Fuels Institute

EVC ELECTRIC VEHICLE COUNCIL

Evaluation of Policies for Electric Vehicle Charging Infrastructure Deployment

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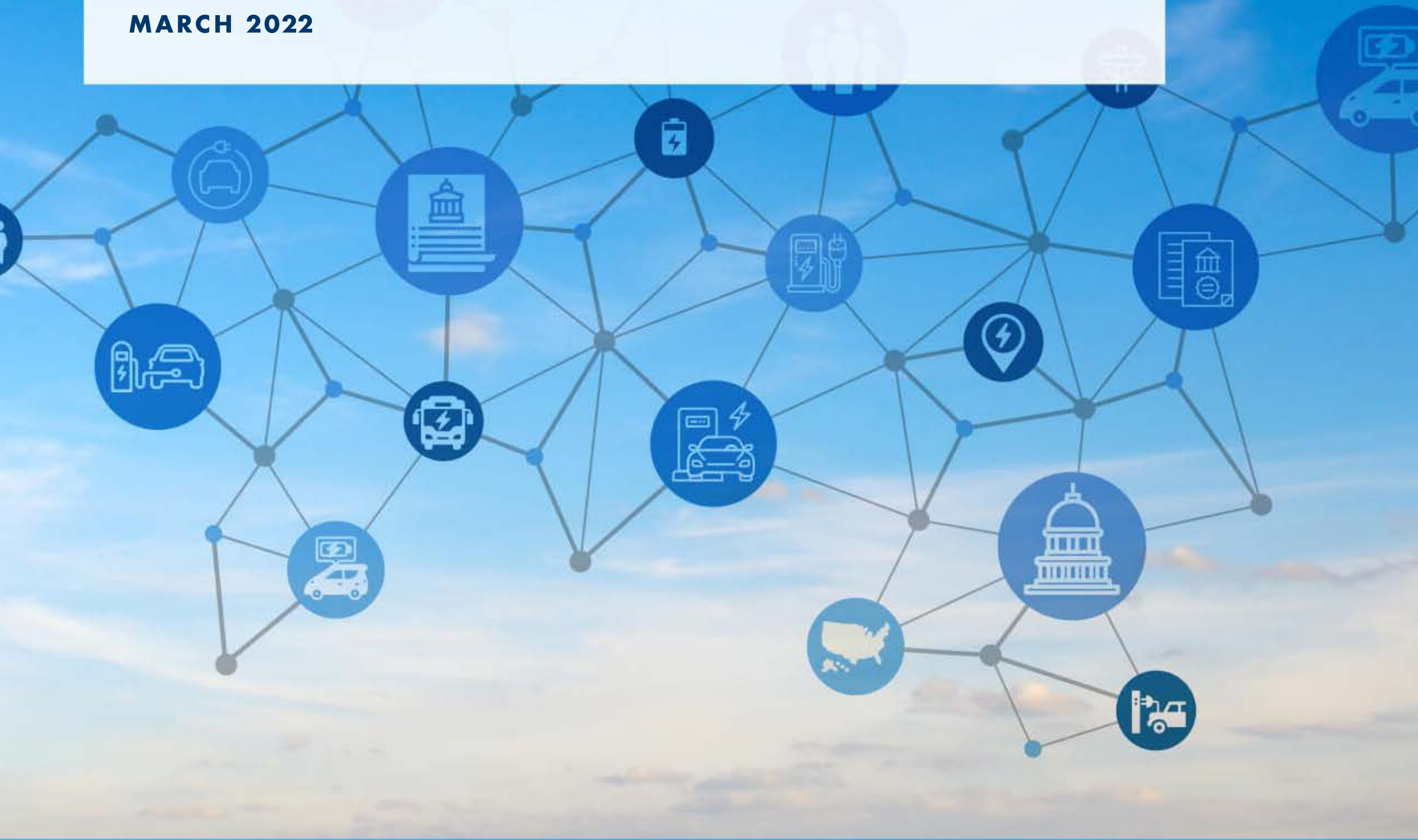

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PROJECT OVERVIEW

The availability of electric vehicle (EV) charging infrastructure, formally referred to as electric vehicle supply equipment (EVSE), is a primary concern with respect to developing an EV and EV charging market in the U.S. According to the Alternative Fuels Data Center (AFDC), a resource of the U.S. Department of Energy's Vehicle Technologies Office (U.S. DOE VTO), there were 45,532 publicly available Level 2 and direct current fast charger (DCFC) EV charging stations in the U.S. containing 111,347 charging ports in November 2021.[1] Estimates vary for how many publicly available EV charging stations, EVSE, and charging ports[2] are required to support the growing number of EVs in the U.S. A 2021 study by the International Council on Clean Transportation (ICCT) suggests that 900,000 public Level 2 chargers and 180,000 DCFCs will be needed to support an anticipated U.S. EV stock of 26 million by 2030.[3] A separate study by Atlas Public Policy found that the total required investment into public charging could be reduced by deploying fewer but higher-power and ultra-fast DCFCs: 350 kilowatts (kW) compared to 150 kW or lower.[4] Relatedly, the Biden administration has set a goal of deploying 500,000 EV charging stations by 2030,[5] representing a buildout of over 454,000 charging stations from November 2021 to 2030.

1 lternative Fuels Data Center, "Alternative Fueling Station Locator," U.S. Department of Energy Vehicle Technologies Office, https://afdc.energy.gov/stations/#/find/nearest?country=US&fuel=ELEC.

2 EV charging stations may include one or more EVSE (the "chargers"), and the EVSE may include one or more ports. See the following webpage for more information on terminology distinctions: https://afdc.energy.gov/fuels/electricity_infrastructure.html

3 International Council for Clean Transportation, *Charging Up America: Assessing the Growing Need for U.S. Charging Infrastructure Through 2030*, white paper, July 2021, https://theicct.org/publications/charging-up-america-jul2021.

4 Lucy McKenzie & Nick Nigro, *U.S. Passenger Vehicle Electrification Infrastructure Assessment*, April 2021, https://atlaspolicy.com/u-s-passenger-vehicle-electrification-infrastructure-assessment

5 The White House, "Fact Sheet: Biden Administration Advances Electric Vehicle Charging Infrastructure," statement, April 22, 2021, https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-biden-administration-advances-electric-vehicle-charging-infrastructure/.

Over the last decade, federal, state, and local governments, utilities, and other stakeholders have introduced new policies, programs, and incentives to support and accelerate both the adoption of EVs and the deployment of EVSE. To help guide the development of such policies and programs, this study evaluated the effectiveness of various policy approaches in contributing to EVSE deployment and broader EV and EV charging market development. Using both quantitative and qualitative methods, the study aimed to complete the following objectives:

- **Identify the major existing U.S. policies, incentives, and programs** (collectively referred to as "policies"), or categories thereof, that have been implemented in the past five years (2016-2020).
- **Evaluate the effectiveness of the policies in influencing EV charging infrastructure development.**
- **Evaluate the relationship of policies and the development of an EV charging market.**
- **Identify opportunities for future policy formulation.**

With a focus on the above objectives, this report aims to provide policymakers, regulators, business leaders, and other stakeholders with insights into the effectiveness of various policy types and approaches in supporting EVSE deployment in an efficient and effective manner.

ABOUT THE PROJECT TEAM

The Fuels Institute is a not-for-profit organization led by a collaborative group of fuel retailers, fuel producers and refiners, alternative and renewable fuels producers, automobile manufacturers, and others with expertise in the fuels and automotive industries. The Institute delivers comprehensive and balanced research and analysis concerning fuels, vehicles, and related policy issues. The Institute does not lobby or advocate for action in either the private or public sector. Institute research seeks to establish a common baseline of information upon which stakeholders can consider various options for resolving challenges in the market. The Electric Vehicle Council is a project of the Fuels Institute comprised of organizations seeking to eliminate confusion and provide guidance for success relative to the installation and operation of retail EV charging stations through stakeholder collaboration, objective research, and market education.

ICF is a global professional firm with more than 50 years of consulting experience in strategic planning, research, program implementation, analytics, digital services, and stakeholder engagement. ICF's staff has deep experience in energy and clean transportation, including alternative fuels, EVs, and EV charging infrastructure. ICF has led many zero-emission vehicle and infrastructure studies and plans on issues spanning technology, markets, and policy. ICF also provides program implementation support, including a long-standing engagement with the National Renewable Energy Laboratory (NREL) to administer the AFDC's comprehensive Federal and State Laws and Incentives Database as well as the Alternative Fueling Station Locator on behalf of the U.S. DOE VTO.

BACKGROUND AND CONTEXT

The technology development and deployment of EVs (which include both all-battery electric vehicles, BEVs, and plug-in hybrid electric vehicles, PHEVs) have advanced exponentially in recent years. This has created opportunities to directly reduce emissions from the transportation sector and has provided opportunities for consumers to benefit from relatively lower cost of ownership compared to internal combustion engine vehicles (e.g., gasoline or diesel) in a number of use cases.

There has been a steady growth in passenger EV adoption in the U.S., even though in 2020 the U.S. market represented only about 10.7% of the world's total stock of 10.2 million EVs, according to the International Energy Agency's (IEA) 2021 Global EV Outlook. As indicated by IEA, Europe and China have been leading the way in new EV sales, with 10% and 6% market share in 2020, respectively, while the U.S. market share for new EV sales has remained at around 2% over the last few years.[6] However, there has been a significant increase in EV adoption in the U.S. especially in the second quarter of 2021, with sales up 270% compared to Q2 of 2020 and reaching a 20% share of passenger-vehicle sales (that is, vehicle types such as sedans and coupes) and 4.7% of all light-duty vehicle sales (all light-duty vehicles including but not limited to passenger cars, SUVs, pickup trucks, minivans, and vans).[7] This trend reflects both declining prices and an increasing variety of EV makes and models with longer vehicle range and better overall performance to satisfy consumers' needs and preferences. As of Q3 2021, there were 32 PHEV models and 19 passenger-style BEV models (26 when including model variants) available on the U.S. market[8], and more models are expected to come to market in 2022 and beyond.[9]

In April 2021, the governors of 12 states (including California) sent a letter to the U.S. President requesting "setting standards to ensure that all new passenger cars and light-duty trucks sold are zero-emission no later than 2035". [10] California, Massachusetts, New York and New Jersey have all set state targets to phase out the sale of gasoline light duty vehicles by 2030 or 2035.[11] Other countries have set targets to require all new passenger cars and light van sales to be zero-emission vehicles

6 International Energy Agency, "Global EV Outlook 2021: Trends and Developments in Electric Vehicle Markets," April 2021, https://www.iea.org/reports/global-ev-outlook-2021/trends-and-developments-in-electric-vehicle-markets.

7 Tom Taylor, "Q2 in Review," Atlas EV Hub, August 23, 2021, https://www.atlasevhub.com/weekly_digest/q2-in-review/.

8 EV Adoption, "BEV Models Currently Available in the US," accessed November 30, 2021, https://evadoption.com/ev-models/bev-models-currently-available-in-the-us/; EV Adoption, "PHEV Models Currently Available in the US," accessed November 30, 2021, https://evadoption.com/ev-models/available-phevs/

9 Inside EVs, "Electric SUVs: Every Current & Upcoming SUV For 2021-2023," accessed November 30, 2021, https://insideevs.com/car-lists/electric-suvs/

10 Car and Driver, "Massachusetts to Ban Sale of New Gas-Powered Cars by 2035," December 31, 2020, accessed January 11, 2022, https://www.caranddriver.com/news/a35104768/massachusetts-ban-new-gas-cars-2035/.

11 Multi-State Governors ZEV letter, April 21, 2021, accessed January 11, 2022, https://www.gov.ca.gov/wp-content/uploads/2021/04/4.21.21-Multi-State-Governors-ZEV-Letter.pdf.

as early as 2025.[12] In addition, current forecasts suggest that EVs will reach cost parity with internal combustion engine (ICE) vehicles by 2025, or when battery manufacturing costs fall below $80 per kilowatt-hour (kWh). For reference, a battery pack was priced at $135 per kWh in 2020.[13] There has also been increasing consumer awareness about the viability of EVs, especially after several major auto manufacturers worldwide announced the phaseout of ICE vehicles within the next decade. Consequently, the number of EVs on the road is projected to increase significantly in the next decade.

The U.S. Department of Energy Vehicle Technologies Office's Alternative Fuel Data Center (AFDC) indicates that in November 2021 the U.S. had 45,532 publicly available Level 2 and DCFC stations, containing 111,347 charging ports.[14] In the near future, the need to deploy the charging infrastructure necessary to support the 26 million EVs expected nationwide by 2030 is indeed one of the most pressing challenges to developing a market for EVs in the U.S.[15] For California alone, a July 2021 report from the California Energy Commission projects that the State will have 7.5 million passenger EVs on its roads by 2030, creating a need for nearly 1.2 million public and shared chargers.[16] As stated previously, estimates for the total number of EVSE required to support EV charging demand vary, and importantly, the approach taken to public charging development will influence the quantity of EVSE needed. For instance, deploying strategically sited, ultra-fast, high-power DCFC may result in fewer required EVSE deployments compared to the approach of deploying lower-power Level 2 chargers or DCFCs.

To support future EV adoption equitably across different population segments and geographic locations, a robust charging infrastructure network is needed to cover corridor travel as well as all residential and commercial applications in urban and rural areas, including multifamily housing, workplaces, retail, and shopping centers. In addition to the grant programs for EV charging infrastructure resulting from the Volkswagen Clean Air Act Civil Settlement,[17] several states, localities, and electric utilities have invested in enabling EVSE deployment through a variety of dedicated financial and policy mechanisms. As described in the "Overview of the Project" section, the purpose of this study was to identify major EVSE-related policies adopted from 2016 through 2020, to examine the effectiveness of these policies in increasing EVSE station deployment, and to assess relationships between these policies and the development of EV charging markets.

12 Sandra Wappelhorst, "Update on Government Targets for Phasing Out New Sales of Internal Combustion Engine Passenger Cars," International Council for Clean Transportation, June 15, 2021, https://theicct.org/publications/update-govt-targets-ice-phaseouts-jun2021.

13 Bloomberg NEF, *Electric Vehicle Outlook Report*, April 2020, https://about.bnef.com/electric-vehicle-outlook/.

14 Department of Energy Alternative Fuel Data Center, Alternative Fueling Station Locator, accessed November 30, 2021, https://afdc.energy.gov/stations/#/analyze?country=US&fuel=ELEC

15 International Council for Clean Transportation, *Charging Up America: Assessing the growing need for U.S. charging infrastructure through 2030*, July 28, 2021, https://theicct.org/publications/charging-up-america-jul2021

16 California Energy Commission, "Report Shows California Needs 1.2 Million Electric Vehicle Chargers by 2030," news release, June 9, 2021, https://www.energy.ca.gov/news/2021-06/report-shows-california-needs-12-million-electric-vehicle-chargers-2030.

17 US Environmental Protection Agency, "Volkswagen Clean Air Act Civil Settlement," accessed September 7, 2021, https://www.epa.gov/enforcement/volkswagen-clean-air-act-civil-settlement.

DATA COLLECTION AND ANALYSIS METHODS

OVERVIEW OF DATA COLLECTION AND ANALYSIS

To meet the objectives listed in the “Project Overview” of this report, the project team used a mix of quantitative and qualitative methods to collect and analyze data and address key questions regarding the effectiveness of various policy types in increasing EVSE station deployment. Quantitative methods included collecting secondary data from various sources and statistical analysis to examine the association between variables of interest. Qualitative methods included semi-structured interviews with government officials, regulators, electric utility officials, and business leaders to obtain their insights and perspectives regarding policy approaches to increasing EVSE deployment. Both quantitative and qualitative results were analyzed and interpreted separately, as well as jointly to corroborate findings across methods. The following sections explain the processes used for data collection and analysis as well as descriptions of the data collected.

QUANTITATIVE DATA

The quantitative analysis conducted as part of this study sought to address three primary research questions, each oriented around the study's main concern of identifying the most effective policy approaches for EVSE station deployment:

1) Is the presence of any, or multiple, policy type(s) associated with more EVSE station deployments and a higher measure of overall EVSE market development?

2) What association, if any, does the extent of policy adoption across different policy types have with the number of charging stations deployed and overall EVSE market development?

3) What association, if any, has public funding had with measures of EVSE station deployment and overall EV charging market development?

To answer these questions, the project team used statistical methods with a dependent variable comprised of the weighted average of state-level per capita EV charging station deployment from 2016 through 2020 and state-level per capita EV sales in the same time frame, collectively referred to as EVSE Market Development. Rather than simply using per capita EVSE station deployment alone as the dependent variable, the research team chose to use this composite variable to represent the market for EV charger deployment in a broader sense. Per capita EVSE station deployment represents the supply side of this market while per capita EV sales represent the demand side. Because the primary focus of this study is to understand the effectiveness of various policy approaches in influencing charging station deployment, the EVSE station deployment component was weighted at 75% while per capita EV sales was weighted at 25%.[18]

To form EVSE Market Development as a variable, the research team collected three sets of data. First, the team collected annual EVSE station deployments per state from 2016 through 2020 via the AFDC Alternative Fueling Station Locator. This data included both public and private charging stations, not including residential stations, and it included stations with Level 1, Level 2, and DC fast chargers. The team also downloaded annual EV sales data per state from 2016 through 2020 using the Alliance for Automotive Innovation's Electric Vehicle Sales Dashboard. Finally, the team downloaded state-level population data from the 2020 U.S. Census. All data was combined to generate a measure of EVSE Market Development using the weighted average method described above.

18 The researchers also considered a dependent variable of EVSE station deployments normalized by EV sales. Such a variable would have provided a sense of how deployments have kept pace with EV sales per state. While that variable is an important consideration, the researchers chose a per-capita variable given projections of relatively large-scale future EV adoption and to reflect how EVSE deployments relate to the larger population, not only pre-existing EV drivers.

After collecting data needed to form the dependent variable, independent variables were then identified and formed. As described in the next section, the research team assessed associations between each independent variable and the dependent variable. The following list describes each, along with the data collected to form them.

Dependent variables:

- **EVSE market development:** A 75:25 weighted average of 1) the number of charging stations deployed per state per capita from 2016 through 2020 (75%), and 2) the number of EV sales per state per capita from 2016 through 2020 (25%). Throughout the remainder of this report, original EVSE market development scores are multiplied by a factor of 1,000 to improve the readability of figures and tables. Original EVSE market development scores are in thousandths and ten-thousandths, whereas the values shown in the following sections are in ones and tenths.
- **EVSE deployment:** The number of charging stations deployed per capita from 2016 through 2020 per state

The EVSE deployment variable was used as a dependent variable in place of EVSE market development where it was more appropriate, such as when assessing the association between public funding and per capita EVSE station deployment. When assessing the impact of demand charges on public DCFC deployments, the dependent variable included only publicly available DCFC stations, and it did not include any private stations or Level 1 or Level 2 chargers (see the "Associations Between Demand Charges and EVSE Market Development" section). Conversely, when evaluating the impact of public funding on per capita EVSE station deployment, the EVSE deployment variable included both public and private charging stations (not residential), and Level 1, Level 2, and DCFCs.

Independent variables:

- **Policy-type presence:** A binary variable indicating whether each policy type has or has not been adopted within a given state
  - **Data collected:** All policies, programs, laws, regulations, and incentives related to non-single-family-residential EVSE deployment that were listed in the AFDC Federal and State Laws and Incentives Database as of August 2021 were collected for every state and The District of Columbia.[19,20,21] The word presence indicates that this variable was set up as a binary variable to indicate whether or not a given policy type had been implemented in a given state.
- **Policy-type extent:** The extent of adoption for each policy type in a given state, measured by the number of different laws, policies, programs, regulations, or incentives implemented that fall within each given policy type
  - **Data collected:** All policies, programs, laws, regulations, and incentives related to non-single-family-residential EVSE deployment that were listed in the AFDC Federal and State Laws and Incentives Database were collected for every state and The District of Columbia. The word extent indicates that this variable was set up as a continuous variable to measure the number of policies of the same type that were adopted in a given state.

19 Policies including both single-family-residential EVSE scope and non-single-family residential EVSE scope were included in the analysis. Policies that either only focused on single-family residential EVSE or those not related to EVSE at all were excluded from the analysis.

20 The AFDC Laws and Incentives Database is a continually updated resource containing all known U.S. laws, policies, incentives, regulations, programs, other policy measures related to alternative fuels. State-level information is updated annually after each state's legislative session ends. Given this and the dynamic nature of legislation and policy, it is possible that some entries may not be reflected. Please refer to the 'About the Data' page on the AFDC website for more information: https://afdc.energy.gov/laws/data_methodology.html

21 Entries in the AFDC Database are correlated to specific pieces of legislation. Depending on how legislation is crafted, some entries may include a number of separate but related policies or programs. Similarly, in some cases, a single piece of legislation may be reflected in multiple different policy types within the database. This study did not parse-out these overlaps. Instead, policy entries were exported from the AFDC and analyzed as-is.

- **Per capita public funding:** The sum of state-level per capita public funding for EVSE from 2016 through 2020
    - **Data collected:** Data on public funding for EVSE (in U.S. dollars) in each state from 2016 through 2020 was collected from the Atlas Public Policy EV Hub's Requests & Public Funding Table on August 24, 2021.[22] EV Hub's Requests & Public Funding Table includes a data export function and filters EVSE funding information into four categories corresponding to charger technology: "Charging Station", "DC Fast Charging Station", "Inductive Charging Station", and "On-Route Charging". Data for all four categories was collected and combined to form this variable. Once all EVSE technology types and years were combined, the result from each state was divided by statewide population from the 2020 U.S. Census to estimate per capita public funding.
- **Demand charges:** the average of all flat demand charges for all commercial electric utility rates by ZIP code; average of rates across 2016 through 2020
    - **Data collected:** Demand charge data was collected on a ZIP code level from the NREL's Utility Rate Database. Data was included for only commercial rates, and only flat demand charges were included in the analysis. The NREL Utility Rate Database contained demand charge rates designed on a time-of-use (TOU) basis for both commercial and industrial rates. The industrial rates and the TOU rates were omitted from the analysis given that flat commercial rates are typically applied to public EV charging stations. All commercial utility rates within a given ZIP code and their corresponding demand charges were averaged together to form a single average rate for each ZIP code.

The following section describes how this data was used and analyzed.

QUANTITATIVE ANALYSIS METHODS

As described in the previous section, the team first calculated the number of charging stations deployed from 2016 through 2020 per capita and the number of EV sales per capita in the same time frame for each state. From there, the team calculated a weighted average of per capita EV charging station deployments and per capita EV sales with EVSE station deployments weighted at 75% and EV sales weighted at 25%. All 50 states and the District of Columbia were ranked based on this weighted average, referred to in this report as EVSE market development. Where appropriate, per capita EVSE station deployment without the incorporation of EV sales was used, such as when assessing the relationship between public funding and state-level EVSE deployment. A table showing both measures of EVSE market development and per capita EVSE deployment for each state is included in Appendix B.

The AFDC Laws and Incentives Database was the primary data source to collect policy, program, regulation, law, and incentive information for all 50 states and the District of Columbia. The AFDC's data download tool is set up such that the team could export all policies related to BEVs and PHEVs. However, the data download tool did not provide a filter for EVSE-related policies, yielding an export of policies related to both vehicles and charging infrastructure. Because this study is focused on examining effective policies for non-residential EVSE deployment, policies that only focused on single-family residential EVSE and those not related to EVSE deployment at all were excluded from the analysis.

The export of state-level policies from the AFDC database included a categorization scheme that was set within the database prior to exporting the data, on which every individual policy entry was based. These categories included the following (Table 1):

22 Atlas Public Policy. (n.d.). EV Hub. In EV Hub. Retrieved August 24, 2021, from https://www.atlasevhub.com/materials/state-policy-dashboard/.

TABLE 1: AFDC LAWS AND INCENTIVES DATABASE POLICY TYPE CATEGORIZATION SCHEME

MAJOR POLICY TYPE	POLICY TYPE	DESCRIPTION
	Grant	EVSE-related grants
	Tax incentive	EVSE-related tax incentives
Incentives (either "state incentive" or "utility or private incentive")	Loans and leases	EVSE-related direct loans, loan guarantees, and leases
	Rebate	EVSE-related rebates
	Exemption	EVSE-related exemptions from taxes or regulations
	Other	Miscellaneous EVSE-related policies, mostly utility or private incentives such as EV-specific rates, make-ready programs, utility-offered grants or rebates, technical assistance, etc.
	Acquisition/fuel use	EVSE-related acquisition or alternative fuel use requirements
	Driving/idling	EVSE-related regulations regarding vehicle operations, including signage authorization and parking regulations
	Registration/licensing	EVSE-related requirements for fuel use, fuel production, vehicle conversion, etc.
	Fuel taxes	EVSE-related fuel/electricity taxes
Laws and regulations	Air quality/emissions	EVSE-related emissions standards, goals and targets, and regulations
	Climate change/ energy initiatives	Programs aimed at reducing greenhouse gas (GHG) emissions, reducing petroleum use, and/or promoting energy independence
	Utility definition	EVSE-related definitions of a regulated public utility as it pertains to the resale of electricity
	Other	Miscellaneous EVSE-related laws and regulations such as regulations to promulgate rules, establish study groups or committees, etc.

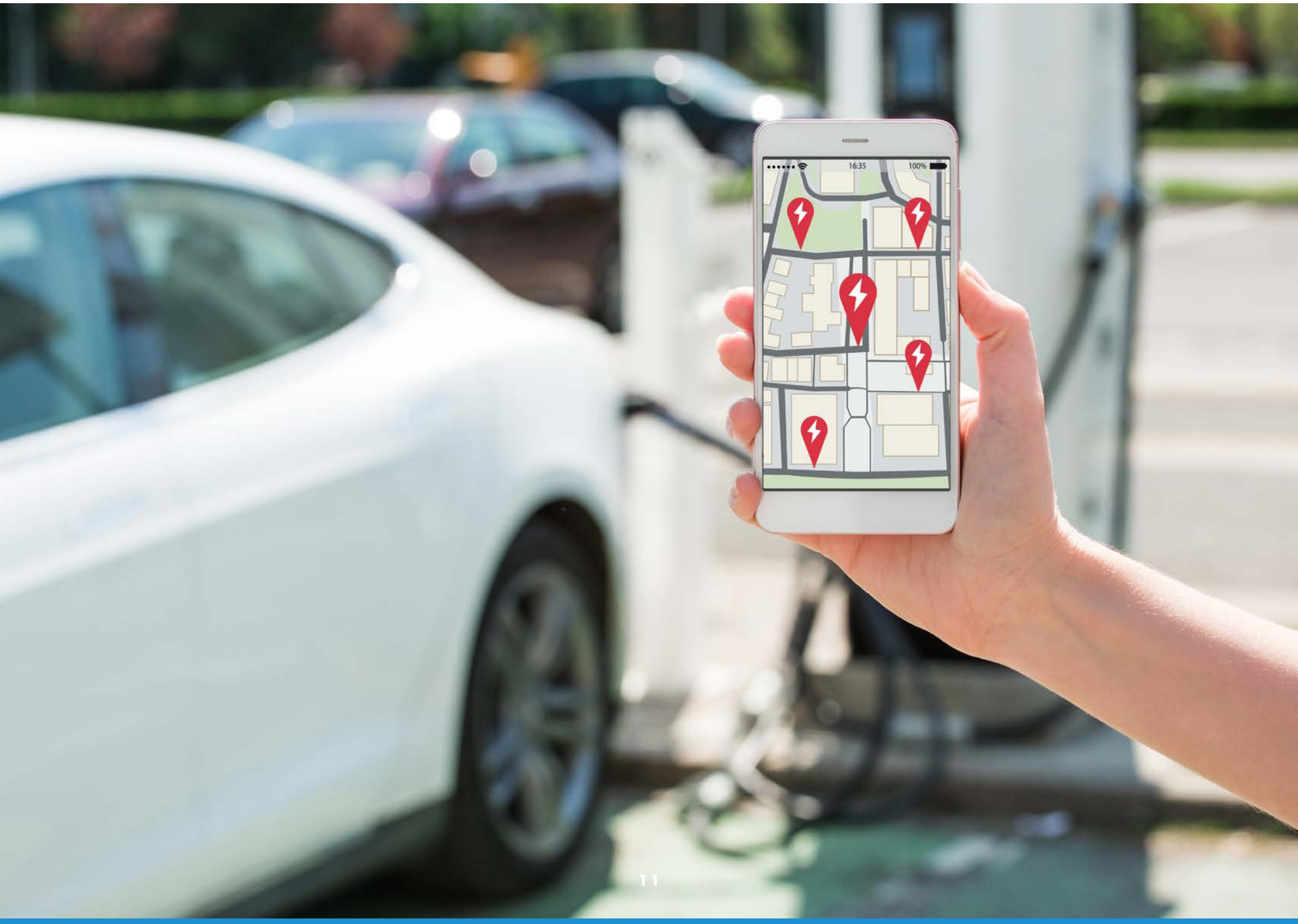
To analyze this data, the team first assessed summary statistics for all variables to understand average values, minimum and maximum values, and the distribution of data points for each variable. From there, the team conducted the following statistical tests to examine the relationship between independent variables and the dependent variable:

- Correlation tests to measure the strength of linear associations between variables,
- T-tests to assess the significance of differences between measures of average EVSE market development among states with and without given policy types, and
- Linear regressions to estimate the effect of independent variables on the dependent variable.

QUALITATIVE ANALYSIS METHODS

The qualitative component of the study consisted of semi-structured stakeholder interviews aiming to understand the effectiveness of existing federal, state, and local policies and programs for EVSE deployment and operation. Selected stakeholders included state government officials from a mix of the top- and bottom-ranked states in terms of the EVSE market development score, representatives from EV service providers (EVSPs), electric utilities, and other subject matter experts in the transportation electrification policy and regulatory space.

The research team identified interviewees by leveraging existing contacts as well as taking recommendations from other subject matter experts. The team held interviews with 24 individuals representing 20 unique entities; a list of interviewees is included in Appendix A. For consistency, all stakeholders were asked the same open-ended questions, which can also be found in Appendix A along with the complete set of answers received, reported without attribution. While every interviewee had unique contributions reflecting their roles and experience in EVSE deployment and operation, several common threads emerged from the conversations. Those common themes are summarized in the "Qualitative Interview Results" section.



QUANTITATIVE RESULTS

SUMMARY OF POLICY ADOPTION BY STATE

Table 2 shows a breakdown of the number of EVSE-related policies across all 50 states and the District of Columbia that were available in the AFDC Laws and Incentives Database as of August 2021.[23]

In addition to the summary above, a state-by-state breakdown of the number of policies by type is included in Appendix C.

ASSOCIATIONS BETWEEN THE PRESENCE OF POLICY TYPES AND EVSE MARKET DEVELOPMENT

INDIVIDUAL POLICY TYPES

To assess the relationship between the presence of any, or multiple, policy type(s) and EVSE market development, the study team used a t-test to compare the EVSE market development scores among states with certain policy types and those without. The t-test produces two key outputs: a p-value, which indicates the probability that observed differences could have occurred by chance, and a t-value, which is a ratio of the difference between the two groups and the variation within each group. Smaller p-values indicate greater statistical significance, which refers to the claim that an effect may be attributable to a particular variable of interest, in this case the given policy type.

TABLE 2: NUMBER OF EVSE-RELATED POLICY ENTRIES IN THE AFDC LAWS AND INCENTIVES DATABASE BY POLICY TYPE

TYPE	NUMBER OF RELEVANT POLICY ENTRIES IN THE AFDC
MAJOR POLICY TYPES	
Laws and regulations	244
State hybrid incentives[24]	3
State incentives	117
Utility or private incentives	130
INCENTIVE TYPES	
Grants	73
Tax incentives	18
Loans and leases	16
Rebates	118
Exemptions	5
Other	51
LAW AND REGULATION TYPES	
Acquisition/fuel use	33
Driving/idling	3
Registration/licensing	7
Fuel taxes	5
Air quality/emissions	48
Climate change/energy initiatives	35
Utility definition	25
Other	129

23 As described in footnote number 19, law and policy entries in the AFDC Database are correlated to specific pieces of legislation; depending on how legislation is crafted, some entries may include a group of separate but related policies or programs. In other cases, a single piece of legislation may be reflected in multiple entries under multiple different policy types. This creates some overlap between entries across multiple policy types. The research team did not parse-out these overlaps. Instead, entries were exported from the AFDC Database and analyzed as-is.

24 The three incentive policies categorized under the State Hybrid Incentives major policy type have either expired or have been repealed. Because there are zero active policies under this major policy type, it was omitted from the remainder of this report.

TABLE 3: T-TEST RESULTS: MAJOR POLICY TYPES

MAJOR POLICY TYPE				
VARIABLE	T-VALUE	GROUP WITH HIGHER EVSE MARKET DEVELOPMENT SCORE	P-VALUE	INTERPRETATION
Laws and regulations	+4.97	With policy	0.000009***	Difference between states is larger than difference among states. States with this policy type have higher EVSE market development scores.
State incentives	+3.09	With policy	0.003485**	Difference between states is larger than difference among states. States with this policy type have higher EVSE market development scores.
Utility/ private incentives	+2.75	With policy	0.008504**	Difference between states is larger than difference among states. States with this policy type have higher EVSE market development scores.

Simply put, results with smaller p-values are considered more reliable. Larger t-values indicate that a larger difference exists between groups. T-values are larger when the differences between groups are bigger than the differences among data within groups. Importantly, higher t-values for one policy do not necessarily mean higher EVSE market development scores among states with that policy when compared to other policies. Instead, the t-value only measures the difference between states with and without the policy type being analyzed. Results for each policy type are not meant to be compared with each other.

The results show that states with any of the following major policy types have higher market development scores compared to states without them: laws and regulations, state incentives, and utility or private incentives. Table 3 shows t-test results for the major policy types.

The t-value for laws and regulations is highest, followed by state incentives, and then utility or private incentives. Importantly, these results do not automatically mean that the adoption of policies categorized as laws and regulations will increase EVSE market development scores more than the adoption of the other major policy types; a confluence of several variables are likely to influence EVSE market development. Instead, these results provide an indication as to which major policy types are influencing EVSE market development, what the direction of those effects are, and which policy types deserve deeper analysis.

As will be described further below, two of the law and regulation types that are showing statistical significance are climate change/energy initiatives and air quality/emissions.[25] The policies and programs tagged under these categories include multi-state regional collaboratives, workgroups, agency coordination efforts, master planning efforts, and initiatives aimed at reducing emissions and improving air quality. These initiatives and programs often include a suite of policy approaches and actions that may enable EVSE deployments, including but not limited to incentives like grants and rebates, funding coordination, and

25 Statistical significance indicates that a result is not likely to have occurred randomly or by chance but rather is likely attributable to a specific cause. Importantly, statistical significance is not to be confused with the word *significance* as it is used in common language, often used to express that something is big or important. Statistical significance does not indicate the size or importance of a result, only its probability of occurring due to a specific cause.

the streamlining of permitting processes. Therefore, it is not likely that states can guarantee increased EVSE deployment by simply passing regulations; rather, these types of initiatives are likely driving EVSE deployments by encompassing other enabling policy approaches.

Of the incentive types, grants and rebates have the highest level of statistical significance and the highest t-values, and therefore, more significant market development score differences between states. Loans and leases, tax incentives, and incentives tagged in the "other" category are also found to have statistical significance but at a lower level than grants and rebates. (Table 4)

Many of the incentives categorized as "other" fall under the utility or private incentives major policy type, including rates designed for EV charging, utility EVSE incentive programs, and technical support programs.

The boxplots in Figure 1 and Figure 2 show the differences in EVSE market development scores between states with and without each incentive type. The gray box indicates the interquartile range of individual market development scores (25th percentile to 75th percentile); the black line indicates the median value for each group; the T-shaped lines extruding from the gray box are the minimum and maximum EVSE market development scores for each group; and the open circles indicate outliers. Original EVSE market development scores were multiplied by a factor of 1,000 to improve the readability of figures and tables; original EVSE market development scores are in thousandths and ten-thousandths.

TABLE 4: T-TEST RESULTS: INCENTIVE TYPES

INCENTIVE TYPE				
VARIABLE	T-VALUE	GROUP WITH HIGHER EVSE MARKET DEVELOPMENT SCORE	P-VALUE	INTERPRETATION
Grants	+2.96	With policy	0.004726**	Difference between states is larger than difference among states. States with this policy type have higher EVSE market development scores.
Rebates	+2.76	With policy	0.008085**	Difference between states is larger than difference among states. States with this policy type have higher EVSE market development scores.
Loans and leases	+2.61	With policy	0.021233*	Difference between states is larger than difference among states. States with this policy type have higher EVSE market development scores.
Other	+2.11	With policy	0.043174*	Difference between states is larger than difference among states. States with this policy type have higher EVSE market development scores.
Tax incentives	+2.09	With policy	0.047858*	Difference between states is larger than difference among states. States with this policy type have higher EVSE scores.
Exemptions	+1.46	With policy	0.224763	Difference between states with and without policy is not significant.

FIGURE 1: BOXPLOTS OF EVSE MARKET DEVELOPMENT SCORES FOR STATES WITH AND WITHOUT GIVEN INCENTIVE TYPES

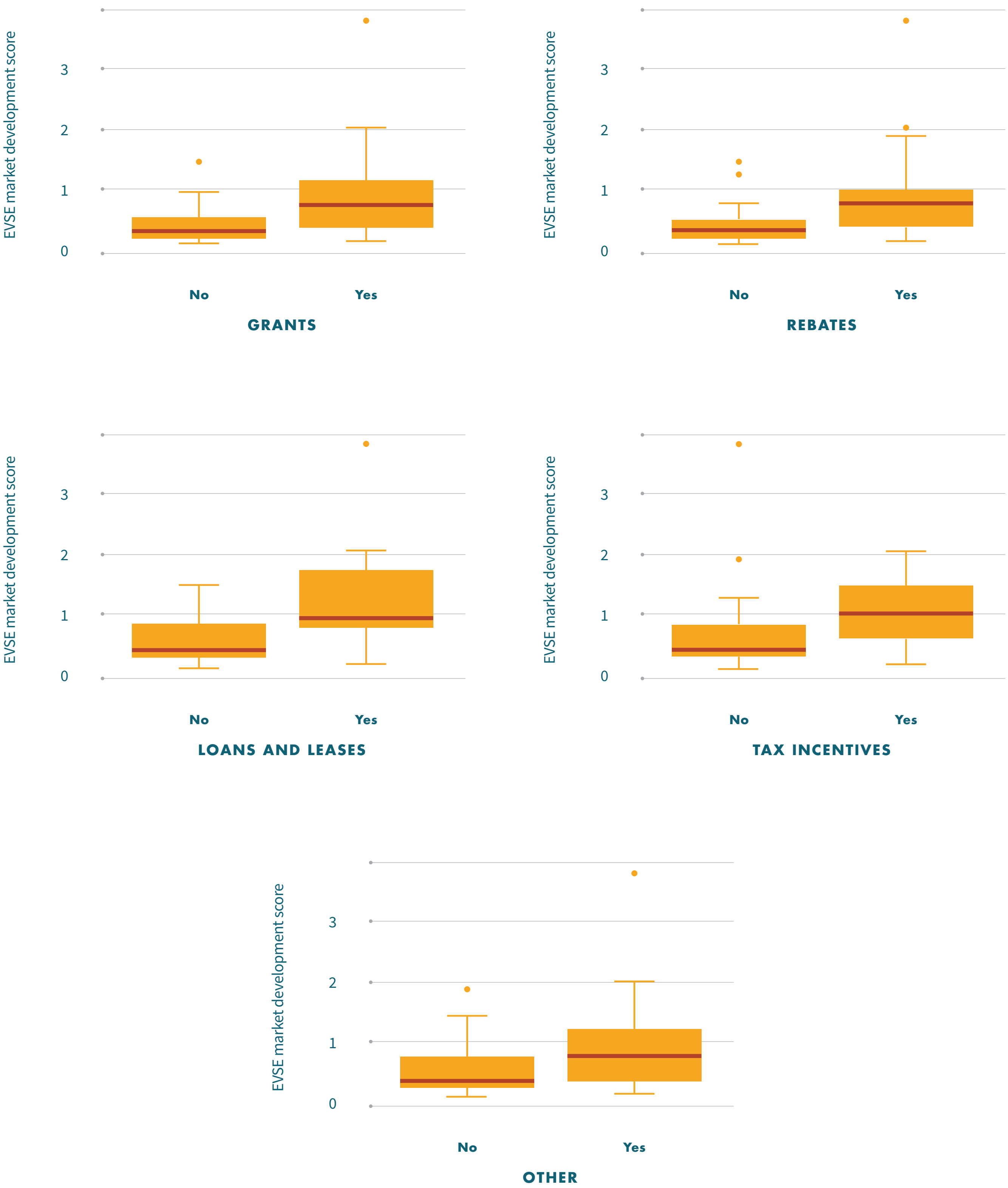


TABLE 5: T-TEST RESULTS: LAW AND REGULATION TYPES

LAW AND REGULATION TYPE				
VARIABLE	T-VALUE	GROUP WITH HIGHER EVSE MARKET DEVELOPMENT SCORE	P-VALUE	INTERPRETATION
Other	+5.31	With policy	0.000004***	Difference between states is larger than difference among states. States with this policy type have higher EVSE market development scores.
Air quality emissions	+4.78	With policy	0.000116***	Difference between states is larger than difference among states. States with this policy type have higher EVSE market development scores.
Fuel taxes	-0.26	Without policy	0.8053	Difference between states with and without policy is not significant.
Climate change/ energy initiatives	+4.62	With policy	0.000160***	Difference between states is larger than difference among states. States with this policy type have higher EVSE market development scores.
Utility definition	+2.76	With policy	0.009785**	Difference between states is larger than difference among states. States with this policy type have higher EVSE market development scores.
Acquisition/ fuel use	+2.61	With policy	0.016363*	Difference between states is larger than difference among states. States with this policy type have higher EVSE market development scores.
Registration/ licensing	+0.98	With policy	0.364775	Difference between states with and without policy is not significant.

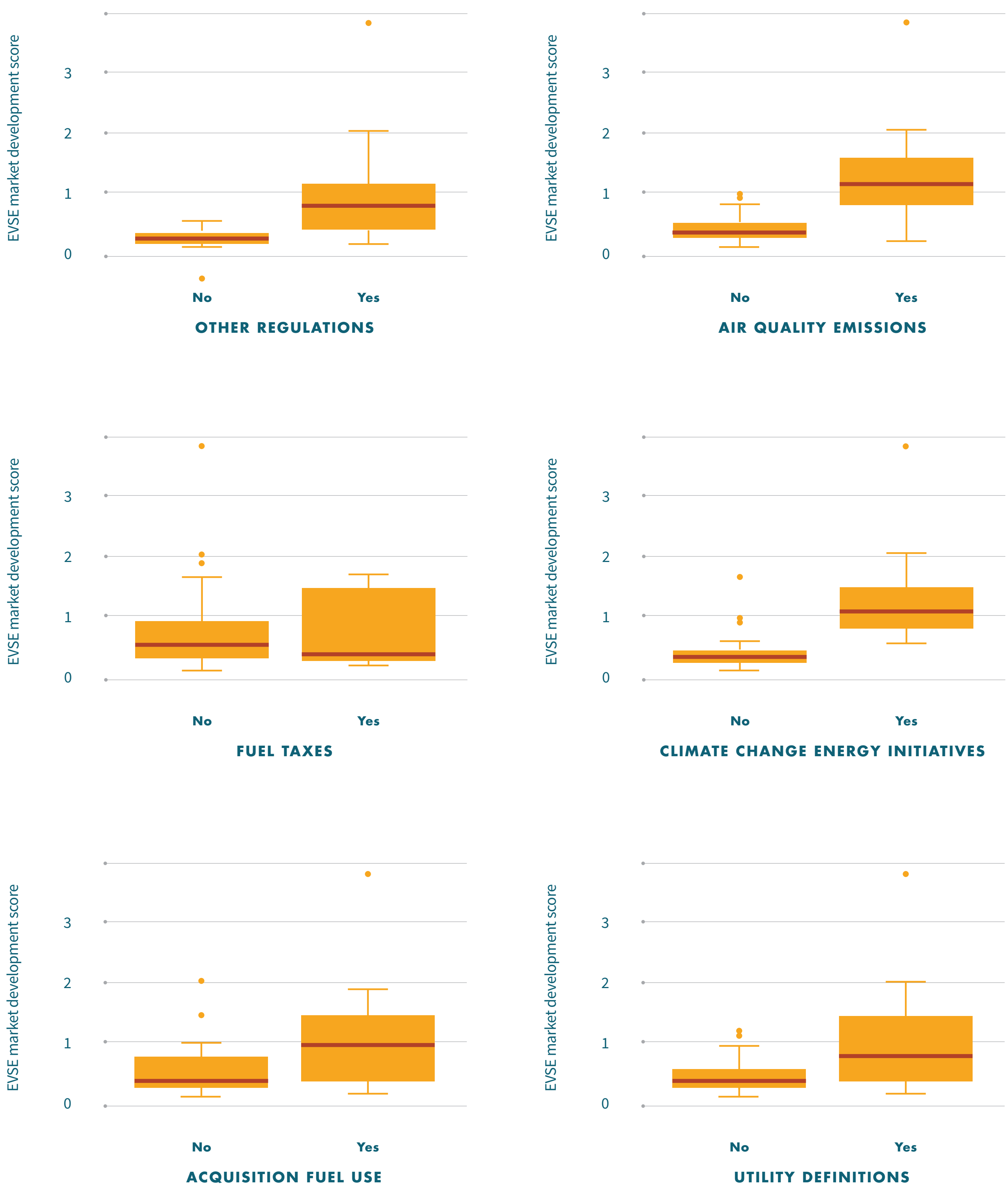
Of the law and regulation types, three types are found to have the highest levels of statistical significance ($p<0.001$) and the highest t-values: policies categorized as "other," air quality/emissions, and climate change/energy initiatives. Policies tagged under the utility definition and acquisition/ fuel use categories are also found to have statistical significance but at a lower level ($p<0.05$). (Table 5)

As with the plots shown above for the incentive types, the boxplots in Figure 2 show the range of EVSE market development scores among states with and without each law and regulation type. Results indicate that states with each given policy type have a higher market development score than those without that policy type, except fuel taxes. Only five states have implemented EVSE-related policies that fall in this category: Alabama, Colorado, Iowa, Oklahoma, and Washington.[26] Alabama has implemented a fee that EV owners must pay annually, of which a portion of funds are distributed to the Electric Transportation Infrastructure Grant Program, which provides grants for EVSE.[27]

26 Several states have implemented fuel taxes or fees for EVs and electricity consumed to charge the EVs. Given this study's focus on EVSE, only state policies in which some portion of tax or fee revenue is directed to EV charging infrastructure development were included in the analysis. State EV fuel taxes and fees that do not direct revenue to charging infrastructure were omitted from the analysis.

27 Alternative Fuels Data Center, "Plug-In Electric Vehicle (PEV) Fee" (Alabama), U.S. Department of Energy Vehicle Technologies Office, accessed August 2021, https://afdc.energy.gov/laws/12205.

FIGURE 2: BOXPLOTS OF EVSE MARKET DEVELOPMENT SCORES FOR STATES WITH AND WITHOUT GIVEN LAW AND REGULATION TYPES



Colorado has implemented an annual $50 fee that EV owners must pay, of which $20 is dedicated to the Electric Vehicle Grant fund to support charging stations.[28] Iowa has implemented an excise tax of $0.026 per kWh delivered into the battery of EVs at any location other than a residence.[29] Oklahoma has implemented an EVSE charging tax of $0.03 per kWh delivered into EVs by public EVSE, which will go into effect in 2024. The revenue from this Oklahoma tax is to be apportioned to the Driving on Road Infrastructure with Vehicles of Electricity (DRIVE) Revolving Fund.[30] Finally, Washington has implemented an annual fee of $150 for all-electric vehicle owners and $75 for plug-in hybrid and fully hybrid electric vehicle owners, of which a portion of funding is used to support charging stations.[31]

Figure 3 is a scatterplot that compares the average EVSE market development score for each state with and without each individual policy type, along with the distribution of individual EVSE market development scores for states that do have each given policy type. The points represent the market development scores for each state that does have the policy type; for example, the points lined up over policy type ID number 1 on the X-axis represent the market development scores for every state that has that policy, and so on. The black and red horizontal lines represent average market development scores for states with and without the policy, respectively. Finally, the vertical error bars indicate the standard deviation in EVSE market development scores among states that have adopted the policy type.

Table 6 provides a legend that matches the policy type IDs in Figure 3.

Per Figure 3 the policy type with the highest average EVSE market development score among states is driving/idling, which also has the largest difference in average market development scores among states with and without the policy; however, the data shows only two states with EVSE-related policies like these adopted (California and Rhode Island) and therefore it should be disregarded. The next two policy types with the highest EVSE market development scores, as well as the next highest difference between states with and without the policies, are climate change/energy initiatives and air quality/emissions. These two policies are also fairly low in standard deviation, ranking sixth and fifth among all policy types, respectively. States with loans and leases are also among the highest in the average market development score rankings, however this policy type has the highest standard deviation among all types. As described previously, states with policies categorized as fuel taxes, which are also directly related to EV charging infrastructure development[21], rank the lowest in average market development scores, but there are only five states with such EVSE-related policies (Alabama, Colorado, Iowa, Oklahoma, and Washington).

28 Hartman, K., Shields, L., "Special Fees on Plug-In Hybrid and Electric Vehicles", National Conference of State Legislatures, accessed November 02, https://www.ncsl.org/research/energy/new-fees-on-hybrid-and-electric-vehicles.aspx

29 Alternative Fuels Data Center, "Alternative Fuel Tax" (Iowa), U.S. Department of Energy Vehicle Technologies Office, accessed August 2021, https://afdc.energy.gov/laws/11480.

30 Alternative Fuels Data Center, "Electric Vehicle Supply Equipment (EVSE) Charging Tax," U.S. Department of Energy Vehicle Technologies Office, accessed August 2021, https://afdc.energy.gov/laws/12649.

31 Hartman, K., Shields, L., "Special Fees on Plug-In Hybrid and Electric Vehicles", National Conference of State Legislatures, accessed November 02, https://www.ncsl.org/research/energy/new-fees-on-hybrid-and-electric-vehicles.aspx

FIGURE 3: EVSE MARKET DEVELOPMENT SCORES BY INDIVIDUAL POLICY TYPE

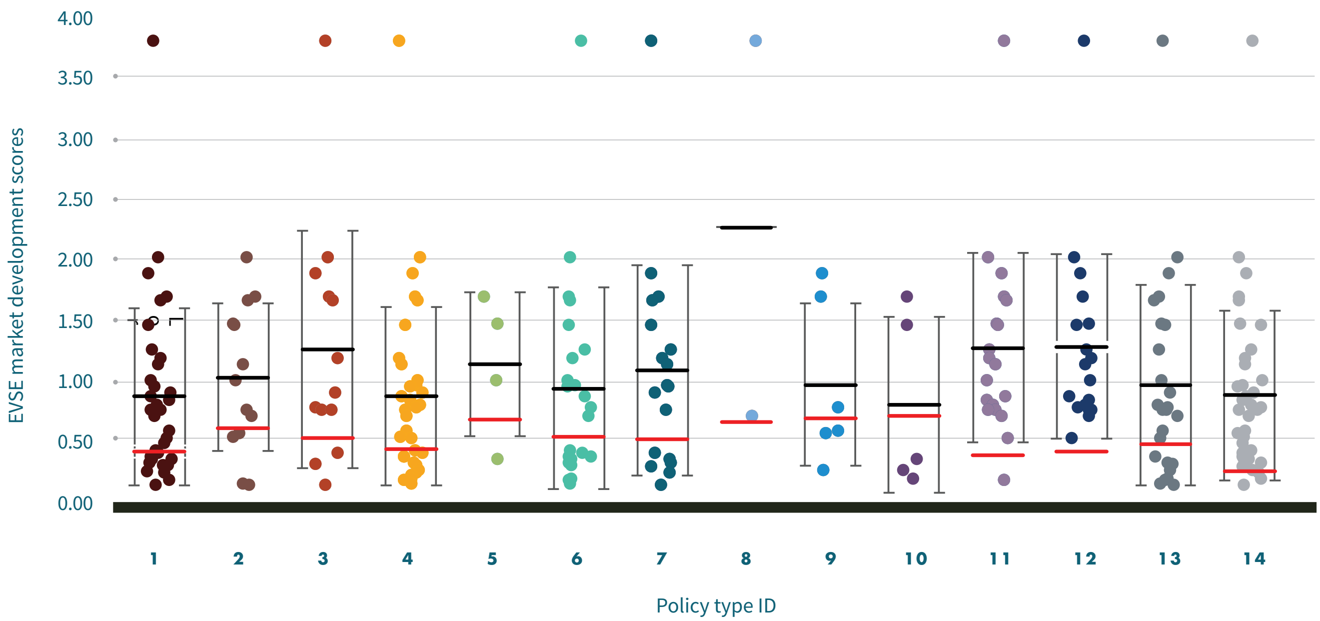


TABLE 6: LEGEND TO MATCH INDIVIDUAL POLICY TYPES WITH POLICY TYPE IDS

POLICY TYPE ID	POLICY TYPE	INCENTIVE OR LAW AND REGULATION
1	Grants	Incentive
2	Tax incentives	Incentive
3	Loans and leases	Incentive
4	Rebates	Incentive
5	Exemptions	Incentive
6	Other incentives	Incentive
7	Acquisition/fuel use	Law and regulation
8	Driving/idling	Law and regulation
9	Registration/licensing	Law and regulation
10	Fuel taxes	Law and regulation
11	Air quality/emissions	Law and regulation
12	Climate change/energy initiatives	Law and regulation
13	Utility definition	Law and regulation
14	Other laws and regulations	Law and regulation

COMBINATIONS OF POLICY TYPES

Notably, states with higher market development scores have implemented more policies across a wider range of policy types. As Figure 4 shows, states with higher market development score rankings have implemented a broader combination of incentives and regulations than lower-ranked states.

Figure 5 summarizes this information further, showing the average EVSE market development score among states that have implemented a certain number of unique policy types.

FIGURE 4: PERCENTAGE OF STATES WITH GIVEN POLICY TYPES

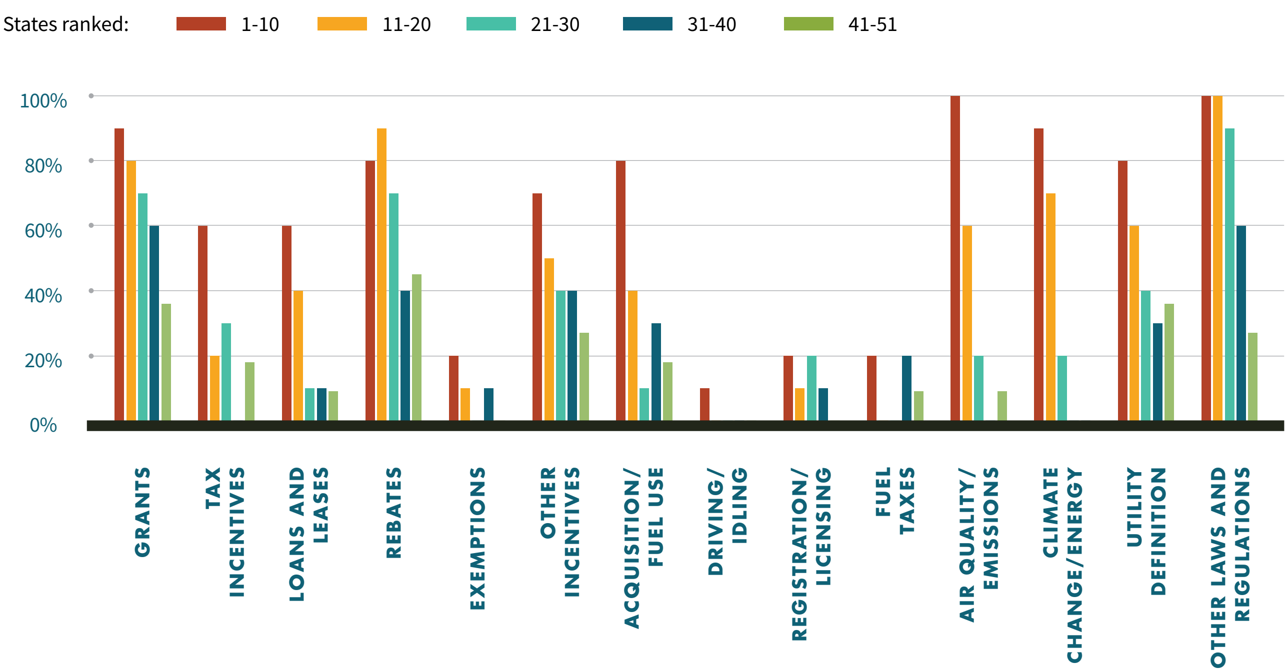
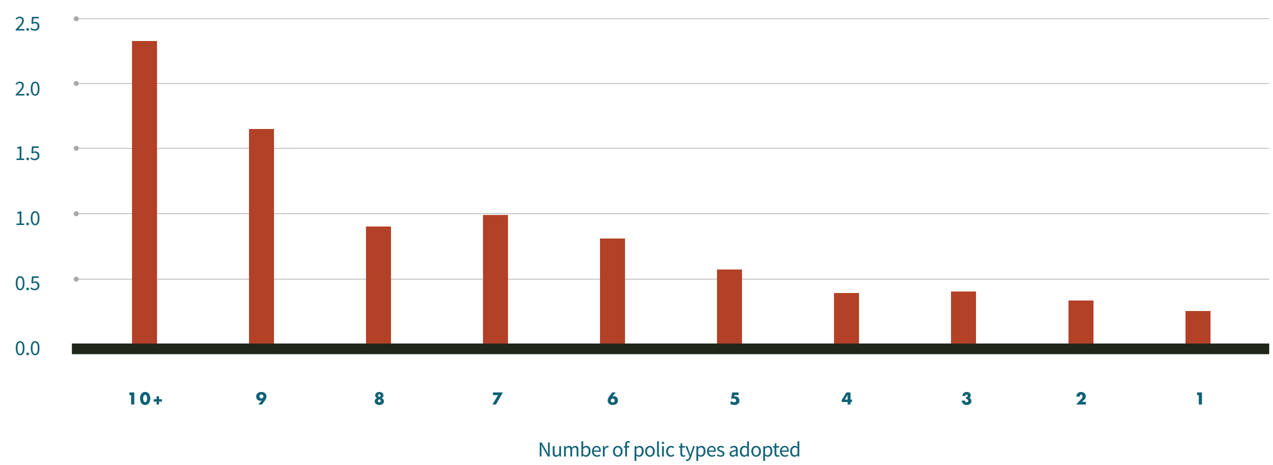


FIGURE 5: AVERAGE EVSE MARKET DEVELOPMENT SCORE BY BREADTH OF POLICY ADOPTION



Given this trend, the study team sought to evaluate the distribution of EVSE market development scores among states with and without certain policy type combinations, as shown in Figure 6 and Table 7. Policy-type combinations were chosen based on their frequency of use among higher-ranked states as well as feedback from the government officials and other stakeholders ICF interviewed (see more in the section on "Qualitative Interview Results"). While Figure 3 in the previous section shows the average EVSE market

FIGURE 6: STATE EVSE MARKET DEVELOPMENT SCORES BY POLICY TYPE COMBINATION SCENARIO

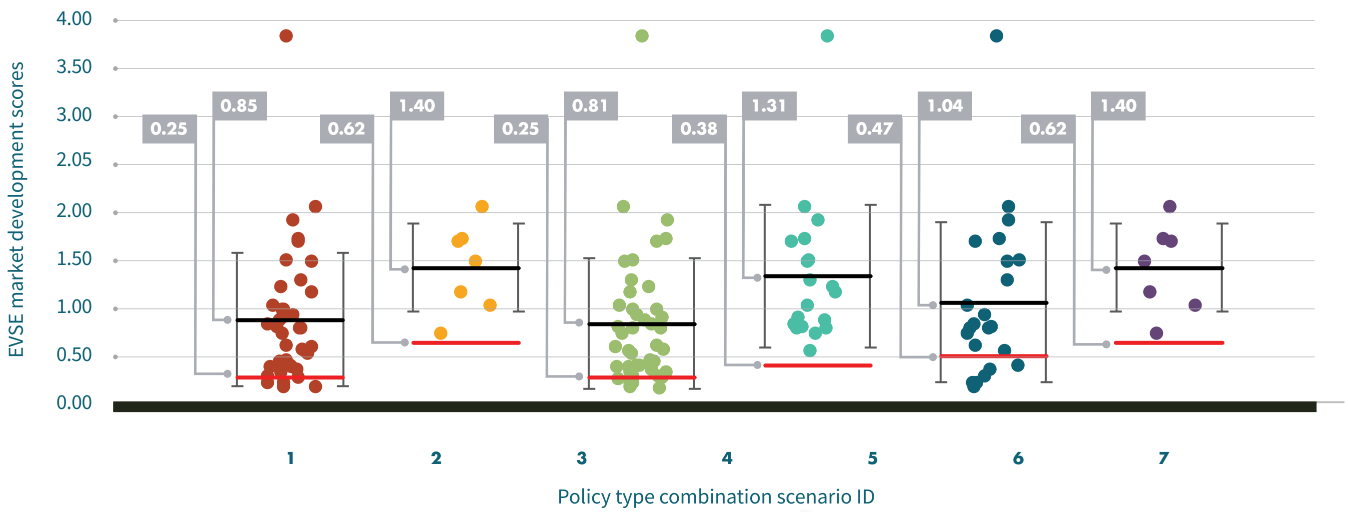


TABLE 7: DESCRIPTIONS OF POLICY TYPE COMBINATION SCENARIOS

POLICY TYPE COMBINATION SCENARIO ID	DESCRIPTION	RANK IN AVERAGE EVSE MARKET DEVELOPMENT SCORES (states with combination)	RANK IN DIFFERENCE BETWEEN STATES WITH AND WITHOUT COMBINATION	RANK IN STANDARD DEVIATION (states with policy)
1	Per the t-tests, one or more of the statistically significant incentive types and one or more of the statistically significant law and regulation types	Fifth	Fourth (0.60, 3.39x different)	Third
2	Grants and rebates and tax incentives	Tied: first	Tied: second (0.78, 2.26x different)	Tied: fifth
3	Grants or rebates or tax incentives	Sixth	Fifth (0.57, 3.32x different)	Fourth
4	1) Grants or rebates or tax incentives and 2) Air quality/emissions or climate change/ energy initiatives	Third	First (0.93, 3.45x different)	Second
5	1) Grants or rebates or tax incentives and 2) Utility definition	Fourth	Sixth (0.57, 2.21x different)	First
6	1) Grants and rebates and tax incentives and 2) Air quality/emissions or climate change/energy initiatives	Tied: first	Tied: second (0.78, 2.26x different)	Tied: fifth

development scores among states with and without each individual policy type, Figure 6 shows the scores among states with and without certain combinations. Table 7 provides a description of each combination as well as their resulting average market development scores, differences between state groups, and standard deviation values.

Combination scenarios 2 and 6 are tied for first in terms of the average EVSE market development scores among states that have this combination of policies. Importantly, these two combinations also share the same rankings for the difference between states and standard deviation among states with the combination of policies implemented. This is because the same states are represented in both groups: Colorado, Connecticut, Hawaii, Maryland, Oregon, Rhode Island, and Washington. While combination scenario 2 requires states to have each of three incentive types (grants, rebates, and tax incentives), combination scenario 6 requires the same and also that one of two law and regulation types is represented (air quality/emissions or climate change/energy initiatives). Therefore, all of the states that have grants, rebates, and tax incentives also have at least one of these law and regulation types. The next highest ranked combination scenario in terms of both average market development scores for states with the combination, and the difference between states with and without the combination, is number 4. Rather than requiring all three of these incentive types to be represented, it only requires that at least one of them be represented, along with one of the same two law and regulation types (air quality/emissions or climate change/ energy initiatives).

Given that the states in combination scenarios 2 and 6 are the same, and given the similarity in requirements for combination scenario 4, these results indicate a strong association between the presence of either air quality/emissions or climate change/energy initiatives policies and higher measures of market development. These results are consistent with Figure 3. As stated previously in the section on "Individual Policy Types," the policies and programs tagged under these categories include multi-state regional collaboratives, workgroups, agency coordination efforts, master planning efforts, and initiatives aimed at reducing emissions and improving air quality. These initiatives and programs often include a suite of policy approaches and actions that may enable EVSE deployments, including developing incentives like grants and rebates, funding coordination, and streamlining permitting processes.

One example of these programs is the Regional Transportation and Climate Initiative (TCI),[32] a regional collaborative of 13 Northeast and Mid-Atlantic states and the District of Columbia, that seeks to reduce carbon emissions from the transportation sector. The TCI launched the Northeast Electric Vehicle Network to coordinate the development of a regional EV charging network through multiple approaches, including the development of public-private partnerships, streamlining permitting processes, and coordinating planning efforts. Other similar multi-state collaboratives have been set up as well, such as the multi-state ZEV Task Force comprised of California, Connecticut, Maryland, Massachusetts, New York, Oregon, Rhode Island, and Vermont to support the deployment of zero-emission vehicles (ZEVs) and related infrastructure,[33] and the Memorandum of Understanding signed by a total of 15 states and the District of Columbia to support deployment of medium- and heavy-duty ZEVs.[34]

Per Figure 4, 100% of states ranked first through 10th in measures of EVSE market development have adopted at least one policy categorized as air

32 The Transportation and Climate Initiative homepage is available at https://www.transportationandclimate.org/.

33 Multi-State ZEV Action Plan: 2018-2021 -- Accelerating the Adoption of Zero Emission Vehicles, https://www.nescaum.org/documents/2018-zev-action-plan.pdf

34 ulti-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding, retrieved from the website for the State of New Jersey, https://www.state.nj.us/dep/aqes/docs/mhdv-zev-mou-20200714.pdf.

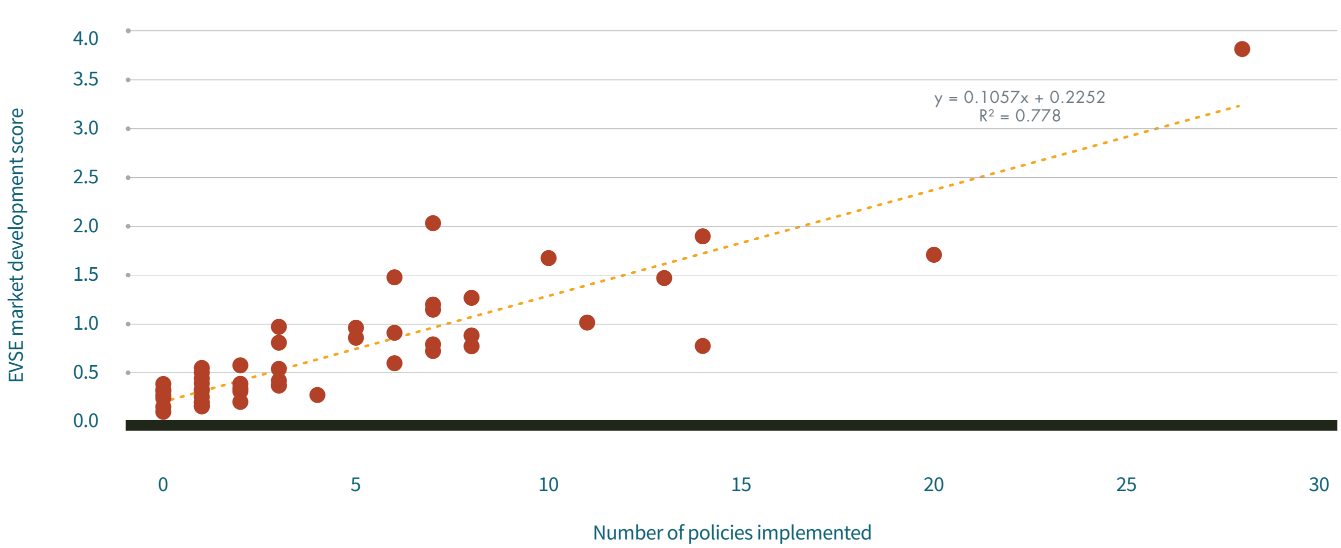
quality/emissions, and 90% of those states have adopted at least one policy categorized as climate change/energy initiative. Sixty and 70% of states ranked 11th through 20th have done the same, respectively, while the percentage of lower-ranked states which have adopted these policies is much lower at only 20%. Thus, it appears that such policies and programs may serve as effective frameworks for more specific policy actions that enable EVSE station deployment through funding, removal of barriers, agency coordination, and by sending clear market signals which indicate that EV adoption and EVSE deployment are among state priorities.

ASSOCIATIONS BETWEEN THE EXTENT OF POLICY ADOPTION AND EVSE MARKET DEVELOPMENT

In addition to examining associations between the presence of certain policy types and EVSE market development, the study team also sought to examine associations between the number of policies adopted by type and market development. Importantly, the t-tests shown in the "Associations Between the Presence of Policy Types and EVSE Market Development" section measured the difference between states that had adopted at least one of a given policy type and those that had not adopted any of a given policy type (a binary value, 0 or 1). Instead of examining the impact of whether or not a state has adopted at least one policy of each given type, the plots in this section show the relationship between the EVSE market development score for each state and the number of policies in a given type which have been adopted.

Figures 7–9 show this information for the major policy type categories in a scatterplot format, while Figures 10 and 11 show the correlation coefficients for each individual incentive or law and regulation type. Correlation coefficients are used to indicate the strength and direction of linear relationships between the variables. The closer the correlation coefficient is to +1 or −1, the stronger the association between the two variables; a positive (+) coefficient indicates a positive relationship between the variables (that is, as X increases, so does Y) and a negative (−) coefficient indicates a negative relationship between the variables (that is, as X increases, Y decreases).

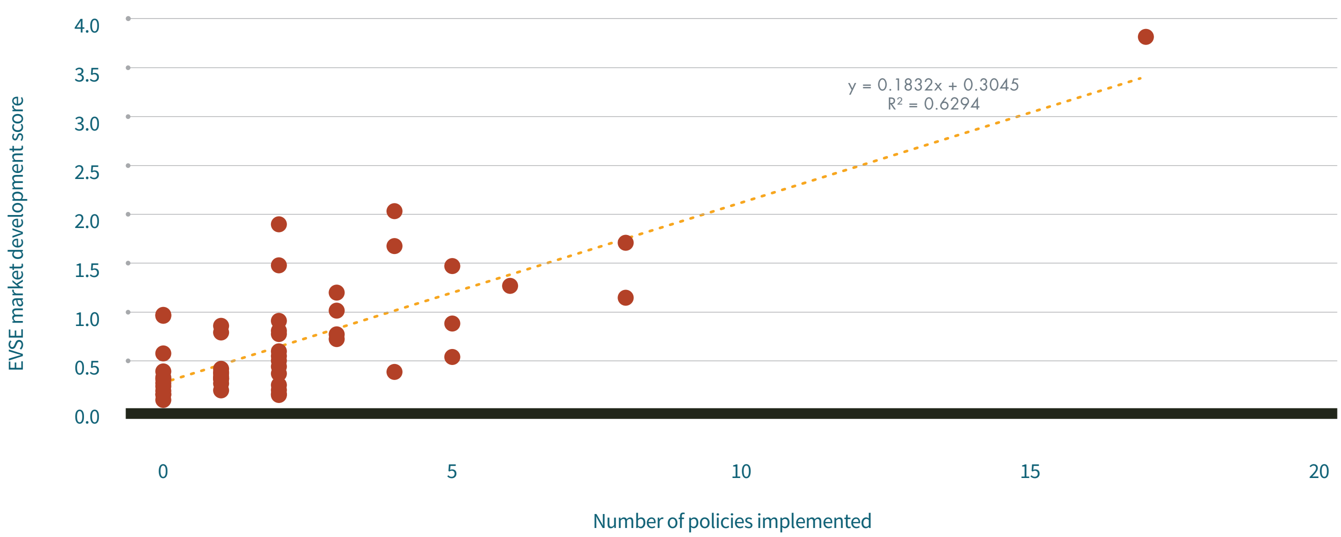
FIGURE 7: REGRESSION PLOT: MAJOR POLICY TYPE—LAWS AND REGULATIONS



Correlation coefficient for EVSE market development and laws and regulations: +0.88

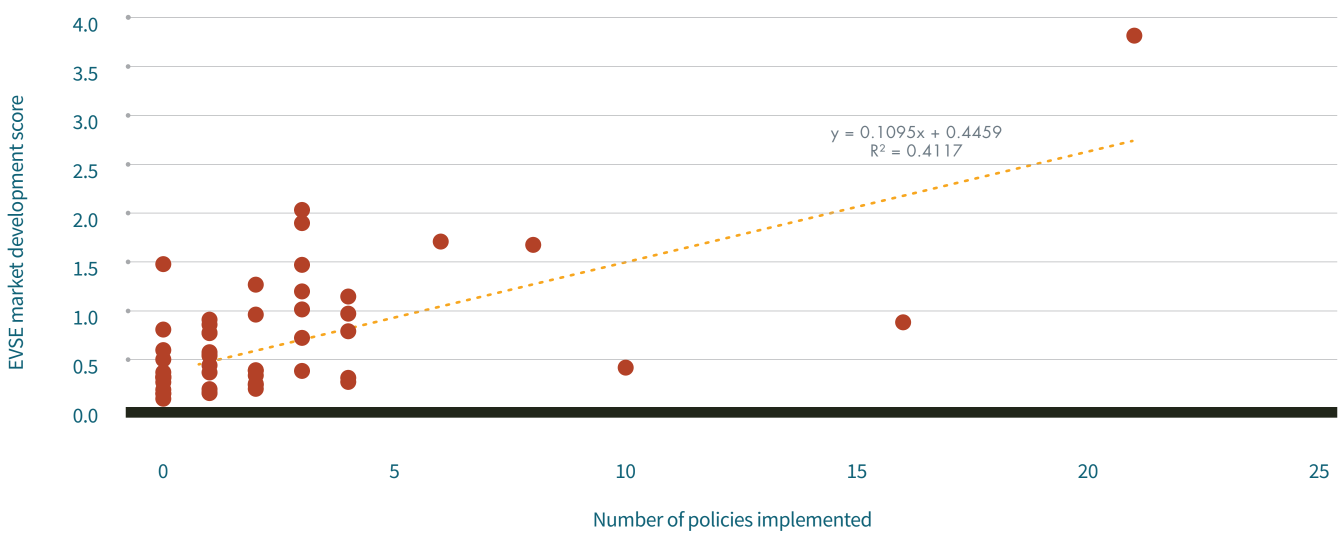
In general, the figures below indicate that states with more adopted policies have higher market development scores, however, the data does not show as strong of an association as the analysis in previous sections. Figures 7-9 show a stronger correlation for laws and regulations and weaker correlations for incentives.

FIGURE 8: REGRESSION PLOT: MAJOR POLICY TYPE—STATE INCENTIVES



Correlation coefficient for EVSE market development and state incentives: +0.79

FIGURE 9: REGRESSION PLOT: MAJOR POLICY TYPE—UTILITY OR PRIVATE INCENTIVES



Correlation coefficient for EVSE market development and utility or private incentives: +0.64

Figures 10-11 show which types of policies have stronger correlations with EVSE market development. Also, it is important to not conflate correlation with causation. These results do not mean that simply implementing a higher quantity of policies will cause a state to increase its market development score. The types of policies adopted, how those policies are designed, and how effectively the policies are administered all likely play a role as well. That said, it is the case that states with higher market development scores have generally adopted more policies across a wider range of policy types, as shown previously in Figures 4 and 5.

FIGURE 10: CORRELATION COEFFICIENTS FOR POLICY TYPE EXTENT VERSUS EVSE MARKET DEVELOPMENT (INCENTIVE TYPES)

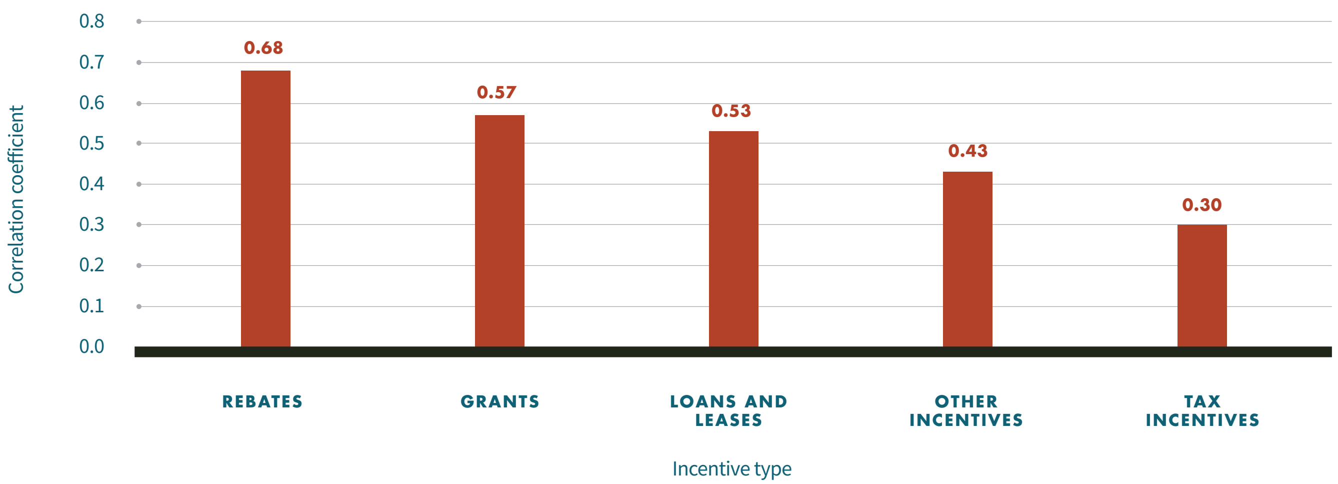
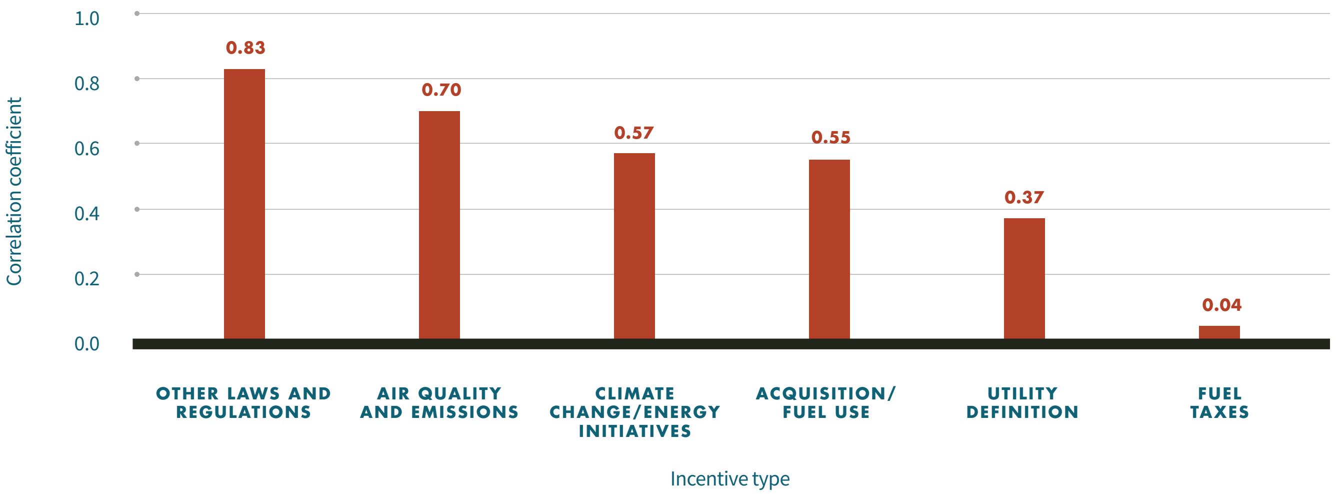


FIGURE 11: CORRELATION COEFFICIENTS FOR POLICY TYPE EXTENT VERSUS EVSE MARKET DEVELOPMENT (LAW AND REGULATION TYPES)



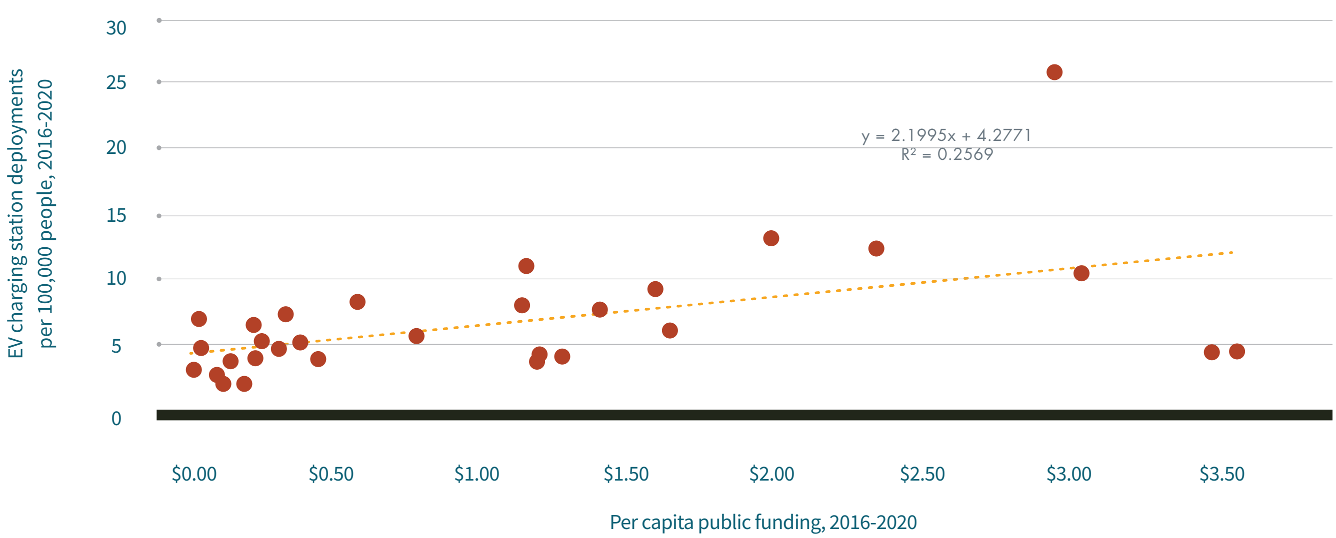
ASSOCIATIONS BETWEEN PUBLIC FUNDING AND EV CHARGING STATION DEPLOYMENT

Funding from both public and private sources is often cited as one of the most important drivers for EVSE deployment. According to Atlas Public Policy's EV Hub, as of August 2021, 31 states announced the investment of public dollars for the deployment of EV charging infrastructure from 2016 through 2020, and 30 of those states had spent some or all of the funding announced.[35] To assess the association that public funding investments may have had on EVSE station deployment during the study's time frame (2016–2020), the study team plotted total public funding per capita against the number of EVSE station deployments per 100,000 people per state on the same timeline. As stated previously, this differs from the dependent variable used in the analysis shown in earlier sections. While previous sections focused on the association of policies with the EVSE market development score, a weighted average of per capita EV charging station deployment and EV sales, this analysis focuses only on charging station deployments without the EV sales component.

Importantly, the data below represents only public funding investments that have already been spent. Atlas Public Policy reports data with one of four categories, and only data categorized as either "Funding Awarded" or "Funding Ended" was included in the following analysis: (Figure 12)

- **Funding Available:** Funding that is tied to an active solicitation and has been announced through the issuance or intention to issue a solicitation for applications but not yet awarded.
- **Funding Awarded:** Funding that has been dedicated to a specific project or recipient.
- **Funding Ended:** Funding related to a program that is no longer active.
- **Funding Pending:** Funding that is no longer available but has not had specific projects or recipients announced.

FIGURE 12: CHARGING STATION DEPLOYMENTS PER 100,000 PEOPLE VS. PER CAPITA PUBLIC FUNDING, 2016-2020 (ONLY FUNDING AWARDED AND FUNDING ENDED)



35 Atlas Public Policy. "State Policy Dashboard." EV Hub. Accessed August, 2021. https://www.atlasevhub.com/materials/state-policy-dashboard/

Most states invested less than $1.50 per capita on charging infrastructure deployment during this timeline, whereas a handful of states invested more than $1.50, up to roughly $3.50. Charging station deployments per 100,000 people for all states having invested public dollars falls between 0 and 10 for most states, but Vermont is an outlier with a much higher rate of charger deployment at roughly 26 per 100,000 people. The R2 for this linear regression is 0.2569, which indicates that about one-quarter of the observed variation in state-level charging station deployments may be explained by levels of public funding. To reiterate, this analysis currently only considers one variable (public funding), and the R2 value may change with the introduction of additional variables in a multivariate analysis. The trendline above suggests that an investment of $1.00 per capita into EV charging infrastructure may yield an estimated 6.48 charging station deployments per 100,000 people.

ASSOCIATIONS BETWEEN DEMAND CHARGES AND EVSE MARKET DEVELOPMENT

BASE ANALYSIS

As is described further in the section on "Qualitative Interview Results," key stakeholders that the research team interviewed expressed concern that utility demand charges may be a barrier to EVSE deployment. Electric utilities have historically used demand charges to help offset the cost of delivering a consistent level of electricity to commercial or industrial customers and to incentivize customers to reduce their peak energy usage. Demand charges are often designed as a flat monthly $/kW rate determined by the highest 15-minute power demand recorded on a customer's meter each month. While this may be an incentive for traditional commercial and industrial customers to reduce peak power demand, interviewees expressed that this structure can be cost prohibitive for EVSE.

To investigate the potential effects of demand charges on charging station deployment, the research team conducted an analysis comparing average demand charges by ZIP code with the number of DCFC stations deployed from 2016 through 2020. Importantly, the measure of DCFC deployed within this analysis refers to the number of charging stations with DCFC, as opposed to a single DCFC itself. For more context, the characterization is as follows: EV charging stations are locations that include one or more EVSE (for example, Level 2 EVSE or DCFC), and EVSE may include one or more charging ports. Demand charge data was collected on a ZIP code level from the NREL's Utility Rate Database. The research team filtered the data to only include demand charges for commercial rates and to only include flat demand charges ($/kW), as opposed to TOU demand charges that were used in a smaller subset of utility rates.

Averages were calculated by ZIP code such that all commercial utility rates within a given ZIP code, and their corresponding demand charges, were averaged together to form the ZIP-code-level average.

The research team collected data on the number of DCFC stations deployed from 2016 through 2020 from the AFDC's Alternative Fueling Station Locator.

This data included only stations containing publicly available DCFC; private chargers were not included, and stations with Level 2 chargers but no DCFC were also not included in the analysis given their relatively low power capacities compared to DCFC.

Also, the team did not disaggregate small and large commercial rates in its analysis. Table 8 shows summary statistics for all utility rates in the NREL database with non-zero demand charges for which data was available,[36] with small commercial and large commercial rates disaggregated.

As will be described further below, the researchers plotted the number of DCFC station deployments against demand charge rates and ran a correlation test to assess the linear relationship between both variables. See Footnote 36 for information on how correlation results for disaggregated small- and large-commercial rates compared to the combined demand charge rate results.

TABLE 8: SUMMARY STATISTICS FOR NON-ZERO DEMAND CHARGES

CATEGORY	NUMBER OF ZIP CODES	MEAN ($/KW)	MEDIAN ($/KW)	MIN ($/KW)	MAX ($/KW)
Small Commercial (< 200 kW)	493	5.650	5.000	0.076	25.170
Large Commercial (>= 200 kW)	1,832	8.084	7.431	0.046	27.830
Full Non-Zero Set	7,202[34]	7.465	6.519	0.004	197.850

36 The full dataset from NREL in our timespan of interest contained over 37,000 rates, of which nearly 17,000 were commercial rates. 7,202 of those were non-zero rates. Not all commercial rates contained a signal to identify each as small or large rates, thus only 2,325 non-zero rates could be identified as either small or large rates (493 small, 1,832 large) and were included in Table 8.

FIGURE 13: HISTOGRAM OF AVERAGE FLAT DEMAND CHARGE RATES (2016–2020)

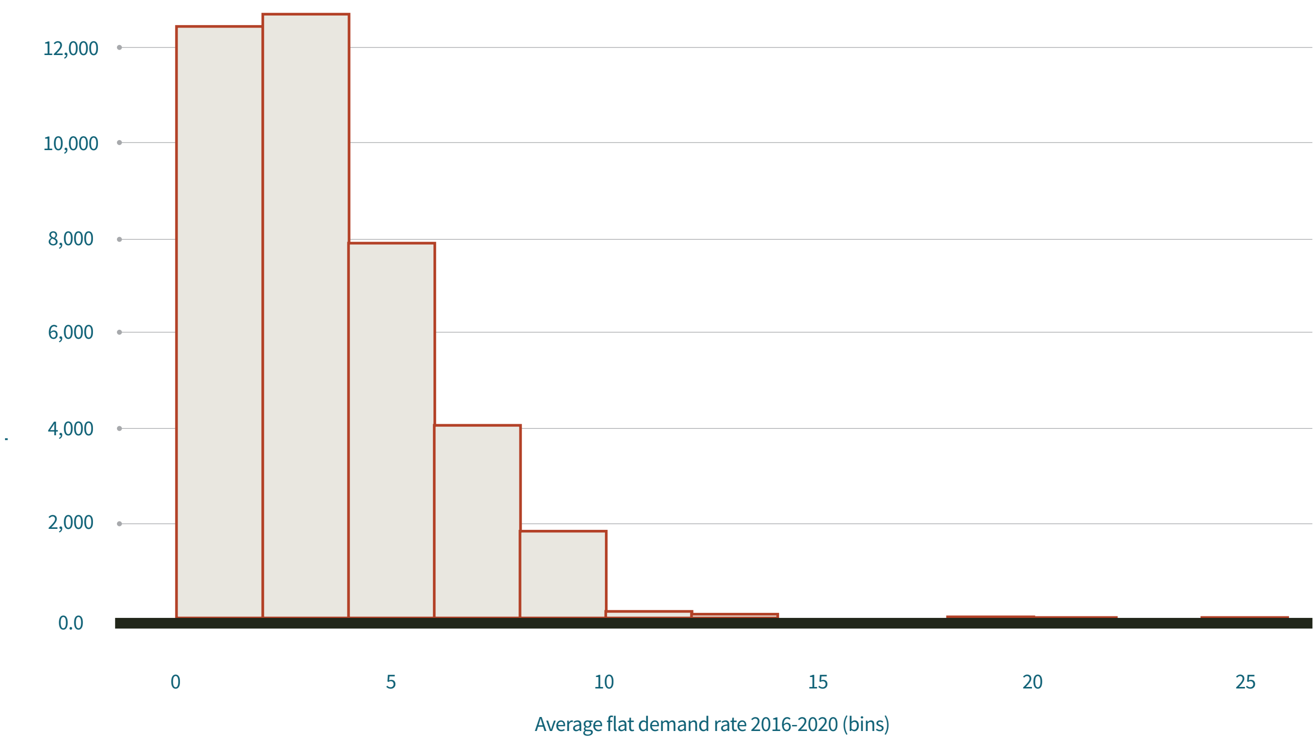


Figure 13 through 16 below show the results of this analysis. First, Figure 13 shows a histogram of average demand rates, with the frequency of average demand charges grouped across several ranges (referred to as bins in the figure).

A majority of average commercial demand charge rates for ZIP codes across the U.S. (from 2016 through 2020) are $5/kW or below. As the dollar amount for average demand rate by ZIP code increases, the number of ZIP codes with those average rates decreases.

Figure 14 shows a scatterplot of the net number of DCFC stations deployed in 2016 through 2020 by the average flat commercial demand charge rate. Each point on the plot represents a single ZIP code.

The data show that all DCFC stations deployed from 2016 through 2020 were deployed in ZIP codes with an average demand charge rate of $12/kW or less. Zero DCFC stations were deployed in ZIP codes with an average demand charge rate above $12/kW, which is expected because very few ZIP codes have an average demand charge rate above $12/kW. Ninety-eight ZIP codes fit this criteria compared to 39,106 ZIP codes with average rates below $12/kW.

Figure 15 shows the same information as Figure 14, but instead of a scatterplot it shows the total number of DCFC stations deployed in ZIP codes with certain ranges of average demand charges.

The figure shows that a slight majority of station deployments took place in ZIP codes with average demand charges of $0/kW to $4/kW; however, there seems to be little to no negative effect on the deployment of DCFC stations until average demand charge rates reach $8/kW. At this point, the number of stations deployed drops significantly; however, as shown in Figure 13, significantly fewer ZIP codes have average demand charge rates above $8/kW compared to ZIP codes with lower average demand charges.

FIGURE 14: NUMBER OF DCFC CHARGING STATIONS DEPLOYED BY ZIP CODE BY AVERAGE FLAT COMMERCIAL DEMAND CHARGE RATE BY ZIP CODE (2016–2020)

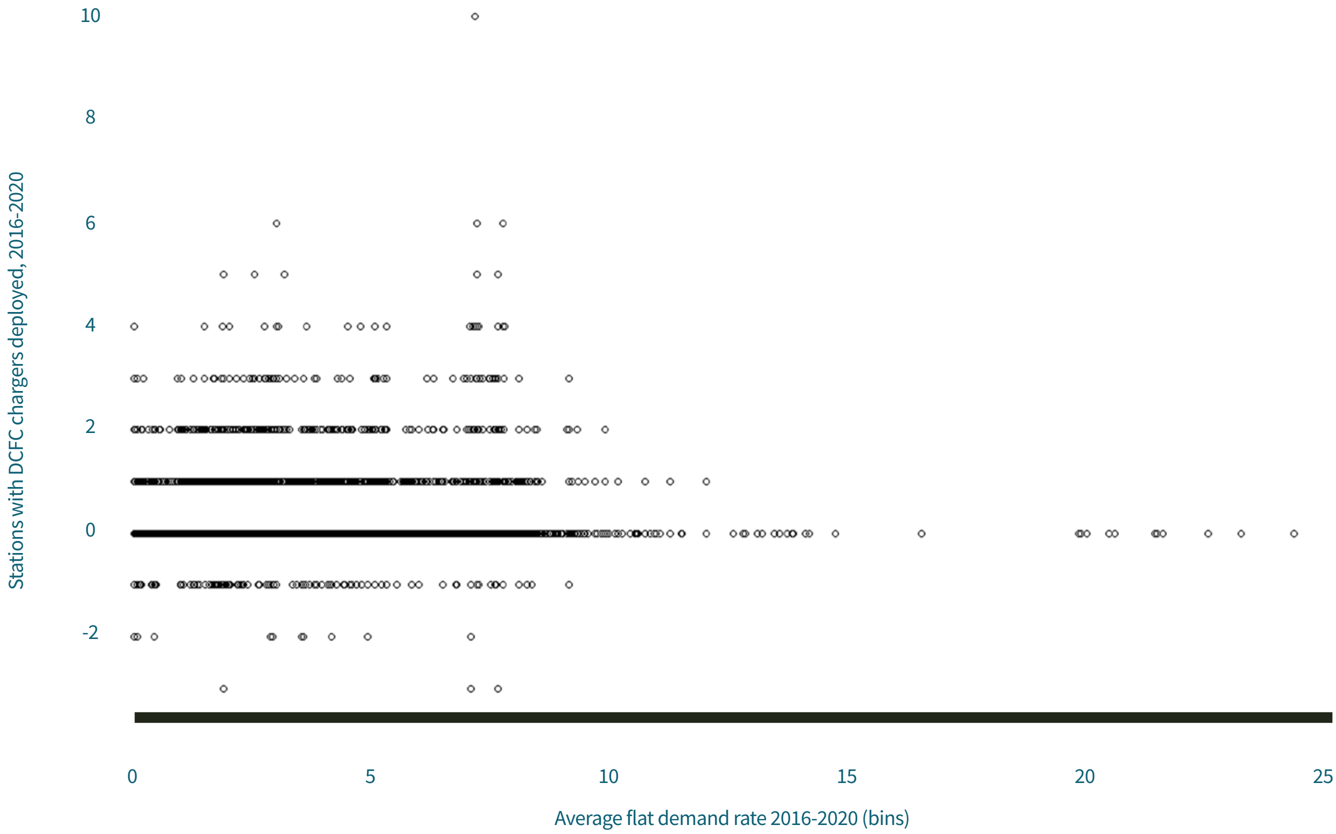


FIGURE 15: TOTAL DCFC CHARGING STATION DEPLOYMENTS BY AVERAGE FLAT COMMERCIAL DEMAND RATE BIN (AVERAGED BY ZIP CODE, 2016–2020)

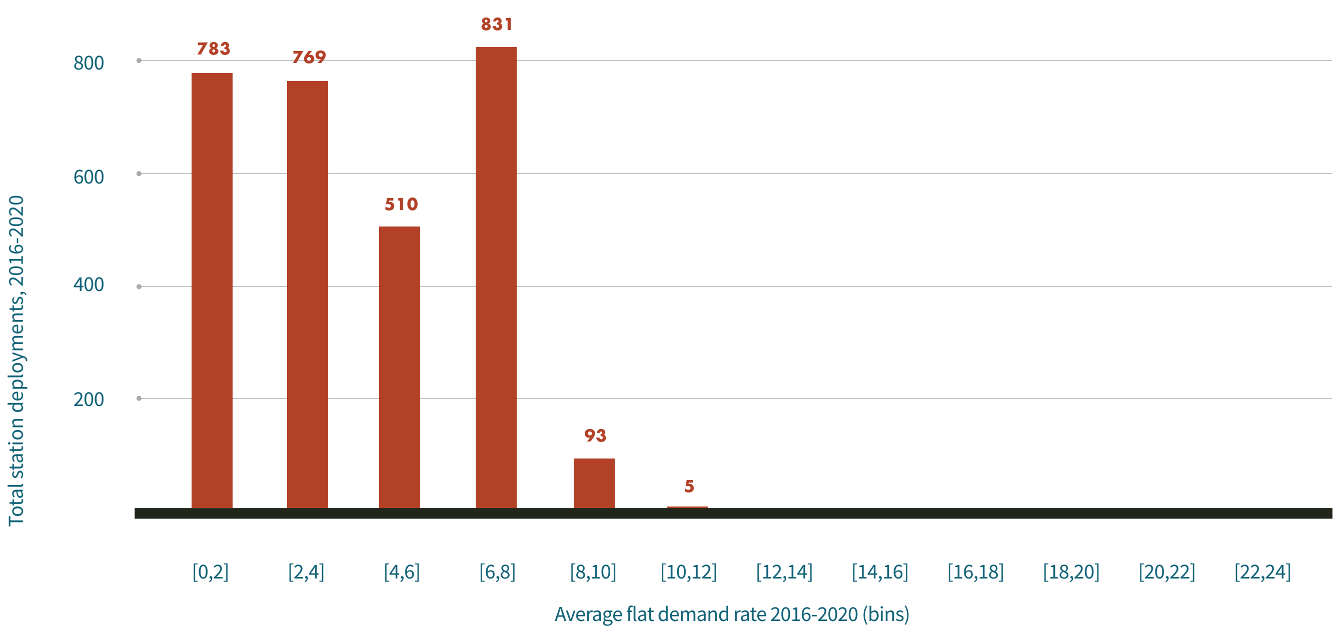


FIGURE 16: AVERAGE NUMBER OF DCFC CHARGING STATIONS DEPLOYED IN ZIP CODES BY AVERAGE FLAT COMMERCIAL DEMAND CHARGE BIN (2016–2020)

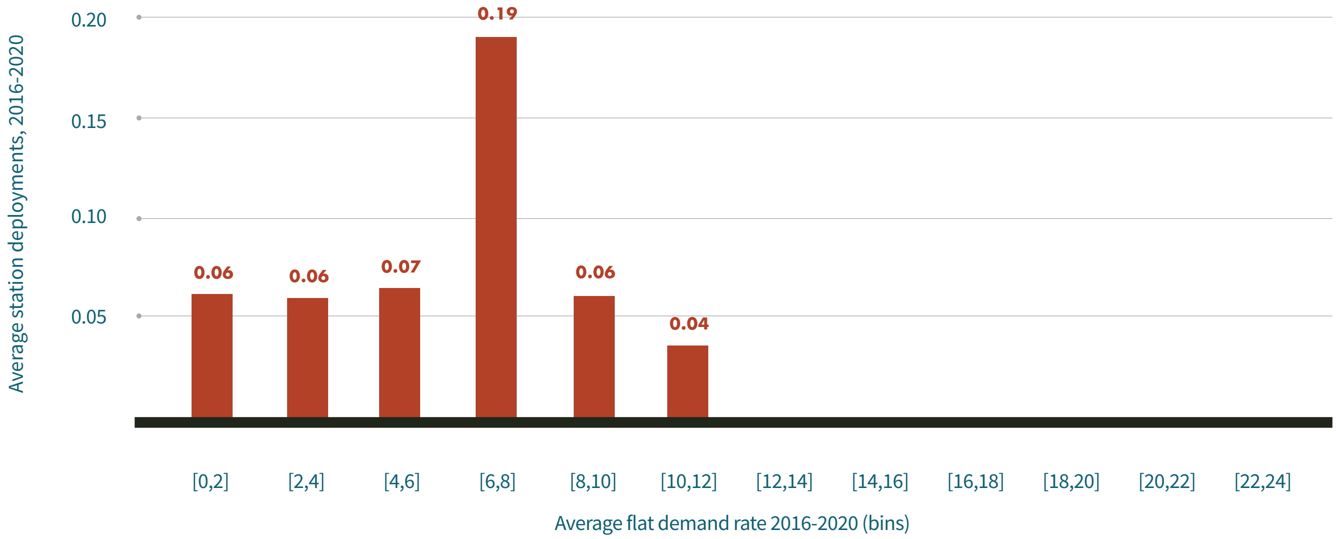


Figure 16 shows the data in terms of the average number of DCFC stations deployed in ZIP codes with certain ranges of average demand charge rates. This figure was created by normalizing the total number of station deployments by the number of ZIP codes within each average demand charge rate range (referred to as bins in the figure).

This data shows a spike in the number of average DCFC station deployments across ZIP codes with average demand charge rates between $6/kW to $8/kW. The remainder of bins show similar results to each other, and as shown in previous figures, there is a drop off in station deployments as the average demand charge rate reaches $10/kW.

Though it could be reasonably expected that higher demand charges would discourage the deployment of high-powered DCFCs due to expectedly high operating costs, the data does not support this expectation. It is possible that favorable policies supporting charger deployment may offset the potential effect of high demand charges.

California seems to be a case in point. It has a high percentage of DCFC stations deployed in ZIP codes with high demand charges, along with some of the highest rankings for EVSE policies.

Of the data available, there are 4,342 ZIP codes with average commercial demand charges between $6/kW and $8/kW.[37] Of those, California ZIP codes make up roughly 44%, followed by Texas at roughly 11%; the remainder of states represent 9% and below with only three other states above 5%. Of the 4,342 ZIP codes with average demand charges in this range, there are 522 ZIP codes that also had at least one net public DCFC station deployed from 2016 through 2020. California makes up 76% of this subset (399 ZIP codes, which represents 15% of all total ZIP codes in California), followed by New Jersey at 5% and a handful of other states representing 1–4%. California is ranked number one in this study's EVSE market development score, and it is among the most active states in using policy approaches for EVSE deployment. When examining states on

37 ZIP code data was retrieved from two sources: Internal Revenue Service (IRS) 2018 Zip Code Data and unitedstateszipcodes.org. IRS data was retrieved first, and ZIP codes were matched with the appropriate states, but the IRS data was missing a portion of the ZIP codes needed. Data from unitedstateszipcodes.org was then retrieved and compared to the IRS ZIP code data to ensure its accuracy. No discrepancies in the latter dataset were found, and it adequately filled the gaps in the IRS data set.

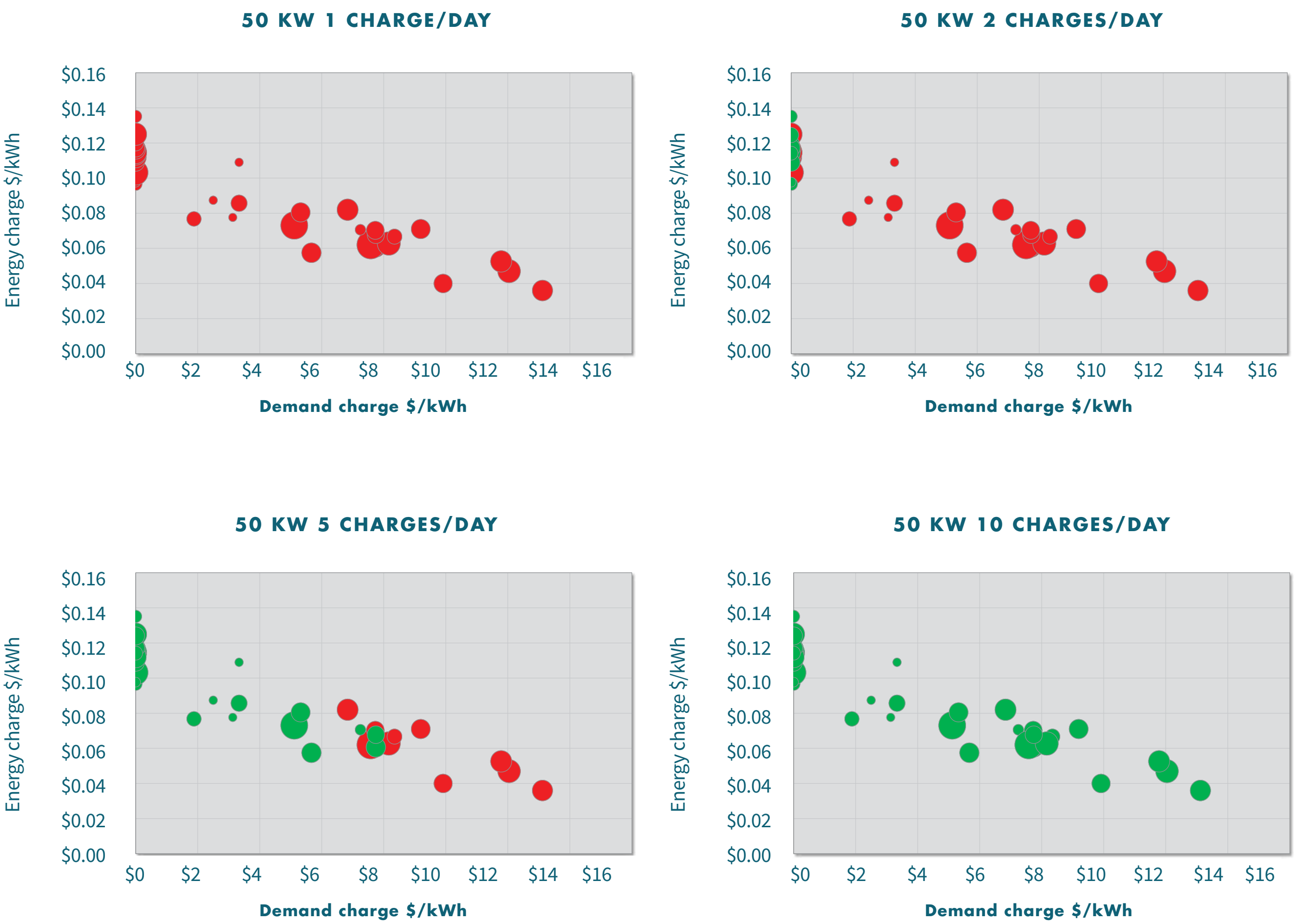
the number of different EVSE deployment-related policy types implemented, California ranks second behind Washington. When examining states on the total number of EVSE deployment-related policies implemented (regardless of type), California ranks first. Given this, it may be the case that a favorable policy environment in California may have counteracted the impact of demand charges to some extent.

For all demand charge ranges together, the correlation coefficient when comparing the number of stations deployed with average flat commercial demand charge rates by ZIP code is very small and positive at +0.059, indicating almost no correlation.[38] As average demand charge rates by ZIP code increases, the number of deployments decreases slightly, but so do the number of ZIP codes with those higher average rates. Collectively, there are 98 ZIP codes with average demand charge rates between $12/kW and $24/kW, compared to 39,106 ZIP codes with average rates below $12/kW. While there are zero DCFC station deployments in ZIP codes with average rates above $12/kW[39], there are also many fewer ZIP codes in which stations could be deployed. Given these results, there is not enough evidence in the data to say that higher demand charges are a deterrent to public DCFC station deployment. Importantly, these results do not say anything about the impact that demand charges may have on the operating costs for DCFC, whether public or private. It is expected that demand charges would increase operating costs for DCFC, but the analysis herein focuses only on the impact of demand charges on deployment. Other studies have examined the operational economics of demand charges and EV charging, particularly a 2019 study by the Great Plains Institute (GPI).

38 Given the potential for small and large commercial demand charge rates to have different impacts on DCFC station deployment, the researchers disaggregated them into two datasets per Table 8 and found no significant difference when compared to the combined results. The correlation coefficient for small commercial rates was +0.064 and for large commercial rates it was +0.045.

39 Importantly, this analysis used average demand charge rates grouped by zip code. There are likely DCFC stations deployed in areas with demand charge rates above $12, but when analyzed at a zip code average level, zero stations are found.

FIGURE 17 BREAK EVEN PERFORMANCE OF 50 KW DCFC STATIONS UNDER VARYING RATES AND UTILIZATION[41]



[Figure 17](#) below shows analysis by GPI that indicates that higher levels of charger utilization led to a more positive business case for DCFC.[40] Green circles indicate stations that break even or profit while red circles indicate stations whose incurred costs are greater than revenues. This may mean larger barriers to DCFC deployment in areas where EV adoption is relatively low, and more favorable economic conditions in areas where EV adoption is high.

The demand charge versus deployment analysis in this section does not show evidence of whether or not demand charges are a deterrent to the deployment of private EVSE. It may be that owners of public DCFC pass higher demand charge costs on to customers through the $/kWh fees they charge, but this analysis has not examined that hypothesis and more analysis is required to further investigate these follow-up questions.

Importantly, there are more factors beyond demand charges that potential EVSE station owners and operators must consider with respect to an overall business case. If substantial demand charges exist

40 Great Plains Institute, *Overcoming Barriers to Expanding Fast Charging Infrastructure in the Midcontinent Region*, white paper written on behalf of Midcontinent Transportation Electrification Collaborative, July 2019, https://scripts.betterenergy.org/reports/GPI_DCFC_Analysis_July_2019.pdf.

41 Data from Great Plains Institute, *Overcoming Barriers to Expanding Fast Charging Infrastructure in the Midcontinent Region*.

but the potential owner believes that the EVSE may eventually make a positive return on investment (ROI), they may deploy and incur the short-term costs in anticipation of long-term gains. In situations where the potential EVSE owner has less confidence in the long-term business case for EVSE, perhaps due to low expected utilization rates, they may decide not to deploy. Several factors may impact the business case for EVSE deployment, such as the rate of local EV registrations, the local policy environment, and population density.

INFLUENCE OF DCFC OUTPUT POWER LEVEL

Another factor that may influence the impact of demand charges on DCFC deployment is the output power level of the DCFC to be deployed. Output power, measured in kilowatts (kW), is a measure of energy transferred per unit of time. Generally, the more power a charger has, the faster it can recharge an EV's battery, depending on the EV's maximum power acceptance rate.[42] Higher-power EVSE are more expensive to purchase and install, and they are likely to incur higher demand charges compared to lower-power EVSE due to higher peak power demand. Given this, deployment of higher-powered DCFC may be less likely than deployment of lower-powered DCFC in ZIP codes with higher average demand charges.

The 2019 GPI study focused on the impact of demand charges on DCFC operating costs and found that "demand charges are more of a barrier for higher-capacity DCFC...For 150 kW, 350 kW, and 450 kW DCFC, a minority of utility demand charge tariffs allowed for profitable operation, even at utilization levels as high as 10 charges per day."[43]

42 Maximum power acceptance rate is the maximum power rate at which a given electric vehicle can receive energy from an EV charger. These rates vary by vehicle and can be a limiting factor in determining charging speeds if the acceptance rate is lower than the power output of the charger.

43 Great Plains Institute, *Overcoming Barriers to Expanding Fast Charging Infrastructure in the Midcontinent Region*, white paper written on behalf of Midcontinent Transportation Electrification Collaborative, July 2019, https://scripts.betterenergy.org/reports/GPI_DCFC_Analysis_July_2019.pdf.

FIGURE 18: BREAKEVEN PERFORMANCE OF DCFCS UNDER VARYING UTILITY DEMAND AND ENERGY CHARGES (VARYING POWER LEVELS AND RELATIVELY HIGH CONSTANT UTILIZATION RATE)[45]

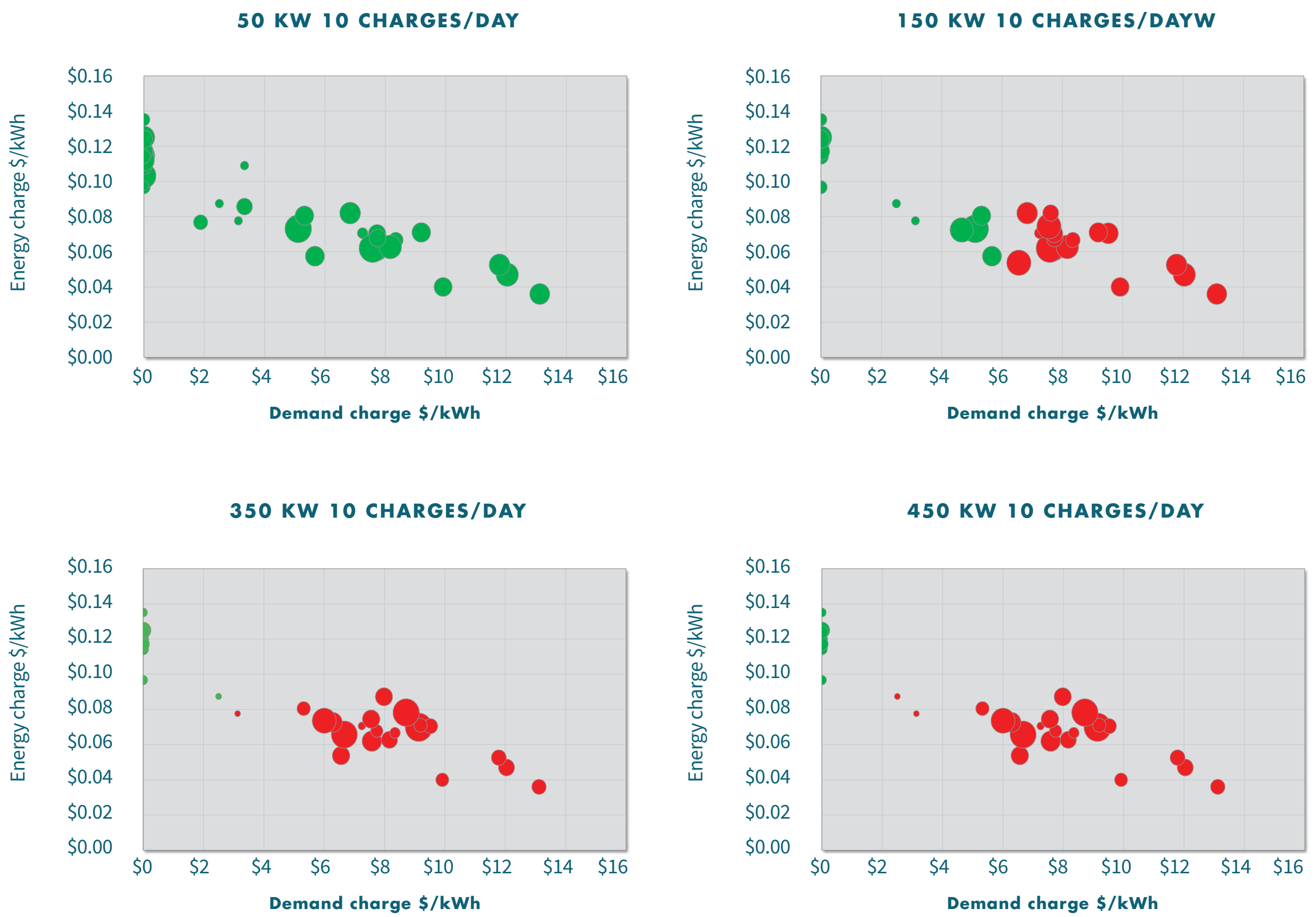


Figure 18 shows the breakeven performance of DCFCs under varying demand charge and energy-charge rates and at a relatively high constant utilization rate of 10 charges per day.[44] Green circles indicate stations that break even or profit while red circles indicate stations whose incurred costs are greater than revenues.

It is pertinent to note that the GPI study did not account for fluctuations in power draw during vehicle charging, and instead assumed a constant power output. The study used calculations versus actual data and assumed that the chargers were outputting maximum power for the duration of the charge. Also, GPI accounted for financial incentives in their calculations by largely excluding financed or amortized capital costs within the operating cost analyses. As the graphs show, the 150 kW DCFCs modeled in the study would not be profitable with demand charges above $6/kW, 350 kW DCFCs would not be profitable with demand charges above $3, and the 450 kW DCFCs would not be profitable with any demand charges (though they would be profitable with zero demand charges). In other words, this study found that demand charges are a hindrance to profitability for high-powered DCFCs, which may be a significant barrier to deployment of such charging stations.

44 Data from Great Plains Institute, *Overcoming Barriers to Expanding Fast Charging Infrastructure in the Midcontinent Region*.

45 Data from Great Plains Institute, *Overcoming Barriers to Expanding Fast Charging Infrastructure in the Midcontinent Region*.

QUALITATIVE INTERVIEW RESULTS

The qualitative component of the study included semi-structured interviews with state government officials, electric utility representatives, EVSP representatives, and other related subject matter experts to gather their expert opinion on policy approaches to EVSE deployment. The following sections describe the key takeaways from those interviews.

FUNDING

All interviewees pointed out the key role of funding to support both EVSE deployment and operation, consistent with the quantitative analysis showing higher EVSE market development scores for states with grants, rebates, and tax incentives. The Volkswagen Clean Air Act Civil Settlement (VW Settlement) was quoted by multiple stakeholders as a critical milestone for EVSE deployment in the U.S., as it provided vital incentives and motivated state agencies across all 50 states to create programs for EVSE deployment. The VW Settlement was also generally described as a key learning opportunity for the state agencies having to create dedicated EV and EVSE programs for the first time. All interviewees stated that, in general, programs are more effective when they are tied to deadlines that help accelerate their execution. Relatedly, several interviewees shared that states which have delayed disbursing the VW Settlement, due to lack of dedicated personnel or other reasons, may have diminished the effectiveness of the program itself over time.

While stakeholders made it clear that funding for EVSE remains as important today as it was a decade ago, they also specified that funding type and funding mechanism are two equally important factors at determining the success of an EVSE policy or program.

A few key common points emerged through these interviews, as follows:

- The majority of interviewees stated that rebates and incentives are considered the most effective approaches to disburse funding, because they are simple processes for both the applicant and the agency administering the program.
- Funding administered by state agencies is considered easier to work with compared to federal funding because state agencies are reported to have a higher degree of flexibility in designing a program. Interviewees stated that this can reduce barriers for applicants and make the programs more time- and cost-effective. One example of flexible program design shared by interviewees was the practice of using separate approaches for Level 2 EVSE and DCFC: opting for flat rebates for Level 2 chargers to keep the program simple for applicants and opting for rebates that cover a percentage of purchase and installation costs for DCFC.

- All EVSPs stated that federal tax credits for EVSE purchase and installation[46] are among the most effective mechanisms to provide long term, stable, and financially significant incentives for the industry. Interviewees cited the solar industry as a recent comparable example, in that cap-free tax credits were an important contributor to reducing solar installation costs.

- Programs that allow matching public and private funds were almost unanimously stated to be effective at increasing EVSE deployment, especially if accompanied by clear timelines. The California Electric Vehicle Incentive Project was cited by several stakeholders as a model example in terms of time-effectiveness because funds were made available on a first-come, first-served basis.[47]

- While unique to the states of California and Oregon, the Low Carbon Fuel Standard (LCFS) and the Clean Fuels Program (CFP), respectively, were consistently highlighted as initiatives with highly positive impacts in supporting the operation of EVSE.[48] These market-based programs are designed to reduce the carbon intensity of transportation fuels through a system of credits that can be earned and then sold to regulated entities. The credit system is economically advantageous for EV charging operators, as credits can be earned as stations are installed and used. Several interviewees expressed that these programs are important in guaranteeing long-term revenue streams for EVSE owners and site hosts, especially for non-residential EVSE hosts in rural corridors where the utilization rate of chargers may be low, possibly yielding fewer opportunities to monetize stations. The LCFS and CFP systems may also help to cover maintenance costs, especially for the more complex DCFCs. As one interviewee put it: "The credit system is vital for DC fast charger infrastructure development."

Common trends also emerged regarding the interviewees' sentiments on policy elements that can make funding programs ineffective, including the following:

- Program delays due to slow funding disbursement or lengthy application processes can translate into significant costs for the applicant. Reportedly, these delays can be large enough to make funding inefficient from a business perspective and diminish overall program effectiveness. Per the interviewees, federal grant programs are reportedly often designed in a way that requires significant administrative work, with funding disbursement "taking too long to translate into useful action," as one interviewee said.

46 A detailed description of the federal tax credit for alternative fuel infrastructure is available on the Alternative Fuel Data Center, https://afdc.energy.gov/laws/10513.

47 California Electric Vehicle Incentive Project homepage, Center for Sustainable Energy, California Energy Commission, https://calevip.org/.

48 "Low Carbon Fuel Standard," California Air Resources Board, accessed August 30, 2021, https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard; "Oregon Clean Fuels Program (CFP)," Oregon Department of Environmental Quality, Oregon state website, accessed August 30, 2021, https://www.oregon.gov/deq/ghgp/cfp/Pages/default.aspx.

- Lack of flexibility in program design and overly prescriptive programs can also diminish overall effectiveness. One example of an overly prescriptive program, as shared by interviewees, is one that pre-selects sites for EVSE installations without adequate site assessment or consideration for operational realities such as the presence of nearby businesses, potential utilization rates, etc.
- Interviewees reported that clear instructions and proper guidance are essential elements in program design. Lack of knowledge and prior experience with EVSE were reported to be deterrents to potential site hosts and may impede EVSE deployment if programs are not accompanied by education and outreach initiatives.

REGULATIONS

When asked about the effectiveness of regulations for EVSE deployment, a few distinct trends emerged in interviewees' answers. First, statewide regulations that set actionable mandates and specific goals for EV adoption, EVSE deployment, and GHG reduction were considered effective at aligning public and private efforts, increasing agency coordination, and creating an environment that stimulates investments. Multiple state government officials disclosed that private investments have increased after climate or transportation-related legislation was passed, because such legislation signaled a favorable policy landscape, often accompanied by state investments as well.

Interviewees also stated that regulations are most effective when they reduce barriers to EVSE deployment and operation, including the following:

- **Recognizing EVSE as an accessory use:** EVSE is a relatively new type of equipment, and most municipal zoning or land use codes have not been modified to include it. In some instances, this can be done quickly by amending the code with an ordinance. In other cases, changing zoning or land use laws involves complex processes requiring the approval of local planning boards and other entities that may have inconsistent rules. Recognizing EVSE as an accessory use in these codes can enable deployment.
- **Allowing potential charger hosts to resell electricity:** Public utilities are regulated by public utility commissions (PUCs) or departments of public utilities (DPUs). To allow charging hosts to resell electricity, state legislatures can establish that an entity providing electricity for the purpose of EV charging is not considered a public utility and therefore is not regulated by PUCs or DPUs. As of July 2021, over 35 states have adopted such definitions, enabling EVSE deployment.[49]

One example of proper site assessment preceding EVSE deployment, as cited by interviewees, is the Colorado Energy Office's EV Fast Charging Plazas Program.

This program is designed to increase access to high-speed charging in and around downtown areas where there is a potential for high utilization, such as near high-density housing and commercial developments, near transit hubs and airports, and in locations where there is a high density of transportation network companies and/or fleet EV drivers.

The intent is a strategic deployment of high-speed charging infrastructure needed by drivers without regular access to home or workplace charging or those in need of opportunity charging.

49 Alternative Fuels Data Center, "Federal and State Laws and Incentives," U.S. Department of Energy Vehicle Technologies Office, accessed September 1, 2021, https://afdc.energy.gov/laws

- **Allowing multi-unit dwelling (MUD) residents to install chargers:** Right-to-charge laws prevent a homeowner association (HOA), condominium board, or other related group, from denying a resident's request to install a charging station in an assigned parking spot. As of July 2021, only nine states (California, Colorado, Florida, Hawaii, Maryland, New York, New Jersey, Oregon, and Virginia) and a few large cities, such as Boston, Massachusetts, have adopted right-to-charge laws. Doing so can eliminate barriers that MUD residents may face [50]in EVSE installation.

Interviewees also reported that several types of regulations represent a barrier or a concern. The ones most frequently cited by interviewees include the following:

- **Prescriptive standards in EVSE products (for example, requirements for card readers, screens, and other technologies that are expensive to maintain) and regulations that add to EVSE installation and equipment costs through strict site design and siting requirements:** Among those, compliance with the Americans with Disabilities Act (ADA) was cited as problematic because of a lack of federal ADA standards specific to EVSE. To harmonize standards at the state level, Minnesota has developed ADA-accessible EV charging installation guidance and requirements for EV charging stations.[51]
- **Buy America requirements:**[52] While stakeholders agreed on the need to develop domestic supply chains for job creation and resiliency, some reported experiencing ambiguity regarding how the Buy America requirements apply to EVSE, and explicitly recommended the creation of clear and consistent guidance from federal partners. Some stakeholders also expressed concern that the requirements included in the Infrastructure Investment and Jobs Act, IIJA (H.R. 3684)[53] would expand the scope of the existing

50 "Legislation Reference – Recharging Equipment at Multi-Unit Housing," PlugInSites, accessed September 1, 2021, https://pluginsites.org/legislation-reference-recharging-equipment-at-multi-unit-housing/; Katherine Brady, "Boston Right to Charge Electric Vehicles," Moriarty Troyer & Malloy LLC, January 28, 2019, https://www.lawmtm.com/boston-right-charge-electric-vehicles.html.

51 Minnesota Pollution Control Agency, *Installation Requirements for Electric Vehicle Charging Stations*, January 2021, https://www.pca.state.mn.us/sites/default/files/p-gen4-20.pdf.

52 The Buy America requirements (established by Section 165 of the Surface Transportation Assistance Act of 1982) differ from the Buy American requirements established by the Buy American Act of 1933. The Buy American Act applies to federal procurement, and prohibits the government from acquiring an article, material, or supply for public use within the U.S. that is not a domestic product. The Buy America Act typically applies to mass-transit procurements for state and local government projects. Under the Buy America Act, end products must be 100% manufactured in the United States and all steel and iron components must be mined, melted, and manufactured in the United States. However, foreign-sourced materials may be allowed if they are valued at $2,500 or 0.1% of the contract value (whichever is greater). This is referred to as the minimal use amount. (Howard Roth, "Buy America vs. Buy American: What's the Difference and Why It Matters", Oles Morrison Rinker & Baker LLP, October 19, 2017, https://www.djc.com/news/co/12105277.html).

53 Infrastructure Investment and Jobs Act, https://www.congress.gov/bill/117th-congress/house-bill/3684. Summary of bill available at ITS America, *Summary of Senate Infrastructure Investment and Jobs Act*, August 10, 2021, https://itsa.org/wp-content/uploads/2021/08/ITS-America-Infrastructure-Investment-and-Jobs-Act-Technology-

Federal Transportation Administration and Federal Highway Administration Buy America rules and apply to all manufactured products. That is, all manufactured products must be made and assembled in the U.S. and have a 55% domestic content by value. These requirements have been cited as a significant near-term barrier and are perceived as hard to meet especially for DCFC. For example, manufacturers indicate that it would take 3-5 years to initiate, permit, construct, and commission plants capable of high volume 350kW charger production in the United States. Interviewees cited concerns that the requirements could diminish the effectiveness of these efforts if domestic manufacturing output does not speed up fast enough to align with rapid evolving technology. Stakeholders also added that it is important that the Department of Transportation answer three critical questions as it proceeds with implementation of the IIJA:

- What is the current production capacity of IIJA Buy America DCFC equipment at existing U.S. manufacturing facilities with a proven track record of volume production? What are the steps that must be taken, and what is a feasible timeline to complete those steps, for experienced and proven DCFC equipment manufacturers to build domestic, high volume manufacturing facilities and domestic supply chains for critical DCFC components?
- How should the United States maintain a cost-effective supply of reliable, high-powered DCFC during the period when domestic production and supply chains are being developed?

The IIJA became public law No 117-58 on November 15, 2021 (after the interviews were conducted for this report). On November 24, 2021, the U.S. Department of Transportation and the U.S. Department of Energy issued a Request for Information (RFI) on the availability of EV chargers manufactured and assembled in the US and whether they comply with applicable Buy America requirements. The deadline for comments on the RFI was set for January 10, 2022.[54]

- **Overly prescriptive policies that force the adoption of standards:** These policies can add capital and operating costs without necessarily improving user experience. Some interviewees cited a premature push for overly prescriptive communication protocol standards that are not yet supported by adequate firmware and software developments; one example shared by interviewees was ISO 15118. Interviewees expressed concern that these may cause security issues. Similarly, other interviewees expressed the desire for a wider range of EVSE products that are simpler and less costly than what is currently available on the market. However, several stakeholders expressed general support for basic standards of open communication consistent with the EV charging interoperability recommendation for state policy makers published by the Northeast States for Coordinated Air Use Management (NESCAUM). In a May 2020 publication regarding interoperability, NESCAUM recommended that states refrain from requiring compliance with ISO 15118 at this time.[55]

Investments-Summary-081021-IIJARTF.pdf

54 Buy America Request for Information (Notice; request for information). Federal Register 86 FR 67115 (November 24, 2021) pp. 67115-67118. Available from https://www.federalregister.gov/documents/2021/11/24/2021-25717/buy-america-request-for-information.

55 Multi-State ZEV Task Force and Northeast Corridor Steering Committee, *Electric Vehicle Charging Interoperability Recommendations for State Policy Makers*, Northeast States for Coordinated Air Use Management, May 2020, https://www.nescaum.org/documents/ev-charging-interoperability-reccomendations_5-1-20.pdf/.

UTILITY POLICIES AND PROGRAMS

Electric utilities have a unique role in enabling transportation electrification through programs and incentives dedicated to preparing the infrastructure required to enable EVSE installation and operation, designing EV-specific rates, and providing technical assistance.

All interviewees strongly agreed on the role of both utility make-ready programs (see Figure 19 for an illustrative example of site and distribution-grid infrastructure addressed in a make-ready program) and EVSE incentives for enabling EVSE deployments, especially if these are accompanied by outreach and education initiatives that aim to clarify program procedures. A few interviewees went even further and suggested that all future government funding dedicated to accelerating the buildout of EV charging networks should be equally split between make-ready initiatives and EVSE acquisition. According to interviewees, doing this may ensure that sites are ready to host chargers, thereby cutting costs associated with delays in preparing the necessary infrastructure.

In addition to programs and incentives designed to cover capital costs, several interviewees also expressed a need for new business models to level-out EVSE operating and maintenance costs so that potential EVSE site hosts are not disincentivized from deployment due to prohibitive operating costs.

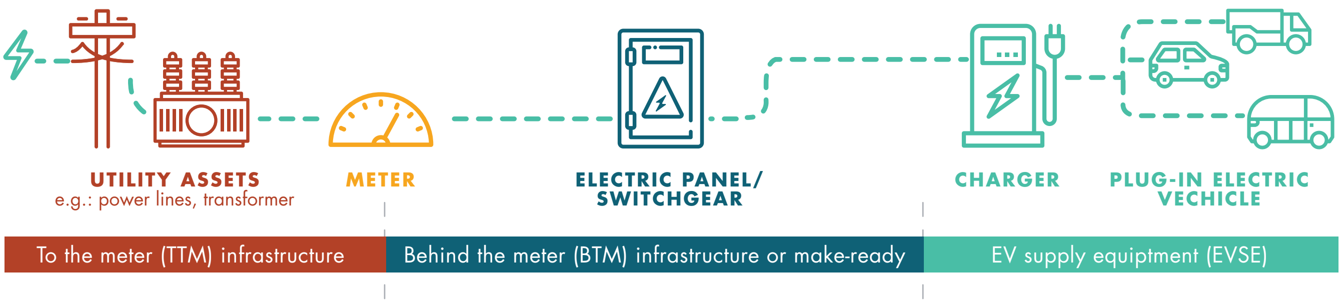
A utility-related policy that interviewees deemed as strongly effective in supporting EVSE operations is rate design. Electricity rates that reduce or smooth operating costs through TOU or demand charge management methods were cited as "highly effective," "vital," and "absolutely necessary." TOU rates are designed with multiple tranches

Make-ready programs are designed to cover the expenses associated with building and installing infrastructure needed to connect and serve a new EV charger.

This includes traditional distribution infrastructure such as step-down transformers, conductor lines, and meters owned and operated by the utility, as well as infrastructure on the customer-side of the meter, such as electric panels and trenching needed to run conduit and cables.

Make-ready program designs vary in terms of equipment eligibility and requirements. Some programs also include advisory services for fleets interested in adopting EVs.

FIGURE 19: PACIFIC GAS & ELECTRIC'S EV FLEET PROGRAM—INFRASTRUCTURE LAYOUT



Source: "EV Fleet Program," Pacific Gas & Electric, retrieved from https://www.pge.com/en_US/large-business/solar-and-vehicles/clean-vehicles/ev-fleet-program/ev-fleet-program.page.

of $/kWh fees for charging that vary depending on the time of day. Such rates can be valuable to EVSE site hosts, EV drivers, and utilities by providing times of day in which charging is relatively low cost while aligning with the utilities' need to cover the costs of distributing electricity to consumers. However, TOU rates may be less effective for DCFC in publicly accessible settings because users expect a high-speed charge in the shortest amount of time possible. While TOU rates may still encourage drivers to use DCFC at times of low grid power demand (and therefore lower electricity costs), other rate strategies and additional technology and business model strategies may be better suited to DCFC use cases.

As explained earlier, electric utilities have historically used demand charges to help offset the cost of delivering a consistent level of electricity to commercial or industrial customers and to incentivize customers to reduce their peak energy usage. All interviewees consulted on this topic stated that most of the non-residential EV charging applications are not compatible with the current utility model of demand charges, especially in the case of DCFCs that deliver a high instantaneous amount of power and are often intended for opportunity charging (that is, used by EV drivers as needed, including during times of peak demand). Per the GPI study cited previously, some of the DCFC costs associated with demand charges can be offset with higher utilization rates[56]; however, in all cases involving high-power DCFC (150 kW and above), the operational economics are not favorable even at higher levels of utilization. As more EVs enter the market, including medium- and heavy-duty EVs with larger batteries, some demand for quicker charging rates, and therefore higher-power chargers, may be expected. One interviewee defined demand charges as "the biggest existential threat for the economic viability for EVSE implementation, especially DC fast chargers" while others suggested that rate reform is "the most important piece of the puzzle to guarantee a successful buildout of EV charging infrastructure and widespread EV adoption."

As described in the section on "[Associations Between Demand Charges and EVSE Market Development]," the research team found no significant correlation between higher average demand charges and fewer public DCFC station deployments. The results also did not provide any insights into whether demand charges are a deterrent to the deployment of private EVSE since the analysis was limited to publicly available DCFC. Importantly, other confounding factors which were not included in the analysis above likely also have an influence on public DCFC station deployment with respect to demand charges. The "[Discussion: Synthesized Quantitative and Qualitative Analysis Results]" section below elaborates more on additional factors.

Several states and utilities are addressing demand charges with various approaches.[57] Following the passage of California SB-1000 in 2018,[58] the California Public Utility Commission opened proceedings to consider rate designs to address demand charges in commercial and industrial rates. In response, some California investor-owned utilities created subscription charges to replace the traditional demand charge. These subscription rates are designed with two components: (1) a sliding-scale subscription fee based on the amount of charging power capacity installed on a meter (measured in kW) and (2) an energy charge based on the amount of energy delivered through the chargers to the vehicles (measured in kWh). The goal of such subscription charge models is to set predictable costs for commercial customers and

56 Great Plains Institute, *Overcoming Barriers to Expanding Fast Charging Infrastructure in the Midcontinent Region*.

57 Several examples of demand charge management approaches can be found on page 9 of this document: https://img1.wsimg.com/blobby/go/2398067f-0bc3-41a7-84e3-4f90ff64c63d/downloads/ATE%20Rate%20Design%20Principles.pdf?ver=1626634532123

58 Transportation Electrification: Electric Vehicle Charging Infrastructure, California SB-1000, (approved by the governor and chaptered by secretary of state September 13, 2018), available at https://leginfo.legislature.ca.gov/faces/billHistoryClient.xhtml?bill_id=201720180SB1000.

fleet operators that may be less cost prohibitive. Comparatively, Vermont-based Green Mountain Power launched a Flexible Load Management Pilot program in July 2021 that offers financial incentives and direct technical expertise to commercial and industrial customers to help them shift electrical use and reduce peak demand.[59]

Additionally, it is pertinent to explain that utility rate design is not the only approach to demand charge management; technological solutions exist as well. Pairing DCFCs with integrated energy storage systems is another approach to reducing and managing demand charges. In such a system, the energy storage system may draw power from the utility grid (or other generation source such as a microgrid) when costs are low and do so consistently at low voltage, and then supply that power to the EVSE when needed, reducing demand charges incurred. Upfront capital costs of this approach would be higher than a station without energy storage but reduced operating costs may improve the overall business case on a case-by-case basis.

Finally, several interviewees highlighted a need for utilities to invest in dedicated personnel with adequate expertise in EVSE installation and knowledge of other site-specific requirements, such as easements. Doing so can reduce delays in making sites EV-ready. Interviewees cited this practice as one that would contribute to more effective and efficient EVSE deployment.

OTHER POLICIES AND PROGRAMS

In addition to funding programs, regulations, and the role of utilities, interviewees also shared thoughts on other policies and programs related to EVSE deployment. Expedited and streamlined permitting processes were cited as one of the most effective policies for EVSE deployment.

A lack of standardized permitting processes in local zoning and land use codes was cited as particularly difficult to work with, time consuming, and therefore costly, which is consistent with the findings of a Rocky Mountain Institute report on EV charging infrastructure "soft" costs.[60] Other interviewees identified the following as ineffective for EVSE deployment: non-uniform EVSE site design guidelines, minimum parking rules, inconsistency across municipal departments about requirements, and a lack of knowledge about EVSE. Interviewees also reported that, in some cases, public opposition to a certain EVSE installation due to conflicting views on preferred location or aesthetics can derail a project by several months.

While these issues with EVSE permitting persist across most jurisdictions and in most states, there has been a growing awareness of the problem, and a number of jurisdictions have taken action, including the following examples:

- **California Local Ordinances:** EVSE legislation (AB 1236, 2015) aims to streamline EVSE permitting processes by requiring all legislative bodies of each county and city to approve an application for EV charging stations through specific permits which are issued by building officials on the basis of health and safety laws. This effectively eliminates the need for multiple approval steps by other boards.[61] Further, the legislation requires all cities and counties adopt an ordinance to create an expedited and streamlined permitting process for EV charging stations. While the law was praised for its original intent, several interviewees observed inconsistent uptake due to the lack of an enforcement mechanism. To incentivize more cities to adopt the law, the status of EVSE-permit streamlining efforts was used as one of the factors to award jurisdictions

59 T&D World, "Green Mountain Power Program Incentivizes Businesses to Reduce Peak Demand on Grid," July 26, 2021, https://www.tdworld.com/distributed-energy-resources/demand-side-management/article/21170597/green-mountain-power-program-incentivizes-businesses-to-reduce-peak-demand-on-grid.

60 Chris Nelder and Emily Rogers, "Reducing Infrastructure EV Charging Costs," Rocky Mountain Institute, June 2019, https://rmi.org/insight/reducing-ev-charging-infrastructure-costs/.

61 "Local Ordinances: Electric Vehicle Charging Stations," California AB 1236 (approved October 8, 2015), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160AB1236.

with California Electric Vehicle Incentive Projects after 2020. Relatedly, an August 2021 Electrify America report on their EVSE deployment efforts in California indicates that typical permitting duration in California is 79 days compared to 62 days as a national average (roughly 27% longer), which signals additional solutions may be required to reduce permitting times.[62]

- **The New Jersey** legislature passed NJ S3223 in July 2021, which establishes EVSE as permitted accessory use in all jurisdictions statewide and requires all municipalities to adopt model ordinances to adopt such definition in their local codes.[63] This measure was taken to expedite EVSE approval.
- **Vermont's Agency of Commerce, Department of Housing and Community Development** has been providing education, guidance, and model ordinance language to implement EVSE-friendly development regulations.[64] Notably, EVSE permitting has not been identified as a major barrier in Vermont because the local boards evaluate permit requests based on safety and electric code compliance only.
- **New York State Energy Research and Development Authority** has made available resources and best practices for jurisdictions that are interested in setting up clear and concise EVSE permitting policies.[65]
- **The City of Seattle Department of Construction and Inspections** has created dedicated fact sheets outlining procedures for the installation of EVSE for single and multifamily homes and for commercial properties.[66]

Along with the streamlining of permitting processes, EV-readiness mandates in building, energy, and zoning codes at the state or municipal level were frequently cited by interviewees as effective. Typically, an EV-readiness mandate (or ordinance) establishes requirements for EV charging infrastructure to be incorporated in new residential and commercial constructions, thus avoiding future retrofitting costs, which can be more expensive than building the infrastructure during initial construction.[67] In doing so, local EV-readiness codes are considered one of the most practical and cost-effective strategies for local governments to increase EVSE deployment and EV adoption, especially in MUDs, which tend to have parking logistics and housing ownership constraints. A growing number of counties and cities are adopting some version of an EV-readiness code, with different percentages of jurisdictions with EV-capable, EV-ready, or EV-installed parking spaces.[68] The three EV-readiness levels that stakeholders may incorporate into building and zoning codes are:

- **EV-Capable Parking Space:** A parking space with an installed electrical panel and conduit, enabling the space to receive an EVSE at any time with the addition of wiring and the rest of the circuit.

62 Electrify America, *California Quarterly Report Summary Q2 2021*, August 2021, https://media.electrifyamerica.com/assets/documents/original/743-SummaryQ22021QuarterlyReporttoCARB.pdf.

63 "Establishes Numerical Requirements and Zoning Standards for Installation of Electric Vehicle Supply Equipment and Make-Ready Parking Spaces," New Jersey SB S3223 (approved July 9, 2021), available at https://legiscan.com/NJ/bill/S3223/2020.

64 Vermont Agency of Commerce & Department of Housing and Community Development Community Planning and Revitalization Division, *Local Electric Vehicle Charging Station Regulation: A Welcome Approach to Electric Vehicle Plug-In Technology*, last updated January 2019, https://accd.vermont.gov/sites/accdnew/files/documents/CD/CPR/EVSE-Friendly Development Regulations.VT_.DHCD_.Sep2018.pdf.

65 New York State Energy Research and Development Authority, "EV Charging Station Permitting Resources," accessed August 30, 2021, https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Siting/EV-Charging-Station-Permitting-Resources.

66 Seattle Department of Construction and Inspections, "Installation of Electric Vehicle (EV) Charger for Commercial Properties," May 9, 2017, http://www.seattle.gov/DPD/Publications/CAM/cam133.pdf.

67 California Air Resources Board, *EV Charging Infrastructure: Nonresidential Building Standards*, November 15, 2019, prepared by Sustainable Transportation and Communities Division, https://ww2.arb.ca.gov/sites/default/files/2020-09/CARB_Technical_Analysis_EV_Charging_Nonresidential_CALGreen_2019_2020_Intervening_Code.pdf.

68 Claire Cooke and Brian Ross, *Summary of Best Practices in Electric Vehicle Ordinances* (Minneapolis, MN: Great Plain Institute, June 2019), https://www.betterenergy.org/wp-content/uploads/2019/06/GPI_EV_Ordinance_Summary_web.pdf.

- **EV-Ready Parking Space:** A parking space with the full circuit installed, including a 208/240 V, 40-amp panel, conduit, wiring, receptacle, and overprotection devices. These spaces are ready to receive an EVSE at any time with no additional preparation.
- **EV-Installed:** A parking space in which the full circuit and the EVSE are installed.

In February 2021, St. Louis, Missouri, became the first major Midwestern city to pass an EV ordinance that mandates EV-ready and EV-installed spaces in new single-family, multifamily, and non-residential buildings.[69]

Importantly, while this study focused primarily on state-level policy, local-level policies, incentives, and programs are also important in developing an EV charging market. As interviewees highlighted above, policies focused on enabling development of charging infrastructure in MUDs is of particular interest, given unique constraints that MUD residents experience regarding parking logistics, housing ownership, and the transience of tenants. As described in the section on "Regulations," interviewees cited right-to-charge laws as effective in reducing barriers for MUD tenants to install EVSE. Other policy-related efforts to enable charging in MUDs include utility programs focused on providing MUD customers with EV rates and infrastructure development assistance, as Xcel Energy recently did with its Multifamily Home Program in Colorado.[70] Additionally, states may choose to award higher levels of funding to EVSE projects that are located in a MUD or disadvantaged community, as seen in some California programs.

Several interviewees also highlighted the role of public-private partnerships (P3) in aligning goals, pooling resources, and spearheading innovation as related to EVSE deployment. A few notable P3 examples that were brought to the research team's attention include the following:

- **The West Coast Electric Highway:**[71] This collaboration between California, Oregon, Washington, and British Columbia to build a corridor of EV charging stations combined several initiatives and organizations under a single

69 City of St. Louis, Missouri, Electric Vehicle Ordinance Fact Sheet, published August 14, 2020, https://www.stlouis-mo.gov/government/departments/planning/sustainability/documents/electric-vehicle-readiness.cfm.

70 "In the Matter of the Application of Public Service Company of Colorado for Approval of its 2021-2023 Transportation Electrification Plan," Public Utilities Commission of the State of Colorado, Proceeding No. 20A-0204E, Decision No. C21-0017, adopted December 23, 2020, available at https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Rates%20&%20Regulations/Regulatory%20Filings/final-decision-TEP.pdf.

71 "West Coast Electric Highway," Washington State Department of Transportation, accessed August 31, 2021, http://westcoastgreenhighway.com/electrichighway.htm.

brand, uniform standards for site locations, and consistent payment methods across the states. Rev West has adopted the same model for the regional collaboration between Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, and Utah to create an Intermountain West Electric Vehicle Corridor.[72]

- **Colorado Energy Office partnership with Kum & Go:**[73] The Colorado Energy Office partnered with the convenience store chain Kum & Go to expand EVSE along highway corridors, bringing a total of 22 DCFCs to the state.
- **Electrify America partnership with Love's Travel Stops:**[74] Similar to the Colorado Energy Office's partnership with Kum & Go, Electrify America partnered with Love's Travel Stops in several states across the U.S.
- **7-Eleven's partnership with ChargePoint and utilities:**[75] Similar to the previous examples, convenience store chain 7-Eleven partnered with ChargePoint and several utilities to expand a network of DCFC in California.
- **New York Power Authority partnership with Electrify America:** The New York Power Authority is working in partnership with Electrify America on DCFC installations across the state.

Finally, a number of interviewees highlighted the importance of having strong, broad support for transportation electrification at the state executive and legislative levels. Doing so can properly equip agency staff with the adequate resources and manpower needed to meet EVSE deployment goals and can align the public, private, and non-profit sectors. Such alignment is also key to harmonized operations between governments and utility schedules for permitting, site preparation, and ultimately EVSE construction. All interviewees shared that lack of collaboration and coordination between state agencies can undermine program execution and therefore the success of well-designed policies and programs.

Furthermore, several interviewees pointed out the importance of having a top-down approach to transportation decarbonization with a clear commitment from governors' offices and other executive branches of government, enabling coherent and effective policies and programs. Interviewees observed that when goals are aligned around decarbonization under clear top-down mandates and targets, it is easier to create and administer EVSE policies and programs, and therefore EVSE deployment is more successful. One example is the U.S. Climate Alliance, a bipartisan coalition of governors committed to reducing GHG emissions.[76] The Alliance promotes coordinated state action and provides opportunities for peer-to-peer learning and sharing of expertise among state agencies that work in the energy and climate areas with the goal of fostering capacity building among state agency staff.

72 "REV West," National Association of State Energy Officials, accessed August 31, 2021, https://www.naseo.org/issues/transportation/rev-west.

73 Jackson Lewis, "Kum & Go Expands EV Charging," *CSP: Convenience Store Products*, August 11, 2021, https://www.cspdailynews.com/fuels/kum-go-expands-ev-charging.

74 Tom Moloughney, "Electrify America Partners with Love's Travel Stops to Further Expand Network," InsideEVs, August 18, 2020, https://insideevs.com/news/439519/electrify-america-loves-travel-stops-partnership/.

75 Samantha Oller, "7-Eleven Adds More EV Charging in California," *CSP: Convenience Store Products*, December 2, 2019, https://www.cspdailynews.com/fuels/7-eleven-adds-more-ev-charging-california.

76 U.S. Climate Alliance website, accessed September 12, 2021, http://www.usclimatealliance.org/.

DISCUSSION

Synthesized Quantitative and Qualitative Analysis Results

Several of the insights that interviewees shared are consistent with results seen in the quantitative analysis. This includes expert opinions and insights regarding effective incentive, law, regulation, and program types, as well as the impact that statewide programs and multi-state collaboratives setting and reaching deployment goals can have on market development.

First, interviewees cited that funding plays a key role in supporting both EVSE deployment and improving the business case for EVSE operation. Indeed, the above examination of policy type combinations shows that average EVSE market development scores are highest among states with grants, rebates, and tax incentives. The same analysis shows that states with at least one of those incentive programs in addition to at least one of the two selected law and regulation types—climate change/energy initiatives or air quality/emissions programs—show similar results. Interviewees went on to say that rebate and grant incentive programs may be the most effective approaches for disbursing funding because they are relatively simple processes for both the applicant and the agency administering the program. While the quantitative analysis does not address the simplicity of processes, it does show that states with grants or rebates have higher measures of market development compared to states without those programs.

Interviewees also stated that federal tax credits for EVSE purchase and installation are among the most effective mechanisms for providing long term, stable, and financially significant incentives for the industry. The quantitative analysis results do not address how federal tax credits stack up to other incentives when assessed on the longevity or stability of their effects, but the results do show a positive association between tax incentives and EVSE market development. As with grants and rebates, states with EVSE-related tax incentive programs have higher market development scores than states without them, on average.

As for laws, regulations, and related programs, interviewees stated that statewide regulations which set actionable goals or mandates for EV adoption, EVSE deployment, and GHG emissions reductions are effective, especially in aligning public and private efforts, increasing agency coordination, and creating an environment that stimulates investment. As with the other policy types discussed above, the quantitative analysis suggests this may be the case. Policies and programs tagged as “climate change/energy initiatives” or “air quality/emissions” programs are associated with higher EVSE market development scores. The policy type combination analysis described above also mirrors these results, showing that the presence of such policies and programs is associated with some of the highest average EVSE market development scores. As described in previous sections, these policy type categories include state workgroups, planning efforts, multi-state collaboratives, and other related efforts to deploy EVs, deploy EVSE, and reduce transportation emissions. There is overlap between these types of programs and other policy types in the analysis because several of these programs provide a framework to implement more specific policy approaches, such as incentive funding and other enabling actions that can reduce barriers to EVSE deployment (for example, streamlining permitting processes).

Interviewees cited other policies that may be effective in enabling increased EVSE deployments, including passing legislation that allows potential charger hosts to resell electricity and not be considered public utilities, and therefore not be regulated by PUCs or DPUs. The quantitative analysis on policies tagged as "utility definition" shows similar results. In general, states with these policies have higher average market development scores than states without them. Similarly, interviewees cited the role that utility make-ready programs, EV-focused rates, and EVSE incentives can play in enabling EVSE deployment, and the quantitative analysis results correspond with this. Analysis shows that states with incentives tagged in the "other" category have higher average market development scores than states without them. Forty-four out of 51 (86%) of the "other" incentives included in this analysis fall under the "utility/private incentives" major policy category, which includes EV-focused rate programs, make-ready programs, EVSE incentive funding, and other related utility programs.

Finally, one area where there is some slight mismatch between interview responses and the quantitative analysis is regarding demand charges. As explained in the "Qualitative Interview Results" section, interviewees stated that the traditional design of utility demand charges is not compatible with non-residential EV charging applications. As described in the section on "Associations Between Demand Charges and EVSE Market Development," the research team compared average flat commercial demand charge rates by ZIP code with the number of public DCFC stations deployed by ZIP code, using the same 2016–2020 timeframe as the rest of the study. This analysis showed that, although the number of public DCFC deployed in ZIP codes with higher average demand charges did decrease, there are also significantly fewer ZIP codes in the U.S. with those higher average demand charges. Given these results, there is not enough evidence in the data to say that higher demand charges are a deterrent to public DCFC deployment.

These results do not say anything about the impact that demand charges have on operating costs for public DCFC; they only examine the association between demand charges and deployment. The impact of demand charges on public DCFC may be different from their impact on private DCFC (or even private Level 2 chargers), such as those at a fleet's private depot facility or garage. While more analysis is required, it may be that public DCFC owners can pass on demand charge costs to customers through the dollar/kWh fees they charge, therefore potentially reducing negative impacts of the demand charges on initial DCFC deployment. Private fleets, on the other hand, cannot pass through demand charge costs to any other parties; they alone are liable for those costs. Other studies have indicated that demand charges may create unfavorable economic conditions for the deployment of high-power DCFC, such as the analysis by GPI which was previously cited and found this result to hold even at higher levels of charger utilization.[77]

The analysis in this study did not break out DCFC by power level (for example, 50 kW, 100 kW, 150 kW, etc.), and doing so may yield more nuanced results. It could be that higher demand charges impact deployment of EVSE differently depending on how high-powered they are, along with the interaction of other factors including EVSE utilization and whether the EVSE incorporate energy storage technologies. As described previously in the "Associations Between Demand Charges and EVSE Market Development" section, the utilization of EVSE also plays a role in determining the business case for DCFC with respect to demand charges. The GPI study found that, in general, higher utilization leads to a more positive business case for DCFC when compared to DCFC of the same power level and lower levels of utilization. More analysis is required to confirm the findings regarding public DCFC above, to examine the impact that demand charges may have on operating costs for public DCFC (including the impact to customers), to examine demand charge impacts on private charger deployments, to understand what influence EVSE power level has on these results, and to understand how utilization may influence the results, especially given the anticipated increase in EV adoption in the coming years. As described in the "Utility Policies and Programs" section, utility rate design efforts are underway to approach the issue of demand charges with respect to EV charging, and technological solutions (such as integrated energy storage) exist as well.

77 Great Plains Institute, Overcoming Barriers to Expanding Fast Charging Infrastructure in the Midcontinent Region, white paper written on behalf of Midcontinent Transportation Electrification Collaborative, July 2019, https://scripts.betterenergy.org/reports/GPI_DCFC_Analysis_July_2019.pdf.

CONCLUSIONS

This study sought to identify the major existing EVSE-deployment-related U.S. policies, incentives, laws, regulations, and programs implemented from 2016 through 2020; to evaluate the effectiveness of these policies; to evaluate the relationship between policies and the development of the broader EV and EV charging market; and to identify opportunities for future policy formulation. Through both quantitative and qualitative analysis, the study has yielded the following major results.

Several policy types contribute to EVSE market development in their own ways: Several incentives, laws, and regulations were associated with higher levels of EVSE market development.

When examining differences in measures of EVSE market development between states with and without individual policy types, a number of policies categorized as both "incentives" and "laws and regulations" were found to have significant positive associations with market development. Incentives include grants, rebates, tax incentives, loans and leases, and utility incentive programs. Laws and regulations include air quality and emissions reduction programs, concerted efforts to increase charger deployments, legislation clarifying that EV charger owners and operators are not to be regulated as public utilities, and requirements related to alternative vehicle procurement and fuel use. Statistical analysis shows that for each of these policy types, the differences between states with and without each one individually are greater than the variation within those two groups of states and that this difference is statistically significant.

States employing a broader set of policy approaches have higher measures of EVSE market development, especially states mixing incentives with state programs focused on transportation emissions reduction and clear deployment goals or mandates.

As described in the "Combinations of Policy Types," section, in general, states with higher measures of EVSE market development have adopted a larger quantity of policies across a wider range of policy types. Figure 4 shows the percentage of states with each EVSE-related policy type examined, and Figure 5 shows the average EVSE market development score for states with certain numbers of unique policy types adopted, clearly indicating that a broader range of policy approaches is positively associated with higher market development.

FIGURE 4: PERCENTAGE OF STATES WITH GIVEN POLICY TYPES

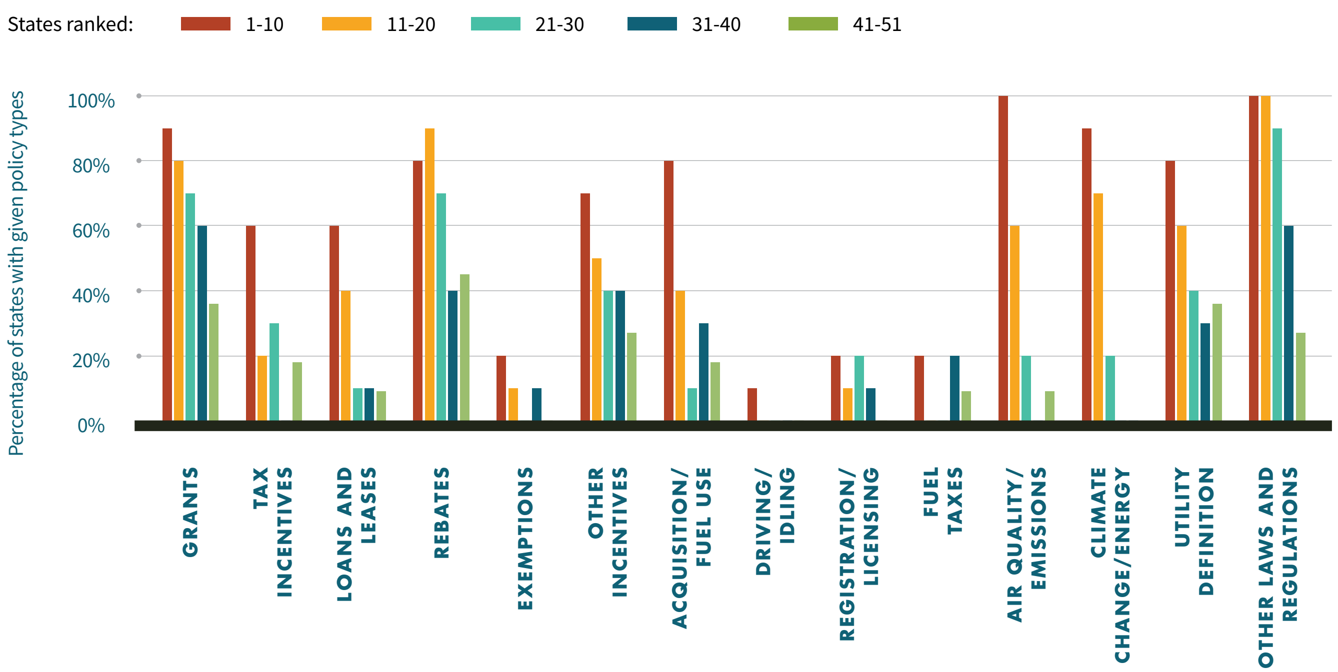
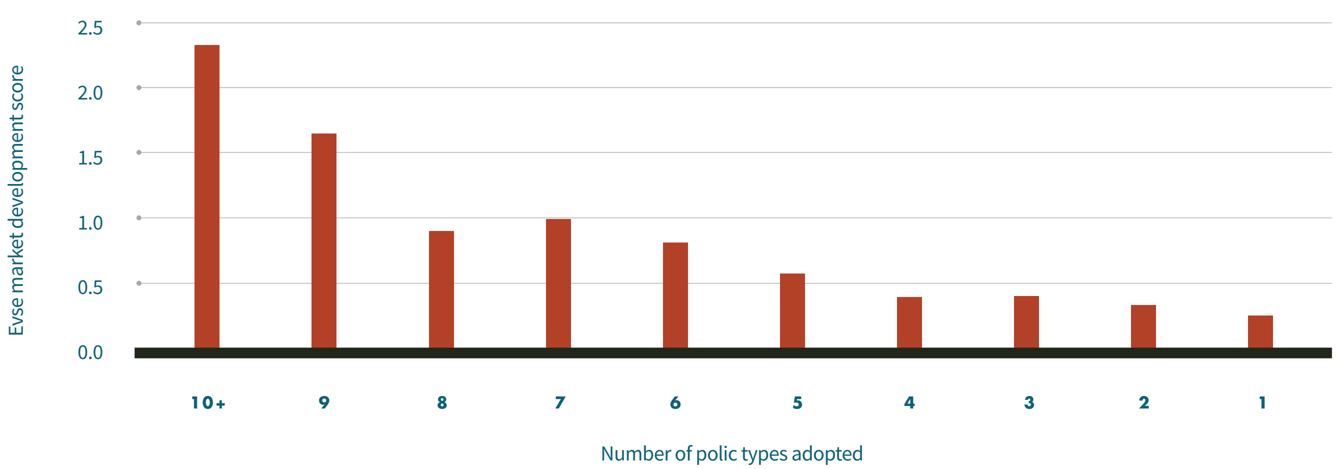


FIGURE 5: AVERAGE EVSE MARKET DEVELOPMENT SCORE BY BREADTH OF POLICY ADOPTION



Certain combinations of policy types were also associated with both higher levels of market development and larger differences between states with and without those combinations, namely incentive funding (grants, rebates, tax incentives) and a state program focused on deploying EVs, deploying EV charging infrastructure, and reducing transportation emissions.

Public funding has been a significant contributor to charging station deployments, accounting for an estimated one-quarter of variation in state-level deployments.

According to Atlas Public Policy's EV Hub, as of August 2021, 31 states announced the investment of public dollars into the deployment of EV charging stations from 2016 through 2020, and 30 of those states had spent some or all of the funding announced.[78] Levels of per capita funding vary by state, as does the ratio of charging stations deployed per 100,000 people compared to per capita funding. A linear regression of this data suggests that public funding may account for roughly 26% of the variation in charging station deployments across the states, on average. The same regression estimates that, on average, a $1.00 per capita investment may yield roughly six (6.48) EV charging station deployments per 100,000 people. Figure 12 shows the distribution of state investment and deployments from 2016 through 2020.

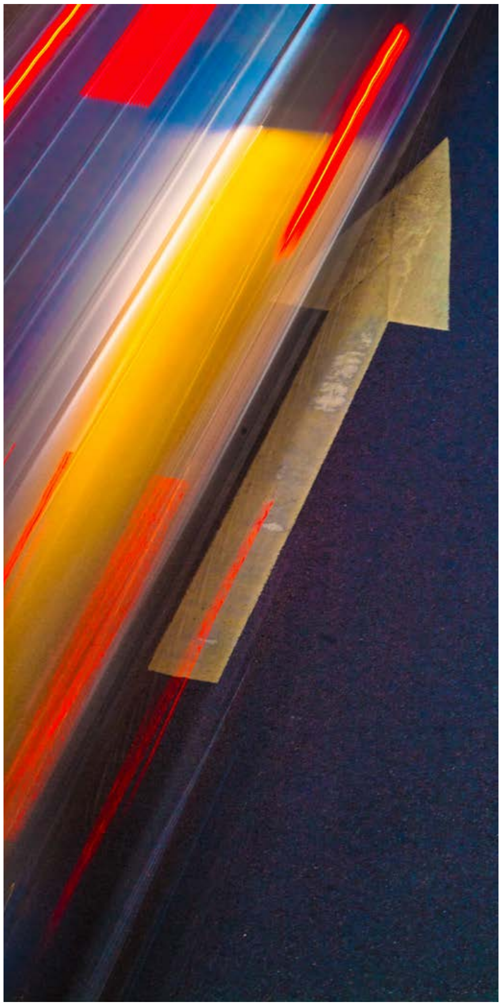
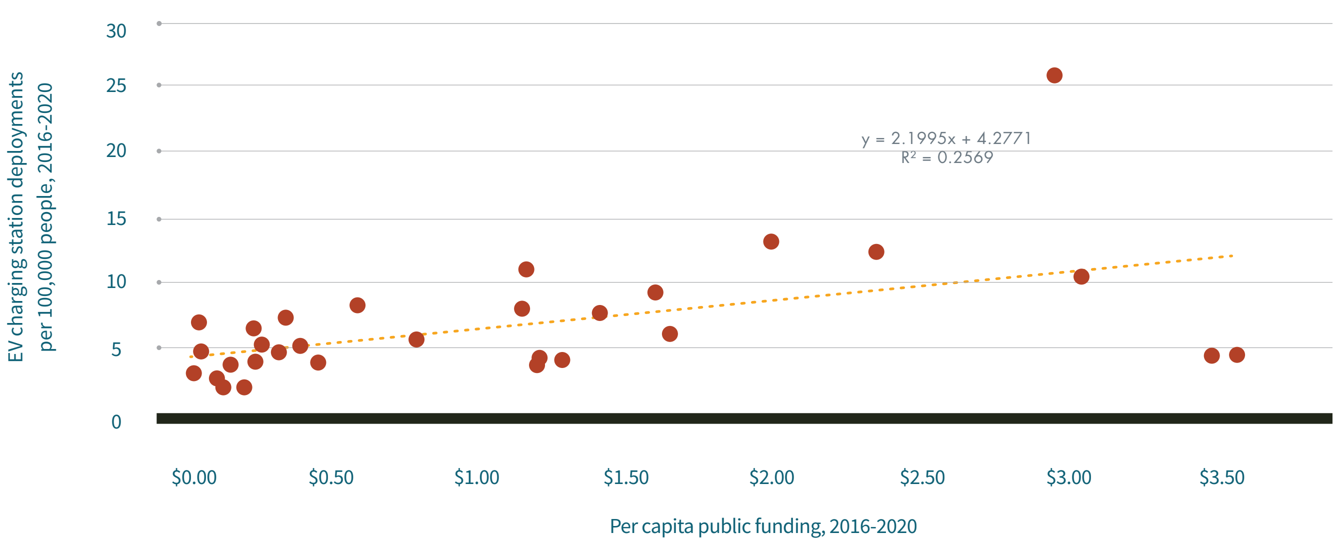


FIGURE 12: CHARGING STATION DEPLOYMENTS PER 100,000 PEOPLE VS. PER CAPITA PUBLIC FUNDING, 2016-2020 (ONLY FUNDING AWARDED AND FUNDING ENDED)



78 Atlas Public Policy. "State Policy Dashboard." EV Hub. Accessed August, 2021. https://www.atlasevhub.com/materials/state-policy-dashboard/

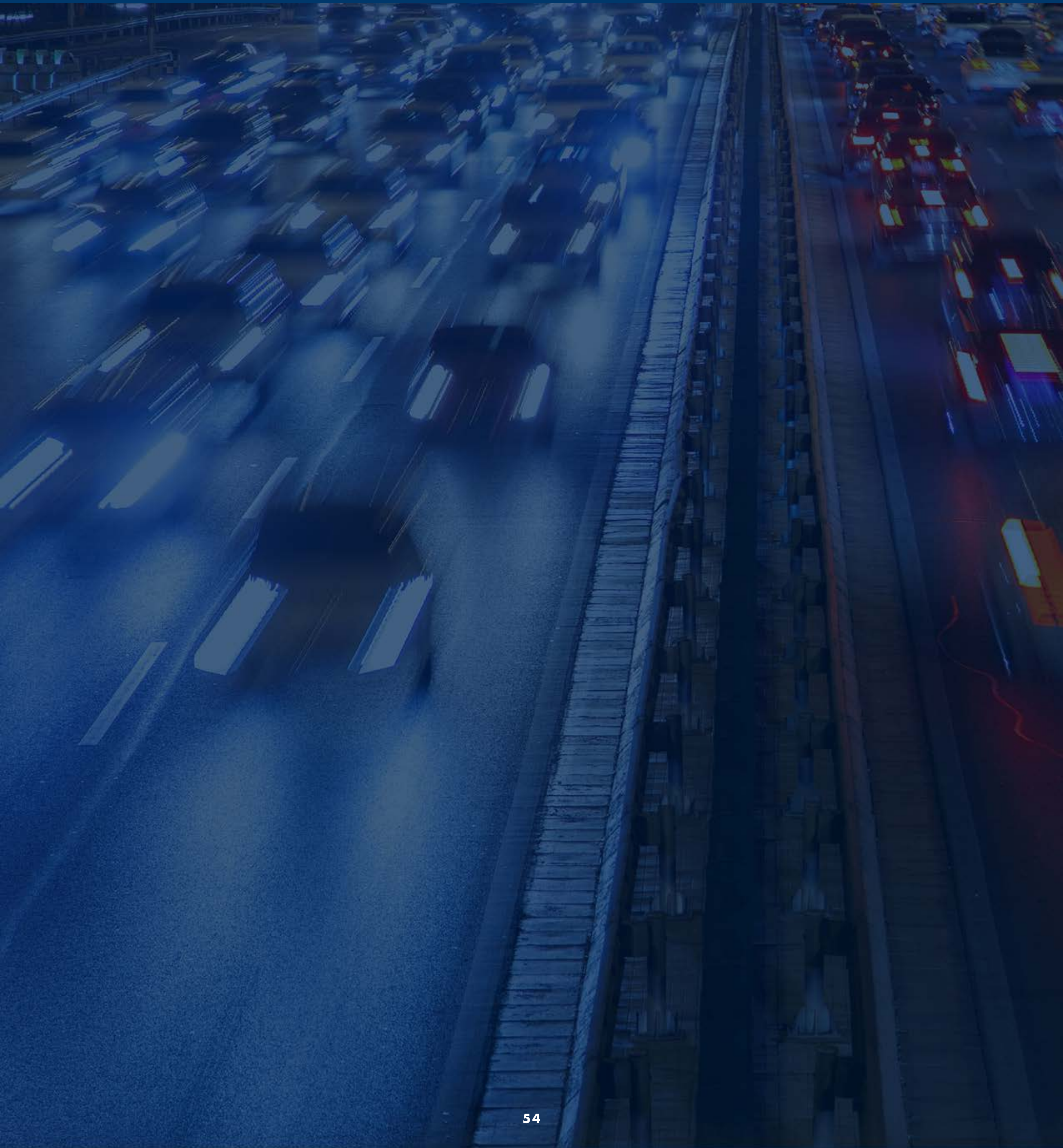
Higher demand charges alone do not appear to have a negative correlation with public DCFC station deployments, but other research and interview stakeholders have noted an impact on operating costs, which in turn might influence future EVSE deployment. More analysis is required.

Utility demand charges are commonly cited as a significant barrier to the deployment and operation of EV charging infrastructure due to prohibitively high operating costs that may result. Analysis comparing average commercial demand charge rates and the number of public charging stations with DCFC deployed by ZIP code shows essentially no correlation between the two. The analysis conducted only assessed the impact of demand charges alone on station deployments, and importantly, there are more factors that potential charging station owners must consider with respect to overall business case than just demand charges. Other factors may include items such as station utilization rate, charger power level, the rate of local EV registrations, the local policy environment, availability of incentives, utility rate design, population density, and utilization of technologies such as energy storage. A more comprehensive analysis is required, and the results in this study do not provide enough evidence to say that demand charges alone have had a significant impact on station deployments; other factors are likely also influencing deployments. The Great Plains Institute study discussed in the "Influence of DCFC Output Power Level" section does show that demand charges can increase operating costs high enough to make higher-powered DCFC less likely to reach profitability or breakeven. This may be a significant barrier to deployment of such high-powered DCFC. However, on the whole, this study's analysis finds no correlation between demand charges and DCFC station deployments. It is important to note that this study's analysis did not separate stations based on their EVSE's power levels. The analysis also did not control for the other potentially confounding variables described above. There could be multiple reasons for these results that warrant further examination. It could be that most public DCFC deployed are on the low end of DCFC power levels, and therefore, are more likely to achieve a positive business case. It could be that public DCFC owners spread demand charge costs by passing them through to their customer base. It may be that charging station owners are deploying EVSE in areas with relatively high demand charges in anticipation of a positive return on investment (ROI) in the mid- to long-term while accepting short-term losses or low ROI, possibly in anticipation of more favorable utility rates and policies. More analysis is required to fully interpret these results.

Interviewed experts shared best practices: Set clear and actionable goals, establish funding programs, encourage flexibility, and align state and local efforts.

The research team interviewed state government officials, electric utility representatives, and EVSP representatives. These experts shared that setting actionable goals for EV adoption, EV charger deployment, and emissions reduction are effective ways of aligning public and private efforts, increasing agency and multi-state coordination, and creating an environment that stimulates investment. Interviewees stated that funding should support both EVSE deployment and operation, and that grants, rebates, and tax incentives are reported to be effective mechanisms. Interviewees also shared that streamlined permitting processes encourage EV charger deployments as well. Finally, interviewees cited that programs with a higher degree of flexibility, clear guidance, and simplicity for applicants are more effective than overly prescriptive or complicated programs.

APPENDIX, GLOSSARY, AND BIBLIOGRAPHY

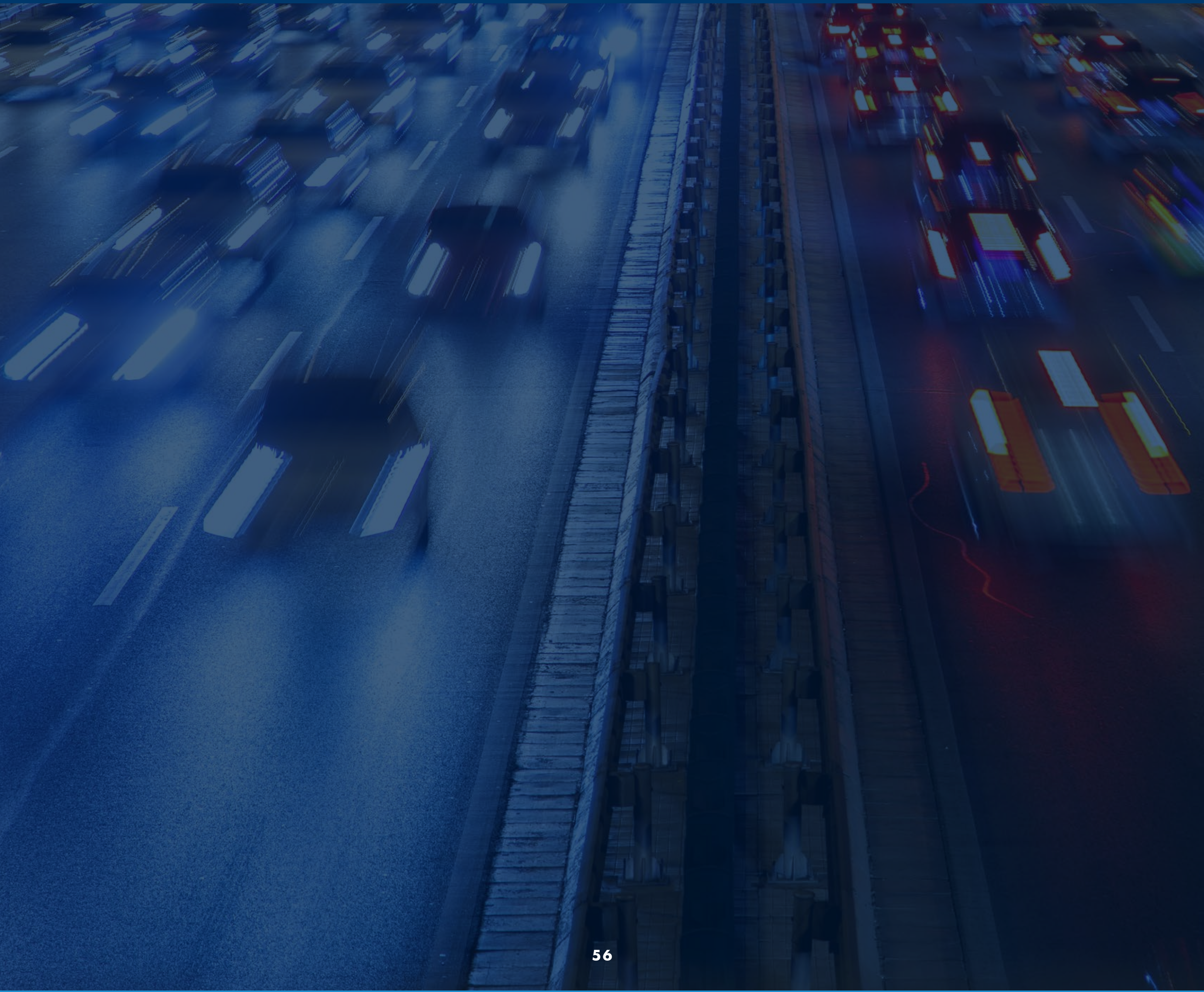


Glossary

ADA	Americans with Disabilities Act
AFDC	Alternative Fuels Data Center
BEV	battery electric vehicle
CFP	Clean Fuels Program
DCFC	direct current fast charger
DPU	departments of public utilities
DRIVE	Driving on Road Infrastructure with Vehicles of Electricity
EV	electric vehicle
EVSE	electric vehicle supply equipment
EVSP	electric vehicle service provider
GHG	greenhouse gas
HOA	homeowner association
ICCT	International Council on Clean Transportation
ICE	internal combustion engine
IEA	International Energy Agency
LCFS	Low Carbon Fuel Standard
MOU	Memorandum of Understanding
MUD	multi-unit dwelling
NESCAUM	Northeast States for Coordinated Air Use Management
NREL	National Renewable Energy Laboratory
PHEV	plug-in hybrid electric vehicles
PUC	public utility commissions
ROI	return on investment
TCI	Transportation and Climate Initiative
TOU	time-of-use
VW Settlement	Volkswagen Clean Air Act Civil Settlement
ZEV	zero-emission vehicle

APPENDIX A

Full Summary of Interview Questions and Responses



Full Summary of Interview Questions and Responses

THE PROJECT TEAM WOULD LIKE TO THANK THE FOLLOWING INDIVIDUALS FOR THEIR PARTICIPATION:

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INTERVIEW QUESTIONS

QUESTION 1: Based on your experience, what are the government (federal, state, and local), utility, and private policies and programs that have been the most (and least) effective for timely and cost competitive EVSE deployment? We are interested in public EVSE deployment, corridor level, commercial entities, businesses and workplaces, and multifamily housing.

Effective policies for EVSE deployment

- Funding
  - Incentives, rebates, and/or tax credits (13 mentions))
  - Grant program (for example, VW Settlement) administered in a flexible manner with low or no administrative burden but with clear guidelines and timelines (8 mentions)
  - Programs that allow matching public and private funds to support EVSE installation, for example, government covering 80% of costs (5 mentions)
  - California LCFS or the Oregon CFP that guarantee long-term clean energy credits (6 mentions)

- **Regulations**
  - EVSE deployment targets tied to GHG reduction and/or EV adoption mandates (9 mentions)
  - Clear program requirements and/or guidance (8 mentions)
- **Utility policies and programs**
  - Make-ready programs and/or utility rebates (11 mentions)
  - Electricity rate structures that reduce or eliminate demand charges (6 mentions)
  - TOU rates (5 mentions)
- **Other policies and programs**
  - Expedited and streamlined permitting processes (10 mentions)
  - Innovative Public Private Partnerships (6 mentions)
  - EV-readiness mandates in building, energy and/or zoning codes, at the state and/or municipal level (6 mentions)
  - Educational programs about EVSE installation for local entities (5 mentions)
  - Right-to-charge legislation (3 mentions)
  - EV corridor designation (3 mentions)

Ineffective policies and barriers for EVSE deployment

- **Funding**
  - Federal grants requiring lengthy application processes and have no flexibility (9 mentions)
  - Programs with no timelines to disburse funding for EVSE (4 mentions)
  - Cap on the tax credit for EVSE purchase and installation (2 mentions)
- **Regulations**
  - Prescriptive standards in EVSE products (for example, requirements for card readers, screens, connectivity requirements, and other technologies that are expensive to maintain) as well as Buy America requirements (6 mentions)
  - Strict site design requirements (6 mentions)
- **Utility policies and programs**
  - Lack of dedicated personnel with EVSE expertise (6 mentions)
  - Demand charges (5 mentions)

Other policies and programs

- Lack of aligned goals and coordination between state agencies (9 mentions)
- Lack of standardization in permitting processes and EVSE site design guidelines (6 mentions)
- Lack of state-agency administrative manpower and/or know-how to manage funds for EVSE deployment (6 mentions)

QUESTION 2: What makes for effective EVSE policy? What makes for ineffective EVSE policy?

Effective

- **Funding**
  - Use of VW Settlement to close charging gaps (3 mentions)
  - Minimal barrier of entry for grant applications (2 mentions)
  - Knowledgeable and experienced entities disbursing funds (1 mention)
  - Outreach to key stakeholders before developing incentives to make programs effective (2 mentions)
- **Regulations**
  - Ability for renters to install EVSE at multi-unit dwellings (2 mentions)
  - Recognizing EVSE as accessory use (2 mentions)
  - Ability for potential charge hosts of reselling electricity (1 mention)
- **Utility policies and programs**
  - Increase EVSE site host ROI by reducing and offsetting operational costs (for example, by setting rates, reducing, or eliminating demand charges) (4 mentions)
  - Troubleshooting issues on utility easements (2 mentions)
  - Comprehensive, long-term plans (1 mention)
  - Engagement with public commission staff (1 mention)
- **Other policies and programs**
  - Harmonized operations between local and state governments as well as utility schedules for permitting, site preparation, and EVSE construction (6 mentions)
  - Collaboration between state agencies (6 mentions)
  - Collaboration and goal alignment between public, private, and non-profit sector (3 mentions)

Ineffective

- **Funding**
  - Federal grants given to states without any prior administrative training (3 mentions)
  - Accounting mechanisms that are difficult to navigate, causing fund disbursement to be delayed and/or withheld (2 mentions)
- **Regulations**
  - Regulations that add to EVSE installation and equipment costs through strict design and siting requirements (4 mentions)
  - Overly prescriptive policies that force the adoption of standards add costs without improving user experience (4 mentions)
  - All requirements (including ADA) that add to site design costs and delays (2 mentions)
  - Anything that restricts site host and EVSE options, forcing customers to adopt a business model (1 mention)
- **Utility policies and programs**
  - Lack of dedicated personnel, soft costs and timelines are long (5 mentions)
  - Lack of executive support at a high level (3 mentions)
  - Lack of EV-ready sites (2 mentions)
  - Lack of engagement with stakeholder groups (1 mention)
- **Other policies and programs**
  - Programs that don't help with equipment operational issues (5 mentions)
  - Lengthy and complicated permitting processes (5 mentions)
  - Lack of commitments and champions at state and local levels (3 mentions)
  - Disconnect between states or local governments (3 mentions)
  - Lack of viable business model for charging hosts (3 mentions)
  - Expedited permitting that does not contain enforcement mechanisms (2 mentions)
  - Inconsistency across municipal department or jurisdictions due to lack of standards (2 mentions)
  - Lack of expertise and knowledge in possible charge hosts/EVSE operators (1 mention)

QUESTION 3: What have been the impediments to implement a particular EVSE policy or a set of policies?

Summarized responses:

- **Lack of a charging host business model that properly addresses demand charges**
- **Permitting processes that are overly prescriptive, too lengthy, and create barriers with easement and right-of-way, causing major impediments and deterring EVSE deployment**
- **Lack of knowledge about EVSE in potential site hosts and contractors; education to potential EVSE hosts and installers is needed to enable effective EVSE deployment**
- **Difficulty in finding adequate site hosts for corridor expansion especially in more rural areas due to several factors, including higher utility costs and lack of partnership opportunities**
- **Lack of dedicated, properly staffed, and prepared utility transportation electrification teams resulting in several-month delays in connecting EVSE to the grid**
- **Lack of independent EVSE maintenance contractors leading to few options for EVSE hosts, and high EVSE maintenance costs**
- **Lack of involvement and cooperation with HOAs and developers regarding make-ready installations in multifamily buildings resulting in EVSE providers installing chargers at nearby buildings to overcome permitting issues with new multifamily dwellings**
    - The multifamily housing landscape can also be difficult to navigate for utilities. Even with rebates, utilities have issues attracting HOAs' interest due to technical, business model, and liability concerns.

QUESTION 4: What is your agency/organization doing to address barriers to EVSE deployment?

Summarized responses:

- **Streamline and simplify permitting processes at the state and local level by:**
    - Collaborating with utilities on investment programs and interconnection processes
    - Designing flexible programs that avoid burdening site hosts and administrative teams by limiting paperwork and providing short timelines
    - Unifying organizations (governments, utilities, EVSE providers, site hosts) to create standardized processes
- **Avoid overly prescriptive and lengthy policies and programs altogether; for some EVSE equipment providers, this means giving up on financial incentives**
- **Collaborate with policymakers and regulatory commissions to make policy/program/regulation navigation easier and align goals**
- **Shape programs to lower the barriers of entry for applicants, specify equipment requirement to qualify for more incentives**

- **Invest in comprehensive education and outreach programs in critical areas such as:**
    - EVSE installer training (for example, through partnership with the International Brotherhood of Electrical Workers)
    - Municipal planning and zoning boards
- **Encourage private investment through various accessible and flexible incentive programs**
- **Focus on data collection on EVSE utilization to inform rate design**
- **Incorporate lessons learned to improve current policies while trying to scale up (pilot) programs**
- **Conduct outreach to a sample of small, medium, and large municipalities to assess the EV readiness for DCFC**
- **Promote access to charging at multifamily by supporting EV-readiness legislation**
- **Help developers overcome soft costs and barriers**

QUESTION 5: Have you been able to assess (qualitatively or quantitatively) the costs associated with developing and implementing EVSE policies—in terms of staff, manpower required for, for example, policy creation, education and outreach, coordination among agencies?

Summarized responses:

- **There are anecdotal examples of very prescriptive approaches in EVSE siting raising the cost of programs in terms of delays.**
- **There is a general correlation between funding availability and EVSE installations especially for DCFC; for example, state agencies or utilities have seen demand for DCFC going up in states immediately after VW Settlement funding was available.**
- **One entity noted that they do not have a formal system for tracking funding conserved/fiscal impact of policy adoption but informally have tried to estimate or capture the cost associated with burdensome paperwork.**

QUESTION 6: Have you been able to assess what impacts your EVSE policies and programs have had on EVSE deployment? Are you tracking any outcome metrics related to the policies/programs you have implemented?

Summarized responses:

- **Stakeholders mentioned qualitatively tracking the following:**
    - Dollars spent per charger deployed (easy to do with the LCFS and CFP initiatives)

- Effect of make-ready programs for EVSE installations
- Effect of adoption of ZEV standards
- Effect of funding availability and timing for disbursement
- Existence of streamlined EVSE permitting processes to identify where it is worth investing
- Utility filings, PUC proceedings, and utility investments

QUESTION 7: What complimentary policies (that is, public outreach, communications, marketing support, etc.) accompanied each EVSE policy, and what influence did they have on the policy's effectiveness?

Summarized responses:

- **Toolkits for workplace charging**
- **Outreach to commercial developers**
- **Community engagement programs to understand where community members want chargers; for example, Hawaiian Electric is using interactive mapping to collect community feedback at www.chargeuphi.com**

QUESTION 8: Can you provide specific examples that could potentially be used for case studies?

No responses were given to this question.

QUESTION 9: What are your plans for future EVSE policy developments or planned future updates to existing policies and programs?

Summarized responses:

- **Colorado:** Senate Bill 260 (SB21-260) creates new sources of dedicated funding and new state enterprises to enable the planning, funding, development, construction, maintenance, and supervision of a sustainable transportation system with a large focus on equity.
- **Oregon:** The Oregon Department of Transportation Climate Office, in partnership with the Oregon Department of Energy, completed the Transportation Electrification Infrastructure Needs Analysis study to identify the charging needs and gaps across Oregon, which led to the adoption of the Electric Vehicles Roadmap Initiative, a strategic action plan to develop policies to build out the EVSE ecosystem and eliminate current barriers.
- **California:** Will be focusing on deploying EVSE in disadvantaged communities and expand private investment opportunities.
- **New York:** Will continue to spend $40 million designated in 2018 for DCFC EVSE deployment.

- **Hawaii: T**he Hawaii's PUC recently approved a performance-based regulatory framework and an Innovation Pilot for Hawaiian Electric to spend $10 million per year for five years to design and implement a make-ready program. Notably, Hawaiian Electric developed the program in collaboration with the PUC over a year-long process, to expedite approval, smooth execution, and achieve higher outcomes.
- **New Jersey:** Will be working to implement and monitor the outcomes of recent legislation including the 2021 extension of the Clean Fleet Electric Vehicle Incentive Program and the implementation of NJ S3223 to streamline EVSE permitting processes. Will be also working together with other stakeholders to access EV charging station data usage to inform rate design.
- **Washington:** Will be implementing new policy and state legislation, including the LCFS and adoption of ZEV standards. Will be also focusing efforts to prepare sites to accommodate the influx of funding for EVSE expansion.
- **Vermont:** Will be focusing on MUD retrofits, initially targeted toward affordable housing with a pilot starting in 2022. In preparation for the influx of federal funding, the state will also create a strategic plan to cover EVSE infrastructure gaps. Education and outreach will be key components across these activities.
- **Massachusetts:** The investor-owned utility companies (Eversource, National Grid, and Unitil) recently submitted proposals to expand their EV programs through 2025. The proposed programs recognize the full scale of market needs and would comprehensively address residential and non-residential sectors, including fleets, workplaces, and commercial. Some notable proposals include:
  - Co-location of energy storage with DCFC (National Grid)
  - Installations of pole-mounted charges in 10-municipalities (National Grid)
  - Change how DCFC station operator pay for electricity to make DCFC financially viable in the short term and financially sustainable in the long term (National Grid and Eversource)
- **Maryland:** The state recently launched the Clean Fuels Incentive Program to boost EV and EVSE deployment across sectors with a focus on medium- and heavy-duty vehicles, including electric school buses. Other initiatives for the near future will focus on EVSE readiness in building codes and new multifamily dwellings, with environmental justice and equity as overarching themes.

APPENDIX B

State-By-State Measures of EVSE Market Development and Per Capita EVSE Deployment, 2016 Through 2020

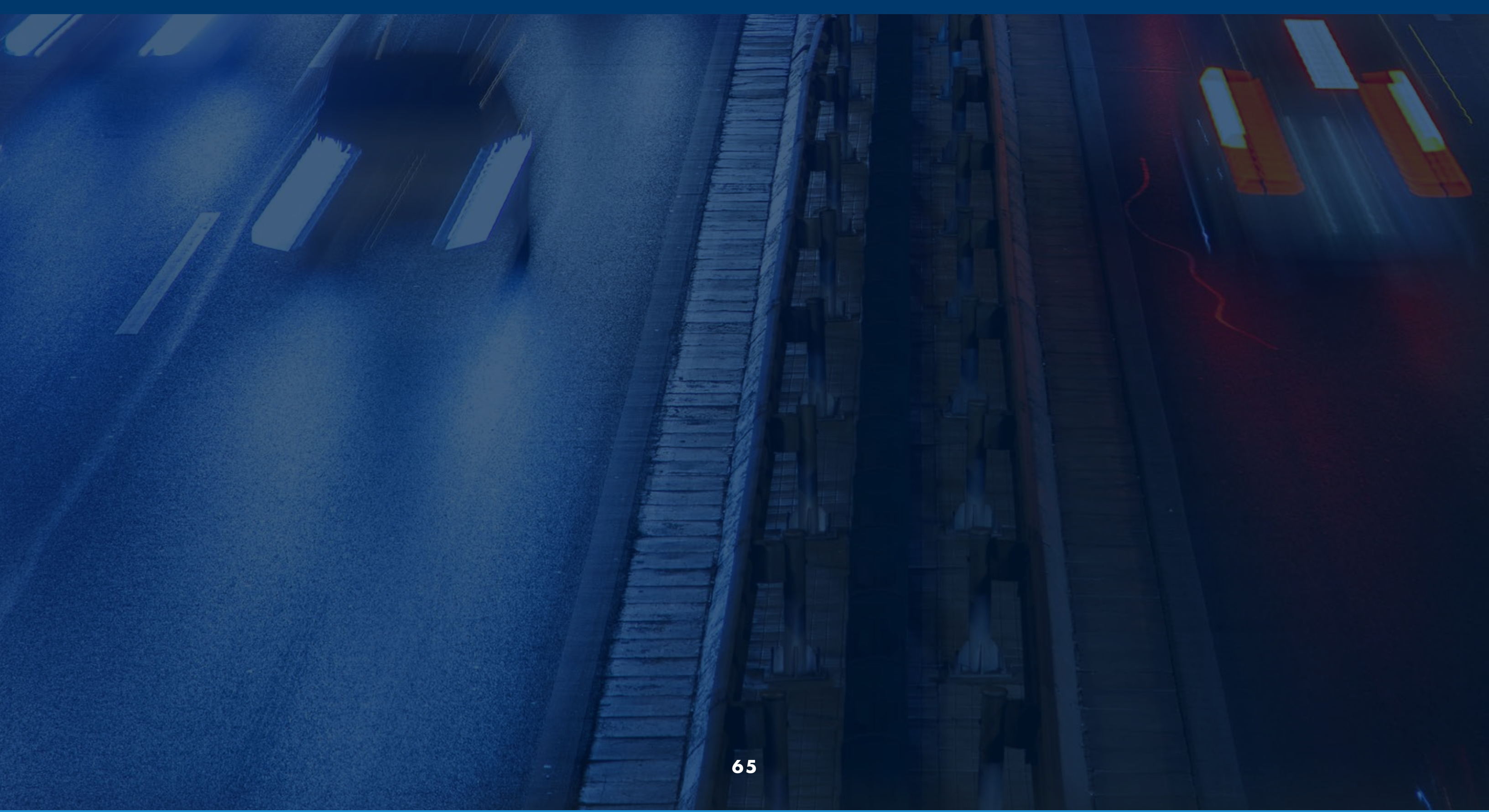


TABLE 9: EVSE MARKET DEVELOPMENT SCORE AND PER CAPITA EVSE DEPLOYMENT BY STATE, 2016–2020

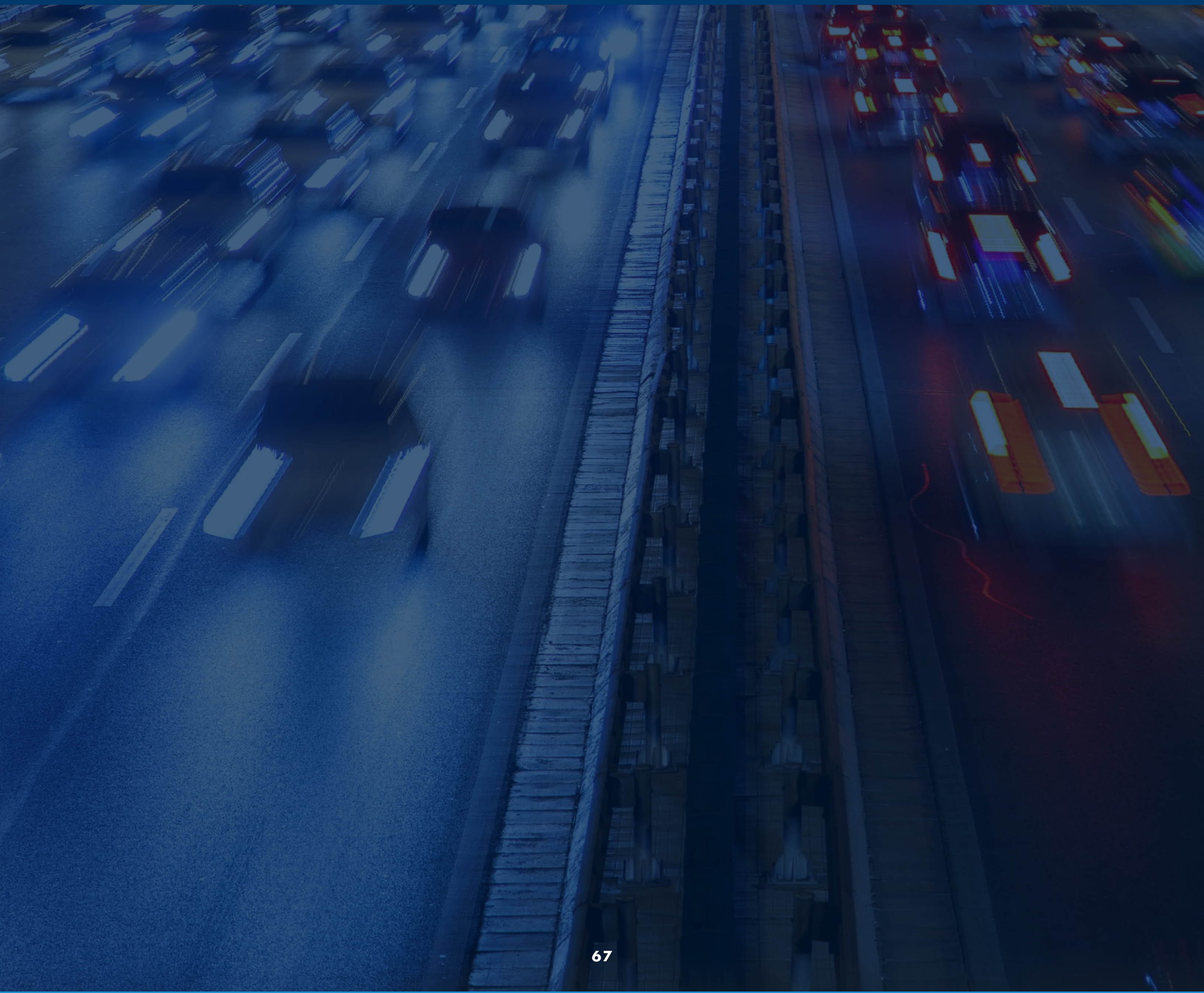
STATE	EVSE MARKET DEVELOPMENT SCORE*	EVSE DEPLOYMENT PER 1,000 PEOPLE, 2016–2020
Alabama	0.202	0.025
Alaska	0.240	0.031
Arizona	0.971	0.035
Arkansas	0.161	0.023
California	3.816	0.110
Colorado	1.470	0.131
Connecticut	1.014	0.060
District of Columbia	1.478	0.165
Delaware	0.808	0.044
Florida	0.791	0.052
Georgia	0.550	0.051
Hawaii	2.032	0.073
Idaho	0.338	0.047
Illinois	0.598	0.027
Indiana	0.314	0.020
Iowa	0.272	0.032
Kansas	0.330	0.030
Kentucky	0.198	0.028
Louisiana	0.151	0.020
Maine	0.772	0.124
Maryland	1.146	0.082
Massachusetts	1.268	0.093
Michigan	0.385	0.030
Minnesota	0.576	0.037
Mississippi	0.100	0.024
Missouri	0.392	0.052
Montana	0.311	0.047

STATE	EVSE MARKET DEVELOPMENT SCORE*	EVSE DEPLOYMENT PER 1,000 PEOPLE, 2016–2020
Nebraska	0.324	0.044
Nevada	0.961	0.064
New Hampshire	0.859	0.044
New Jersey	1.199	0.041
New Mexico	0.370	0.041
New York	0.882	0.073
North Carolina	0.503	0.048
North Dakota	0.155	0.045
Ohio	0.442	0.040
Oklahoma	0.369	0.056
Oregon	1.675	0.069
Pennsylvania	0.540	0.038
Rhode Island	0.723	0.076
South Carolina	0.269	0.025
South Dakota	0.193	0.039
Tennessee	0.317	0.018
Texas	0.387	0.027
Utah	0.909	0.104
Vermont	1.898	0.258
Virginia	0.775	0.060
Washington	1.709	0.079
Wisconsin	0.419	0.027
West Virginia	0.158	0.034
Wyoming	0.253	0.079
Average	**0.725**	**0.057**
Median	**0.503**	**0.044**

**EVSE market development is a weighted average of the number of EV charging stations deployed from 2016 through 2020 per state per capita (75% weight) and the number of EV sales per state per capita (25% weight) in the same time frame. State-level population estimates from the 2020 U.S. Census were used to estimate per capita values. Resulting values were then multiplied by 1,000 to improve readability of the values; original EVSE market development scores are in thousandths and ten-thousandths.*

APPENDIX C

Summary of State-Level EVSE Policies



The source of data for tables in Appendix C is the Alternative Fuels Data Center Federal and State Laws and Incentives Database.[79] This database is updated regularly to reflect up-to-date information on U.S. laws, incentives, regulations, and policies. Policy listing data for this study was retrieved in August 2021. Refer to the "Quantitative Data" section for information on what types of policy listings were included and excluded from this study's analysis.

TABLE 10: NUMBER OF POLICY LISTINGS PER MAJOR POLICY TYPE AND STATE

STATE	NUMBER OF EVSE-RELATED POLICY LISTINGS PER MAJOR POLICY TYPE			
	LAWS AND REGULATIONS	STATE HYBRID INCENTIVES	STATE INCENTIVES	UTILITY/PRIVATE INCENTIVES
Alabama	2	0	2	2
Alaska	0	0	0	2
Arizona	3	0	0	4
Arkansas	1	0	2	1
California	28	0	17	21
Colorado	14	0	5	3
Connecticut	11	1	3	3
District of Columbia	6	0	2	0
Delaware	3	0	2	0
Florida	7	0	1	4
Georgia	1	0	2	1
Hawaii	7	0	4	3
Idaho	2	0	1	2
Illinois	6	0	2	0
Indiana	0	1	1	4
Iowa	4	0	0	4
Kansas	1	0	0	0
Kentucky	1	0	1	1
Louisiana	0	1	2	0
Maine	8	0	3	1
Maryland	7	0	8	4
Massachusetts	8	0	6	2
Michigan	0	0	1	3
Minnesota	2	0	0	1
Mississippi	0	0	0	0
Missouri	1	0	0	2
Montana	2	0	0	0
Nebraska	0	0	1	0

79 Alternative Fuels Data Center, "Federal and State Laws and Incentives," U.S. Department of Energy Vehicle Technologies Office, accessed August, 2021, https://afdc.energy.gov/laws.

STATE	NUMBER OF EVSE-RELATED POLICY LISTINGS PER MAJOR POLICY TYPE			
	LAWS AND REGULATIONS	STATE HYBRID INCENTIVES	STATE INCENTIVES	UTILITY/PRIVATE INCENTIVES
Nevada	5	0	0	2
New Hampshire	5	0	1	1
New Jersey	7	0	3	3
New Mexico	3	0	2	0
New York	8	0	5	16
North Carolina	1	0	2	0
North Dakota	1	0	0	0
Ohio	1	0	2	1
Oklahoma	3	0	1	1
Oregon	10	0	4	8
Pennsylvania	3	0	5	1
Rhode Island	7	0	3	3
South Carolina	0	0	1	0
South Dakota	1	0	0	0
Tennessee	1	0	1	0
Texas	2	0	4	2
Utah	6	0	2	1
Vermont	14	0	2	3
Virginia	14	0	2	1
Washington	21	0	8	6
Wisconsin	3	0	1	10
West Virginia	1	0	0	1
Wyoming	1	0	2	2
Totals	**241**	**3**	**117**	**130**
Share of policy type compared to all policies across the major category	**49%**	**1%**	**24%**	**26%**

TABLE 11: NUMBER OF POLICY LISTINGS PER INCENTIVE TYPE AND STATE

STATE	NUMBER OF EVSE-RELATED POLICY LISTINGS PER INCENTIVE TYPE					
	GRANTS	TAX INCENTIVES	LOANS AND LEASES	REBATES	EXEMPTIONS	OTHER
Alabama	0	0	0	2	0	1
Alaska	0	0	0	2	0	0
Arizona	0	0	0	3	0	1
Arkansas	0	1	0	1	0	1
California	6	0	2	26	0	8
Colorado	3	1	0	3	0	1
Connecticut	2	2	0	2	1	1
District of Columbia	0	2	0	0	1	0
Delaware	1	0	0	1	0	0
Florida	0	0	2	2	0	2
Georgia	0	1	0	2	0	0
Hawaii	1	1	1	4	0	1
Idaho	1	0	0	2	0	1
Illinois	1	0	0	1	0	0
Indiana	2	0	0	3	0	3
Iowa	0	0	0	4	0	0
Kansas	0	0	0	0	0	0
Kentucky	1	0	0	1	0	1
Louisiana	1	2	0	0	0	0
Maine	2	1	1	0	0	0
Maryland	6	1	0	5	0	0
Massachusetts	6	0	0	0	0	2
Michigan	1	0	0	3	0	1
Minnesota	0	1	0	0	0	0
Mississippi	0	0	0	0	0	0
Missouri	0	0	0	0	0	2
Montana	0	0	0	0	0	0
Nebraska	0	0	1	0	0	0
Nevada	1	0	0	1	0	1
New Hampshire	1	0	0	1	0	0
New Jersey	2	0	1	3	0	1
New Mexico	1	0	0	0	0	1
New York	3	0	0	13	0	13
North Carolina	2	0	0	0	0	0
North Dakota	0	0	0	0	0	0

STATE	NUMBER OF EVSE-RELATED POLICY LISTINGS PER INCENTIVE TYPE					
	GRANTS	TAX INCENTIVES	LOANS AND LEASES	REBATES	EXEMPTIONS	OTHER
Ohio	2	0	0	1	0	1
Oklahoma	1	0	0	0	1	0
Oregon	2	2	1	4	0	3
Pennsylvania	3	0	0	3	0	0
Rhode Island	1	1	0	2	0	2
South Carolina	1	0	0	0	0	0
South Dakota	0	0	0	0	0	0
Tennessee	1	0	0	0	0	0
Texas	4	0	0	2	0	0
Utah	2	0	1	2	0	0
Vermont	1	0	1	3	0	0
Virginia	2	0	2	1	0	0
Washington	6	2	1	4	2	2
Wisconsin	1	0	1	9	0	1
West Virginia	0	0	1	0	0	0
Wyoming	2	0	0	2	0	0
Totals	**73**	**18**	**16**	**118**	**5**	**51**
Share of incentive type compared to all policies across all incentive types	**29%**	**7%**	**6%**	**47%**	**2%**	**20%**

TABLE 12: NUMBER OF POLICY LISTINGS PER LAW AND REGULATION TYPE AND STATE

STATE	NUMBER OF EVSE-RELATED POLICY LISTINGS PER LAW AND REGULATION TYPE									
	ACQUISITION/ FUEL USE	DRIVING/ IDLING	REGISTRATION/ LICENSING	FUEL TAXES	FUEL PRODUCTION/ QUALITY	RENEWABLE FUEL STANDARD/ MANDATE	AIR QUALITY/ EMISSIONS	CLIMATE CHANGE/ ENERGY INITIATIVES	UTILITY DEFINITION	OTHER
Alabama	0	0	0	1	0	0	0	0	1	1
Alaska	0	0	0	0	0	0	0	0	0	0
Arizona	2	0	0	0	0	0	0	0	0	2
Arkansas	0	0	0	0	0	0	0	0	1	0
California	4	2	0	0	0	0	4	2	1	16
Colorado	7	0	0	1	0	0	2	3	1	5
Connecticut	0	0	0	0	0	0	3	2	1	6
District of Columbia	0	0	0	0	0	0	2	1	1	3
Delaware	0	0	0	0	0	0	1	1	1	1
Florida	0	0	1	0	0	0	0	1	1	4
Georgia	0	0	0	0	0	0	0	0	0	1
Hawaii	0	0	0	0	0	0	1	1	1	4
Idaho	1	0	0	0	0	0	0	0	1	1
Illinois	0	0	1	0	0	0	0	0	1	4
Indiana	0	0	0	0	0	0	0	0	0	0
Iowa	0	0	1	1	0	0	0	0	1	1
Kansas	0	0	0	0	0	0	0	0	1	0
Kentucky	0	0	0	0	0	0	0	0	1	0
Louisiana	0	0	0	0	0	0	0	0	0	0
Maine	1	0	0	0	0	0	4	2	1	2
Maryland	1	0	0	0	0	0	3	1	0	3
Massachusetts	1	0	0	0	0	0	3	1	1	3
Michigan	0	0	0	0	0	0	0	0	0	0
Minnesota	0	0	1	0	0	0	0	0	0	1
Mississippi	0	0	0	0	0	0	0	0	0	0
Missouri	0	0	0	0	0	0	0	0	0	1
Montana	1	0	0	0	0	0	0	0	0	2
Nebraska	0	0	0	0	0	0	0	0	0	0
Nevada	1	0	0	0	0	0	0	0	0	5
New Hampshire	0	0	0	0	0	0	1	1	0	4
New Jersey	1	0	0	0	0	0	2	3	0	2
New Mexico	2	0	0	0	0	0	0	0	0	2

STATE	NUMBER OF EVSE-RELATED POLICY LISTINGS PER LAW AND REGULATION TYPE									
	ACQUISITION/ FUEL USE	DRIVING/ IDLING	REGISTRATION/ LICENSING	FUEL TAXES	FUEL PRODUCTION/ QUALITY	RENEWABLE FUEL STANDARD/ MANDATE	AIR QUALITY/ EMISSIONS	CLIMATE CHANGE/ ENERGY INITIATIVES	UTILITY DEFINITION	OTHER
New York	0	0	0	0	0	0	3	1	0	6
North Carolina	0	0	0	0	0	0	0	0	0	1
North Dakota	0	0	0	0	0	0	0	0	0	1
Ohio	0	0	0	0	0	0	0	0	0	1
Oklahoma	0	0	0	1	0	0	0	0	0	2
Oregon	1	0	0	0	0	0	3	0	1	6
Pennsylvania	0	0	0	0	0	0	2	1	1	0
Rhode Island	0	1	0	0	0	0	4	3	1	2
South Carolina	0	0	0	0	0	0	0	0	0	0
South Dakota	0	0	0	0	0	0	1	0	0	0
Tennessee	0	0	0	0	0	0	0	0	0	1
Texas	0	0	0	0	0	0	0	0	1	1
Utah	1	0	0	0	0	0	0	0	1	5
Vermont	2	0	1	0	0	0	4	7	1	6
Virginia	0	0	0	0	0	0	1	2	1	10
Washington	3	0	2	1	0	0	4	2	1	11
Wisconsin	2	0	0	0	0	0	0	0	0	1
West Virginia	1	0	0	0	0	0	0	0	1	0
Wyoming	1	0	0	0	0	0	0	0	0	1
Totals	**33**	**3**	**7**	**5**	**0**	**0**	**48**	**35**	**25**	**129**
Share of law and regulation type compared to all policies across all law and regulation types	**14%**	**1%**	**3%**	**2%**	**0%**	**0%**	**20%**	**15%**	**10%**	**54%**

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EVC ELECTRIC VEHICLE COUNCIL

About the Electric Vehicle Council

The Electric Vehicle Council is a non-advocacy organization whose mission is to coordinate the efforts of organizations actively engaged in supporting the deployment of EV charging infrastructure. The EV Council works to distribute existing research and education materials to amplify and enhance its value to the market, as well as conducts original research to fill gaps in knowledge and further educate interested stakeholders concerning the opportunities, challenges, and successful strategies associated with the installation and operation of EV charging stations.

For more information on the Electric Vehicle Council and a current list of members, please visit: fuelsinstitute.org/Councils/Electric-Vehicle-Council

About the Fuels Institute

The Fuels Institute, founded by NACS in 2013, is a 501(c)(4) non-profit research-oriented think tank dedicated to evaluating the market issues related to vehicles and the fuels that power them. By bringing together diverse stakeholders of the transportation and fuels markets, the Institute helps to identify opportunities and challenges associated with new technologies and to facilitate industry coordination to help ensure that consumers derive the greatest benefit.

The Fuels Institute commissions and publishes comprehensive, fact-based research projects that address the interests of the affected stakeholders. Such publications will help to inform both business owners considering long-term investment decisions and policymakers considering legislation and regulations affecting the market. Research is independent and unbiased, designed to answer questions, not advocate a specific outcome. Participants in the Fuels Institute are dedicated to promoting facts and providing decision makers with the most credible information possible so that the market can deliver the best in vehicle and fueling options to the consumer.

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