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SUSTAINING ELECTRIC VEHICLE MARKET GROWTH IN U.S. CITIES

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EXECUTIVE SUMMARY

The global electric vehicle market continues to expand, and governments at all levels are continuously seeking to accelerate growth. In 2015, about 115,000 electric vehicles were sold in the United States, accounting for about a fifth of global sales of electric vehicles. However, most automakers are still deploying their first-generation electric vehicles, and electric vehicle sales still represent less than 1% of the national new vehicle market. At this stage, innovative government policies are still needed to spur the broader electric vehicle market.

This assessment analyzes the U.S. electric vehicle market and the actions driving it. The assessment catalogues actions in place, identifies best policy practices, and discerns links between various electric vehicle promotion actions and electric vehicle sales. The analysis is especially focused on the 50 most populous metropolitan areas, which represent about 82% of the 2015 U.S. electric vehicle market. The work statistically analyzes the connections among various state and local policies, public and workplace charging infrastructure, consumer incentives, model availability, and the share of new vehicles that are plug-in electric.

Figure ES-1 illustrates the share of new vehicle registrations that are plug-in electric across U.S. metropolitan areas. The 50 most populous metropolitan areas that are the focus of this analysis are labeled. Major West coast metropolitan areas tend to be where the shares of new vehicles that are electric vehicles are highest. The San Jose area has the highest share at 9.5%, followed by several other California areas at 4% to 5%. Regional leaders through Oregon, Washington, Georgia, and Colorado have 2% to 3% shares. Overall, the share of new vehicles that are plug-in electric in these 50 areas is 1%, three times higher than in the rest of the United States.

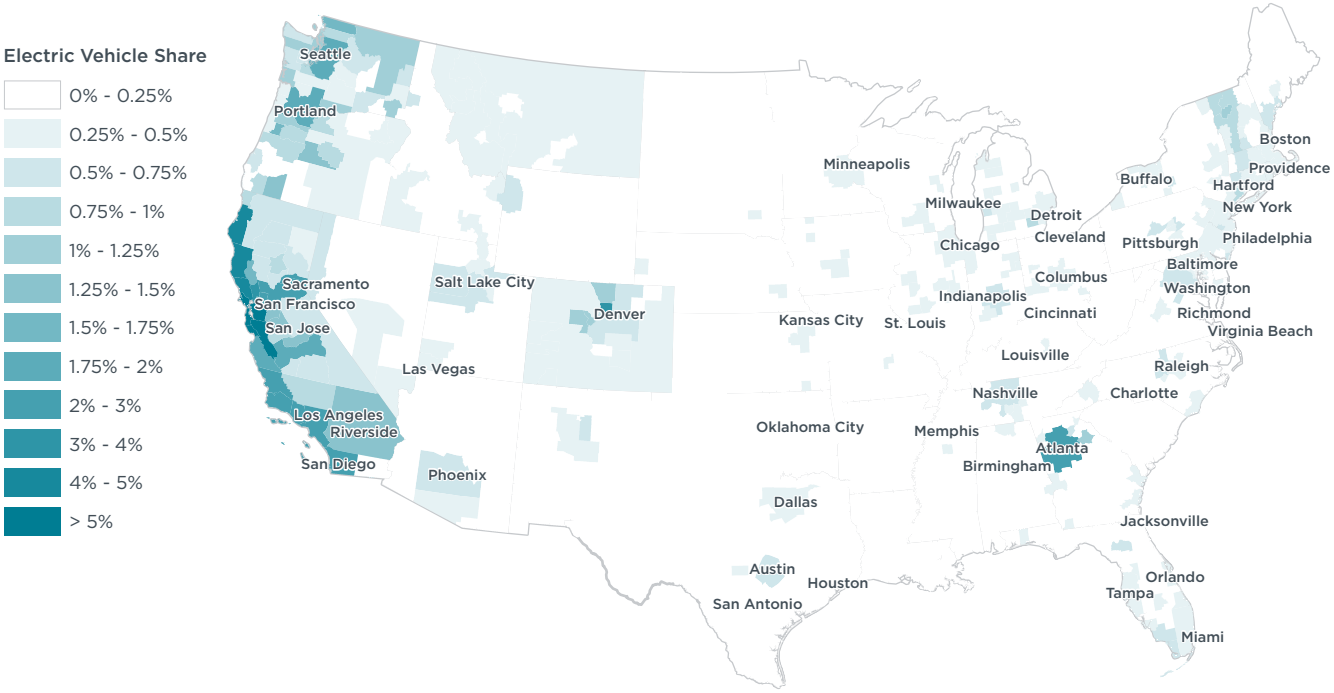

Figure ES-1. Electric vehicle share of new 2015 vehicle registrations by metropolitan area
(New vehicle registration data from IHS Automotive)

Several factors are helping to encourage sales of electric vehicles in pockets across the country. We find statistically significant relationships between increasing electric vehicle share of new autos and these factors: availability, consumer financial incentives, public charging infrastructure, workplace charging infrastructure, high-occupancy vehicle lane access, and number of local electric vehicle promotional measures. Areas where policymakers and automakers have been most proactive with these supporting actions tend to be those that stand out as electric vehicle share leaders. We also note that there are other factors, such as demographic variables, that were not included in the statistical analysis of underlying electric vehicle activities but that could also be relevant. Our analysis led to these four conclusions on electric vehicle uptake:

Comprehensive actions by diverse stakeholders are key to expanding the electric vehicle market. Measures including workplace charging, utility policy, state incentives, and local and regional promotional actions all help to overcome prevailing consumer barriers to adopting electric vehicles more widely. Sustained and expanded implementation of these policies is likely to further expand the electric vehicle market.

Electric vehicle market growth is linked to model availability. Cumulative U.S. electric vehicle sales through 2015 surpassed 400,000. These sales have been concentrated in the relatively few markets that have more electric models available. Most prospective consumers have access to only a handful of electric models, and electric vehicle uptake has remained especially low in these markets. The availability of new electric vehicles did not substantially increase from 2014 to 2015, and 2015 sales were similar to 2014. Market growth in California especially shows how increased model availability is stimulating sales.

Public charging infrastructure remains a key barrier to electric vehicle sales in many areas. This study reaffirms the finding that public charging infrastructure is significantly linked to electric vehicle market growth. Public charging infrastructure expanded 50% from 2014 to 2015. In particular, expansive networks in northern California and isolated areas elsewhere such as Portland, Austin, and Nashville, are linked with higher electric vehicle sales. Other areas have less extensive public charging. The nationwide average for electric charging infrastructure is one-quarter of what it is in market-leading cities.

Incentives remain a key part of developing the early vehicle market. Financial consumer incentives are found to be key drivers for sustaining electric vehicle purchases. Incentives, for example in California, Colorado, and Washington, are consistently associated with the leading regional electric vehicle markets. The 90% drop in Atlanta's electric vehicle market in mid-2015, following the suspension of the Georgia incentive, underscores the importance of financial incentives to sustaining development of the market.

The implications of this assessment of U.S. metropolitan areas are broad. Regions across North America, Europe, and China are proactively implementing incentives and deploying charging infrastructure to sustain growth in the electric vehicle market. All these markets can learn from others' experiences with what actions are working best, and which can be improved. The launch and greater availability of lower-cost and higher-range electric vehicles will broaden the electric vehicle market. Markets with best-practice policies will help accelerate the transition to an electric fleet.

I. INTRODUCTION

The global electric vehicle market continues to grow, and governments continue to seek ways to accelerate market expansion for a variety of reasons. Many governments are trying to address the effects of transportation on climate change, energy use, and air quality. Local governments are also focused on achieving air quality and climate goals, as well as reaping employment and economic benefits from the development of a new industry.

The global electric vehicle market in 2015 surpassed 500,000 sales, up more than 60% from 2014. About a third of all electric vehicle sales in the world from 2010-2015 were in the United States. Figure 1 shows the eight automakers with the most U.S. electric vehicle sales in 2015, along with the number of their deliveries from 2013 to 2015 (based on Hybridcars, 2015). These eight companies represent 97% of U.S. electric vehicle sales so far. The figure shows that four automakers each averaged roughly 20,000 electric sales a year over the three years. Sales in 2015 roughly matched those of 2013 and 2014 even as gasoline prices fell.

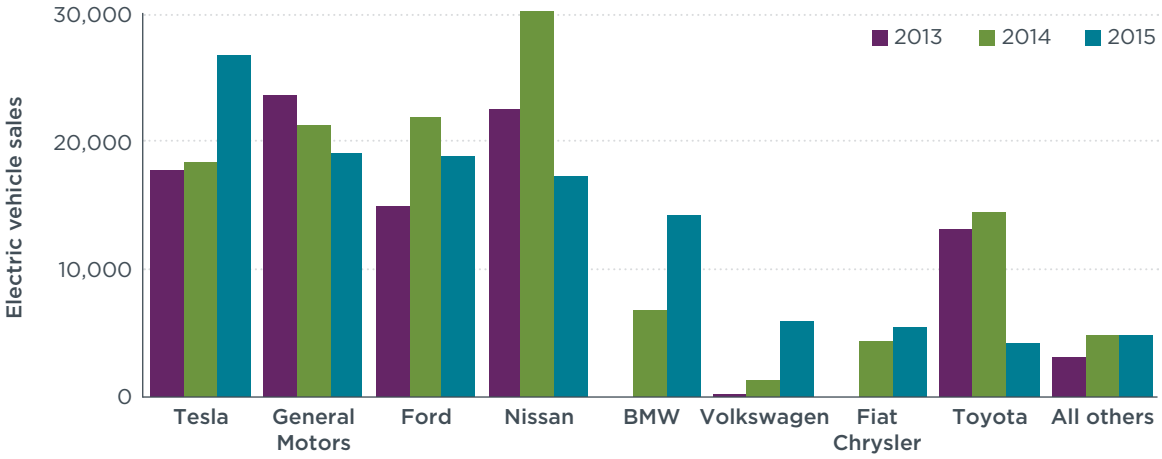

Figure 1. Annual electric vehicle sales in the United States through 2015

Many customers await the widely publicized next generation of electric vehicles being introduced through 2020. With next-generation models about to enter the market at lower prices and higher volume, it is an important time for governments to consider their support policies and charging infrastructure. General Motors, Nissan, and Tesla are nearing the 2016-2017 launches of lower-cost and longer-range electric vehicles (Cobb, 2015; Randall, 2016; Shelton, 2015). Plug-in hybrid electric vehicle models, or cars that can be plugged in to charge the batteries but also are equipped with internal combustion engines, are headed toward higher all-electric ranges (Toyota, 2016; Lassa, 2015; Boeriu, 2014; Motoring, 2016). In addition, Volkswagen, BMW, and Mercedes have announced greatly expanded electric offerings within the next couple of years (Allan, 2016; BMW, 2014; Sinclair, 2015).

The uptake of electric vehicles varies greatly across the U.S., largely based on support policies (e.g., see Jin et al., 2014; Lutsey et al., 2015; Lutsey, 2015). Various state and local policy moves on infrastructure, incentives, and information campaigns help to overcome consumer barriers related to these vehicles (NRC, 2015). Providing financial incentives diminishes the upfront cost difference between electric and conventional vehicles.

Expanded public charging infrastructure increases the functional electric vehicle range and decreases range-related anxiety for electric vehicle users. Utility actions help enhance the fuel-saving cost benefits and can help educate consumers. A series of local and state nonfinancial incentives, such as preferential carpool lane and parking access, provide perks and increase the visibility of the new technology. Public events provide fundamental education and awareness.

This assessment analyzes the U.S. electric vehicle market in 2015. The analysis catalogues support actions, identifies best policy practices, and discerns links between the various electric vehicle promotion actions and uptake. Uptake is measured as the percent of new vehicles registered that are plug-in electric vehicles. The analytical approach of this assessment builds upon the work of Jin et al. (2014) and Lutsey et al. (2015). The analysis is especially focused on the top 50 metropolitan areas by population, which account for four-fifths of the 2015 electric vehicle market as well as over half of the nation's population and over two-thirds of public charging infrastructure. In various sections below, where data were available, as many as 200 large metropolitan areas are included to help identify wider trends. Separately, we conducted a parallel analysis to highlight trends among mid-sized and smaller metropolitan areas with the highest electric vehicle concentration within their region (see Kwan et al, 2016). The work statistically analyzes the connection between various state and local actions and the share of new vehicles that are battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs).

II. DATA COLLECTION ON ELECTRIC VEHICLE PROMOTION ACTIVITIES

This section collects and summarizes data on major state and city policy, charging infrastructure, and utility activities that support electric vehicles across major U.S. metropolitan areas. Specifically we collect information on 33 such promotion actions that were in place in the metropolitan areas in 2015. When possible, we provide quantification of various data, for example incentives and charging infrastructure. For discrete qualitative actions, we more simply catalogue which metropolitan areas had the given actions or policies in 2015. The approach here follows that of two previous papers (Jin et al., 2014; Lutsey et al., 2015). Building on previous work, we expand the assessment from 25 to 50 metropolitan areas and clarify the definitions of several electric vehicle promotion activities to reflect various actions underway. Also, we add increased coverage on the relative prevalence of workplace charging. The Annex includes a summary list of the 33 actions and examples of metropolitan areas with those actions in place. The actions, and their implementation across the 50 most populous metropolitan areas, are summarized in the final summary subsection below (see Table 1).

CONSUMER INCENTIVES

Consumer incentives to promote the purchase of electric vehicles are in place in many states. These incentives help to accelerate the early electric vehicle market as technology costs come down and as consumers become more aware of the new technology and more comfortable with it. Consumer financial incentives are widely found to be linked with electric vehicle sales (e.g., Jin et al., 2014; Lutsey et al., 2015; Yang et al., 2016; Vergis et al., 2014; Vergis & Chen, 2014). Such policies are generally enacted to help states reduce petroleum spending, enable consumer fuel-saving, reduce air pollution, and lower climate-related emissions. Local promotions and incentives, including access to highway lanes and free parking, are also found to be important to many consumers (Bakker & Trip, 2013; Li et al., 2016; Lutsey et al., 2015; Sierzchula et al., 2014; Haugeland & Kvisle, 2013). This section summarizes the various state and local incentives in place across the 50 most populous metropolitan areas.

Purchasing incentives. At the end of 2015, 24 of the 50 metropolitan areas in this study had some form of state rebate, tax credit, or substantial tax exemption for the purchase or lease of an electric vehicle. The value of incentives typically ranges from $1,000 to $3,000 for each battery electric vehicle. Incentives for plug-in hybrid electric vehicles are typically about half as much. Rebates in Massachusetts and Connecticut were newly implemented in 2014 and 2015. Rhode Island's incentives were installed in early 2016 and are therefore not included in our 2015 market study. The rebate in Georgia was revoked in July 2015 and was thus applicable for half the year. In addition to state incentives, two cities also had local incentive programs. They were Seattle, with an exemption from city and county purchase taxes, and Riverside, with a rebate. Incentives in Pennsylvania and Texas were limited in number and availability throughout the year, so they are not included in this analysis.

Averaging across all 50 metropolitan areas, the available incentive for battery electric vehicles was about $770 and about $380 for plug-in hybrid electric vehicles. Of those metropolitan areas that had consumer purchase incentives, $2,000 was the average for battery electric vehicles and $1,200, for plug-in hybrids. Our estimates include

a weighting of the incentives for metropolitan areas that span multiple states. For example, the Portland area's population is 20% in Washington state, which has an incentive, and 80% in Oregon, which does not. The average incentive for Portland includes a 20% weighting of the Washington incentive and an 80% weighting for no incentive in Oregon.

Vehicle operation incentives. After the purchase (or initial lease), there are also a number of incentives for electric vehicle owners. These can come in the form of exemptions from state license taxes, registration fees, and inspections. Of the 50 metropolitan areas, 27 have such incentives. The most common is an exemption from semi-annual emissions inspections. These typically are much smaller than vehicle purchasing incentives and are typically worth around $100. Phoenix stands out as having an exempted registration fee of $1,000 for each battery electric vehicle. There are also additional state fees for registering and using electric vehicles, thereby providing a disincentive, in eight of the metropolitan areas: Georgia (Atlanta), North Carolina (Charlotte, Raleigh), Washington state (Portland, Seattle), Virginia (Washington, D.C.; Virginia Beach; Richmond).

Parking incentives. Several cities and states provide substantial parking benefits to electric vehicle users. Nevada and Hawaii provide free parking for electric vehicles at eligible public parking facilities that are metered. Las Vegas is the only major metropolitan area in the study with this practice; we estimate a parking benefit of $625 over the vehicle's lifetime (Jin et al., 2014). Of the metropolitan areas in this study, 12 have some form of local parking support policy for electric vehicles. In these programs, local authorities directly provide new designated parking for electric vehicle users or establish policies to increase their number over time. Boston, Denver, New York City, Sacramento, and San Jose offer examples. Often these policies are linked to expanded battery charging infrastructure. Perhaps the most widespread among the programs, New York City's 2014 policy requires that 25% of new parking be electric-vehicle ready, with an expectation of at least 5,000 new such spots over the next seven years. Generally, this means parking areas are equipped with charging outlets or offer electrical capacity and conduit for future upgrades.

High-occupancy vehicle lane access. In our 50 metropolitan areas, we identified 15 that in 2015 allowed single-occupant electric autos to use lanes otherwise reserved for high-occupancy vehicles. Previous analyses indicate the average benefit to electric vehicle users can be substantial, especially where there are more highway lane-miles of HOV lane and where congestion is relatively high. Here we apply the method of Jin et al (2014). We estimate that the areas where access to HOV lanes has the highest value are Sacramento, Phoenix, Atlanta, Raleigh, San Jose, San Francisco, Nashville, and Los Angeles (ranging from $800 in Sacramento to $2,400 in Los Angeles).

PUBLIC AND WORKPLACE CHARGING INFRASTRUCTURE

Greater charging availability helps address key consumer barriers regarding the range and the convenience of electric vehicles. Expanded charging infrastructure increases user confidence and makes greater range and functionality possible. Charging networks also elevate the visibility of electric vehicle use. Charging of vehicle batteries tends to be largely done at home, followed by workplace charging and public charging (INL, 2015). Several studies emphasize the importance of home charging (Lin and Greene, 2011; Bailie et al, 2015). Public charging infrastructure has been found in a variety of studies to help

encourage electric vehicle purchases (e.g., see Bakker & Trip, 2013; Li et al, 2015; Lutsey et al, 2015; Sierzchula et al., 2014; Vergis & Chen, 2014).

A combination of public and private actions is greatly increasing charging infrastructure. Governments support this by directly funding deployment, offering residential and commercial electric vehicle service equipment (EVSE) incentives, and promoting electric vehicle-ready buildings. In addition, automakers including Tesla, Nissan, Volkswagen, and BMW are directly supporting the deployment of charging infrastructure with various provider partners. Electric power utilities have become more engaged in the deployment of charging equipment, with public utilities commissions in California and Oregon approving deployment of charging infrastructure (Edison International, 2016; SDGE, 2016; Portland General Electric, 2016).

We analyze public and workplace charging infrastructure data to assess the charging availability across the various metropolitan areas. Charging infrastructure data are from the U.S. DOE Alternative Fuel Data Center (U.S. DOE, 2016a) and U.S. DOE Workplace Charging Challenge data (from Olexsak, 2016). These data are indexed to the total population within the metropolitan areas to provide a comparable metric across various regions. Figure 2 summarizes the data. From left to right, the figure shows public direct current (DC) fast charging, public Level 2 charging, and workplace charging per million population. DC fast charging allows a typical electric vehicle (e.g., Nissan Leaf) battery pack to be charged by 19 kWh or about 80% increase in its state of charge in approximately 30 minutes, whereas Level 2 would take 3-4 hours for the same charge. The metropolitan areas are ordered from top to bottom based on the sum of the three columns. Total public charging infrastructure per capita increased by 50% from 2014 to 2015. Public DC fast charging grew more quickly than Level 2 in 2015, increasing by more than 140%. As part of the overall growth, there was substantial growth in all three major charging standard types that are in use by various automakers (i.e., CHAdeMO, SAE Combo, and Tesla).

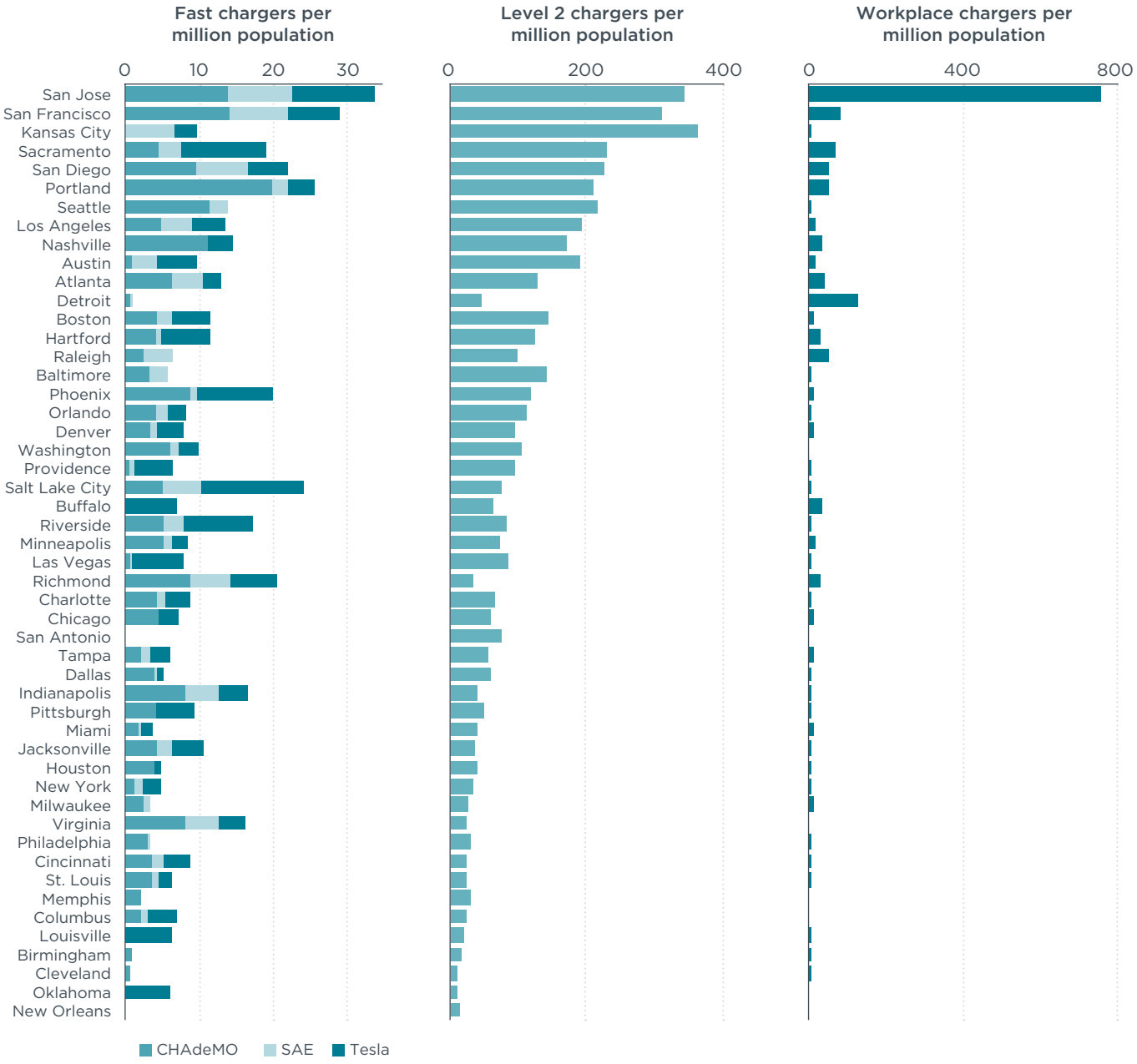

Figure 2. Charging infrastructure per million population in 50 most populous metropolitan areas in 2015 for public fast charging (three types), public Level 2, and estimated workplace charge points (ordered by most total charging)

Several trends emerge from the metropolitan areas with highest charging infrastructure deployment per capita. Overall the public charging infrastructure is 88% Level 2 and 12% DC fast. Cities with the most public charging infrastructure have roughly 350 Level 2 and 30 DC fast charge points for each million residents. The leading 10 metropolitan areas have on average 10 times the public charging availability of the bottom 10 cities. The 10 areas with the highest public charging per capita include five California cities, the two northwest cities (Portland and Seattle), Kansas City, Austin, and Nashville. When examining just the DC fast charging availability, similar cities emerge as having extensive

charging networks. In addition, Salt Lake City, Richmond, Phoenix, and Indianapolis were in the top 10 in rapid charging availability per million people in 2015. DC fast charge points are considerably more valuable than Level 2 charge points because of the additional time convenience. Also prominently shown in the figure is how workplace charging availability is far greater in the San Jose area than in all other cities.

State-level charging infrastructure actions. In addition to the quantification of workplace charging and the value of public charging, several other local measures promote charging infrastructure. We identify and track 10 discrete, qualitative state, local, and utility actions to support this infrastructure. These steps include state actions such as low-carbon fuel policy, which provides assistance to charging providers (7 areas), private charger incentives for consumers or commercial businesses or both (23 areas), and public charger incentives such as promotion incentives or direct deployment of public charging equipment (27 areas).

City-level charging infrastructure actions. Potential city-level actions on charging infrastructure are wide-ranging. These include streamlined permitting processes for electric vehicle service equipment (7 areas), incentives for EVSE installation (3 areas), electric vehicle-ready building codes (3 areas), and city-owned chargers (31 areas). In addition, electric power utilities can support electric vehicles by funding infrastructure deployment, as discussed below. Workplace charging is in evidence in 43 of the metropolitan areas, but as the findings in the figure above show, availability of workplace charge points per capita vary greatly across metropolitan areas.

PLANNING, POLICY, AND OTHER PROMOTION ACTIVITIES

Other policy and planning actions go far beyond consumer incentives and charging infrastructure actions. These generally fall into categories that include state regulation, state and city policy planning, electric vehicle fleet initiatives, and other outreach, education, and awareness activities.

Electric vehicle policy. Regulations on vehicle efficiency and carbon dioxide emissions promote electric vehicles to some degree. To comply with U.S. efficiency regulations, electric vehicle uptake would only need to increase to about 2% of new light-duty vehicle sales by the 2025 model year (U.S. EPA, 2012). To the extent that regulations progressively pushed for lower carbon emissions and greater efficiency, the standards would promote more electric vehicles. California and 9 other states have adopted the Zero-Emission Vehicle (ZEV) regulatory program that would require an estimated 15% of new vehicles sales in 2025 to be electric. The regulation pushes automakers to emphasize sales and marketing of electric vehicles more heavily in ZEV states. The regulation also provides relative certainty about future electric vehicle deployment to assist in the planning of charging infrastructure as well as other local support.

Of the 50 metropolitan areas, 13 are in states that have adopted the ZEV regulatory program. Six are in California, and the seven others are in states including Oregon, New York, Massachusetts, Connecticut, Maryland, and Rhode Island. We note that the regulation can differ functionally among the ZEV states. Electric model availability tends to be greater in California (Searle et al, 2016). To foster technology development and help control associated costs, the ZEV regulation allows manufacturers to focus early deployment of electric vehicles in California, delaying market introduction in the other ZEV states. Beginning in model year 2018, manufacturers will be required

to place increasing numbers of electric vehicles in the ZEV-adopting states outside of California. In addition, eight of these states engage in additional activities, including the implementation of a multi-state plan to help support ZEV deployment (NESCAUM, 2013, 2014)

ZEV Alliance participation. Several states have sought to accelerate electric vehicle adoption by increasing their collaboration and best-practice learning through exchanges with international governments. The International Zero-Emission Vehicle Alliance is a consortium of governments including eight states, two Canadian provinces, and four European countries. The states engage with other governments that are proactive in promoting electric vehicles in collaborative activities including coordinating action plans and best-policy practices. This action is applicable for the same 13 metropolitan areas that are located in ZEV-adopting states.

City electric vehicle action plans. Many of the metropolitan areas have city-level or regional-level electric vehicle strategies. Often these are called action plans or readiness plans, and many were supported by the DOE Clean Cities program (U.S. DOE, 2016b). We found that 21 of the 50 metropolitan areas have implemented such plans. These typically have played an important role by creating a forum and network of local, state, utility, charging providers, auto dealers, and other organizations to discuss common issues about the growth of the market for electric vehicles. The 3-year DOE EV Project collected data on more than 8,000 electric vehicles, more than 17,000 charging stations, more than 120 million miles of driving, and more than 6 million charging events (INL, 2015). Of this study's 50 metropolitan areas, 14 had electric vehicles enrolled in the program. The EV Project provides data and lessons on the early deployment of electric vehicles, their usage, and charging patterns that have otherwise not been available.

Other public outreach and awareness activities. There is a general lack of knowledge and understanding of basic questions related to electric vehicles (e.g., Krause et al., 2013; Kurani et al., 2016). Various public outreach and awareness activities work to fill in the gaps in consumers' understanding. Outreach activities help create a foundational understanding about electric vehicle models in the market, the various types and functionality of electric vehicles, available incentives, charging options, and potential benefits. We found that 22 metropolitan areas had electric vehicle information programs of some kind. The *Drive Electric Chicago* website, for example, includes links to an electric vehicle cost calculator, instructions on charging installation, electric vehicle events, links to locate charge points, and information on incentives (City of Chicago, 2015). Other cities include maps and addresses of public charging, discussion of electric vehicle advantages and ways to overcome obstacles, and videos on the importance of electric vehicles and associated city efforts.

In addition, 29 metropolitan areas held events in 2015 to educate consumers and increase awareness of electric vehicles. Kansas City Regional Clean Cities hosted ride-and-drive events at multiple locations, with involvement by cities, counties, charging providers, electric-vehicle enthusiasts, nonprofit groups, and local businesses (Kansas City Star, 2015). Other examples include promotional events with dozens of electric vehicles available for test drives and discussions with owners such as took place in Austin (Plug in America, 2015). And there were ribbon-cuttings for public charging stations, such as one in Hartford that the Connecticut governor, local policymakers, and auto dealers attended (CTC, 2015).

The promotion of local manufacturing of electric vehicle technology further supports awareness by creating local businesses that connect communities to the industry. Often these policies are tied to explicit requirements for minimum levels of job creation and private investment in factories. Several states provide incentives for electric vehicle technology producers, and 15 of the 50 metropolitan areas are in those states. Examples are in Georgia, South Carolina, and Virginia (U.S. DOE, 2016c).

Fleets. The integration of electric vehicles in fleets is growing and becoming more diverse through municipal fleet purchases, state incentives, and procurement guidelines and targets. Other fleet uses with rising electric vehicle placements include taxis, car-sharing programs, and utilities. We found that 22 of the 50 metropolitan areas have state fleet purchasing guidelines or incentives. California, Oregon, and Washington have sought to expand the use of ZEVs in fleets, with the goal that 10% of new vehicle purchases for public and private fleets will be electric by 2016 (Pacific Coast Collaborative, 2014).

There are many city-level fleet programs, including 30 cities with general green fleet targets that promote electric vehicles, 11 cities that have specific quantitative targets for electric vehicle placement in their fleets, and 11 areas with city car-sharing programs that are linked to electric vehicles. Many of the cities with electric vehicle targets participate in the West Coast Electric Fleets initiative, a joint project led by the governments of California, Oregon, Washington, and British Columbia (West Coast Electric Fleets, 2016). San Diego has a target to increase the number electric vehicles in its municipal fleet to 50% by 2020 and 90% by 2035 (City of San Diego, 2015).

By 2025, the City of New York plans to deploy 2,000 electric autos, or half the non-emergency vehicles in its fleet (City of New York, 2015). In addition, New York aims by 2020 to convert a third of the taxi fleet to BEVs, or about 4,400 cars (City of New York, 2013). Portland's CityFleet program in 2016 achieved its goal of 20% for electric vehicles in the city sedan fleet (City of Portland, 2016). Among car-sharing programs, BlueIndy in Indianapolis is building its program toward 500 all-electric Bolloré Bluecar vehicles and 200 charge points (BlueIndy, 2016).

Utilities. Electric utilities are promoting electric vehicles in different ways. Part of their motivation is the potential for electric vehicles to increase revenue, reduce rates, and manage grid loads (e.g., see Ryan and Lavin, 2015). In 2015, several utilities moved toward more planning for electric vehicles. Seven metropolitan areas are deploying public charging infrastructure funded by ratepayers. Kansas City Power & Light had the first major program (KCP&L, 2015); Southern California Edison and San Diego Gas & Electric have such programs in place (SDGE, 2016; Edison International, 2016); and Pacific Gas & Electric and Oregon could be headed toward similar programs (Walton, 2015; Drive Oregon, 2016). We found 17 metropolitan areas with some form of charging pilot project or other research that will help in defining next steps to support electric vehicles. In addition, utilities in nine of the 50 areas are providing charging infrastructure incentives to consumers, generally through grants to retail and commercial customers for installing charging stations.

Many utilities also have customer programs that educate, support, and steer consumers toward electric vehicles and optimal charging practices. We identified 42 metropolitan areas where utilities offered time-of-use rates. Eleven of them also provided preferential rates for electric vehicles. These programs are structured to benefit consumers and

utilities alike; consumers receive financial benefits while utilities are better positioned to manage grid loads. In addition, almost all utilities (in 48 of the 50 areas) have offered web and printed informational materials or outreach events to increase understanding and awareness. Among these, utilities in 12 areas offered some form of electric vehicle cost comparison tool.

SUMMARY OF ACTIONS

Supportive actions are summarized in Table 1, categorized across columns into state, local, and utility categories. The 50 metropolitan areas are ranked by number of electric vehicle promotion actions. Five California regions have taken the most steps, with 21 to 26 of the 33 that we identified.

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

Metropolitan area	State action											Local action														Utility action							Total actions (out of 33)
	State ZEV program	State ZEV Alliance participation	State low carbon fuel policy	State BEV purchase incentive	State PHEV purchase incentive	State fee reduction or testing exemption	State private charger incentive, support	State public charger promotion	State parking benefit	State fleet purchasing incentive	State manufacturing incentive	City electric vehicle strategy	Streamlined EVSE permitting process	EV-ready building code	City vehicle purchase incentive	City parking benefit	City private charger incentive, support	City carpool lane (HOV) access	City-owned EV chargers	US DOE EV Project key area	Workplace charging	City car sharing program link	City informational materials	City outreach events	City green fleet target	City electric vehicle fleet target	Utility charging pilot or other research	Utility public charging infrastructure	Utility time of use rates offered	Utility preferential EV rates	Utility private charger incentive, support	Utility info materials or outreach events	Utility cost comparison tool	
San Francisco	X	X	X	X	X		X	X		X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	26
San Jose	X	X	X	X	X		X	X		X	X	X	X			X	X	X	X		X		X	X	X	X	X	X	X	X	X	X	26
Los Angeles	X	X	X	X	X		X	X		X	X		X	X				X	X	X	X	X	X		X	X		X	X	X	X		24
San Diego	X	X	X	X	X		X	X		X	X	X						X		X	X	X	X		X	X	X	X	X	X		X		22
Sacramento	X	X	X	X	X		X	X		X	X					X		X			X			X	X	X	X	X	X	X		X	X	21
Portland	X	X	X	X	X		X	X		X		X	X						X	X	X	X	X		X	X		X	X			X		20
Riverside	X	X	X	X	X		X	X		X	X	X			X			X	X				X		X				X	X		X	X	19
New York	X	X				X	X					X		X		X		X	X		X		X	X	X	X	X		X	X		X		18
Charlotte				X	X	X		X		X	X	X	X						X		X		X	X	X		X		X		X	X	17
Seattle				X	X	X	X	X		X	X	X	X		X				X	X			X	X	X	X						X		17
Raleigh				X	X	X		X		X	X	X	X						X		X		X	X	X		X					X	X	16
Washington				X	X	X	X			X	X							X		X	X	X	X		X		X		X			X	X	16
Atlanta								X			X	X	X					X		X	X		X	X	X		X		X		X	X	X	15
Boston	X	X		X	X		X	X		X						X			X		X		X	X	X				X			X		15
Philadelphia				X	X			X				X				X			X	X	X	X	X	X			X		X		X	X		15
Kansas City				X	X	X	X	X		X	X	X									X		X	X	X			X				X		14
Denver				X	X		X	X		X				X		X			X		X		X	X	X							X		13
Hartford	X	X		X	X	X		X		X											X			X			X		X			X	X	13
Austin						X						X				X			X		X			X	X	X			X	X	X	X		12
Chicago						X		X		X	X						X			X	X	X			X				X			X	X	12
Orlando						X	X					X				X			X		X		X	X	X				X			X	X	12
Salt Lake City				X	X			X		X		X				X		X			X			X	X				X			X		12
St. Louis				X	X	X	X	X		X	X								X		X				X				X			X		12
Baltimore	X	X		X	X		X			X									X		X								X			X		10
Dallas						X						X							X	X	X		X	X	X				X			X		10
Houston						X						X							X	X	X	X	X		X				X			X		10
Indianapolis											X	X							X		X	X			X	X	X		X			X		10
Nashville				X	X											X		X	X	X	X				X	X						X		10
Providence	X	X				X		X		X									X		X			X					X			X		10
Buffalo	X	X				X	X	X													X	X							X			X		9
Las Vegas						X			X							X					X	X		X					X		X	X		9
Phoenix						X	X											X	X	X	X						X		X			X		9
Richmond						X				X								X			X			X	X				X	X		X		9
Cincinnati						X		X								X			X		X						X		X			X		8
Cleveland						X		X				X							X		X			X							X	X		8
Jacksonville						X	X												X		X		X	X					X			X		8
Memphis				X	X							X							X	X				X					X			X		8
Tampa						X	X												X		X			X			X		X			X		8
Columbus						X		X				X							X					X	X		X							7
Detroit						X															X			X					X	X	X	X		7
Miami						X	X											X			X								X			X	X	7
New Orleans				X	X		X	X																X			X					X		7
Oklahoma City							X	X																X	X				X			X	X	7
Birmingham																					X			X					X	X	X	X		6
San Antonio						X													X		X		X		X							X		6
Virginia Beach						X				X								X											X	X		X		6
Louisville																					X			X	X				X			X		5
Milwaukee																			X		X		X						X			X		5
Pittsburgh				X	X			X													X								X					5
Minneapolis																			X		X								X			X		4

"X" denotes given electric deployment action is in place in the metropolitan area in 2015
ZEV = Zero Emission Vehicle; BEV = Battery electric vehicle; PHEV = Plug-in hybrid electric vehicle; HOV = high-occupancy vehicle lane;
EVSE = Electric vehicle service equipment

III. ANALYSIS OF ELECTRIC VEHICLE MARKET

This section analyzes the electric vehicle market and underlying factors. We analyze data on new electric vehicle sales, measured as percentage of new light-duty vehicle registrations that are plug-in electric vehicles in 2015. The vehicle registration data are from IHS Automotive. We discuss and carry out a statistical analysis of correlations between electric vehicle uptake and public charging infrastructure, model availability, policy incentives, and electric vehicle promotion measures.

ELECTRIC VEHICLE UPTAKE

About 115,000 new electric vehicles were registered in 2015, in a light-duty vehicle market of 16 million. About 82% of these new electric vehicles were in the 50 most populous metropolitan areas. These areas account for 61% of the light-duty vehicle market and 55% of the U.S. population. These areas have three times as many sales of electric vehicles as the rest of the country (1% vs. 0.3%).

Figure 3 shows the share of new autos that are plug-in electric vehicles across the more than 900 metropolitan statistical areas. The 50 most populous are labeled. These larger metropolitan areas tend to have higher electric vehicle sales than surrounding areas. Major West Coast metropolitan areas tend to be where electric vehicle penetration is highest. California alone accounted for 54% of new electric vehicle registrations in 2015. The San Jose area has the highest electric vehicle share at 9.5%, followed by several other California areas at 4% to 5%. Regional leaders through Oregon, Washington, Georgia, and Colorado have 2-3% electric vehicle shares.

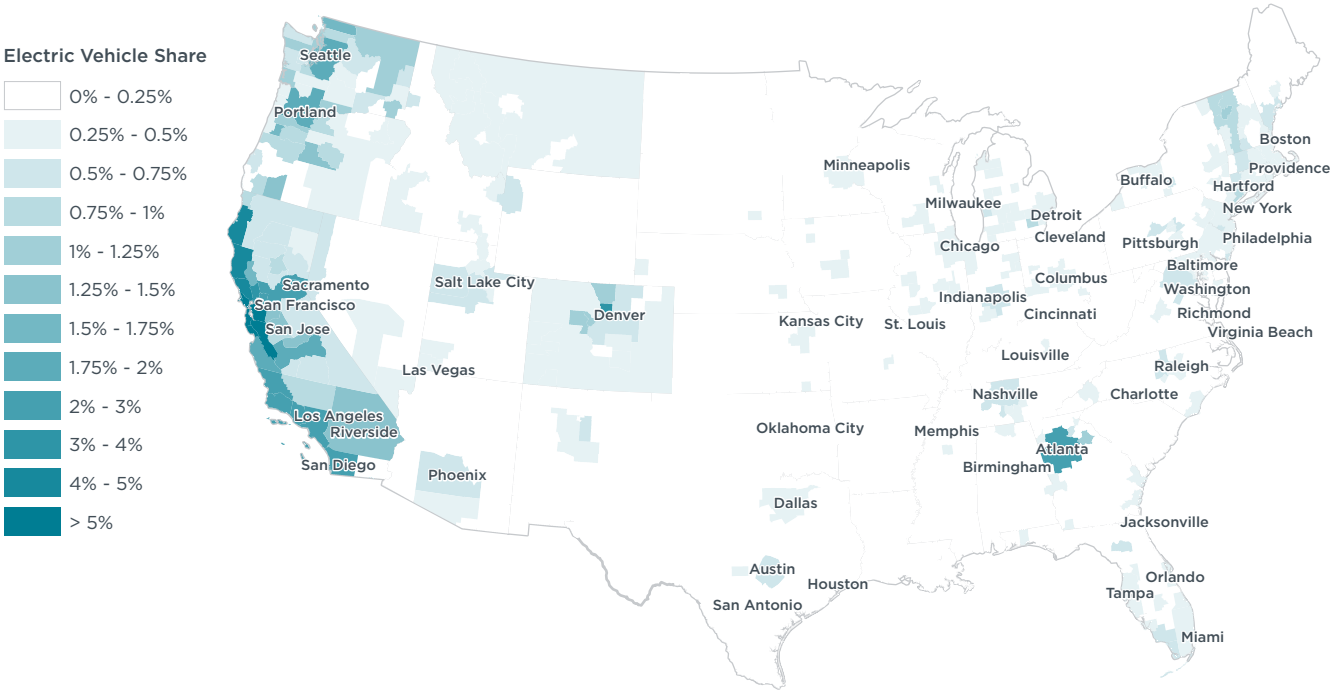

Figure 3. Electric vehicle share of new 2015 vehicle registrations by metropolitan area
(New vehicle registration data from IHS Automotive)

We also analyzed local electric vehicle data for changes from 2014 to 2015. The size of the electric vehicle market nationally did not change much, but there were substantial shifts within specific regional markets. The three largest annual increases in new electric vehicle

registrations were the Los Angeles area (from about 20,000 to more than 23,000), the San Francisco area (from about 12,200 to more than 13,100), and the San Jose area (from about 9,100 to more than 9,700). The largest drops were in the Atlanta area (from almost 10,000 to about 6,500) and the Detroit area (from about 2,500 to 1,200).

The largest growth in electric vehicle sales occurred in the Barre (Vermont), Boulder (Colorado), Modesto (California), and Bend (Oregon) areas, with gains of 55% to 96%. The areas of Bridgeport (Connecticut), Fort Collins (Colorado), Indianapolis (Indiana), Las Vegas (Nevada), Naples (Florida), Oklahoma City (Oklahoma), Reno (Nevada), and Salem (Oregon), recorded increases of 24% to 45%. Electric vehicle demand dropped in Atlanta and Athens (Georgia) by 40% and in Detroit by 56%.

PUBLIC CHARGING INFRASTRUCTURE

As availability of public charging is a key issue for electric vehicles, we analyze the charging infrastructure across metropolitan areas based on the U.S. DOE Alternative Fuel Data Center database (U.S. DOE, 2016a). Analysis is based on public charging infrastructure per million population in each metropolitan area. We separately evaluate public Level 2 and public direct current (DC) fast charging to inform how each type is expanding across the 200 most populous metropolitan areas.

Figure 4 shows public charging infrastructure availability and electric vehicle share for the 200 most populous metropolitan areas. The horizontal axis shows Level 2 chargers per million population; the vertical axis, the electric vehicle share of new vehicle sales; and the size of the data circles is proportional to the number of DC fast chargers per million population. The average public charging infrastructure nationally is shown as 10 DC fast chargers and 75 Level 2 chargers per million population. Many of the metropolitan areas with the highest electric vehicle shares tend have greater than average charging availability. Specifically, 19 of the 20 cities with the highest electric vehicle share have greater-than-average availability of fast charging, and 18 of the 20 leading cities have greater-than-average access to Level 2 charging.

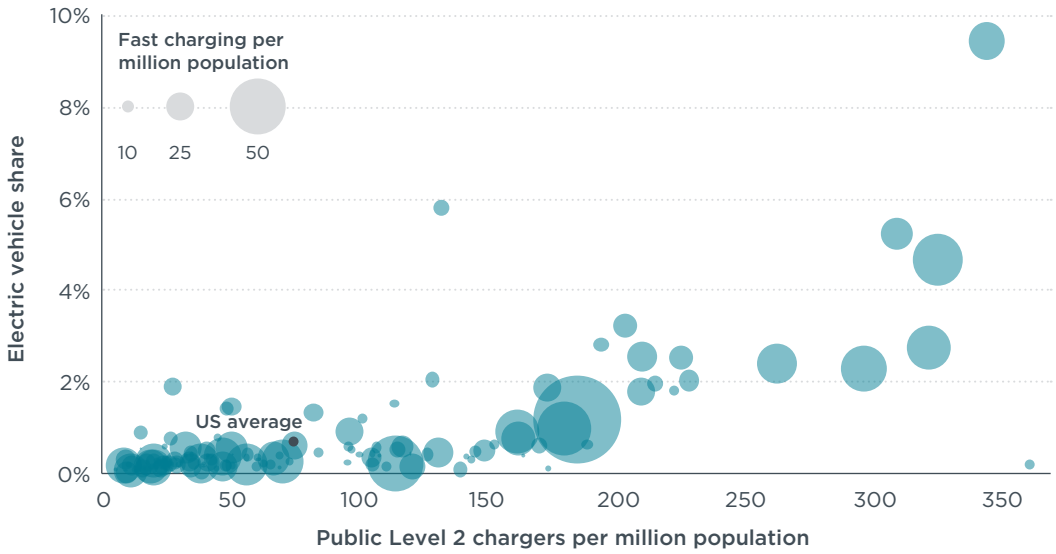

Figure 4. Electric vehicle share of new vehicles corresponding to public Level 2 and direct-current fast charge points per million population for the 200 most populous metropolitan areas

We make several other observations based on this analysis. The benchmarks of 200 to 300 Level 2 chargers and about 30 DC fast chargers per million population correspond with the areas of highest electric vehicle adoption. The data also indicate that metropolitan areas are deploying about 10 public Level 2 chargers for every DC fast charger. We also assessed the relationship between electric vehicle sales and chargers per registered electric vehicle. The additional analysis revealed a similar result to the per capita data. This is largely due to new vehicle ownership patterns being quite similar for major U.S. metropolitan areas. Although there is a clear pattern between chargers per capita and percentage of electric vehicle sales, the relationship between percent electric vehicle uptake and chargers per electric vehicle does not show a discernible trend.

Metropolitan areas with the most extensive charging infrastructure availability per capita provide a value of approximately $1,000 for electric vehicle owners, based on the analytical approach we have previously used (See Lutsey et al, 2015). This value is based on the relative availability of the charging network and ability to expand the functional range of the electric vehicle to avoid possible replacement vehicle trip costs (e.g., from another household vehicle, a rental vehicle, car-sharing or taxi service). We also acknowledge that there is substantial value in workplace charging that, for many electric vehicle users, could be more valuable than general public charging.

MODEL AVAILABILITY

A common question that arises is how much the limited availability of electric vehicle models across the U.S. plays into the relative electric vehicle uptake (see Reichmuth and Anair, 2016). The number of different electric models available is widely discussed as a prerequisite to expanding sales because of the value of competitive choices for consumers. We analyze how model availability differs across the 200 most populous metropolitan areas. Availability in an area is analyzed based on the number of electric vehicle models that had at least 20 new registrations in 2015. The general trend, as assessed statistically further below, is that greater electric vehicle model availability is clearly linked with higher electric vehicle uptake. The areas with the highest electric vehicle share tended to have about 20 competing models. Los Angeles, San Diego, San Francisco, and San Jose each had at least 18 electric models with at least 20 new registrations and at least 24 models with at least one new registration. Sales penetration in these four areas was between 3.4 times the national rate (San Diego) and 13 times (San Jose). Boulder, Colorado, and Bremerton, Oregon, were counter-examples with high purchase rates despite relatively limited choice of models.

Based on this analysis, we find that 80% of metropolitan areas had no more than five electric models available, based on the 20-registrations threshold. We also analyzed the data according to the population in each metropolitan area to reflect where the prospective market resides. This showed that 51% of the U.S. population is in a metropolitan area that had five or fewer electric models available, based on the threshold of 20 electric vehicle deliveries in 2015. Consumers in California had about four times as many electric vehicle choices as the average market nationally.

We also analyzed model availability for the previous year. Thirty of the 50 largest metropolitan areas had the same number of electric models or fewer in 2015 as in 2014. Of the 200 largest areas, 155 had the same number or fewer in 2015 as in the year before.

POLICY INCENTIVES

We also examine the connection between electric vehicle uptake and consumer incentives. These are summarized in Figure 5. Also shown are 2015 electric vehicle market shares by metropolitan area, determining the order from left to right. Incentives include state tax reductions and rebates available in 2015. "Other incentives" were exemptions from local fees and inspections and the estimated benefit of HOV lane access (Jin et al., 2014; Lutsey et al., 2015). We do not include incentives that were available only for a limited number of vehicles. The values shown are an average of BEV and PHEV incentives in each area. Future-year benefits and fees are included over a six-year vehicle ownership period with a 5% annual discount rate. The figure documents that there are substantial incentives available in most of the areas to the left with higher electric vehicle demand. While most of the high-sales areas offer substantial incentives, there are counter-examples with high incentives but low electric vehicle demand, as well as low incentives but relatively high uptake.

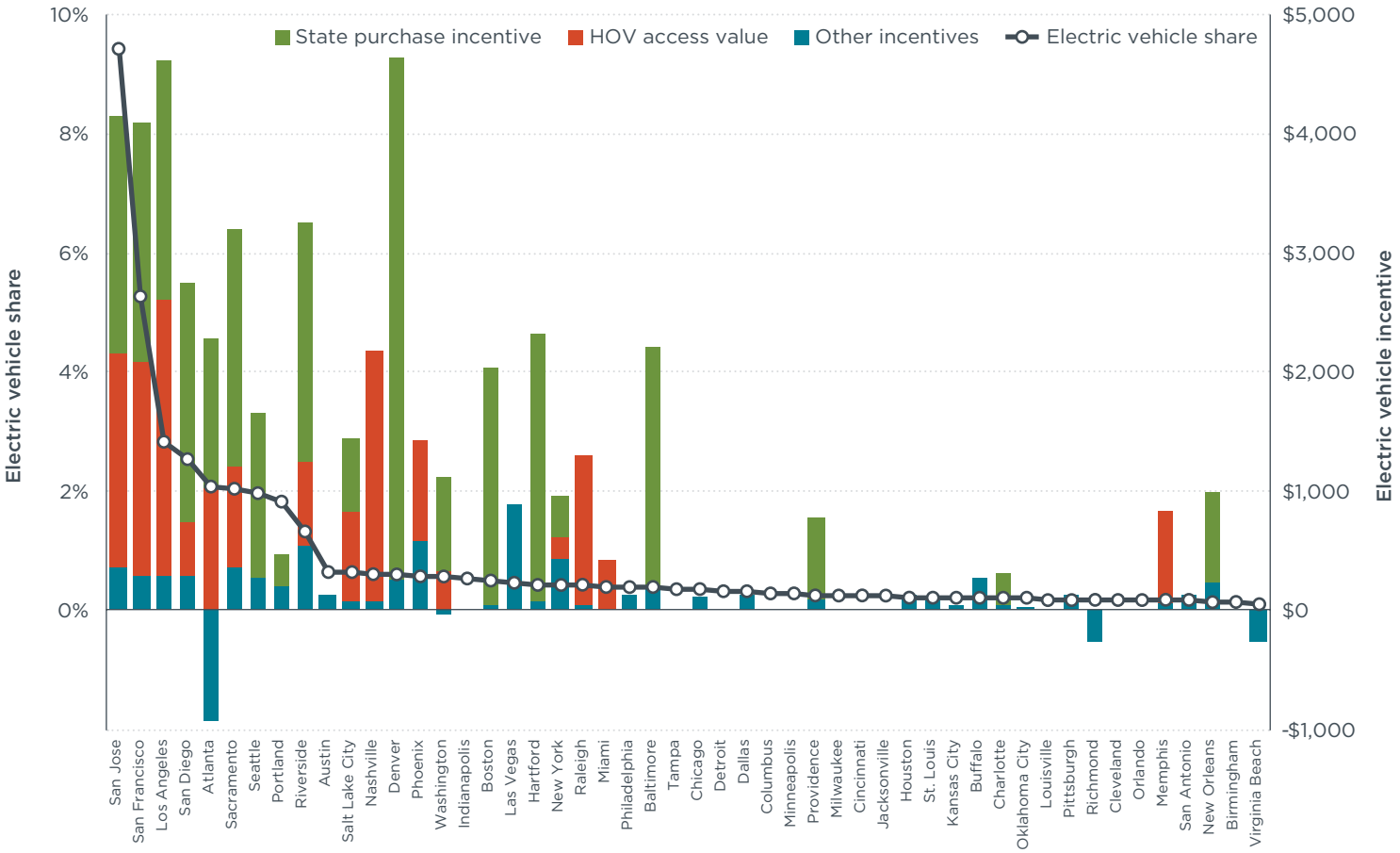

Figure 5. Electric vehicle share of new vehicles and available consumer incentives

We make several additional observations based on the findings. The California areas tend to have a full combination of incentives and the highest electric vehicle uptake. Atlanta shows a high incentive (and an additional electric vehicle fee of $200 per year) and high market share. Notably, Georgia's sales dropped by 80-90% in mid-2015 when the incentive was suspended and the new electric vehicle fee was enacted (Caputo, 2016). End-of-year registration data confirms that monthly sales from August through

December were 90% lower than from January through July. Denver shows a large incentive but low electric uptake. Colorado is now changing its incentive design to be simpler and more marketable at the point of sale in 2016 (see Colorado, 2016). Incentive design elements are found to be more effective in encouraging electric vehicle sales and thus may spur purchases in the Denver area (Yang et al, 2016).

ELECTRIC VEHICLE PROMOTION ACTIONS

Figure 6 shows how electric vehicle demand relates to local promotion actions for the 50 most populous metropolitan areas. The number of state, city, and utility promotion actions in each of the 50 metropolitan areas from Table 1 are summarized in Figure 6, along with electric vehicle market share. There is a general visual trend suggesting a link between promotion actions and electric vehicle purchases. The five metropolitan areas with the greatest number of electric vehicle promotion actions make up five of the six areas with the highest electric vehicle market shares. At the same time, several areas stand out for having applied many of the promotion actions without generating significant market response. These include Boston, Charlotte, New York, Philadelphia, Raleigh, and Washington, with 15 to 18 actions but below-average uptake for electric vehicles.

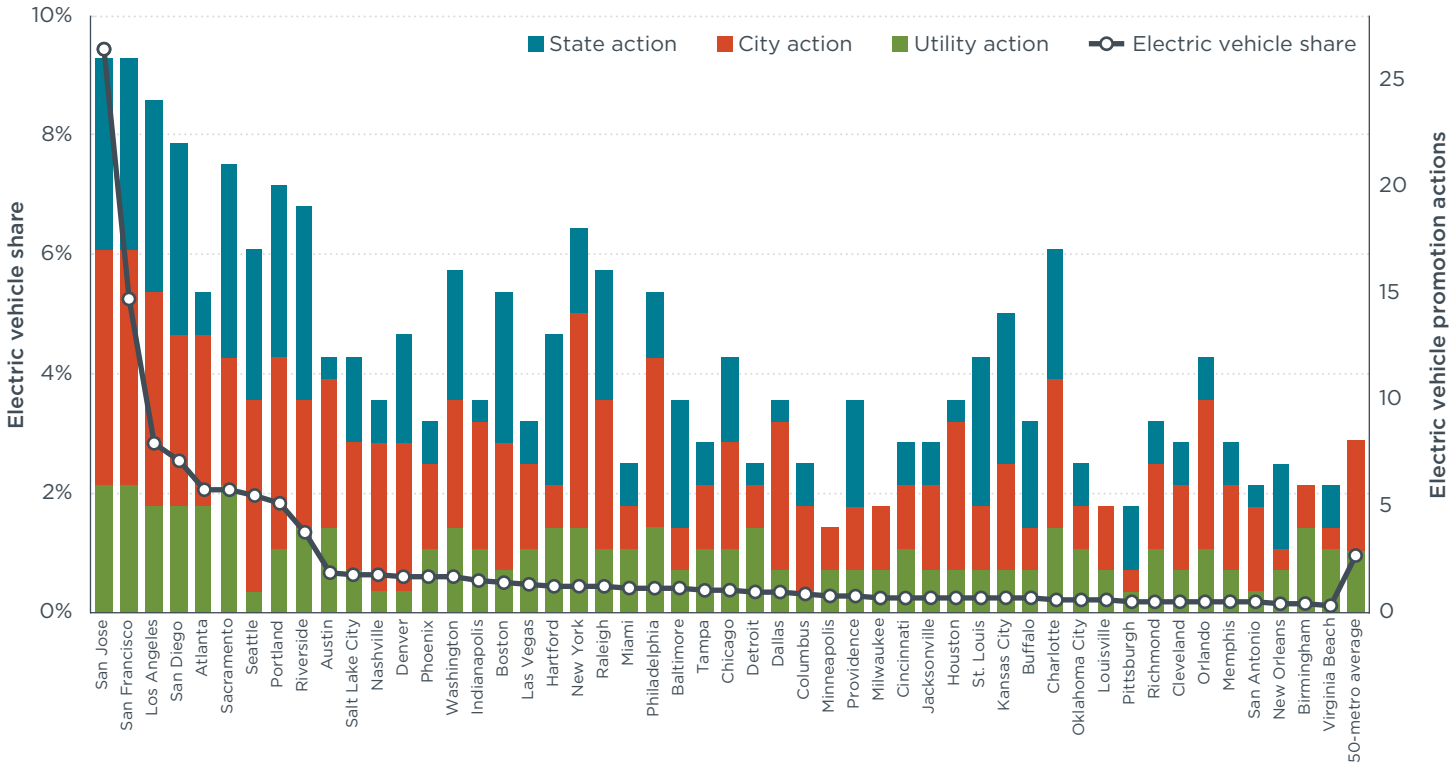

Figure 6. Electric vehicle promotion actions and share of new vehicles

COMPARISON OF 50 MAJOR METROPOLITAN AREAS

Figure 7 illustrates how electric vehicle demand relates to charging infrastructure and local promotion actions for the 50 most populous areas. The horizontal axis tallies total local, state, and utility promotion actions, and the vertical axis represents total public charging infrastructure per capita. The size of the bubble for each metropolitan area indicates the

electric vehicle market share. The data show a general trend for higher electric vehicle shares in those areas where charging infrastructure and promotion actions are more prevalent. The areas are given different colors to indicate geographic location (California red, Northwest turquoise, South yellow, Mountain purple, Midwest orange, Northeast green). As we have seen, five of the six top electric vehicle markets are in California, have the most promotion actions, and have among the highest charging availability.

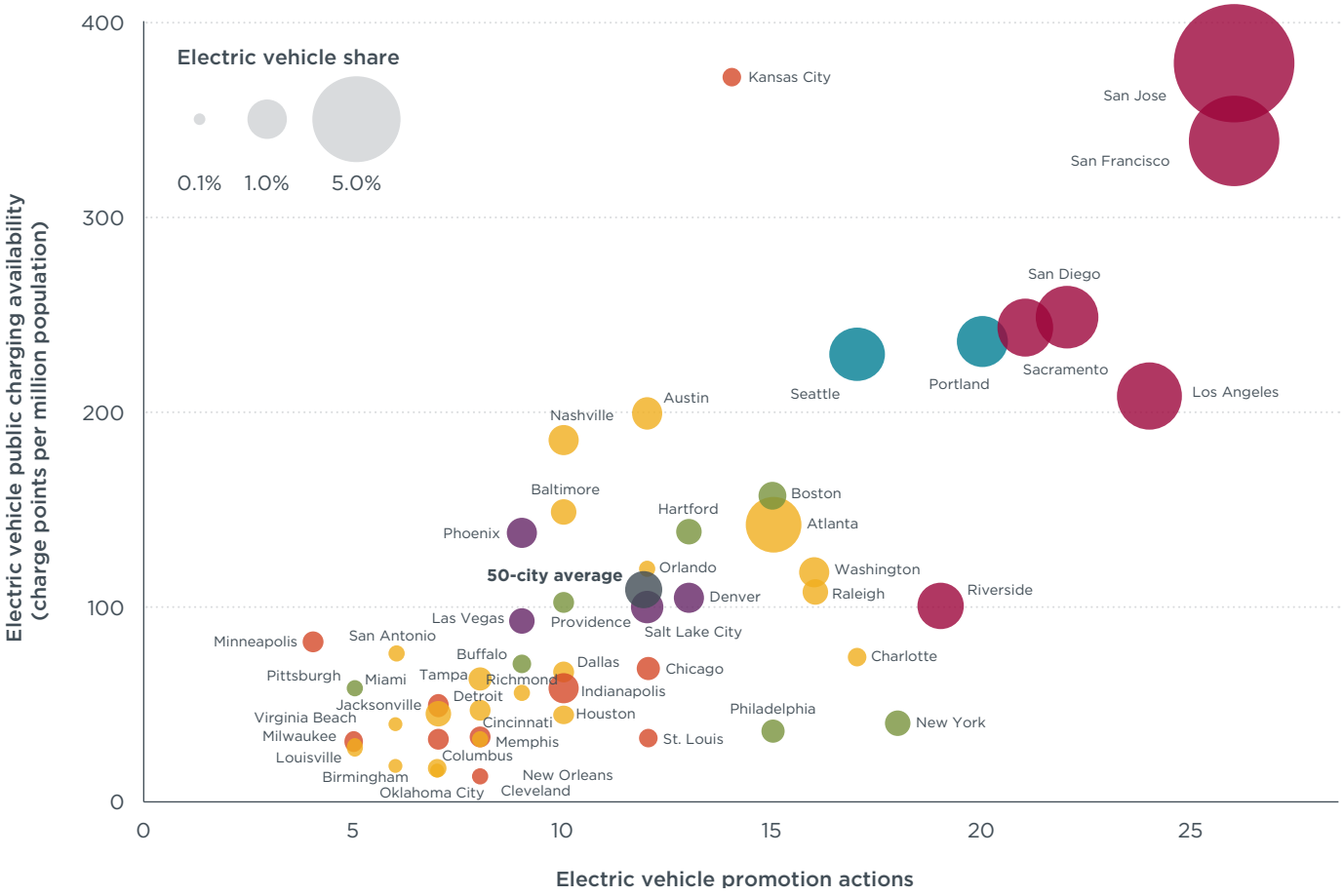

Figure 7. Electric vehicle public charging availability, promotion actions, and share of new vehicles

Considering Figure 7 as four quadrants around the 50-city average data point, the relative gaps in charging infrastructure and local promotion actions become clear. Areas in the lower right (e.g., Charlotte, New York, Philadelphia) lack sufficient charging infrastructure. Areas in the upper left (e.g., Phoenix and Nashville) are behind in promotion activities. The 24 metropolitan areas in the lower left are limited in both. The eight metropolitan areas with the highest electric vehicle market shares are all in the upper right quadrant, with high local promotion activity and high charging infrastructure.

Figure 8 summarizes several of the variables for the 50 metropolitan areas by electric vehicle market share. Putting all these data together in one figure shows the general positive link between the electric vehicle share and many of the potential underlying factors. Figure 8 also highlights anomalies in which various factors do not fit the general trend of positive linkage with higher electric vehicle uptake. In Kansas City, there is

relatively high charging infrastructure per capita but low electric vehicle uptake. Kansas City has low model availability, a moderate number of promotion actions, and low incentives, so this helps explain the result. The New York area has high model availability and many local promotion actions, but only moderate electric vehicle uptake. Several areas, including Baltimore and Providence, stand out as having high consumer incentives but low electric vehicle sales shares. Conversely, Portland, Austin, and Indianapolis are relatively high in electric vehicle purchase rates without substantial incentives. Nashville and Hartford stick out as having relatively high electric vehicle sales shares with limited model availability. These examples demonstrate how no stand-alone factor is likely to significantly increase electric vehicle sales shares. Rather, a comprehensive package of high model availability, extensive public charging infrastructure, a large number of promotion actions, and significant consumer incentives is likely to drive electric vehicle sales. This result is statistically tested in the following section.

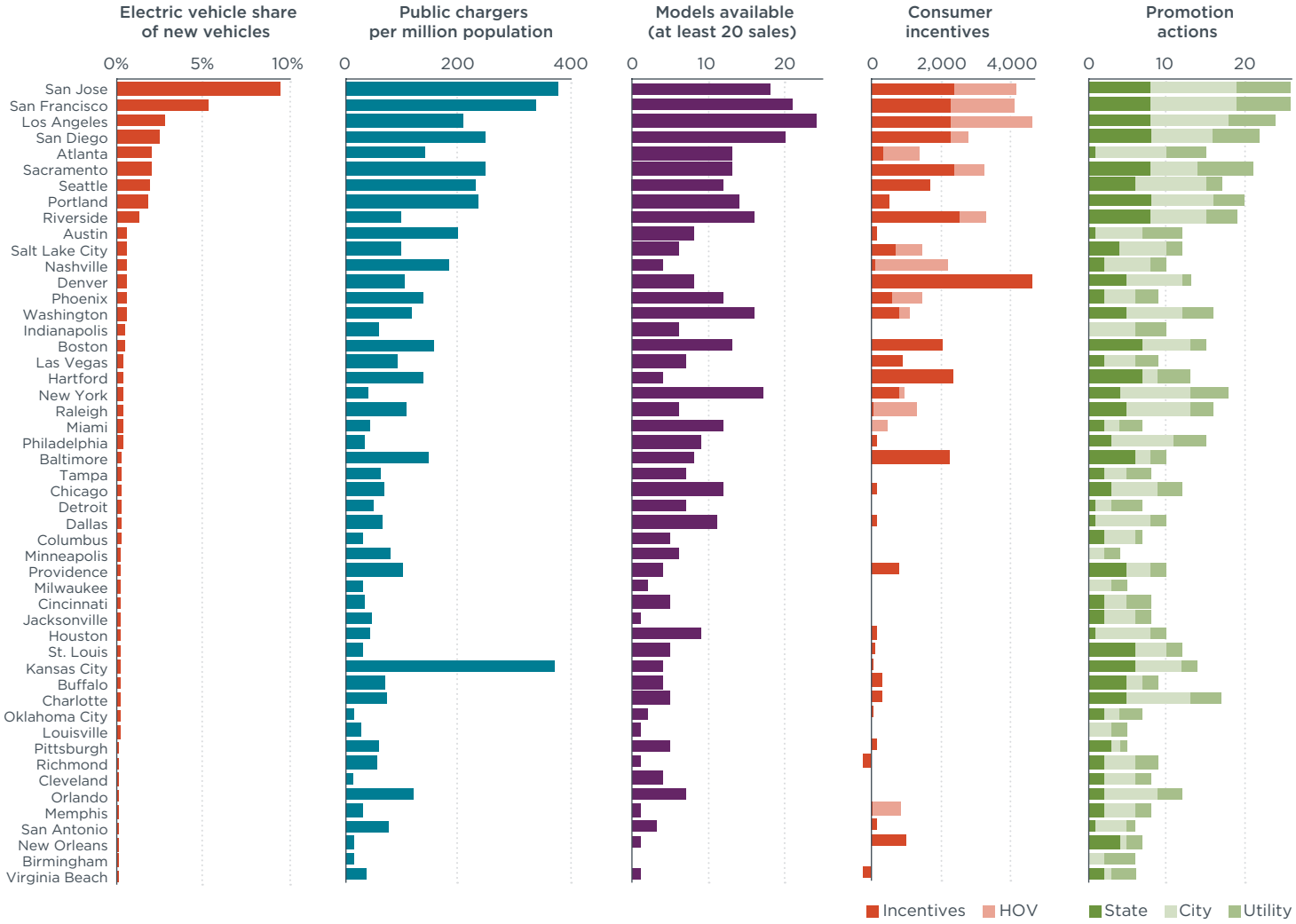

Figure 8. Electric vehicle sales share, model availability, public charging infrastructure, promotion actions, and incentives in 2015 in the 50 most populous U.S. metropolitan areas

STATISTICAL ANALYSIS

This section provides a statistical analysis to discern links between the potential electric vehicle market drivers and electric vehicle demand. The analysis is based on the 200 most populous metropolitan areas, where data are available. To analyze the relative importance of local promotion actions, we conduct additional statistical analysis for the 50 most populous metropolitan areas. The 50-area analysis allows us to include additional variables of workplace charging, HOV lane access, and local actions to promote the sale and use of electric vehicles.

The results are summarized in Table 2. We examine the relationships between the variables to discern the strongest fits at both the 200- and 50-metropolitan areas level. We find six strong statistical fits that link electric vehicle uptake to model availability, state consumer purchasing incentives, public charging, workplace charging, HOV lane access, and number of local promotion actions. Each column in the table represents a unique statistically significant regression with three of four independent variables (each marked with "X") regressed against electric vehicle share. We conduct the analysis for battery electric vehicles (BEV), plug-in hybrid electric vehicles (PHEV), and both forms of electric vehicles (EV). This revealed additional statistically significant regressions with nuanced differences.

For the regressions of data on the top 200 metropolitan areas, we found three statistical fits, one each for BEVs, PHEVs, and EVs, each with three independent variables. Also in the table are three separate statistical regressions, each with three or four independent variables, for the 50 most populous metropolitan areas. As summarized in the table, the analysis revealed the six statistically significant regressions for p-values of less than 0.05, for a range of variables related to model availability, state consumer purchasing incentives, public charging per capita, workplace charging per capita, HOV lane access, and number of promotion actions. The statistical fits were considerably stronger in the 50-metropolitan area regressions (adjusted R-squared of 0.88 to 0.90) than in the 200-metropolitan area regressions (adjusted R-squared of 0.52 to 0.58).

Table 2. Summary of statistically significant independent variables for eleven statistical regressions on electric vehicle shares in United States metropolitan areas

Company	200 U.S. metropolitan areas			50 U.S. metropolitan areas		
	BEV	PHEV	EV	BEV	PHEV	EV
Model availability, BEV	X			X		
Model availability, PHEV		X				
Model availability EV			X			X
State BEV incentive	X					
State PHEV Incentive		X			X	
State EV incentive			X			
Public charging per capita	X	X	X	X		X
Workplace charging per capita				X	X	X
High occupancy vehicle (HOV) lane access				X	X	X
Promotion actions (city, utility, state)					X	
Regression adjusted R-squared	**0.58**	**0.52**	**0.57**	**0.88**	**0.88**	**0.90**

X = significant variable (p-value < 0.05)

Generally the statistically significant regressions of Table 2 provide clear links between model availability, incentives, local promotion action, and electric vehicle uptake. The three separate 200-metropolitan area regressions clearly indicate that incentives, infrastructure, and model availability are key factors for the growth in the electric vehicle market. This is the most comprehensive local level analysis we are aware of—including 200 markets and also separately analyzing BEVs and PHEVs. This indicates that greater model availability, consumer fiscal incentives, and more public charging infrastructure will be key ingredients to further electric vehicle market growth. This result is sensible considering that model availability is necessary to increase consumer options, incentives help to overcome electric vehicles' higher cost, and public infrastructure increases the vehicles' functional electric range. The lower R-squared values for the 200-area regressions indicate that there are more unexplained factors that are affecting electric vehicle market shares than in the 50-area regressions.

The regressions with 50 metropolitan areas are more detailed, more robust, and offer more detailed points of interpretation on what is driving electric vehicle sales. We were able to collect more data on more dimensions, especially on local promotion actions, in the top 50 areas. The more robust statistical fits are shown by the higher adjusted R-squared values (i.e., 0.88 and above). These more detailed regressions still provide further credence to the same underlying factors as the 200-area analysis (i.e., model availability, incentives, public charging). In addition to those factors, the detailed regressions emphasize how important workplace charging, HOV lane access, and local promotion actions are in predicting electric vehicle purchases. Finally, in comparing the 200- and 50-area results, we find that the more local promotion and charging activities that are identified and assessed, the less important financial incentives become in the statistical analysis of the underlying electric vehicle uptake factors.

IV. CONCLUSIONS

A range of factors are helping to expand the electric vehicle market in pockets across the United States. We find statistically significant relationships between the electric vehicle share of new auto sales and these six local market characteristics: electric vehicle model availability, consumer financial incentives, public charging infrastructure, workplace charging infrastructure, high-occupancy vehicle lane access, and number of local electric vehicle promotion actions. The areas across the U.S. that are proactive with these underlying support actions tend to be the ones that stand out as electric vehicle market leaders.

Comprehensive actions by diverse stakeholders are key to increasing demand for electric vehicles. Sales in California, Portland, and Seattle illustrate this. Metropolitan areas such as New York, Kansas City, and Baltimore demonstrate how no single factor is likely to result in significant electric vehicle uptake. In addition to promoting high model availability, public charging infrastructure, and consumer incentives, actions including workplace charging, utility policy, state incentives, and local and regional promotion actions are all helping to overcome consumer barriers to adopting electric vehicles more widely. Sustained and expanded implementation of these policies across the U.S. is likely to further expand the electric vehicle market.

Total electric vehicle sales in the United States through the middle of 2016 has surpassed 500,000. Growth in the emerging market has generally been linked to model availability. Regions with high electric vehicle sales tend to be markets where a significant number of different models are available to prospective buyers. The majority of consumers have access to only a handful of electric models. The availability of new electric vehicles did not substantially increase from 2014 to 2015. Market growth in California especially shows how increased model availability is stimulating demand. California's Zero-Emission Vehicle program ensures that manufacturers offer a broader class of electric vehicles in greater numbers over time. Increasing electric vehicle model availability helps capture a wider set of consumers, further spurring market growth.

Public charging infrastructure is also helping support electric vehicle sales, but it remains a key deficiency in many areas. This study reaffirms the finding that public charging infrastructure is significantly linked to electric vehicle market growth. Especially expansive networks in northern California are linked with higher electric vehicle uptake. Other isolated areas with extensive charging infrastructure such as Portland, Austin, and Nashville are also linked with higher electric vehicle sales. The national average for electric charging infrastructure is just one quarter of leading-city benchmarks.

Incentives remain a key part of developing the market for electrics. Financial consumer incentives are found to be key drivers for sustaining electric vehicle uptake. Incentives are consistently associated with the leading regional electric vehicle markets. The 90% drop in electric vehicle sales in mid-2015 in the Atlanta area following the suspension of the Georgia incentive underscores the point.

The implications of this assessment of U.S. metropolitan areas are broad. Regions across North America, Europe, China, and elsewhere are proactively implementing incentives, developing long-term regulatory policy, and deploying charging infrastructure to sustain growth in the electric vehicle market. Every region can learn from the experience of others regarding which measures work the best and which can

be improved. The launch and greater availability of lower-cost, higher-range electric models will broaden the market and bring greater economies of scale. Expanding the application of best-practice promotion policies will continue to accelerate the transition to a global electric vehicle fleet.

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ANNEX

Table A1. Examples of representative electric vehicle promotion actions

Action	Level	Example and link
State ZEV program	State	California – Zero Emission Vehicle program
ZEV Alliance participation	State	Multiple – Zero Emission Vehicle Alliance
State low carbon fuel policy	State	California – Low Carbon Fuel Standard Oregon – Clean Fuels Program
State BEV purchase incentive	State	Colorado – Innovative Motor Vehicle and Alternative Fuel Vehicle Credits
State PHEV purchase incentive	State	Massachusetts – Massachusetts Offers Rebates for Electric Vehicles
State fee reduction or testing exemption	State	Arizona – Reduced Vehicle License Tax
State private charger incentive, support	State	Delaware – Electric Vehicle Charging Equipment Rebate Program Missouri – Alternative Fuel Infrastructure Tax Credit
State public charger promotion	State	Connecticut – Electric Vehicle Charger Incentive Program
State parking benefit	State	Hawaii – Free Parking for Electric Vehicles
State fleet purchasing incentive	State	Maryland – Freedom Fleet Voucher Program
State manufacturing incentive	State	Georgia – Investment Tax Credit
City electric vehicle strategy	Local	Portland, Oregon – Electric Vehicles: The Portland Way
Streamlined EVSE permitting process	Local	Charlotte, North Carolina – Trade Internet Permitting (TIP) System Los Angeles, California – Electronic e-Permit System
EV-ready building code	Local	Los Angeles, California – Los Angeles Municipal Code Denver, Colorado – Electric vehicle charging requirements
City vehicle purchase incentive	Local	Riverside, California – Alternative Fuel Vehicle Rebate Program
City parking benefit	Local	Cincinnati, Ohio – Free Parking for All-Electric Vehicles Philadelphia, Pennsylvania – Philadelphia Parking Authority
City private charger incentive, support	Local	Chicago, Illinois – Drive Clean Station Denver, Colorado – Charge Ahead Colorado
City carpool lane (HOV) access	Local	Nashville, Tennessee – HOV Smart Pass
City-owned EV chargers	Local	Baltimore, Maryland – Electric vehicle charging stations Raleigh, North Carolina – Public charging stations
US DOE EV Project key area	Local	Multiple – The EV Project
Workplace charging	Local	San Jose, California – 1500 charge points at over 20 workplaces
City car sharing program link	Local	Indianapolis, Indiana – BlueIndy
City info materials	Local	Chicago, Illinois – Drive Electric Chicago Milwaukee, Wisconsin – Electric Vehicle Charging Stations
City outreach events	Local	Austin, Texas – National Drive Electric Week
City green fleet target	Local	San Diego, California – Climate Action Plan Louisville, Kentucky – ZeroBus fleet
City electric vehicle fleet target	Local	New York, New York – NYC Clean Fleet
Utility charging pilot or other research	Utility	New Orleans, Louisiana – Entergy's Near-Term Electric Vehicle Strategy
Utility public charging infrastructure	Utility	Los Angeles, California – Southern California Edison "Charge Ready" San Diego, California – San Diego Gas & Electric
Utility time of use rates offered	Utility	Detroit, Michigan – DTE Time-of-Day Electric Rate
Utility preferential EV rates	Utility	San Francisco, California – PG&E New Electric Vehicle Rate Options
Utility private charger incentive, support	Utility	Austin, Texas – Austin Energy Home and Multifamily Properties Charging Rebate
Utility info materials or outreach events	Utility	Minneapolis, Minnesota – Xcel Energy – Electric Vehicles
Utility cost comparison tool	Utility	New York – ConEdison – Electric Vehicles