CALIFORNIA ENERGY COMMISSION

California Energy Commission

Clean Transportation Program

FINAL PROJECT REPORT

Sacramento Regional TakeCharge Plan Implementation: Grocery Store Fast Charge Pilot

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PREFACE

Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) created the Clean Transportation Program, formerly known as the Alternative and Renewable Fuel and Vehicle Technology Program. The statute authorizes the California Energy Commission (CEC) to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013) reauthorizes the Clean Transportation Program through January 1, 2024, and specifies that the CEC allocate up to $20 million per year (or up to 20 percent of each fiscal year's funds) in funding for hydrogen station development until at least 100 stations are operational.

The Clean Transportation Program has an annual budget of about $100 million and provides financial support for projects that:

- Reduce California's use and dependence on petroleum transportation fuels and increase the use of alternative and renewable fuels and advanced vehicle technologies.
- Produce sustainable alternative and renewable low-carbon fuels in California.
- Expand alternative fueling infrastructure and fueling stations.
- Improve the efficiency, performance and market viability of alternative light-, medium-, and heavy-duty vehicle technologies.
- Retrofit medium- and heavy-duty on-road and non-road vehicle fleets to alternative technologies or fuel use.
- Expand the alternative fueling infrastructure available to existing fleets, public transit, and transportation corridors.
- Establish workforce-training programs and conduct public outreach on the benefits of alternative transportation fuels and vehicle technologies.

To be eligible for funding under the Clean Transportation Program, a project must be consistent with the CEC's annual *Investment Plan Update for the Clean Transportation Program*. The CEC issued PON-13-606 to provide funding opportunities for electric vehicle charging infrastructure. In response to PON-13-606, the recipient submitted an application which was proposed for funding in the Energy Commission's Notice of Proposed Awards dated July 3, 2014, and the agreement was executed as ARV-13-023 on November 10, 2014.

ABSTRACT

The California Energy Commission's Clean Transportation Program, formerly known as the Alternative and Renewable Fuels and Vehicle Technology Program, awarded the Sacramento Area Council of Governments $498,677 to install publically-available direct current fast chargers and level-2 electric vehicle supply equipment in area grocery stores to demonstrate that these specific land uses are potential locations for future installs.

This report outlines the process for negotiating with the host locations, designing and planning of electric vehicle supply equipment locations, the purchase and installation processes, and electric vehicle supply equipment usage.

Keywords: California Energy Commission, Sacramento Area Council of Governments, Sacramento Municipal Utilities District, electric vehicle supply equipment, Nugget Market, Sacramento Natural Foods Co-Op, Direct Current Fast Charger

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EXECUTIVE SUMMARY

The Sacramento Area Council of Governments created an electric vehicle supply equipment infrastructure plan in 2013 called TakeCharge. This plan estimated the amount, charging level needs, and general locations of electric vehicle supply equipment infrastructure based on a forecast of electrical vehicles in the region. One policy identified in TakeCharge was the use of electric vehicle supply equipment at certain locations to provide easily-accessible charging opportunities near multi-family dwelling units for those residents and at publicly-available locations that are visited by many people. That could help reduce range anxiety and accelerate the purchase of electric vehicles in the Sacramento region.

The funds received from the California Energy Commission were used to install electric vehicle supply equipment at pre-selected grocery stores within Sacramento Municipal Utility District's service territory to demonstrate that grocery stores are a suitable location for these types of EVSE.

Over a data collection period of six months, the electric vehicle supply equipment provided 11,305 kilowatt-hours of charging. This resulted in a reduction of almost 2,850 pounds of carbon dioxide, 7 pounds of volatile organic compounds, 5 pounds of oxides of nitrogen, and 45 pounds of carbon monoxide.

CHAPTER 1: Introduction

Problem Statement

Key barriers to large-scale electric vehicle (EV) adoption need to be removed in order to achieve the goals outlined in Governor Brown's Executive Order B-16-2012, which called for 1.5 million zero emission vehicles (ZEVs) by 2025. Three current barriers to EV adoption are: a limited ability to quickly charge in public settings, range anxiety on longer trips, and the lack of EV charging opportunities for those living in multi-unit dwellings (MUDs) like apartment complexes or condominiums. These barriers can be addressed by placing EV chargers, also known as electric vehicle supply equipment (EVSE), at locations that can address all three of these barriers.

The California Energy Commission (CEC) awarded $498,677 in grant funds to the Sacramento Area Council of Governments (SACOG) to create a regional EVSE installation and readiness plan to help overcome these and other barriers to EV adoption in El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba counties. The recently-adopted TakeCharge plan detailed below is the first step toward achieving the goals set forth in Executive Order B-16-2012 in the Sacramento region, and it will help the state reach its zero-emission vehicle and climate change goals.

Goals of the Project

The goal of this project is to begin implementing TakeCharge, the Sacramento area's EVSE installation and readiness plan that outlines the actions needed to help overcome some of the barriers and to help increase the adoption of EVs in the region. This project is a technology demonstration that will install EVSE at local grocery stores located along major corridors and will provide charging opportunities for the public in urban areas located along Interstate 80, Interstate 5, State Route 99, and U.S. Route 50, all of which are near clusters of MUD developments. This demonstration will then be used as a model by current and future property holders, businesses, and public agencies for future TakeCharge projects.

Objectives of the Project

The objectives of this project are to install EVSE at grocery store locations using a design that Sacramento Municipal Utility District (SMUD) created. The EVSE will meet three needs:

1. Publicly-accessible charging;
2. Charging along major freeway corridors in the region;
3. Charging located near MUD developments.

SACOG and SMUD will monitor the use of the EVSE and will document when they are being used, how often they are used, whether shopping or charging is the primary purpose of the visit, and users' willingness to pay for charging. This data will be used to determine whether similar publicly-accessible EVSE in the region are worth pursuing.

CHAPTER 2:
Property Owner Negotiations

Four sites were identified that met the needs of the demonstration project:

1. Sacramento Natural Foods Co-op (SNFC) at 2820 R Street, Sacramento, CA 95816
2. Nugget Market on Florin Road (NMFR) at 1040 Florin Road, Sacramento, CA 95831
3. Sprouts Market Land Park (SMLP) at 4408 Del Rio Road, Sacramento, CA 95822
4. Nugget Market in Elk Grove (NMEG) at 7101 Elk Grove Boulevard, Elk Grove, CA 95758.

Sacramento Natural Foods Co-Op

Property negotiations with the SNFC started in November 2013, which consisted of initial meetings with Paul Cultrera, the SNFC general manager, and Sally Freelander, the representative of Separovich and Domich, the site developers and land owners.

At the time of this initial meeting, the site construction had already begun for the parking garage site. Freelander described the project in detail and explained that four parcels would be part of the overall project, with two of the parcels being the former site of a plating manufacturer that required the State of California Department of Toxic Substances Control to clean prior to start of construction.

The owner of the parking garage, Parking Partners 3, LLC, and the property owner of the SNFC grocery store, Park Co-op, was represented by Freelander of Separovich and Domich. Negotiations concluded that, due to the limited amount of space available and the new siting standards requirement required by the Americans with Disabilities Act (ADA), the SNFC's main parking lot would have one type of EVSE called a direct current fast charger (DCFC) and that two level-2 EVSE would be installed in the parking garage.

Contract negotiations continued for months between SMUD Real Estate Services, SMUD's legal team, and Freelander to capture all the engineering changes necessary for the DCFC installation and wiring, the level-2 EVSE installation and wiring, SMUD's video camera security system in the parking garage, changes to the existing building permit for the DCFC and level-2 EVSE, legal exhibits showing siting of all the required electrical equipment, SMUD utility room electrical design to support the DCFC and level-2 EVSE, and SMUD's Rule 16 application, which mandates installation of an upgraded transformer to meet the new load requirements.

The final versions of the real estate license agreements were signed on March 30, 2016, between SMUD and Separovich and Domich. SMUD supply chain contracts were issued and signed by both SMUD and Separovich and Domich on February 1, 2016.

Nugget Market, Florin Road

SMUD Real Estate Services started negotiations with Bill Andrews, representing the property owner, Florin Five LLC, on May 18, 2015. Initial onsite meetings were scheduled and SMUD presented the initial project concept to Andrews. On June 3, 2015, BKF engineering started

work on site legal exhibits, including a detailed site survey. On July 22, 2015, SMUD's Real Estate Services presented a draft license agreement and siting plans for EVSE in the NMFR parking lot. Negotiations continued for a few months to resolve landscaping, fencing around the infrastructure, protecting existing trees, and verification of compliance of the design to city codes and standards.

On September 3, 2015, BKF Engineering started work on detailed construction drawings for the NMFR location and requested a new site survey to ensure that the path of travel from the EVSE parking stalls to the existing common sidewalk complied with ADA regulations. This new survey was necessary to determine how much construction work would be necessary to tie in the new path of travel to the existing sidewalk. The survey determined that the sidewalk ramp, and the entire common area around the ramp, was not ADA-compliant. SMUD Real Estate Services presented the findings to Andrews for further review with the property owner.

On October 2, 2015, SMUD was asked to prepare an accessibility upgrade evaluation for the property owners so the owners could review the total cost to resolve the ADA path of travel and ADA compliance issues. SMUD asked BKF Engineering to write a technical report of the survey findings. On December 10, 2015, SMUD presented the key findings:

- The cross-path slope exceeds the maximum allowable slope change.
- The slope in the parking area exceeds the maximum allowable slope.
- The depth of the existing parking stalls is less than the required 18 feet.

All of these items would have been addressed during the construction; however, the survey also found that the common area sidewalk that included the entrances to NMFR and its neighbor Starbucks Coffee was also not ADA-compliant. On January 27, 2016, Andrews contacted SMUD Real Estate Services and stated that the property owner was not prepared to sign a construction contract at this time and that SACOG and SMUD should move on to other opportunities.

Raef Porter, project manager at SACOG, was made aware of NMFR's decision and SMUD presented an alternate site at that time—SMLP. SACOG approved the new site and SMUD began the preliminary process of site evaluations.

Sprouts Market, Land Park

The property owner of SMLP contacted SMUD on November 23, 2015, stating an interest in having EVSE at the SMLP property. At that time, SACOG told the property owner that it had all four of sites identified for this TakeCharge project. After not being able to reach an agreement with NMFR, SACOG reached out to the property owner of SMLP on January 20, 2016, to discuss their interest in participating in this project. The property owner expressed an interest and negotiations began.

BKF Engineering ordered the site survey based on two siting plan options that were approved by the property owner. The detailed construction drawings and legal exhibits were presented to the property owner on February 23, 2016, for review. On March 3, 2016, the property owners declined to enter into the project.

Nugget Market, Elk Grove

On May 18, 2015, SMUD began negotiations with Jason Jaques and Mitch Engstrom of Engstrom Properties, owners of the NMEG site, for the installation of two DCFCs and two level-2 EVSE. On June 3, 2015, SMUD and Engstrom Properties had reached an agreement as to the site location for the infrastructure and EVSE which started the legal exhibits for the contract.

The proposed high voltage lines for the new electrical service went through multiple design reviews due to private property issues and SACOG's and SMUD's inability to get legal rights to dig for the electrical line extension. The new service was eventually extended within a public utility easement, which allowed for direct access to the NMEG property without crossing into multiple private properties.

The site layout designs for the concrete masonry unit enclosure, which would contain the SMUD high voltage transformer, meter mains, and switch gear, was relocated two times until Engstrom Properties approved the location at the back of the property and "out of sight" from the general public. On February 9, 2016, SMUD received approval for the third proposed site of the infrastructure. These changes were shared with the grid asset team for a new high voltage path for trenching, boring, and junction boxes. BKF Engineering was given the okay to precede with final detailed construction drawings.

On April 6, 2016, SMUD and Engstrom Properties signed the agreement for construction and installation of the EVSE.

CHAPTER 3:
EVSE Installation

Background

The proposal made to the CEC for grant solicitation PON-13-606 was for SACOG and SMUD to purchase and install the infrastructure for one DCFC, two level-2 EVSE, and two level-1 EVSE at up to three locations; however, due to changes at the installation locations, SACOG was only able to install the EVSE at only two locations: SNFC and NMEG. Additionally, the number and types of EVSE changed from what was originally proposed above to installing and commissioning three DCFC, and four level-2 EVSE. This was for economic, customer service, and marketing reasons—SACOG found that purchasing level-2 EVSE was nearly the same price as purchasing level-1 EVSE, and that level-2 EVSE takes less time to charge an EV battery than level-1 EVSE.

Electric Vehicle Supply Equipment

The DCFC EVSE are dual port, 50 kilowatt (kW), 480 volts direct current (VDC), 100-amp EVSE. This type of EVSE can charge an EV in about 30 minutes. SMUD will remain the owner and operator of the EVSE. To manage the payment system on the EVSE, however, SMUD contracted Greenlots, an open charge point provider (OCPP) which has radio-frequency identification technology that is compatible with the EVSE SMUD purchased for this project.

The level-2 EVSE are single port, 7.2 kW, 208-240 volts alternating current (VAC), 30-amp EVSE. Depending on the type of vehicle and the size of its battery, level-2 EVSE can fully charge an EV in less than 12 hours. Like the DCFC, the EVSE will be owned and operated by SMUD and Greenlots will manage the payment system.

Each DCFC cost around $40,000, and each level-2 EVSE cost nearly $8,300. All supporting equipment, including but not limited to cabinets, panels, signs, and security cameras cost about $22,500.

Sacramento Natural Foods Co-Op

Site Plan

SMUD's role with the SNFC was as a consultant. As the buildings were already under construction, the SNFC property owner already had its own civil engineers and general contractor. The site plans that were completed by SNFC's engineers included the new ADA access and path of travel requirements.

Construction

Property owners Separovich and Domich completed engineering and had contracted with High Tech Electric, YHLA Architects, and West Fork Construction to install the one DCFC and two level-2 EVSE in the parking garage.

The cost of construction for SNFC was about $57,200, and the complete cost to install the EVSE at this location was around $113,800.

Economic Benefits

Construction and installation of the EVSE at SNFC resulted in about 10 full time temporary construction jobs and around three full time temporary architectural and engineering jobs, as well as purchasing materials from local sources.

Nugget Market Elk Grove

Site Plan

The site plan for Nugget Market Elk Grove differed significantly from the proposal made to the CEC for grant solicitation PON-13-606.

Preliminary site plans went through multiple revisions while at the same time obtaining and executing subcontracts. On May 25, 2016, BKF Engineering, with the assistance of SMUD, submitted the construction drawings and filed an application for a building permit with the City of Elk Grove, and on July 12, 2016, the city issued the permit. On August 8, 2016, SMUD held a meeting at the NMEG location with the project team and the property owner to review the construction drawings prior to the start of construction. BKF Engineering revised the bore path and issued new drawings to reduce the construction risk, resulting in construction starting on August 22, 2016.

A fixed-priced contract was awarded to Arrow Construction, as it was the only company to bid on the request for quotation that was issued by SMUD. Arrow Construction's bid included the trenching and boring through the parking lot, the new SMUD service and all the associated requirements, complete removal of existing parking asphalt and installation of new asphalt that is complaint to ADA parking and path of travel, and the concrete masonry unit enclosure for the infrastructure.

Construction

SMUD purchased the two DCFC and the two level-2 EVSE, while all other required equipment and construction materials were purchased by Arrow Construction. This included a concrete masonry unit enclosure, a high voltage transformer, meter mains, and switch gear.

While digging the trench from the new transformer to the location of the EVSE, Arrow Construction discovered a manhole cover which led to a 10-inch sewer line that was not recorded on the easement. Neither SACOG, SMUD, nor Arrow Construction had knowledge of this sewer line until it was discovered, and it was, all construction stopped. SMUD began working with Sacramento County and the city of Elk Grove to properly identify the sewer line and easement and to obtain an encroachment permit for the NMEG portion of the project. The encroachment permit from Sacramento Area Sewer District, required the concrete masonry unit enclosure and infrastructure be moved to another location. Once again, SACOG and SMUD revised construction drawings for the concrete masonry unit area. These were updated by BKF Engineering and submitted to the City of Elk Grove for an updated building permit. Finding the unrecorded sewer line caused a seven-week delay and an increase in costs of about $85,000.

The cost of construction for NMEG was about $363,400, and the complete cost to install the EVSE at NMEG was around $460,000.

Economic Benefits

Construction and installation of the EVSE at NMEG resulted in about 20 full-time temporary construction jobs and around five full-time temporary architectural and engineering jobs, as well as purchasing materials from local sources.

Overall Project Costs

The Sacramento Regional TakeCharge Plan Implementation: Grocery Store Fast Charge Pilot project had a reimbursable budget of $498,676, with a match share commitment of $474,156, for a total of $972,832. SACOG, however, only used about $284,000 of its grant funds and spent about $695,200 in match share. The total cost of the project was around $979,300.

CHAPTER 4:
Site Commissioning and Opening

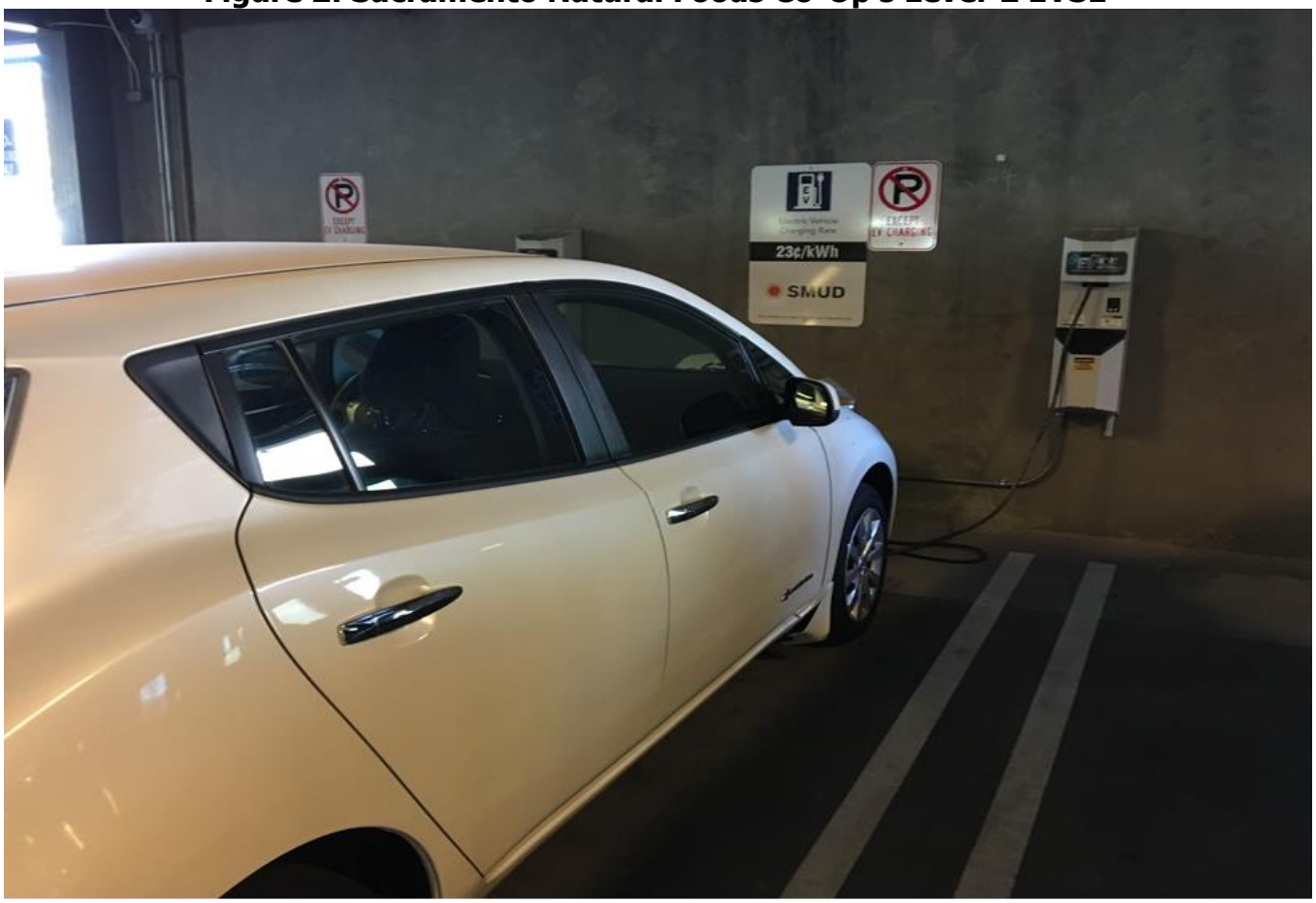
Sacramento Natural Foods Coop

All commissioning and testing for the SNFC site was completed on January 13, 2017. The EVSE were to be commissioned sooner than that, but the DCFCs needed updates to the software and required hardware upgrades; the wireless router needed to be programmed and installed and the OCPP software needed to be installed and programmed for Greenlots' remote payment system. The level-2 EVSE payment system was not installed at the time of construction at the site because the documentation from the OEM didn't provide sufficient instructions and details on what was required. SMUD hired an electrician to finish the installation of payment system. Figures 1 and 2 depict the DCFC in use from the point of view of the user.

Figure 1: Sacramento Natural Foods Co-Op's DCFC

Source: Sacramento Area Council of Governments

Figure 2: Sacramento Natural Foods Co-Op's Level-2 EVSE



Source: Sacramento Area Council of Governments

Nugget Market Elk Grove

All commissioning and testing for the SNFC site was completed on January 13, 2017. The EVSE were to be commissioned sooner than that, but like SNFC they needed updates to the DCFC's software and hardware upgrades; the wireless router needed to be programmed and installed, and OCPP software needed to be installed and programmed for Greenlots' remote payment system. Figure 3 shows the charger in use at Nugget Market in Elk Grove.

Figure 3: Nugget Market Elk Grove's DCFC

Source: Sacramento Area Council of Governments

EV Parking Stall Accessibility

At the time when SNFC and NMEG were being planned and designed, the California Building Standards Code (CBC) did not have a provision for dedicated ADA-accessible EVSE parking stalls. Knowing that this was going to change with the January 1, 2017, CBC cycle update, SMUD decided to implement design elements at NMEG that would allow an EV parking stall to be converted into an accessible EV parking stall in the future. With that decision, certain parameters for designing accessibility standards for the EV parking stalls with EVSE required significant additional site work that resulted in additional costs for the project. The following design elements were implemented:

Path of Travel

A key point of accessibility design is defining a path of travel. With regard to the EV parking stalls, an ADA-accessible path of travel was created between the stalls and the main public entrance of the retail establishment adjacent to the parking stalls. Barriers to accessibility of the existing surface improvements – not only adjacent to the parking stalls, but also from the stalls to the entrance – were addressed.

Slope Requirements

To comply with ADA-accessibility requirements, the EV parking stalls cannot exceed 2% slope in any direction. The slope leading from the EV parking stalls to the building parking lot exit cannot exceed 4.9% along the path of travel and 2% across the path. Having the EV stalls comply with these requirements increased the amount of asphalt pavement and concrete work that is usually required with standard parking stalls.

Dimensional and Surface Requirements

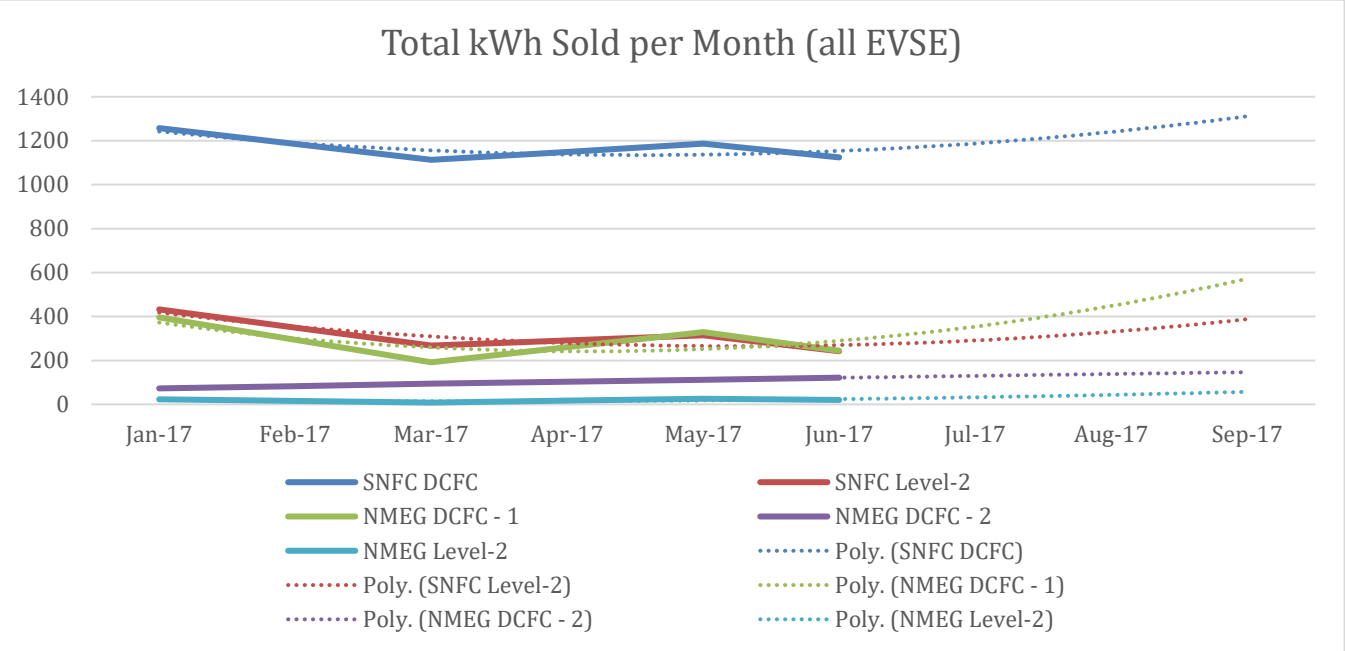
ADA-accessible parking stalls are required to be 9-feet wide by 18-feet deep (standard) and 12-feet wide by 18-feet deep (van), with a 5-feet wide accessibility aisle. Designing EV parking stalls to ADA standards resulted in existing curbs being demolished and reconstructed so as to provide the additional width needed for the accessibility aisles. The design took into account the clearance requirements around the EV parking stall and the EVSE, allowing a minimum of four feet of accessibility between the curb and the EVSE. In addition, the EVSE was placed so that maximum height and depth requirements are not violated.

CHAPTER 5:
EVSE Usage

All of the EVSE installed for this project saw their highest use after the initial installation. The DCFCs provided the highest amount of charging, meaning the most kilowatt-hours (kWh) are being provided by these EVSE. The number of EVSE charging sessions is not part of the data provided through the EVSE telematics, so it is unknown whether the vehicles are using the DCFCs for longer periods of time on a single charge or if they have a higher number of charging sessions, but are charging for less time per charge.

As Table 1 shows, all EVSE are increasingly being used, with a slight dip in use in June 2017. Using a polynomial forecast, labeled in the table as "Poly," each EVSE is expected to increase in usage over the subsequent three-month period.

Table 1: EVSE Use Over Time



Source: Sacramento Municipal Utility District

The SNFC DCFC is the highest-used EVSE of those installed for this project. It is, in fact, the most used EVSE in the SMUD portfolio in terms of kilowatt-hours used. Even the two DCFCs at the NMEG location, combined, are much lower compared to the single DCFC at the SNFC.

The level-2 EVSE at both the SNFC and NMEG locations have much lower kilowatts-hours used when compared to the DCFC, with the NMEG location being the lowest used of all EVSE. There are two factors that could contribute to this lower usage of the level-2 EVSE:

1. The DCFCs are in more visible locations at both sites. The level-2 EVSE at SNFC are in the parking garage, and at NMEG they are located on the side of the building behind the DCFCs.

2. The NMEG location has two DCFCs, and more drivers appear to be choosing to use the fast level of charging at these locations over the level-2 EVSE since there is likely more availability.

Sacramento Natural Foods Co-Op

The level-2 EVSE and DCFC at this location have received the most use since commissioning, as compared to NMEG and other SMUD-managed EVSE locations. The different levels of charging seem to track each other in terms of usage, meaning that the highs and lows occur at the same time as seen in Table 2. This indicates something outside of the location is a factor in determining fluctuation in EVSE usage, but the reason for that is unknown.

The total amount of electricity consumed at this location ranges from around 1,300 kWh to 1,700 kWh per month. Assuming the average EV consumes 29 kWh per 100 miles[1], these EVSE have provided about 4,400 miles to 5,800 miles of range per month. With model year (MY) 2017 internal combustion engines having an estimated 25 miles per gallon (MPG)[2], and EVs having an estimated 115 miles per gallon equivalent (MPGe)[3], the EVSE at SNFC displaced around 140 gallons to 180 gallons of gasoline per month. This resulted in an average reduction of more than 3,100 pounds (lbs.) of CO_2 per month[4].

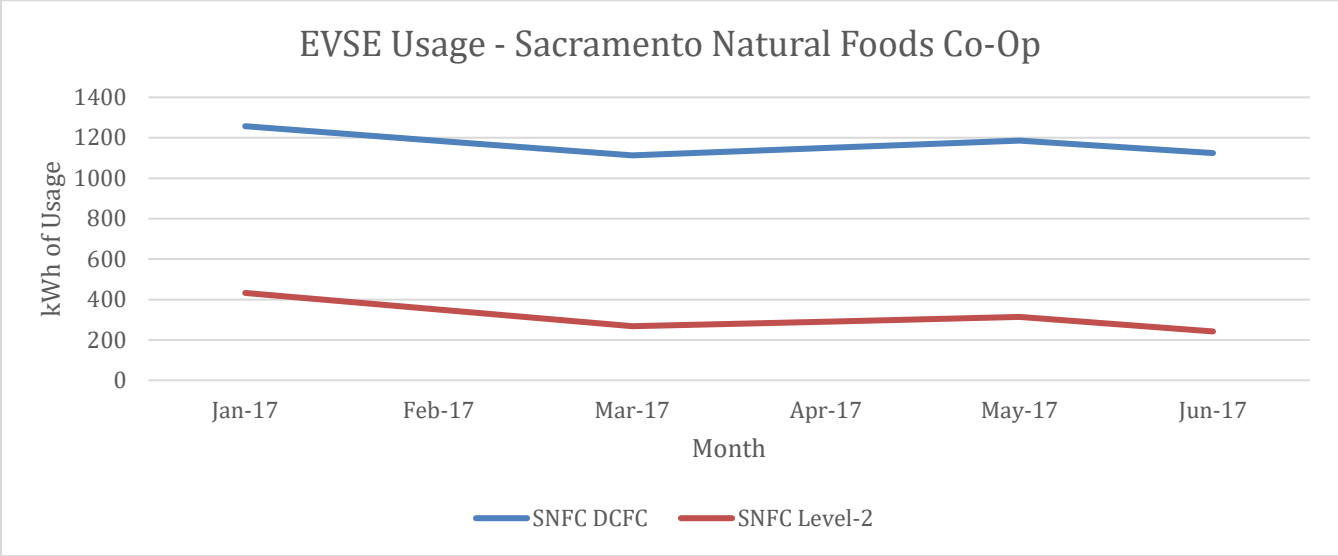
1 United States Department of Energy (https://www.fueleconomy.gov/feg/evtech.shtml)

2 United States Environmental Protection Agency (https://www.epa.gov/automotive-trends/highlights-automotive-trends-report)

3 Kilowatt-hours to Miles per Gallon (http://www.mpgtokpl.net/calculator/kwh100-miles-kilowatt-hour-100-miles-mpge-mpg-equivalent-calculator)

4 United States Energy Information Administration (https://www.eia.gov/environment/emissions/co2_vol_mass.php)

Table 2: Sacramento Natural Foods Co-Op's EVSE Usage



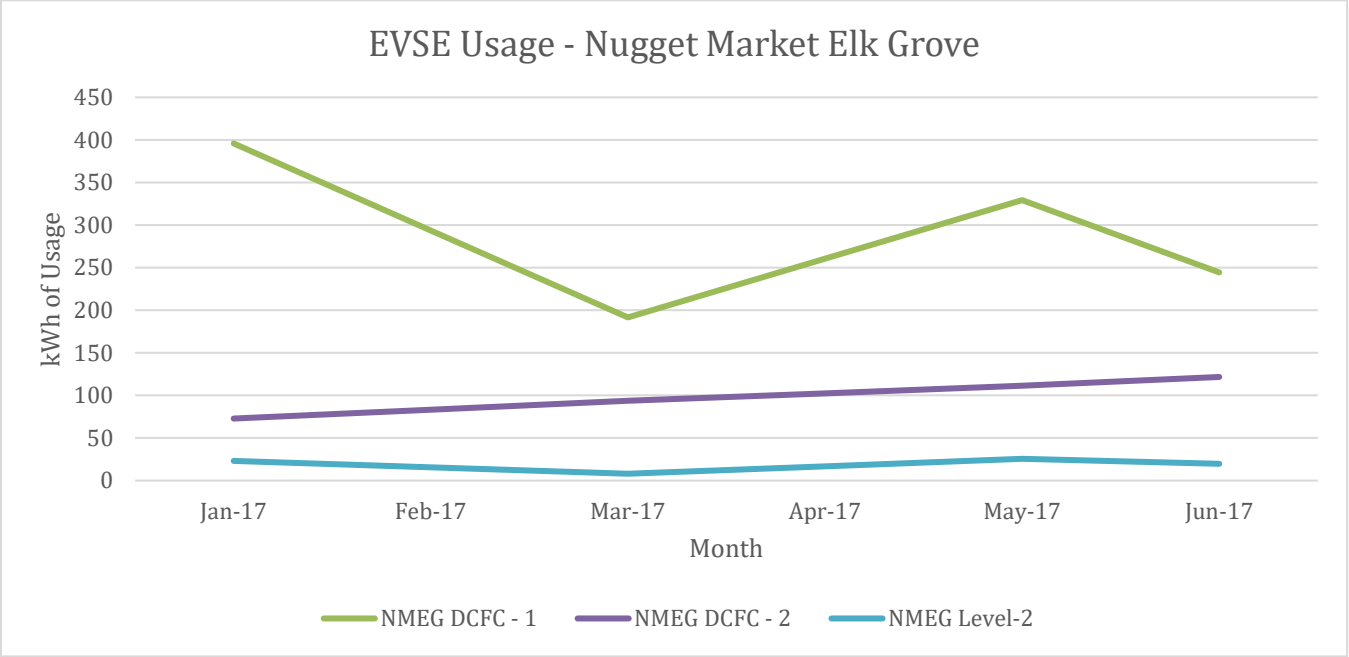
Source: Sacramento Municipal Utility District

Nugget Market Elk Grove

The EVSE at the NMEG were used less than those at SNFC, but, as shown above in Table 1, they are seeing continual increases in use over the six-month period covered in this report. Unlike the SNFC, the fluctuation in the use of these EVSE does not seem to track on a monthly basis, with highs and lows occurring at different times (shown in Table 3). This could be due to the presence of two DCFCs at the location, and the overall lack of additional EVSE available nearby.

The total amount of electricity consumed at this location ranges from around 300 kWh to 500 kWh per month. Assuming the average EV consumes 29 kWh per 100 miles, these EVSE have provided about 1,000 miles to 1,700 miles of range per month. With model year (MY) 2017 internal combustion engines having an estimated 25 MPG, and EVs having an estimated 115 MPGe, the EVSE at NMEG displaced around 32 gallons to 55 gallons of gasoline per month. This resulted in an average reduction of more than 840 lbs. of CO_2 per month.

Table 3: Nugget Market Elk Grove's EVSE Usage



Source: Sacramento Municipal Utility District

CHAPTER 6: Conclusions

Overall, the purchase and installation of the EVSE at these grocery store locations as part of the demonstration for this grant was no more difficult than other locations. The same barriers existed here during the property agreement phase that exists in the other sites SMUD has installed. Those barriers include:

- Contracting and legal review.
- Agreement on siting and design of EVSE and transformers.
- Existing issues on the site, like ADA, landscaping, and lighting.

The SNFC location, which was under new construction, proved to be easier to negotiate with than installing EVSE at existing locations. This was due in part to the willingness of SNFC to have the EVSE on site and the ability to make changes to the overall plan through the design, permitting, and construction phases.

While this project conducted only six months of data collection, the numbers show that the grocery store demonstration was successful. The DCFCs at both locations were used more than anticipated, when compared to the EVSE that SMUD offers at other locations. The total amount of electricity consumed at all of the locations is 11,305 kWh (Table 4). Assuming the average EV consumes 29 kWh per 100 miles, these EVSE have provided nearly 39,000 miles of range. With MY 2017 internal combustion engines having an estimated 25 MPG, and EVs having an estimated 115 MPGe, the EVSE at both locations over the six-month demonstration period displaced more than 1,200 gallons of gasoline. This resulted in a reduction of around 23,500 lbs. of CO_2, nearly 70 lbs. of volatile organic compounds, about 50 lbs. of oxides of nitrogen, and more than 600 lbs. of carbon monoxide.

SACOG will continue to monitor the usage of these EVSE and work with SMUD and other partners on the purchase and installation of EVSE at similar locations.

Table 4: Kilowatt-Hours of Usage per Month for all TakeCharge EVSE

LOCATION	TYPE	1/2017	2/2017	3/2017	4/2017	5/2017	6/2017	Total
SNFC	DCFC	1,257	1,185	1,112	1,149	1,186	1,124	**7,013**
SNFC	Level-2	432	349	267	290	313	241	**1,892**
NMEG	DCFC - 1	395	293	191	260	329	244	**1,712**
NMEG	DCFC - 2	72	83	93	102	111	121	**582**
NMEG	Level-2	23	15	8	16	25	19	**106**
	Total:	**2,179**	**1,925**	**1,671**	**1,817**	**1,964**	**1,749**	**11,305**

Source: Sacramento Municipal Utility District

GLOSSARY

AMERICAN WITH DISABILITIES ACT (ADA) – ADA refers to the Americans with Disabilities Act of 1990 which is one of the most significant federal laws governing discrimination against persons with disabilities. This Act prohibits discrimination against individuals with disabilities in employment, housing, education, and access to public services. The ADA defines a disability as any of the following: 1. "a physical or mental impairment that substantially limits one or more of the major life activities of the individual." 2. "a record of such impairment." or 3. "being regarded as having such an impairment."

CALIFORNIA BUILDING STANDARDS CODE (CBC) – Thea compilation of three types of building standards from three different origins:

- Building standards that have been adopted by state agencies without change from building standards contained in national model codes;
- Building standards that have been adopted and adapted from national model codes to address California's ever-changing conditions; and
- Building standards, authorized by the California legislature, that constitute amendments not covered by national model codes, that have been created and adopted to address particular California concerns.

CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL – The state agency established to protect people and environment from harmful effects of toxic substances by restoring contaminated resources, enforcing hazardous waste laws, reducing hazardous waste generation, and encouraging the manufacture of chemically safer products

CALIFORNIA ENERGY COMMISSION (CEC) - The state agency established by the Warren-Alquist State Energy Resources Conservation and Development Act in 1974 (Public Resources Code, Sections 25000 et seq.) responsible for energy policy. The Energy Commission's five major areas of responsibilities are:

- Forecasting future statewide energy needs.
- Licensing power plants sufficient to meet those needs.
- Promoting energy conservation and efficiency measures.
- Developing renewable and alternative energy resources, including providing assistance to develop clean transportation fuels.
- Planning for and directing state response to energy emergencies.

CARBON DIOXIDE (CO_2) - A colorless, odorless, non-poisonous gas that is a normal part of the air. Carbon dioxide is exhaled by humans and animals and is absorbed by green growing things and by the sea. CO_2 is the greenhouse gas whose concentration is being most affected directly by human activities. CO_2 also serves as the reference to compare all other greenhouse gases (see carbon dioxide equivalent).

CARBON MONOXIDE (CO) - A colorless, odorless, highly poisonous gas made up of carbon and oxygen molecules formed by the incomplete combustion of carbon or carbonaceous material, including gasoline. It is a major air pollutant on the basis of weight.

DIRECT CURRENT FAST CHARGER (DCFC) – An EV charger that uses supplied 480 VAC electric circuit to deliver DC voltage to an EV, usually taking 30 minutes to 1 hour to fully charge an EV with a standard battery capacity. It is also referred to as Level-3 EVSE.

ELECTRIC VEHICLES (EV) – A broad category that includes all vehicles that are fully powered by electricity or an electric motor.

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE) - Infrastructure designed to supply power to charge EVs. EVSE can charge a wide variety of EVs including BEVs and PHEVs.

ELECTRICAL TRANSFORMER – An electrical device that is used for increasing or decreasing the alternating voltages in electric power applications.

GREENHOUSE GASES (GHG) – Any gas that absorbs infra-red radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), halogenated fluorocarbons (HCFCs), ozone (O_3), perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

INTERNAL COMBUSTION ENGINE (ICE) – An engine that generates motive power by the burning of gasoline, oil, or other fuel with air inside the engine, the hot gases produced being used to drive a piston or do other work as they expand.

KILOWATT (kW) - One thousand (1,000) watts. A unit of measure of the amount of electricity needed to operate given equipment. On a hot summer afternoon a typical home, with central air conditioning and other equipment in use, might have a demand of four kW each hour.

KILOWATT-HOUR (kWh) - The most commonly-used unit of measure telling the amount of electricity consumed over time. It means one kilowatt of electricity supplied for one hour. In 1989, a typical California household consumes 534 kWh in an average month.

LEVEL-1 EVSE – An EV charger that uses a cord that plugs into a standard 120 volt outlet, usually taking between 8-20 hours to fully charge an EV with a standard battery capacity.

LEVEL-2 EVSE – An EV charger that uses a 240 volt electric circuit, usually taking 4-8 hours to fully charge an EV with a standard battery capacity. Level 2 is the most common type of public charging in California

MILES PER GALLON – (MPG) - Miles per gallon (a measurement of a vehicle's rate of fuel consumption).

MILES PER GALLON EQUIVALENT (MPGe) - a measure of the average distance traveled per unit of energy consumed. MPGe is used by the United States Environmental Protection Agency (EPA) to compare energy consumption of alternative fuel vehicles, plug-in electric vehicles and other advanced technology vehicles with the energy consumption of conventional internal combustion vehicles rated in miles per US gallon.

MODEL YEAR (MY) - the term model year means a manufacturer's annual production period (as determined by the Federal Trade Commission) for motor vehicles or a class of motor vehicles. If a manufacturer has no annual production period, the term "model year" means the calendar year.”

MULTI-UNIT DWELLING (MUD) – A classification of housing where multiple separate housing units for residential inhabitants are contained within one building or several buildings within one complex. Apartments, condominiums, townhouses, and duplexes are the most common MUDs.

OPEN CHARGE POINT PROTOCOL (OCPP) – An international open communication standard. OCPP-compliant hardware and software is designed to function together regardless of manufacturer. This allows EVSE site hosts to mix and match charging stations and choose the network provider of their choice without issues of interoperability and compatibility.

ORIGINAL EQUIPMENT MANUFACTURER (OEM) - makes equipment or components that are then marketed by its client, another manufacturer or a reseller, usually under that reseller's own name.

OXIDES OF NITROGEN (NOx) - Oxides of nitrogen that are a chief component of air pollution that can be produced by the burning of fossil fuels. Also called nitrogen oxides.

PARTICULATE MATTER (PM) - Unburned fuel particles that form smoke or soot and stick to lung tissue when inhaled. A chief component of exhaust emissions from heavy-duty diesel engines. Measured at 2.5 micrometers ($PM_{2.5}$) and 10.0 micrometers (PM_{10}).

POLYNOMIAL FORECAST – A statistical model that uses several data points on a graph to predict a future occurrence.

RADIO-FREQUENCY IDENTIFICATION TECHNOLOGY (RFID) – A wireless non-contact use of radio frequency waves that communicate through the use of a transponder and a receiver to store and transfer data

SACRAMENTO AREA COUNCIL OF GOVERNMENTS (SACOG) – An association of local governments in the six-county Sacramento region that provides transportation planning and funding for the region.

SACRAMENTO MUNICIPAL UTILITIES DISTRICT (SMUD) – A publicly-owned utility that provides electricity to most of Sacramento County and a portion of Placer County.

TAKECHARGE – A regional electric vehicle plan commissioned by SACOG and the Capital Area PEV Coordinating Council that was created to increase the adoption of zero-emission vehicles, reduce greenhouse gas emissions, and create opportunities for existing and future EV drivers to fuel their vehicles.

VOLATILE ORGANIC COMPOUNDS (VOC) – Gases that are emitted from certain solids or liquids, are composed of a variety of chemicals, and have adverse health effects.

VOLT (V) - A unit of electromotive force. It is the amount of force required to drive a steady current of one ampere through a resistance of one ohm. Electrical systems of most homes and office have 120 volts.

VOLTS ALTERNATING CURRENT (VAC) - Flow of electricity that constantly changes direction between positive and negative sides. Almost all power produced by electric utilities in the United States moves in current that shifts direction at a rate of 60 times per second.

VOLTS DIRECT CURRENT (VDC) - A charge of electricity that flows in one direction and is the type of power that comes from a battery.

ZERO EMISSION (ZE) - An engine, motor, process, or other energy source, that emits no waste products that pollute the environment or disrupt the climate.

ZERO EMISSION VEHICLE (ZEV) - Vehicles which produce no emissions from the on-board source of power (e.g., an electric vehicle).