BRIEFING

AUGUST 2020

Update on electric vehicle adoption across U.S. cities

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This briefing assesses the U.S. electric vehicle market in 2019 and the policy actions by cities, states, and electric power utilities that were driving it.

INTRODUCTION

The transition to electric vehicles continues as governments increasingly develop and adopt policies to accelerate electric vehicle growth. Globally, about 2.2 million new plug-in electric vehicles were sold in 2019, representing about 2.5% of global light-duty vehicle sales.[1] With about 320,000 new sales in 2019, the United States is the third largest electric vehicle market, following China and Europe.

Figure 1 shows the annual electric vehicle sales in the United States from 2010 through 2019. The twelve companies highlighted accounted for about 95% of 2019 electric vehicle sales. The Tesla Model 3 was the highest-selling model, with about 145,000 new sales. Other high-selling models with between 10,000 to 20,000 sales in 2019 included the Toyota Prius Prime, Tesla Model X, Chevrolet Bolt, Tesla Model S, Nissan Leaf, and Honda Clarity. Overall, battery electric vehicles (BEVs) accounted for about 73% of the 2019 market, while plug-in hybrid electric vehicles (PHEVs) accounted for 27%.

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

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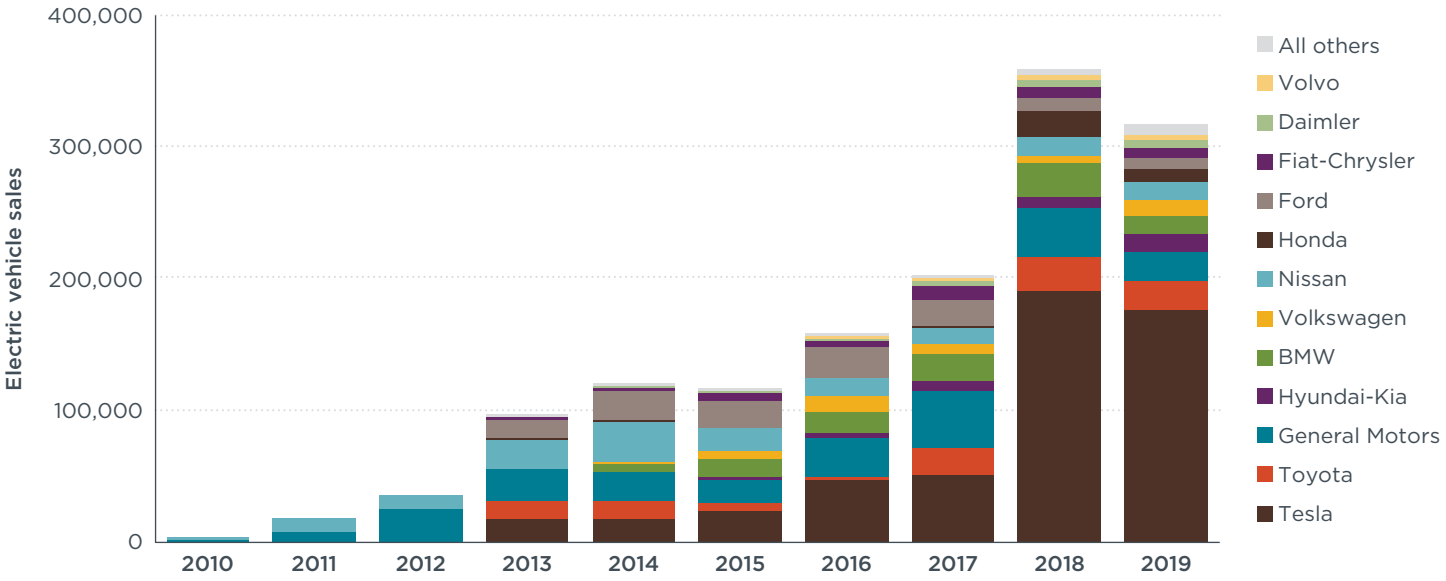

Figure 1. Automaker electric vehicle sales in the United States through 2019. Vehicle sales data are from EV-volumes, 2020.

Although the market was slightly down in 2019, there were underlying shifts. Tesla and General Motors sales declined in their first full calendar year without federal incentives. Many automakers brought new models to market and announced commitments to manufacture electric vehicles with longer battery range and lower cost. All-electric models like the Hyundai Kona, the Audi e-tron, and the next-generation Nissan Leaf with 50% longer electric range than the previous model, entered the market in 2019. Other models, including the Jaguar I-Pace and Kia Niro, launched in late 2018 and continued to become more widely available across the United States. PHEV sales overall were lower in 2018, as the BEV share of electric sales of 73% was up from 65% in 2018. Overall, there were 29 electric vehicle models with over 1,000 U.S. sales in 2019, up from 27 in 2018.

Government policies and promotion activities are helping to overcome prevailing consumer barriers related to higher upfront costs, electric vehicle range and range anxiety, lack of awareness, and insufficient model availability. As the federal government is removing vehicle efficiency and state-level zero-emission vehicle requirements,[2] and the $7,500 electric vehicle tax credit phases out for manufacturers,[3] local actions become more important. City and state authorities work accordingly to develop stronger policy tools to drive infrastructure investment and electric vehicle market growth toward their emission-reduction goals.

This briefing builds upon our annual U.S. electric vehicle market analysis of state, local, and utility actions to promote electric vehicles. There are major uncertainties about how the industry and the market will respond to the 2020 pandemic and economic

2 The safer affordable fuel-efficient (SAFE) vehicles rule for model years 2021-2026 passenger cars and light trucks. 85 Fed. Reg. 24174 (April 30, 2020), https://www.federalregister.gov/documents/2020/04/30/2020-06967/the-safer-affordable-fuel-efficient-safe-vehicles-rule-for-model-years-2021-2026-passenger-cars-and and The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule Part One: One National Program, 84 Fed Reg 51310 (September 27, 2019), https://www.federalregister.gov/documents/2019/09/27/2019-20672/the-safer-affordable-fuel-efficient-safe-vehicles-rule-part-one-one-national-program

3 Tesla and General Motors reached their 200,000 electric vehicle cap in 2018. See "Plug-In Electric Drive Vehicle Credit (IRC 30D)," Internal Revenue Service, April 9, 2019, https://www.irs.gov/businesses/plug-in-electric-vehicle-credit-irc-30-and-irc-30d

recovery, but this briefing offers a status update on many actions that remain critical to sustaining the electric transition. As done in our previous analysis,[4] we assess relationships between electric vehicle uptake and various underlying factors including incentives, charging infrastructure, model availability, access to high-occupancy vehicle lanes, and regional policy actions. This analysis incorporates updated data to identify best practice policies and market trends. The analytical focus is primarily on the 50 most populous U.S. metropolitan areas,[5] which collectively accounted for 55% of the nation's population.

DATA COLLECTION ON ELECTRIC VEHICLE INFRASTRUCTURE, POLICY, AND UPTAKE

This section summarizes key data and sources on electric vehicle charging infrastructure deployment,[6] policy support activities, and electric vehicle uptake.[7] Electric vehicle uptake is measured as the percentage of new light-duty vehicle registrations that are plug-in electric, including BEVs and PHEVs. Policy data are collected for the 50 most populous metropolitan areas and include 48 unique state, city, and utility policy actions.

CHARGING INFRASTRUCTURE

Greater availability of charging infrastructure at home, the workplace, and public locations is critical to growing the electric vehicle market, increasing driver confidence, and expanding overall visibility and exposure to the technology. We assess the relative deployment of charging infrastructure across the major metropolitan areas based on data from the U.S. Department of Energy Alternative Fuels Data Center (AFDC) in terms of number of chargers per million population. Previously, we evaluated charging infrastructure as the number of outlets or plugs. In this study, the number of chargers is analyzed due to the increasing prevalence of dual-head chargers that typically do not allow for the charging of two vehicles simultaneously.

Figure 2 illustrates the number of public direct current (DC) fast chargers and public Level 2 chargers per million population, based on AFDC data in the 50 most populous metropolitan areas. In total, about 14% of the public chargers were DC fast, while 86% were Level 2. San Jose, San Francisco, Los Angeles, San Diego, Sacramento, and Seattle had the most charging infrastructure, ranging from 60 to 180 DC fast and 400 to 1,200 Level 2 public chargers per capita. Salt Lake City, Portland, and Baltimore followed with about 45 to 55 DC fast chargers and 300 to 400 Level 2 chargers per capita. Charging infrastructure in Kansas City and Austin have high densities of public Level 2 charger but relatively little DC fast charging, while Riverside has a relatively

4 Peter Slowik and Nic Lutsey, The surge of electric vehicles in United States cities, (ICCT: Washington DC, 2018) https://theicct.org/publications/surge-EVs-US-cities-2019

5 U.S. Census Bureau, "Metropolitan and Micropolitan Statistical Area Population Totals: 2010-2019" (2020), https://www.census.gov/data/tables/time-series/demo/popest/2010s-total-metro-and-micro-statistical-areas.html#par_textimage

6 Charging data are from U.S. Department of Energy Alternative Fuels Data Center (2020), https://afdc.energy.gov/.

7 Registration data are from IHS Markit (New vehicle registration data, 2020), https://ihsmarkit.com/.
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high number of DC fast chargers. The top five locations had, on average, about 12 times the public chargers per capita compared to the bottom five areas. Over half of the metropolitan areas shown had fewer than 30 DC fast chargers and 200 Level 2 chargers per million population.

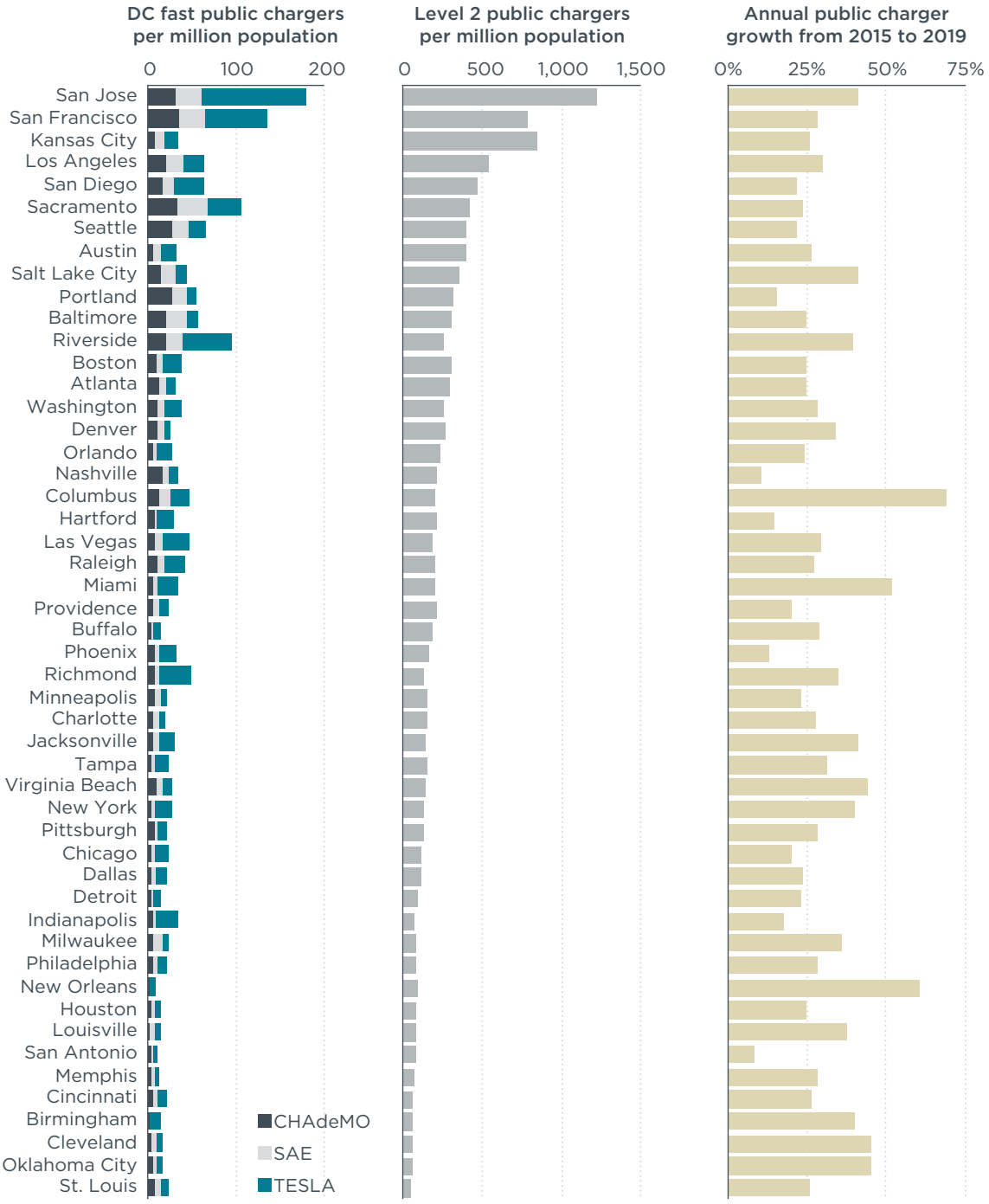

Figure 2. Public DC fast and Level 2 chargers per million population in 2019 and relative growth rate in the 50 most populous U.S. metropolitan areas. The areas are listed from top to bottom in the order of total public chargers per capita. Data are from U.S. DOE Alternative Fuels Data Center.

Figure 2 also illustrates charger growth shown as the four-year compounded annual percentage increase from 2015 through 2019. On average, total public chargers

increased by 30% per year over 2015 through 2019 across the 50 areas. Over this period, Level 2 charging grew by 29% per year and DC fast grew by 52% per year. Overall, these trends are roughly in line with estimated charging needed by 2025.[8] Of the 50 metropolitan areas shown in the figure, Columbus had the highest growth rate at 69%. Other cities with growth rates of 45% and above include Miami, New Orleans, Cleveland, and Oklahoma City. The relationship between electric vehicle uptake and charging infrastructure in 2019 is discussed below.

SUMMARY OF ELECTRIC VEHICLE SUPPORT ACTIVITIES

Table 1 summarizes the 48 unique electric vehicle policy activities, categorized by state, local, and utility actions, implemented in the 50 metropolitan areas. Only actions in place for more than half of calendar year 2019 are included. This year, we also include data on state ZEV funding from the Volkswagen Clean Air Act violation settlement,[9] city quantitative electric vehicle goals, electric vehicle strategies, city curbside or right-of-way charging programs, and toll reductions for electric vehicles.

States, cities, and utilities continue to implement more electric vehicle promotion actions, although the relative number of actions varies greatly. Six California cities had the most actions, ranging from 35 to 42. Portland, New York City, Boston, Seattle, Denver, Buffalo, and Baltimore had 23 to 34 actions. Both Philadelphia and Pittsburgh benefited from more state actions in 2019, including Pennsylvania's participation in the U.S Climate Alliance, incentives for low-income households, and more charging investments. Buffalo saw an increase from 16 to 24 actions, including building city-owned chargers and organizing outreach events in low-income communities. Providence adopted new actions such as delivering more informational web materials and procuring new electric buses. The utility provider for Buffalo and Providence, National Grid, provided additional public and commercial charger incentives. Cities are also electrifying their own government fleets: in 2019, about 140 local governments, including 34 of the 50 studied here, committed to purchasing over 2,100 electric vehicles by 2020 as part of the Climate Mayors EV Purchasing Collaborative.[10]

States are responsible for allocating funding from the Volkswagen Settlement Mitigation Trust, and many direct those funds to support electric vehicle procurement and infrastructure deployment. Nine out of the 50 metropolitan areas are in states that have directed over half of this funding toward transportation electrification. Twenty-four areas in 13 states had comprehensive electric vehicle strategies that direct other dedicated funding and coordinate long-term planning.

At the local level, setting a quantitative electric vehicle goal or target is key to establishing a long-term vision and identifying near-term actions; seven cities had adopted a quantitative electric vehicle goal. Cities have increasingly adopted more detailed electric vehicle strategies to guide future actions and prepare for the electric mobility transition. Twenty-two cities had such readiness plans in place. Five cities have been working on curbside or right-of-way charging programs to provide charging in space-constrained urban areas and encourage drivers without access to home charging. Six areas provided toll reduction on express lanes for electric vehicle drivers.

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8 Michael Nicholas, Dale Hall, and Nic Lutsey, Quantifying the electric vehicle charging infrastructure gap across U.S. market. (ICCT: Washington DC, 2019), https://www.theicct.org/publications/charging-gap-US

9 Atlas EV Hub, https://www.atlasevhub.com/materials/vw-environmental-mitigation-fund-tracking/#state-tracking-dashboards

10 "What is the collaborative?", Climate Mayors, accessed May 12, 2020, https://driveevfleets.org/what-is-the-collaborative/

Table 1. Electric vehicle promotion actions across major U.S. metropolitan areas

Metropolitan area	State action																
	State ZEV program	State International ZEV Alliance participation	State U.S. Climate Alliance participation	State low carbon fuel policy	State BEV purchase incentive	State PHEV purchase incentive	State increased incentive for low-income	State fee reduction or testing exemption	No state annual electric vehicle fee	State private charger incentive or support	State public charger promotion or support	State parking benefit	State fleet purchasing incentive	State manufacturing incentive	State allows direct sales to consumers	State directs VW mitigation plan funding to ZEVs	State electric vehicle strategy
Los Angeles	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x
San Francisco	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x
Sacramento	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x
San Jose	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x
San Diego	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x
Riverside	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x
Portland	x	x	x	x	x	x	x	x	x		x		x		x		x
New York	x	x	x		x	x		x	x	x	x		x		x		x
Boston	x	x	x		x			x	x	x	x	x	x		x	x	
Seattle		x	x					x		x	x		x	x	x		x
Denver			x		x	x		x		x	x		x		x		x
Buffalo	x	x	x		x	x		x	x	x	x		x		x		x
Baltimore	x	x	x		x	x		x	x	x	x		x		x		
Salt Lake City								x	x		x				x		x
Atlanta								x						x	x	x	
Columbus									x		x				x		x
Austin								x	x								
Washington					x	x		x	x	x	x		x		x		
Philadelphia			x		x	x	x		x	x	x		x		x		x
Hartford	x	x	x		x	x		x	x	x			x	x			
Pittsburgh			x		x	x	x		x	x	x		x		x		x
Providence	x	x	x					x	x		x		x		x	x	x
Phoenix								x	x	x	x	x			x		
Las Vegas			x					x	x		x	x			x		x
Minneapolis			x								x				x	x	x
Charlotte			x					x			x			x			x
Raleigh			x					x			x				x		x
Chicago			x					x	x						x		
New Orleans					x	x			x	x	x						
Detroit			x														x
Cincinnati									x		x				x		x
San Antonio									x								
Miami									x						x		
Indianapolis															x		
Houston								x	x								
Orlando									x						x		
Kansas City															x		
Nashville															x		x
Richmond			x								x				x		
Louisville									x								
Birmingham									x					x			
Cleveland								x	x		x				x		x
Oklahoma City									x	x	x		x				
Memphis															x		x
Dallas								x	x								
Virginia Beach			x								x				x		
Tampa									x						x		
St. Louis								x							x		
Milwaukee			x					x									
Jacksonville									x						x		

Metropolitan area	Local action																	
	City quantitative electric vehicle goal	City electric vehicle strategy	City streamlined EVSE permitting process	City EV-ready building code	City EV purchase incentive	City parking benefit	City charger incentive or support	City toll reduction benefit	City carpool lane (HOV) access	City-owned EV chargers	City electric ride-hailing program or pilot	City electric carsharing program	City curbside or right of way charging program	City informational materials	City outreach events	City outreach events in low-income communities	City electric vehicle fleet or procurement target	City electric buses in public transportation
Los Angeles	x	x	x	x				x	x	x	x	x	x	x	x	x	x	x
San Francisco	x	x	x	x				x	x	x	x	x		x	x	x	x	x
Sacramento	x	x	x	x		x			x	x	x	x	x	x	x	x	x	x
San Jose		x	x	x		x		x	x	x				x	x		x	x
San Diego		x	x	x				x	x	x	x			x	x		x	
Riverside		x	x	x	x				x	x				x	x			
Portland	x	x	x	x						x	x		x	x	x	x	x	x
New York		x	x	x		x		x	x	x	x			x	x		x	x
Boston				x	x					x				x	x		x	x
Seattle	x	x	x	x		x				x	x		x	x	x		x	x
Denver	x	x		x						x	x			x	x	x	x	x
Buffalo										x		x			x	x		
Baltimore		x								x	x			x	x		x	
Salt Lake City		x		x		x			x	x	x			x	x	x		
Atlanta		x	x	x				x	x	x				x	x		x	
Columbus	x						x			x	x			x	x	x	x	
Austin		x								x			x	x	x	x	x	
Washington		x					x		x		x				x		x	x
Philadelphia						x				x				x	x		x	x
Hartford										x				x	x			
Pittsburgh										x	x				x		x	
Providence														x	x	x	x	x
Phoenix									x						x		x	
Las Vegas										x					x			
Minneapolis										x		x		x	x		x	
Charlotte		x	x						x	x				x	x		x	
Raleigh			x			x			x	x				x	x	x		
Chicago			x							x				x	x		x	x
New Orleans			x												x		x	
Detroit										x	x	x			x		x	
Cincinnati		x				x				x				x	x		x	
San Antonio		x				x				x				x	x	x	x	x
Miami		x		x					x	x					x		x	
Indianapolis				x		x				x		x			x		x	x
Houston		x	x							x		x		x	x		x	
Orlando		x								x				x	x		x	
Kansas City						x				x		x			x	x	x	
Nashville						x			x	x					x	x	x	x
Richmond									x	x				x	x			
Louisville														x	x		x	x
Birmingham															x	x	x	
Cleveland															x		x	
Oklahoma City															x			
Memphis									x	x					x	x		
Dallas		x								x	x				x			x
Virginia Beach									x						x			
Tampa										x				x	x			
St. Louis												x			x		x	
Milwaukee										x				x	x			
Jacksonville															x			

Metropolitan area	Utility action													Total actions (out of 48)
	Utility electric vehicle strategy	Utility public charging infrastructure	Utility public charging infrastructure in low-income communities	Utility time of use rates offered	Utility preferential EV rates	Utility EV purchase incentive	Utility residential charger incentive or support	Utility increased charger incentive at multifamily properties	Utility commercial charger incentive or support	Utility info materials or outreach events	Utility EVSE info materials or support at multifamily properties	Utility cost comparison tool	Utility electric vehicle fleet	
Los Angeles	x	x		x	x	x	x		x	x	x	x	x	42
San Francisco		x	x	x	x	x		x	x	x	x	x	x	41
Sacramento		x	x	x	x	x			x	x		x	x	40
San Jose		x	x	x	x	x		x	x	x	x	x	x	38
San Diego		x	x	x	x	x		x	x	x	x	x	x	37
Riverside	x	x	x	x	x	x			x	x	x	x	x	35
Portland	x	x	x	x	x					x	x	x	x	34
New York		x		x	x				x	x		x		30
Boston		x	x	x	x					x		x	x	26
Seattle		x								x	x	x	x	26
Denver				x						x	x	x	x	24
Buffalo		x		x	x			x	x	x		x	x	24
Baltimore		x		x	x					x		x	x	23
Salt Lake City		x		x	x			x	x	x		x	x	22
Atlanta		x		x	x		x			x	x	x	x	21
Columbus		x	x					x	x	x	x	x	x	20
Austin	x	x	x		x		x	x	x	x	x	x	x	20
Washington		x		x						x			x	19
Philadelphia						x				x			x	19
Hartford				x	x					x		x	x	18
Pittsburgh										x	x	x	x	18
Providence									x	x			x	18
Phoenix				x	x			x	x	x	x	x	x	17
Las Vegas		x		x	x			x	x	x		x	x	17
Minneapolis				x	x					x	x	x	x	16
Charlotte				x						x		x	x	16
Raleigh				x						x		x	x	16
Chicago				x						x	x	x	x	15
New Orleans							x		x	x		x	x	13
Detroit				x	x		x			x		x	x	13
Cincinnati										x		x	x	13
San Antonio		x								x		x	x	13
Miami				x						x		x	x	12
Indianapolis		x		x	x					x				12
Houston										x		x	x	12
Orlando		x				x				x			x	11
Kansas City		x		x						x		x		11
Nashville										x	x			11
Richmond				x						x		x	x	11
Louisville		x		x						x		x	x	10
Birmingham				x	x					x	x			9
Cleveland										x		x		9
Oklahoma City				x						x		x	x	9
Memphis		x								x			x	9
Dallas										x		x		9
Virginia Beach				x						x		x	x	9
Tampa										x		x	x	8
St. Louis				x						x		x		8
Milwaukee				x						x		x		8
Jacksonville		x				x				x		x		7

Notes: "X" indicates that a given electric deployment action was in place in 2019. ZEV = Zero Emission Vehicle; BEV = Battery electric vehicle; PHEV = Plug-in hybrid electric vehicle; VW = Volkswagen; HOV = high-occupancy vehicle lane; EVSE = Electric vehicle service equipment

Investments in charging infrastructure buildout made up a substantial share of new adopted policy actions in 2019. Infrastructure support actions, including financial and non-financial policies, are important in reducing costs and barriers, and accelerating future infrastructure deployment.[11] As part of the Volkswagen settlement, Pennsylvania allocated approximately $17 million for DC fast charger grants and Level 2 charger rebates. Miami passed EV-ready building codes while Washington, DC and Columbus codes were under development at the end of 2019.

Utility companies play a critical role in the market growth with more planning and investment. Both Portland General Electric and Austin Energy had comprehensive transportation electrification strategies.[12] National Grid and Consolidated Edison of New York provided up to $7,500 and $4,000 for DC fast chargers, respectively. Approximately 30% of $1.3 billion utilities investment filings for transportation electrification tracked since 2012 was approved in 2019—half of which was in California.[13] Another $1.4 billion in utility infrastructure investments were pending at the end of 2019, indicating the growth and momentum toward greatly increased utility investment across the nation. Many utilities added electric vehicle cost comparison tools to their websites. They also have been creative with outreach campaigns to reach broader prospective electric drivers. For example, Sacramento Municipal Utility District's Charge Up Change video contest encouraged middle school students to create videos on the benefits of electric vehicles.[14]

There were several additional policy developments that were adopted in late 2019 and early 2020 and are, therefore, not captured in Table 1. Connecticut released its new electric vehicle roadmap, which includes the goal of 500,000 total electric vehicles in the state by 2030. Colorado and Washington State adopted zero-emission vehicle regulations requiring increasing shares of electric vehicles in future years. Minnesota started a three-year pilot program that provides a one-time $250 toll credit to BEV owners, or $125 to PHEV owners. Washington State reinstated its electric vehicle sales tax exemption, which offers up to $1,600 for used vehicles and $2,500 for new vehicles that cost less than $45,000. Houston and Memphis established electric vehicle targets, Boston developed a new charging infrastructure installation and permitting guide, and New Orleans approved additional investments for city-owned public chargers. Los Angeles adopted stronger EV-ready building codes that require 30% of the total parking spaces in new buildings to be ready for EV charging equipment and 10% of spaces to have charging installed. Cleveland and Columbus received electric bus development and procurement grants, while many more cities instituted pilot projects involving the purchasing of one to two electric buses.

Additional cities have adopted electric vehicle sales goals or strategies for future years. Table 2 shows nine such areas. Los Angeles aims for 80% of all registered vehicles to be zero emission by 2035, growing to 100% by 2050. San Francisco aims for 50% electric vehicle sales shares by 2025 and 100% by 2030. Memphis has a goal for 30% of

11 Chris Nelder, and Emily Rogers, Reducing EV charging infrastructure costs, (Rocky Mountain Institute: Colorado, 2019), https://rmi.org/insight/reducing-ev-charging-infrastructure-costs

12 "Oregon approves Portland General's transportation electrification plan, setting stage for 1M EVs", UtilityDive, accessed May 26, 2020, https://www.utilitydive.com/news/oregon-approves-portland-generals-transportation-electrification-plan-set/572493/ and Smart Mobility Roadmap, (City of Austin, 2017) https://austintexas.gov/sites/default/files/files/Smart_Mobility_Roadmap_-_Final.pdf

13 Atlas EV Hub, https://www.atlasevhub.com/materials/electric-utility-filings/

14 "SMUD announces student winners of its Charge Up Change video contest", SMUD, accessed May 12, 2020, https://www.smud.org/en/Corporate/About-us/News-and-Media/2020/2020/SMUD-announces-student-winners-of-its-Charge-Up-Change-video-contest

overall vehicle miles driven be on electric vehicles by 2035 and 50% by 2050. Denver and Seattle aim for 30% of their overall vehicle population be electric vehicles by 2030, and Houston set a goal of 30% electric vehicle sales by 2030.

Table 2. Examples of city electric vehicle goals and strategies

City	Goal	Strategy	Strategy details
Columbus	1.8% ownership by 2020. Deploy 900 public charging stations.	None identified	None identified
Denver	15% of total registration by 2025, 30% by 2030, and 100% by 2050. 100% in city fleet by 2020	Opportunities for vehicle electrification in Denver Metro area and across Colorado	Discusses steps to address DC fast charging availability and multi-family housing charging access barriers
Houston	30% of new vehicle sales by 2030	Evolve Houston electric vehicle roadmap	Outlines awareness, affordability, and availability actions, with suggested key stakeholders
Los Angeles	25% of total registrations are ZEVs by 2025, 80% by 2035, and 100% by 2050. Deploy 10,000 public chargers by 2022; 28,000 chargers by 2028.	L.A.'s Green New Deal	Establishes targets with initiatives from 2021 to 2030
Memphis	5% of vehicle travel by 2025, 30% by 2035, and 50% by 2050	None identified	None identified
Portland	Replace at least 10,000 vehicles. Double public Level 2 and DCFC. 30% in city fleet by 2020	2017 City of Portland electric vehicle strategy	Details 49 unique actions with lead bureaus
Sacramento	35% of total registrations are ZEVs by 2025	Electric vehicle strategy	Outlines 8 core performance targets with lead department and entities
San Francisco	50% of new registrations by 2025 and 100% by 2030	Proposed electric vehicle roadmap for San Francisco	Establishes 6 main strategies with lead and support authorities
Seattle	30% ownership by 2030	Drive Clean Seattle Implementation Strategy	Coordinates 5 implementation actions with lead departments

Table 2 also lists several city electric vehicle strategy documents, which provide more detail regarding cities' specific goals and identify the actions needed to overcome electric vehicle barriers.[15] One example is Portland, where the electric vehicle strategy outlines overarching electric-vehicle-related goals and identifies 49 unique actions and the associated departments to lead them.

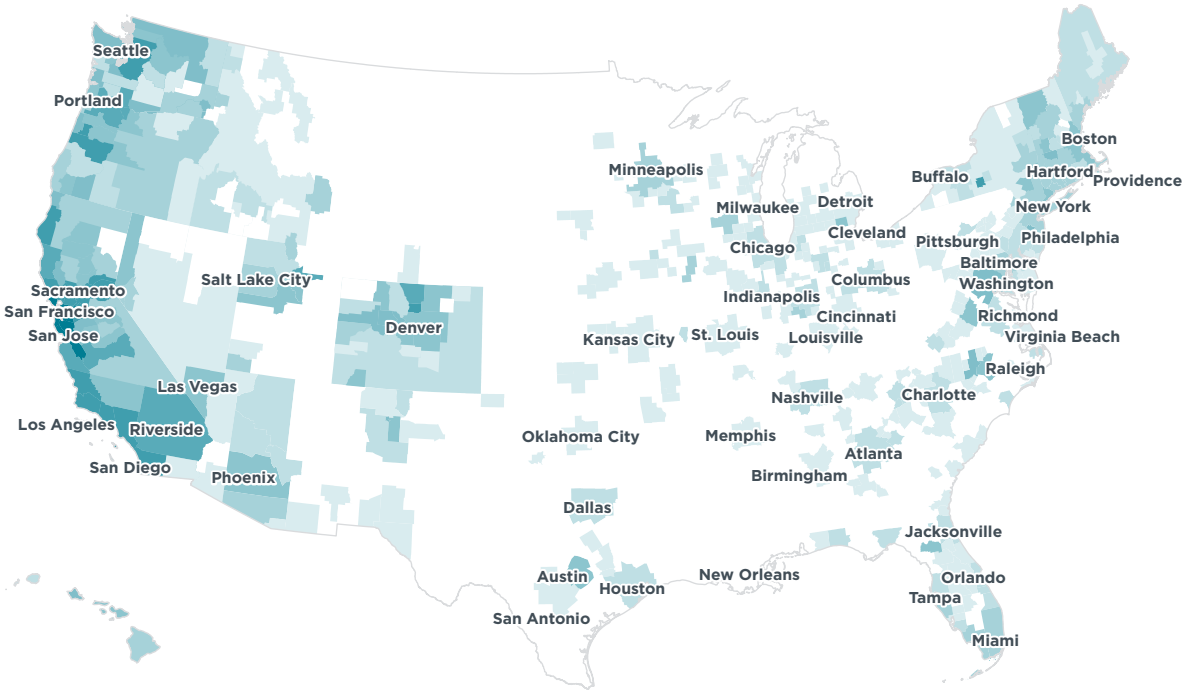
ELECTRIC VEHICLE UPTAKE

Electric vehicles accounted for about 2% of new U.S. light-duty vehicle sales in 2019, remaining steady compared to 2018. The 50 most populous metropolitan areas

15 "Electric vehicle charging infrastructure", City of Columbus, accessed May 26, 2020, https://smart.columbus.gov/projects/electric-vehicle-charging-infrastructure; City and County of Denver Department of Environmental Health & Southwest Energy Efficiency Project, "Opportunities for vehicle electrification in the Denver Metro area and across Colorado" (2017), https://www.denvergov.org/content/dam/denvergov/Portals/771/documents/EQ/EV/EVFinalReport.pdf; Evolve Houston, "Electric vehicle roadmap" (2019), https://www.evolvehouston.org/; Los Angeles Mayor's Office of Sustainability, "L.A.'s Green New Deal" (2019), https://plan.lamayor.org/sites/default/files/pLAn_2019_final.pdf; "Climate Action Plan", City of Memphis, accessed May 26, 2020, https://memphistn.gov/news/what_s_new/climate_action_plan; Portland Bureau of Planning and Sustainability, "2017 City of Portland electric vehicle strategy" (2016), https://beta.portland.gov/sites/default/files/2019-07/final_electric-vehicle_report2016_web.pdf; City of Sacramento, "Electric vehicle strategy" (2017), https://www.cityofsacramento.org/-/media/Corporate/Files/Public-Works/Electric-Vehicles/EVStrategy_171206_FINAL_DRAFT_CityOfSacramento.pdf; San Francisco Mayor's electric vehicle working group, "Proposed electric vehicle roadmap for San Francisco" (2019), https://sfenvironment.org/sites/default/files/fliers/files/sfe_tr_ev-roadmap.pdf; Seattle Office of Sustainability & Environment, "2017 Drive Clean Seattle Implementation Strategy" (2017), https://www.seattle.gov/Documents/Departments/Environment/ClimateChange/Drive_Clean_Seattle_2017_Report.pdf

accounted for 80% of new 2019 U.S. electric vehicle registrations, 61% of the total light-duty vehicle market, and 55% of the U.S. population; the 50 metropolitan areas together had 2.7% electric vehicle uptake compared to 1% in the rest of the country.[16]

Figure 3 shows the electric vehicle share of new 2019 vehicle registrations across the more than 900 metropolitan statistical areas, with the 50 most populous areas labeled. As shown, areas across the west coast tend to have the highest electric vehicle uptake, and there are additional hotspots in Colorado, Utah, and the Northeast. California alone was home to just under half of all new 2019 electric vehicle sales. At 7%, the electric vehicle uptake in the west coast of the United States was three-and-a-half times the national average. San Jose had the highest share at about 20%, followed by the other California areas, Seattle, and Portland, which ranged from 4.5% to 12%. Other major metropolitan areas, including Austin, Boston, Denver, Hartford, New York, Phoenix, and Washington D.C., had above average electric vehicle uptake. In terms of total new vehicles entering the fleet, Los Angeles had the highest, with about 55,000 new electric registrations, followed by San Francisco, San Jose, and New York with about 28,000, 20,000, and 18,000 registrations, respectively.



Electric vehicle share

0% - 0.5% | 0.5% - 1% | 1% - 1.5% | 1.5% - 2% | 2% - 3% | 3% - 4% | 4% - 5% | 5% - 10% | > 10%

Figure 3. Electric vehicle shares of new 2019 vehicle registrations by metropolitan area. New vehicle registration data are from IHS Markit.

16 Electric vehicle volume and share data throughout this report are based on IHS Market new registrations, including battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), excluding fuel cell vehicles and low-speed electric vehicles. Based on new registrations for calendar year end 2019 for cars and light trucks of gross vehicle weight classes 1 and 2, excluding three-quarter-ton and one-ton light trucks, provided by IHS Markit. See IHS disclaimer above in footnote 7.

ANALYSIS OF ELECTRIC VEHICLE MARKET DEVELOPMENT AND UNDERLYING FACTORS

Charging infrastructure deployment, model availability, and the adoption of promotion actions are vital underlying factors supporting the growth of the electric vehicle market. This section evaluates these factors and their relationship with electric vehicle uptake in more depth.

CHARGING INFRASTRUCTURE AND ELECTRIC VEHICLE UPTAKE

Using data from AFDC, we analyze Level 2 and DC fast charging public infrastructure for the 200 most populous metropolitan area. Figure 4 plots the relationship between public chargers per million population (x-axis) and electric vehicle share (y-axis), with the size of each data bubble corresponding to the 2019 electric vehicle registrations at each respective area. Selected markets with relatively high electric vehicle uptake or high infrastructure deployment are named. [17] The U.S average electric vehicle uptake and approximately 225 chargers per million population is shown in the lower-left corner.

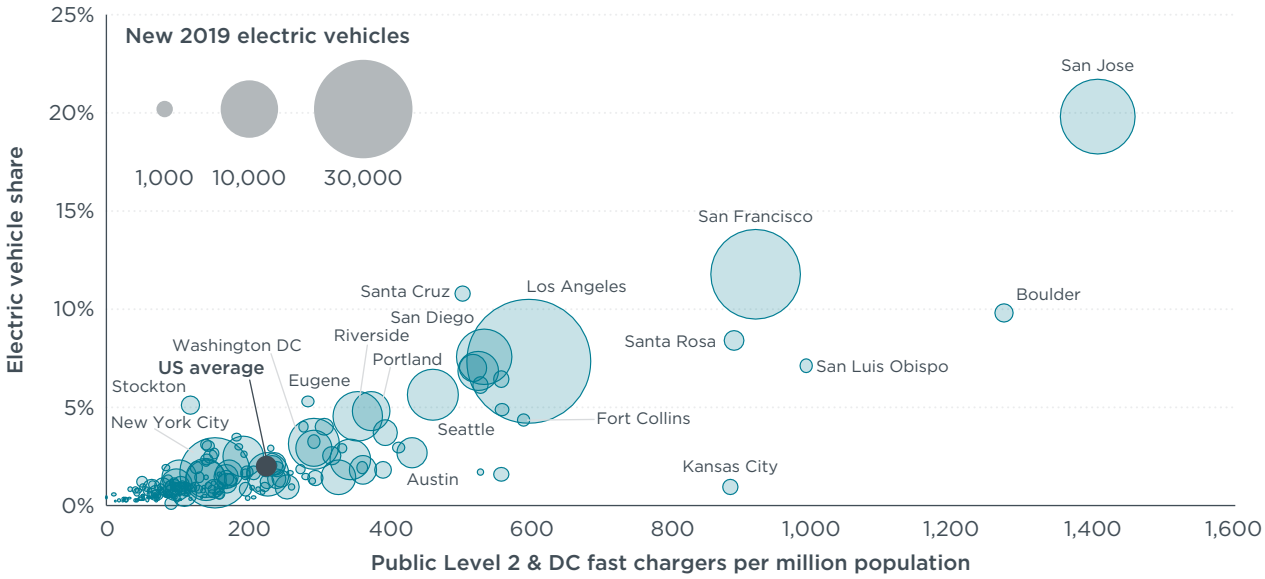


Figure 4. Electric vehicle share of new vehicles and public chargers per million population for the 200 most populous U.S metropolitan areas. New vehicle registration data are from IHS Markit; charging infrastructure data are from U.S. DOE Alternative Fuels Data Center.

The figure shows the general trend where areas with higher uptake tend to have more public charging infrastructure. The five areas with the highest uptake had 2.5 to 6.5 times more chargers than the average. Thirteen of the 15 markets with more than 5% uptake had at least 450 total public chargers per million population, or double the national average. Kansas City had one of the highest numbers of public chargers per capita, but relatively low electric vehicle uptake. Regional electric vehicle uptake leaders such as Washington D.C., Denver, Austin, and Boston had approximately 300 to 450 public chargers per million residents. Several less-populated areas, including Boulder, Eugene, Fort Collins, and several California cities, also had high market adoption and public charging availability. Overall, 62 of the 200 most populous areas

17 Based on registration data from IHS Markit (New vehicle registration data, 2020), https://ihsmarkit.com/. See IHS disclaimer in footnote 7 and data description in footnote 16.

had more than 200 public chargers per million population in 2019, an increase from 46 areas in 2018.[18] However, half of the population still lives in areas with fewer than 155 chargers per million population.

Although not depicted graphically, the underlying data reveals variations in electric vehicle-to-charger ratios. Among the 50 most populous areas, the high-uptake areas of San Jose, San Francisco, San Diego, and Los Angeles each had approximately 30 electric vehicles per public charger. Several other high-uptake areas, including Sacramento, Seattle, Portland, and Riverside, had 20-24 electric vehicles per public chargers. The data on electric vehicles-per-public-charger ratios correspond to our previous findings that the relatively more developed electric vehicle markets are moving beyond deploying infrastructure for sufficient geographic coverage and are reaching higher rates of utilization and thus higher ratios of electric vehicles to public chargers.[19]

MODEL AVAILABILITY AND ELECTRIC VEHICLE UPTAKE

Consumers' vehicle preferences vary widely, and the availability of more electric models across more vehicle segments and in higher volumes is a prerequisite to greater adoption. Up from just five models in 2011, there were over 50 plug-in models in 2019, yet the availability of these vehicles varies dramatically across the United States. Figure 5 shows the number of models available in the most 50 populous areas on the horizontal axis and the corresponding market shares on the vertical axis, with the bubble size related to new 2019 registrations.[20] Model availability is defined as models with more than 20 new registrations in the region in 2019, in order to distinguish those that were available beyond a few selected showrooms. Although less conclusive than the relationship between charging availability and electric share, the figure shows a general trend, where areas with more models tend to have higher absolute electric vehicle registrations.

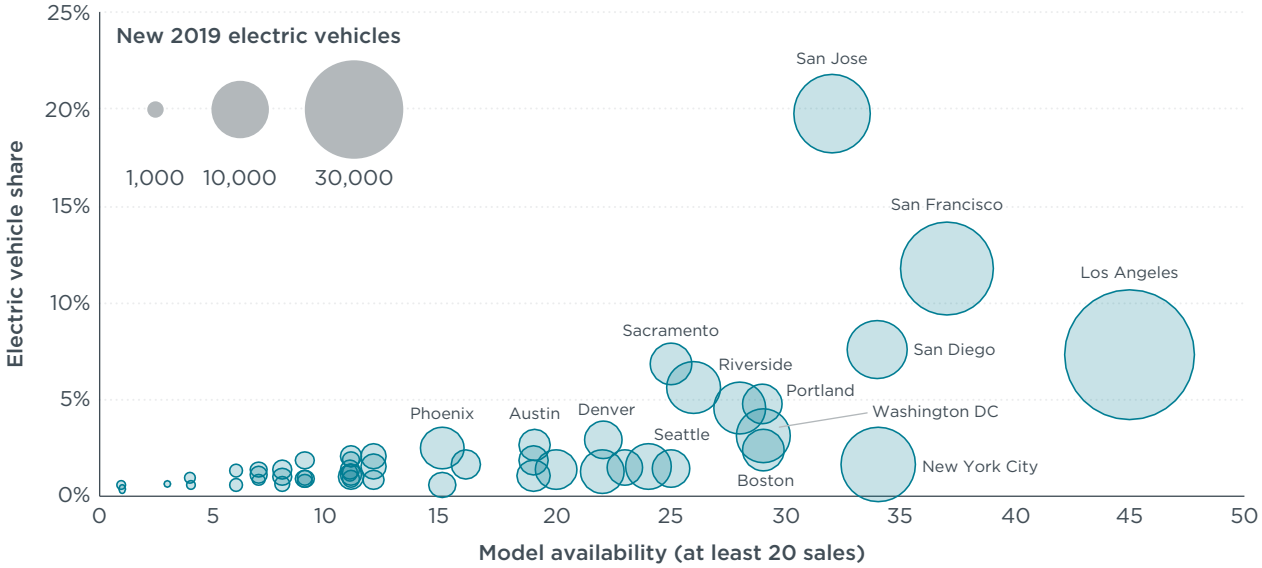


Figure 5. Electric vehicle shares of new vehicles and model availability in the 50 most populous U.S metropolitan areas. New vehicle registration data are from IHS Markit.

18 End-of-2019 charging data compared with end-of-2018 charging data, also from U.S Department of Energy Alternative Fuels Data Center (2019), https://afdc.energy.gov/.

19 Michael Nicholas, Dale Hall, and Nic Lutsey, Quantifying the electric vehicle charging infrastructure gap across U.S. market. (ICCT: Washington DC, 2019), https://www.theicct.org/publications/charging-gap-US

20 Based on registration data from IHS Markit (New vehicle registration data, 2020), https://ihsmarkit.com/. See IHS disclaimer in footnote 7 and data description in footnote 16.

The figure shows how the areas with above 4% uptake, or twice the national average, had at least 25 electric vehicle models available. The five leading metropolitan areas by electric vehicle volume, representing over 41% of new electric vehicles in 2019,[21] were also the top five in terms of model availability with 32 to 45 models. Twenty-six of the 50 areas had a reduction in model availability compared to 2018. Of the 200 most populous metropolitan areas, 80% had no more than 10 models available. Across the nation, more than half of the population lives in an area with fewer than 12 electric models available.

POLICY INCENTIVES AND ELECTRIC VEHICLE UPTAKE

Incentives, both financial and nonfinancial, contribute to electric vehicle market growth by lowering costs and providing additional convenience to drivers. Figure 6 shows the estimated value of consumer incentives and the electric vehicle share of new vehicles in 2019 across the 50 areas.[22] The areas with the highest market shares are to the left and descend to the lowest share to the right. The figure shows that in many areas, high incentives correspond with high market share. In California, drivers benefit from a state rebate, typically $2,000, and utility incentives ranging from $600 to $1,000. In addition, California provides HOV access to electric vehicles, although recent changes to the state's California Clean Air Vehicle decal program phases out HOV access after 3 years. Colorado provides a $5,000 tax credit for electric vehicle purchases. Connecticut, Maryland, New York, Oregon, Pennsylvania, and Louisiana also provided drivers some form of purchase incentive. Many Washington D.C. metropolitan area residents can benefit from Maryland's incentive. Relatively few utilities outside of those in California offered electric vehicle incentives. Some states levy specific taxes or fees on electric vehicles, resulting in a disincentive as shown by the red bars in Figure 6. Overall, most of the areas that are in states with annual electric vehicle fees had below average electric vehicle shares.

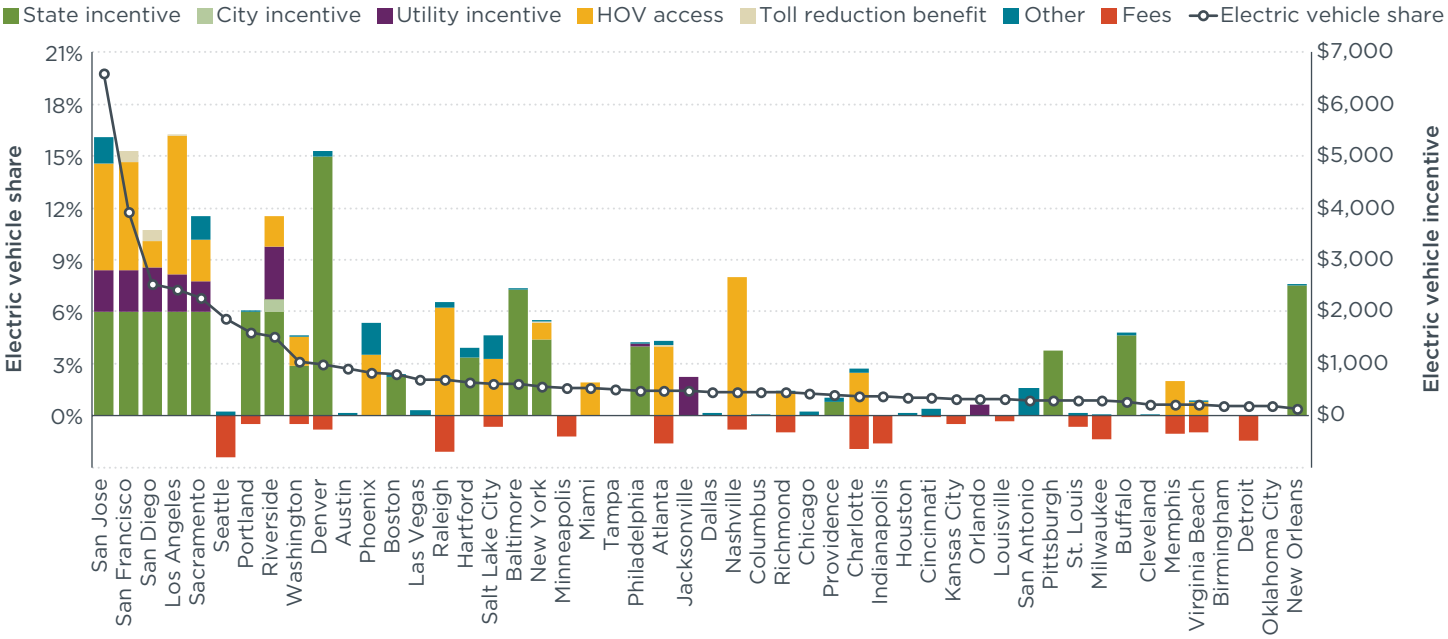


Figure 6. Electric vehicle shares of new vehicles and available consumer incentives in the 50 most populous U.S metropolitan areas. New vehicle registration data are from IHS Markit.

21 Based on registration data from IHS Markit (New vehicle registration data, 2020), https://ihsmarkit.com/. See IHS disclaimer in footnote 7 and data description in footnote 16.

22 Registration data are from IHS Markit (New vehicle registration data, 2020), https://ihsmarkit.com/. See IHS disclaimer in footnote 7 and data description in footnote 16.

States use different policy mechanisms to implement EV incentive programs. Many states offer rebates at the time of vehicle purchase such as Connecticut, New York, and Pennsylvania. Several states apply tax exemptions or credits rather than rebates. For example, Colorado and Louisiana apply an income tax credit, Maryland issues an excise tax credit, and Washington State uses an exemption in sales tax (from August 2019 on, not shown). The growing number of electric vehicles and the production of increasingly more-efficient combustion vehicles have spurred broader consideration of the overall vehicle taxation system, including the relative fees and taxes for vehicle sales, vehicle registration, and energy use. How states fiscally support electric vehicle uptake through the broader zero-emission transition remains an active area of development for governments.[23]

There are also some counterexamples of areas with low incentives and relatively high uptake, although these areas tend to have several other supporting policy measures. In Seattle, as mentioned previously, new electric vehicle buyers were eligible for a purchase tax exemption worth about $2,500 beginning in August 2019 and thus is not shown in the figure above. In Austin, although there are no electric vehicle purchase incentives, there are numerous infrastructure support programs, such as incentives for residential, commercial, and fast charging infrastructure, and local level activities working to overcome awareness and convenience barriers.

PROMOTION ACTIONS AND ELECTRIC VEHICLE UPTAKE

Figure 7 displays the state, city, and utility promotion actions (bar, right axis) and electric vehicle share of new vehicle sales (line, left axis) in 2019 across the 50 areas, ordered from left to right based on highest market share.[24] As shown, areas with more policy actions tend to have high electric vehicle shares. The 5 areas with the highest shares were in California and had a mix of state, local, and utility actions, ranging from 35 to 42 actions. Other markets with above-average uptake, including Seattle, Portland, Washington D.C., Denver, Austin, and Boston, had 20 to 34 actions in place. Areas with the lowest uptake tended to have fewer than 13 actions.

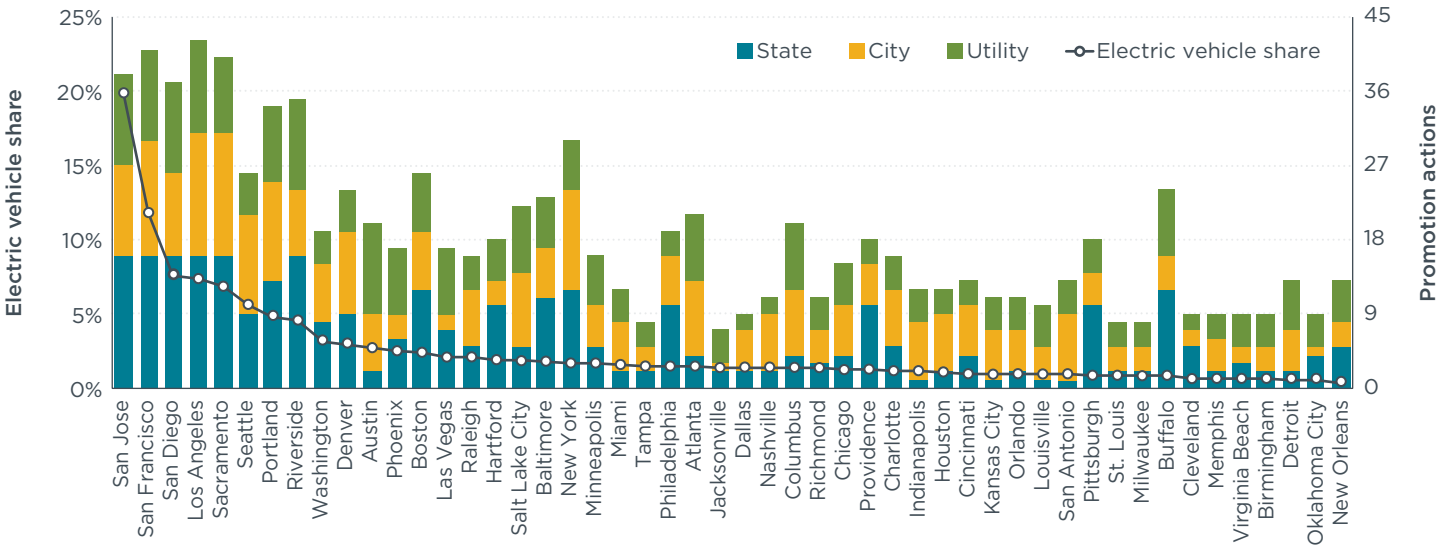


Figure 7. Electric vehicle shares of new vehicles and promotion actions in the 50 most populous U.S metropolitan areas. New vehicle registration data are from IHS Markit, 2019.

23 Peter Slowik, Dale Hall, Nic Lutsey, Michael Nicholas, and Sandra Wappelhorst, Funding the transition to all zero-emission vehicles (ICCT: Washington DC, 2019), https://theicct.org/publications/funding-ZEV-transition

24 Based on registration data from IHS Markit (New vehicle registration data, 2020), https://ihsmarkit.com/. See IHS disclaimer in footnote 7 and data description in footnote 16.

The figure reveals relative gaps in policy actions. Seattle appears especially active with its city-level polices and incentives and would benefit from more state and utility actions. Austin had many local and utility actions and above average electric vehicle uptake, yet state-level actions are lacking. In contrast, Pittsburgh and Buffalo provided state purchase incentives and strong all-level policy support yet had relatively low electric vehicle market shares and low model availability. Areas that could benefit from greater local-level actions include Las Vegas, Jacksonville, Cleveland, Virginia Beach, and Oklahoma City. Utility actions appear especially limited in Dallas, Nashville, and Cleveland.

COMPARISON OF 50 MAJOR METROPOLITAN AREAS

This section further investigates the relationships between the underlying factors outlined above and electric vehicles uptake. Figure 8 illustrates how public charging infrastructure (vertical axis), promotion actions (horizontal axis), and model availability (circle color) relate to electric vehicle uptake[25] (circle size). The figure shows the general trend where areas with highest uptake tend to have the most extensive infrastructure deployment, many promotion actions, and high model availability. This is illustrated by the large blue circles in the upper right quadrant of the figure, which include the California cities along with Austin, Boston, Denver, Portland, Seattle, and Washington D.C.

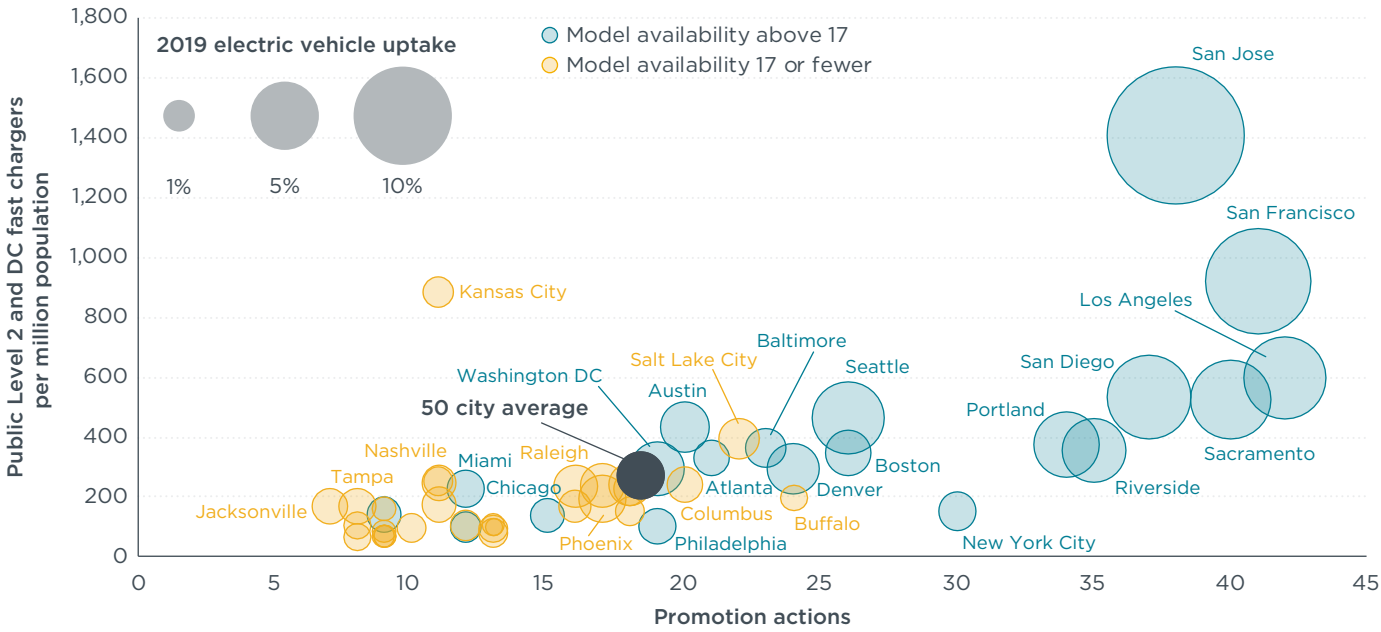


Figure 8. Public chargers, promotion actions, model availability, and electric vehicle uptake in the 50 most populous U.S metropolitan areas. New vehicle registration data are from IHS Markit; charging infrastructure data are from U.S. DOE Alternative Fuels Data Center.

25 Based on registration data from IHS Markit (New vehicle registration data, 2020), https://ihsmarkit.com/. See IHS disclaimer in footnote 7 and data description in footnote 16.

Relative gaps are reflected by where areas are positioned in the four quadrants around the 50-city average of Figure 8. Areas in the lower left quadrant (i.e., below 18 actions and below 275 public chargers per million population) have relatively fewer promotion actions, less public charging infrastructure, and tend to have lower model availability. As shown by the relatively smaller bubble size, these areas also tend to have lower electric vehicle uptake than the national and 50-city average. Markets such as Chicago, Miami, and Philadelphia have good model availability and can be strengthened with more infrastructure and policy actions. In the upper left quadrant, Kansas City stands out with strong public charging, yet promotion actions and model availability appear to be lacking.

In the upper right quadrant of Figure 8, many California cities, Seattle, and Portland with high uptake showed at least 350 public chargers. Atlanta, Austin, Baltimore, Denver, Seattle, and Washington D.C. could benefit from more promotional actions. Salt Lake City appears poised for market growth with above average public charging and promotion actions but had limited model availability. Nearby, Columbus had above average promotion actions and would benefit from greater model availability and infrastructure. In the lower right quadrant, Buffalo and New York City had well-developed promotion actions and could benefit from greater charging infrastructure, and model availability appears lacking in Buffalo. Several additional areas, including Hartford, Las Vegas, Phoenix, Providence, and Raleigh, clustered around the 50-city average in the lower left, would benefit from increased model availability, public charging infrastructure, and promotion actions.

Figure 9 plots electric vehicle uptake in the 50 areas and each of the underlying factors outlined above, ordered from top to bottom based on 2019 electric vehicle shares.[26] The figure shows a trend where areas with the highest shares tended to have a high number of public chargers, high model availability, strong consumer incentives, and many promotion actions. The top 10 areas in terms of electric vehicle shares largely overlap with the top 10 areas for public charging infrastructure (7 of the top 10), model availability (8 of the top 10), incentives (7 of the top 10), and promotion actions (8 of the top 10).

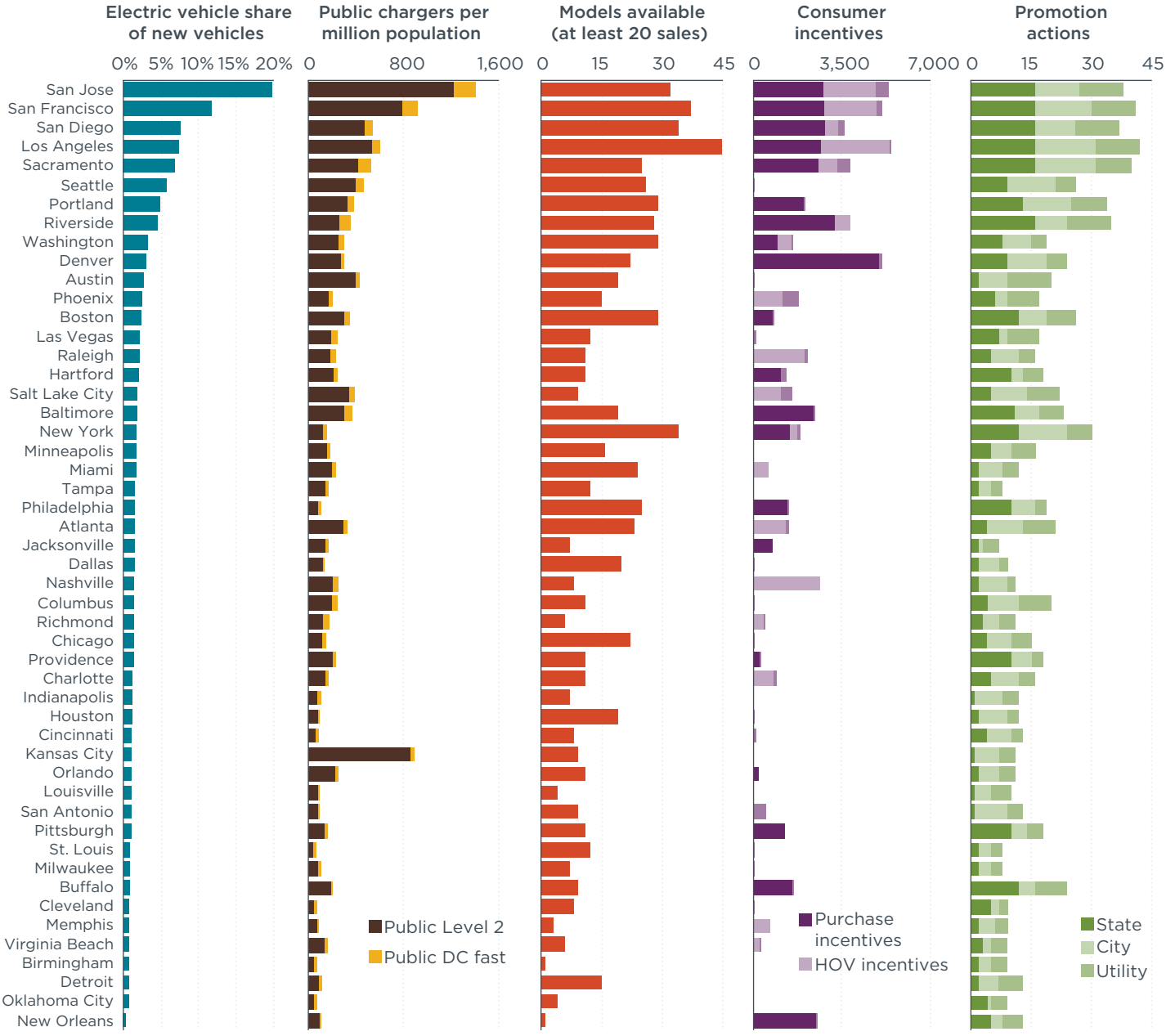


Figure 9. 2019 electric vehicle uptake, charging infrastructure, model availability, incentives, and promotion actions in the 50 most populous U.S. metropolitan areas. New vehicle registration data are from IHS Markit.

26 Based on registration data from IHS Markit (New vehicle registration data, 2020), https://ihsmarkit.com/. See IHS disclaimer in footnote 7 and data description in footnote 16.

As shown in the figure, the top 10 areas in terms of electric vehicle shares largely overlap with the top 10 areas for public charging infrastructure (7 of the top 10), model availability (8 of the top 10), incentives (7 of the top 10), and promotion actions (8 of the top 10). However, there are also some counterexamples where some of the variables do not follow the trend with higher electric vehicle uptake. In Seattle, Washington State's electric vehicle purchase tax credit, which became available in August 2019, is excluded from the data. Nashville and New Orleans had significant incentives but relatively low uptake; these cities had some of the lowest model availability and relatively few promotional actions. Kansas City is shown with strong public charging, yet model availability, promotion actions, and consumer incentives are generally lacking. Pittsburgh and Buffalo had incentives and promotion actions, but relatively low market uptake and could benefit from greater model availability and infrastructure deployment.

Austin has been a region-leading market with above average uptake and a highly active community-owned utility with many infrastructure, fleet, awareness, education, and dealership programs tailored to various groups of prospective electric vehicle users.[27] Along with the other Texas cities, Austin would significantly benefit from more widespread state-level incentives. Texas offered a relatively symbolic 2,000 electric vehicle rebates in 2019, which was far less than 1% of state's overall vehicle sales. Other markets that appear ripe for electric vehicle market growth with infrastructure and local and utility policy actions in place that could similarly benefit from state-level incentives include Las Vegas, Raleigh, Salt Lake City, Minneapolis, Atlanta, and Columbus. Markets with promotional actions and incentives in place that could benefit from more infrastructure include Phoenix, New York, and Philadelphia.

CONCLUSIONS

Although the electric share of new vehicle sales in the United States overall remained at 2%, the share increased in many local markets and there is growing support from various local, state, and utility promotion actions. Major uncertainties remain about how the industry and the market will evolve in 2020 and beyond, but this briefing points to many actions that will remain important to sustaining electric vehicle growth through the economic recovery. These activities, including regulations, consumer financial and nonfinancial incentives, charging infrastructure development, and consumer awareness programs, reduce electric vehicle adoption barriers. Areas with the greatest electric vehicle adoption had the strongest and most comprehensive underlying policy support. Our analysis leads us to the following four conclusions:

Electric vehicle policy support packages are continuously being adopted and improved by states, cities, and utilities. Various states and cities are addressing climate change and air quality issues by implementing additional policies to accelerate electric vehicle market growth. New Jersey joined the International Zero-Emission Vehicle Alliance, and eight states joined the bipartisan U.S. Climate Alliance to collaborate on climate mitigation. Nine states allocated more than half of their Volkswagen mitigation funds toward transportation electrification. More states, cities, and utilities set electric vehicle goals and rolled out detailed strategies to reach them. Markets like Atlanta, Austin, Baltimore, Houston, Memphis, New York City, Portland, Salt Lake City, Seattle, Washington D.C., and many in California continue to sharpen and implement their electric vehicle action plans, with similar actions that are carefully tailored to the local context.

27 "Plug-in Austin Electric Vehicles", Austin Energy, accessed May 12, 2020, https://austinenergy.com/ae/green-power/plug-in-austin

Electric vehicle market growth critically depends on the greater availability of electric vehicle options. Vehicle manufacturers are investing billions in electric vehicles and have announced dozens of upcoming models. However, access to electric vehicles lags significantly across the country, and market growth paused in 2019. The top five markets each had at least 25 electric models available and represent a substantial fraction of new U.S. electric vehicles, but half of the U.S. population had access to fewer than 12 electric models. Greater availability of electric models is key to continuing U.S. market growth, and state-level zero-emission vehicle regulations are the most direct way to overcome the limited availability. Federal government action to remove those regulations drives the need for stronger city and state policy for air quality and climate goals.

Consumer incentives remain important while upfront purchase cost remains a barrier. Incentives help to reduce electric vehicles' upfront cost as battery costs continue to decline. The 10 areas with the highest uptake had state incentives typically worth $2,000 to $5,000. Carpool lane access and parking policies benefit electric vehicle drivers in California as well as Atlanta, Nashville, Phoenix, Raleigh, and Salt Lake City. With federal tax credits waning and the vehicle efficiency regulation rollback, states are poised to consider broader tax and fee policies[28] to steer the transition to zero-emission mobility.

Charging infrastructure grows in unison with electric vehicle adoption. Although most charging is done at home, electric vehicle growth remains linked to expanding public charging infrastructure. With the average compounded annual growth rate at 30% across the 50 metropolitan areas, charging infrastructure deployment is in line to meet the expected charging gap through 2025.[29] Areas with the highest electric vehicle shares typically had at least 450 public chargers per million population. While the top market San Jose had charging per capita 3-times this benchmark, half of the U.S. population lives where charging is less than half the same benchmark. There is some momentum toward stronger EV-ready building codes and greater utility investments, with over $350 million dollars of filings approved in 2019. Although regional efforts are growing, considering the relatively modest investments needed,[30] charging infrastructure is a ripe opportunity for federal economic stimulus support.

While electric vehicle sales declined and electric shares remained steady across the United States in 2019, it is an uncertain time for the electric market. Federal policy, including weakening vehicle regulations and the waning federal tax credit, provide an unsteady environment for increased industry investment. With federal policy in flux, there is risk that electric vehicle investments and market deployment increasingly flow toward Europe and China. To counter that, U.S. cities and states could look to leading global examples of vehicle taxation, zero-emission areas, fleet regulations, and infrastructure policy[31] to flex their own authority and achieve their clean transport goals.

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28 Bloomberg, "Regulator says California might make dramatic moves if Trump relaxes emissions standards", Los Angeles Times, May 16, 2019, https://www.latimes.com/business/la-fi-hy-california-auto-emissions-trump-20190516-story.html

29 Michael Nicholas, Dale Hall, and Nic Lutsey, Quantifying the electric vehicle charging infrastructure gap across U.S. market. (ICCT: Washington DC, 2019), https://www.theicct.org/publications/charging-gap-US

30 Michael Nicholas, Estimating electric vehicle charging infrastructure costs across major U.S. metropolitan areas, (ICCT: Washington DC, 2019), https://theicct.org/publications/city-EV-charging-guide

31 For examples, see Sandra Wappelhorst, Dale Hall, Mike Nicholas, and Nic Lutsey, Analyzing Policies to grow the electric vehicle market in European cities, (ICCT: Washington DC, 2019). https://theicct.org/publications/electric-vehicle-policies-eu-cities; Dale Hall 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; Dale Hall and Nic Lutsey, Electric vehicle charging guide for cities, (ICCT: Washington DC, 2019), https://theicct.org/publications/city-EV-charging-guide