BRIEFING

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Update on the global transition to electric vehicles through 2019

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Many national and local governments around the world motivated to achieve climate, air quality, and industrial growth objectives have announced bold vehicle electrification goals. Many of the governments are turning those goals into action by implementing policies to overcome the prevailing barriers and accelerate electric vehicle uptake.

This briefing provides an update on market and policy developments through the end of 2019 related to the global transition to electric vehicles. It provides a summary of vehicle electrification goals set by major markets globally, actions adopted to achieve those goals, and progress toward those goals. Data and supporting actions are summarized, including where enforceable regulations are in place. The briefing focuses primarily on passenger electric vehicles (EVs), including battery electric vehicle (BEV) and plug-in hybrid electric vehicles (PHEV) technologies, where there has been the most market and policy progress. Where related policies and market data are available, associated heavy-duty vehicle and fuel cell vehicle (FCV) information are also included.

VEHICLE ELECTRIFICATION TARGETS

Table 1 provides a list of vehicle electrification targets announced by national governments. Most goals focus on light-duty vehicles, especially passenger cars. More than a dozen countries, mostly in Europe, have proposed a timeline to phase out new sales of fossil fuel passenger cars or to only sell zero-emission models by 2050. Among them, Norway has the most ambitious target, aiming to achieve a 100% electric vehicle share of new passenger vehicle and light-duty van sales by 2025. Comparatively, major markets in Asia, including China, Japan, India, and South Korea, are less ambitious.

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These four countries all have set target dates to achieve an EV share of around 30% but lack official long-term statements about full electrification. The United States, the second largest vehicle electric market worldwide, does not have a federal-level vehicle electrification target.

Table 1. Vehicle electrification goals announced by select national-level governments.

Government	Target vehicle type	Target year	Target on new sales	Source
Canada [a]	Vehicles	2040	100% electric vehicles	Government document
China [b]	Vehicles	2025	25% electric vehicles	Draft government document
Costa Rica [c]	Light-duty vehicles	2050	100% electric vehicles	Government document
Denmark [d]	Passenger cars	2030	No gasoline or diesel vehicles	Government document
		2035	No gasoline, diesel, or plug-in hybrid electric vehicles	
France [e]	Passenger cars and light-duty commercial vehicles	2040	No vehicles using fossil fuels	Law
Germany [f]	Passenger vehicles	2050	100% electric vehicles	ZEV Alliance commitment
Iceland [g]	Passenger cars	2030	No gasoline or diesel vehicles	Government document
India [h]	Passenger cars	2030	30% electric vehicles	Speech of Transport Minister
Ireland [i]	Passenger cars	2030	No fossil fuel vehicles	Government document
Israel [j]	Passenger cars	2030	No gasoline or diesel vehicles	Speech of Energy Minister
Japan [k]	Passenger vehicles	2030	23%-33% electric vehicles	Government document
Netherlands [l]	Passenger cars	2030	100% electric vehicles	Government document
Norway [m]	Passenger vehicles	2025	100% electric vehicles	Government document
	Light-duty vans	2025	100% electric vehicles	
	Long-distance coaches	2030	75% electric vehicles	
	Trucks	2030	50% electric vehicles	
Portugal [n]	Passenger cars	2040	No vehicles with internal combustion engines	Speech of First Secretary of State for Mobility
Scotland [o]	Passenger cars and vans	2032	No gasoline or diesel vehicles	Government document
Singapore [p]	Vehicles	2040	No internal combustion engine vehicles	Speech of Deputy Prime Minister
Siri Lanka [q]	Vehicles	2040	100% electric or hybrid vehicles	Speech of Finance Minister
Slovenia [r]	Passenger cars and light-duty commercial vehicles	2030	100% vehicles with CO_2 emissions up to 50 g/km	Government document
South Korea [s]	Passenger cars	2030	33% electric vehicles	Speech of President
Spain [t]	Passenger cars	2040	100% electric vehicles	Draft law
Sweden [u]	Passenger cars	2030	No gasoline or diesel vehicles	Government document
United Kingdom [v]	Passenger cars and vans	2035	No petrol, diesel, hybrid, or plug-in hybrid vehicles	Speech of Prime Minister

[a] Department of Finance Canada, "Investing in the Middle Class. Budget 2019," (2019), https://www.budget.gc.ca/2019/docs/plan/budget-2019-en.pdf

[b] Chinese Ministry of Industry and Information Technology,"新能源汽车产业发展规划(2021-2035年)(征求意见稿) [New Energy Vehicle Industry Development Plan (2021-2035), proposal for public comments)]," (2019), http://www.miit.gov.cn/n1146285/n1146352/n3054355/n3057585/n3057589/c7552776/content.html

[c] Government of Costa Rica, "National Decarbonization Plan 2018-2050," (2019), https://unfccc.int/sites/default/files/resource/NationalDecarbonizationPlan.pdf

[d] Danish Ministry of Energy, Utilities and Climate, "Sammen om en grønnere fremtid. Klima- og lufudspil [Together about one greener future. Climate and Air Plan]," (2018), https://efkm.dk/media/12350/klimaministeriet_klimaogluftudspil_digital.pdf

[e] 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=

[f] International ZEV Alliance, International ZEV Alliance Announcement, (2015), http://www.zevalliance.org/international-zev-alliance-announcement/

[g] Ministry for the Environment and Natural Resources, "Iceland's Climate Action Plan for 2018-2030," (2018), https://www.government.is/library/Files/Icelands%20new%20Climate%20Action%20Plan%20for%202018%202030.pdf. This target is on new registrations instead of new sales of cars, and exemptions, such as for remote areas, will be considered.

[h] "India turns to electric vehicles to beat pollution," *BBC News*, (July 24, 2019), https://www.bbc.com/news/world-asia-india-48961525

[i] Government of Ireland, "Climate Action Plan 2019. To Tackle Climate Breakdown. Annex of Actions.," (2018), https://www.dccae.gov.ie/en-ie/climate-action/publications/Documents/16/Climate_%20Action_Plan_2019_Annex_of_Actions.pdf

[j] Shoshanna Solomon, "Israel aims to eliminate use of coal, gasoline and diesel by 2030," *The Times of Israel,* (February 27, 2018), https://www.timesofisrael.com/israel-aims-to-eliminate-use-of-coal-gasoline-and-diesel-by-2030/

[k] 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

[l] Dutch Government, Klimaatakkoord [Climate Agreement], (2019), https://www.klimaatakkoord.nl/documenten/publicaties/2019/06/28/klimaatakkoord

[m] Norwegian Ministry of Transport and Communications, "National Transport Plan 2018-2029," (2017), https://www.regjeringen.no/contentassets/7c52fd2938ca42209e4286fe86bb28bd/en-gb/pdfs/stm201620170033000engpdfs.pdf

[n] Filipa Almeida Mendes, "Governo aumenta apoios à compra de carros eléctricos [Government increases support for the purchase of electric cars]," *Publico*, (November 17, 2018), https://www.publico.pt/2018/11/17/sociedade/noticia/governo-quer-veiculos-electricos-circular-portugal-1851418?fbclid=IwAR19alFsBAEOeA4j9gxGfKxvoPydN2wU7dKxemjDZWMqqL7d0R-CeFY7qYo

[o] Scottish Government, "Climate Change Plan: third report on proposals and policies 2018-2032 (RPP3)," (February 6, 2018), https://www.gov.scot/publications/scottish-governments-climate-change-plan-third-report-proposals-policies-2018/pages/12/

[p] Aradhana Aravindan and John Geddie, "Singapore aims to phase out petrol and diesel vehicles by 2040," *Reuters*, (February 18, 2020), https://www.reuters.com/article/us-singapore-economy-budget-autos/singapore-aims-to-phase-out-petrol-and-diesel-vehicles-by-2040-idUSKBN20C15D

[q] Target is for stock instead of new vehicle sales. "Sri Lanka to scrap state-owned fossil fuel vehicles by 2025," *The Straits Times*, (November 10, 2017). https://www.straitstimes.com/asia/south-asia/sri-lanka-to-scrap-state-owned-fossil-fuel-vehicles-by-2025

[r] Ministry of Infrastructure of the Republic of Slovenia, Strategija na področju razvoja trga za vzpostavitev ustrezne infrastrukture v zvezi z alternativnimi gorivi v prometnem sektorju v Republiki Sloveniji [Market Development Strategy for the Establishment of Adequate Alternative Fuel Infrastructure in the Transport Sector in the Republic of Slovenia], (2017), https://e-uprava.gov.si/.download/edemokracija/datotekaVsebina/298735?disposition=inline.

[s] 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

[t] Congress of Deputies of Spain Proposición de Ley sobre Cambio Climático y Transición Energética [Proposed Law on Climate Change and Energy Transition], (2019), http://www.congreso.es/public_oficiales/L13/CONG/BOCG/B/BOCG-13-B-48-1.PDF. Spain's Draft Law on Climate Change and Energy Transition, has been approved and is in its final administrative processing.

[u] Government Offices of Sweden, "Klimatpolitiska handlingsplanen – Fakta-PM [Climate Policy Action Plan - Facts PM," (2019), https://www.regeringen.se/4af76e/contentassets/fe520eab3a954eb39084aced9490b14c/klimatpolitiska-handlingsplanen-fakta-pm.pdf. Government analyzing conditions for a national ban on combustion vehicle sales, final report due 1 February 2021.

[v] Prime Minister Johnson announced bringing forward its combustion vehicle phase out to 2035 (from original 2040 target) and including hybrids in the phase-out. The proposal is now in an open consultation process, with July 2020 deadline. Department for Transport, Open consultation: Consulting on ending the sale of new petrol, diesel and hybrid cars and vans, https://www.gov.uk/government/consultations/consulting-on-ending-the-sale-of-new-petrol-diesel-and-hybrid-cars-and-vans

Although Table 1 summarizes the goals in terms of percentages of EV sales, the announcements themselves use different terminologies, including zero-emission vehicles and ultra-low emission vehicles, or refer to phasing out combustion or fossil-fuel vehicles. As of May 2020, none of the countries established legally-binding 100% zero-emission requirements with enforceable fines, but several, such as France and Spain, have taken official steps toward that goal. As shown, few targets have been proposed to electrify the heavy-duty sector where relevant technologies are generally less mature, and more barriers and uncertainties exist.

Several states and provinces have set more aggressive targets than their national governments, as is shown in Table 2. California and nine other U.S. states, as members of International Zero-Emission Vehicle Alliance (ZEV Alliance), have, in the absence of federal targets, committed to achieving a 100% EV share of new passenger vehicle sales by 2050. Some U.S. states have interim targets, like New Jersey's new vehicle goal of an 85% EV market share by 2040, and California's cumulative goal for 5 million ZEVs by 2030. British Columbia, the westernmost province of Canada, has adopted legislation to require an increasing percentage of new light-duty vehicles sold or leased within its jurisdiction be zero emission, reaching 100% by 2040; once implemented, this would be the first 100% ZEV regulation globally with legally enforceable fines. Canada has the same 2040 target at the national level, but the federal goal is not legally-binding. Hainan, the southernmost island province of China, has announced a detailed timeline to restrict new sales of gasoline and diesel vehicles and shift to electric sales by 2030. Hainan's targets also halt all gasoline and diesel use in the entire province for specific vehicle types by 2030. The Hainan targets are more aggressive than China's national plan of a 25% EV share of new vehicle sales by 2025.

Table 2. Vehicle electrification goals announced by select provincial-level governments.

Government	Vehicle type	Target year	New vehicle target	Stock target	Source
British Columbia (Canada) [a]	Light-duty vehicles	2040	100% electric vehicles		Law
California (US) [b]	Vehicles	2030		5 million zero-emission vehicles	Executive order
Hainan (China) [c]	Government and car-sharing vehicles, light-duty trucks	2020	100% electric vehicles		Government document
		2025		No gasoline or diesel vehicles	
	Taxis	2020		No gasoline or diesel vehicles	
	Ride-hailing vehicles	2020	No gasoline or diesel vehicles		
		2030		No gasoline or diesel vehicles	
	Sanitation vehicles	2020	50% electric vehicles		
		2030		No gasoline or diesel vehicles	
	Rental cars, coaches	2025	No gasoline or diesel vehicles		
		2030		No gasoline or diesel vehicles	
	Buses	2020	No gasoline or diesel vehicles		
		2025		No gasoline or diesel vehicles	
	Private cars	2030	100% electric vehicles		
New Jersey (US) [d]	Light-duty vehicles	2040	85% electric vehicles		Law
Québec (Canada); Baden-Württemberg (Germany); California, Connecticut, Maryland, Massachusetts, New Jersey, New York, Oregon, Rhode Island, Vermont, Washington (US) [e]	Passenger vehicles	2050	100% zero-emission vehicles		ZEV Alliance commitment

[a] British Columbia, Zero-Emission Vehicles Act (Bill 28 – 2019), https://www.leg.bc.ca/parliamentary-business/legislation-debates-proceedings/41st-parliament/4th-session/bills/first-reading/gov28-1

[b] Office of Governor Edmund G. Brown Jr., "Governor Brown Takes Action to Increase Zero-Emission Vehicles, Fund New Climate Investments," (January 26,2018), https://www.ca.gov/archive/gov39/2018/01/26/governor-brown-takes-action-to-increase-zero-emission-vehicles-fund-new-climate-investments/index.html

[c] Hainan Provincial People's Government, 海南省清洁能源汽车发展规划 [Development Plan of Clean Energy Vehicle in Hainan Province], https://www.hainan.gov.cn/hainan/xnyzcwj/201907/cb9368c30a0f42e7a4cae7dad6651a09.shtml

[d] "New Jersey advancing plug-ins: 330K units by end of 2025, 2M by 2035, 85% of new vehicles by 2040," *Green Car Congress*, (January 14, 2020) https://www.greencarcongress.com/2020/01/20200114-nj.html

[e] International ZEV Alliance, "International ZEV Alliance Announcement," (2015), http://www.zevalliance.org/international-zev-alliance-announcement/. U.S. states, Québec also have ZEV regulations requiring 8%-10% EV sales by 2025.

Cities have even more progressive zero-emission mobility goals. Table 3 shows city vehicle electrification targets, which often pertain to the overall stock rather than sales and apply to varying vehicle types and to specific parts of the city. For example, 35 cities on six continents have committed, through the C40 Cities Green and Healthy Streets platform, to procure only zero-emission buses by 2025 and ensure a major area of the city be zero emission by 2030. A dozen Chinese cities suffering from serious air pollution are expected to achieve the transition to a 100% electric bus fleet by the end of 2020. Several Chinese cities, including Shenzhen, Guangzhou, and Zhuhai,

have already completed this transition. Shenzhen has also fully electrified its taxi fleet. Several European cities, such as London, Paris, and Oslo, are targeting a shift to a fully fossil-free city in the coming decades. Often the cities first require zero-emission vehicles in the dense urban center, before expanding the zero-emission-only portion of the city. There are many more city-level vehicle electrification goals which are not summarized in the table due to limited space.

Table 3. Vehicle electrification goals announced by selected city-level governments.

Government	Target year	Vehicle electrification targets	Source
Amsterdam (Netherlands) [a]	2022	Emission-free buses in the city centre	Government document
	2025	Area within A10 ring road emission-free (passenger cars, motorbikes exempted)	
	2030	All emission-free transport	
Beijing, Hangzhou, Hefei, Jinan, Nanjing, Ningbo, Shanghai, Shijiazhuang, Taiyuan, Tianjin, Xi'an, Zhengzhou (China) [b]	2020	100% electric bus fleet in built-up areas	Government document
London (UK) [c]	2020	Town centre zero emission zones	Government document
	2025	Central London zero emission zone	
	2033	All taxis and private-hire vehicles zero emission capable	
	2037	All buses zero emission	
	2050	All vehicles zero emission	
Oslo (Norway) [d]	2020	Fossil-free public transport	Government document
	2024	Fossil-free city center	
	2030	Fossil-free city	
Paris (France) [e]	2024	Phase out the use of diesel vehicles	Government document
	2030	Phase out the use of gasoline vehicles	
Rio de Janeiro (Brazil); Vancouver (Canada); Santiago (Chile); Medellin (Columbia); Copenhagen (Denmark); Quito (Ecuador); Paris (France); Berlin, Heidelberg (Germany); Jakarta (Indonesia); Tokyo (Japan); Milan, Rome (Italy); Mexico City (Mexico); Amsterdam, Rotterdam (Netherlands); Auckland (New Zealand); Oslo (Norway); Warsaw (Poland); Moscow (Russia); Cape Town (South Africa); Seoul (South Korea); Barcelona, Madrid (Spain); Birmingham, Greater Manchester, London, Liverpool, Oxford (UK); Austin, Honolulu, Los Angeles, Santa Monica, Seattle, West Hollywood (USA) [f]	2025	Procure only zero emission buses	Green and Healthy Streets commitment (C40 Cities)
	2030	Ensure major area of city is zero emission	

[a] City of Amsterdam, Clean Air Action Plan, (2019), https://www.amsterdam.nl/en/policy/sustainability/clean-air/

[b] China State Council, 打赢蓝天保卫战三年行动计划 [Three-year Action Plan to Win the Battle to Defend a Blue Sky], (2018), http://www.gov.cn/zhengce/content/2018-07/03/content_5303158.htm

[c] Mayor of London, Mayor's Transport Strategy, (2018), https://www.london.gov.uk/sites/default/files/mayors-transport-strategy-2018.pdf

[d] City of Oslo, Climate budget 2018, (2017) https://www.klimaoslo.no/wp-content/uploads/sites/88/2018/02/Climate-Budget-English.pdf

[e] Mairie de Paris, "Plan Climat de Paris [Climate Plan of Paris], (2018), https://www.apc-paris.com/system/files/file_fields/2018/04/20/nouveauplanclimat.pdf

[f] C40 Cities, Our Commitment to Green and Healthy Streets: Fossil Fuel Free Streets Declaration, (20180, https://www.c40.org/other/green-and-healthy-streets

The city targets listed in Table 3 do not include fully-binding plans with enforcement mechanisms in place to require 100% zero-emission vehicles. However, the cities are each taking steps to encourage EV adoption and zero-emission transport by expanding transit access, developing charger-ready building codes, and installing curbside charging. In addition, the cities are conducting stakeholder engagement with

the initially affected neighborhoods and encouraging zero-emission freight delivery in order to achieve their electrification goals.

Although very few of the national and local targets are yet legally-binding, they are of crucial importance. The targets provide a clear signal to automakers, charging infrastructure providers, and vehicle fleet managers to make the transition to electric vehicles. However, further steps remain to turn the goals into enforceable policies to ensure they are achieved.

VEHICLE ELECTRIFICATION ACTIONS

In the past decade, a wide variety of vehicle policies and actions have been adopted to overcome key barriers and help achieve vehicle electrification goals. These policies can be mainly classified into four categories: (1) vehicle regulations to ensure high EV model availability, (2) financial incentives to make electric vehicles cost competitive with conventional fuel vehicles, (3) charging infrastructure to make electric vehicles as convenient as conventional fuel vehicles, and (4) campaigns and promotional actions to increase consumer awareness and understanding about electric vehicles. In addition, international cooperation has played an important role in accelerating the transition to electric vehicles. Multi-government collaborations allow policy makers around the world to disseminate lessons learned, share successful experiences, jointly tackle problems, and signal the rising momentum toward electric vehicles.

VEHICLE REGULATIONS

Many governments are adopting regulations that require increased deployment of electric vehicles. The transition to electric vehicles requires that sufficient electric vehicle model offerings are available across vehicle classes and company brands on the market. The most effective policies to ensure sufficient availability of electric vehicles are direct electric vehicle regulations—often call Zero Emission Vehicle (ZEV) or New Energy Vehicle (NEV) regulations—which require each manufacturer to deploy increasing shares of electric vehicles over time.

By early 2020, California and ten other U.S. states,[1] the Canadian province of Québec, and China, have adopted direct electric vehicle regulations for passenger vehicles. Analysis of expected manufacturer compliance indicates that the adopted ZEV regulation will lead to around 10%-15% electric vehicle sales in California by 2025.[2] On June 21, 2020, China released a policy document to extend its NEV regulation from 2020 to 2023.[3] Based on the newly-finalized NEV credit requirements, electric vehicle share in China is likely to at least double from 2019 to 2023. As described above, British Columbia has also adopted such legislation, but unlike other North America policies that are through 2025, British Columbia also requires 100% zero-emission vehicle sales by 2040.

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1 These ten states are Colorado, Connecticut, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Rhode Island, and Vermont. Also an eleventh, Washington state, adopted ZEV regulation in May 2020 legislation https://app.leg.wa.gov/billsummary?BillNumber=5811&Year=2019

2 Nic Lutsey, *Modernizing vehicle regulations for electrification*, (ICCT: Washington DC, 2018), https://theicct.org/publications/modernizing-regulations-electrification

3 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]*, http://www.miit.gov.cn/n1146285/n1146352/n3054355/n3057585/n3057589/c7981147/content.html?from=timeline&isappinstalled=0&tsrfkkwcwyn=

California and China are each in the process of developing regulations to require increased uptake of zero-emission heavy-duty vehicles, which will be the first in the world. In June of 2020, California adopted a strengthened proposal to require increasing percentages of zero-emission new truck sales across three vehicle classes. The regulations set increasing requirements that reach 40% (heavy tractors), 55% (commercial vans and pickups), and 75% (medium-duty trucks) zero-emission vehicle shares by 2035.[4]

Strong regulations on vehicle greenhouse gas emissions or vehicle fuel economy can also push increased electric vehicle availability. The key example of regulations which are strong enough to require electric vehicle sales are the 2020-2030 CO_2 emission standards for passenger cars and light-duty commercial vehicles in the European Union. In early 2020, the EU-level regulations are spurring EV sales share (7.8% January-April 2020) in Europe that is approximately double the 2019 EV share of 3.6%.[5] Going forward, stronger ZEV, CO_2, or efficiency regulations will be critical to ensure sufficient volume of electric vehicles to reach economies of scale and become a mainstream technology.

FINANCIAL INCENTIVES

Fiscal incentives have played an integral role in spurring electric vehicle sales. Almost all global electric vehicle sales to date occurred in markets with financial incentives to make electric vehicles more cost competitive with conventional vehicle alternatives. Specific policies include upfront purchase incentives (e.g., China, Japan, France, Germany, the United Kingdom), federal tax credits (e.g., the United States), and tax and registration fee exemption or discounts (e.g., Netherlands, Norway, Sweden).[6] Financial incentives will remain important in the near future until electric vehicles reach cost parity with conventional vehicles. Prematurely ending these policies can stifle electric vehicle sales, as happened in Denmark in 2016 and the U.S. state of Georgia in 2015. In April 2020, China announced it would extend its national subsidies and tax breaks for electric vehicles by two years until end of 2022,[7] whereas the policies were originally scheduled to be terminated at the end of 2020.

With the continued decline of battery prices, several jurisdictions have modified their incentive schemes to reduce incentive values in recent years. For example, China has phased down its purchase subsidies for electric vehicles six times from 2014 to 2020. Starting from March 12, 2020, the United Kingdom's plug-in car grant was reduced from £3,500 to £3,000,[8] the third time this grant has been cut since it launched in 2011. However, there are also markets that are proposing to increase incentives for electric vehicles. For example, Germany increased the maximum subsidies from €4,000 to

4 California Air Resources Board, Proposed Advanced Clean Trucks Regulation, (May 2020), https://ww2.arb.ca.gov/rulemaking/2019/advancedcleantrucks

5 EV-Sales, Europe April 2020, (28 May 2020), http://ev-sales.blogspot.com/2020/05/europe-april-2020.html

6 Sandra Wappelhorst, Dale Hall, Mike Nicholas, and Nic Lutsey, *Analyzing policies to grow the electric vehicle market in European cities*, (ICCT: Washington, DC, 2020), http://www.theicct.org/publications/electric-vehicle-policies-eu-cities and Dale Hall, Hongyang Cui, and Nic Lutsey, *Electric vehicle capitals: Showing the path to a mainstream market*, (ICCT: Washington, DC, 2019), https://theicct.org/publications/ev-capitals-of-the-world-2019

7 "China Weighs Cuts to Electric-Car Subsidies. It Just Extended," *Bloomberg News*, (April 1, 2020), https://www.bloomberg.com/news/articles/2020-04-01/china-mulling-cutting-electric-car-subsidies-it-just-extended

8 Department for Transport & Office for Low Emission Vehicles, "Updates on plug-in vehicle grants following today's budget," (March 11, 2020), https://www.gov.uk/government/news/plug-in-vehicle-grants-update-following-todays-budget

€6,000 for battery electric cars and from €3,000 to €4,500 for plug-in hybrid electric cars registered after November 4, 2019.[9]

CHARGING INFRASTRUCTURE

The transition to electric vehicles requires a convenient and reliable charging infrastructure network. Policies that have been adopted to support charging access include city charging strategies (e.g., New York, Oslo, Shenzhen), fiscal incentives for the construction and operation of charging infrastructure (e.g., Chinese national government, Beijing, Paris, Tokyo), streamlined permitting process for charging station development (e.g., Los Angeles, San Jose, Seattle), and EV-ready building and parking codes which mandate a percentage of new parking spaces be equipped with charging wiring and equipment (e.g., Beijing, London, San Francisco).[10] Governments in China also ensure a smooth and convenient charging experience through regulating charging pricing, standards, and payment mechanisms (e.g., Shanghai, Tianjin, Wuhan). Much more charging infrastructure will be needed as the electric vehicle market grows and as charging needs evolve with local conditions.[11] Government and operator strategies are evolving from simply putting more charge points on the ground to catering to identified consumer needs with the strategic placement of public charge points. With diligent infrastructure planning, electric vehicle charging could ultimately be more convenient for many drivers than fueling conventional vehicles.

CONSUMER AWARENESS

At this early stage of the transition to electric vehicles, many consumers are unaware of the availability and benefits of electric models, or are concerned about their safety, reliability, and performance. To improve consumer awareness and acceptance of this new technology, educational and advertising campaigns, as well as indirect actions to increase the visibility of electric vehicles, have been widely adopted.[12] For example, many cities have set up informational websites to provide consumers with convenient access to information on electric models, incentive policies, and charging infrastructure locations (e.g., Beijing, Berlin, Los Angeles). Various electric vehicle test drive events have been held in cities like Beijing, Madrid, San Francisco, San Jose, and Shanghai. Special privileges for electric vehicle drivers, like exemptions from license plate auctions or lotteries (e.g., Shanghai, Hangzhou), access to carpool or bus lanes (e.g., New York, San Jose), special parking permits (e.g., Paris, Liuzhou), and planned zero-emission zones (e.g., London, Oslo) are also effective measures. There are relatively few national electric vehicle promotion campaigns, but the United Kingdom's Go Ultra Low campaign includes many consumer outreach components. In addition, electrification of bus, taxi, ride-hailing, and car-sharing fleets increases the visibility of electric vehicles and enables firsthand experiences for consumers driving or riding in electric vehicles.

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9 Daniel Bönninghausen, "Increased EV subsidies go into effect in Germany," (February 18, 2020), https://www.electrive.com/2020/02/18/increased-ev-subsidies-go-into-effect-in-germany/. In addition, Germany's stimulus package as of June 2020 includes increasing incentives up to €6,000. Reuters, "Factbox: German stimulus to drive forward green vehicles," (June 4, 2020), https://www.reuters.com/article/us-health-coronavirus-germany-autos-fact/factbox-german-stimulus-to-drive-forward-green-vehicles-idUSKBN23B1QU

10 Dale Hall, Hongyang Cui, and Nic Lutsey, *Electric vehicle capitals: Showing the path to a mainstream market*, (ICCT: Washington, DC, 2019), https://theicct.org/publications/ev-capitals-of-the-world-2019

11 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 and Dale Hall and Nic Lutsey, *Electric vehicle charging guide for cities*, (ICCT: Washington, DC, 2020), https://theicct.org/publications/city-EV-charging-guide

12 Lingzhi Jin and Peter Slowik, *Literature review of electric vehicle consumer awareness and outreach activities*, (ICCT: Washington, DC, 2017), http://www.zevalliance.org/literature-review-ev-consumer-awareness-and-outreach/

INTERNATIONAL COOPERATION

International cooperation has played a unique role in accelerating the global transition to electric vehicles by facilitating faster learning from global market and policy developments. One representative cooperation platform is the International ZEV Alliance, which is an intergovernmental organization founded in 2015 with an aim to reduce greenhouse gas emissions from the transport sector to mitigate climate change. Members of ZEV Alliance include five nations (Canada, Germany, Netherlands, Norway, United Kingdom), ten U.S. states, two Canadian provinces, and one German state. Policy makers from these jurisdictions meet regularly to collaborate and share knowledge. In addition, ZEV Alliance conducts a series of technical studies on topics such as how to design incentive policies, how to electrify the heavy-duty sector, and how to meet the growing infrastructure needs for electric vehicles. The ZEV Alliance members commit to achieve 100% zero-emission passenger vehicle sales no later than 2050, providing a clear signal to industry and stimulating investments. Other successful international cooperation platforms include C40 Cities, Electric Vehicle Initiative (EVI), Under2 Coalition, and the Transportation Decarbonization Alliance (TDA). The EVI's EV30@30 campaign goal, among 11 member countries and 29 supporting companies and organizations, is to reach a 30% electric vehicle sales share by 2030.[13]

VEHICLE ELECTRIFICATION PROGRESS

ELECTRIC VEHICLE SALES

Global cumulative sales of electric passenger vehicles passed 1 million in 2015, 3 million in 2017, and 5 million in 2018. In 2019, cumulative sales passed 7 million.[14] Figure 1 illustrates the location of the cumulative passenger electric vehicle sales through 2019 by market. By the end of 2019, about 94 countries on six continents have seen deployment of at least one electric vehicle. Among them, 24 markets have achieved cumulative sales of over 10,000. Ten national markets have surpassed 100,000 sales, while China and the United States even have passed 1 million. The largest ten markets together account for over 90% of the global cumulative sales of passenger electric vehicles through 2019. The electric vehicle growth to over 7 million sales from 2010 through 2019 was about twice as fast as the equivalent initial years of hybrid vehicle growth from 2000 through 2009.

13 International Energy Agency, Electric Vehicles Initiative, (February 14, 2020), https://www.iea.org/areas-of-work/programmes-and-partnerships/electric-vehicles-initiative. Thirteen EVI countries: Canada, Chile, China, Finland, France, Germany, India, Japan, Netherlands, New Zealand, Norway, Sweden, United Kingdom

14 EV-Volumes (EV Data Center, 2020), http://www.ev-volumes.com/datacenter/

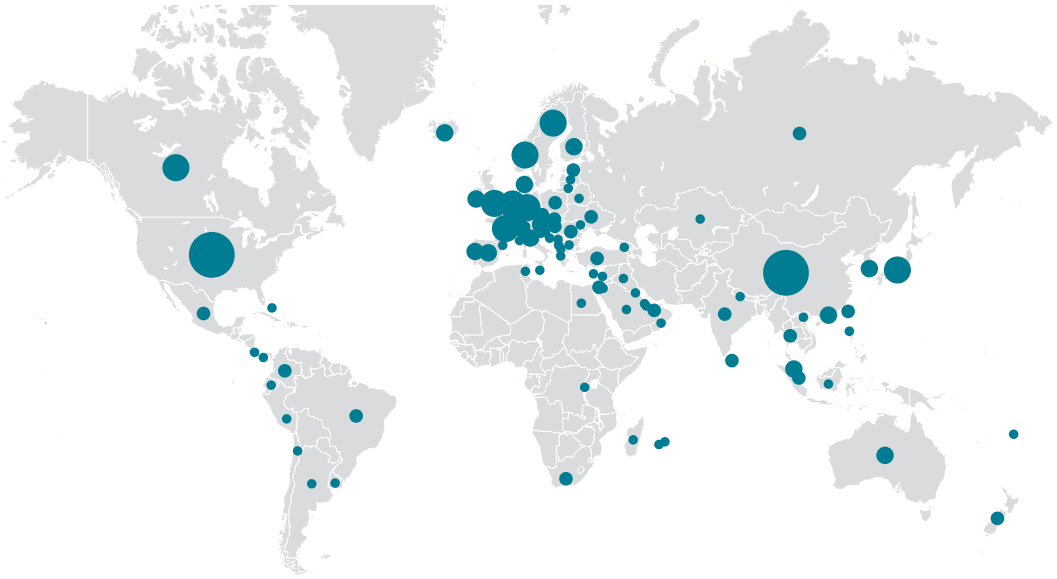

Figure 1. Cumulative passenger electric vehicle sales through 2019 by markets. Vehicle sales data from EV-volumes, 2019.

Figure 2 illustrates annual passenger electric vehicle sales by markets from 2010 through 2019. The annual average growth rate of passenger electric vehicle sales globally was as high as 50% from 2012 through 2019. However, the sales growth slowed down substantially to 9% growth from 2018 to 2019. Overall passenger vehicle sales declined by 4% from 2018 to 2019, so the electric vehicle market growth, although modest in 2019, compared well in the context of the global auto industry downturn.

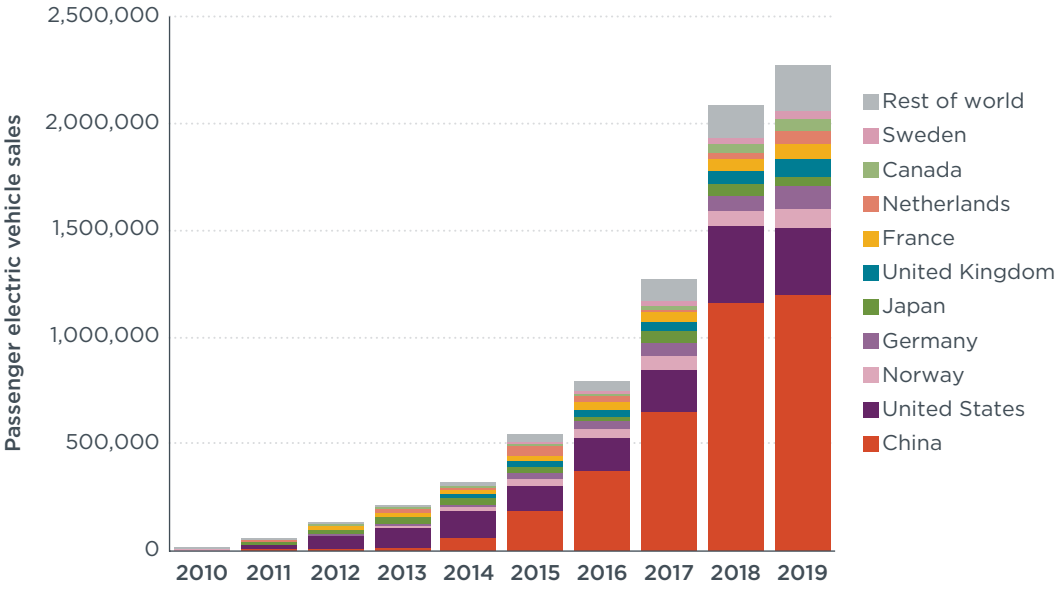

Figure 2. Annual passenger electric vehicle sales by markets from 2010 to 2019. Vehicle sales data from EV-volumes, 2019.

China maintained its position with the highest EV sales in 2019, since it surpassed the United States in 2015. In 2019, China sold 1.2 million passenger electric vehicles, or 53% of the world's total. China is also the country with the largest total cumulative passenger electric vehicle sales. By the end of 2019, China's cumulative passenger electric vehicle sales reached 3.66 million, accounting for 48% of the global stock. The other top ten markets in terms of cumulative sales of passenger electric vehicles include the United States, Germany, Norway, the United Kingdom, the Netherlands, France, Canada, Japan, and Sweden. All of these markets have regulations, incentives, charging infrastructure deployment, and consumer promotion actions to spur electric vehicle uptake.

By comparison, hydrogen fuel cell vehicle (FCV) sales through 2019 have been low relative to electric vehicles. There have been approximately 18,000 cumulative FCV sales from 2013 through 2019, with most of these sales in the United States (44%), South Korea (28%), and Japan (20%). These locations are primarily where Toyota, Hyundai, and Honda focused their initial low-volume FCV model deployment and where hydrogen infrastructure is available.

The global market of heavy-duty electric vehicles is still at a very early stage, with cumulative sales of less than 1 million through 2019. By the end of 2019, 60 countries on six continents had seen deployment of at least one electric heavy-duty vehicle. However, over 98% of the global cumulative sales through 2019 occurred China. No other market has achieved cumulative heavy-duty electric vehicle sales of more than 2,000. Outside of China, only the United States and India had over 1,000 cumulative sales of at least 1,000. Over 70% (44 of 60) of the countries with at least one heavy-duty electric vehicle sale had less than 100 cumulative sales.

ELECTRIC VEHICLE SHARES

The electric vehicle sales share of new passenger vehicles has continuously increased over the past decade. The global average level exceeded 1% in 2017 and 2.5% in 2018. In 2019, the electric vehicle sales share hit an all-time high of 2.8%. Figure 3 presents the 2010-2019 electric vehicle share of new passenger vehicle sales in the top 10 national passenger vehicle markets, and the global average level for comparison. China exceeded the global average in 2014 and then quickly overtook other markets in the following years. In 2019, China achieved an electric vehicle share of 5.3%, which was almost double the global average and the highest among the top 10 vehicle markets, followed by the United Kingdom (3.4%), France (3.1%), Germany (3.1%), and Canada (2.7%), which are closely following the global trend.

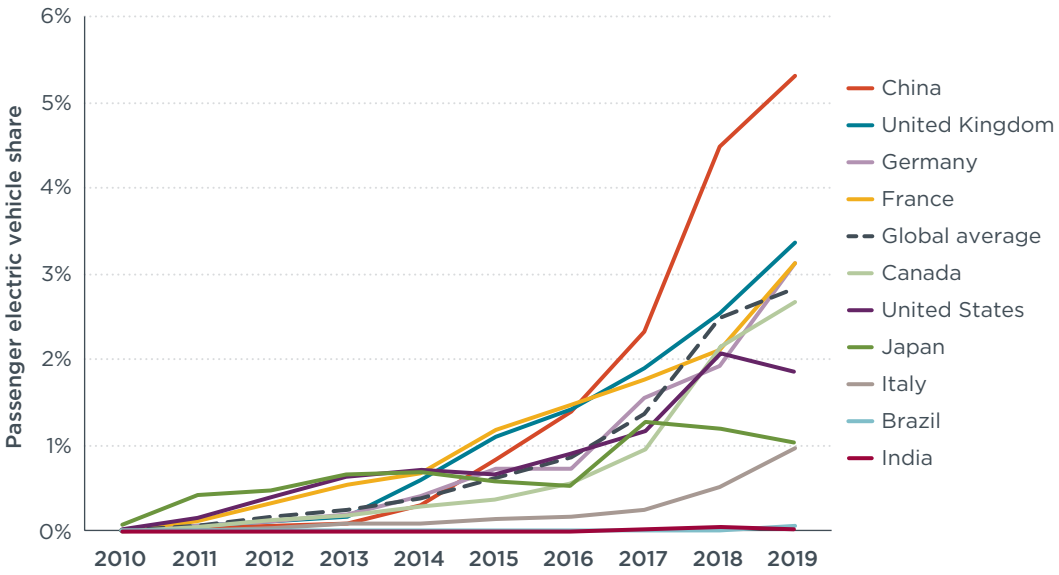

Figure 3. Electric vehicle shares of new passenger vehicle sales for largest markets. Vehicle sales data from EV-volumes, 2019.

In some major automotive markets, the sales share growth is well below the global average. In Japan, this is in part due to the technology preference of regulations, industry, and consumers for hybrid vehicles and FCVs, the latter of which are still at an early stage of commercialization. In 2019, the United States also experienced its first decrease in since 2014. This is partially due to reduced financial incentives for manufacturers Tesla and General Motors after the companies reached the 200,000-electric-vehicle sales cap. Another potential reason for the decline is the uncertainty regarding clean vehicle investments in the United States due to the rollback of U.S. 2025 light-duty vehicle fuel economy regulation. The other two top-10 automotive markets – India and Brazil – are still at very early passenger vehicle electrification stages, with electric vehicle sales shares of less than 0.1%.

Some smaller markets have higher electric vehicle shares than those shown in Figure 3. In 2019, Norway achieved a record-high electric vehicle share of 58%, ranking first globally. This is the first time ever that electric vehicle share of a national-level market exceeded 50%. Other markets with an electric vehicle share higher than China in 2019 include Iceland (25%), the Netherlands (15%), Sweden (12%), Finland (7%), Portugal (6%), and Switzerland (6%). However, these markets are much smaller than the China light-duty vehicle market of more than 22 million units. The FCV share of global passenger vehicle sales in 2019 was much lower than the electric vehicle share, at 0.009%, with South Korea having the highest national FCV share at 0.27%.

LOCAL-LEVEL MARKET DEVELOPMENT

Cities have consistently been at the leading edge of electrification since the modern introduction of electric vehicle models. Driven by innovative and aggressive local policies as well as support from the national and regional governments, cities globally have made much more electric vehicle progress than is indicated by national average uptake.

Figure 4 shows the cumulative sales of electric passenger vehicles through 2019 (bubble size) in ten metropolitan areas around the world with the highest totals. The figure also shows the annual sales of electric passenger vehicles in 2019 (horizontal

axis) and the EV share of new passenger vehicle sales in 2019 (vertical axis) for these cities. The data collection shown is based on our previous "electric vehicle capitals" analysis,[15] with updated vehicle data through calendar year 2019. The three local-level markets with the highest cumulative electric sales in the world are in China. The top two cities, Shanghai and Beijing, both had more than 300,000 electric passenger vehicles; four cities surpassed 200,000; and nine had more than 100,000. Among the top 10 local-level markets, six are in China, two are in United States, and the remaining two are in Europe.

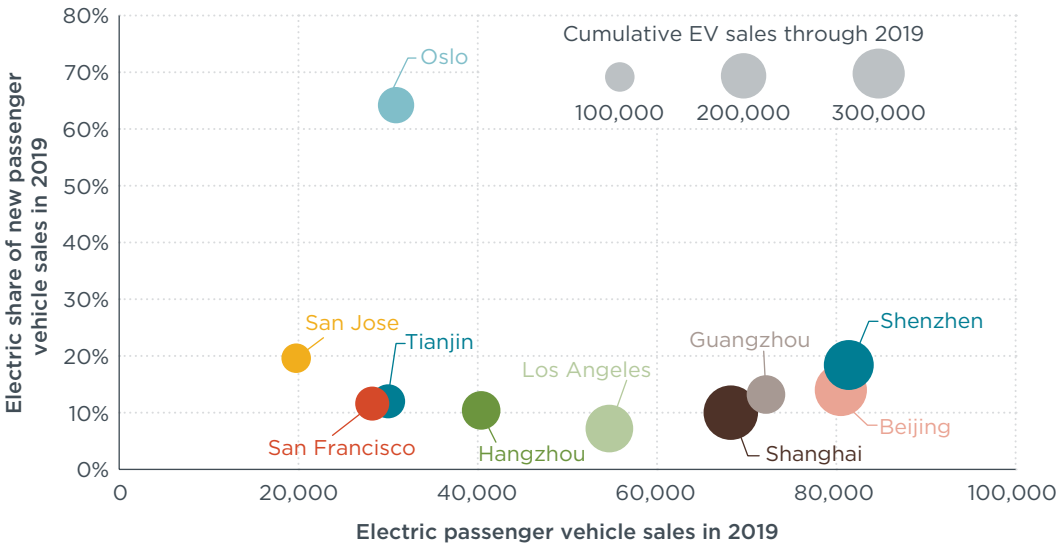

Figure 4. Electric passenger vehicle sales in 2019 and EV shares of new passenger vehicle sales in 10 metropolitan areas with the largest cumulative electric passenger vehicle sales through 2019. Circle size shows cumulative electric passenger vehicle sales through 2019.

Figure 4 also shows the passenger electric vehicle sales and new vehicle shares in 2019. In terms of annual sales, Shenzhen, with over 81,427 vehicles sold, ranked first in 2019, followed by Beijing (80,567) and Guangzhou (72,270). In terms of the EV share of new passenger vehicle sales, Oslo with 64% ranked first in 2019, followed by San Jose, California (20%) and Shenzhen (19%). A few emerging cities with fewer cumulative sales than the top 10 local-level markets shown also saw high electric vehicle deployment in 2019. For example, Liuzhou, a relatively small industrial city in southwestern China, achieved electric passenger vehicle sales of 24,609 and an EV share of 24% in 2019, due to its local supportive policy measures.[16]

ELECTRIC VEHICLE PROGRESS VERSUS GOALS

Although progress has been made through 2019, the global transition to electric vehicles is still at an early stage. Figure 5 compares the historical EV share of new passenger vehicle sales in high EV-volume markets with their vehicle electrification

15 Based on Dale Hall, Hongyang Cui, and Nic Lutsey, *Electric vehicle capitals: Showing the path to a mainstream market*, (ICCT: Washington, DC, 2019), https://theicct.org/publications/ev-capitals-of-the-world-2019

16 See Hongyang Cui and Hui He, "Liuzhou: A new model for the transition to electric vehicles? [staff blog]," International Council on Clean Transportation, (December 18, 2019), https://theicct.org/blog/staff/liuzhou-new-model-transition-electric-vehicles

targets.[17] Norway is the only country that appears to be truly on track to meet its EV goal. If Norway continues to grow at its current rate, it could achieve its 100% EV share goal in 2025. The Netherlands is experiencing increased growth after fluctuations from 2014 to 2017 due to a restructuring of its incentive program. The other countries listed will need to make significant progress to meet their targets. Continued policy support, as well as innovations in vehicle technology and progress in infrastructure build out, will be needed to accelerate growth rates and ensure that the goals for full vehicle electrification are achieved.

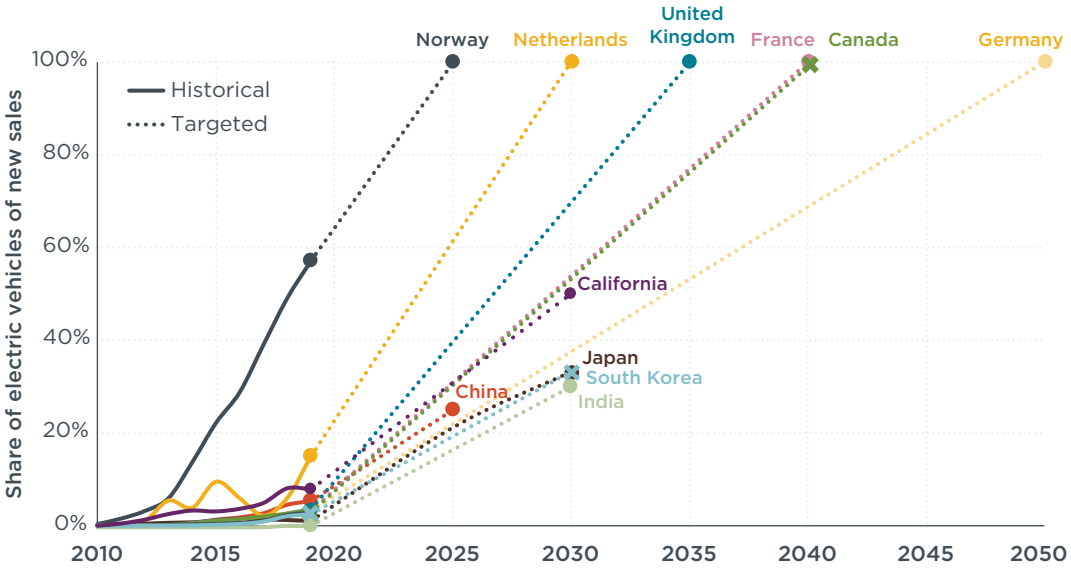

Figure 5. Historical and targeted electric shares of new passenger vehicle sales by markets.

CONCLUSIONS

From this high-level synthesis of the global electric vehicle goals, policies, and early electric vehicle market uptake, we conclude with the following four points.

Governments are increasingly showing their determination to transition to electric vehicles. More than a dozen countries have proposed timelines to transition to all zero-emission vehicles within the next three decades. Many states and provinces have set more aggressive goals than their national governments, and cities in particular have been targeting a much faster transition. Taken together, these ambitious targets provide a clear signal to automakers and infrastructure providers to accelerate their investments.[18]

Commitment to vehicle regulations globally has varied. European markets in early 2020 appear to be on the cutting edge, with an EU-level regulation through 2030

17 See the analysis at Nic Lutsey, *Modernizing vehicle regulations for electrification* (ICCT: Washington, DC, 2018), https://theicct.org/publications/modernizing-regulations-electrification. For China, data shown are electric vehicle shares of all new vehicle sales. For California, the 2030 EV share target (50%) is an ICCT estimation based on California's 5 million EV stock target in 2030. California also indicates it is analyzing 100% electric vehicle sales by 2035 as it assesses its ZEV regulations. California Air Resources Board, "Advanced Clean Cars II Regulations: Informational Update," (May 28, 2020) https://ww3.arb.ca.gov/board/books/2020/052820/20-5-3pres.pdf

18 Sandra Wappelhorst, *The end of the road?: An overview of combustion-engine car phase-out announcements across Europe* (ICCT: Washington, DC, 2020), https://theicct.org/publications/combustion-engine-car-phase-out-EU

and reinforcing city-level policies under development to increase electric vehicle market uptake. However, European governments have by and large not converted their 100% zero-emission goals to enforceable laws. The other top markets of China and the United States have several pioneering local markets, but otherwise are due for updated policies to ensure they are on paths toward a full transition to zero-emissions. In China's case, the early market success through 2019 has not yet translated into New Energy Vehicle regulations for 2025 and beyond. In the United States, the 2025 efficiency regulations are being weakened, and more policies to support the transition to electric vehicles are emerging from cities and states.

Multi-pronged action paves the way for the transition to electric vehicles. Governments at all levels have leveraged a variety of policy tools to overcome EV barriers and stimulate the market. The policy measures include regulations to ensure high EV model availability, financial incentives to make EVs cost competitive, charging infrastructure to ensure EVs are convenient, and campaigns to increase consumer awareness. The highest EV-uptake markets have all such actions in place, and they also tend to learn from international cooperation platforms to accelerate their transition to electric vehicles.

Although still at an early stage, there has been significant progress in the transition to electric vehicles. By the end of 2019, electric vehicles have been deployed in over 100 countries. With dramatic growth through 2019, electric vehicle sales surpassed 7 million roughly twice as fast as it took conventional hybrids to do so, despite having greater cost and infrastructure barriers to overcome. EV shares of new passenger vehicle sales have kept increasing, reaching a record-high of nearly 3% globally in 2019. Nine metropolitan areas have deployed more than 100,000 electric vehicles. China markets have led in EV sales, accounting for around 50% of passenger electric sales, 98% of heavy-duty electric sales, and six of the top ten local-markets for electric vehicle sales in the world.

This end-of-2019 electric vehicle summary points to multiple areas for further updates through 2020. Continued efforts are underway by governments, so tracking 2020 government regulation changes, including for passenger and heavy-duty vehicles, is especially important. Further investigation into changes in EV incentives and charging infrastructure, would be helpful to compare global efforts to tackle two of the foremost electrification barriers. Tracking EV market developments through the middle of 2020 will be important to see the relative effect in EV sales, as compared to overall vehicle sales, as economies reopen following the pandemic shutdowns.

Although there are uncertainties about how quickly the transition to electric vehicles can occur, this briefing provides some clarity on movements in 2019. Many leading countries and cities and regions have proposed ambitious goals for a complete transition to electric vehicles. Many of those governments are beginning to convert their ambitious electrification goals into policies that ensure they make progress toward their air quality, climate, and economic objectives. Only France and British Columbia so far have moved to make enforceable laws for 100% zero-emission vehicles, but many governments are making administrative steps and conducting stakeholder processes toward that end.