454.htm

» **Oslo**⁶⁵ mandates electric vehicle purchases for the city fleet under a procurement strategy that serves as a steering document for vehicle acquisitions. Additionally, the city signed a framework agreement to transform its fleet by acquiring ZEVs.

- **Create detailed public fleet operation plans:** Include route planning and service rationalization plans for the electric public fleet, ensuring proper coordination between state authorities and operators and manufacturers.
 - » **California**⁶⁶ requires transit agencies to submit zero-emission bus rollout plans that demonstrate purchase and infrastructure buildout programs, associated financial planning, and workforce training.

COMMERCIAL AND CORPORATE FLEET TRANSITION

Pushing the transition of commercial and corporate fleets increases electric vehicle uptake by familiarizing passengers with electric vehicle technology while achieving economies of scale as a result of buying in bulk. To accelerate the electrification of commercial and corporate fleets, reducing the cost of owning and operating such fleets, state governments can adopt additional regulatory measures, including mandatory and instructive measures.

65 Geir Rossebo, "Procurement transportation and emission footprint report," BuyZET (September 2017). <http://www.buyzet.eu/wp-content/uploads/2017/11/Oslo-BuyZET-Transportation-Mapping-Report.pdf>

66 "California ARB releases proposed Innovative Clean Transit (ICT) regulation; 100% ZEB purchasing by 2029," *Green Car Congress*, August 8, 2018, <https://www.greencarcongress.com/2018/08/20180808-arbict.html>

- **Mandate new/upgrade purchase and phased**

conversion: Require that new fleet procurement be electric vehicles or mandate conversion of commercial and corporate fleets to electric vehicles in a phased manner. In addition, mandate that old, scrapped, and condemned three- and four-wheelers and buses be replaced by new electric vehicles.

» **Shenzhen**⁶⁷ requires the replacement of all taxis with electric vehicles, supported by government subsidies.

- **Provide financing schemes targeting commercial**

vehicle and fleet owners: Introduce special subsidies, financing schemes with interest subventions or down payment subsidies, and low-interest loans in collaboration with state empaneled financial institutions for commercial vehicle owners or fleet companies. Special incentives for fleet companies should be contingent on verifiable evidence of high annual electric vehicle miles traveled, such as public data made available by the companies.

» **Delhi**⁶⁸ has proposed a hire-purchase scheme for e-rickshaw drivers through Delhi Financial Corp. Drivers provide 5% of the purchase price of the e-rickshaw as an initial deposit and pay the remainder along with interest at 5% over 36 months.

- **Facilitate ride-hailing and car-sharing programs:**

Collaborate with ride-sharing companies, app-based aggregators, and manufacturers to promote electric ride sharing.

» **Shanghai**⁶⁹ launched the EVCARD program, a membership-based, self-service, internet technology-

integrated car rental system, with a fleet made up solely of electric cars, in collaboration with electric car manufacturers BMW, Chery, and Roewe.

- **Exempt permit fees:** Exempt electric vehicles from permit charges to drive down the cost of operation and encourage business owners to choose electric vehicles. To operate vehicles with commercial intent within the state, a vehicle owner would need to obtain a permit from the state government that would be valid for a fixed duration, after which it could be renewed. The permit fee would be charged by the government at the time of issuance and at renewals.

» **Delhi**⁷⁰ has proposed to waive permit fees for electric auto rickshaws.

- **Relax permit requirement for commercial electric vehicles:** Offer an open permit, which provides flexibility to owners to use their commercial vehicles for different purposes, and a streamlined application process for commercial electric vehicles.⁷¹ Provide flexibility for passenger electric vehicles by removing the division between contract and shared permits. This would encourage ride-hailing and car-sharing businesses to invest in electric vehicles.

» **Delhi**⁷² has proposed open permits for electric three-wheelers. India's central government has also come out in support of open permits for electric vehicles.⁷³

67 He et al., *Assessment of electric car promotion policies in Chinese cities.*

68 Government of NCT Delhi, "Draft Delhi Electric Vehicle Policy 2018."

69 He et al., *Assessment of electric car promotion policies in Chinese cities.*

70 Government of NCT Delhi, "Draft Delhi Electric Vehicle Policy 2018."

71 Open permits provide flexibility to owners to use their commercial vehicles for different purposes. This policy is particularly useful for passenger carriers where permit requirements differ with minor difference in usage

72 Ibid.

73 "End of permit raj for electric, alternative-fuel vehicles," *The Economic Times*, September 6, 2018, <https://economictimes.indiatimes.com/news/economy/policy/end-of-permit-raj-for-electric-alternative-fuel-vehicles/articleshow/65711728.cms>

- **Implement user-incentive schemes for ride sharing:** Grant city governments the authority to initiate pricing schemes for transportation network companies with incentives for electric ride sharing.
 - » **Delhi**⁷⁴ has proposed to introduce a user-incentive scheme in which the state will reimburse customers a maximum of 20% of the trip cost for hailing an e-cab/e-auto ride through app-based aggregators.
- **Introduce fleet-based mandates for commercial fleets:** Mandates such as ZEV and CO₂ regulations could increase the electric vehicle share of commercial fleets. This would help to reduce emissions, incentivize electrification, and promote shared rides.
 - » **California**⁷⁵ has proposed the Clean Miles Standard and Incentive Program, which would enable state agencies to implement regulations for transportation network companies to electrify fleets and reduce emissions per passenger mile.
- **Encourage data sharing and interoperability:** Create a public database and implement frameworks and standards for data sharing and interoperability with support from the central government. In addition, require the collection and public sharing of data regarding electric vehicle miles by commercial businesses such as ride-hailing, car-sharing, e-delivery, and freight services and charging infrastructure usage by private operators. Such strategies would enable investors and stakeholders to bring about innovative electric vehicle ride-sharing business models and help in future policy design.
 - » **Hamburg**⁷⁶ in Germany set up seamless data sharing and partnering that enabled the Moovel app by Daimler. The app combines information about public transportation and ride-hailing/car-sharing services with a high proportion of electrified vehicles and helps users reserve, book, and pay for trips.
- **Provide pick-up benefits:** Designate separate zones with shorter wait times for passenger pick-up and drop-off by electric shared fleets at train stations, airports, and urban centers.
 - » **Stockholm**⁷⁷ grants preference to low-emission taxis—electric/hydrogen/natural gas powered—at Arlanda airport, giving them the shortest wait times for picking up passengers.
- **Coordinate financing of the operation:** Collaborate with local governments and transit agencies to implement financing mechanisms that ensure the seamless adoption of electric vehicles. Additionally, introduce incentive programs and support policies such as taxing conventional vehicles and fossil fuels, the proceeds from which could be used to fund incentive programs.
 - » **California**⁷⁸ requires that the Department of General Services coordinate with local governments to assess funding sources for ZEV procurement and supporting infrastructure.

74 Government of NCT Delhi, "Draft Delhi Electric Vehicle Policy 2018."

75 "Clean miles standard," California Air Resource Board, accessed February 22, 2019, <https://ww2.arb.ca.gov/index.php/our-work/programs/clean-miles-standard>

76 "Urban mobility: Hamburg and Daimler AG intensify partnership," Moovel, accessed February 1, 2019, https://www.moovel.com/en_us/news-resources/press/urban-mobility-hamburg-and-daimler-ag-intensify-their-partnership

77 "Making a green taxi fleet possible," Aviation Benefits Beyond Borders, accessed July 15, 2019 <https://aviationbenefits.org/case-studies/making-a-green-taxi-fleet-possible/>

78 Zero-Emission Vehicle Purchasing and Electric Vehicle Service Equipment Infrastructure Requirements https://www.dgs.ca.gov/-/media/Divisions/OSPPR/Memos/MM16_07.ashx?la=en&hash=7992AEC73614A488F3FBDD27818A42618DB8A458



Bounce electric two-wheeler user Aishwarya in Bangalore

- **Facilitate covenants with business owners:** Initiate agreements with mobility service providers, freight, delivery, e-commerce businesses, corporations, and governments under which businesses pledge to electrify fleets in return for benefits such as preferential treatment in bidding for government projects.
 - » **Amsterdam**⁷⁹ created the Clean Taxi for Amsterdam covenant under which all taxi companies agreed to electrify their fleets by 2025. In return, taxi companies are eligible for monetary incentives of €5,000 (\$5,600) for every electric taxi purchased and have access to fast-charging facilities. Until the entire fleet is converted, electric vehicles get priority at taxi stands.
- **Allocate corporate social responsibility (CSR) spending on fleet electrification:** Mandate use of a portion of CSR funds for fleet electrification and encourage businesses to add fleet electrification to their sustainability goals.
 - » **Telangana**⁸⁰ has proposed to allow CSR funds to go toward electrification of the employee commuting fleet.
- **Facilitate electric retrofit:** Encourage conversion of the existing fleet through electric retrofit and subsidize retrofit kits.
 - » **The U.S. District of Columbia**⁸¹ provides a rebate on equipment and labor costs for the conversion of conventional vehicles to electric vehicles.

79 Municipality of Amsterdam, “Clean Taxis for Amsterdam Covenant,” (February 2016), https://assets.amsterdam.nl/publish/pages/865246/convenant_schone_taxis_amsterdam.pdf

80 Government of Telangana, “Telangana electric vehicle policy - draft 27.09.2017.”

81 “District of Columbia Laws and Incentives,” Alternate Fuels Data Center, accessed February 1, 2019, https://afdc.energy.gov/laws/state_summary?state=DC

3.4 OVERCOME BARRIER #4 – DEVELOP CHARGING INFRASTRUCTURE NETWORK

Developing the charging infrastructure network would provide more charging options, enable electric vehicle drivers to take longer trips, and increase the attractiveness of owning an electric vehicle without a home charger. Because of the complexity of developing a comprehensive charging infrastructure network, it is important for the state government to focus its program on the form of charging infrastructure that meets a clear need.⁸² Many governments are promoting construction of public charging infrastructure through regulations and partnerships while also supporting the installation of home and workplace charging (Table 7).

Table 7 Summary of strategies to develop charging infrastructure network

Strategies	Policy Actions	Priority
Regulations and framework	Unify charger standards and interoperability ●●●○	Tier 1
	Streamline the permitting and inspection process ●●●○	Tier 1
	Amend building codes ●●●●	Tier 2
	Integrate electric mobility in zoning laws and land-use policies ●●●●	Tier 2
	Implement electric vehicle parking regulation ●●●○	Tier 2
	Establish payment and billing models ●●●○	Tier 2
Engagement through grants and partnerships	Fund and facilitate PPP platforms ●●●●	Tier 1
	Install fast-charging stations along highways ●●●○	Tier 1
	Authorize utilities to install charging stations in state-owned facilities ●●●○	Tier 1
	Install charging stations in public transit hubs, airports, and train stations ●●●○	Tier 1
	Install charging infrastructure for electric buses, electric taxis, and electric three-wheelers ●●●○	Tier 1
	Support grid modernization initiatives ●●●○	Tier 3
	Encourage demand management through the use of smart meters ●●●○	Tier 3
Incentives for charging infrastructure investment	Provide financial incentives to investors ●●●●	Tier 1
	Deploy public land for charging infrastructure and battery swapping stations ●●●○	Tier 1
Home and workplace charging infrastructure	Provide a home charger subsidy ●●●●	Tier 1
	Promote workplace charging infrastructure ●●●●	Tier 1
	Construct charging stations at government offices ●●●○	Tier 1
	Support curbside parking infrastructure ●●●○	Tier 1
	Promote awareness among multi-unit home dwellers and property owners ●●●○	Tier 2

⁸² Hall and Lutsey, *Emerging best practices for electric vehicle charging infrastructure*.

REGULATIONS AND FRAMEWORKS

Regulations are essential for systematic development of charging infrastructure. This includes unifying charger standards and payment requirements and effectively enforcing policies that benefit electric vehicle charging. Regulations are also effective in promoting investments in charging infrastructure from private-sector players, such as mandating that buildings to be ready for charging installation and streamlining permitting of electric vehicle supply equipment (EVSE).

- **Unify charger standards and interoperability:** Work with the central government on developing standards for charging infrastructure that support interoperability, including connectors and swappable batteries for physical plugs, back-end communications, and power supply standards.
 - » **Washington**⁸³ requires that all new fast chargers in the state be compatible with CHAdeMO (short for Charge de Move) and Combined Charging System (CCS) using SAE J1172 connectors so that the stations can cater to more electric vehicles.
- **Streamline the permitting and inspection process:** Direct cities and municipalities to develop standardized and streamlined EVSE permitting and inspection procedures. Consistent permit and inspection procedures across jurisdictions will encourage EVSE installations at homes and workplaces as well as investment by private developers. Requiring permits ensures that installations are safe and comply with

83 Washington State Department of Transportation, “Washington State Electric Vehicle Action Plan 2015–2020” (February 2015). https://www.wsdot.wa.gov/NR/rdonlyres/F65504FO-A721-44C4-9C91-15BA181E1948/0/Action_Plan_Fact_Sheet.pdf

code. Inspections are conducted once installations are complete to certify safety.

- » **California**⁸⁴ requires that cities and regional governments come up with readiness plans for electric vehicles that include providing opportunities to streamline the EVSE permitting and inspection process.
- **Amend building codes:** Require all new construction to be EVSE-ready so that all new residential, commercial, and industrial buildings are equipped to install charging stations. Amend building codes to ensure that appropriately sized electric panels and conduits are installed near parking spaces so that charging stations can be added to the buildings later.
 - » **Xi’an**⁸⁵ requires that 30% of spaces in the Chinese city’s new parking lots be EVSE ready.
- **Integrate electric mobility in zoning laws and land-use policies:** Such integration could encourage creating appropriate electric vehicle infrastructure in various land-use designations.
 - » **California**⁸⁶ requires that the state’s regions work together to reduce greenhouse gas (GHG) emissions from cars and light trucks through integration of the planning processes for transportation, land use, and housing.

84 California Office of the Governor, “2018 ZEV Action Plan: Priorities Update” (September 2018). <http://business.ca.gov/Portals/0/ZEV/2018-ZEV-Action-Plan-Priorities-Update.pdf>

85 Hui He, Lingzhi Jin, Hongyang Cui, and Huan Zhou, *Assessment of electric car promotion policies in Chinese cities*, (ICCT: Washington, DC, 2018), <https://www.theicct.org/publications/assessment-electric-car-promotion-policies-chinese-cities>

86 Sarah Mawhorter, Amy Martin, and Carol J. Galante, *California’s SB 375 and the Pursuit of Sustainable and Affordable Development*, (Terner Center: UC Berkeley, July 2018), http://ternercenter.berkeley.edu/uploads/SB375_July_2018_Final.pdf

- **Implement electric vehicle parking regulations:** Adopt regulations to enforce preferential electric vehicle parking. Assign responsible agencies to monitor and penalize the parking of non-electric vehicles or unconnected electric vehicles in parking spots designated for electric vehicles.
 - » **Illinois**⁸⁷ prohibits parking of unconnected electric vehicles and conventional vehicles in parking spots with charging facilities designated for electric vehicles.
- **Establish payment and billing models:** Work on developing interoperable billing and payment model frameworks with support from businesses and state distribution companies (DISCOMs) investing in charging infrastructure installations. Hassle-free payment across different charging stations through systems such as access cards would make electric vehicle use more attractive. Also, ensure open access for all public charging facilities, devoid of any subscription fee for access.
 - » **Quebec**⁸⁸ entered into an interoperability agreement with FLO, a private North American network of charging stations previously known as VERNetwork. Customers can use the same access card to pay at public charging stations as well as at the FLO network's charging stations.

87 "Legislation Reference – Reserved Parking for Plug-In Vehicle Charging" PlugInSites, accessed February 1, 2019, <https://pluginsites.org/plug-in-vehicle-parking-legislation-reference/>

88 "Interoperability of electric vehicle charging networks," AddEnergie, accessed February 1, 2019, <https://addenergietechnologies.com/en/interoperability-electric-vehicle-charging-networks/>

ENGAGEMENT THROUGH GRANTS AND PARTNERSHIPS

Even with grants to fund charging development, public charging networks often materialize through partnerships with cities, municipalities, utilities, manufacturers, and private-sector players. When there is a high volume of electric vehicle penetration, states need to get support from electric utilities to integrate these vehicles with the grid in ways that minimize the negative effects.⁸⁹ To spend grants smartly, the state can establish a platform for PPP, fund certain forms of charging infrastructure with a choice of most appropriate partner, and collaborate with electricity utilities on grid modernization.

- **Fund and facilitate PPP platforms:** Introduce and fund initiatives in partnership with cities, municipalities, state utilities, automobile manufacturers, and other private entities to facilitate a large-scale public charging infrastructure network within the state.
 - » **Quebec**⁹⁰ and province-owned utility Hydro-Quebec partner with various stakeholders including cities, municipalities, institutions, and businesses to expand the network of public charging stations in the province, known as the Electric Circuit network. The partnership is based on two business models: the 240-volt standard charging and 400-volt fast charging station business models. In the 240-volt model, the purchase and installation costs of charging equipment are borne by the partner, and the utility provides expertise in selecting the technology and overseeing

89 High volume of electric vehicle penetration can increase peak loads, over-stressing local distribution systems and increasing air emissions from electricity generation.

90 "Our Partners," The Electric Circuit, accessed February 1, 2019, <https://lecircuitelectrique.com/partenaires>

the rollouts. The revenue generated is received by the partner in this case. In the 400-volt business model, the utility bears the purchase and installation cost of the charging station at the partner’s establishment, and the revenue generated is received by the utility.

- **Install fast-charging stations along highways:** Priority should be on prominent, heavily traveled roads.

» **Quebec**⁹¹ partnered with automaker Nissan to develop 25 fast-charging stations along major highways and in urban centers.

- **Authorize utilities to install charging stations in state-owned facilities:** DISCOMs could win approval to build charging stations in public places such as government buildings, commercial centers, public parking areas, and tourist spots using ratepayer or government funds.

» **California**⁹² approved a plan by PG&E to operate the largest utility-sponsored electric vehicle charging program in the United States.

- **Install charging stations in public transit hubs, airports, and train stations:** Work with public enterprises such as road transport corporations and state utilities to deploy charging stations. These would provide charging facilities to commercial fleets such as taxis and three-wheelers catering to passengers’ first-mile and last-mile connectivity, and also to private transport via the hubs’ parking facilities.

91 Government of Québec, “Transportation Electrification Plan.”

92 Emma Foehringer Merchant, “PG&E Launches Country’s Largest Utility-Sponsored EV Charging Program,” *Greentech Media*, January 17, 2018, <https://www.greentechmedia.com/articles/read/pg-e-launches-country-s-largest-utility-sponsored-ev-charging-program#gs.Mnp5c10Y>

» **Los Angeles**⁹³ through the Metropolitan Transportation Authority installed charging stations at major public transit hubs with funding from the California Energy Commission. The stations were installed and operated in partnership with EV Connect, a private electric vehicle charging provider.

- **Install charging infrastructure for electric buses, taxis, and three-wheelers:** Partner with cities to add dedicated infrastructure at bus depots and taxi stands.

» **Shenzhen**⁹⁴ has built more than 500 bus charging stations and 8,000 charging poles to cater to electric buses and e-taxis.

- **Support grid modernization initiatives:** Encourage state utilities to invest in upgrading power networks. Support and collaborate with the central government on such projects.

» **New York**⁹⁵ launched the Reforming the Energy Vision initiative to make the grid smarter and more reliable and efficient.

- **Encourage demand management through the use of smart meters:** Provide incentives for utilities and DISCOMs to invest in smart meters to avoid grid overloads. Use of smart meters enables utilities to manage load resources remotely and automatically. It also provides customers with the flexibility to schedule charging during off-peak periods when rates are lowest.

93 Anna Chen, “Electric vehicle charging stations coming to Metro park and ride stations,” *TheSource*, January 2, 2013, <https://thesource.metro.net/2013/01/02/electric-vehicle-charging-stations-coming-to-metro-park-and-ride-stations/>

94 http://jtys.sz.gov.cn/zwgk/jtzx/gzdt/gjdt_80994/201712/t20171228_10630454.htm

95 “Reforming the Energy Vision,” New York State, accessed February 1, 2019, <https://rev.ny.gov/>

» **British Columbia**⁹⁶ through the province’s utility BC Hydro is working on the provincial government-funded EV Smart Infrastructure project. It supports mitigation of electric vehicle charging impacts on the electric grid using smart meter infrastructure.

INCENTIVES FOR CHARGING INFRASTRUCTURE INVESTMENT

An open market that promotes competition among charging providers will facilitate the early growth of infrastructure and help to identify leading business models.⁹⁷ The state can enact favorable policies to encourage different private entities to invest in the sector in addition to infrastructure directly deployed and funded by the government.

- **Provide financial incentives to investors:** Offer monetary benefits such as purchase subsidies, SGST reimbursement, and low-interest loans to private developers, commercial building owners, and private parking facilities, as well as to local governments and state entities. This is to encourage early deployment of charging infrastructure and battery swapping stations.
 - » **Maryland**⁹⁸ provides a rebate for 40% of EVSE purchase and installation costs to a maximum of \$5,000 for private investors and \$4,000 for state

96 “The British Columbia Electric Vehicle Smart Infrastructure Project,” Natural Resources Canada, accessed June 25, 2019, <https://www.nrcan.gc.ca/science-and-data/funding-partnerships/funding-opportunities/current-investments/british-columbia-electric-vehicle-smart-infrastructure-project/16387>.

97 Hall and Lutsey, *Emerging best practices for electric vehicle charging infrastructure*.

98 “Maryland Laws and Incentives,” Alternate Fuels Data Center, accessed February 1, 2019, https://afdc.energy.gov/laws/state_summary?state=MD.

and local government entities while **Nebraska**⁹⁹ offers low-cost loans to install EVSE through its Dollar and Energy Saving Loan program.

- **Allocate public land for charging infrastructure and battery swapping stations:** Public land could be made available rent-free or at a subsidized rate, or leases could be offered to private players for long time periods.
 - » **Stockholm**¹⁰⁰ provides public land rent-free for a certain number of years under specific service-level agreements with private energy technology companies and utilities.

HOME AND WORKPLACE CHARGING INFRASTRUCTURE

As the vast majority of charging events have been carried out with private charging infrastructure, states can refer to policy actions that promote the three charging options mentioned below. For people who live in a single-family home or who have dedicated parking spots, installation of Level 2 charging equipment with higher charging power than Level 1 can add to costs. For residents who do not have dedicated parking spots, there is a need for charging infrastructure in shared parking facilities or at curbside stations. In the absence of home charging facilities, workplace charging

99 “Nebraska Laws and Incentives,” Alternate Fuels Data Center, accessed February 1, 2019, https://afdc.energy.gov/laws/state_summary?state=NE.

100 City of Stockholm, “Summary of the City of Stockholm’s electric vehicle strategy,” http://urbact.eu/sites/default/files/import/Projects/EVUE/documents_media/Stockholm_s_EV_strategy_summary_Eng.pdf.

dedicated to employees can serve as the primary charging location for drivers.

- **Provide a home charger subsidy:** Offer financial incentives such as subsidies, SGST reimbursement, and low-interest loans to encourage homeowners, owners of apartment complexes, and residential townships to invest in EVSE installation.
 - » **British Columbia**¹⁰¹ provides 75% rebates for Level 2 charging stations, up to C\$4,500 (\$3,400) per station, in multi-unit residential buildings.
- **Promote workplace charging infrastructure:** Provide subsidies to businesses to install charging stations at workplaces for employees. The state could also incentivize businesses to offer a reduced charging fee or free charging for employees.
 - » **Massachusetts**¹⁰² through its Electric Vehicle Incentive Program provides 50% funding, up to \$25,000, for the hardware costs to employers that invest in Level 1 or Level 2 charging infrastructure.
- **Construct charging stations in government offices:** Mandate the installation of charging stations for employees in the parking lots of government offices.

101 Province of British Columbia, “Multi Unit Residential Building Charging Program: Phase 2 Application Guide” (March 27, 2017). <https://pluginbc.ca/wp/wp-content/uploads/2017/03/MURB-2.0-Program-Guide.pdf>

102 “Apply for MassEVIP Workplace Charging Incentives,” Commonwealth of Massachusetts, accessed February 1, 2019, <https://www.mass.gov/how-to/apply-for-massevip-workplace-charging-incentives>

» **Telangana**¹⁰³ has proposed requiring charging infrastructure for employees in all government offices.

- **Support curbside charging infrastructure:** Work with cities, municipalities, and state utilities to locate suitable spots and fund the installation of Level 2 charging on streets and curbs for apartment complexes where installations are not feasible.
 - » **London**¹⁰⁴ has invested £45 million (\$54 million) to install 1,500 street charging stations upon request for residents who have no access to off-street parking.
- **Promote awareness among multi-unit home dwellers and property owners:** Work with cities and municipalities to increase awareness among property owners and residents about the benefits of charging station installation and the incentives available.
 - » **California**¹⁰⁵ created the emPower the People program, which assists residents in advocating for charging infrastructure in multi-unit dwellings and provides materials to property owners regarding the benefits of installing charging stations in their buildings and how to reduce installation costs.

103 Government of Telangana, “Telangana electric vehicle policy – draft 27.09.2017”.

104 “1500 electric vehicle charging points to be installed across London,” Greater London Authority, August 2, 2017, <https://www.london.gov.uk/city-hall-blog/1500-electric-vehicle-charging-points-be-installed-across-london#>

105 Veloz, “emPower the People for Electric Mobility,” (2017), http://www.veloz.org/wp-content/uploads/2017/07/EMPOWER_final.pdf

3.5 OVERCOME BARRIER #5 – RAISE PUBLIC AWARENESS

To build a successful market for electric vehicles, it is necessary to provide relevant, timely, and clear information to potential buyers. Stakeholders in major electric vehicle markets have implemented strategies to address the lack of consumer awareness about electric vehicles.¹⁰⁶ States can refer to three categories of awareness-raising strategies: mass communication, personal communication, and education (Table 8).

Table 8 Summary of strategies to raise public awareness

Strategies	Policy Actions	Priority
Mass communication	Organize a general public outreach campaign ●●●●○	Tier 1
	Display consistent EV-related signage ●●●●○	Tier 1
	Develop public websites as a tool to propagate information ●●●●○	Tier 1
	Collaborate with the central government on national-level campaigns ●●●●○	Tier 1
	Highlight the electric vehicle fleet using labels ●●●●○	Tier 1
	Encourage promising stakeholders through awards and recognition ●●●●○	Tier 2
	Fund market research ●●●●○	Tier 3
Personal communication	Create targeted outreach campaigns ●●●●○	Tier 1
	Showcase ride-and-drive events ●●●●○	Tier 1
	Identify regions for electric vehicle demonstrations ●●●●○	Tier 2
	Introduce awareness activities for auto dealers ●●●●○	Tier 2
	Promote electric mobility in tourist destinations ●●●●○	Tier 2
Education and skill training	Develop an electric mobility vocational training program ●●●●○	Tier 2
	Introduce advanced degree and certificate programs ●●●●○	Tier 2
	Introduce electric mobility for children and youth ●●●●○	Tier 3
	Introduce EV driving schools ●●●●○	Tier 3

¹⁰⁶ Jin and Slowik, *Literature review of electric vehicle consumer awareness and outreach*.

MASS COMMUNICATION

Mass communication efforts include market research, general and targeted campaigns, awards, public websites, outreach campaigns, and exposing consumers to electric vehicle technology through the visibility of electric vehicle fleets, charging infrastructure, and signage. States can forge strategic alliances with nongovernmental organizations and commercial organizations such as manufacturers and fleet companies.

- **Organize general public outreach campaigns:**

Create campaigns to raise awareness among consumers about electric vehicle technology and incentive programs through print, video, radio, social media, and public events.

» **British Columbia**¹⁰⁷ launched the campaign Emotive—the Electric Vehicle Experience to raise the profile of electric cars and support market uptake in the province. The program is implemented through social media campaigns and public events such as ride-and-drive programs in partnership with local dealerships.

- **Display consistent signage:** Adopt consistent signage along highways and city roads to identify public charging infrastructure, designated electric vehicle parking, and restrictions related to charging.

» **Washington, Oregon, and California**¹⁰⁸ departments of transportation adopted a standardized symbol to identify publicly accessible electric vehicle charging stations along major roadways.

107 “The EVolution is here!” Emotive, accessed February 1, 2019, <https://www.emotivebc.ca/>

108 “Electric vehicle signs,” West Coast Green Highway, accessed February 1, 2019, <http://www.westcoastgreenhighway.com/evsigns.htm>

- **Develop public websites as a tool to propagate information:** Create a dedicated, easy-to-navigate website encompassing every aspect of electric vehicles such as available models, upfront costs, charging infrastructure locations, and battery technology. Include information on state incentives available for electric vehicles, charging infrastructure, and fleet owners as a tool to educate consumers and update information on a timely basis.

» **Oregon**¹⁰⁹ created the Go Electric Oregon EV education website to provide information tailored for Oregon consumers.

- **Collaborate with the central government on national-level campaigns:** Explore opportunities to create national-level electric vehicle education campaigns.

» **London**¹¹⁰ collaborated with the central government’s Go Ultra Low Cities program to promote electric vehicle awareness.

- **Highlight the electric vehicle fleet using special markings:** Put labels on electric vehicles, especially buses and vehicles in commercial fleets, to raise public awareness.

» **Arizona**¹¹¹ requires the Department of Motor Vehicles to provide owners of alternative-fuel vehicles stickers to distinguish them from conventional vehicles. The stickers come with benefits including access to the carpool lane.

109 Go Electric Oregon, accessed February 1, 2019, <https://goelectric.oregon.gov/>

110 “Go Ultra Low City Scheme,” London Councils, accessed February 1, 2019, <https://www.londoncouncils.gov.uk/our-key-themes/transport/roads/gulcs>

111 Arizona State Revised Statute § 28-2416, <https://www.azleg.gov/viewdocument/?docName=https://www.azleg.gov/ars/28/02416.htm>

- **Encourage leading stakeholders through awards and recognition:** These can motivate individuals, organizations, and businesses that play an important role in furthering electric mobility. Publicize the awards to stakeholders aware.
 - » **Bavaria**¹¹² in Germany grants awards to companies and organizations that pioneer in various fields of electric mobility. The award is known as eCarTec and is worth €60,000 (\$67,000).
- **Fund market research:** Collaborate with universities and research organizations to study consumer awareness of various aspects of electric vehicle technology and related policies. Market research is a precursor to any outreach campaign. It helps to identify target audiences and aids in designing campaigns. It is also important in monitoring and evaluating of the effectiveness of campaigns.
 - » **California**¹¹³ collaborates with the Center for Sustainable Energy, which manages the EV rebate program in California, to conduct yearly surveys of plug-in electric vehicle drivers in the state.

PERSONAL COMMUNICATION

Personal communication targets specific groups of potential buyers or stakeholders. It includes strategies such as targeted campaigns, electric vehicle demonstrations, ride-and-drive events, auto dealer

education, and tourist experiences. These strategies familiarize the audience with electric vehicles by providing first-hand experience.

- **Create targeted outreach campaigns:** Work with cities and municipalities to develop programs designed to educate a specific audience such as taxi owners, fleet companies, and three-wheeler owners about electric vehicle benefits and the incentive programs available.
 - » **Coventry**¹¹⁴ in the United Kingdom launched the Go Electric Taxi scheme to educate taxi owners about the benefits of electric vehicles with a two-week test-drive opportunity.
- **Showcase ride-and-drive events:** Conduct statewide events in collaboration with other stakeholders such as automobile manufacturers, nonprofit organizations, and cities and municipalities in which citizens can test-drive electric vehicles. Collaborate with state transport authorities to organize free electric bus riding events. Ride-and-drive events provide consumers with first-hand experience, which is among the most influential ways of raising awareness. Such events should also provide a platform for electric vehicle owners and users to share experiences.
 - » **California**¹¹⁵ municipalities, state agencies, and utilities collaborated with the nonprofit organizations Veloz and Charge Across Town to conduct a statewide ride-and-drive program, Best Drive Ever 2017. A

112 “eCartec Award 2011,” PresseBox May 16,2011, <https://www.pressebox.com/pressrelease/munichexpo-veranstaltungs-gmbh-muenchen/eCarTec-Award-2011/boxid/423797>

113 “EV Consumer Survey Dashboard,” California Clean Vehicle Rebate Project, accessed February 1, 2019, <https://cleanvehiclerebate.org/eng/survey-dashboard/ev>

114 “UK first as ‘Go Electric Taxi’ scheme is launched in Coventry, the home of the black cab,” Coventry City Council, September 5, 2018, http://www.coventry.gov.uk/news/article/2617/uk_first_as_go_electric_taxi_scheme_is_launched_in_coventry_the_home_of_the_black_cab

115 “Best Drive Ever,” Veloz, accessed February 1, 2019, <https://www.veloz.org/initiatives/best-drive-ever/>

survey conducted after the event indicated that on an average, 10% of the respondents purchased or leased an electric vehicle after their exposure to the ride and drive event.

- **Identify regions for electric vehicle demonstrations:**

This is meant to engage and mobilize local stakeholders. Such demonstration projects may include charging infrastructure deployment, fleet conversions, electric ride-sharing programs, ride-and-drive events, operation and maintenance centers for electric vehicles, and exhibitions for the public.

» **Quebec**¹¹⁶ funds the Montreal City Mobility demonstration project, which brings together private and public stakeholders to implement innovative technologies. This is a three-year project that entails acquisition of three electric buses that rely on conductive fast-charging technology.

- **Introduce awareness activities for auto dealers:**

Develop programs to train dealership salespeople about electric vehicles and encourage dealerships to make simple, consistent, and consumer-focused information on incentives available in showrooms. Dealerships play a significant role in marketing electric vehicles, making it essential to educate and motivate dealers and salespeople.

» **California**¹¹⁷ has developed educational videos for auto salespeople. The state also recognizes dealerships

116 “STM has successful first year with City Mobility,” Société de transport de Montréal, June 8, 2018, <http://www.stm.info/en/press/press-releases/2018/stm-has-successful-first-year-with-city-mobility>

117 “Governor’s Environmental and Economic Leadership Awards,” California Environment Protection Agency, accessed February 1, 2019, <https://calepa.ca.gov/Awards/GEELA/>

through the Governor’s Environmental and Economic Leadership Award ZEV dealer category. The award recognizes efforts by dealer groups to enhance and promote the sale of ZEVs.

- **Promote electric mobility in tourist destinations:**

Incorporating electric vehicles in the tourism industry can contribute to increasing consumer awareness and expanding the base of potential buyers, while reducing the local air pollution that results from tourist activity. This can be achieved by electrifying shuttles, promoting electric car rentals, installing charging station networks at tourist spots, providing relevant information regarding charging infrastructure, and promoting awareness through tourism websites. Policy actions concerned with fleet electrification and charging infrastructure were covered in previous sections.

» **Oregon**¹¹⁸ developed Oregon Electric Byways with an extensive charging infrastructure network along scenic routes and facilitated electric vehicle rentals for tourists through private-sector partnerships.

EDUCATION AND SKILLS TRAINING

Education would lead to lasting changes in consumers’ perspectives. A state can raise awareness through education and skills-development programs. Examples of education programs include youth education and academic programs that offer advanced degrees. Skills development can give those in the labor force the capacity to strengthen technology competence in electric mobility. States should support equipping the labor force with the

118 “Oregon Electric Byways,” Travel Oregon, accessed February 1, 2019, <https://traveloregon.com/things-to-do/trip-ideas/electric-vehicle-trips/oregon-electric-byways/>

skills to deal with the variety of needs posed by electric vehicle infrastructure, such as equipment manufacturing, repair, maintenance, and EVSE installations.

- **Develop an electric mobility vocational training program:** With industry partnerships, develop or provide funding to institutes to develop training programs for skills development in electric vehicle technology. Provide a fixed stipend to encourage students to participate in the training program.
 - » **Quebec**¹¹⁹ has developed an electric vehicle vocational training program for professionals through a publicly funded technical college.
- **Introduce electric mobility to children and youth starting at the elementary level:** In collaboration with cities, municipalities, and universities, initiate programs such as science fairs and tech festivals where students can get hands-on experience in projects related to electric vehicles. The introduction of electric mobility at the elementary and secondary levels of education would help facilitate awareness and encourage students to pursue careers in electric mobility. This would also help create awareness among parents about the advantages of electric vehicles.
 - » **Indiana**¹²⁰ has created the Indiana Advanced Electric Vehicle Training and Education Consortium to develop programs for K-12 students.

119 “Electric Vehicle Technology–ELC.1A,” Groupe Collegia, accessed February 1, 2019 <https://www.collegia.qc.ca/connec-te/>

120 James Caruthers, J. Dietz, Libby Pelter, Jie Chen, Glen Roberson, Paul McGinn, and Vinodegopal Kizhanipuram, “Indiana Advanced Electric Vehicle Training and Education Consortium (I-AEVtec) Technical Report,” Office of Scientific and Technical Information, U.S. Department of Energy, (2013). <https://www.osti.gov/servlets/purl/1097114>

- **Introduce advanced-degree and certificate programs:** Collaborate with state universities and the electric vehicle industry to develop bachelor’s, master’s, and certificate programs dedicated to electric vehicle technology.
 - » **Baden-Wuerttemberg**¹²¹ in Germany, in collaboration with the University of Stuttgart, developed a master’s degree in electric mobility.
- **Introduce electric vehicle driving schools:** Educating drivers about electric mobility is a great opportunity to spread awareness. Integrating driving instruction with electric mobility ensures that drivers are skilled enough to operate an electric vehicle. Direct cities and municipalities to work with driving schools and automobile manufacturers and dealerships to incorporate electric mobility into the driver-training process. Such driving schools could cover issues such as driving range, charging time, characteristics of acceleration and regenerative braking, and to be more conscious of pedestrians, who may not hear the silent powertrain of electric vehicles.
 - » **Stuttgart**¹²² has driving schools working with automobile manufacturer Daimler AG to train both new and experienced drivers to gain greater familiarity and comfort with electric vehicles.

121 State Agency for Electric Mobility and Fuel Cell Technology Baden-Württemberg, “Baden-Württemberg on Route to Electromobility,” Structure study BWe Mobil, (2011). https://www.emobil-sw.de/files/e-mobil/content/DE/Publikationen/PDF/e_mobil_structure_study_en.pdf

122 “Learning the future: Daimler introduces electric mobility in driving schools,” Daimler, (April 10, 2015), <https://media.daimler.com/marsMediaSite/en/instance/ko/Learning-the-future-Daimler-introduces-electric-mobility-in-driving-schools.xhtml?oid=9920100>

4 A CASE IN ACTION: ELECTRIC VEHICLE STRATEGY IN QUEBEC

This section uses the framework defined in this guidebook and the process detailed in **Section 2.3** to evaluate the existing electric vehicle strategy in the Canadian province Quebec. With 99% of its electricity coming from affordable, renewable hydropower, Quebec rolled out its electric vehicle policy primarily to curb GHG emissions. The goal is to use the clean electricity to power transportation, which accounts for 44.7% of GHG emissions in the province.

STEP 1: REVIEW ELECTRIC VEHICLE DEVELOPMENT PRIORITIES AND BARRIERS

Quebec's goal is to reach 100,000 electric vehicle registrations by 2020. When the planning process began in 2011, electric vehicles were only a small percentage of new sales, and Quebec was still at the early stage of electric vehicle market development. Quebec needed policy actions capable of addressing all five key market barriers and providing opportunities to develop the electric vehicle market across all vehicle types and fleets.

STEP 2: FORM AN INITIAL POLICY PACKAGE

Quebec's transport ministry unveiled its initial policy package, the Transportation Electrification Action Plan 2015–2020. It deploys 35 initiatives to promote electric transportation, develop the industry, and improve the environment. The action plan was developed by an alliance of provincial ministries and agencies involved in transportation electrification. Quebec also adopted the ZEV Act, similar to California's ZEV program, which

seeks to increase the availability of electric vehicles in the Quebec market.¹²³

STEP 3: EXAMINE THE INITIAL POLICY PACKAGE

With collaborative support from different ministries, the action plan covers a wide range of measures that promote electrification across different fleets:

- The province adopted a ZEV standard, which financially supports manufacturers in research and demonstration activities and incentivizes investment projects in Quebec.
- Quebec makes electric vehicles more affordable by providing rebates for two-wheelers and passenger cars, new and used.¹²⁴ There are additional benefits like high-occupancy vehicle lane access, toll exemptions and, in certain municipalities, free parking for electric vehicles.¹²⁵
- Quebec eases procurement of electric school buses, taxis, buses, and local government fleets through financial support.
- To improve the convenience of electric vehicle use, the province provides rebates for home and public chargers and funds for the installation of fast-charging networks. It also supports the expansion of public charging-station networks through partnerships with

123 "The zero-emission vehicle (ZEV) standard," Ministry of Sustainable Development, Environment and Fight Against Climate Change, accessed February 1, 2019, <http://www.environnement.gouv.qc.ca/changementsclimatiques/vze/index-en.htm>

124 "Branchez Vous: Choosing Your Plug-In Vehicle," Innovative Vehicle Institute, 2017. https://branchevous.org/wp-content/uploads/2017/01/brochure-bv2017_lowres_ang.pdf

125 Ibid.



Bengaluru's electric bus pilot in 2014.
(Ramesh NG/Flickr)

public and private utilities as well as other entities, including municipalities.¹²⁶

Table 9 provides a detailed overview of the electric vehicle development policies in Quebec. The cost of each policy action comes directly from the budget in the action plan document. We conducted our own evaluation of all other specifications. In general, Quebec implements a number of policies that are frequently adopted by other leading markets.

STEP 4: EVALUATE THE COMPREHENSIVENESS AND FEASIBILITY OF THE POLICY PACKAGE

- Does the designed policy package cover the priorities that the state has identified?
 - » In Quebec, electric vehicle policies have wide fleet and vehicle coverage across private, public, company vehicles, two-wheelers, passenger vehicles, commercial vehicles, and buses. All types of fleets and vehicles are equally eligible for most policies.
- Does the package include policy actions to address all of the market barriers that the state has identified?
 - » Quebec's electric vehicle program is designed to address all five barriers identified in this guidebook, with a special emphasis on the expansion of charging infrastructure. The policy actions also widely cover the sub-strategies for each barrier. The sub-strategies that are not addressed are: disincentivizing conventional vehicle purchase, battery recycling and reuse, and incentives for public charging infrastructure investors.

¹²⁶ "Electric Circuit: Over 800 Charging Stations in Five Years," Hydro Quebec, March 30, 2017, <http://news.hydroquebec.com/en/press-releases/1196/electric-circuit-over-800-charging-stations-in-five-years/>

Table 9 Details of EV development policy actions in Quebec

Policy actions	Fleet coverage ^a			Vehicle coverage ^b				Total cost in millions of C\$ (2015-2020)	Government role			Policy Priority
	Priv	Pub	Co	2-W	PV	CV	Bus		F- Funding	S- Supervisory	C- Collaborative	
Overcome Barrier 1												
Mandate manufacturers to produce EVs ●●●○	✓	✓	✓		✓	✓	✓	–		✓		Tier 1
Provide financial incentives to set up manufacturing units ●●●○	✓	✓	✓	✓	✓	✓	✓	30	✓	✓		Tier 2
Support product/technology marketing ●○○○	✓	✓	✓	✓	✓	✓	✓	4.75	✓	✓		Tier 2
Support development and demonstration of new technologies ●●●●	✓	✓	✓	✓	✓	✓	✓	81.5	✓	✓	✓	Tier 1
Support organization of technical events for stakeholders ●●○○	✓	✓	✓	✓	✓	✓	✓	0.6				Tier 3
Overcome Barrier 2												
Provide purchase subsidy for EVs ●●●●	✓	✓	✓	✓	✓	✓	✓	93	✓	✓		Tier 1
Exempt parking fee/toll ●●●●	✓	✓	✓		✓	✓		*		✓		Tier 1
Provide preferential lane access ●●●○	✓	✓	✓		✓	✓	✓	*		✓		
Overcome Barrier 3												
Mandate new/upgrade purchase ●●●●		✓	✓		✓		✓	45	✓	✓		Tier 1
Provide financing benefit targeting commercial vehicle/fleet owners ●●●●			✓		✓	✓	✓	19.1	✓	✓		Tier 1
Overcome Barrier 4												
Amend building code ●●●●	✓	✓	✓	✓	✓	✓	✓	–		✓		Tier 2
Implement EV parking regulation ●●○○	✓	✓	✓	✓	✓	✓	✓	–		✓		Tier 2
Integrate electric mobility in zoning laws and land use policies ●●●●	✓	✓	✓	✓	✓	✓	✓	–		✓		Tier 2
Establish payment/billing framework ●●○○	✓	✓	✓	✓	✓	✓	✓	–		✓	✓	Tier 2
Fund and facilitate PPP platform ●●●●	✓	✓	✓	✓	✓	✓	✓	3	✓	✓	✓	Tier 1
Install fast charging along highways ●●●●	✓	✓	✓	✓	✓	✓	✓	2.5	✓	✓	✓	Tier 1
Provide residential charger subsidy ●●●●	✓			✓	✓			5.4	✓	✓		Tier 1
Promote workplace charging ●●●●	✓	✓		✓	✓	✓		9	✓	✓		Tier 1
Construct charging in gov. offices ●●●○	✓	✓	✓	✓	✓	✓		5	✓	✓		Tier 1
Overcome Barrier 5												
Organize public outreach campaigns ●●●○	✓	✓	✓	✓	✓	✓	✓	8.6	✓	✓	✓	Tier 1
Identify regions for EV demonstrations ●●●●		✓					✓	11.9				Tier 1
Develop electric mobility vocational training program ●●●○								–				Tier 2
Introduce advanced degree program ●●○○	✓	✓	✓	✓	✓	✓	✓	–		✓	✓	Tier 2

^aPriv – private fleet; Pub – public fleet; Co – commercial fleet; ^b2-W – two-wheeler; 3-W – three-wheeler; PV – passenger vehicle; CV – commercial vehicle
 * The policy can be assigned tier 1 priority in Quebec’s context

- Does the policy package have a number of prioritized policies that need to be implemented in the near term?
 - » Quebec has tier 1 policies for all barriers it seeks to address. Out of 23 policy actions, Quebec has 14 tier 1 policies, eight tier 2 policies and one tier 3 policy. At least half of the policy actions in each barrier were of tier 1 priority.
- Does the government have enough resources to support the implementation of the policy package?
 - » A budget of C\$420 million was allocated to undertake the initiatives over the 2015-2020 period.¹²⁷ There is specific funding to finance individual policy actions.
- Does the government have enough authority to carry out its role?
 - » The government agencies in Quebec are expected to play a variety of roles in implementing and enforcing the policies. More investigation is needed to know whether the appropriate agencies have been assigned to carry out the activities.

STEP 5: REVISE THE POLICY PACKAGE TOWARD AN AGREEMENT AMONG STAKEHOLDERS

Based on the information in this guidebook, there are three areas on which Quebec could focus to enhance this policy package: (1) improve fiscal mechanisms to disincentivize conventional vehicle purchases, (2) establish battery recycling and reuse programs, and (3) incentivize charging infrastructure investment. However, an in-depth investigation of market reaction to different

¹²⁷ The policy can be assigned tier 1 priority in Quebec's context.

actions is needed before Quebec will be ready to revise its policy package.

In 2017, electric vehicles were 1.5% of total vehicle sales in Quebec.¹²⁸ As of December 2018, the province had almost 39,179 registered electric vehicles.¹²⁹ Electric vehicle sales rose from 7,200 in 2017 to 17,788¹³⁰ in 2018, an increase of 147%. More than 1,500 public charging stations and 125 fast-charging stations were installed in Quebec as of October 2018. Quebec's policy package is making a measurable impact on the electric vehicle market.

Quebec's efforts to promote electric vehicles will continue as the government has announced additional financial support for existing transportation electrification initiatives in its Sustainable Mobility Action Plan 2018–2023.¹³¹

Annex I provides three more examples of state-level electric vehicle deployment. These case studies are of Zhejiang in China, Baden-Wuerttemberg in Germany, and Oregon. They detail the motivations of those governments in promoting electric vehicles, their electric

¹²⁸ "Plug-in vehicle market share: Canada, 20th in the world, thanks to Quebec who could compete in the top 5," Branchez Vous, January 25, 2018, <https://branchezvous.org/en/plug-vehicle-market-share-canada-20th-world-thanks-quebec-compete-top-5/>

¹²⁹ "SAAQ-AVÉQ statistics on electromobility in Québec as of December 31, 2018," AVEQ, accessed March 26, 2019 <http://www.aveq.ca/actualiteacutes/statistiques-saaq-aveq-sur-lelectromobilite-au-quebec-en-date-du-31-decembre-2018-infographie>

¹³⁰ Ministère de l'Environnement et de la Lutte contre les changements climatiques, "Bilan Norme Véhicules zéro émission au 31 décembre 2018 [Standard zero-emission vehicles balance sheet as of December 31, 2018]," (February 2019). <http://environnement.gouv.qc.ca/changementsclimatiques/vze/bilan-norme-vze20181231.pdf>

¹³¹ Transporter Le Québec Vers La Modernité, "Plan d'action 2018-2023 [Action Plan of the Sustainable Mobility Policy - 2030]," (2018), https://www.transports.gouv.qc.ca/fr/ministere/role_ministere/DocumentsPMD/PMD-plan-action.pdf



Electric vehicles charging during
Ola's pilot project in Nagpur.

vehicle promotion goals, the responsible agency in charge of electric vehicle development, the highlights of electric vehicle policies, achievements of the programs, and future policy plans. These examples are expected to show the different pathways a state could take to achieve electric vehicle development targets and to inspire states to design and carry out plans to promote electric vehicles.

ANNEX I MORE EXAMPLES OF STATE-LEVEL ELECTRIC VEHICLE STRATEGIES

ZHEJIANG, CHINA

BADEN-WUERTTEMBERG, GERMANY

OREGON, UNITED STATES

ZHEJIANG, CHINA

Aiming to stimulate the auto industry, reduce oil consumption, improve local air quality, and realize sustainable development, Zhejiang province has been heavily promoting electric vehicles over the past decade.

In 2016, the Zhejiang Development and Reform Commission released Zhejiang's 13th Five-Year Development Plan for the New-Energy Vehicle Industry. The plan's purpose is to support the development of the electric vehicle industry within its jurisdiction from 2016 to 2020.¹³² A budget of 1.5 billion yuan (\$216 million) was planned to promote the deployment of electric vehicles over the five years.

Zhejiang's development plan not only develops the private-sector electric vehicle market but also takes fleets into consideration. Strong policy efforts are

made to electrify the bus, taxi, sanitation, tourist, airport, logistics, and car-sharing fleets in the province. The development plan mandates that at least 50% of new government vehicle purchases and at least 30% of new public service vehicle purchases be electric between 2016 and 2020. Under the plan, the 11 cities in Zhejiang take advantage of financial support from the provincial government and deploy a wide array of policies and actions to address major barriers to promote electric vehicles. For example, all cities provide financial incentives to reduce the total cost of ownership of electric vehicles. Additionally, Zhejiang hosts the Global Future Mobility Conference every year to promote exchange and cooperation among local and national governments, manufacturers, suppliers, utilities, and research institutes.

These policy actions have led to great success. In 2017, the annual sales of electric vehicles in Zhejiang reached 68,482, with a market share of 4%. As of October 2018, nearly 140,000 electric vehicles were registered in Zhejiang.¹³³ More than 11,000 public charging stations were installed—45% of them fast-charging stations.¹³⁴ The local auto industry has been accelerating the transition to electric. Geely, the largest automaker in Zhejiang, launched its Blue Geely Initiative in 2015. It includes a promise that 90% of annual sales in 2020 will be electric vehicles.¹³⁵

Zhejiang's electric vehicle market is expected to continue growing in the future. According to the development plan, from 2016 to 2020 Zhejiang aims to deploy at least 230,000 electric vehicles and more than 210,000 charging stations.

¹³² Zhejiang Development and Reform Commission, "Zhejiang's 13th Five-Year Development Plan on New-Energy Vehicle Industry" (August 22, 2016). <http://m.evpartner.com/news/detail-21813.html>

¹³³ Huang Lin and Fan Xiaoyun, "[新能源汽车走俏车江 电动汽车保有量超十万辆] [Electric vehicle stock in Zhejiang exceeds 100,000]," Zhejiang Online, October 12, 2018, http://ec.zjol.com.cn/ezx/201810/t20181012_8462231.shtml

¹³⁴ China Electric Vehicle Charging Infrastructure Promotion Alliance, "充电联盟充电基础设施汇总-201810 [A summary of EV charging infrastructure data - October 2018 (2018)]. Retrieved from <http://www.evcpa.org.cn/?jdfwkey=c523k3>

¹³⁵ "Geely Auto Announces 'Blue Geely' Initiative," Geely Auto Group, November 18, 2015, <http://global.geely.com/2015/11/18/geely-auto-announces-blue-geely-initiative/>

BADEN-WUERTTEMBERG, GERMANY

The German state of Baden-Wuerttemberg is one of the leading economic regions in Germany and Europe. The automotive industry is the bedrock of the state's economy, representing a quarter of industrial turnover.¹³⁶ Baden-Wuerttemberg has publicly committed to becoming a leading center for electric mobility in Germany.¹³⁷ The state wants to sustain its economic stability while also achieving its climate targets, and therefore aims to have 200,000 electric vehicles on the road by 2020.¹³⁸

In 2010, the government of Baden-Wuerttemberg founded the “State Initiative Electric Mobility Baden-Wuerttemberg” and allocated about €80 million between 2010 and 2015 to complement national EV funding. The state initiative was continued and expanded in 2017, and the state said it would invest an additional €43.5 million by 2021. The government set up the “State Agency for Electric Mobility and

Fuel Cell Technology Baden-Wuerttemberg” (e-mobil BW GmbH), an umbrella organization, to coordinate different activities and stakeholders.

To roll out electric mobility, Baden-Wuerttemberg took a broad-based, holistic approach to driver engagement. It covers a wide range of electric vehicles for all applications and integrates a number of stakeholder bodies.

Initiatives and projects cover a broad mix of active elements. These include ownership incentive programs, expansion of the charging infrastructure network, procurement of vehicles, and information and awareness campaigns, and they cover urban and rural areas alike. Examples of incentive programs to promote electric vehicle uptake include:

- Individual or institutional owners of an electric passenger car receive a grant of as much as €5,000 if they are registered in areas where NOx legal limits are exceeded.
- Financial support of as much as €3,000 for the purchase of electric cargo bikes.

- Transport companies based in Baden-Wuerttemberg that buy an electric bus can also receive a fixed state grant of €10,000. This is in addition to funding from the German central government.

This alignment of state and national government resources and a shared political vision has allowed real change to occur at an effective pace. The number of electric vehicles has increased steadily in Baden-Wuerttemberg. From 2016 to 2017, newly registered BEVs and fuel cell electric vehicles increased by 106% to 4,400, and the number of plug-in hybrid electric vehicles increased by 132% to 5,600. In 2017, 2.1% of all new registered passenger cars in Baden-Wuerttemberg were electric vehicles, whereas the German average was 1.6%.¹³⁹ In terms of charging infrastructure, as of July 2018, there were almost 13,500 public charging points across Germany, of which about 2,200, or 16%, were in Baden-Wuerttemberg.¹⁴⁰ These figures are expected to continue growing with the extension of the state initiative until 2021.

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137 “Baden-Württemberg expands promotion of electromobility,” Ministry of Baden-Württemberg, accessed June 20, 2017, <https://www.baden-wuerttemberg.de/de/service/presse/pressemitteilung/pid/baden-wuerttemberg-baut-foerderung-der-elektromobilitaet-aus/>

138 Ministry of Environment, Climate and Energy Baden-Württemberg, “Integriertes Energie- und Klimaschutzkonzept Baden-Württemberg (IEKK)” [Integrated Energy and Climate Protection Plan Baden-Wuerttemberg] (2014). https://um.baden-wuerttemberg.de/fileadmin/redaktion/m-um/intern/Dateien/Dokumente/2_Presse_und_Service/Publikationen/Klima/140715_IEKK.pdf

139 “Neuzulassungen von Pkw im Jahr 2017 nach ausgewählten Kraftstoffarten” [New registrations of passenger cars in the year 2017 for selected fuel types] Kraftfahrtbundesamt (KBA), (2018). https://www.kba.de/DE/Statistik/Fahrzeuge/Neuzulassungen/neuzulassungen_node.html

140 “Elektromobilität: Rund 13.500 öffentliche Ladepunkte in Deutschland [Electromobility: Around 13,500 public charging points in Germany],” BDEW, September 14, 2018, <https://www.bdew.de/presse/presseinformationen/hamburg-weiterhin-spitzenreiter-im-staedte-ranking/>

OREGON, UNITED STATES

Transportation is the largest source of GHG emissions in Oregon, accounting for 40% of such emissions in 2016.¹⁴¹ This, combined with abundant hydroelectric and wind resources, makes the transition to ZEVs a crucial part of the state's decarbonization plans.

Oregon's electric vehicle program is not led by one department or agency. Instead, several stakeholders share responsibility, doing so by addressing the key barriers of cost, convenient charging, and consumer awareness.¹⁴² Some of the principal actions in the state's plan include:

- The Department of Environmental Quality administers the Oregon Clean Vehicle Rebate program, which provides as much as \$2,500 for the purchase of an electric vehicle, based on battery capacity, and an additional \$2,500 to low-income households.¹⁴³ The rebate is funded by a tax on car dealerships and the state's Clean Fuels Program.
- The Public Utilities Commission has directed the state's two main utilities to expand public

charging infrastructure; the utilities also offer incentives for residential charging.¹⁴⁴

- The Department of Administrative Services is transitioning the state fleet to electric vehicles and crafting regulations for charging infrastructure at state buildings, workplaces, and parking lots.
- A PPP of state agencies, automakers, charging manufacturers, cities, and fleet operators builds consumer awareness of electric vehicles, advocates electric vehicle-friendly policies, and promotes the electric vehicle industry. One pioneering program is the EV Showcase in downtown Portland, where people can take test drives, explore charging options, and consult experts.

A hallmark of Oregon's electric vehicle program is collaboration and learning from other jurisdictions. Oregon has adopted California's ZEV regulation requiring automakers to sell an increasing number of ZEVs. Oregon has joined the Multi-State ZEV Task Force with eight other U.S. states and the

International ZEV Alliance to share lessons and push for faster progress on ZEVs. A concrete example of this collaboration is the West Coast Electric Highway, a dense network of fast-charging stations on major routes through California, Oregon, Washington, and British Columbia.

Oregon's efforts are enhanced by those in Portland, the state's largest city. Portland has implemented a comprehensive electric vehicle strategy to meet its decarbonization goals and improve air quality.¹⁴⁵ City policies in this plan include electric vehicle-ready building codes, installing public charging, and electrifying buses and city vehicles. In total, 26 electric vehicle actions have been enacted by the state, the city, or the electric utility in the Portland area.¹⁴⁶

About 18,000 electric vehicles were sold in Oregon through August 2018, well on the way to the goal of 50,000 total sales through 2020. In 2018, Oregon had an electric vehicle sales share of 3.67%, the third-highest in the United States.

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142 "Oregon's EV Strategy," State of Oregon, accessed February 1, 2019, <https://goelectric.oregon.gov/our-strategy/>

143 "Oregon Clean Vehicle Rebate Program," Department of Environmental Quality, State of Oregon, accessed February 1, 2019, <https://www.oregon.gov/deq/aaq/programs/pages/zev-rebate.aspx>

144 Ethan Howland, "Oregon PUB reviews utility electric vehicle proposals," Public Power Daily, September 1, 2017, <https://www.publicpower.org/periodical/article/oregon-puc-reviews-utility-electric-vehicle-proposals>

145 Bureau of Planning and Sustainability, City of Portland, "2017 City of Portland Electric Vehicle Strategy," (December 2016), <https://www.portlandoregon.gov/bps/article/619275>

146 Peter Slowik and Nic Lutsey, *The continued transition to electric vehicles in U.S. cities* (ICCT: Washington, DC, 2018), <https://theicct.org/publications/continued-EV-transition-us-cities-2018>

ANNEX II CRITERIA TO EVALUATE PRIORITY TIERS

Barrier	Tier 1	Tier 2	Tier 3
Expand EV model availability	Policy actions that could guarantee an increase in EV investment (mandate-based policies)	Policy actions that could spur targeted investment	Policy actions that could help support industry development in the long run
Improve EV cost-competitiveness	Policy actions that could significantly reduce EV purchase price and operating costs for consumers in the near term	Policy actions that could reduce EV purchase price and operating costs to some extent, or in the longer term	Policy actions that would have minimal direct effect on EV cost and policies not adaptable to the Indian context
Accelerate EV deployment across different fleets	Policy actions that will guarantee fleet transition to EV or provide strong financial or administrative support for mass EV fleet transition	Policy actions that could provide some financial or administrative support for EV fleet transition	Policy actions that show less direct support for EV fleet transition
Develop charging infrastructure network	Policy actions that could quickly increase investment in charging infrastructure and improve access to charging equipment	Policy actions that could foster investment in longer-term charging infrastructure growth	Policy actions that could have an indirect positive impact on charging infrastructure development
Raise public awareness	Policy actions that could impact the largest group of consumers and campaigns providing consumers first-hand EV experience	Policy actions that could support awareness among a smaller group of consumers or professionals	Policy actions that could foster EV awareness in the long run

ANNEX III LIST OF ICCT PAPERS ON BEST PRACTICES AND MARKET-SPECIFIC EXPERIENCE WITH ELECTRIC VEHICLE POLICIES

Emerging best practices	
Principles for effective electric vehicle incentive design	Link
Integrating electric vehicles within U.S. and European efficiency regulations	Link
Emerging best practices for electric vehicle charging infrastructure	Link
Lessons learned on early electric vehicle fast-charging deployments	Link
Literature review on power utility best practices regarding electric vehicles	Link
Literature review of electric vehicle consumer awareness and outreach	Link
Experience in leading markets	
Electric vehicle capitals of the world: what markets are leading the transition to electric	Link
Electric vehicle capitals of the world: demonstrating the path to electric drive	Link
Electric vehicle capitals: accelerating the global transition to electric drive	Link
Assessment of electric car promotion policies in Chinese cities	Link
Leading edge of electric vehicle market development in the United States: An analysis of California cities	Link
Expanding the electric vehicle market in U.S. cities	Link
The continued transition to electric vehicles in U.S. cities	Link

