How do Publicly Accessible Charging Infrastructure Installation Costs Vary by Geographic Location?

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Key Conclusions

- Average installation cost per unit for all publicly accessible Level 2 electric vehicle supply equipment (EVSE) installed in EV Project markets was $3,108.
- The five most expensive geographic markets had per unit installation costs over $4,000 ($4,004 to $4,588).
- The five least expensive geographic markets had per unit installation costs under $2,600 ($2,088 to $2,609)
- Similar to residential EVSE and direct current (DC) fast charger installation costs, the alternating current (AC) Level 2 EVSE installed in California were the most expensive installations.

Introduction

Publicly accessible charge stations are defined as those installed for businesses, institutions, and municipalities to provide charging to any and all plug-in electric vehicle (PEV) drivers. Typically, there is no prior relationship between the station owner and the station user that would prompt the installation, whereas fleet, workplace, and residential charging stations are intended to serve a specific vehicle or restricted population of vehicles.

Costs for installation of these units were an important part of the EV Project infrastructure study because these costs had an impact on host participation and, consequently, on the perception of PEV adoption.

Amongst the objectives for The EV Project was deployment of EVSE for PEV charging in geographically diverse markets. EV Project markets were selected based on the sales and marketing plans of PEV partners Nissan and Chevrolet. The diversity this provided enabled the project to evaluate the geographic considerations that affected installation costs and use of the charging infrastructure.

More than 8,000 Nissan Leafs and Chevrolet Volts purchased or leased in these markets were enrolled in The EV Project. Drivers of these vehicles agreed to allow EV Project researchers to collect and analyze data from their use of their PEVs and home EVSE, as well as their use of public charging infrastructure.

This paper provides an analysis of the installation costs for this publicly accessible EVSE and discusses the geographic factors that drove variations in the cost to install this charging infrastructure.

Data Analyzed

Information analyzed for this paper came from reports generated from The EV Project database, which was populated using data from charging site hosts, project support personnel, and the electrical contractors installing EVSE. The paper also benefits from the direct experience of The EV Project management team, which managed deployment of publicly accessible charging infrastructure.

Of the nearly 4,000 AC Level 2 EVSE units installed for public use, installation cost data for analysis is available for 2,479 units (approximately 60%). Although this is a good sample size and a reasonable representation of the total number of installations, the data available for analysis were not evenly collected over the study markets, as shown in Appendix A.

EV Project Commercial Deployment Approach

To interpret and fully understand installation cost data collected from deployment of publicly accessible charging infrastructure in The EV Project, one must understand the approach that was taken to recruit hosts for the charging infrastructure.

The objective for deployment of the “away from home” charging infrastructure in The EV Project was to provide charging where PEV drivers were likely to park or where hosts would like to have them park. In the first five markets of The EV Project, a local group of stakeholders participated in a detailed planning process developed by The EV Project’s Micro-Climate process.[1] One of the deliverables of this process was a plan for deployment of publicly accessible EVSE in the market. Local project personnel then solicited charging site hosts in the desired geographic locations to support deployment of this infrastructure. While the remaining markets did not implement a formal Micro-Climate process, they benefitted directly from the lessons learned when placing EVSE in the first five markets.

The EV Project plan directed installation of publicly accessible EVSE to begin in April 2011, about 3 months after residential installations began. This infrastructure was placed in accordance with the plan in the parking lots of retail locations, public attraction sites, public buildings, workplace environments, and many other venues.

A typical public EVSE site included multiple charging stations, which was encouraged for the benefit of both PEV drivers (to assure availability of EVSE) and hosts (to attract

more PEV drivers as customers for their business). Installation of multiple EVSE at a site often times also resulted in a lower installed cost per EVSE unit.

By the end of 2011, The EV Project installed publicly accessible Blink EVSE in the following10 geographically diverse markets:

1. Arizona (metro Phoenix and Tucson)
2. San Diego, CA
3. Oregon (Portland metro, Corvallis, Eugene, and Salem)
4. Seattle, WA (Seattle metro, Tacoma, and Olympia)
5. Tennessee (entire state)
6. San Francisco, CA
7. Los Angeles, CA
8. Washington, D.C. (metro area including MD and VA)
9. Dallas, TX
10. Houston, TX.

In spring 2012, The EV Project added the following three new markets:

1. Chicago, IL
2. Philadelphia, PN
3. Atlanta, GA.

Observations

The average installation cost for publicly accessible AC Level 2 EVSE in all EV Project markets is shown in Figure 1. The overall average was $3,108 per unit installed, with installation costs varying from less than $600 per unit to over $12,000.

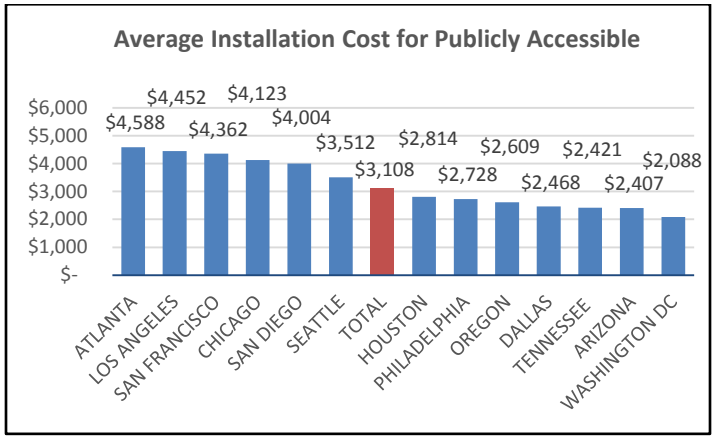

Figure 1. Average installation cost for publicly accessible EVSE by EV Project market.

The three California markets of Los Angeles, San Diego, and San Francisco were near the top in public EVSE costs, as they were for residential EVSE installation costs.[2] Data analyzed for all three California markets had significant installation numbers; however, the Chicago (19), Houston (52), Philadelphia (33), and Washington D.C. (38) market installation data provided far fewer samples.

A graphical representation of the comparative number of publicly accessible EVSE installations that had cost data available for analysis is shown in Figure 2. Three of the 13 markets defined for analysis (i.e., Arizona, Oregon, and San Diego) had 60% of the installations with cost data. Meanwhile, four identified markets are barely distinguishable in the pie chart. These low sample sizes do not provide a good basis for comparing average costs in these markets with other markets.

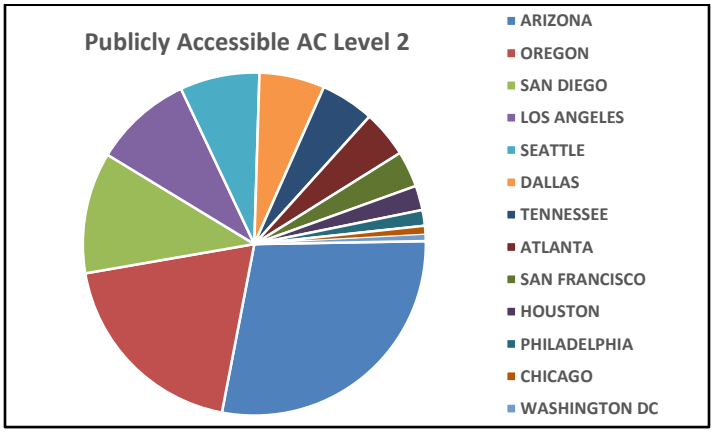

Figure 2. Number of publicly accessible AC Level 2 EVSE per market for which installation cost data are available.

The Atlanta installation cost data also deserve further analysis because their installation costs were unexpectedly high when compared to their position as the least expensive market for residential installation costs.

The 40 most expensive installations in the Atlanta market (i.e., 26% of the total installations with cost data in Atlanta) had an average cost of $7,175 per unit installed. This is well over twice the average installation cost of $3,108 and is the reason the average Level 2 installation costs in Atlanta appear to the far left in Figure 1. All 40 of these installations were part of a national agreement to install Blink charging stations. There was significant funding support from the national organization hosting these EVSE, enabling it to dictate placement of the EVSE in prominent locations in the parking area. These stations were installed away from the front of the building, in conspicuous parking spaces that were not in direct competition with shoppers seeking the shortest path to and from the store. The long electrical runs from the electric service panel (typically at the back of the store) to a location well into the parking lot

at the front of the store, made these installations much more expensive than typical installations in other markets.

Although the number of installations was small, the publicly accessible installations in Washington D.C. were also of interest. These EVSE installations represented the least expensive installations, in large part, because nearly 80% of them (Figure 3) were wall-mounted installations. These less expensive installations are discussed further in the paper, "What were the cost drivers for publicly accessible charging installations?"[4].

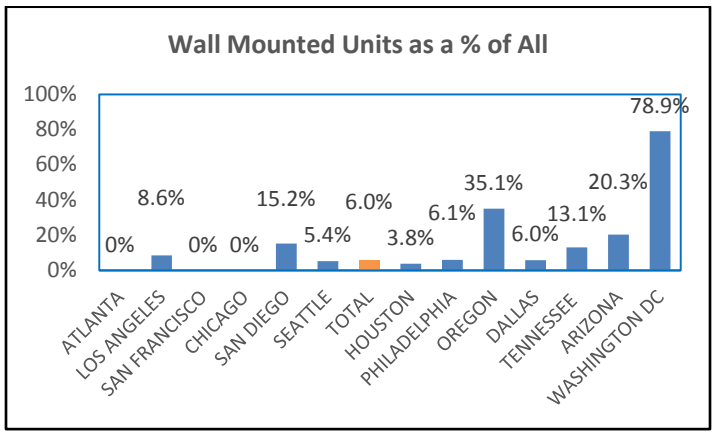

Figure 3. Wall-mounted units as a percentage of all non-residential units deployed.

As with residential charging costs by region,[5] labor was the primary geographic differentiator of EVSE installation cost, because the prevailing wages dictated by the Davis Bacon Act, which vary by market, were used for installation labor in all of The EV Project.

Another factor that affected installation costs in different markets was implementation of Americans with Disability Act (ADA) requirements as understood by the local permitting authority having jurisdiction. While Federal ADA requirements were in place during the term of The EV Project, these had not been specifically promulgated to the local level during the term of The EV Project, leaving the local authorities having jurisdiction to provide their own interpretations of ADA requirements. The authority having jurisdiction interpretations varied widely from locations with no ADA requirements at all to others that required fully accessible EVSE (including van accessible parking spaces) and accessibility from the EVSE to buildings on the host site.

Although ADA compliance was an objective for all EV Project installations for publicly accessible EVSE, requirements in the San Diego market were particularly rigorous and added significantly to installation cost.[6] An example of an ADA-compliant site is shown in Figure 4. The requirements typically affected the entire site layout; therefore, overall site installation costs were higher. This requirement was most prevalent at DC fast charger sites, which required an ADA accessbile AC Level 2 EVSE be installed alongside the DC fast charger unit.

Figure 4. ADA-access compliant EVSE installation.

The EV Project's approach to ADA can be found in The EV Project Lesson Learned White Paper, "Accessibility at Public EV Charging Locations."[7]

Conclusions

For markets with sufficient sample quantities for comparison, the average installation costs for publicly accessible AC Level 2 EVSE charging infrastructure varied by a factor of two across geographic markets; Arizona at $2,407 vs. Atlanta at $4,588.

Some charging site hosts supplemented the installation allowance provided by The EV Project to make their EVSE installations a more visible part of their business. While these decisions on EVSE installation met the host's objectives, they also led to higher-than-average installation costs.

As with residential installation costs,[8] California costs for labor and permitting of publicly accessible EVSE installations made them among the most expensive sites by geographic region. Further details on installation costs and cost drivers for publicly accessible EVSE can be found in the lessons learned paper, "What were the Cost Drivers for Publicly Accessible Charging Installations?"[9]

About The EV Project

The EV Project was the largest PEV infrastructure demonstration project in the world, equally funded by the U.S. Department of Energy (DOE) through the American Recovery and Reinvestment Act and private sector partners. The EV Project deployed over 12,000 AC Level 2

charging stations for residential and commercial use and over 100 dual-port DC fast chargers in 17 U.S. regions. Approximately 8,300 Nissan LEAFs™, Chevrolet Volts, and Smart ForTwo Electric Drive vehicles were enrolled in the project.

Project participants gave written consent for EV Project researchers to collect and analyze data from their vehicles and/or charging units. Data collected from the vehicles and charging infrastructure represented almost 125 million miles of driving and 4 million charging events. The data collection phase of The EV Project ran from January 1, 2011, through December 31, 2013. Idaho National Laboratory is responsible for analyzing the data and publishing summary reports, technical papers, and lessons learned on vehicle and charging unit use.

Company Profile

Idaho National Laboratory is one of DOE's 10 multi-program national laboratories. The laboratory performs work in each of DOE's strategic goal areas: energy, national security, science, and the environment. Idaho National Laboratory is the nation's leading center for nuclear energy research and development. Day-to-day management and operation of the laboratory is the responsibility of Battelle Energy Alliance.

For more information, visit avt.inl.gov/evproject.shtml and avt.inl.gov/chargepoint.shtml.

References

[1] http://avt.inel.gov/evproject.shtml#LessonsLearned EV Project lesson learned white paper, "The EV Micro-Climate Deployment Process in San Diego."

[2] http://avt.inel.gov/evproject.shtml#LessonsLearned EV Project lesson learned white paper, "How do Residential Charging Installation Costs Vary by Geographic Location?"

[3] http://avt.inel.gov/evproject.shtml#LessonsLearned EV Project lesson learned white paper, "How do Residential Charging Installation Costs Vary by Geographic Location?"

[4] http://avt.inel.gov/evproject.shtml#LessonsLearned EV Project lesson learned white paper, "What were the cost drivers for publicly accessible charging installations?"

[5] http://avt.inel.gov/evproject.shtml#LessonsLearned EV Project lesson learned white paper, "How do Residential Charging Installation Costs Vary by Geographic Location?"

[6] https://www.sandiego.gov/development-services/pdf/industry/tpolicy11b1.pdf Technical Policy11B-1 Subject: "Accessibility to Electrical Vehicle Charging Stations."

[7] http://avt.inel.gov/evproject.shtml#LessonsLearned EV Project lesson learned white paper, "Accessibility at Public EV Charging Locations."

[8] http://avt.inel.gov/evproject.shtml#LessonsLearned EV Project lesson learned white paper, "How do Residential Charging Installation Costs Vary by Geographic Location?"

[9] http://avt.inel.gov/evproject.shtml#LessonsLearned EV Project lesson learned white paper, "What were the cost drivers for publicly accessible charging installations?"

Appendix A

Table A-1. AC Level 2 EVSE installed, cost data available, and percentage of those installed with cost data for analysis.

Market	EVSE Installed per EV Project Status Report August 2013	EVSE with Installation Cost Data Available	Percentage of Installation Data Available for Analysis
Atlanta	202	141	69.8%
Los Angeles	440	208	47.3%
San Francisco	168	110	65.5%
Chicago	25	19	76.0%
San Diego	634	361	56.9%
Seattle	398	165	41.5%
Houston	134	52	38.8%
Philadelphia	75	33	44.0%
Oregon	527	437	82.9%
Dallas	433	167	38.6%
Tennessee	621	130	20.9%
Arizona	631	618	97.9%
Washington DC	39	38	97.4%
Total	**4,327**	**2,479**	**57.3%**