DRISI

CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

Research Results

Evaluate Zero-Emission Vehicle Charging Stations at Caltrans Facilities

Research Direct Current Fast Charging (DCFC) installation cost, challenges, and opportunities for process improvements for future installations.

Design

MAY 2024

Project Title:
Evaluate Zero-Emission Vehicle Charging Stations at Caltrans Facilities

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WHAT WAS THE NEED?

Governor's Executive Order B-16-2012 mandates to reduce greenhouse gas emission. Electric vehicles offer a clean fuel alternative to meet above mandate; however, range anxiety and charging frequency and gaps between existing charging stations challenges adoption.

Caltrans is deploying charging stations to fill in gaps between existing charging stations. This effort will provide the data needed for planning process improvement for future installment.

WHAT WAS OUR GOAL?

The goals of the 30-30 project were to fill gaps in California's Direct Current Fast Chargers (DCFC) network service of 80 miles or greater in remote or underserved locations while collaborating with the California Energy Commission (CEC) and the Governor's office. The ultimate goal of the project was to install Zero Emission Vehicle (ZEV) charging stations in 37 Caltrans locations on high priority routes. The sites have been selected by Caltrans by evaluating previous studies and the best information available at the time. This research collected data on the implementation, maintenance, and utilization of new charging facilities being deployed to increase the charging coverage throughout California.

WHAT DID WE DO?

The UC Davis ITS team conducted literature review pertaining to

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other studies of DC Fast Charger construction costs and launch. Team also reviewed publicly available DCFC construction cost information/ studies conducted and published by State Agencies, U.S. Department of Energy, national labs, and independent research agencies. There was a gap in reliable studies that used real world case studies that were published and peer reviewed. Major private charging network companies who have reliable information and experience were not willing to share such information publicly because of their competitive advantage in an industry that is relatively new. Therefore, the full costs of installation and project launch for the Caltrans sites were carefully collected and validated independently for this study. The Institute of Transportation Studies (ITS) research team first interviewed Caltrans personnel such as design engineers, program managers, resident engineers, and landscape architects because they were involved in the construction and launch of the chargers. Each Caltrans site had unique construction and planning challenges to understand. Feedback from Caltrans personnel helped understand the management structure and the division of labor/ responsibilities within the DCFC projects design, scoping, and execution. They then collected best available cost information from winning project bids and any further cost changes during the project execution.

The cost information was categorized into relevant project sites where possible. Then cost information was further categorized by item description and amounts to better understand the cost elements and their contribution to final costs.
The ITS team then analyzed detailed architectural plans as well as detailed civil and electrical construction plans to understand the cost elements for most sites and how early-stage planning and design decisions have impacted final costs.
The costs were compared between different design choices in make-ready infrastructure, and between grid connected and off-grid solar DCFC station designs to better understand the holistic costs and implications of different design choices.

WHAT WAS THE OUTCOME?

The Caltrans 30-30 project, focusing on the installation of ZEV chargers in remote locations, encountered notable challenges leading to higher construction costs ranging from $122,000 to $440,000 per charger. These challenges included difficulties in obtaining energy supply due to the remote nature of the sites, absence of shared utility infrastructure resulting in higher make-ready construction costs, and increased costs associated with labor and material mobilization, particularly in locations with high foot traffic. Co-locating charging stations on opposite sides of freeways also introduced complexities and potential costs linked to limited access to local electrical grid.

Since the project initiation in 2017, the range of many plug-in electric vehicle (PEVs) models have improved and PEV adoption rates have also increased in California. As this project aims to support drivers taking long distance trips using PEVs, the project is even more relevant now. Range of PEVs have improved significantly as many PEV now allow for a range of 200-300 miles per charge. As of august 2022, the EPA has certified at least 14 light duty electric vehicles models to have a range of 300 miles or more. In terms of charging data analysis, variations were observed among different connectors and networks. For instance, drivers using the BTC Power CCS connector experienced an average connection time of 41.2 minutes with a consumption of 24.2 kWh, while CHAdeMO users had a 35.3-minute connection time and consumed 17.3 kWh.

WHAT IS THE BENEFIT?

The report delved into the reliability of Caltrans 30-30 ZEV chargers, uncovering maintenance and operational issues during the 2021-2022 period. Identified concerns included unattended repairs, equipment damages, charging capability issues, power outages, and planned rest stop closures. To address these challenges, the report proposed a novel probabilistic method leveraging usage

patterns to identify hidden charge failures, showcasing its potential to significantly improve charger operation and maintenance in future project phases. This information will assist Caltrans to develop policy and procedures regarding the deployment of future charging stations.

IMAGES

Image 1: Shandon Rest Area (Images from Google under fair use)

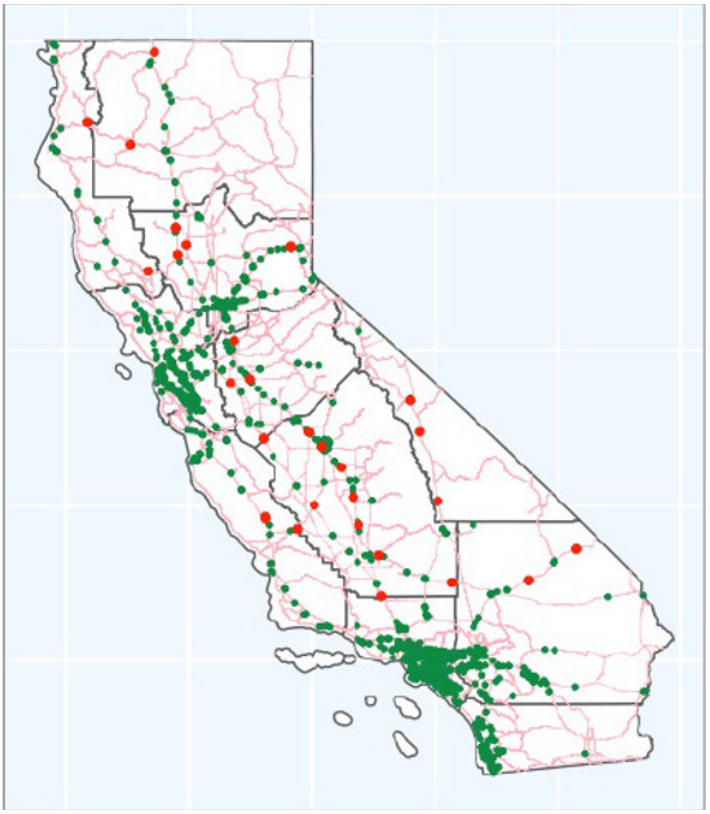

Image 2: Caltrans ZEV stations with California major roadways