CALIFORNIA STATE UNIVERSITY
Stanislaus

EV Charging Desert:

The Challenges with Electric Vehicle Charging in Stanislaus County

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Introduction

Figure 1. Tesla Model 3. (Tesla Motors, 2022)

In 2020, California State Governor Gavin Newsom issued an executive order banning the sale of new internal combustion engine automobiles by 2035 (Newsom, 2020). With the rise of fully electric vehicles (EVs) and the impending surge of additional EV sales through 2035, Stanislaus County is severely underprepared for the demands on public EV charging infrastructure. Tesla Motors is one of the most popular choices for fully electric vehicles (Liu, 2021) and has significant local charging infrastructure (Stanislaus County, 2022). Stanislaus County must prepare for the influx of varying vehicle manufactures and their varying charging solutions. Optimal placement of EV charging stations is just as important as the actual physical location itself (Battapothula et al., 2019). Can Stanislaus County take proactive measures to significantly improve the lacking public EV charging infrastructure, before the impending increase of electric vehicle charging demand surpasses the EV charger supply?

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Research Question

With the rapid increase of electric vehicle owners in Stanislaus County, can the lack of public EV charging infrastructure be addressed in a timely manner that offers all residents convenient access while optimizing location distances, costs and charging speeds?

Figure 2. Tesla Charge port.
(Tesla Motors, 2022)

Figure 3. Tesla Superchargers.
(Tesla Motors, 2022)

$$\min \left\{ \sum_{j=1}^{N_{FCS}} SDC\,(j) + \sum_{k=1}^{N_{TEV}} C_{EVU}\,(k) + C_{NPL} + C_{DG} + \max v_{dev} \right\}$$

Figure 4. Objective Function for optimal EV charging station placement.
(Battapothula et al., 2019)

Background and Literature Review

Recently a county report was released, that looks to address the EV charging concerns of residents (Stanislaus County, 2022). While this report addresses many of the core concerns for EV charging infrastructure in Stanislaus County, one area that can be explored further is the optimal placement of EV charging stations. The current evaluation of several parcels of land in Modesto that are targeted for potential EV charging locations (Stanislaus County, 2022), are too close to one another to be effective. Many of these locations are less than two miles from one another (Stanislaus County, 2022) and serve the same residents, having the potential to leave many residents without access to charging due to unequal distribution of charging infrastructure.

The negative effects of EV charger proximity are described by Battapothula et al.(2019). In the research paper, an objective function is presented that considers cost, charging speed, and location distance (Battapothula et al., 2019). Utilizing this algorithm an accurate projection could be given on the optimal distance for EV charging stations in Modesto. I will explore the objective function's data estimate of EV charging locations using the county's criteria for a highly valued location and compare if the two estimates correlate that a location is in fact, a critical location for new EV charging stations.

Methods

Target Groups (Participants)

- New or prospective electric vehicle owners in Stanislaus County
- Local government planning officials

Design

- This research project will consist of non-experimental data analysis and projection for the adequate amount of publicly available electric vehicle chargers in Stanislaus County.
- Search for a correlation between electric vehicle ownership and socioeconomic status, to help identify economic challenges and disparities associated with EV ownership and how that impacts EV charger access.

Materials

- Electric vehicle ownership data from the Stanislaus Council of Governments study (Stanislaus County, 2022) exploring the electric vehicle charging infrastructure.
- United States 2020 Census Data of Stanislaus County residents.
- Peer reviewed research articles discussing the transition to electric vehicles.
- Objective Function for optimal EV charging station placement (Battapothula et al., 2019)

Procedures

- Data used for initial evaluation will be from the Stanislaus County electric vehicle charging infrastructure study (Stanislaus County, 2022).
- Taking the total number of households in the county (US Census Bureau, 2020) and dividing by the number of publicly available vehicle chargers, will generate a ratio of chargers per household.
- Numerical data will be compared to another county in California with developed EV infrastructure to determine how accessible charging is in each county.
- Create a projection for the total number of required EV chargers to meet anticipated future demand by 2035 using the objective function (Battapothula et al., 2019).

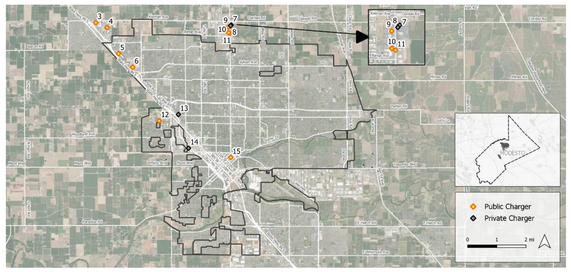

Figure 5. Map of Existing EV Charging Stations in Modesto, CA.
(Stanislaus County, 2022)

Expected Results

My hypothesis is that larger more technologically adept counties in California will have significantly more EV charging infrastructure due to larger population density, better government and private funding, and higher demand. These forward-thinking counties will be better prepared for California's mainstream transition to electric vehicles. While Stanislaus County will trail significantly behind in EV charging infrastructure, forcing residents to more heavily rely upon fossil fueled automobiles.

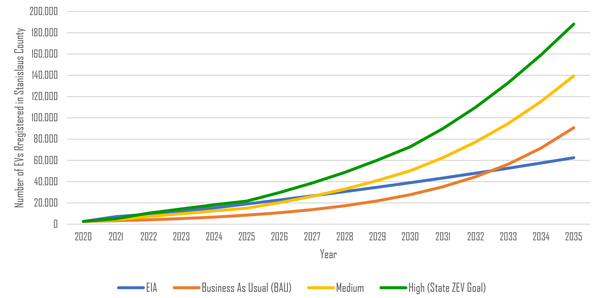

Figure 6. EV Registration Growth Projections for Stanislaus County
(Stanislaus County, 2022)

Significance

Electric vehicles have become the dominant form of alternative fuel transportation. Federal, state, and local governments continue to propose new legislation to reduce greenhouse gases and carbon emissions. Understanding how electric vehicles and charging stations integrate into existing transportation infrastructure will be critical for mainstream adoption. Electric Vehicles will soon be the main form of personal transportation in Stanislaus County, without proper action and infrastructure residents will be left with inadequate EV charging options.

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