How Well did Non-residential EVSE Installations Match the Planned Areas in San Diego?

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Key Conclusions

- The San Diego planning process developed 3,333 target areas for deployment.
- The EV Project installed 530 non-residential electric vehicle supply equipment (EVSE) in 160 locations in the San Diego region.
- 98% of the installed EVSE units are within target areas.
- 98% of installed sites are within target areas.
- More than 1,135 target areas (34%) were served by the 160 deployed EVSE sites.

Introduction

The lack of public charging infrastructure for plug-in electric vehicles (PEVs) has been identified as a barrier to the widespread adoption of PEVs. Federal and state grants have been awarded to promote public charging and for retail businesses to have an interest in installing charging infrastructure. A common question for charger installations is, "Where should the chargers be placed?" One of the objectives of The EV Project was to study the interaction of PEV drivers with public infrastructure; therefore, again leading to the question of where this infrastructure should be placed.

In the early stages of PEV delivery to local markets, the options were as follows:

- Plan locations related to key attraction sites where PEV parking is anticipated
- Solicit retail and public charging hosts for random placement
- Ask early adopters where they want public infrastructure
- Identify sites near known high-traffic areas.

The EV Project chose locations related to key attraction sites where PEV parking is anticipated for planned deployment. The planning process used for San Diego is well documented in Appendix A. This paper considers how closely the final EVSE installation locations matched the planned approach.

Analysis Approach

The PEV charging stations, or more appropriately identified as EVSE, delivered by The EV Project included both residential and non-residential units. Non-residential EVSE included those installed in workplace environments, fleet applications, and those for public use that were located near retail centers, parking lots, and similar locations. The planning process identified target areas for EVSE deployment. In this analysis, the final EVSE deployment locations are plotted against the target locations to identify how well they match.

A preliminary report on this topic was prepared prior to the final installation of all project EVSE and reported in, "The Micro-Climate deployment Process in San Diego."[1] This report updates that paper to the final installation status.

Plan Results

Appendix A and Reference 1 provide the details of the planning process for non-residential EVSE placement in the San Diego region. That planning effort focused on attraction or destination sites, with anticipated high turnover of PEVs. The results of that process provided 3,333 targeted areas (Figure 1). Each circle is a quarter-mile buffer surrounding the target location. The quarter-mile buffer was determined to be the maximum distance a person would walk from the EVSE to the attraction. The close proximity of several of the attraction sites caused overlap in many target areas, especially in the metropolitan San Diego area.

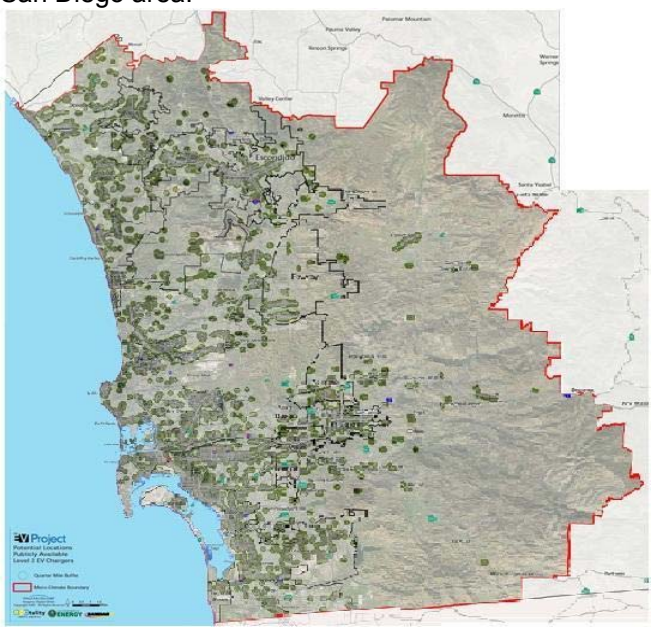

Figure 1. Target areas in San Diego are denoted by small gray circles. The green circles are the ¼ mile buffer areas that contain an EVSE.

The primary focus of The EV Project's regional manager in San Diego was to solicit business and property owners to be charging site hosts in those target areas.

Challenges to Deployment

The EV Project provided an alternating current (AC) Level 2 EVSE unit at no cost to the host, as well as a fixed credit toward installation costs with an agreement that the host would allow The EV Project to collect and analyze data from the equipment for the duration of the project. Several factors impacted the host's decision to accept the EVSE unit and installation cost credit offered. These included installation costs exceeding that credit, impact on the existing parking, Americans with Disabilities Act (ADA) compliance requirements, city permitting requirements, delays in the process, and the host company's internal legal, marketing, and strategic planning considerations.

For the local authority having jurisdiction (AHJ), installation of an electrical device in public locations involved parking considerations and compliance with ADA. This was new to most AHJs and little guidance was available. The EV Project did provide ADA compliance recommendations[2], but these recommendations were unofficial. Consequently, each AHJ developed their own requirements, which varied and made installation in some jurisdictions overly conservative and prohibitively costly.

The EV Project schedule delivered residential EVSE concurrent with vehicle delivery starting in December 2010. Installation of non-residential EVSE commenced in April 2011, consistent with the original project's schedule to closely following adoption of PEVs, and had a target for completion of that infrastructure by the end of 2011. The year 2012 was devoted to data collection and analysis. According to the schedule, non-residential EVSE installations occurred prior to complete deployment of the residential component.

The resulting scarcity of the PEVs deployed, market uncertainties, permit issues, and other uncertainties identified above resulted in less than an enthusiastic response to the invitation to become a charging site host, except by the most motivated hosts.

Results

A site that is desirable for publicly accessible charging should include more than one EVSE; therefore, the charging opportunity is available for more than one PEV at a time. Installation cost per EVSE is also reduced for sites with multiple units. Thus, the hosts were encouraged to provide space for at least two units. Several of the anticipated high-utilization sites installed larger numbers of EVSE. Table 1 identifies the number of sites with multiple EVSE in the San Diego market.

Table 1. Number of EVSE per site.

EVSE Count	Number of Sites
≥10	5
9	2
8	4
7	7
6	4
5	12
4	18
3	33
2	42
1	33

Final distribution of The EV Project's non-residential EVSE included 530 EVSE in 160 different sites (see Figure 2).

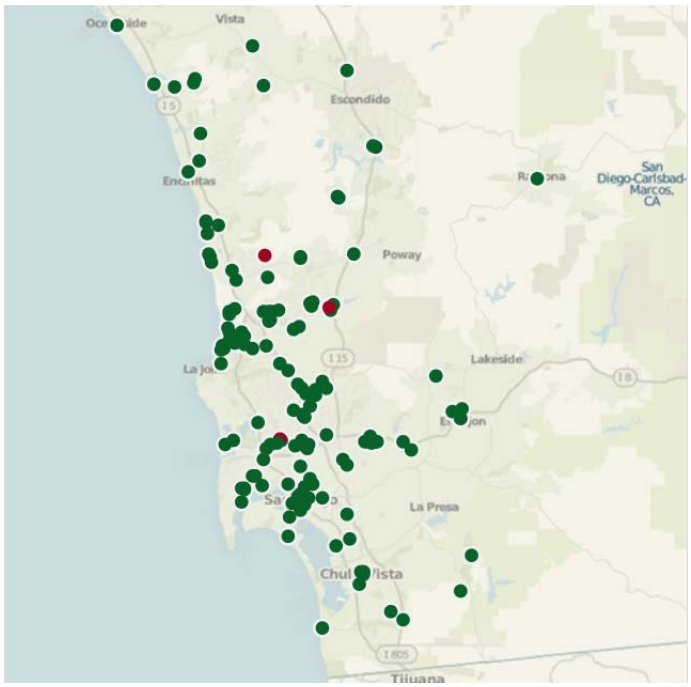

Figure 2. Final deployment sites of non-residential AC Level 2 EVSE. The green circles are EVSE installed in target areas. The red circles are EVSE that were not located within target areas.

Reference 1 reported that nine installed locations were outside the areas targeted by the planning process. However, correction of GPS coordinates reduced that to three locations. These three locations, shown in red, contain a total of 12 EVSE and all are associated with educational facilities.

Because many of the target areas overlap, an installed EVSE may actually be installed in and serve more than one target area. Reference 1 reported 1,138 target areas were served by the deployed EVSE.

Conclusions

Ninety-eight percent of the deployed EVSE units are in locations that were targeted in the San Diego planning process and 98% of the deployed sites are within the targeted areas. This success in meeting the planning goals provides a starting point for continued evaluation of the effectiveness of the planning process. Public utilization of these non-residential EVSE is evaluated in separate EV Project documents[3]. Overlapping of target sites resulted in more than 34% of the priority planned target areas being served by the 160 deployed EVSE sites.

About The EV Project

The EV Project was the largest PEV infrastructure demonstration project in the world. Equally funded by DOE through the American Recovery and Reinvestment Act and private sector partners, it supported the initial rollout of the Nissan Leaf and Chevrolet Volt PEVs, as well as the first deployment of PEVs in an all-PEV ride share application. The EV Project deployed over 12,000 AC Level 2 charging stations and over 100 dual-port DC fast chargers in 16 metropolitan areas across the United States during the period January 1, 2011, through December 31, 2013. Drivers of approximately 8,300 Nissan Leafs, Chevrolet Volts, and Smart ForTwo Electric Drive vehicles were enrolled in the project.

Project participants allowed EV Project researchers to collect and analyze data from their vehicles and chargers. Data collected from project vehicles and charging infrastructure document nearly 125 million miles of driving and over 4 million charging events in significant detail, characterizing the earliest days of electric vehicle adoption through significant penetration of both the vehicles and charging infrastructure. The data reside at Idaho National Laboratory, which is responsible for analyzing the data and publishing summary reports, technical papers, and lessons learned on vehicle and charger 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 about INL, visit http://www.inl.gov.

References

[1]"The Micro-Climate deployment Process in San Diego," Lessons Learned, avt.inl.gov/evproject.shtml.

[2]"Accessibility at Public EV Charging Stations," Lessons Learned, avt.inl.gov/evproject.shtml.

[3]2013 EV Project Electric Vehicle Charging Infrastructure Summary Report http://avt.inel.gov/pdf/EVProj/EVProject%20Infrastructure%20ReportJan13Dec13.pdf

[3]2012 EV Project Electric Vehicle Charging Infrastructure Summary Report http://avt.inel.gov/pdf/EVProj/EVProject%20Infrastructure%20ReportJan12Dec12.pdf

[3]2011 EV Project Electric Vehicle Charging Infrastructure Summary Report http://avt.inel.gov/pdf/EVProj/EVProject%20Infrastructure%20ReportJan11Dec11.pdf

Appendix A: San Diego Public EVSE Location Planning

Approach

The EV Micro-Climate® planning process was developed during The EV Project as an integrated turn-key program to ensure an area is well equipped with the needed infrastructure to support consumer adoption of electric transportation. Beginning with extensive feasibility and infrastructure planning studies, the program provided a blueprint to create a rich EV infrastructure.

The EV Micro-Climate process enlisted highly interested stakeholders in the region to provide local context, history, and drive for EV adoption. These stakeholders became the local EV Project Stakeholder Advisory Committee (ESAC) and they were active throughout the planning process. The Micro-Climate process focused the interests of this highly diverse group to produce three major planning documents. The evaluation of the Micro-Climate planning process is available at http://avt.inel.gov/evproject.shtml#LessonsLearned .

The EV Micro-Climate process in San Diego produced three documents: (1) Electric Vehicle Charging Infrastructure Deployment Guidelines for the Greater San Diego Area (May 2010), (2) Long-Range EV Charging Infrastructure Plan for Greater San Diego (October 2010), and (3) the EV Micro-Climate Plan for San Diego Region, California (February 2011). All documents are available at the same website referenced above.

Documents

The EV Infrastructure Deployment Guidelines provided indoctrination information and general guidance for starting the planning process. The Long Range Plan projected the PEV population in the greater San Diego area by the year 2020 and the projected public charging infrastructure densities that would support this population. The EV Micro-Climate Plan for San Diego narrowed the future look to the next 2 to 3 years to provide direction for the near-term installation of publicly available EVSE provided by The EV Project.

Methodology

The San Diego ESAC took an aggressive municipal planning approach to identify target locations within the boundary of The EV Project in the San Diego region (shown in Figure A1).

Figure A1. San Diego region of The EV Project.

There may be many different motivations for the host in locating public EVSE including generation of revenue from fees, promoting a public environmental image, encouraging patronage by the PEV driver demographic, and providing range extension for PEV drivers. The ESAC determined optimum locations for publicly accessible EVSE would be those with the following:

- High number of users
  - Integrated into daily life
  - Available to many different users
- High frequency of vehicle turnover
  - Vehicle stay times of 45 minutes to approximately 3 hours
- Significant availability
  - Maximize the number of open days per week and per year
  - Maximize the number of open hours per day.

When planning the locations, the geographic model was the Master Geographic Reference Areas (MGRA), which is a proprietary data unit designed and used by the San Diego Association of Governments. The 18,756 MGRAs are geographic areas roughly the size of census blocks in urban and suburban areas and census block groups in rural areas. MGRAs are designed to nest into larger standard geographies, such as census tracts, zip codes, and municipal boundaries. MGRAs are polygon shapes rather than points, but contain the points of interest that were expected to attract PEV drivers. An MGRA may contain more than one point of interest.

Several factors were considered in evaluating the suitability of an MGRA for its attraction to PEV drivers, and all MGRAs were rated with the results normalized to provide a score of 0 to 1. MRGAs with normalized scores above 0.16 were selected for target EVSE locations (Figure A2). This identified 3,333 of the total 18,756 MGRAs.

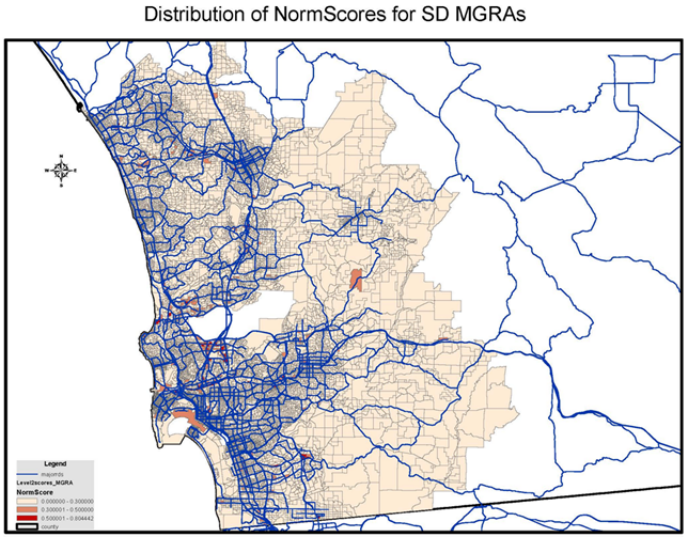

Figure A2. Normalized PEV Attractions MGRAs.

It is a generally accepted practice that a quarter of a mile is a reasonable walking distance between a parked PEV charging and the point of interest. A quarter-mile buffer circle from the center point of the MGRA provided the target location for a publicly accessible AC Level 2 EVSE unit.

Some MGRAs within high population densities are smaller than the quarter-mile buffer; therefore, many of the buffers regions overlapped.

This effort then resulted in maps of the San Diego region with quarter-mile radius buffers around the top-ranked MGRAs. Figure A3 shows one portion of the San Diego region with these buffers identified.

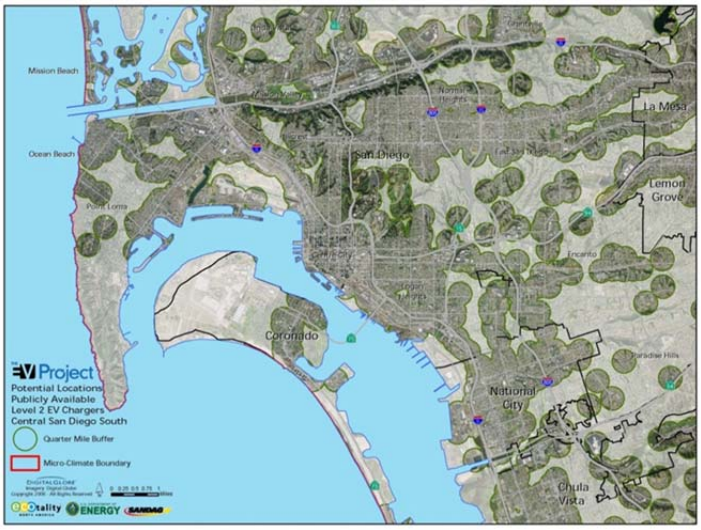

Figure A3. Quarter-mile buffers in San Diego region.

These buffers then were the primary targets used by The EV Project regional manager when seeking hosts for the deployment of publicly available EVSE.