BRIEFING

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Electric vehicle capitals: Accelerating electric mobility in a year of disruption

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This briefing provides an update on the 25 largest electric passenger vehicle markets worldwide, which together represent 32% of 2020 global new electric vehicle sales and 34% of global electric passenger vehicles on the roads. We analyze their electric vehicle uptake, charging infrastructure development, electrification goals, planning, and incentives to draw lessons to assist local governments in their transition to electric mobility. Electric vehicles in this paper include battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs).

INTRODUCTION

Despite the 15% drop in vehicle sales worldwide in 2020 due to the global pandemic, the electric vehicle (EV) market continued to grow, with a 42% increase in EV sales compared to 2019.[1] This growth has been spurred by strong government policies, among which green economic recovery packages and strong vehicle emission standards played a major role, particularly in Europe. Figure 1 displays the growth in new electric passenger vehicle sales by market from 2010 to 2020. 2020 was a record-breaking year for EVs with annual sales exceeding 3 million, representing 5% of global new passenger vehicle sales.[2]

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1 Hongyang Cui, Dale Hall, Jin Li, and Nic Lutsey, *Update on the global transition to electric vehicles through 2020*, (ICCT: Washington DC, 2021), https://theicct.org/publications/global-update-evs-transition-oct21.

2 Data obtained from EV-Volumes.com, (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.

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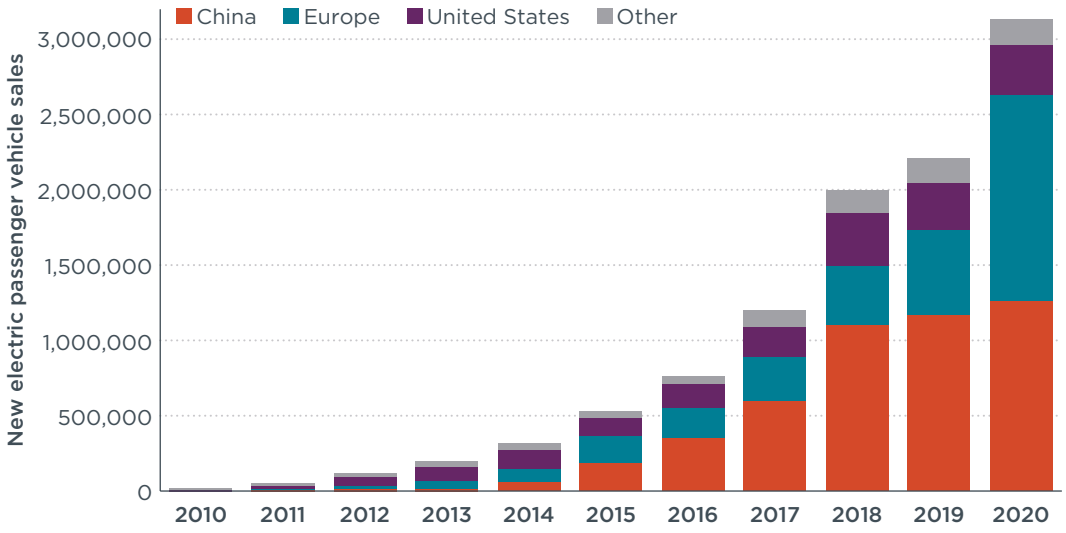

Figure 1. Global new electric passenger vehicle sales by market from 2010 to 2020

The growth in EV sales in 2020 was led by Europe, which saw a 143% increase in sales from 2019, the largest of all markets presented in Figure 1. Strong European economic recovery packages including financial incentives and industrial policy, along with European Union regulations on vehicle CO_2 emission standards, have made Europe the largest single market of electric vehicles, surpassing China by almost 100,000 units. While all markets shown in the figure saw a decrease in overall passenger car sales in 2020, EV sales increased in every market displayed above. Absolute new EV sales in China, the United States (U.S.), and the rest of the world increased by 8%, 4%, and 1% respectively. This growth was made possible thanks to national and European Union-level policies and actions, but metropolitan areas and cities play a key role as well in the electric mobility transition.[3]

This briefing analyzes the contribution of leading cities to the global electric vehicle market and the factors behind their success. We identify the 25 leading metropolitan areas in new electric passenger vehicle registrations in 2020, which we call "electric vehicle capitals": Beijing, Changsha, Chengdu, Chongqing, Guangzhou, Haikou, Hangzhou, Liuzhou, Shanghai, Shenzhen, Suzhou, Tianjin, and Zhengzhou in China; Amsterdam, the Netherlands; Bergen and Oslo, Norway; London, United Kingdom; Paris, France; Stockholm, Sweden; Stuttgart, and Munich, Germany; Seoul, South Korea; and Los Angeles, San Francisco, and New York in the United States. This list has changed significantly from the previous year[4] with 6 cities making their debut in this ranking: Stuttgart and Munich, Germany; Seoul, South Korea; and Chengdu, Haikou,

3 Marie Rajon Bernard, Dale Hall, and Nic Lutsey, *Update on Electric Vehicle Uptake in European Cities*, (ICCT: Washington DC, 2021), https://theicct.org/publications/ev-uptake-eu-cities-oct21.

4 Dall Hall, Hongyang Cui, Marie Rajon Bernard, Shuyang Li, and Nic Lutsey, *Electric vehicle capitals: Cities aim for all-electric mobility*, (ICCT: Washington DC, 2021), https://theicct.org/publications/electric-vehicle-capitals-update-sept2020.

and Suzhou, China.[5] These metropolitan areas are replacing San Jose, United States; Tokyo, Japan; and Qingdao, Weifang, Wuhan, and Xi'an, China.

The ranking methodology differs slightly from previous years, which were based on cumulative registrations. This change was made because the EV market has rapidly evolved in 2020 and leading EV markets with strong policies and programs in favor of passenger car electrification are better represented by absolute 2020 new electric vehicle registrations than by cumulative EV registrations through 2020.

Unless otherwise noted, this briefing focuses on light-duty passenger vehicles (passenger cars, including SUVs, in Europe, South Korea, and China, and cars and light trucks in the United States). These vehicles represent the greatest share of fuel consumption and greenhouse gas emissions in the transport sector, and are the vehicle segment showing the most market progress.[6] In this report, new electric vehicle registrations are considered a proxy for new electric vehicle sales. In some cities, many cars may be registered by vehicle manufacturers (Daimler in Stuttgart and BMW in Munich, for example) or other large fleets, but may be moved and used elsewhere. For example, company cars and rental cars may be registered at company headquarters but used in some other locale. Finally, fuel-cell electric passenger vehicles are not included in this analysis because they represented less than 0.1% of new sales in 2020 in every market.

ELECTRIC VEHICLE SALES

The 25 electric vehicle capitals were selected based on the absolute number of electric vehicles sold in 2020. Figure 2 presents the 2020 registrations distinguished between plug-in hybrid (light blue) and battery electric (dark blue) vehicles for the left axis and the 2020 share of electric vehicle registrations (red diamond and right axis).[7] Altogether, these cities represent 32% of 2020 global electric vehicle registrations and 13% of 2020 global passenger vehicle registrations, yet only 4% of the world's population.

5 In Europe, metropolitan areas are NUTS3 regions or a combination of NUTS3 regions which represent all agglomerations of at least 250,000 inhabitants: Eurostat. "Background - Metropolitan Regions," n.d. https://ec.europa.eu/eurostat/web/metropolitan-regions/background.
In China, EV capital boundaries are the same as city boundaries, i.e. they include the city center (also called urban area) and all districts government surrounding the city.
In the United States, metropolitan areas are defined as standardized county or equivalent-based areas having at least one urbanized area of 50,000 or more population, plus adjacent territory that has a high degree of social and economic integration with the core, as measured by commuting ties. "Metropolitan Areas Delineation Files," Census.gov., accessed November 15, 2021, https://www.census.gov/geographies/reference-files/time-series/demo/metro-micro/delineation-files.html.
The Seoul metropolitan region encompasses the 3 provinces of Seoul, Incheon, and Gyeonggi-do, "Seoul Capital Area," in *Wikipedia*, September 25, 2021, https://en.wikipedia.org/w/index.php?title=Seoul_Capital_Area&oldid=1046377497.

6 Drew Kodjak, "A Strategy to Decarbonize the Global Transport Sector by 2050, Explained." *ICCT Staff Blog* (blog), May 7, 2021, https://theicct.org/blog/staff/vision2050-explained-may2021.

7 Rajon Bernard, Marie, Dale Hall, and Nic Lutsey. "Update on Electric Vehicle Uptake in European Cities." Washington, D.C.: International Council on Clean Transportation, October 8, 2021. https://theicct.org/publications/ev-uptake-eu-cities-oct21; Anh Bui, Peter Slowik, and Nic Lutsey, *Update on Electric Vehicle Adoption across U.S. Cities*, (ICCT: Washington DC, 2020), https://theicct.org/publications/ev-update-us-cities-aug2020; California Energy Commission, "Zero Emission Vehicle and Infrastructure Statistics," accessed in September 2021, https://www.energy.ca.gov/data-reports/energy-insights/zero-emission-vehicle-and-charger-statistics; Automotive Data Center of China Automotive Technology and Research Center (CATARC), "Market Data China Automative Technology - 市场数据-中汽数据有限公司." http://www.catarc.info/scsj/.

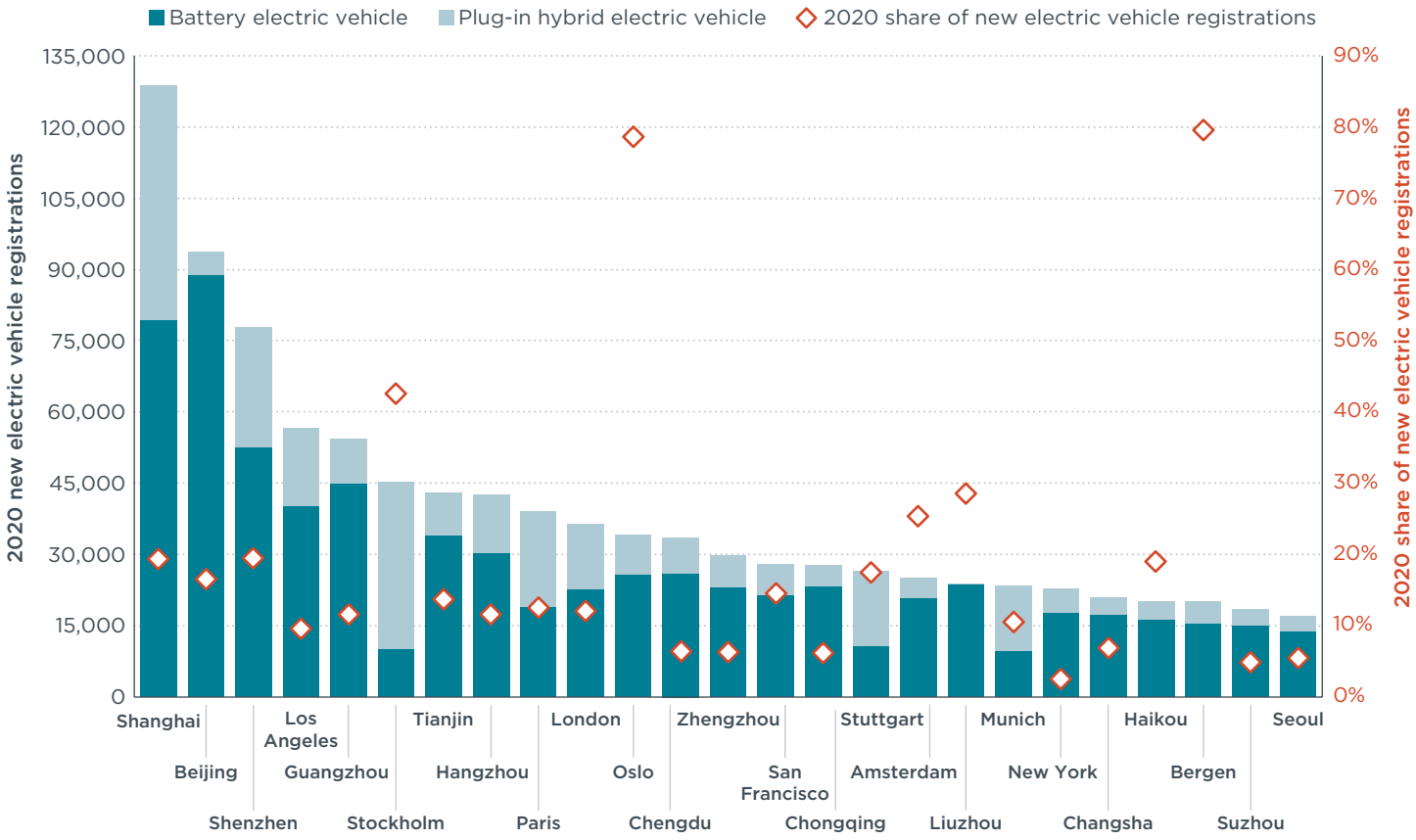

Figure 2. 2020 number of electric vehicles registered (left axis) and share of electric vehicle registrations (right axis) for the 25 electric vehicle capitals

Each of the electric vehicle capitals had more than 17,000 new electric vehicles registered in 2020, representing between 2.5% (New York) and 80% (Bergen) of their respective total passenger car registrations. Shanghai is leading in absolute EV registrations with close to 129,000 units, of which 79,500 are battery electric vehicles, followed by Beijing (93,600 units) and Shenzhen (77,900 units). When focusing on battery electric vehicle registrations, Beijing maintains its lead from previous years with 88,900 units.

In terms of the electric vehicle share of new vehicle registrations, European cities are leading, with EV registration shares of at least 10.5% in 2020. The two Norwegian cities, Bergen and Oslo, maintain a large lead in registration share with both close to 80%, followed by Stockholm (Sweden) with 43% and Liuzhou (China) with 29%. 17 EV capitals had EV registration shares above 10%, compared to 13 in 2019.

The composition of EV markets by powertrain varies across the 25 EV capitals. In 21 cities BEV were the most popular type. BEVs accounted for more than 80% of new EV sales in 9 cities: Amsterdam, the Netherlands; Beijing, Changsha, Chongqing, Guangzhou, Haikou, Liuzhou, and Suzhou China; and Seoul, South Korea. In contrast, in 4 European cities, (Munich and Stuttgart, Germany; Paris, France; and Stockholm, Sweden), PHEVs were the majority of EV sales in 2020. The higher PHEVs shares can be explained by multiple factors, including high PHEV subsidies, a large number of credits allocated to PHEVs in the European CO_2 standards, some European manufacturers producing more PHEVs than BEVs, and a large share of company cars for which the fuel is paid by the company and not necessarily the home electricity.

TRENDS AMONG THE WORLD'S ELECTRIC VEHICLE CAPITALS

The ranking criteria has been updated compared to last year to focus on the global metropolitan areas with the most new EV registrations in the past year, rather than those with the most cumulative registrations. This new ranking prioritizes the cities experiencing the fastest recent EV market growth in order to identify effective policy developments and market and infrastructure trends, rather than cities which may have had higher EV sales in previous years but may not have performed as strongly in 2020.

Despite this change in methodology, 19 of the 25 EV capitals are veterans of the previous edition. As in previous years, approximately half of the EV capitals are in China, the largest share of any region. Haikou, capital city of Hainan province, the EV front runner in China,[8] made its debut with a 19% EV registration share, representing around 20,000 EVs sold in 2020. However, one of the most apparent trends in 2020 was that European markets have performed particularly well, with 8 European cities among the 25 capitals in 2020 compared to 6 in 2019. Stuttgart and Munich, parts of the European-leading EV market of Germany, made their debut with 17.5% and 10.6% of EV registrations in 2020. Other noteworthy changes include Tokyo, which exited the list of EV capitals; its 0.6% EV registration share, representing about 5,700 EVs sold in 2020, was the lowest share and volume since 2016. The Seoul metropolitan area made its entrance with more than 17,000 EVs sold, representing 5.5% of registrations.

Figure 3 below provides a focus on the evolution of the electric vehicle market for the 10 EV capitals with the highest 2020 absolute EV registrations. The top figure displays the evolution of the absolute EV registrations from 2016 to 2020 in dark shade for BEVs and light shade for PHEVs and the bottom figures focuses on EV registration share. The color scheme is the same as in previous figures, with red representing cities in China, purple for cities in the U.S., and blue for cities in Europe.

8 Jin Li, and Hongyang Cui, Update on Hainan's progress towards its 100% EV ambition through 2020, International Council on Clean Transportation, forthcoming.

Figure 3. New electric vehicle registrations (top) and share of registrations (bottom) from 2016 to 2020 for the 10 EV capitals with the highest 2020 absolute EV registrations

Several insights can be drawn from Figure 3. After some markets in the U.S. and China experienced a slowdown in 2019, EV share of registrations and absolute EV registrations increased in most markets in 2020 despite the effects of the COVID-19 pandemic. The most dramatic market changes were in Europe, where Stockholm, Paris, and London all more than doubled their EV share of registrations compared to 2019. Among the metropolitan areas highlighted in Figure 3, Paris had the highest proportional increase from 2019 in both absolute EV registrations (2.4 times higher) and EV share of registrations (3.1 times higher). While not shown on these graphs, Stuttgart had the highest proportional increase of all EV capitals from 2019, in terms of both EV share of registrations (5.2 times higher) and absolute EV registrations (4.1 times higher). These 10 metropolitan areas are home to 23% of all EVs registered worldwide through 2020 and 20% of EVs registered in 2020. For all 25 electric

vehicle capitals, the share increases to 34% of EVs worldwide and 32% of 2020 EV registrations.

CHARGING INFRASTRUCTURE

A reliable and dense charging infrastructure network is a key factor in the broad transition to electric mobility, and local governments have a critical role to play in this. While charging deployment strategies and needs vary significantly depending on local policies, housing, and transport patterns,[9] all EV capitals are taking actions to efficiently plan for and implement public charging infrastructure.

Figure 4 displays the absolute number of public normal (also called L2) and fast chargers, the number of public chargers per million population, and the number of EVs per charger, for each EV capital with available data. Data for some EV capitals in China were not available and are missing from the Figure. Metropolitan areas are ordered by markets and then decreasing number of public chargers per million population from top to bottom.

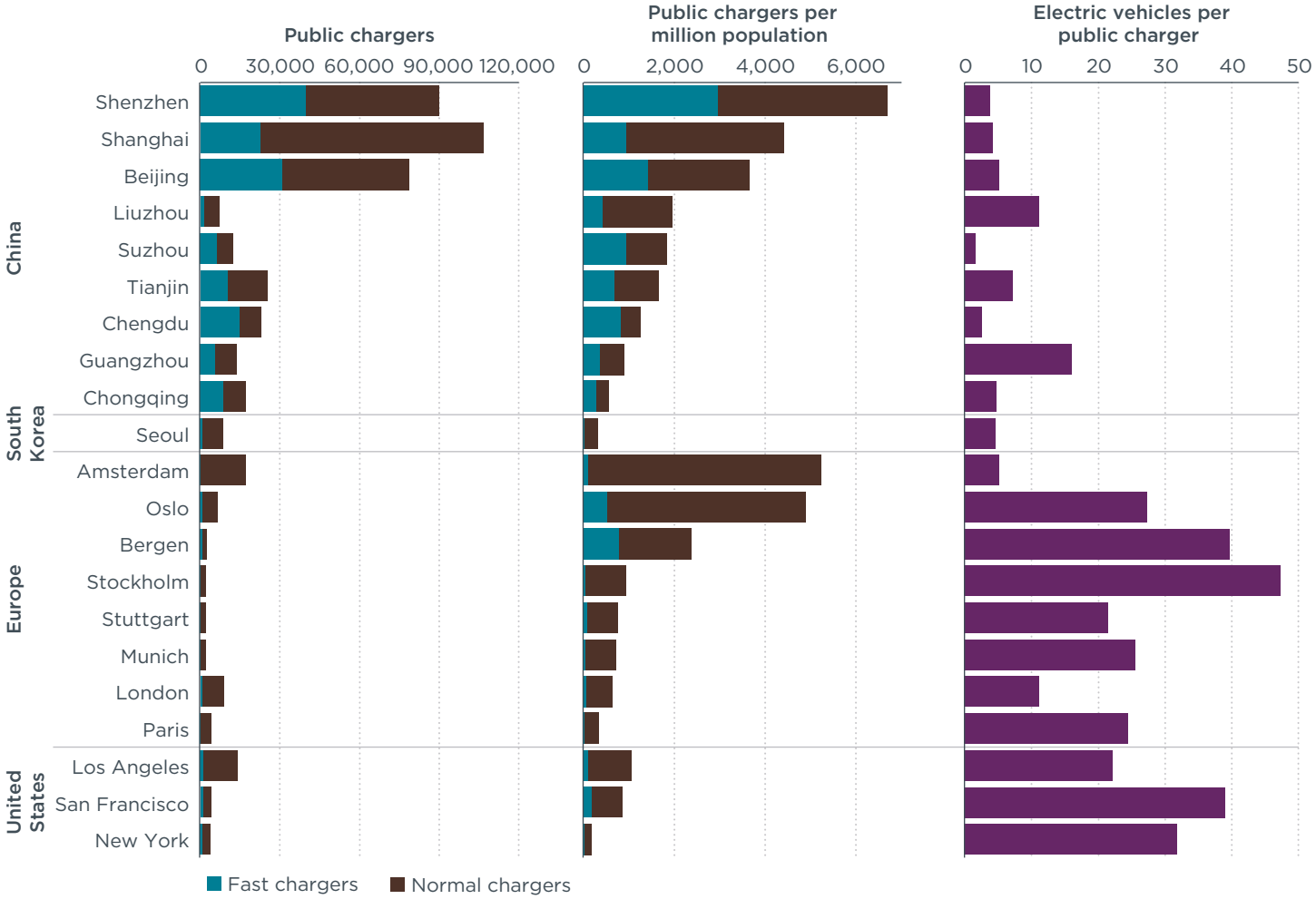

Figure 4. Public charging infrastructure deployment in the electric vehicle capitals through 2020

Figure 4 shows that there is no "one-size-fits-all" solution for the amount and type of chargers needed. The local charging ecosystem depends on factors such as EV owners' housing types, vehicle mix (BEV vs PHEV), land availability, driving patterns, and city strategies. For example, in Seoul, Amsterdam, and most Chinese cities, most EV

9 Dale Hall and Nic Lutsey, *Charging Infrastructure in Cities: Metrics for Evaluating Future Needs*, (ICCT: Washington DC, 2020), https://theicct.org/publications/EV_charging_metrics_aug2020.

drivers do not have access to private parking and thus rely heavily on public charging, resulting in some of the lowest EV per charger ratios.

The metropolitan areas with the highest 2020 EV share of registrations also tend to have the highest public chargers per million population. This shows that EV uptake increases in parallel with high charging infrastructure deployment. For example, in Europe, Bergen and Oslo had the two highest shares of EV registrations in 2020 and rank 2nd and 3rd in public chargers per million population. Similarly, in China, Shenzhen and Shanghai rank 1st and 2nd in terms of public chargers per million population and 2nd and 3rd in terms of 2020 share of EV registrations, after Liuzhou.

PATTERNS OF GROWTH IN THE EV CHARGING NETWORK DURING 2020

Partly due to the COVID-19 pandemic, in European and U.S. cities, the 2020 rate of growth in charging infrastructure networks was slower than the rate of growth of the electric passenger car fleet. As previously discussed, the metropolitan areas highlighted in this report, especially in Europe, saw a substantial increase in EV registrations and thus EVs on the roads in 2020. This led to higher EVs per charger ratios in 2020 compared to 2019. As an example, while the Paris metropolitan area had around 15 EVs per charger in 2019, this ratio increased to 24 for 2020.

In contrast, charging infrastructure rollout in China expanded dramatically in 2020 with 284,000 new public chargers installed, resulting in a total of 800,000 public EV chargers at the end of 2020.[10] This charging infrastructure rollout was led by cities and as a result, the EVs per charger's ratio decreased for most cities in China. As an example, the number of EVs per charge point in Beijing decreased from 12 in 2019 to 5 in 2020. More generally, as shown in Figure 4, Chinese EV capitals have among the lowest EV per charger ratios of all EV capitals. It is important to note that Chinese cities generally need more public charging infrastructure than U.S. cities, for example. Indeed, in China, most EVs are owned by apartment dwellers while in the U.S. more drivers live in detached houses with easier access to off-street parking and thus home charging. China's successful 2020 rollout can also be attributed to its strategy. China released its New Infrastructure Strategy in 2020 with a section dedicated to electric vehicle charging infrastructure in order to build charging infrastructure ahead of drivers demand.[11] South Korea also performed well in charging infrastructure deployment with a 45% increase in the number of slow chargers installed, reaching 54,000 units.[12]

Electric vehicle charging infrastructure rollout has been supported by many policies and strategies at the national and local levels. These actions, along with other key policies adopted by the electric vehicle capitals to spur EV uptake, are described in the following section.

SUPPORTING POLICIES AND ACTIONS

Efficiently and quickly transitioning to electric vehicles requires strong policies and actions. Common policy approaches have emerged across different cities, and lessons can be drawn from these leading markets. The EV capitals have supported EV uptake through a range of measures ranging from financial and non-financial

10 Colin McKerracher, "Charging up China," *Bloomberg.Com*, March 23, 2021, https://www.bloomberg.com/news/newsletters/2021-03-23/charging-up-china.

11 State Council, "国务院办公厅关于印发新能源汽车产业发展规划（2021—2035年）的通知（国办发（2020）39号）_政府信息公开专栏 - The General Office of the State Council on Printing and Distributing the New Energy Automobile Industry Notice of Development Plan (2021-2035)," October 20, 2020, http://www.gov.cn/zhengce/content/2020-11/02/content_5556716.htm.

12 International Energy Agency, "Global EV Outlook 2021," 2021, 101, https://iea.blob.core.windows.net/assets/ed5f4484-f556-4110-8c5c-4ede8bcba637/GlobalEVOutlook2021.pdf.

incentives, fleets electrification goals, and zero-emission zone planning, to charging infrastructure deployment strategies and consumer awareness programs, which are all discussed below.

Purchase incentives. Purchase incentives have been key for all markets to spur EV uptake in early years. Vehicle purchase incentives are generally distributed by national governments. However, some cities also offer subsidies: For example, given that a high share of electric cars is purchased by companies, especially in Europe, Paris offers companies a subsidy up to €6,000 for the purchase of a new EV which can be combined with the national subsidy. Paris metropolitan region also offers subsidies based on household income to ensure an equitable transition. As another example, in April 2020, the Chinese central government extended the national subsidies for purchasing electric vehicles by two years, from the end of 2020 to the end of 2022.[13] In addition, some cities revived their local-level subsidies for purchasing electric vehicles, which were eliminated in June 2019, as part of their recovery packages against COVID-19 in 2020. For example, Guangzhou offered an EV purchase subsidy of CNY 10,000 per vehicle from April 2020, on top of China's national subsidies.[14]

Other financial incentives. Beyond upfront vehicle purchase incentives, cities can also improve the financial case for electric vehicle ownership by offering discounts or exemptions on parking, tolls, or congestion charges for electric vehicles. Some cities also offer free parking or tolls; however, in order to improve long-term revenue and manage congestion, many cities have set plans to phase out these incentives over time. As an example, in Oslo, BEVs were previously allowed to enter the congestion charging zone for free but now have to pay a discounted rate (less than half) compared to gasoline and diesel vehicles, and PHEVs are charged the same as gasoline vehicles. Similarly, in London all EVs used to benefit from free congestion charges but starting in October 2021, only BEVs and FCEVs will be allowed in the congestion zone for free and this benefit will end in December 2025.

Non-financial benefits. Cities can use non-financial incentives such as road access and registration privileges to spur EV uptake and target certain users. As with the above financial benefits, these incentives will likely need to be phased out as the EV market expands in order to manage congestion and not encourage increased use of vehicles in the city. For example, Oslo previously granted all EVs access to bus lanes, but in response to congestion and slower bus speeds, Oslo changed its policy in 2015 to allow only high occupancy EVs in bus lanes. As another example of adaptation, in Shanghai, the city decided to extend the free license plate benefits to EV buyers until December 2023 but decided to end it for PHEVs starting in January 2023. Meanwhile, Amsterdam prioritizes electric vehicle owners on its parking permit waiting list. These examples point to the importance of ongoing tracking of the EV market to balance EV incentives with other transportation goals.

Zero-emission zones. An increasing number of cities, especially in Europe, have introduced low-emission zones and are now planning for zero-emission zones (ZEZ). A ZEZ is an area where only zero-emission vehicles, such as BEVs, are granted unrestricted access. Many cities are taking an incremental approach by creating a ZEZ in the city center or a specific neighborhood and slowly extending it to the entire metropolitan area. Alternatively, cities may also initially target one vehicle segment, like delivery vans, then expand the regulation to all vehicles. As an example, Amsterdam introduced a low-emission zone in 2009 for trucks in the city center and has been

13 Hongyang Cui and Hui He, *China Announced 2020–2022 Subsidies for New Energy Vehicles*, (ICCT: Washington DC, 2020), https://theicct.org/publications/china-2020-22-subsidies-new-energy-vehicles-jul2020.

14 The People's Government of Guangzhou Municipality, "《广州市促进汽车生产消费若干措施》印发 - 广州市人民政府门户网站 - Some Measures to Promote Automobile Production and Consumption in Guangzhou," accessed November 1, 2021, http://www.gz.gov.cn/zwfw/zxfw/jtfw/content/post_5759403.html.

tightening access requirements ever since. Amsterdam's plan is to only allow zero-emission buses in the city center starting in 2022 and trucks, vans and taxis as soon as 2025, with the goal of having a city-wide ZEZ affecting all vehicles starting in 2030. A ZEZ affecting delivery vans is already in place in Shenzhen, which was one of the first cities globally (after Rotterdam in the Netherlands) to introduce a zero-emission freight/delivery zone also known as "green logistics zones" in 2018. Shenzhen started with 10 small "green logistics zones."[15]

Charging infrastructure. City-level planning is key to support EV adoption through a dense, reliable, and interoperable charging infrastructure network. In the first stages of EV uptake, mass rollout of charging infrastructure is key to building a comprehensive charging infrastructure network and to spurring drivers' confidence. However, as markets leave the early adopter phase, a demand-driven approach in which EV users or future EV users can request or suggest charging station locations can complement a planning-oriented city approach which considers other aspects such as equity.[16] This strategy provides better opportunities for the private sector to step in and develop profitable charging infrastructure by siting charging points in locations where they are more likely to be used.

The Seoul metropolitan government has announced the installation of 3,000 new fast chargers by the end of 2021 and 5,000 by 2022, for an overall goal of 200,000 fast chargers by 2025 to meet the increasing demand. They also announced a target of 500,000 slow chargers by 2025, 10 times more than at the end of 2020. To find the right locations, they are taking recommendations from residents of Seoul on where to locate the stations. Residents of Seoul can call or fill out a form to request the installation of an EV charging station near their home.[17] This strategy is also undertaken in many European cities like Amsterdam and London where EV owners without access to off-street parking can make a request online for expansion of the public charging network.[18] As another example, in its 2021 five year plan, the Shanghai municipal government announced a plan to deploy 200,000 charging points with standardized data collecting capabilities.[19] One of the main reasons for this data collection is to aid in making decisions about where to build future charging infrastructure. Data collection and transparency on data usage is a powerful tool to efficiently plan for public charging infrastructure deployment.

Beijing's approach differs slightly from others with its plan of building 50,000 EV charge points and 100 battery swapping stations by 2022. Battery swapping has seen renewed interest in China in 2020 and is now spreading to other major markets with companies like Nio, which is planning to bring four battery swap stations in Oslo by the end of 2021, and Ample which opened its first battery swap station in San Francisco. This technology could be convenient for some use types such as high-mileage taxi fleets.

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15 Hongyang Cui, Pramoda Gode, and Sandra Wappelhorst, *A Global Overview of Zero-Emission Zones in Cities and Their Development Progress*, (ICCT: Washington DC, 2021), https://theicct.org/publications/global-cities-zez-dev-EN-aug21.

16 Marie Rajon Bernard and Dale Hall, *Efficient Planning and Implementation of Public Chargers: Lessons Learned from European Cities*, (ICCT: Washington DC, 2021), https://theicct.org/publications/European-cities-charging-infra-feb2021.

17 Official Website of the Seoul Metropolitan Government. "Seoul Is Speeding up to Secure 5,000 Rapid EV Chargers by 2022 -," June 3, 2021, http://english.seoul.go.kr/seoul-is-speeding-up-to-secure-5000-rapid-ev-chargers-by-2022/.

18 Marie Rajon Bernard and Dale Hall, *Efficient Planning and Implementation of Public Chargers: Lessons Learned from European Cities*, (ICCT: Washington, DC, 2021), https://theicct.org/sites/default/files/publications/European-cities-charging-infra-feb2021.pdf.

19 Shanghai Municipal People's Government, "Shanghai National Economic and Social Development Fourteenth Five-Year Plan and 2035 Long-Term Goals Outline," October 2021, https://www.shanghai.gov.cn/cmsres/8c/8c8fa1641d9f4807a6897a8c243d96ec/c70c2c6673ae425efd7c11f0502c3ee9.pdf.

Finally, some cities also provide charging infrastructure subsidies at the local level, sometimes complementing national and regional subsidies. Paris provides an example of how local, regional, and national charging programs can work together. Companies or local governments installing public chargers benefit from the national, privately funded, Advenir program covering up to 60% of the cost of charger hardware and installation. In addition to this, the Île de France region, a provincial-level jurisdiction including the Paris metropolitan region, covers 50% of material, installation, and grid connection costs, up to €2,500 for normal chargers, and the city of Paris provides an additional subsidy of up to €500.[20]

EV-ready building codes. As of 2021, every EV capital, except one, has EV-ready building or construction codes in place either at the national, regional, or local level. Most of the charging today happens privately at home or at work which are the most convenient and cheapest charging options. The expansion of the private charging infrastructure is thus of outstanding importance. EV ready building and construction codes are a powerful tool to spur low-cost charging options, at both commercial and residential buildings, by requiring a certain amount of parking spaces to include the necessary electrical equipment to enable easy and low-cost charging station installation when buildings are built or renovated. For example, public parking garages are an important potential location for chargers that could meet overnight charging needs for residents as well as daytime charging for nearby workplaces and destinations, particularly in dense urban areas. In this regard, the New York City Department of Transportation has set the goal of equipping 20% of all spaces in municipal public parking lots and garages with Level 2 (also called normal) chargers by 2025, increasing to 40% by 2030.[21]

Public fleet electrification. Cities usually have direct influence over municipal fleets and public transit either through direct ownership or through licensing processes, enabling them to set clear electrification targets. In addition to the disproportionate air quality benefits from replacing these primarily diesel vehicles, bus electrification brings electric vehicle technology to a broader segment of the population given that public transit is used more among low-income groups.

Leading cities like Shenzhen and Guangzhou, which already have 100% electric bus fleets,[22] provided financial incentives, rapidly deployed charging infrastructure, and developed strong partnerships with many stakeholders.[23] Engagement and collaboration between local government, industry, bus companies, and civil society are key to reaching a fully electric bus fleet. In Bergen, after planning for 18 months, a 100% fossil-fuel free bus fleet (102 battery-electric and 26 biodiesel buses) began service on December 1st 2020, the result of a public-private partnership between the public transport authority Skyss and the private transportation company Keolis.[24]

As for municipal fleets, electric vehicle capitals are leading by example as many have added electric vehicles to their municipal fleets and have set goals for full electrification. In 2018, the mayor of Los Angeles launched the Climate Mayors' Purchasing Collaborative, a collaboration of cities across the United States to leverage their purchasing power and accelerate the transition to electric municipal fleets. This

20 Marie Rajon Bernard, Dale Hall, and Nic Lutsey, *Update on Electric Vehicle Uptake in European Cities*, (ICCT: Washington DC, 2021), https://theicct.org/publications/ev-uptake-eu-cities-oct21.

21 New York City Department of Transportation, "Electric Vehicles," Accessed November 2, 2021, https://www1.nyc.gov/html/dot/html/motorist/electric-vehicles.shtml#/find/nearest.

22 C40, "Cities100: Citywide Rapid Bus Electrification in Guangzhou," Accessed September 27, 2021, https://www.c40knowledgehub.org/s/article/Cities100-Citywide-rapid-bus-electrification-in-Guangzhou?language=en_US.

23 Lingzhi Jin, "Preparing to Succeed: Fleet-Wide Planning Is Key in the Transition to Electric Buses." *ICCT Staff Blog* (blog), July 15, 2020, https://theicct.org/blog/staff/fleet-wide-planning-key-to-ebus-transition-jul2020.

24 Keolis, "Norway Launch of a Large 100% Fossil-Free Bus Network in Bergen to Reduce CO2 Emissions by 85% | Keolis," December 12, 2020, https://www.keolis.com/en/media/newsroom/press-releases/norway-launch-large-100-fossil-free-bus-network-bergen-reduce-co2.

collaborative also includes a platform to support public fleet electrification through trainings, best practices, and resources on public infrastructure deployment.[25] San Francisco has passed a zero-emission municipal fleet ordinance stating that all light-duty passenger vehicles in city fleets must be zero-emission by December 2022.

Private fleet electrification. Cities often have influence over taxis and car-sharing services through licensing processes and can leverage this power to reach zero-emission mobility. Car sharing have grown in recent years, offering an interesting alternative to private car ownership and the potential to trigger mass EV adoption faster. Cities like Paris have already reached 100% BEV free-floating car sharing and 65% EVs (31% BEV and 34% PHEV) for round trip car sharing.[26] Car sharing should be thought about holistically to make sure there is no competition with public transit; such an approach has been undertaken in Stuttgart, Germany. The core element of this integrated approach is the Stuttgart Service Card, which allows access to public transport, electric car- and bike-sharing, EV charging stations, and libraries and other public services.[27]

Another integrated approach has been implemented in San Francisco through the Clean Cars for All program.[28] Income-qualified residents can recycle old cars in exchange for grant funding to use on an electric car, an electric bike, public transit, and car-sharing services. Los Angeles also provides an example of a sustainable and equitable transition through its BlueLA car sharing program, which has now been acquired by Blink Mobility.[29] BlueLA started in 2015 with the goal of developing EV car sharing in disadvantaged communities to serve low-income residents, increase EV exposure, and reduce green-house gas emissions. Blink Mobility, which designs, manufactures, and operates EV charging stations, is now expanding the network with support from the Mayor's Office of Sustainability, Share Use Mobility Center, and a committee of community-based organizations.[30]

Taxis and ride-hailing vehicles are also high priorities for electrification, as their high annual mileage means that each electric vehicle in this sector offers outsize climate and public health benefits. Electrifying these vehicles can also encourage a broader transition by increasing public awareness of EVs and spurring deployment of public charging infrastructure. Major cities where these fleets are concentrated can play a role in making this transition faster and maximizing the benefits for drivers, the public, and the climate.[31] Electric vehicle capitals are seeking to accelerate electrification of these sectors through regulations as well as engaging with taxi and ride-hailing operators. As an example, in London, all taxis and ride-hailing vehicles will have to be zero-emission capable as soon as 2033. To make sure this transition is feasible and equitable, London organized discussions and outreach events with taxi drivers, in order to understand their charging needs.[32]

25 Climate Mayors, "EV Purchasing Collaborative," Climate Mayors, accessed September 27, 2021, https://climatemayors.org/ev-purchasing-collaborative/.

26 Michael Nicholas and Marie Rajon Bernard, *Success Factors for Electric Carsharing*, (ICCT: Washington DC, 2021, https://theicct.org/publications/na-us-eu-ldv-electric-carsharing-factors-aug21.

27 Stuttgart, "PolygoCard - Alles Auf Einer Karte," Landeshauptstadt Stuttgart, accessed September 27, 2021, https://www.stuttgart.de/leben/mobilitaet/oepnv/polygo.php.

28 Bay Area Air Quality Management District, "Clean Cars for All Program," accessed November 23, 2021, https://www.baaqmd.gov/funding-and-incentives/residents/clean-cars-for-all/mobility-options.

29 Michael Nicholas and Marie Rajon Bernard, *Success Factors for Electric Carsharing*, (ICCT: Washington DC, 2021, https://theicct.org/publications/na-us-eu-ldv-electric-carsharing-factors-aug21.

30 Blink Mobility, "About Us : Blink Mobility - Los Angeles, CA Electric Car Sharing Service," *Blink Mobility* (blog), accessed November 23, 2021, https://blinkmobility.com/about-blink-mobility/.

31 Dale Hall, Michael Nicholas, and Marie Rajon Bernard, *Guide to Electrifying Ride-Hailing Vehicles for Cities*" (ICCT: Washington DC, 2021), https://theicct.org/publications/ride-hailing-cities-guide-mar2021.

32 The Mayor's Electric Vehicle Infrastructure Taskforce, "London Electric Vehicle Infrastructure Delivery Plan" (London: Mayor of London, June 2019), https://lruc.content.tfl.gov.uk/london-electric-vehicle-infrastructure-taskforce-delivery-plan.pdf.

Consumer awareness. Reaching mass EV adoption requires widespread trust and understanding of electric vehicle and charging technologies. Local governments are well positioned to deliver clear messages and communicate with their citizens on the benefits of EVs, and reassure them on charging and the related range anxiety. The Greater Paris region has contributed to the development of the online platform "I drive on electricity" ("Je roule en électrique"), a dedicated website to answer all EV-related questions and to accompany EV buyers throughout the entire process, from awareness to EV purchasing to driving and charging.[33]

As another example, Liuzhou began engagement with consumers during the early stages of the transition with a free test-drive campaign in 2017. This event was deemed successful as 70% of participants decided to purchase the EV they tried.[34] Liuzhou municipal government also engaged with its citizens through a survey to understand what the most successful incentives and policies could be to spur EV uptake. Los Angeles offers a different example of customer engagement through its publicly owned power utility. LADWP (Los Angeles Department of Water and Power) has a specific section on its website for electric vehicles, covering potential EV buyers' concerns.[35] LADWP also created educational material for car salespersons.[36]

Collaboration with all stakeholders. To efficiently transition to EVs and roll out charging infrastructure, working closely with all stakeholders is key. Important stakeholders include, but are not limited to, public agencies, local politicians and residents, and private sector stakeholders such as grid operators, charging station operators, electric vehicle driver groups, land and business owners, and shared mobility operators.[37] As an example, the London Mayor's office set up an EV Infrastructure Task Force in 2018 made up of city officials, auto industry companies, electricity providers, fleet managers, charging station operators, shared mobility operators, and many other stakeholders to build a long-term strategy and align investment plans.[38] As another example, since improving charging convenience in old existing residential buildings is often challenging, Hainan government (Haikou's province) initiated a collaboration with key stakeholders such as charging station operators, grid companies, and property management companies to find practical and innovative solutions.[39]

Summary of electric vehicle actions by cities. The EV capitals have put in place a range of actions across a number of areas to efficiently and quickly increase EV uptake. Regional and national policies and actions have also contributed to their success. Table 1 below summarizes which actions have been implemented by which cities. The 'x' symbol indicates that the policy has been implemented at the local level and the 'o' symbol that it has been implemented at the regional or national level. Metropolitan areas are listed by markets and then in decreasing order of total number of policies implemented from top to bottom.

33 AVERE France, Ministère de la transition écologique, "Je-Roule-En-Electrique.Fr, Pour Vous Accompagner Vers La Mobilité Électrique," accessed September 29, 2021, https://www.je-roule-en-electrique.fr/.

34 Hongyang Cui, "Liuzhou: A New Model for the Transition to Electric Vehicles?" *ICCT Staff Blog* (blog), December 18, 2019, https://theicct.org/blog/staff/liuzhou-new-model-transition-electric-vehicles.

35 LADWP (Los Angeles Department of Water and Power), "Electric Vehicles (EVs)," n.d., https://www.ladwp.com/ladwp/faces/ladwp/residential/r-gogreen/r-gg-driveelectric?_adf.ctrl-state=540xrhnu3_4&pact_id=1009732&&_afrLoop=169070829632658.

36 "Los Angeles PlugStar Program," accessed October 11, 2021, https://pluginamerica.org/plugstar/programs/los-angeles-dealer-program/.

37 Marie Rajon Bernard and Dale Hall, *Efficient Planning and Implementation of Public Chargers: Lessons Learned from European Cities*, (ICCT: Washington, DC, 2021), https://theicct.org/sites/default/files/publications/European-cities-charging-infra-feb2021.pdf.

38 The Mayor's Electric Vehicle Infrastructure Taskforce, "London Electric Vehicle Infrastructure Delivery Plan" n.d., https://lruc.content.tfl.gov.uk/london-electric-vehicle-infrastructure-taskforce-delivery-plan.pdf.

39 Jin Li, and Hongyang Cui, Update on Hainan's progress towards its 100% EV ambition through 2020.

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

Country	Metropolitan area	Total number of policies	City planning					Infrastructure				Fleets					Electric vehicle benefits				Consumer awareness
			100% electric sales goal	100% electric stock goal	Existing and planned zero-emission zone	Low-emission zone in place	Fossil Fuel Free Streets declaration	Public charging incentives	Private charging incentives	EV-ready building code	Demand-driven strategy	City government fleet electrification goal	Taxi fleet electrification goal	Electric car-sharing program	100% electric bus goal (stock or sales)	100% electric (or fossil fuel free) bus achieved	Financial incentives	Electric vehicle parking privileges	Road access benefits (high occupancy lanes and bus lanes) and registration privileges	Toll, bridges, or ferry discounts	Events and campaigns by public agencies, utilities, and/or NGOs
China	Shenzhen	13			×	×		⊗		⊗		×	×	×	×	×	⊗	⊗	×		×
	Haikou	12				×		⊗		○		○	○	○	⊗	×	○	⊗	○		×
	Hangzhou	11				×		⊗	×	⊗			⊗	×	⊗		⊗	×	×		×
	Beijing	10				×		⊗		×		×	×		×		○	×	×		×
	Chongqing	10				×		⊗		×		×			×		○	×	×	×	×
	Liuzhou	10				×		⊗		⊗		×	×		×		○	⊗	×		×
	Shanghai	10				×		⊗		×		×	×	×	×		○	×	×		×
	Tianjin	10				×		⊗		×		×	×		×		⊗	×	×		×
	Zhengzhou	10				×		⊗		⊗		⊗	⊗		⊗		⊗	×	×		×
	Guangzhou	9				×		⊗		⊗			⊗		⊗	×	⊗	⊗	×		×
	Changsha	8						⊗		○			×		×		○	⊗	×		×
	Chengdu	8				×		⊗	×						×		○	×	×		×
	Suzhou	8				×		⊗		⊗				×			○	×	×		×
Netherlands	Amsterdam	17	⊗	×	×	×	×	×	×	×	×	○	×	×	×		○	×		○	×
United Kingdom	London	17	⊗	×	×	×	×	⊗	⊗	×	×	×	×	×	×		○	×		×	×
France	Paris	16	⊗	×	×	×	×	×	×	⊗		×	×	×	×		⊗	×	×		⊗
Norway	Oslo	16	⊗	×	×	×	×		×	⊗	×	⊗	×	×	×		○	×	×	○	
	Bergen	13	⊗	×	×	×				○		⊗	×	×	×	×	○	×		○	
Germany	Stuttgart	10				×		○	○	○		×		×			○	×	×		○
	Munich	9				×		⊗	○	○		×		×	×		⊗				⊗
Sweden	Stockholm	9	○			×		○	⊗	×	×	×		×			○				
South Korea	Seoul	11				×	×		×	○	×	×	○	×	⊗		⊗				×
United States	Los Angeles	13	○	×	×		×	⊗	⊗	×		×		×	×		○		○	○	
	New York	11	○					⊗	⊗	×	×	×			×		○		○	○	×
	San Francisco	11	⊗	×				⊗	⊗	×		×			×		○		○	○	×

Notes: × = action by local government; ○ = action by state or national government; ⊗ = action at multiple levels,
100% electric stock goal is equivalent to a plan for a city-wide zero-emission zone,
100% electric sales goal is assumed as of the effective date of a city's 100% electric stock goal.

Every EV capital has in place at least 8 promotion actions—up to 17 for Amsterdam and London—showing that a wide range of policies and actions is key to efficiently spur EV uptake. Among the most widespread policies are financial incentives (available

in all EV capitals), EV-ready building codes (implemented for all but one EV capital), and public fleet electrification goals (22 EV capitals having set full bus sales and/or stock electrification goals). While Shenzhen and most European EV capitals have zero-emission zones in place or planned, this impactful policy has yet to be adopted by other cities. Regarding charging infrastructure, many EV capitals such as Amsterdam, London, New York, and Seoul have begun to implement a demand-driven strategy.

Though not a local level policy, it is worth noting that EV capitals are all in markets with strong CO_2 emission standards or where Zero-Emission Vehicle (ZEV) regulations are in place. In 2017, China implemented a New Energy Vehicle (NEV) mandate policy for passenger cars that mandates NEV credit targets for manufacturers for 2019 and 2020 and was linked to China's corporate average fuel consumption. This policy has now been extended to 2023.[40] In the United States, California was the first jurisdiction to establish ZEV regulations in 1990. That standard has now been adopted by 14 other states including New York. Manufacturers must fulfill a certain ZEV percentage credit requirement which becomes more stringent each year. ZEV credits are awarded based on ZEV sales in the states.[41] In 2020, South Korea announced its own ZEV sales regulation based on California's ZEV regulation.[42] Europe has had CO_2 emission standards in place since 2009 which require that the average emissions of all newly registered vehicles from a manufacturer in one year not exceed a defined limit in grams of CO_2 per kilometer (g CO_2/km). The European Commission released a proposal strengthening the current 2030 CO_2 targets in July 2021; this proposal sets a target of 0 g CO_2/km in 2035, effectively requiring a shift to 100% zero-emission vehicles by that date.[43]

Table 2 lists impactful policies at the city level to spur EV uptake within each of the categories discussed in this paper. The second and third columns provide examples of how the selected policies have been implemented in some of the EV capitals.

40 Zhinan Chen and Hui He, *The Second Phase of China's New Energy Vehicle Mandate Policy for Passenger Cars* (ICCT: Washington DC, 2021), https://theicct.org/publications/china-new-energy-vehicle-mandate-phase2-may2021.

41 Shikha Rokadiya and Zifei Yang, *Overview of Global Zero-Emission Vehicle Mandate Programs*, (ICCT: Washington DC, 2021), https://theicct.org/publications/global-zero-emission-vehicle-mandate-program.

42 UC Davis, "California's ZEV Rule a Model, This Time for Korea, With Help From ITS-Davis Researchers," ITS, January 13, 2021, https://its.ucdavis.edu/blog-post/californias-zev-rule-a-model-this-time-for-korea-with-help-from-its-davis-researchers/.

43 Jan Dornoff, Peter Mock, Chelsea Baldino, Georg Bieker, Sonsoles Díaz, Josh Miller, Arijit Sen, Uwe Tietge, and Sandra Wappelhorst, *Fit for 55: A Review and Evaluation of the European Commission Proposal for Amending the CO_2 Targets for New Cars and Vans*, (ICCT: Washington DC, 2021), https://theicct.org/publications/fit-for-55-review-eu-sept21.

Table 2. Selected city policies to efficiently spur EV uptake

Selected policies	Selected cities	Policy description
Planned zero-emission zone	Amsterdam and Shenzhen	• Amsterdam introduced a low-emission zone in 2009 first only affecting trucks in the city center and has been tightening ever since with the goal of having a city wide zero-emission zone affecting all vehicles starting in 2030.[a] • Shenzhen was one of the first cities globally to introduce a zero-emission freight/delivery zone also known as "green logistics zone" in 2018.[a]
Private fleets electrification goals	Paris, Beijing, and Haikou	• Paris has reached 100% BEV free-floating car sharing and 65% of its round-trip fleet is already electric.[b] • By the end of 2021, all new taxis in Beijing have to be electric.[c] • By 2030, all new private cars in Haikou must be electric.[d]
Public fleets electrification goals	Bergen and San Francisco	• As a result of partnership between the public transport authority Skyss and the private transportation company Keolis, Bergen launched its 100% fossil-free bus fleet in December 2020.[e] • San Francisco has passed a zero-emission municipal fleet ordinance stating that all light-duty passenger vehicles in the city fleets must be zero-emission by December 2022.[f]
Demand-driven charging infrastructure deployment strategy	Seoul, London, and New York	• Seoul citizens and business owners can call or fill out and send a form to request a charging station at a specific location.[g] • London citizens without access to off-street parking can contact their borough to ask for an on-street charging station near their home.[h] • New York Department of Transportation collected input from the public on where chargers should be installed and allows business owners to request the installation of an EV charger outside their business.[i]
Consumer awareness programs	Liuzhou and Paris	• Liuzhou organized a free EV test drive campaign and engaged with its citizens through a survey to understand what the most successful incentives and policies could be to spur EV uptake.[j] • Paris contributed to an online platform "I drive on electricity" ("Je roule en électrique") to answer EV-related questions and guide EV buyers throughout the entire process (from awareness to driving and charging).[k]

[a] Hongyang Cui, Pramoda Gode, and Sandra Wappelhorst. *A Global Overview of Zero-Emission Zones in Cities and Their Development Progress*, https://theicct.org/publications/global-cities-zez-dev-EN-aug21.
[b] Michael Nicholas and Marie Rajon Bernard, *Success Factors for Electric Carsharing*, (ICCT: Washington DC, 2021), https://theicct.org/publications/na-us-eu-ldv-electric-carsharing-factors-aug21.
[c] General Office of Beijing Municipal People's Government, "北京市人民政府办公厅关于印发《北京市深入打好污染防治攻坚战2021年行动计划》的通知_综合类-北京市促进民间与社会投资信息平台 (Notice of the General Office of the Beijing Municipal People's Government on Printing and Distributing the 2021 Action Plan for Beijing to Deepen the Battle of Pollution)," March 4, 2021, http://invest.beijing.gov.cn/xxpt/tzzc/bjszc/zhlbj/202103/t20210304_2299434.html.
[d] Jin Li, and Hongyang Cui, Update on Hainan's progress towards its 100% EV ambition through 2020.
[e] "Norway Launch of a Large 100% Fossil-Free Bus Network in Bergen to Reduce CO_2 Emissions by 85%" Keolis, accessed December 8, 2021, https://www.keolis.com/en/media/newsroom/press-releases/norway-launch-large-100-fossil-free-bus-network-bergen-reduce-co2.
[f] "Board of Supervisors Unanimously Approves Legislation to Require More Electric Vehicle Charging Stations | Office of the Mayor," City and County of San Francisco, accessed October 8, 2019, https://sfmayor.org/article/board-supervisors-unanimously-approves-legislation-require-more-electric-vehicle-charging.
[g] Official Website of the Seoul Metropolitan Government. "Seoul Is Speeding up to Secure 5,000 Rapid EV Chargers by 2022 -,"
[h] London Councils, "Suggest a Location for an EV Charge Point | London Councils," accessed October 4, 2021, https://www.londoncouncils.gov.uk/our-key-themes/transport/electric-vehicle-charging/suggest-location-ev-charge-point.
[i] New York City Department of Transportation, "NYC DOT-- Electric Vehicles," accessed October 4, 2021, https://www1.nyc.gov/html/dot/html/motorist/electric-vehicles.shtml#/find/nearest.
[j] Hongyang Cui, "Liuzhou: A New Model for the Transition to Electric Vehicles?" *ICCT Staff Blog* (blog), December 18, 2019, https://theicct.org/blog/staff/liuzhou-new-model-transition-electric-vehicles
[k] AVERE France, Ministère de la transition écologique, "Je-Roule-En-Electrique.Fr, Pour Vous Accompagner Vers La Mobilité Électrique," https://www.je-roule-en-electrique.fr/.

CONCLUSIONS

This briefing identifies the top 25 leading EV markets by 2020 new registrations, termed EV capitals, and provides data on electric passenger vehicle registrations, charging infrastructure, and policies in place in these metropolitan areas. While each EV capital has its own strategy to efficiently increase EV uptake, in order to decrease air pollution and mitigate climate impacts, tailored to the local context, this paper identifies common practices among these leading markets, giving insights about successful practices and key policies.

As shown in Figure 5, the 25 EV capitals represent 32% of 2020 global electric vehicle registrations, with each representing at least 0.5% of the entire global EV market. For broader context, they represent 13% of 2020 global passenger vehicle registrations and only 4% of the world's population. As shown, 13 EV capitals are in China (red), 8 in Europe (blue), 3 in the US (purple), and one in South Korea (yellow).

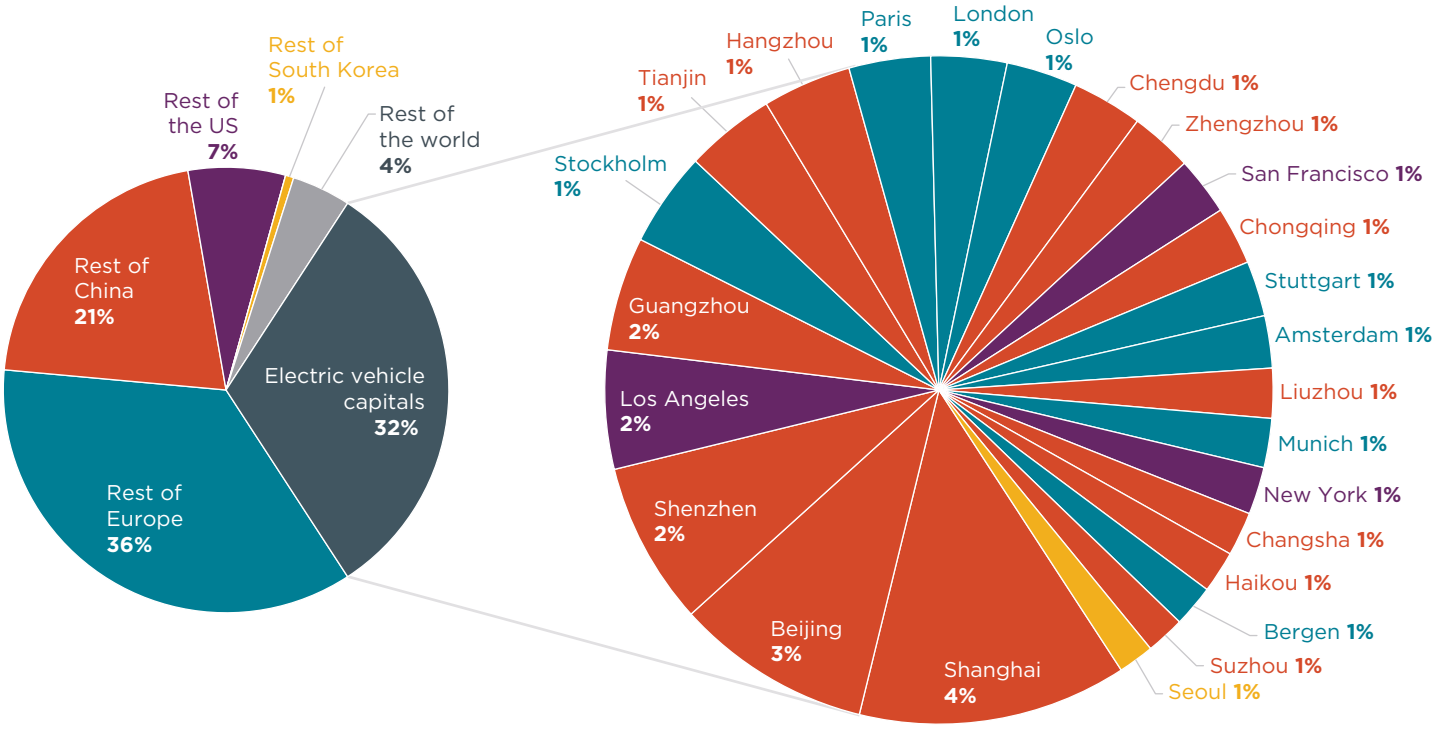

Figure 5. Share of 2020 global electric vehicle registrations in different markets with a specific focus on the 25 electric vehicle capitals (right)

When comparing to previous years' rankings, we must look at cumulative EV registrations through 2020. While the 25 EV capitals represented 45% of the world's EVs in 2016, their share has been decreasing steadily to 44% in 2017, 42% in 2018, 40% in 2019, and 34% through 2020. This shows that EVs are becoming more and more common around the world.

This briefing leads to the following conclusions:

European cities led in EV uptake in 2020. While in previous years the EV capitals usually counted 6 European cities, this number increased to 8 in 2020 as Europe saw a 143% increase in EV sales compared to 2019. This compared to 8% for China and South Korea, 4% for the United States and 1% for the rest of the world. While Chinese EV capitals still represent the largest EV markets in absolute EV registrations, European EV capitals are well ahead in EV share of registrations, ranging from 10.6% in Munich to 80% in Bergen. This compares to EV registrations ranging from 2.5% in New York to

29% in Liuzhou for non-European EV capitals. However, while only 54% of European EV capitals' electric registrations are BEVs this share rises to a 77% average for the 17 other EV capitals.

EV capitals are implementing policies to encourage a robust, comprehensive charging infrastructure network. While EV capitals started by building a comprehensive charging infrastructure network providing even coverage in the entire metropolitan area, most are now at the point where a different strategy makes sense. A demand-driven strategy in which current and potential EV buyers can request or suggest a charging station location could complement a planning-oriented approach to deliver more efficient use of the infrastructure and allow the private sector to step in. Besides, EV capitals are engaging with all stakeholders and adopting charger deployment goals to make sure charging infrastructure availability is not limiting electric vehicle adoption and is deployed efficiently and equitably. In addition to these strategies, it is noteworthy that 24 of the EV capitals have EV-ready building codes in place.

EV capitals are updating their comprehensive policy packages to adapt to market developments. Cities have many tools at their disposal to spur electric vehicle uptake quickly and efficiently. Every EV capital has at least 8 promotion actions in place, with up to 17 in Amsterdam and London, showing that a wide range of policies and actions is key to efficiently spur EV uptake. As the EV market develops, some policies that were key in the early stages are being phased out, some policies are being introduced or expanded, and some would be continued but re-evaluated as the market grows. Benefits such as priority road access can slowly be rolled back, and financial subsidies can be refined to target specific groups of customers such as low-income households. Charging infrastructure deployment and consumer awareness strategies can be reassessed to meet specific needs and to include equity aspects. Zero-emission zones (ZEZs) can be introduced or expanded in area and scope to move toward full electrification, and full electrification targets can be extended to more vehicle groups and brought forward.

EV capitals are increasingly planning for and implementing zero-emission zones (ZEZs). As other policies are phased out, ZEZs appear to be a promising opportunity for cities to move toward 100% ZEVs and are increasingly being announced for passenger and freight vehicles in EV capitals. ZEZs are areas of the city where only zero-emission vehicles, such as battery electric vehicles, are granted unrestricted access. These zones can affect different categories of vehicles, from private vehicles to delivery fleets and taxis, and the area usually expands over time starting from the city center and growing to the entire metropolitan region. Zero-emission mobility also concerns public fleets, like buses, which many cities have pledged to fully electrify over different time horizons, usually up to 2030.