BRIEFING

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Update on the global transition to electric vehicles through 2020

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There was substantial progress made in the global transition to electric vehicles in 2020, despite the COVID-19 pandemic and global economic downturn. More ambitious vehicle electrification targets were announced by governments at different levels. Adapted policy tools were effectively leveraged, in some cases as a part of the economic stimulus packages, to accelerate electric vehicle uptake. In this context, the global electric vehicle market achieved a major milestone in 2020 with cumulative electric passenger vehicle sales exceeding 10 million and the electric share of new passenger vehicle sales hitting a record-high of 4.6%.

This briefing provides an update on electric vehicle market and policy developments globally through 2020, with a focus on changes since our previous update in 2019.[1] It includes information on how several governments in major markets have revised their vehicle electrification targets and developed related policies, as well as summarizes global electric vehicle market growth in 2020. This briefing considers battery electric vehicle (BEV), plug-in hybrid electric vehicle (PHEV), and fuel cell electric vehicle (FCEV) technologies but does not examine non-plug-in hybrid electric vehicles.

VEHICLE ELECTRIFICATION TARGETS

In 2020, many national and provincial-level governments around the world announced new non-binding vehicle electrification targets, as summarized below.

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1 Hongyang Cui, Dale Hall, and Nic Lutsey, *Update on the global transition to electric vehicles through 2019*, (ICCT: Washington, DC, 2020), https://theicct.org/publications/update-global-ev-transition-2019.

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- In April 2020, the French government announced the goal to achieve a stock of 1.16 million electric passenger cars (660,000 BEVs and 500,000 PHEVs) and 170,000 electric light commercial vehicles by 2023, and a stock of 4.8 million electric passenger cars (3 million BEVs and 1.8 million PHEVs) and 500,000 electric light commercial vehicles by 2028.[2] This is supplemental to France's goal to phase out new sales of passenger cars and light commercial vehicles running on fossil fuels by 2030.
- In July 2020, California, Colorado, Connecticut, Hawaii, Maine, Maryland, Massachusetts, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Rhode Island, Vermont, Washington, and the District of Columbia signed a multi-state medium- and heavy-duty zero emission vehicle Memorandum of Understanding (MoU). The signatories agree to strive to achieve a 30% and 100% zero emission vehicle (ZEV) share of new medium- and heavy-duty vehicle sales in their jurisdictions by 2030 and 2050, respectively.[3]
- In September 2020, Governor Newsom of the U.S. state of California issued an executive order which announced the goal to achieve a 100% ZEV share of new passenger car and light-duty truck sales by 2035.[4] Although the ZEV goals are for 100% BEVs and FCVs, the California ZEV regulation incorporates, and indicates phasing down the role of, PHEVs.[5] California also set a goal in the same executive order to achieve a zero-emission drayage truck fleet by 2035 and a zero-emission medium- and heavy-duty vehicle fleet by 2045. California Air Resources Board (CARB) are developing vehicle regulations mandating increasing volumes of new ZEV sales towards the targets.
- In September 2020, South Korean President Moon announced that the country will invest $17 billion to boost the number of electric cars to 1.13 million by 2025 and increase the number of hydrogen vehicles to 200,000.[6] This is supplemental to South Korea's target to achieve a 33% electric share of new passenger car sales by 2030, which was announced in 2019.
- In November 2020, China State Council released its *New Energy Vehicle (NEV) Industrial Development Plan 2021-2035* containing a goal to reach a 20% new energy vehicle share of new vehicle sales by 2025.[7] In the Chinese context, NEVs include BEVs, FCVs, and PHEVs. The October 2020 *Energy-saving and New Energy Vehicle Technology Roadmap 2.0* prepared by Society of Automotive Engineering (SAE) China under the direction of Ministry of Industry and Information Technology (MIIT) proposed unofficial NEV share targets of around 40% by 2030 and over 50% by 2035.[8]

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2 French Republic, Décret n° 2020-456 du 21 avril 2020 relatif à la programmation pluriannuelle de l'énergie [Decree Number 2020-456 of April 21, 2020 relating to multiannual energy programming], (2020), https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000041814432/.

3 "Multi-state medium- and heavy-duty zero emission vehicle Memorandum of Understanding," (July 14, 2020), https://www.energy.ca.gov/sites/default/files/2020-08/Multistate-Truck-ZEV-Governors-MOU-20200714_ADA.pdf.

4 Office of Governor Gavin Newsom, "Governor Newsom announces California will phase out gasoline-powered cars & drastically reduce demand for fossil fuel in California's fight against climate change," (September 23, 2020), https://www.gov.ca.gov/2020/09/23/governor-newsom-announces-california-will-phase-out-gasoline-powered-cars-drastically-reduce-demand-for-fossil-fuel-in-californias-fight-against-climate-change/.

5 California Air Resources Board, "Public workshop on Advanced Clean Cars II," (access July 1, 2021), https://ww2.arb.ca.gov/events/public-workshop-advanced-clean-cars-ii.

6 Michelle Lewis, "South Korea to boost EV numbers to 1.13 million by 2025," *Electrek*, September 8, 2020, https://electrek.co/2020/09/08/south-korea-to-boost-ev-numbers-to-1-13-million-by-2025/

7 China State Council, 新能源汽车产业发展规划（2021-2035）[New Energy Vehicle Industrial Development Plan 2021-2035], (2020), http://www.gov.cn/zhengce/content/2020-11/02/content_5556716.htm.

8 Society of Automotive Engineers (SAE) China, "《节能与新能源汽车技术路线图2.0》正式发布 [Energy-saving and New Energy Vehicle Technology Roadmap 2.0 officially released]", (October 27, 2020), http://www.sae-china.org/news/society/202010/3957.html.

» In November 2020, the government of the Canadian province of Québec released its *2030 Green Economy Plan* and announced a goal of 1.5 million electric vehicles on the roads by 2030 and phase out new sales of gasoline-powered light-duty vehicles by 2035.[9] This makes Québec the second Canadian province, following British Columbia, to target a full transition to vehicle electrification.

» In November 2020, the government of the United Kingdom announced a goal to phase out new sales of petrol and diesel cars and vans by 2030 and make all new cars and vans be fully zero emission (i.e., BEVs and FCVs) from 2035. PHEVs and full hybrid electric vehicles (HEVs) with a minimum electric range, which will be defined through consultation later, could be allowed for sold between 2030 and 2035.[10] The original target of the United Kingdom was to phase out new sales of petrol and diesel cars and vans by 2040.

» In December 2020, the government of Scotland released an updated version of its *2018-2032 Climate Change Plan* and announced the goal to phase out new sales of petrol and diesel cars and vans by 2030, a two-year acceleration from the previous target.[11] This is in line with the updated targets of the United Kingdom.

As of end 2020, more than 20 national and provincial-level governments, mostly in Europe and North America, have proposed timelines to phase out new sales of internal combustion engine (ICE) passenger cars in the 2025-2050 time frame.[12] Meanwhile, 2020 saw increasing momentum on electrifying the medium- and heavy-duty vehicles. These ambitous targets on vehicle electrification are of crucial importance as they provide a clear signal to automakers and charging infrastructure providers to accelerate their investments.

Most of the goals directly call for fully electric or zero-emission vehicles, but the near-term policies in most of those jurisdictions provide some incentive support and partial regulatory credit for PHEVs. Some of the associated announcements are vague regarding how quickly they will phase down the near-term support for PHEVs within the various zero-emission policies. None of the targets are legally binding with enforceable penalties, except the 2040 targets of British Columbia. Further steps are needed to develop mandatory enforceable near-term policies to ensure the long-term goals are achieved.

VEHICLE ELECTRIFICATION POLICIES

In 2020, governments around the world continued to leverage policy tools to overcome key adoption barriers and help achieve vehicle electrification goals. These mainly include vehicle regulations, financial incentives, and charging infrastructure development.

9 Government of Québec, 2030 Plan for a Green Economy, (2020), https://www.quebec.ca/en/government/policies-orientations/plan-green-economy.

10 Government of the United Kingdom, "Government takes historic step towards net-zero with end of sale of new petrol and diesel cars by 2030," (November 18, 2020), https://www.gov.uk/government/news/government-takes-historic-step-towards-net-zero-with-end-of-sale-of-new-petrol-and-diesel-cars-by-2030.

11 Government of Scotland, "Securing a green recovery on a path to net zero: climate change plan 2018-2032-update," (2020), https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/pages/9/.

12 Sandra Wappelhorst, *Update on government targets for phasing out new sales of internal combustion engine passenger cars*, (ICCT: Washington, DC, 2021), https://theicct.org/publications/update-govt-targets-ice-phaseouts-jun2021.

VEHICLE REGULATIONS

Vehicle regulations play an essential role in ensuring sufficient availability of electric vehicles. These include direct electric vehicle regulations requiring increased deployment of electric vehicles, and strong vehicle greenhouse gas emissions or vehicle fuel economy standards. In 2020, governments in Europe, China, and North America adopted or began to develop regulations targeting these areas.

For light-duty vehicles, China adopted a policy document in June 2020 to extend its new energy vehicle (NEV) regulation for passenger vehicles from 2020 to 2023.[13] Based on the new NEV credit requirements, the electric vehicle share of China's new passenger vehicle sales is likely to at least double between 2020 and 2023, from 5.3% in 2019.[14] In July 2020, British Columbia adopted regulation which requires automakers to hit increasing annual levels of electric vehicle sales of 10% of new light-duty vehicle sales by 2025, 30% by 2030, and 100% by 2040, which is the first electric vehicle regulation worldwide mandating a 100% electric vehicle sales share.[15] California also began to develop new post-2025 ZEV requirements, with the aim of 100% ZEV share of new light-duty vehicle sales by 2035.[16]

On January 1, 2020, stricter CO_2 emission standards for light-duty vehicles came into force in European Union. The EU fleet-average CO_2 emission requirements for new passenger cars and vans were tightened by 27% and 16% over 2015 to 2019, reaching 95 g/km and 147 g/km, respectively.[17] This was a key driver of the increased electric vehicle model availability and increased electric vehicle sales share across Europe, reaching 11% in 2020 compared to 3% in 2019. As part of the European Green Deal, the European Commission is currently seeking to further tighten the standards. [18] By contrast, the United States' light-duty vehicle greenhouse gas (GHG) and fuel efficiency standards were significantly weakened in March 2020,[19] which the Biden Administration is working to reverse.

For medium- to heavy-duty vehicles, California Air Resources Board (CARB) adopted the world's first ZEV regulation for medium- and heavy-duty vehicles in June 2020, requiring increasing percentage of new ZEV truck sales across three vehicle classes from 2024. The regulation sets increasing requirements of 40% (heavy tractors), 55%

13 China Ministry of Industry and Information Technology, 关于修改《乘用车企业平均燃料消耗量与新能源汽车积分并行管理办法》的决定 [Decision on revising Parallel Management Regulation for Corporate Average Fuel Consumption and New Energy Vehicle Credits for Passenger Cars], (2020), http://www.gov.cn/zhengce/zhengceku/2020-06/22/content_5521144.htm.

14 Shiqi Ou, Rujie Yu, Zhenhong Lin, Xin He, Jessey Bouchard, and Steve Przesmitzki, Evaluating China's Passenger Vehicle Market under the Vehicle Policies for 2021-2023, *World Electric Vehicle Journal, 12*(2), 72.

15 Province of British Columbia, Zero-Emission Vehicles Regulation, (2020), https://www.bclaws.gov.bc.ca/civix/document/id/oic/oic_cur/0448_2020.

16 California Air Resources Board, Governor Newsom's Zero-Emission by 2035 Executive Order (N-79-20), (2021), https://ww2.arb.ca.gov/resources/fact-sheets/governor-newsoms-zero-emission-2035-executive-order-n-79-20 and California Air Resources Board, "Public workshop on Advanced Clean Cars II," (accessed July 1, 2021), https://ww2.arb.ca.gov/events/public-workshop-advanced-clean-cars-ii.

17 European Commission, CO_2 emission performance standards for cars and vans, (Accessed July 1, 2021), https://ec.europa.eu/clima/policies/transport/vehicles/regulation_en.

18 European Parliament, Revision of the regulation setting CO_2 emission performance standards for cars and light commercial vehicles, (accessed August 1, 2021) https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-co2-emission-standards-for-cars-and-vans-post-euro6vi-emission-standards.

19 U.S. National Highway Traffic Safety Administration, "U.S. DOT and EPA put safety and American families first with final fuel on fuel economy standards," (March 31, 2020), https://www.nhtsa.gov/press-releases/us-dot-and-epa-put-safety-and-american-families-first-final-rule-fuel-economy; Aaron Isenstadt and Nic Lutsey, Summary of the Trump Administration's fatally flawed U.S. light-duty vehicle efficiency standards, (ICCT: Washington, DC, 2020), https://theicct.org/publications/fatally-flawed-trump-NHTSA-analysis.

(commercial vans and pickups), and 75% (medium-duty trucks) ZEV shares by 2035.[20] Under the Executive Order issued in September 2020, California Air Resources Board (CARB) will develop new ZEV regulations requiring increasing volumes of new zero-emission trucks and buses sold and operated towards the target of 100% of the fleet transitioning to ZEVs by 2045 where feasible and for all drayage trucks to be ZEVs by 2035. China is also in the process of developing NEV regulations for light- to heavy-duty commercial vehicles.[21]

FINANCIAL INCENTIVES

Financial incentives bridge the initial price gap between electric vehicles and ICE vehicles before cost parity with ICE vehicles is achieved. In 2020, governments around the world continued to leverage financial incentives to stimulate electric vehicle uptake.

Several leading European markets of electric vehicles, such as Germany, France, and Italy, increased the values of financial incentives in 2020 as a part of their recovery packages in response to COVID-19.[22] In May 2020, France increased the maximum subsidies for purchasing new BEVs from €6,000 to €7,000 and revived the subsidies for purchasing new PHEVs, capped at €2,000. A subsidy of €1,000 was also offered for the purchase of used electric vehicles with a maximum CO_2 emission rate of 20 g/km.[23] In June 2020, Germany increased the maximum subsidies from €6,000 to €9,000 for purchasing BEVs and from €4,500 and €6,750 for purchasing PHEVs, including a car manufacturer share of €3,000 for BEVs and €2,250 for PHEVs.[24] In August 2020, Italy increased the maximum subsidies from €4,000 to €6,000 for purchasing BEVs and from €1,500 to €3,500 for purchasing PHEVs, including a car manufacturer share of €1,000.[25]

In April 2020, China extended the subsidies and tax breaks for NEVs by two years until the end of 2022, whereas the policies were originally scheduled to be terminated at the end of 2020.[26]

CHARGING INFRASTRUCTURE

The construction of a convenient and reliable charging infrastructure network is one of the largest hurdles in the transition to an electric future. In 2020, governments worldwide continued their efforts to improve the electric vehicle charging infrastructure network within their jurisdictions.

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20 California Air Resources Board, "Advanced Clean Trucks Fact Sheet," (June 25, 2020), https://ww2.arb.ca.gov/resources/fact-sheets/advanced-clean-trucks-fact-sheet.

21 "商用车新能源积分政策已在制定中[New energy vehicle credit policy for commercial vehicles is under development]," (January 18, 2021), https://www.caixin.com/2021-01-18/101652375.html.

22 Sandra Wappelhorst, "Economic recovery packages in response to COVID-19: Another push for electric vehicles in Europe? [blog post]" (August 3, 2020), https://theicct.org/blog/staff/economic-recovery-covid-19-ev-europe-aug2020.

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24 Federal Government of Germany, Kaufprämie für Elektroautos erhöht [Purchase premium for electric cars increased], https://www.bundesregierung.de/breg-de/themen/energiewende/kaufpraemie-fuer-elektroautos-erhoeht-369482.

25 Sara Occhipinti, "Decreto Rilancio: il testo coordinato pubblicato in Gazzetta [Relaunch Decree: the coordinated text published in the Gazzetta]," (July 2, 2020), https://www.altalex.com/documents/news/2020/07/09/decreto-rilancio#par2.

26 China Ministry of Finance, 关于完善新能源汽车推广应用财政补贴政策的通知 [Notice on optimizing fiscal subsidies for promoting new energy vehicles], (2020), http://jjs.mof.gov.cn/zhengcefagui/202004/t20200423_3502975.htm?from=timeline&isappinstalled=0.

Many governments offered new funding to support the deployment of electric vehicle charging infrastructure, often as a part of their recovery packages in response to COVID-19. For example, in April 2020, China's National Development and Reform Commission announced an investestment of around 10 billion yuan to build 200,000 public chargers, 400,000 private chargers, and 48,000 public charging stations.[27] In July 2020, New York Governor Cuomo announced an investment program that would allocate $701 million through 2025 to create more than 50,000 charging stations.[28] In August 2020, California Public Utilities Commission approved $436 million in funding to support approximately 37,800 electric vehicle charge ports.[29]

Governments are also updating laws and regulations designed to spur charging growth. For example, to achieve the goal of one million charging points by 2025 set by the European Green Deal,[30] the European Commission began to revise the Alternative Fuels Infrastructure Directive (AFID) in September 2020, which is the key policy tool within the overall EU strategy to develop the charging infrastructure ecosystem. Through this revision, the European Commission is seeking to introduce mandatory national targets for the deployment of sufficient charging infrastructure.[31]

PROGRESS ON VEHICLE ELECTRIFICATION

This section focuses on battery electric and plug-in hybrid electric passenger vehicles, where there has been the most market progress. Where related market data are available, associated commercial vehicle and fuel cell electric vehicle information are also included.

ELECTRIC VEHICLE SALES

The global electric vehicle market achieved a major milestone in 2020 with cumulative electric passenger vehicle sales passing 10 million, a 42% increase from 2019.[32] The 10.5 million cumulative electric passenger vehicle sales were largely concentrated in East Asia, Europe, and North America. These three regions together represented 92% of the global total and were home to the top 19 countries with the most cumulative electric sales through 2020. A total of 13 national markets have achieved cumulative sales of over 100,000, while 27 markets have surpassed 10,000; these compare to 10 and 23 markets which achieved those milestones in 2019, respectively. Meanwhile, the global electric vehicle market continues to expand. Through 2020, 99 countries and regions on six continents, including 59 emerging economies, have seen deployment of at least one electric vehicle, up from 95 markets in 2019.

27 Bo Pang, "国务院联防联控机制：将继续加大新能源汽车充电基础设施建设力度 [Joint Prevention and Control Mechanism of the State Council: China will continue increasing new energy vehicle charging infrastructure deployment]," (April 9, 2020), http://www.gov.cn/xinwen/2020-04/09/content_5500705.htm.

28 "New York to invest $750 million to expand electric-vehicle infrastructure," *Reuters*, July 17, 2020, https://www.reuters.com/article/us-autos-electric-new-york-idUSKCN24H3DD.

29 Stephen Edelstein, "California approves $437M utility-based program: 38,000 new EV chargers over 5 years," *Green Car Reports*, August 31, 2020, https://www.greencarreports.com/news/1129425_california-approves-437m-utility-based-program-38-000-new-ev-chargers-over-5-years.

30 European Commission, The European Green Deal, (2019), https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC_1&format=PDF.

31 European Commission, Proposal for a regulation of the European Parliament and the Council on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU of the European Parliament and of the Council, (July 14, 2021), https://ec.europa.eu/info/sites/default/files/revision_of_the_directive_on_deployment_of_the_alternative_fuels_infrastructure_with_annex_0.pdf.

32 EV-Volumes (EV Data Center, 2021), http://www.ev-volumes.com/datacenter/.

China remained far ahead of other markets with 4.8 million cumulative sales through 2020, representing 45% of the global total and equal to the other nine countries in the top ten combined. Although Europe as a single market surpassed China in annual sales in 2020, the cumulative sales of Europe was still one third lower than China.[33] Besides China, the only other national market surpassing 1 million was the United States, with cumulative sales of 1.8 million through 2020. Following China and the United States by cumulative sales were Germany (almost 690,000), the United Kingdom (almost 450,000), Norway (over 430,000), France (almost 420,000), Japan (almost 330,000), the Netherlands (over 300,000), Sweden (over 210,000), and Canada (almost 190,000). These ten leading markets together accounted for 91% of the cumulative electric passenger vehicle sales globally through 2020.

The global vehicle market was heavily affected by the COVID-19 pandemic in 2020. Overall passenger vehicle sales globally declined by 15% from 2019 to 2020. All major markets, except for South Korea, recorded lower passenger vehicle sales in 2020 compared to the previous year. However, the global electric vehicle market sustained sound growth in 2020 despite the pandemic. The annual electric passenger vehicle sales globally hit a record high of 3.1 million in 2020, a 42% increase over 2019. All major markets, except Japan and Canada, experienced an increase on electric passenger vehicle sales in 2020.

Figure 1 illustrates annual electric passenger vehicle sales by markets from 2010 through 2020, ordered from bottom to top by new sales in 2020. China maintained its position as the largest national market of electric passenger vehicles in 2020, which it has held since it surpassed the United States in 2015. In 2020, China sold 1.3 million electric passenger vehicles, 8.7% higher than the 2019 level and representing 41% of the world's total. The other top ten national markets in terms of annual electric passenger vehicle sales in 2020 included Germany (over 390,000), the United States (around 330,000), France (around 190,000), the United Kingdom (around 180,000), Norway (around 110,000), Sweden (around 100,000), the Netherlands (around 90,000), Italy (over 60,000), and Belgium (around 50,000). These ten national markets together accounted for 88% of the global total in 2020.

With strengthened vehicle regulations and sustained incentives, Europe overtook China for the first time since 2016 to become the world's largest single market of electric passenger vehicles in 2020. In 2020, Europe sold 1.4 million electric passenger vehicles, a 143% increase over Europe's 2019 sales and 8% more than China's 2020 sales. Eight out of the above-mentioned top ten national markets in terms of annual electric passenger vehicle sales in 2020 were from Europe, six of which recorded annual growth rates of over 100%: Germany (270%), Italy (247%), France (200%), Belgium (171%), the United Kingdom (135%), and Sweden (134%).

After experiencing a decline in 2019, the United States bounced back somewhat in 2020 and achieved a 4% increase in electric passenger vehicle sales. However, the annual sales of around 330,000 in 2020 was still 9% lower than its peak of around 360,000 in 2018. The comparatively slow electric market growth in the United Sates compared to China and Europe is likely due to automakers slower pace of launching new electric models due to weaker vehicle regulations and lesser availability of incentives for the most popular brands, such as Tesla and General Motors.

33 In this paper, Europe refers to the 27 European Union Member States, the United Kingdom, and the countries of the European Free Trade Association (EFTA) including Iceland, Liechtenstein, Norway, and Switzerland.

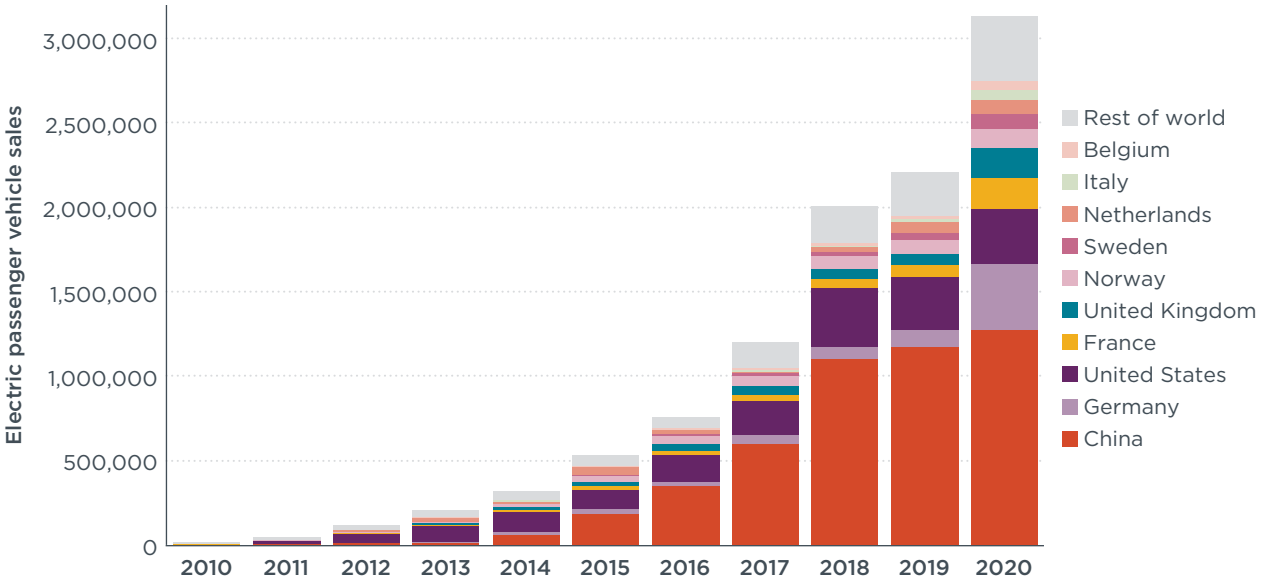

Figure 1. Annual electric passenger vehicle sales by markets from 2010 to 2020. Vehicle sales data from EV-Volumes, 2021.

Figure 2 shows electric passenger vehicle sales by automaker in 2020, ordered from top to bottom by number of sales. A total of 11 companies sold more than 100,000 electric passenger vehicles in 2020, compared to 6 such companies in 2019 and no such companies in 2015. Tesla led automakers globally with nearly 500,000 sales in 2020, a 36% increase over 2019. After production at its Shanghai factory, Tesla sold nearly 150,000 electric passenger vehicles in China in 2020, second only to BYD in China sales, for an increase of 213% over 2019. In Europe, however, Tesla's sales declined by 11% in 2020. Tesla's global share decreased from 18% in 2019 to 16% in 2020.

An important shift of the competitive landscape in the electric vehicle market in 2020 was the rise of traditional auto manufacturers. Volkswagen, Renault-Nissan-Mitsubishi, BMW, Hyundai-Kia, and Daimler moved up to 2nd, 3rd, 4th, 5th, and 7th place in sales ranking, respectively, mainly attributable to their robust performance in Europe. In 2020, Volkswagen sold over 420,000 electric passenger vehicles globally, an increase of 197% over 2019. Its 2020 sales growth rate in Europe was even higher, reaching 346%. The other four automakers on the top ten list (BYD, Geely, SAIC and Wuling) are all headquartered in China. These automakers' sales were almost exclusively in China, except Geely, which owns the Swedish brand Volvo and had high sales in Europe. It is worth noting that the sales by automaker is more complex than presented in Figure 2, due to automakers' joint ventures, partnerships, and mutual investments.

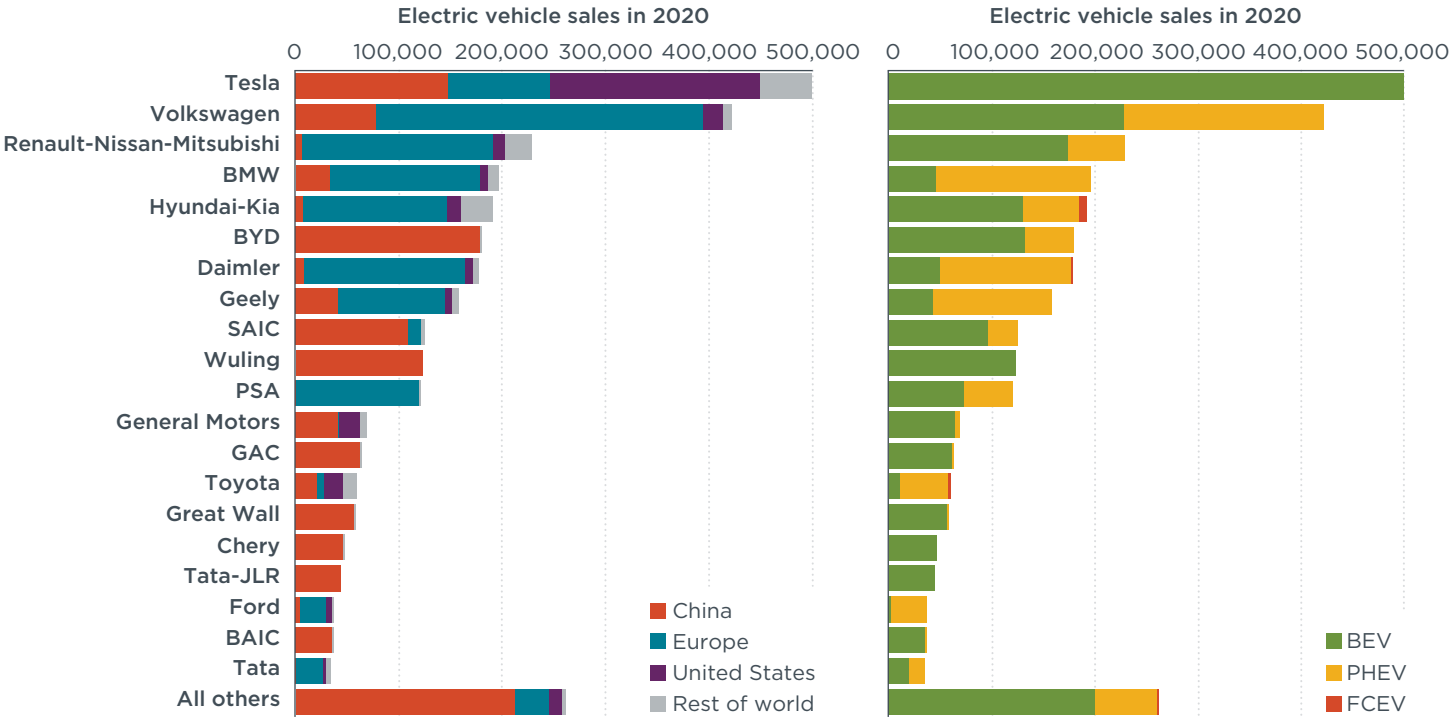

Figure 2. Electric passenger vehicle sales by automaker in 2020 by sales market and technology type. Vehicle sales data from EV-Volumes, 2021.

Various automakers are focusing on different electric-drive technologies. The global electric passenger vehicle sales in 2020 were 68.3% BEV, 31.4% PHEV, and 0.3% FCV. Although BEVs continues to be the predominant technology pathway, the market share of PHEVs increased by 6% from the previous year, mainly due to the increasing sales of PHEV models produced locally in Europe. Sales of FCVs through 2020 have been low relative to sales of BEVs and PHEVs. There have been approximately 27,000 cumulative FCV sales from 2013 through 2020, with most of these sales in South Korea (41%), the United States (33%), and Japan (16%). These locations are primarily where Hyundai, Toyota, and Honda focused their initial low-volume FCV model deployment and where hydrogen infrastructure is available. South Korea was the only country with annual FCV sales larger than 1,000 in 2020. The other five countries with sales of 100 or more are the United States, Japan, Germany, France, and the Netherlands.

The right side of Figure 2 shows the technology breakdown of electric vehicle sales for each automaker. Of the 20 highest-selling automakers, the electric vehicle sales of 8 were over 90% BEV, with Tesla, Wuling, Chery, and Tata-JLR having 100% BEV sales. Only Ford had electric vehicle sales that were over 90% PHEV. Others like Volkswagen, BMW, and BYD had more diverse mixes of BEV and PHEV sales.

By comparison, the global market of electric commercial vehicles is still at a very early stage. Global sales of electric buses and trucks peaked in 2016 and 2017, respectively and experienced continuous declines afterwards. In 2020, about 62,000 electric buses were sold worldwide, a 27% decline over 2019. Electric truck sales contracted more significantly. The 2020 sales of nearly 7,000 units represented a 72% reduction over 2019. China continued to dominate global sales of electric commercial vehicles, accounting for 97.7% and 99.2% of electric bus and truck sales through 2020, respectively.[34]

34 Ben Sharpe and Claire Buysse, *Zero-emission bus and truck market in the United States and Canada: A 2020 update*, (ICCT: Washington, DC, 2021), https://theicct.org/publications/canada-race-to-zero-FS-may2021.

ELECTRIC VEHICLE SALES SHARES

In 2020, the global electric vehicle share of new passenger vehicle sales hit an all-time high of 4.6%, up from 2.8% in 2019. Figure 3 presents the 2010–2020 electric vehicle shares of new passenger vehicle sales in the top ten national passenger vehicle markets, and the global average level for comparison. European countries led the world in electric vehicle penetration, with an average electric vehicle share of 11% in 2020, over three times the 2019 level of 3%. Germany achieved an electric vehicle share of 13%, triple the global average, over quadruple its 2019 level, and the highest among the top ten passenger vehicle markets. France and the United Kingdom each achieved a 11% electric vehicle share in 2020, a fourfold and threefold increase over the previous year, respectively. China dropped from 1st to 4th in electric vehicle share among the top ten passenger vehicle markets, though it saw an increase from 5% in 2019 to 6% in 2020.

The electric vehicle sales shares of the other top ten passenger vehicle markets in 2020 were all well below the global average. Canada (3.0%) and the United States (2.3%) both achieved a record-high electric vehicle shares in 2020. Although not shown, the state of California, with an electric vehicle share of above 8%, had nearly four times the overall U.S. uptake.[35] The electric vehicle share of South Korea, the only major market with an increase in overall passenger vehicle sales in 2020, remained unchanged at 2.2%. Japan saw an electric vehicle share of 0.8% in 2020, a third consecutive decrease since 2018; this could largely be due to more policy, industry, and consumer focus on hybrids (and to some extent FCVs). India and Brazil are still at very early passenger vehicle electrification stages, with electric vehicle shares of less than 0.2%.

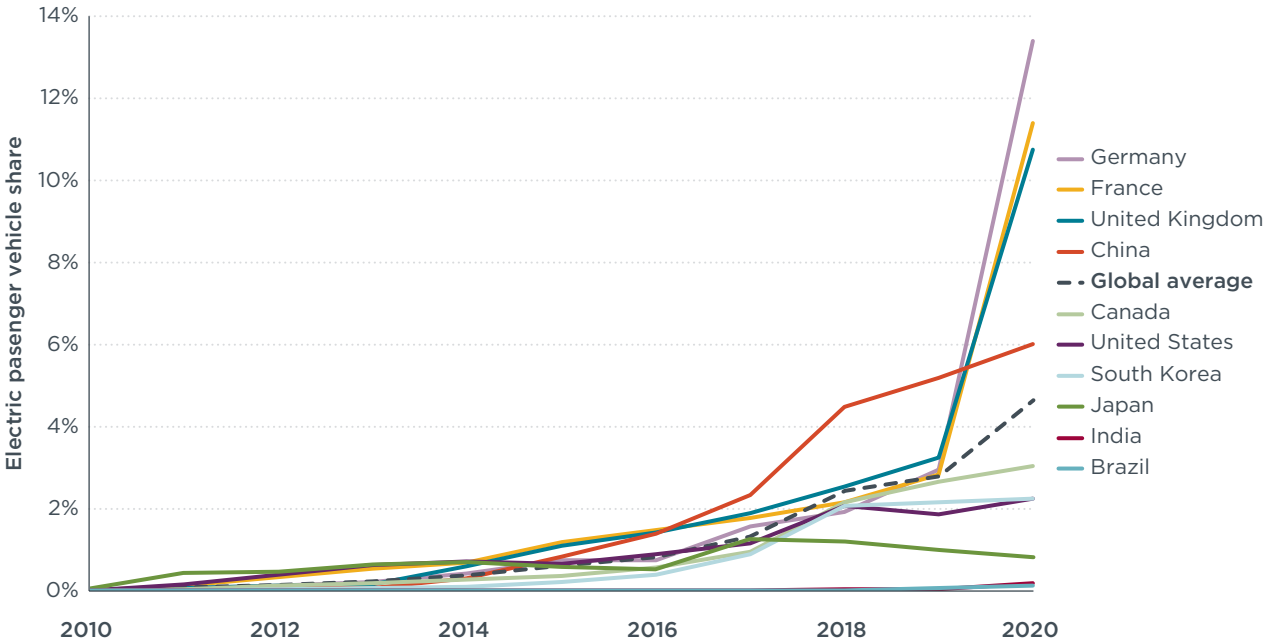

Figure 3. Electric vehicle shares of new passenger vehicle sales for largest markets from 2010 to 2020. Vehicle sales data from EV-Volumes, 2021.

Some smaller markets have higher electric vehicle sales shares than those shown in Figure 3. Norway maintained its top rank globally with a record-high electric vehicle share of 75% in 2020. This is the first time ever that electric vehicle share of a national-

35 "California Auto Outlook," CNCDA, 2021, https://www.cncda.org/wp-content/uploads/Cal-Covering-4Q-20.pdf.

level market exceeded 60%. Other markets with an electric vehicle share higher than Germany in 2020 include Iceland (51%), Sweden (32%), the Netherlands (25%), Finland (18%), Denmark (16%), Switzerland (14%), and Portugal (14%). However, these vehicle markets are smaller by at least one order of magnitude than the top ten markets shown in Figure 3. A total of 14 markets worldwide achieved an electric vehicle share of over 10%, compared with only 4 such markets in 2019. The FCV share of global passenger vehicle sales in 2020 was much lower than the electric vehicle share, at 0.012%, with South Korea having the highest national FCV share of new sales, at 0.37%.

ELECTRIC VEHICLE MODEL AVAILABILITY

The availability of attractive high-volume electric vehicle models across automaker brands, vehicle types, and markets is a prerequisite to developing a mainstream electric vehicle market. Figure 4 summarizes the total number of electric passenger vehicle models available globally from 2010 to 2020. This analysis on model availability focuses on models that surpass a threshold of 5,000 annual sales. The threshold is applied to highlight models for which substantial efforts are made by automakers to develop a supply chain, manufacturing line, marketing, and dealer training to deploy those models in significant numbers.

As shown in Figure 4, the total number of electric passenger vehicle models increased significantly from 2010 to 2020. Based on a 5,000 sales threshold, there were 136 unique electric passenger vehicle models available globally in 2020, up from 91 such models in 2019, 33 such models in 2015, and zero such models in 2010. Including models with at least 1,000 sales, thereby including early and small-volume models as well as older discontinued models, would increase the 2020 global model count from 136 to 687. In 2020, the electric passenger vehicle models available in China, Europe, and the United States were 137, 102, and 31, respectively, based on the 1,000 sales cutoff. Many national markets accross the world have access to just a few models. In context, there are hundreds of unique internal combustion engine passenger vehicle models each in the China, Europe, and U.S. markets that span automaker brands, power, size, and vehicle types to give consumers far more options. For a mainstream electric vehicle market, there will similarly need to be many hundreds of high-production electric vehicle models.

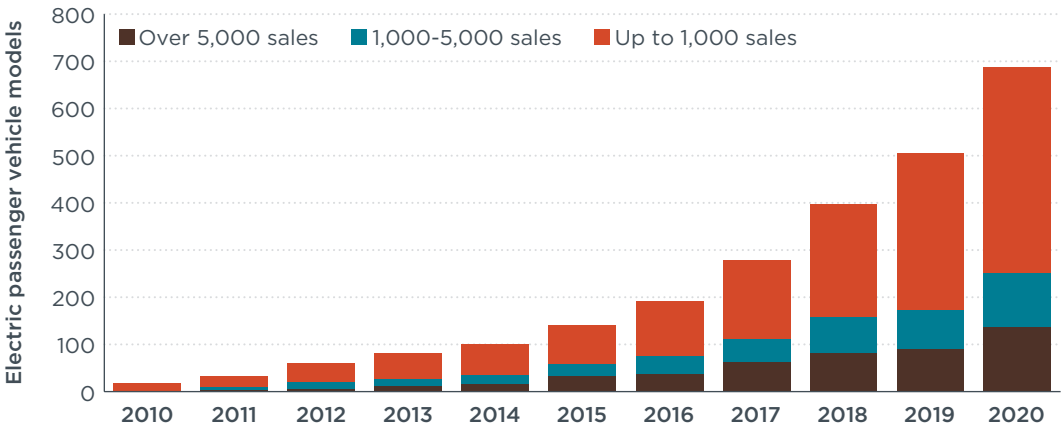

Figure 4. Electric passenger vehicle models available globally from 2010 to 2020.

ELECTRIC VEHICLE COST COMPETITIVENESS

The pace of vehicle electrification will largely depend on how quickly electric vehicle costs decline and reach price parity with conventional combustion vehicles. Due to continuous lithium-ion battery technology and manufacturing-level improvements, the costs of automotive lithium-ion batteries have been reduced significantly in the past decade. Based on global industry surveys, sales-weighted average battery pack-level costs were approximately $137 per kilowatt-hour (kWh) in 2020, a decline of 12% over 2019.[36] With continued technology and production scale advancements, this trend is estimated to be maintained in the coming decade.

Figure 5 summarizes recent expert research projections of 2020–2035 battery pack costs.[37] The three bold lines in the figure are the ICCT's latest battery pack estimates in the United States (yellow), China (red), and Europe (blue). The battery pack costs are projected to continue declining in these three leading markets with an annual reduction of around 7% to hit $58–$83 per kWh by 2030. China's battery costs are approximately 20%–30% lower than the United States and Europe. This is mainly because batteries manufactured in China benefit from higher production volume and lower material costs.

36 "Battery pack prices cited below $100/kWh for the first time in 2020, while market average sits at $137/kWh, *Bloomberg New Energy Finance*, December 16, 2020, https://about.bnef.com/blog/battery-pack-prices-cited-below-100-kwh-for-the-first-time-in-2020-while-market-average-sits-at-137-kwh/; Bloomberg New Energy Finance, "Electric vehicle outlook 2020," https://efiling.energy.ca.gov/getdocument.aspx?tn=233410.

37 Technical studies listed in this figure include: UBS, "UBS evidence lab electric car teardown: Disruption ahead?" (May 18, 2017), https://neo.ubs.com/shared/d1ZTxnvF2k/; Gert Berkmans, Maarten Messagie, Jelle Smekens, Noshin Omar, Lieselot Vanhaverbeke, and Joeri Van Mierlo, "Cost Projection of State of the Art Lithium-Ion Batteries for Electric Vehicles Up to 2030," Energies 10, no.9 (September 2017):1314, https://www.mdpi.com/1996-1073/10/9/1314; Shabbir Ahmed, Paul Nelson, Naresh Susarla, and Dennis Dees, "Automotive Battery Cost Using BatPac" (2018), https://www.iea.org/media/%20Workshops/2018/Session2ShabbirAhmedANL.pdf; Menahem Anderman, "The xEV Industry Insider Report" (2018), https://totalbatteryconsulting.com/industry-reports/xEV-report/Extract-from-the-2018-%20xEV-Industry-Report.pdf; China Automotive Technology and Research Center (CATARC), 中国传统汽车和新能源汽车发展趋势研究 [Development trend of conventional vehicles and new energy vehicles in China throughout 2050] (2019), personal communication; P3, Tesla battery day 2020 – technology announcement analysis (2020), https://www.electrive.net/wp-content/uploads/2020/09/200923_Tesla_Battery-Day_P3-%20Assessment-published.pdf; China industry Technology Innovation Strategic Alliance for Electric Vehicles (CAEV), 后补贴时代电动汽车产品技术方案及市场需求研究[Research on electric vehicle product technology and market demand in the post-subsidy era], (2020), personal communication; Nic Lutsey and Michael Nicholas, *Update on electric vehicle costs in the United States through 2030*, (ICCT: Washington, DC, 2019), https://theicct.org/publications/update-US-2030-electric-vehicle-cost; Nic Lutsey, Hongyang Cui, and Rujie Yu, *Evaluating electric vehicle costs and benefits in China in the 2020-2035 time frame*, (ICCT: Washington, DC, 2021), https://theicct.org/publications/ev-costs-benefits-china-EN-apr2021; Peter Mock and Sonsoles Díaz, *Pathway to decarbonization: The European passenger car market, 2021-2035*, (ICCT: Washington, DC, 2021), https://theicct.org/publications/decarbonize-EU-PVs-may2021.

The lowest dashed line in Figure 6 represents analysis of Tesla's announcements in late 2020 and provides a reasonable lower bound of cost for companies with lower-cost, high-volume battery manufacturing. Besides battery costs, indirect costs including research and development, depreciation, and amortized costs are also likely to fall as costs are spread over more vehicles and manufacturing processes are improved.

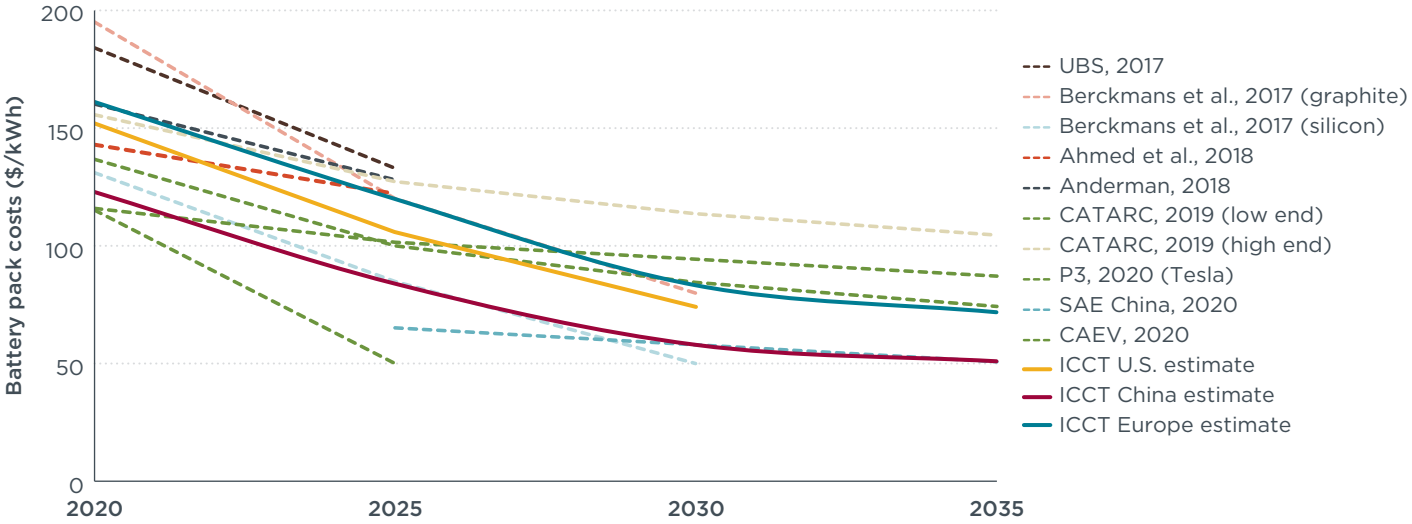

Figure 5. Estimates on electric vehicle battery pack costs during 2020-2035 from technical studies.

With continued significant decreases in battery costs and indirect costs, electric passenger vehicles are estimated to reach initial price parity with conventional vehicles within five to ten years in the Unites States, China, and Europe. The timing of price parity varies by electric range and vehicle class. A typical battery electric car with a range of 350 kilometers is estimated to reach price parity with corresponding conventional vehicles in the United States (with a power of 150 kW), China (94 kW), and Europe (98 kW) in 2026, 2028, and 2029, respectively.[38] Cost-competitiveness for electric vehicles in these three leading markets will be reached several years faster than initial vehicle price parity, as it is based primarily on fuel savings. Before electric vehicle cost parity arrives, sustained and targeted fiscal incentives will still play an essential role in bridging the price gap between conventional and electric vehicles.

CHARGING INFRASTRUCTURE DEVELOPMENT

A comprehensive charging ecosystem is needed to ensure electric vehicles are as convenient for drivers as gasoline or diesel vehicles. Figure 6 shows the growth in global cumulative sales of electric passenger vehicles and public charger stock between 2011 and 2020. Cumulative sales of electric passenger vehicles grew to over 10 million by the end of 2020, with an annual average growth rate of 79% from 2011 to 2020. Public charging infrastructure has averaged growth of 68% annually over the same span to reach 1.3 million chargers at the end of 2020. These trends are inter-related: broader availability of charging increases electric vehicle drivers' confidence, and more electric vehicle drivers encourage governments, industry, and property owners to install more charging stations. At the end of 2020, there were approximately eight electric passenger vehicles per public charger globally.

38 Lutsey and Nicholas, *Update on electric vehicle costs in the United States through 2030*; Lutsey, Cui, and Yu, *Evaluating electric vehicle costs and benefits in China in the 2020-2035 time frame*; Mock and Díaz, *Pathway to decarbonization: The European passenger car market, 2021-2035*.

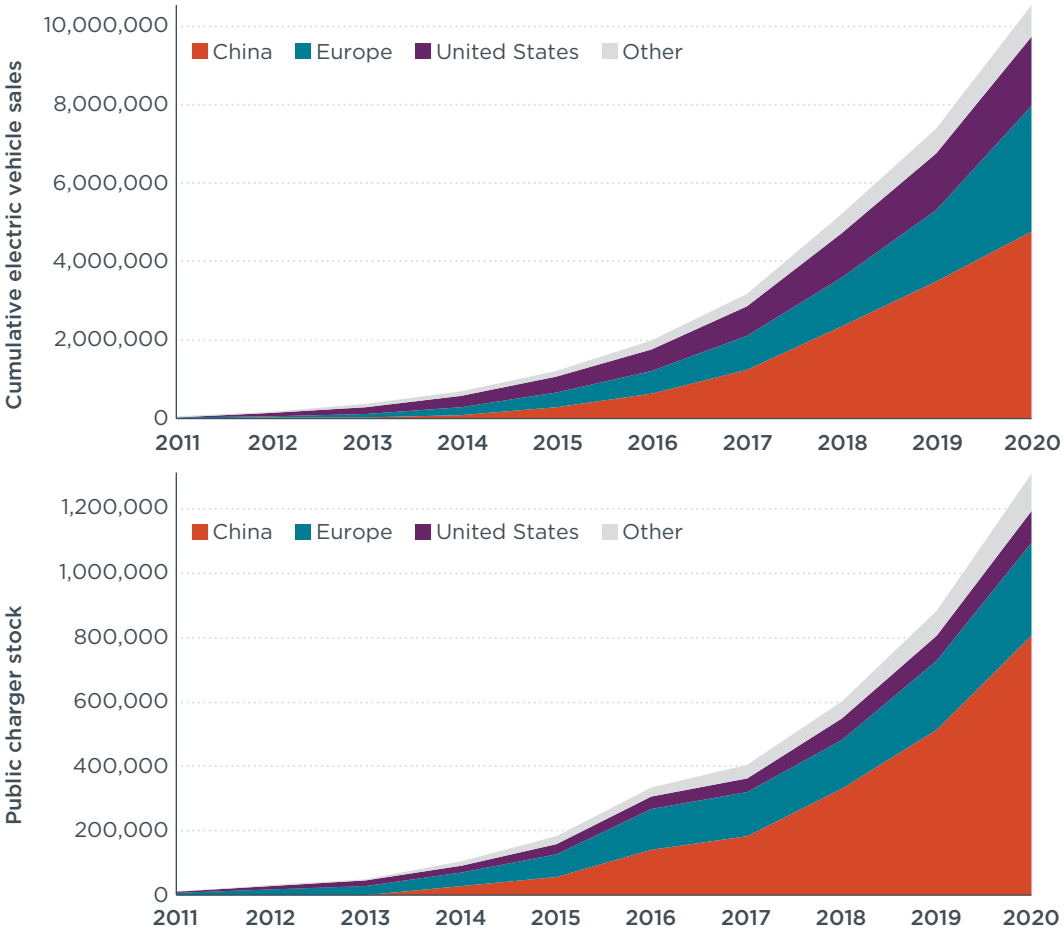

Figure 6. Global cumulative electric passenger vehicle sales and public charger stock by markets from 2011 to 2020.

Figure 7 shows the public charging infrastructure development progress of the ten national markets with the largest cumulative sales of electric passenger vehicles through 2020. The charger counts are shown by chargers per million residents to normalize the varying market sizes. In addition, the relative amount of public regular charging compared to direct current fast charging (power capacity above 43 kilowatt) is shown, with shares ranging from 3% in the Netherlands to 38% in China. The data points, corresponding to the right axis, show the electric passenger vehicles per public charge point. As indicated, the markets of the Netherlands and Norway had greater relative public charging availability at over 3,000 chargers per capita. When assessed as electric passenger vehicle per public charger, the Netherlands and China had the most charging with one charger per 5–6 electric passenger vehicles, while Norway had the highest ratio among countries examined at 25.

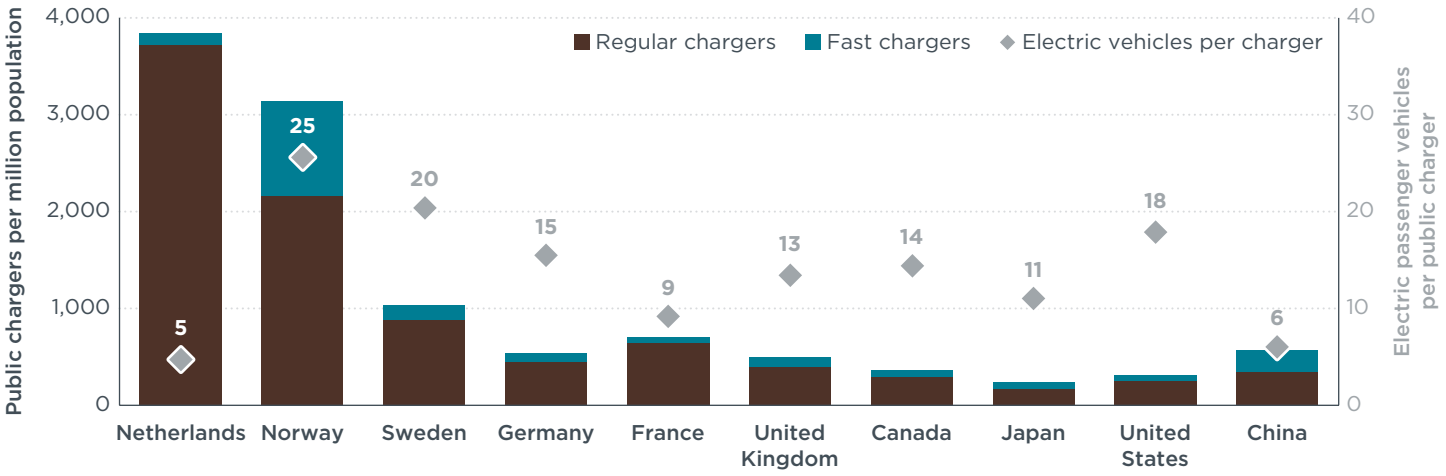

Figure 7. Public chargers per million population (regular and fast) and electric passenger vehicles per public charger for the ten national markets with the largest cumulative sales of electric passenger vehicles through 2020.

The differences shown in the figure illustrates that there is no "one-size-fits-all" solution for charging infrastructure. The amount and type of charging needed depend on factors such as housing stock, commuting patterns, vehicle mix, typical driving patterns, and the amount of fast charging. Nonetheless, one point remains certain from the trends: much more charging of all kinds is needed in all markets to enable a full transition to electric vehicles, and this requires increased investments and continued policy efforts.[39]

In addition to the public charging stations, there are also battery-swapping and hydrogen stations that support much smaller numbers of vehicles. By the end of 2020, there were 555 battery-swapping station in China.[40] In the United States and Europe, only small pilot projects exist after battery-swapping initiatives in the early 2010s were unsuccessful. Hydrogen stations were largely concentrated in California, China, Germany, Japan, and South Korea, where the vast majority of the world's 27,000 FCVs are located. It is estimated that there were approximately 550–600 hydrogen stations globally by the end of 2020, including 142 in Japan, 100 in Germany, 69 in China, 60 in South Korea, 47 in California, and 34 in France.[41]

ELECTRIC VEHICLE PROGRESS VERSES GOALS

Figure 8 compares the historical and targeted electric vehicle shares of new passenger vehicle sales in markets which have announced goals for the electric share of new

39 Michael Nicholas, Dale Hall, and Nic Lutsey, *Quantifying the electric vehicle charging infrastructure gap across U.S. markets*, (ICCT: Washington, DC, 2019), https://theicct.org/publications/charging-gap-US; Michael Nicholas and Nic Lutsey, *Quantifying the electric vehicle charging infrastructure gap in the United Kingdom*, (ICCT: Washington, DC, 2020), https://theicct.org/publications/charging-gap-UK-2020; and Michael Nicholas and Sandra Wappelhorst, *Regional charging infrastructure requirements in Germany through 2030*, (ICCT: Washington, DC, 2020), https://theicct.org/publications/regional-charging-infra-germany-oct2020

40 Jinghua Xi, "截至2020年底，全国换电站555座，增长81.4% [There were 555 battery-swapping stations in China by the end of 2020, an increase of 81.4% over the previous year]," (March 22, 2021), http://www.ndanev.com/2021/03/22/11/

41 California Energy Commission, Zero Emission Vehicle and Infrastructure Statistics, (accessed July 1, 2021), https://www.energy.ca.gov/data-reports/energy-insights/zero-emission-vehicle-and-charger-statistics; "Record Number of Newly Opened Hydrogen Refueling Stations in 2020," FuelCellsWorks, (February 17, 2021), https://fuelcellsworks.com/news/record-number-of-newly-opened-hydrogen-refuelling-stations-in-2020/; "584 Hydrogen Fueling Stations Launched in 33 countries, Says Information Trends," (January 28, 2021), https://www.prnewswire.com/news-releases/584-hydrogen-fueling-stations-launched-in-33-countries-says-information-trends-301217235.html

vehicle sales.[42] Norway, with a record-high electric vehicle share of 74.7% in 2020, is in a good position to achieve its 100% electric vehicle share goal in 2025. The other four European countries, including the Netherlands, the United Kingdom, France, and Germany, are also relatively on track to meet its goal thanks to a sharp increase on electric vehicle shares in 2020. If these countries continue to grow at the 2020 rate, they could achieve the 100% electric vehicle share goals in their target years.

The other markets shown in the figure, all in Asia and North America, are still relatively far from their announced goals and will need to make significant progress to meet their vehicle electrification targets. Despite the stunning progress made through 2020, the global transition to electric vehicles is still at an early stage. Continued policy support, as well as innovations in vehicle technology and progress in infrastructure build out, will be needed to accelerate growth and ensure that the goals for full vehicle electrification are achieved.

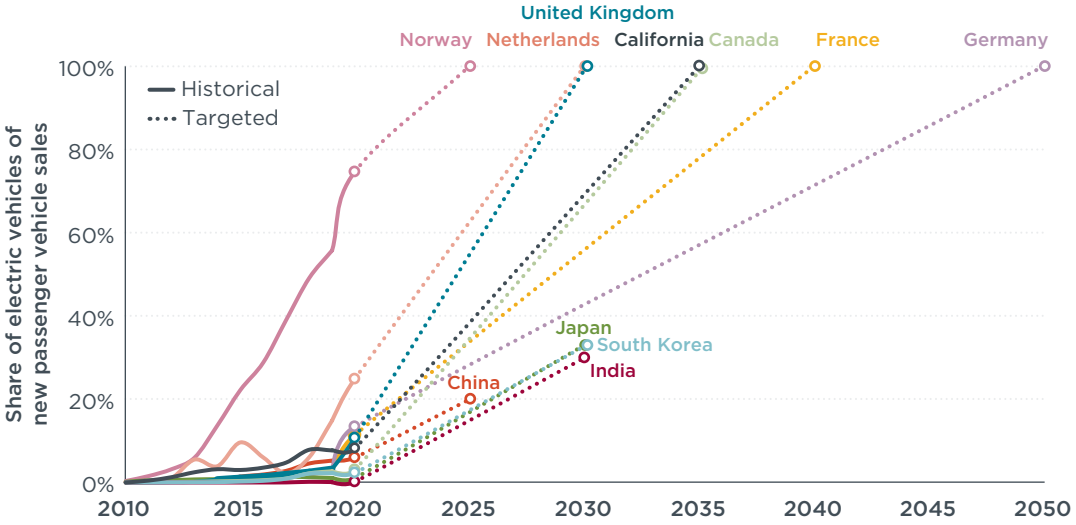

Figure 8. Historical and targeted electric vehicle shares of new passenger vehicle sales by markets.

42 References for electric vehicle share targets shown in this figure include: Office of Governor Gavin Newsom, "Governor Newsom announces California will phase out gasoline-powered cars & drastically reduce demand for fossil fuel in California's fight against climate change," (September 26, 2020), https://www.gov.ca.gov/2020/09/23/governor-newsom-announces-california-will-phase-out-gasoline-powered-cars-drastically-reduce-demand-for-fossil-fuel-in-californias-fight-against-climate-change/; Government of Canada, Building a green economy: Government of Canada to require 100% of car and passenger truck sales be zero-emission by 2035 in Canada, (2021), https://www.canada.ca/en/transport-canada/news/2021/06/building-a-green-economy-government-of-canada-to-require-100-of-car-and-passenger-truck-sales-be-zero-emission-by-2035-in-canada.html; China State Council, 新能源汽车产业发展规划(2021-2035年) [New Energy Vehicle Industrial Development Plan (2021-2035)], (2020), http://www.gov.cn/zhengce/content/2020-11/02/content_5556716.htm; French Republic, LOI n° 2019-1428 du 24 décembre 2019 d'orientation des mobilités [Law Number 2019-1428 of 24 December 2019 on Mobility Orientation], https://www.legifrance.gouv.fr/affichTexte.do?categorieLien=id&cidTexte=JORFTEXT000039666574&dateTexte=; International ZEV Alliance, International ZEV Alliance Announcement, (2015), http://www.zevalliance.org/international-zev-alliance-announcement/; "India turns to electric vehicles to beat pollution," *BBC News*, (July 24, 2019), https://www.bbc.com/news/world-asia-india-48961525; Ministry of Economy, Trade and Industry, "次世代自動車戦略2010 [Next-Generation Vehicle Strategy 2010]," (2010) https://www.a3ps.at/site/sites/default/files/conferences/2011_eco-mobility2011/2011_Eco-Mobility_01_04_Miura.pdf; Dutch Government, Mission Zero Powered by Holland, (2020), https://www.rvo.nl/sites/default/files/2019/06/Misson%20Zero%20Powered%20by%20Holland.pdf; Norwegian Ministry of Transport, National Transport Plan 2022-2033, (2021), https://www.regjeringen.no/contentassets/117831ad96524b9b9eaadf72d88d3704/en-gb/pdfs/meld-st-20-national-transport-plan-summary.pdf; Cho Chung-un, "Korea aims to become world's No.1 green car provider, first to commercialize autonomous driving," *Korea Herald*, (October 15, 2019), http://www.koreaherald.com/view.php?ud=20191015000824; Government of the United Kingdom, "Government takes historic step towards net-zero with end of sale of new petrol and diesel cars by 2030," (November 18, 2020), https://www.gov.uk/government/news/government-takes-historic-step-towards-net-zero-with-end-of-sale-of-new-petrol-and-diesel-cars-by-2030.

CONCLUSIONS

From this high-level synthesis of the electric vehicle market and policy developments globally through 2020, we conclude with the following three points.

The global electric vehicle market achieved substantial growth in 2020. Despite the impacts of the COVID-19 pandemic, the global transition to electric vehicles continued in 2020. The global market achieved a major milestone with the cumulative electric passenger vehicle sales exceeding 10 million, and the electric share of new passenger vehicle sales hit a record-high 4.6%. Thanks to sustained policy adoption and technology deployment, 2020 saw a 49% increase in the number of high-volume electric passenger vehicle models, a 12% decline of average battery pack cost, and a 48% increase in public electric vehicle charger stock. Europe overtook China to become the world's largest single market of electric passenger vehicles. This would appear to put European countries, such as France, the Netherlands, Norway, and United Kingdom, on track toward their ambitious 100% electric vehicle sales share goals.

Governments are showing stronger determination to embrace an electric future. At least 21 national and provincial-level governments worldwide, including Canada, China, France, Scotland, South Korea, the United Kingdom, and 15 states of the United States announced new targets for vehicle electrification in 2020. As of end 2020, more than 20 countries, provinces and states globally, mostly in Europe and North America, have proposed to phase out new sales of ICE passenger cars or to only sell new electric models in the 2025–2050 time frame. Meanwhile, 2020 saw increasing momentum on electrifying medium- and heavy-duty vehicles. These ambitious targets provide a clear signal to automakers, charging infrastructure providers, and vehicle fleet managers to make the transition to electric vehicles.

Continued and adapted policy support is tackling barriers and stimulating electric vehicle uptake. There was substantial progress on the development of vehicle regulations, which are critical to ensure increased electric vehicle deployment. Such policies include the world's first electric vehicle regulation requiring 100% zero-emission vehicle sales share in British Columbia, the world's first electric vehicle regulation for medium- and heavy-duty vehicles in California, the extension of China's electric vehicle regulation from 2020 to 2023, and the implementation of EU's tightened CO_2 emission requirements for the new light-duty vehicle fleet. Additional policy efforts include sustaining financial incentives for electric vehicle purchases and investing in the development of charging infrastructure networks. These targeted efforts help break down barriers and pave the way for a growing electric vehicle market.

This end-of-2020 electric vehicle summary points to multiple areas for further research. It will be important to track several new under-development policies, including China's NEV regulation for commercial vehicles, California's new ZEV regulations for light-duty and medium- and heavy-duty vehicles, the revision of the EU light-duty CO_2 emission standards, and the potential revision of the U.S. greenhouse gas and fuel efficiency standards. Meanwhile, the three major electric vehicle markets—the European Union, China, and the United States—have all set long-term carbon emission reduction targets. These high-level targets may become the most important catalyst to stronger electric vehicle commitments and policies in the next decade.

Monitoring the recovery of vehicle markets following the COVID-19 pandemic, as well as deeper local-level trends, will be important to understand how markets and policies are evolving. Continued tracking of the transition to electric vehicles in the three major

markets helps us to better understand the path ahead toward a larger, mainstream market. Further investigation of electric vehicle uptake in emerging markets will also be important to ensure that the transition to electric vehicles, and their climate and consumer benefits, is truly global.