

## Electric vehicle capitals: Cities aim for all-electric mobility

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This briefing provides an update on the 25 largest electric passenger vehicle markets worldwide, which together represent 40% of global cumulative electric vehicle sales. The paper examines electric vehicle uptake, charging infrastructure, planning, goals, and policies among the top electric markets to discern lessons on the global transition to electric mobility.

### INTRODUCTION

The transition to electric mobility continues in major markets across the world, spurred by strong government policy, technological development, increasing model availability, and consumer demand. Figure 1 displays the growth in electric passenger vehicle sales by market from 2010 to 2019, when global sales exceeded 2.25 million.<sup>1</sup> At the same time, the global share of new passenger vehicles that are plug-in electric increased to approximately 3%. China is the largest electric vehicle market globally and accounted for half of all 2019 sales, followed by Europe, the United States, and Japan.<sup>2</sup> Although there are uncertainties about how the industry and the market will respond to the 2020 pandemic and economic recovery, the electric vehicle market, particularly in Europe, has fared better than combustion vehicles through mid-2020.<sup>3</sup>

1 Data obtained from EV-Volumes (EV Data Center, 2020), <http://www.ev-volumes.com/datacenter/>. Europe in the chart includes the European Union, the European Free Trade Area, and the United Kingdom.

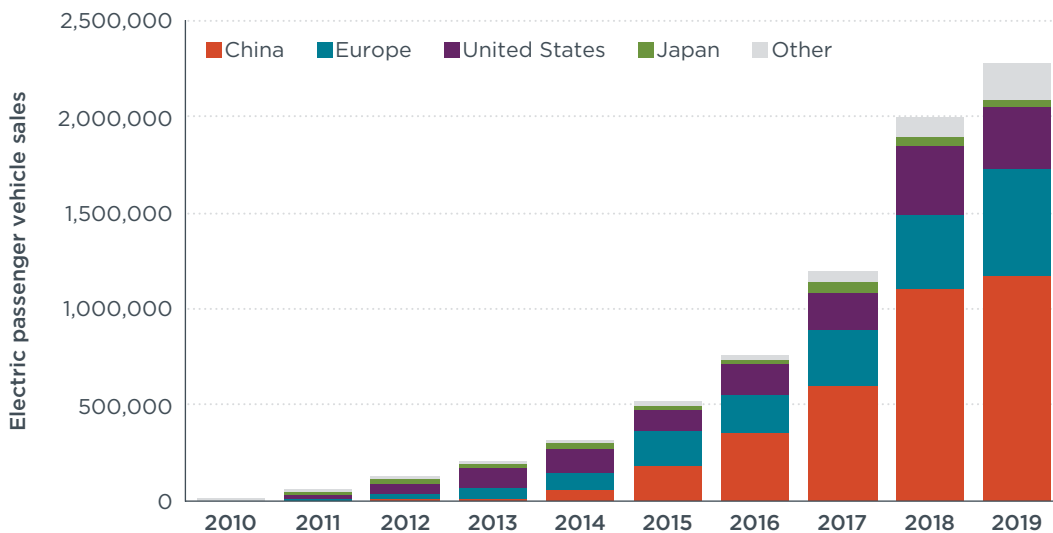
2 Hongyang Cui, Dale Hall, & Nic Lutsey, *Update on the Global Transition to Electric Vehicles through 2019*, (ICCT: Washington, D.C., 2020), <https://theicct.org/publications/update-global-ev-transition-2019>.

3 Peter Mock and Uwe Tietge, "Market Monitor: European Passenger Car Registrations, January-June 2020," (ICCT: Washington, D.C., 2020), <https://theicct.org/publications/market-monitor-european-passenger-car-registrations-january-june-2020>.

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**Figure 1.** Global electric passenger vehicle sales by market from 2010 to 2019.

This sustained growth in electric vehicle sales has been made possible in part by the actions of national governments, including electric vehicle regulations, vehicle emissions standards, financial incentives, and industrial policy. Yet, within each of these markets, electric vehicle uptake varies widely, with particular regions and cities setting stronger targets and achieving higher electric vehicle adoption. Through 2018, the 25 metropolitan areas with the most electric vehicles made up 42% of the global market.<sup>4</sup> Deeper analyses of the United States and Europe also reveal the role of major cities in developing policies and building the mainstream electric vehicle market.<sup>5</sup>

This briefing analyzes the contribution of major cities to the global electric vehicle market and the factors behind the success of these cities. We identify the 25 cities with the most cumulative electric passenger vehicles through 2019, which we call “electric vehicle capitals”: Shanghai, Beijing, Shenzhen, Hangzhou, Guangzhou, Tianjin, Qingdao, Zhengzhou, Changsha, Liuzhou, Weifang, Wuhan, Chongqing, and Xi’an in China; Tokyo, Japan; Oslo and Bergen, Norway; Paris, France; London, United Kingdom; Amsterdam, the Netherlands; Stockholm, Sweden; and Los Angeles, San Francisco, San Jose, and New York in the United States. This list of electric vehicle capitals is unchanged from the previous year, with one exception. Liuzhou, an industrial city in southwestern China, replaced San Diego and made its debut in the list, a result of its distinctive policy efforts.<sup>6</sup>

For each of these 25 cities, we assess electric vehicle sales patterns, charging infrastructure deployment, and local promotion actions. Although the markets are named by their major cities, the data for the cities include the broader surrounding metropolitan areas in order to reflect household travel patterns, charging infrastructure, and policy (except in China, where city boundaries are larger). Unless otherwise noted, this briefing focuses on passenger vehicles, which represent the

4 Hall, Cui, and Lutsey, *Electric Vehicle Capitals: Showing the Path to a Mainstream Market*.

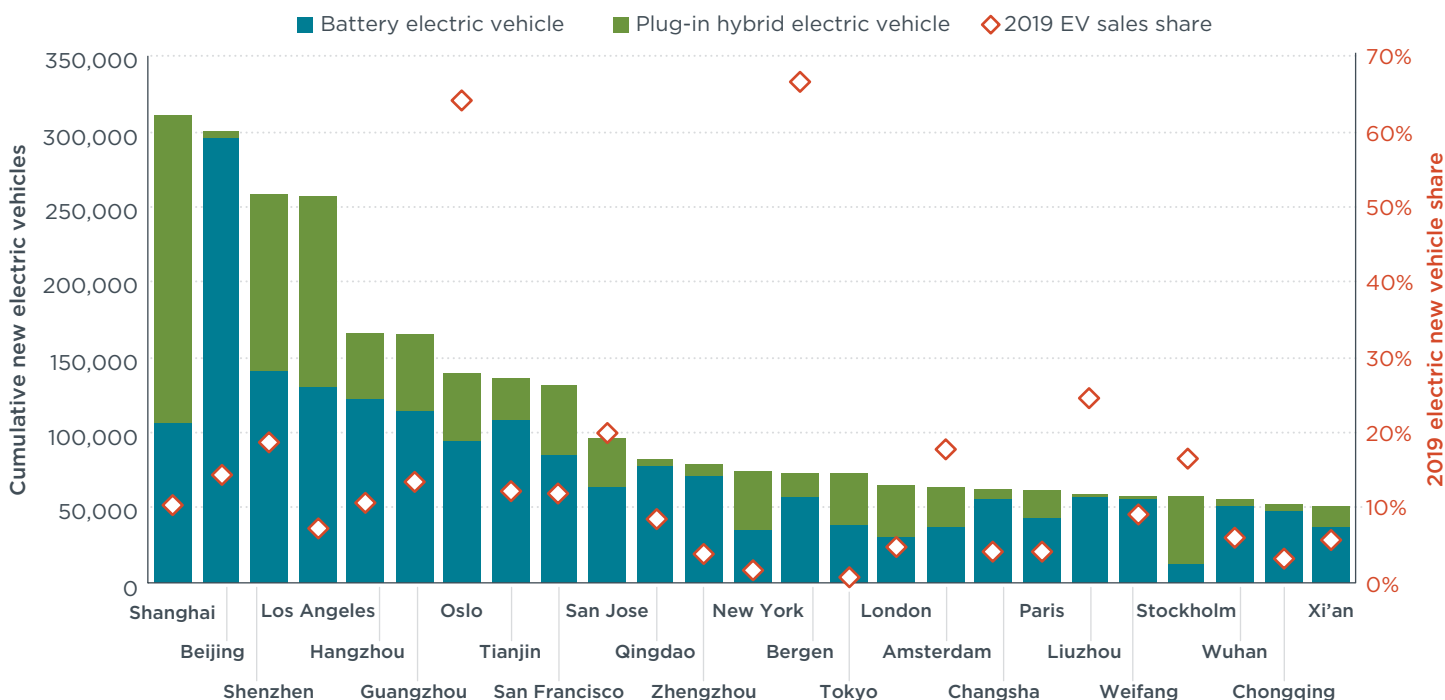
5 Anh Bui, Peter Slowik, and Nic Lutsey, *Update on electric vehicle adoption across U.S. cities*, (ICCT: Washington, D.C., 2020), <https://theicct.org/publications/ev-update-us-cities-aug2020> and Sandra Wappelhorst, Dale Hall, Mike Nicholas, and Nic Lutsey, *Analyzing Policies to Grow the Electric Vehicle Market in European Cities*, (ICCT: Washington, D.C., 2020), <https://theicct.org/publications/electric-vehicle-policies-eu-cities>.

6 Hongyang Cui, “Liuzhou: A New Model for the Transition to Electric Vehicles?” ICCT Staff blog, December 18, 2019, <https://theicct.org/blog/staff/liuzhou-new-model-transition-electric-vehicles>.

greatest share of fuel consumption and greenhouse gas emissions in the transport sector and have been a major focus for transport electrification policy.

## ELECTRIC VEHICLE SALES

The 25 electric vehicle capitals are selected based on cumulative plug-in electric passenger vehicles from 2010 to 2019. Figure 2 illustrates these cumulative sales, distinguishing between battery electric vehicles (BEVs, blue) and plug-in hybrid electric vehicles (PHEVs, green). It also shows the electric vehicle sales share of new passenger vehicle sales in 2019 for these cities (points, right axis). The total for each market is based on new vehicle sales, registrations, or incentive payments, which we consider to all be close proxies for sales.<sup>7</sup>



**Figure 2.** Cumulative electric passenger vehicles through 2019 and 2019 electric vehicle share of new passenger vehicles in the 25 metropolitan areas with the most electric vehicles.

Each of the 25 electric vehicle capitals has registered at least 50,000 electric passenger vehicles. As in previous years, Shanghai leads in cumulative electric vehicles, with over 310,000 registered through 2019, closely followed by Beijing (300,000), Shenzhen (260,000), and Los Angeles (255,000). Beijing maintains its large lead in cumulative BEV registrations, around 295,000 through 2019, more than twice as many as any other city.

<sup>7</sup> Based on registration data from Anh Bui, Peter Slowik, and Nic Lutsey, *Update on electric vehicle adoption across U.S. cities*, (ICCT: Washington, D.C., 2020), <https://theicct.org/publications/ev-update-us-cities-aug2020>; Dale Hall, Sandra Wappelhorst, Peter Mock, and Nic Lutsey, *European Electric Vehicle Factbook 2019/2020*, (ICCT: Washington, D.C., 2020), <https://theicct.org/publications/european-electric-vehicle-factbook-20192020>; Norsk Elbilforening (EV data for Norway, 2020) [Personal correspondence]; and Automotive Data Center of China Automotive Technology and Research Center (CATARC), <http://www.catarc.info/scsj/>.

The two electric vehicle capitals in Norway continue to grow their electric vehicle sales shares further into the mainstream market, with 67% of passenger vehicle sales being electric in Bergen in 2019 and 64% in Oslo. Liuzhou had the greatest sales share outside of Norway at 24%, while San Jose and Shenzhen each had sales shares close to 20%. Thirteen of these capitals experienced electric vehicle sales shares over 10% in 2019, an increase of one over the previous year. A deeper discussion of the evolution of electric vehicle sales trends in these cities is presented below.

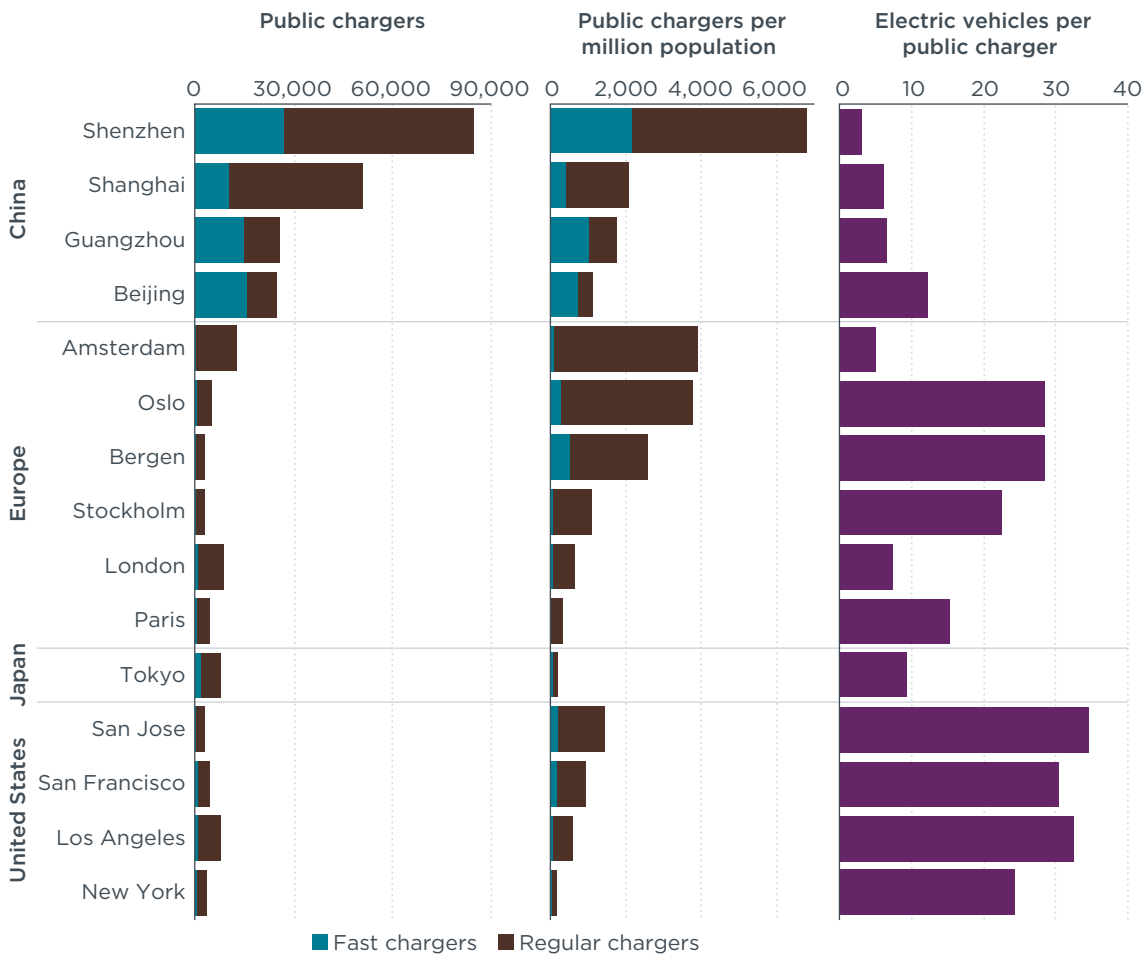
## CHARGING INFRASTRUCTURE

One of the largest hurdles in the broad transition to electric mobility is the construction of a comprehensive charging infrastructure network to build range confidence and maximize electric vehicles' emission reductions and cost savings, by enabling greater electric vehicle utility. Cities have an especially critical role in building charging infrastructure as many urban drivers lack convenient home charging.<sup>8</sup> The needs for charging infrastructure vary widely among the leading cities due to underlying transportation, demographic, and housing patterns. Yet, all of the cities are working to develop innovative solutions to accelerate charging infrastructure growth.

Figure 3 compares the amount of public charging available at the end of 2019 in each market using several metrics: the absolute number of public chargers, the number of public chargers per million population, and the number of electric passenger vehicles per public charger. The metropolitan areas are listed from top to bottom by the four main regions, then in decreasing order of number of chargers per million population within each region. Data for the remaining electric vehicle capitals in China were not available. The figures for Shenzhen and Guangzhou may include some dedicated chargers, such as private workplace chargers and bus and sanitation truck chargers. Although there are minor data source inconsistencies across the markets, the major trends in each region and city concerning the three metrics are evident.

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<sup>8</sup> Dale Hall and Nic Lutsey, *Electric Vehicle Charging Guide for Cities*, (ICCT: Washington, D.C., 2020), <https://theicct.org/publications/city-EV-charging-guide>.



**Figure 3.** Public charging infrastructure deployment in selected electric vehicle capitals through 2019.

The figure illustrates a number of trends across the electric vehicle capitals. First, the cities in China have by far the most public charging on an absolute basis: each of the four cities analyzed here have more than twice as much as any city outside of China. When considering charging per million population, Shenzhen has a wide lead with over 6,700 public chargers per million population. Amsterdam and Oslo follow with just under 4,000 chargers per million population, with all other cities counting below 2,500 in that metric. There is no clear pattern in terms of the number of electric vehicles per public charger. While Shenzhen, Shanghai, Guangzhou, Amsterdam, London, and Tokyo have fewer than 10 electric vehicles per public charger, the ratio is greater than 25 in Oslo, Bergen, and the three cities in California. This metric depends strongly on access to private home charging and on vehicle usage patterns.<sup>9</sup>

Electric vehicle charging infrastructure buildout has been supported by policies and strategies at the local, regional, and national level, including additional programs to tackle home and workplace charging. The key policies and actions in place in the electric vehicle capitals are described and catalogued in the section on supporting policies and actions.

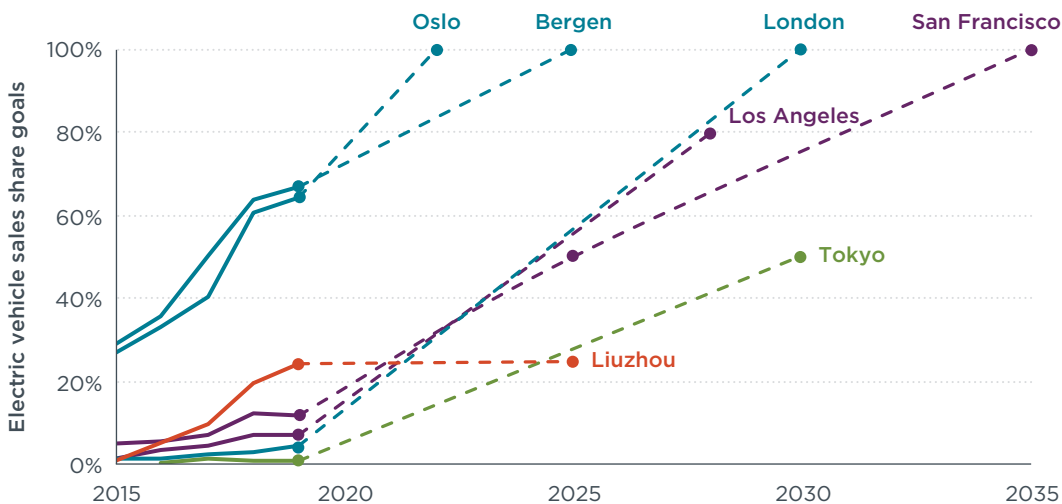
<sup>9</sup> Dale Hall and Nic Lutsey, *Charging infrastructure in cities: Metrics for evaluating future needs*, (ICCT: Washington, D.C., 2020), [https://theicct.org/publications/EV\\_charging\\_metrics\\_aug2020](https://theicct.org/publications/EV_charging_metrics_aug2020).

## ELECTRIC VEHICLE GOALS AND PLANNING

Beyond their high electric vehicle uptake through 2019, the electric vehicle capitals have set strong ambitions for future growth which drive city planning and policy to accelerate the transition to electric vehicles. This section summarizes the goals and targets of the electric vehicle capitals in terms of share of electric vehicle sales, electric vehicle shares of on-road vehicles, and implementation of low- and zero-emission zones. Setting all-electric goals is a critical initial step before establishing concrete action plans, policies, and city agency responsibilities to put cities on a path to achieve those goals. While most of the electric vehicle capitals established 100% electric bus goals by 2018, 2019 saw many of the high electric-uptake markets embrace goals for all-electric vehicle sales, stock, or usage within parts of the city.

With regard to goals and targets, Chinese cities operate under the unique Five-Year Plan framework, which plot the country's path based on a set of development goals. Since the 14<sup>th</sup> Five Year Plan, which covers 2021 to 2025, has not yet been released, most Chinese cities' targets do not go beyond the 2020 horizon. The policies in electric vehicle capitals in Europe and North America may offer useful references as cities in China adopt their next far-reaching targets to accelerate electric mobility.

*Electric vehicle sales goals.* A first step on the path towards eliminating emissions from cars in cities is phasing out the sale of gasoline- and diesel-powered vehicles. Therefore, as a part of long-term transport decarbonization strategies, many cities have set goals concerning the share of electric vehicle sales. Figure 4 illustrates electric vehicle sales shares through 2019 for seven of the electric vehicle capitals with future-year goals, which range from sales shares of 25% in 2025 (Liuzhou), including passenger and commercial vehicles to sales shares of 100% as early as 2022 (Oslo). The figure also includes the 2019 sales shares for each of these metropolitan areas, which may differ slightly from the sales shares within the cities themselves.

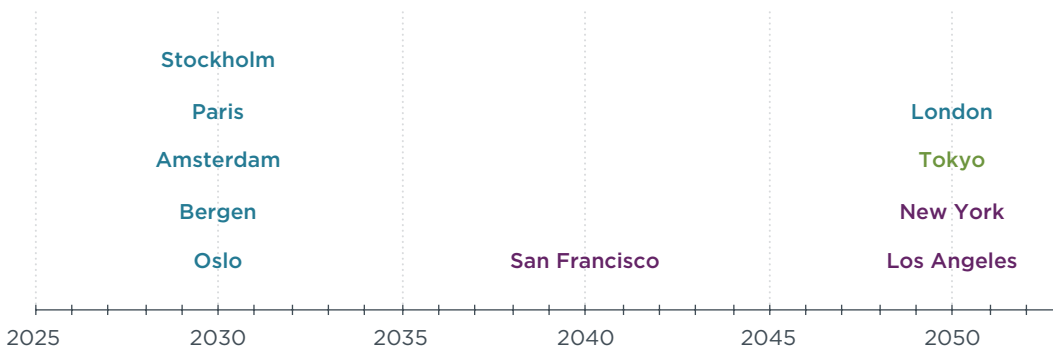


**Figure 4.** Goals for shares of electric vehicle sales in selected electric vehicle capitals.

The two cities which have the most rapid all-electric targets—Oslo and Bergen—are also the cities ranked highest in terms of 2019 share of electric vehicle sales. The only Chinese city that has set a goal beyond 2020, Liuzhou, is also the highest-ranking city outside of Norway in terms of electric vehicle sales share. Liuzhou's 2019 sales share of passenger vehicles (24%) was close to meeting its 2025 target, suggesting that the

city could increase its ambition. The cities requiring the steepest rates of growth to meet their goals are Tokyo (46% compound annual growth rate), London (32%), and Los Angeles (30%).

*Combustion vehicle phase-out goals.* Most of the electric vehicle capitals outside of China have set ambitious targets regarding the percentage of vehicles on the roads that are electric and have developed phase-out plans for gasoline-powered cars. Figure 5 shows the timing of cities' 100% zero-emission goals for passenger vehicle stock. Ten of the electric vehicle capitals have set goals for the complete phase-out of combustion engine cars (five by 2030, one by 2040, and four by 2050).



**Figure 5.** Targeted year of full electrification of vehicles on the roads in the electric vehicle capitals.

European cities are paving the way, with five capitals announcing an end to the use of internal combustion engines in the city as soon as 2030. This mirrors a trend across Europe, with many local and national governments setting long-term targets for a combustion engine phase-out.<sup>10</sup> Also shown, three U.S. cities and Tokyo, Japan, have 2040 or 2050 all-electric targets. Although not depicted in the figure, San Jose has developed a detailed plan to move from 6% electric vehicle stock share in 2019 to 61% in 2030 and 82% in 2050.

During the 13th Five-Year Plan period (2016-2020), cities in China set goals regarding the share of all vehicles on the road (including cars, buses, and trucks) that are electric for 2020: Shenzhen aimed for 3-5% of its vehicle stock being electric in 2020 and Tianjin set the goal at 4.5%. During this period, electric uptake in China has generally outpaced the 2016 expectations. For Shenzhen, the electric stock share of over 10% in 2019 was double its 2020 goal.

*Low- and zero-emission zones.* In order to increase electric vehicle uptake, many electric vehicle capitals have begun implementing low- and zero-emission zones, which only allow cleaner vehicles based on specified eligibility criteria within specified parts of the city. Twenty of the electric vehicle capitals (all except Changsha and the U.S. cities) have a low-emission zone in place. Six of the capitals (Amsterdam, London, Los Angeles, Oslo, Paris, and Tokyo) have signed the Fossil Fuel Free Streets Declaration, a Mayor-level commitment to procure only zero-emission buses from 2025 and ensure a major area of their city is zero emission by 2030.<sup>11</sup> Among those cities, Amsterdam has

<sup>10</sup> Sandra Wappelhorst, *The End of the Road? An Overview of Combustion-Engine Car Phase-out Announcements across Europe*, (ICCT: Washington, D.C., 2020), <https://theicct.org/publications/combustion-engine-car-phase-out-EU>.

<sup>11</sup> C40 Cities. "C40: Green and Healthy Streets." Accessed July 20, 2020. <https://www.c40.org/other/green-and-healthy-streets>.

set a more immediate time frame of 2025 for its zero-emission area, which will include freight vehicles. Only Bergen and London have implemented some form of zero-emission zones in their city centers, but several others have announced plans to create zero-emission zones, which apply to specific vehicle types or usage. For example, Los Angeles is working in 2020 on a zero-emission goods delivery pilot zone as a precursor to the zero-emission goods and people movement zone planned for 2030. Notably nearly all the China electric capitals have low-emission, but not zero-emission, zones.

## SUPPORTING POLICIES AND ACTIONS

To achieve their all-electric goals, cities have enacted a wide range of supporting policies and actions to make electric vehicles broadly attractive to a mainstream market. These fall into several general categories: making electric vehicles financially viable through incentives, spurring the development of convenient charging systems, and accelerating vehicle adoption in fleets. This section discusses several effective policies in each of these categories.

*Financial incentives.* Direct financial incentives are among the most important electric vehicle adoption policies. These incentives are usually distributed by national or state governments; in fact, direct purchase subsidies or tax reductions are available from the national government in all of the electric vehicle capitals.<sup>12</sup> Among these 25 capitals, only Tokyo offers city-level financial incentives to all new private car buyers.<sup>13</sup> In June 2019, cities in China stopped offering financial incentives under guidance from the central government, a decision followed by a sharp electric vehicle sales drop.<sup>14</sup> Cities were instead encouraged to provide enhanced support for charging infrastructure and zero-emission buses. Incentives elsewhere have continued, such as the national-level incentives offered in China, the Netherlands, and France, and are being extended as a part of broader economic recovery packages.<sup>15</sup>

Some electric vehicle capitals provide targeted incentives for specific applications, such as low-income residents or taxis. Small businesses in the Paris region can receive an incentive of up to €6,000 (\$7,050) to purchase electric light-duty company vehicles, and taxis can receive a similar bonus to convert to electric.<sup>16</sup> The local air quality district in San Francisco provides incentives for low-income residents to buy new or used electric vehicles; similar programs are in place in Los Angeles and Paris for those replacing older vehicles. In Beijing, taxis can receive a one-time bonus as high as 73,800 yuan (\$10,500) for switching to a battery electric vehicle.<sup>17</sup>

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12 International Energy Agency, “Global EV Outlook 2020” (Paris, May 2020), <https://www.iea.org/reports/global-ev-outlook-2020>.

13 “電気自動車等の普及促進事業（EV・PHV車両）[Promotion of electric vehicles],” Tokyo Metropolitan Center for Climate Change Actions, accessed July 10, 2020, <https://www.tokyo-co2down.jp/individual/subsidy/ev/index.html>.

14 Zeng Le, “乘用车1月销量同比下降21.5%，2019年新能源销量六连跌 [Passenger car association: January sales of passenger cars fell 21.5% year-on-year, and sales of new energy fell for six consecutive months in 2019],” Sohu, February 17, 2020, [https://www.sohu.com/a/373621786\\_171087](https://www.sohu.com/a/373621786_171087).

15 Sandra Wappelhorst, “Economic Recovery Packages in Response to COVID-19: Another Push for Electric Vehicles in Europe?,” ICCT Staff blog, August 3, 2020, <https://theicct.org/blog/staff/economic-recovery-covid-19-ev-europe-aug2020>.

16 Région Île-de-France. “Acquisition de véhicules propres par les TPE et PME franciliennes. [Acquisition of clean vehicles for small businesses in the Paris region]” Accessed July 27, 2020. <https://www.iledefrance.fr/acquisition-de-vehicules-propres-par-les-tpe-et-pme-franciliennes>.

17 “关于对出租汽车更新为纯电动车资金奖励政策的通知 [Notice on financial incentives for taxis to convert to battery electric vehicles],” Beijing Bureau of Finance, accessed July 17, 2019, [http://czj.beijing.gov.cn/zwx/tztg/201912/t20191206\\_893379.html](http://czj.beijing.gov.cn/zwx/tztg/201912/t20191206_893379.html).



*Non-financial incentives.* Cities can decrease the cost of electric vehicle ownership in other ways, such as reducing parking fees or tolls. Parking benefits are one of the most widespread actions across the capitals, taking the form of free garage or street parking, or prioritized access to coveted parking permits. For example, Paris offers free parking at 130,000 metered spaces, and San Jose allows free parking at all metered spaces and several public garages. Liuzhou provides free parking at all street parking spaces and many public garages and had approximately 8,000 spaces reserved for electric vehicles at the end of 2019. Local governments also offer waived or reduced tolls for bridges, tunnels, or ferries. This policy was pioneered in Norway, and both Oslo and Bergen still offer reduced tolls for fully electric cars. Likewise, Chinese cities like Chongqing and Wuhan also exempt electric vehicles from tolls for highways, bridges, and tunnels.

Cities also create incentives to save drivers time and make electric vehicles more convenient. In each of the metropolitan areas of the U.S. electric capitals, electric vehicles have access to carpool lanes regardless of occupancy. Other capitals, including Oslo and Xi'an, allow electric vehicles to drive in bus-only lanes. In many cities in China, such as Beijing, Tianjin, and Zhengzhou, conventional vehicles are prohibited from driving in central areas once per week based on their license plate number, while electric vehicles are not subject to such limitations.

China's registration policies are the strongest local-level actions to accelerate electric vehicle uptake. To reduce urban congestion and air pollution, several large cities in China impose an upper limit on new car registrations. New car licenses are distributed through an auction (as in Shanghai), a lottery (as in Beijing), or a combination of the two (as in Shenzhen, Tianjin, Guangzhou, and Hangzhou). These quotas typically represent a significant impediment to licensing a new car: The odds of winning a plate in Beijing was 1 in 2,740 in December 2019, whereas the average license auction cost in Shanghai reached 89,653 yuan (about \$12,800) in 2019. Cities with such quotas in China typically exempt electric cars.<sup>18</sup> In the Beijing lottery, however, more license plates were reserved for electric than conventional cars (54,000 vs 38,000 in 2019). By March 2020, more than 460,000 people in Beijing were waiting for electric car license plates, indicating that some drivers on the list in 2020 would not get a license plate until 2029 under the annual 54,000-electric car quota.

*Electrification of fleets.* Fleets, both public and private, often represent ideal applications for electric vehicles given their high utilization and the emphasis placed on lifetime cost of ownership. Cities often have greater influence over fleets, especially municipals fleets, than over private vehicles. Most of the 25 electric capitals have set targets for converting their light-duty fleets to electric: San Francisco requires the electrification of all the city's passenger cars by 2022, and London has set a similar target by 2025. New York City, San Jose, and Stockholm have "electric first" policies which require that new vehicles be electric if an appropriate model is available. All 14 China electric vehicle capitals have policies to encourage the electrification of city government fleets, and many of them, such as Shanghai, Beijing, Shenzhen, require a certain percentage of new government vehicles be electric.

Many cities also strive to electrify private fleets, including taxi, ride-hailing, and car-sharing vehicles. Shenzhen has completely electrified their taxis as of early 2020, and other cities have near-term targets: Hangzhou in 2021, Beijing and Guangzhou in 2022,

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<sup>18</sup> D1EV, "国务院：新能源汽车不得限行限购 [State Council: Prohibiting setting registration and driving restrictions on new energy vehicles]," (September 29, 2015). <https://www.d1ev.com/news/shichang/40299>.

Oslo in 2023, Bergen in 2024, and Amsterdam in 2025. Amsterdam allows electric taxis to move to the front of the queue at key locations, such as the central train station. Ride-hailing or private hire vehicles are also switching to electric, a process that is essentially complete in Shenzhen, where all ride-hailing vehicles will be electric in 2020. To meet its goal for all-electric taxis and private hire vehicles by 2033, London has required all new taxis be electric by 2018 and all new private hire vehicles by 2020. Regulations in California under development in 2020 encourage electrification of the ride-hailing fleets. Finally, almost all of the electric vehicle capitals have electric car-sharing services in place. For example, EVCARD, the Shanghai-based electric car-sharing program, has extended its service to 65 cities, with more than 50,000 electric cars in operation and over 12 million electric kilometers travelled by July 2020.

*Charging infrastructure.* Cities have taken diverse approaches to expand the charging infrastructure ecosystem. One effective policy is to provide incentives or financial support for infrastructure deployment. All 14 electric vehicle capitals in China benefit from national- and city-level incentives for those that install public charging. The incentive value can be based on the power in kW (as in Shenzhen) or as a portion of the total cost (30% in Hangzhou). Other cities target incentives toward specific applications, such as home charging for taxis (Paris, Oslo, London, and Tokyo), multi-unit dwellings (Oslo and Paris), or curbside or streetlamp chargers (Los Angeles).

Cities also engage in planning activities to ensure sufficient future charging installations, for example with multi-stakeholder charging strategies, as seen in London, Stockholm, Oslo, San Francisco, and Beijing. Electric vehicle-ready building and construction codes are another tool for advancing charging at a low cost by mandating a minimum percentage of spaces contain the wiring and electrical capacity for vehicle charging at the time of construction or renovation. These requirements are found at the local, state, or national level in every electric vehicle capital. Beijing, Guangzhou, Oslo, and San Francisco have exemplary codes with requirements that 100% of spaces in some building types have the wiring for vehicle charging in place. Cities continue to strengthen their building codes by adding requirements for buildings undergoing retrofits and increasing the electrical capacity so that more vehicles can charge simultaneously.

*Summary of electric vehicle actions by city.* The electric vehicle capitals have developed electric vehicle planning goals and implemented comprehensive actions across multiple areas to help achieve those goals. These cities have also benefited from supportive policies at the state and national levels. Table 1 below summarizes which of 20 actions and policies described above are implemented in the 25 electric vehicle capitals. The actions in each capital are denoted with different symbols according to their adoption by the local government (x), a state or national government (O), or at multiple levels of government (⊗). The first five columns summarize city-level planning goals publicly signaling plans for 100% electric vehicle sales, stock, and zones within the city. The following 15 columns show supporting infrastructure, fleet, and incentive programs to help achieve those goals.

**Table 1.** Summary of planning and promotion actions in place in electric vehicle capitals.

Country	Metropolitan area	City planning				Infrastructure				Fleets				Incentives						
		100% electric sales goal	100% electric stock goal	Planned central zero-emission zone	Low emission zone in place	Fossil Fuel Free Streets declaration	Public charging incentives	Private charging incentives	EV-ready building code	Charging strategy	City government fleet goal	Taxi electrification goal	Ride-hailing electrification goal	Electric car-sharing program	100% electric bus goal	100% electric buses achieved	Financial incentives	License plate preferential access	Electric vehicle parking privileges	Access to bus/carpool lanes
China	Shanghai				x	⊗		x	x	x	x		x	⊗		○	x	x		
	Beijing				x	⊗		x	x	x	x		x	○		○	x	x		
	Shenzhen				x	⊗		x	x	x	x	x	x		x	○	x	x		
	Hangzhou				x	⊗	x	⊗	x	○	x		x	⊗		○	x	x	○	
	Guangzhou				x	⊗		⊗	x	⊗	⊗	x	x		x	○	x	⊗	x	
	Tianjin				x	⊗		x	x	x	x		x	⊗		○	x	x		
	Qingdao				x	⊗		⊗	x	⊗	x		x	⊗		○		⊗		
	Zhengzhou				x	⊗		⊗	x	⊗	⊗	x	x	⊗		○		⊗		
	Changsha					⊗		⊗	x	x	x		x	x		○		x		
	Liuzhou				x	⊗		⊗	x	x			x			○		⊗	⊗	
	Weifang				x	⊗		⊗	x	○			x			○		⊗		
	Wuhan				x	⊗		x	x	⊗	x	x	x	x		○		⊗		x
	Chongqing				x	⊗		x	x	x			x			○		x		x
Xi'an				x	⊗		⊗	x	⊗	x	x	x	○		○		x	⊗		
Japan	Tokyo			x	x	x	⊗	x		x	x		x			⊗				
Norway	Oslo	x	x	x	x	x		x	x	x	⊗	x		x	x	○		x	x	○
	Bergen	x	x	x	x			x	x		⊗	x		x		○		x		○
France	Paris		x		x	x		x	x		x	x		x	x	⊗		x		
United Kingdom	London	x	x	x	x	x		○	x	x	x		x	x	x	○		x		x
Netherlands	Amsterdam		x	x	x	x	x	x	x	○	x		x	x		○		x		○
Sweden	Stockholm		x		x		○	○	x	x	x		x			○				
United States	Los Angeles		x	x		x	○	⊗	x	⊗	x		x	x		○			○	○
	San Francisco	x	x				⊗	○	x	⊗	x			x		○			○	○
	San Jose						○	○	x	⊗	x			○		○		x	○	○
	New York		x						○	x				x		○			○	○

Notes: **x** = action by local government; **○** = action by state or national government; **⊗** = action at multiple levels

The table illustrates the cities’ actions to adopt a comprehensive suite of policies and programs, boosted by complementary state and national policies, to support the transition to electric vehicles. Among the cities with the most policies in place are Shenzhen, Guangzhou, Oslo, and Amsterdam. Local fleet electrification targets and electric vehicle-ready building codes have become nearly universal among capital cities. There are regional differences, partly based on city regulatory authority: cities in China often offer parking and public charging perks and exempt electric cars from license restrictions, cities in Europe frequently have 100% electric goals and fleet requirements, and cities in the United States often offer access to carpool lanes and toll discounts. Also, 13 of the cities in China have low-emission zones, but none have made public announcements about their transition to zero-emission zones.

Table 2 summarizes how policies described above are implemented in leading markets. Each of these policies are customized according to local needs and authorities. Over time, many of these policies have been strengthened, such as accelerating timelines for municipal car or bus fleet electrification, while others have been scaled back as the market expands, such as restrictions placed on electric vehicles in bus and carpool lanes.

**Table 2.** Highlighted electric vehicle city planning and promotion actions.

Policy area	Selected city	Policy description
<b>100% electric sales goal</b>	San Francisco	Roadmap for 100% electric new vehicles by 2030, including 6 main strategies <sup>a</sup>
<b>100% electric stock goal</b>	Los Angeles	Goal for 100% electric vehicles by 2050, with charging initiatives through 2030 <sup>b</sup>
<b>Planned zero-emission area</b>	London	Zero-emission central London and town centers by 2025, all inner London by 2040 <sup>c</sup>
<b>Low-emission zone in place</b>	Bergen	Low-emission zone converted to zero-emission zone from 2020-2030 <sup>d</sup>
<b>Fossil fuel free streets declaration</b>	Paris	Only zero-emission buses from 2025 and a major area of the city being zero emission by 2030 <sup>e</sup>
<b>Public charging incentives</b>	Beijing	Charging subsidies as high as 200,000 yuan per station per year <sup>f</sup>
<b>Private charging incentives</b>	Tokyo	Grant covering up to 400,000 yen (\$3,700) charger expenses <sup>g</sup>
<b>Electric vehicle-ready building code</b>	Xi'an	All new residential building spots (30% parking in new areas) equipped with chargers or wiring <sup>h</sup>
<b>Charging infrastructure strategy</b>	Oslo	Detailed modeling of public charging needs by neighborhood <sup>i</sup>
<b>City fleet electrification goal</b>	San Francisco	City commits to electrifying its light-duty passenger vehicle fleet by 2022 <sup>j</sup>
<b>Taxi electrification goal</b>	Hangzhou	Taxi fleets to be 100% electric by the end of 2021 <sup>k</sup>
<b>Ride-hailing electrification goal</b>	Shenzhen	Ride-hailing fleets to be 100% electric by the end of 2020 <sup>l</sup>
<b>Electric car-sharing program</b>	Shanghai	EVCARD, largest global electric car sharing company, expanded to other cities <sup>m</sup>
<b>100% electric bus goal</b>	Amsterdam	All buses zero-emission by 2025 (earliest date for a major city in Europe) <sup>n</sup>
<b>100% electric buses achieved</b>	Guangzhou	Second major global city to fully electrify bus fleet, with 11,200 electric buses <sup>o</sup>
<b>Vehicle purchase incentive</b>	Paris	Company vehicles and taxis eligible for grant of up to €6000 <sup>p</sup>
<b>License plate preferential access</b>	Shanghai	Electric cars exempted from license plate auction (valued at 89,653 yuan) <sup>q</sup>
<b>Electric vehicle parking perks</b>	San Jose	Free parking in municipal garages and at metered street parking spaces <sup>r</sup>
<b>Access to bus/carpool lanes</b>	Liuzhou	Electric two-seaters have access to bus lanes <sup>s</sup>
<b>Toll/bridge/ferry discounts</b>	Chongqing	New energy vehicles bought by 2020 exempt from toll road and bridge charges <sup>t</sup>

a San Francisco Mayor's electric vehicle working group, "Proposed electric vehicle roadmap for San Francisco" (2019), [https://sfenvironment.org/sites/default/files/liers/files/sfe\\_tr\\_ev-roadmap.pdf](https://sfenvironment.org/sites/default/files/liers/files/sfe_tr_ev-roadmap.pdf)

b Los Angeles Mayor's Office of Sustainability, "L.A.'s Green New Deal" (2019), [https://plan.lamayor.org/sites/default/files/pLAn\\_2019\\_final.pdf](https://plan.lamayor.org/sites/default/files/pLAn_2019_final.pdf)

c Greater London Authority, "Mayor's Transport Strategy" (London, March 2018), <https://www.london.gov.uk/what-we-do/transport/our-vision-transport/mayors-transport-strategy-2018>

d Bergen Kommune, "Green Strategy Climate and Energy Action Plan for Bergen" (Bergen, Norway, September 21, 2016), <https://www.bergen.kommune.no/publisering/api/filer/T538064818>

e C40 Cities. Our commitment to green and healthy streets. <https://www.c40.org/other/green-and-healthy-streets>

f Beijing Municipal Management Commission, "规范性文件图解——《2019-2020年度北京市电动汽车社会公用充电设施运营考核奖励实施细则》的解读 [2019-2020 Beijing Electric Vehicle Social Public Charging Facilities Operation Assessment and Reward Implementation Rules]", (March 31, 2020), [http://csglw.beijing.gov.cn/zwx/zcwj/zcjd/wjld/202003/t20200331\\_1771273.html](http://csglw.beijing.gov.cn/zwx/zcwj/zcjd/wjld/202003/t20200331_1771273.html)

g "Tokyo CO2 down, Project to promote electric vehicles - external power supply [電気自動車等の普及促進事業 (外部給電器)]", accessed August 4, 2020, <https://www.tokyo-co2down.jp/individual/subsidy/ev-feed/index.html>

h "西安市人民政府办公厅关于印发进一步加快新能源汽车推广应用的实施方案的通知 [Notice of the General Office of the Xi'an Municipal People's Government on Issuing the Implementation Plan for Further Accelerating the Promotion and Application of New Energy Vehicles]", China New Energy Vehicle Network (August 4, 2017), <http://www.chinanev.net/news/newscontent/id/14433>

i Bymiljøetaten, Oslo kommune, "Kartlegging av ladebehov i Oslo kommune" (Oslo, November 28, 2019), [https://www.oslo.kommune.no/getfile.php/13354701-1576848117/Tjenester\\_og\\_tilbud/Gate\\_transport\\_og\\_parkering/Parkering/Kartlegging\\_av\\_ladebehov\\_i\\_Oslo\\_kommune.pdf](https://www.oslo.kommune.no/getfile.php/13354701-1576848117/Tjenester_og_tilbud/Gate_transport_og_parkering/Parkering/Kartlegging_av_ladebehov_i_Oslo_kommune.pdf)

j The Department of the Environment City and County of San Francisco, "San Francisco's Electric Vehicle Ready Community Blueprint" (San Francisco, July 2019), [https://sfenvironment.org/sites/default/files/editor-uploads/transportation\\_vehicle/san\\_francisco\\_ev\\_blueprint.pdf](https://sfenvironment.org/sites/default/files/editor-uploads/transportation_vehicle/san_francisco_ev_blueprint.pdf)

k "近3年发财政补贴超8亿元, 杭州将持续推广新能源车 [Three years to issue financial subsidies of over 800 million yuan, Hangzhou will continue to promote new energy vehicles]", Huitong Finance International (August 31, 2018), <https://www.fx678.com/C/20190831/201908311628272060.html>

l "深圳市网约车将于2021年全面开启电动化 [Shenzhen online car-hailing fully electric in 2021]", New Energy Automobile Network (July, 2020), <https://m.xnyauto.com/news/35577.html>

m "About EV Card," EVCARD (accessed August 5, 2020), <https://www.evcard.com/about/>

n City of Amsterdam, "Clean Air Action Plan" (Amsterdam, April 2019), <https://www.amsterdam.nl/en/policy/sustainability/clean-air/>

o "Cities100: Citywide rapid bus electrification in Guangzhou," C40 Knowledge Hub (October 2019), [https://www.c40knowledgehub.org/s/article/Cities100-Citywide-rapid-bus-electrification-in-Guangzhou?language=en\\_US](https://www.c40knowledgehub.org/s/article/Cities100-Citywide-rapid-bus-electrification-in-Guangzhou?language=en_US)

p "Acquisition de véhicules propres par les TPE et PME franciliennes [Acquisition of clean vehicles by VSEs and SMEs in Ile-de-France]," Régional Ile-de-France (accessed August 5, 2020), <https://www.iledefrance.fr/acquisition-de-vehicules-propres-par-les-tpe-et-pme-franciliennes>

q "2019年上海拍牌情况统计 [Statistics of Shanghai licensing in 2019]," Shanghai Local Treasury Synthesis (January 16, 2020), <http://sh.bendibao.com/zffw/20191117/212994.shtml>

r "ParkSJ Clean Air Program," San Jose Downtown Business Association (accessed August 5, 2020), <https://parksj.org/parking-programs-services/clean-air-program/>

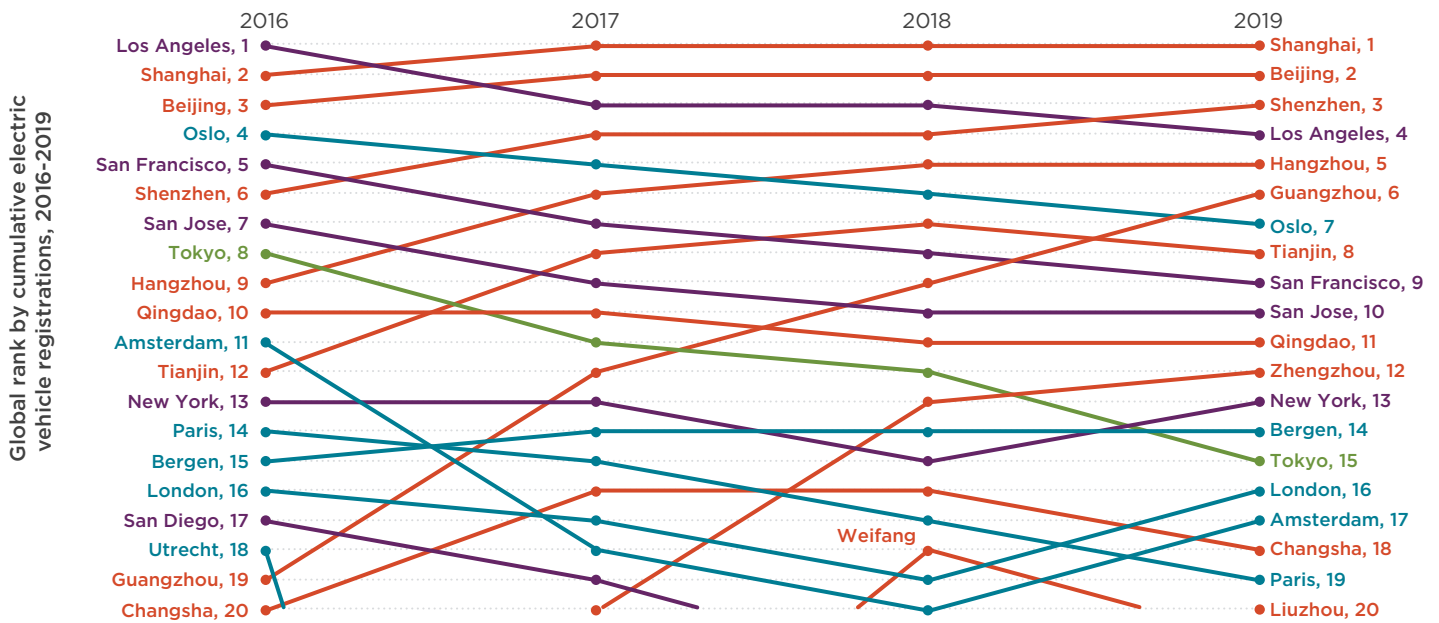
s "柳州新能源汽车福利: 7月1日起能走公交专用道 [Liuzhou New Energy Vehicle Welfare: Can use the bus lane from July 1]," Liuzhou Daily (June 29, 2017), [http://gx.sina.com.cn/news/gx/2017-06-29/detail-ifyhrxsk1432195.shtml?from=gx\\_cnxh](http://gx.sina.com.cn/news/gx/2017-06-29/detail-ifyhrxsk1432195.shtml?from=gx_cnxh)

t "在重庆买新能源汽车 2020年12月31日前免缴路桥费 [New energy vehicles in Chongqing are exempt from road and bridge tolls before December 31, 2020]," Chongqing Evening News (January 3, 2020), <https://auto.huanqiu.com/article/9CaKrnJZwhf>

## TRENDS AMONG THE WORLD'S ELECTRIC VEHICLE CAPITALS

While the global electric vehicle market has grown and evolved, a small number of cities have consistently led the world in the transition toward all-electric vehicle sales as well as in developing supporting policies and charging infrastructure. This section discusses the evolution of electric vehicle sales in some of the electric vehicle capitals from 2015 to 2019, and compares and contrasts the trends in different cities.

Figure 6 illustrates the rankings of the 20 largest local-level electric vehicle markets from 2016 through 2019, measured by cumulative new electric passenger vehicles in each year. The top 20 metropolitan-area levels in 2016 and 2019 are labeled, with lines connecting their positions in the intervening years. Red lines and markers correspond to cities in China, purple to the United States, blue to Europe, and green to Japan, as in previous figures.

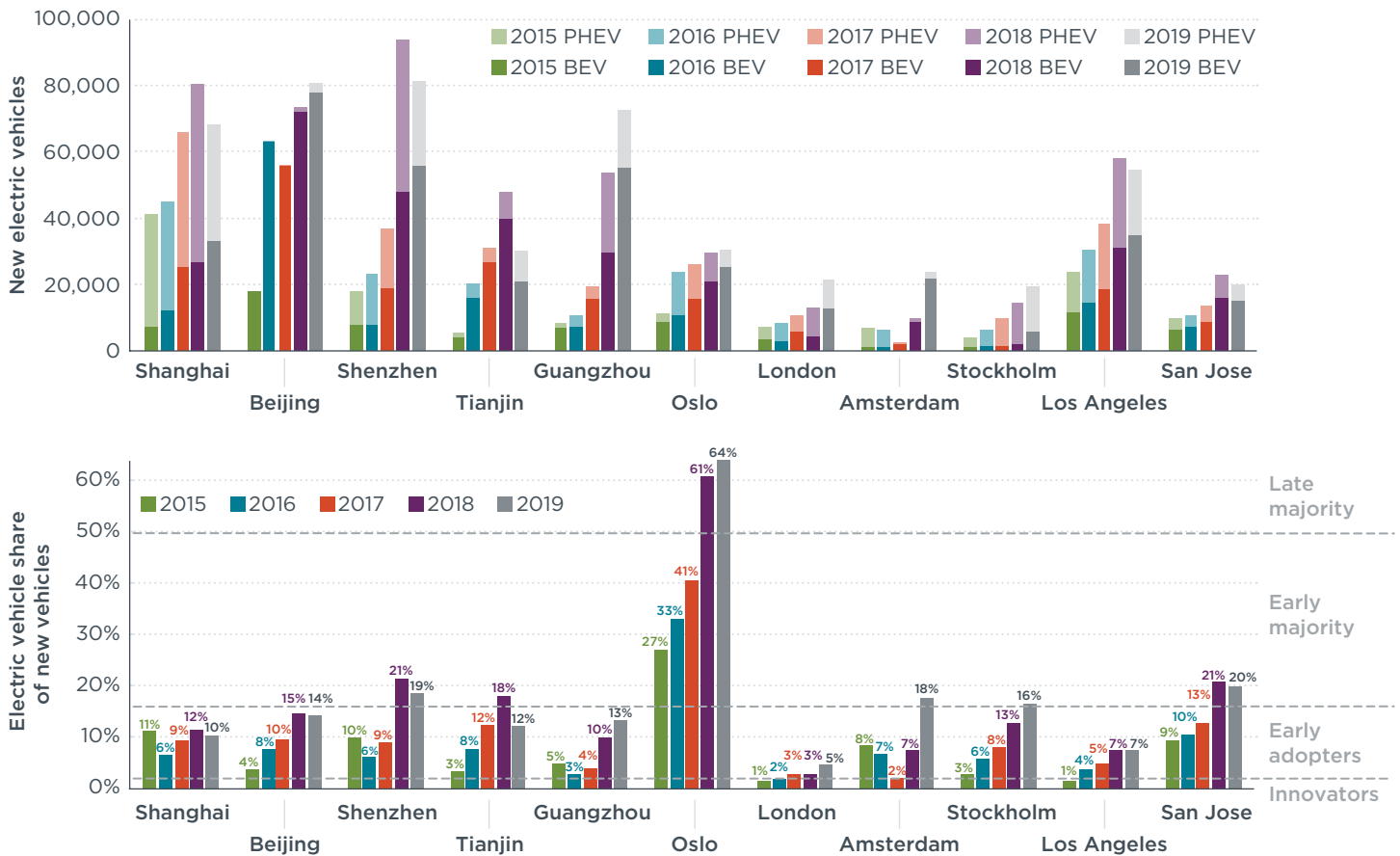


**Figure 6.** Global ranking of metropolitan areas by electric passenger vehicle stock from 2016-2019.

Figure 6 shows the continuing growth of the electrical vehicle market in cities in China, with the neighboring cities of Shenzhen and Guangzhou each moving up in the rankings. New York, London, and Amsterdam also moved up multiple spots from 2018. Some markets from the top-20 electric markets in 2016 have since dropped out (San Diego, Utrecht), while others have newly entered the top 20 (Zhengzhou, Liuzhou). Eighteen of the top 20 cities in 2016 were also in the top 20 in 2019, indicating that sustained activities in these cities are enabling sustained high sales.

Analyzing the relative year-to-year electric shares and sales growth shows the relative historical growth in a selection of the markets. Figure 7 illustrates the growth in new electric vehicles (top) and electric vehicle shares of new vehicles (bottom) for five markets in China, four in Europe, and two in the United States from 2015 through 2019.<sup>19</sup> In the top figure, the darker bars represent new BEVs and the lighter bars represent new PHEVs.

<sup>19</sup> New vehicle registration data are from Bui, Slowik, and Lutsey, *Update on electric vehicle adoption across U.S. cities*; Hall, Cui, and Lutsey, *Electric Vehicle Capitals: Showing the Path to a Mainstream Market*; Norsk Elbilforening; and China Automotive Technology and Research Center



**Figure 7.** Electric passenger vehicle registrations and share of new vehicles in selected metropolitan areas for 2015-2019.

Shown to the right side of the bottom figure are the consumer market categories from the Rogers’ “diffusion of innovation” framework,<sup>20</sup> where the first 2.5% of the market are “innovators,” followed by the next 13.5% as “early adopters,” and the following 34% as the “early majority.” Within this framework, the diffusion of electric new vehicle sales in most markets around the world is still largely in the innovator category, and most electric vehicle capitals are in the early adopters phase. However, in the local markets of Shenzhen, Amsterdam, Stockholm, and San Jose (as well as Liuzhou, not shown), electric vehicle adoption is progressing past early adopters to the early majority phase of new vehicle buyers. Oslo (along with Bergen, not shown) has pushed into the late majority phase.

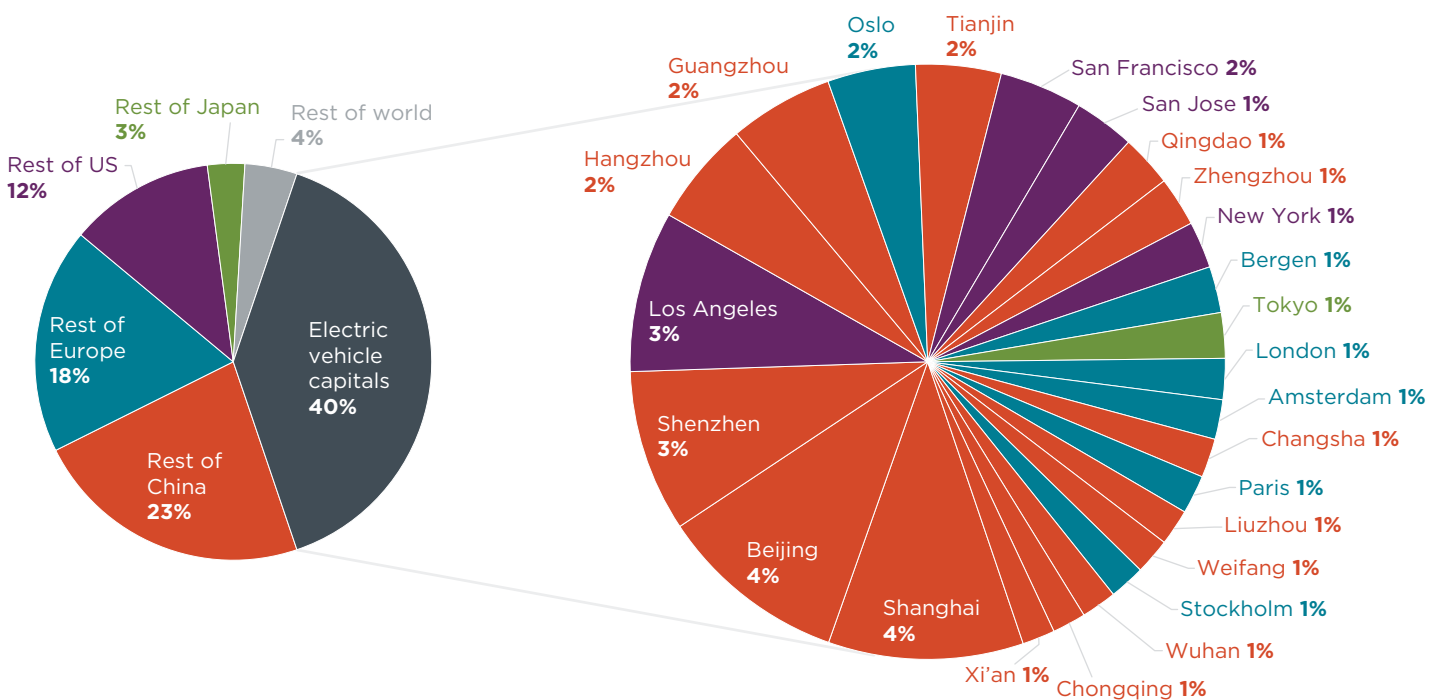
Figure 7 offers several insights into electric vehicle growth patterns. While the global electric vehicle market has slowed in 2019, there were stark regional differences. Some cities, such as Shanghai, Tianjin, and Los Angeles, saw significant drops in registrations from 2018 to 2019. Others continued their growth trajectories, including all of the cities in Europe as well as Guangzhou. Because many cities also saw disruption in the broader passenger vehicle market, changes in registrations did not always line up with changes in registration shares. This has been the case with Oslo (flat registrations but increasing share), Beijing (increasing registrations but flat share), and Los Angeles (decreasing registrations but flat share).

20 Everett M. Rogers, *Diffusion of innovations*, (Free Press of Glencoe: New York, 1962)

While there has been little variation in the composition of the electric vehicle capitals, their share of global electric vehicle market has shown a consistent, if gradual, decrease over the past 4 years. The cumulative electric vehicle sales in these 25 cities represented 45% of the world's total through 2016, 44% through 2017, 42% through 2018, and 40% through 2019. This indicates that the electric vehicle market is expanding beyond these large, influential cities, with many small cities and even rural areas growing at a faster rate than the electric vehicle capitals. This reflects how 100% electric goals and supporting electric vehicle policies, originally developed in the electric vehicle capitals, are expanding to more markets.<sup>21</sup>

## CONCLUSIONS

This briefing compiles data on electric passenger vehicle sales, infrastructure, goals, and policies in the 25 largest electric vehicle markets at the metropolitan area level through 2019. Uncertainties remain regarding how the industry and the market will evolve, but this briefing points to many actions that will remain important to sustaining electric vehicle growth through the economic recovery in 2020 and beyond. As shown in Figure 8, the 25 electric capitals made up 40% of cumulative global electric passenger vehicle sales through 2019. Of these 25 markets, 14 are in China, 6 are in Europe, 4 are in the United States, and 1 is in Japan.



**Figure 8.** Global electric vehicles in 25 electric vehicle capitals as a share of the global electric vehicle stock.

From this research, we draw the following conclusions:

*Cities are aiming for 100% electric mobility.* Cities are signaling there will be no place for vehicle emissions on their streets in the years ahead. Of the 25 electric vehicle capitals, 17 have established 100% electric bus targets. Ten of the 25 cities, all in Europe

<sup>21</sup> Cui, Hall, & Lutsey, *Update on the Global Transition to Electric Vehicles through 2019*

or the United States, have 100% electric vehicle goals for passenger vehicles. As the cities in China draft their next Five-Year Plans in 2020-2021, they have an opportunity to accelerate electrification by establishing their own goals. Thirteen cities in China have low-emission zones, which could be progressively strengthened and pave the way for zero-emission areas. In addition, four of the global electric capitals also have exemplary building codes that require 100% of spaces within specified building types be electric vehicle-ready. Many cities also have policies to convert municipal, taxi, and ride-hailing fleets to all-electric. Setting all-electric goals is a critical first step for cities to set follow-on action plans, policies, and city agency responsibilities.

*Major markets are adopting similar policies and seeing market success.* The cities are backing up their bold electric vehicle goals with policy and promotion actions. The electric vehicle capitals are implementing actions concerning city planning, infrastructure, incentives, and fleets to pave the way for an all-electric future. Increasingly, cities with zero-emission goals are conducting major planning efforts that identify city agency roles and new city policies and infrastructure programs to break down consumer barriers. At the same time, different regions are also developing unique solutions based on their regulatory authorities; for example, licensing restrictions have created a powerful incentive for electric vehicles in cities in China, while cities in Europe are promoting electric vehicles through city access restrictions and congestion charges. These cities' actions are paying off: Through 2019, the 25 electric vehicle capitals made up 40% of cumulative global electric passenger vehicle sales, despite having just 4% of the world's population and 12% of the new passenger vehicle sales. The markets of Bergen (with 67% electric share), Oslo (64%), Liuzhou (24%), San Jose (20%), Shenzhen (19%), Amsterdam (18%), and Stockholm (17%) each had at least five times the global electric vehicle uptake of 3% in 2019.

*Policies continue to evolve to fit a mainstream market.* Seven of the electric vehicle capitals have moved from “early adopters” to the mainstream new car buyer market, with others poised to enter mainstream adoption in the coming years. As such, cities are adjusting their policies to further incentivize market growth while limiting government outlays. Most electric vehicle capitals have ended or restricted access to city-level financial incentives, and benefits such as toll discounts and access to bus or carpool lanes are gradually being scaled back. In contrast, cities are strengthening building codes with 100% electric vehicle-ready requirements and developing long-term infrastructure plans to ensure a more robust charging infrastructure network for a broader market. As cities work toward an eventual phase-out of combustion vehicles, key areas of focus are implementing and expanding low- and zero-emission zones and accelerating the electrification of shared fleets with high annual use.

*The global electric vehicle market is spreading beyond the largest cities.* The 25 largest metropolitan area-level electric vehicle markets contained 40% of the world's passenger electric vehicle stock as of the end of 2019—this share has steadily declined each of past four years since reaching 45% in 2016. The same cities contained 34% of new passenger electric vehicle sales in 2019. The leading cities are no longer growing at a faster pace than the rest of the world, as smaller cities and even some rural areas are now experiencing electric growth. This is especially the case in China, where uptake is increasing in many cities beyond those highlighted in this report. As the world transitions to electric vehicles, the electric vehicle capitals may stand out less in terms of vehicle numbers, yet their innovative policies and mainstream electric vehicle market success still provide valuable lessons.