CALIFORNIA ENERGY COMMISSION

California Energy Commission

Clean Transportation Program

FINAL PROJECT REPORT

Electric Vehicle Charging Stations at Multi-Unit Dwellings

Prepared for: California Energy Commission

Prepared by: Granville Homes, Inc.

Gavin Newsom, Governor

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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 (ARFVTP). 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 nonroad 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 Clean Transportation Program Investment Plan Update. The CEC issued PON-13-60 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 CEC's notice of proposed awards April 4, 2014 and the agreement was executed as ARV-13-024 on July 23, 2014.

ABSTRACT

This Final Project Report documents installation process for chargers at The Lede residential project from Granville Homes' Urban Development. The report also provides usage at the charging stations.

The California Energy Commission awarded Granville Homes $25,886 to install electric vehicle charging stations for the use of residents and visitors at The Lede.

Keywords: California Energy Commission, Clean Transportation Program, Granville Homes, ChargePoint, Electric Vehicle Charging Station, Electric Vehicle Supply Equipment.

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EXECUTIVE SUMMARY

This project installed one dual-port level-2 commercial charging stations at “The Lede” multi-unit housing development in Fresno, California. Installation occurred in 2016.

Granville Homes proposed to install three dual-port level-2 electric vehicle charging stations at its previously-completed “Fulton Village” multi-unit dwelling project located in Fresno. Engineers determined that Fulton Village’s electrical system could not handle the electrical load of the planned EV chargers. Rather than expend additional costs for upgrading an existing site, Granville opted to instead install the three chargers at two Fresno locations that were currently under construction or in the planning stages: “The Lede” and a project at 8092 North Millbrook Avenue, respectively. One charger was to be installed at The Lede while the other two were planned for the North Millbrook project.

Granville contracted with Sparky Electric and installed one ChargePoint dual-post level-2 charger at “The Lede,” but changes in the residential housing market and continuous construction delays resulted in Granville canceling this agreement prior to the installation of the chargers at the North Millbrook project.

Between October 1, 2016 and January 31, 2018, the charging station recorded 19 charging events using nearly 112 kilowatt hours, displacing more than three gallons of gasoline equivalent, and reducing greenhouse gas emissions by almost 68 pounds.

CHAPTER 1: Project Introduction and Objectives

Background

The city of Fresno is about 112 square miles with a population of around 500,000 people. The city is located at the eastern edge of California's Central Valley and nearly in the middle of the San Joaquin Valley along the north-to-south axis. This location, coupled with northerly prevailing winds that collect air pollutants from regions north and blow them south, has caused Fresno to have some of the worst air quality in the United States. In an effort to reduce the amount of greenhouse gas (GHG) emissions, air pollutants, and the carbon footprint of its residential projects, Granville Homes (Granville) included a plan to install electric vehicle (EV) chargers at multi-unit dwellings like apartment complexes, townhomes, and condominiums.

Objectives

There were two objectives of grant agreement ARV-13-024. One objective was to become a champion in the central valley for installing EV chargers in multi-unit dwellings. This will be accomplished by offering EV charging to its residents and to encourage EV growth among non-home owners who would otherwise not have a reliable place to charge.

A secondary objective was to serve as a case study to model the best practices for use at additional Granville locations and for other multi-unit dwelling in the valley. The chargers will have an Open Charge Point Protocol, which will give Granville freedom to choose the most optimal service provider and will prevent the charger's software from becoming outdated or obsolete.

CHAPTER 2: Project Development and Installation

Fulton Village is a three-story multi-unit dwelling, with mixed-use development, and 46 housing units located in downtown Fresno (Table 1). It is owned by Granville, which rents the housing units to residents. Fulton Village is known for its cutting-edge, so-called "green," technologies, including individual solar panel systems, tankless water heaters, and other environmentally-friendly amenities never before seen in downtown Fresno.

The dual-port charging stations that were to be installed at Fulton Village would have been located between parking spaces that were not assigned to or associated with individual units. This would have allowed multiple vehicles to charge at a time and maximize the parking available for EV charging at the site. The dual-port level-2 smart charging stations' Open Charge Point Protocol would have included a payment system software that would work with either a network card or major credit cards. These chargers, however, were not installed at Fulton Village.

Siting issues at Fulton Village first arose as it became known that the parking stalls there are rented out to the tenants instead of open parking, and none of the tenants have EVs. Additionally, Fulton Village's electrical system could not handle the electrical load of the planned EV chargers, and rather than expend additional costs for upgrading an existing site, Granville sought other ways to install the chargers at Fulton Village, even considering installing the EV chargers along the public street; however, the City of Fresno did not approve.

Granville requested and received permission from the CEC to move 1 of the EV chargers from Fulton Village to The Lede development (also downtown) and the other two chargers would go to a future project site located on North Millbrook Avenue (Table 2).

Table 1: Proposed Location

Location	Address
Fulton Village	1759 Fulton Street, Fresno, CA 93721

Source: Granville Homes

Table 2: List of Proposed Backup Locations

Location	Address
The Lede	1530 Fulton Street, Fresno, CA 93721
North Millbrook Project	8092 North Millbrook Avenue, Fresno, CA 93720
Copper River Ranch	1607 East Benvenuto Drive, Fresno, CA 93730

Source: Granville Homes

Charging Equipment

The charging equipment chosen for this project was the ChargePoint CT4021-GW1 (Figure 1). It is a dual-port charger, meaning that it can charge two vehicles simultaneously. The charger is powered by 208/240 volts AC and has an output of 7.2 kilowatts (kW). As a level-2 charger, with its SAE J1772 connector plugs, it can fully charge 2 100-mile light-duty vehicle batteries

in less than 5 hours. The charging time is paid for by the person using the charger through the use of ChargePoint's commercial network service plan.

Figure 1: The Lede Dual Port Level-2 Charger

Photo Credit: Granville Homes

The Lede

Completion of The Lede housing development was originally planned for December 31, 2015; however, due to major delays that included obtaining project approval, utility site planning, Pacific Gas and Electric (PG&E) electrical infrastructure installation, and other delays, construction did not end until September 2016. Granville purchased the charger and accessories for around $9,400 and subcontracted Sparky Electric to install the equipment for about $3,100. Installation construction for the charger began on June 1, 2016 and was

completed in July 2016 (Figure 2). The charger was not connected and brought online, however, until October 15, 2016, when tenants started moving in.

Figure 2: The Lede Housing Development

Photo Credit: https://www.apartments.com/the-lede-fresno-ca/287c66c/

8092 North Millbrook Project

The apartment development at North Millbrook and East Nees was planned to be completed by early 2017. Granville submitted an application for land entitlement in July 2016 and it was approved in October 2016. Once planning and design work on the property began, however, many unexpected problems kept appearing and delaying construction. For instance, there is a seasonal subterranean creek running through the middle of the property that caused grading and drainage problems on the site. Also, the electrical and water utility plans that Granville submitted for the project had to be changed due to conflicts with existing PG&E and the Fresno Irrigation District infrastructure. Adding to the delays, contractors stopped working on this multi-unit dwelling to work on projects for higher-demand single-family residence housing.

Figure 3: The Project Site at North Millbrook Avenue and East Nees Avenue

Photo Credit: Granville Homes

On December 4, 2017, Granville advised the CEC that construction at the location had yet to start (Figure 3) and that completion of the 8092 North Millbrook Project, along with the installation of the two EV chargers, would be delayed beyond the end of the agreement date of March 30, 2018. On December 7, 2017, Granville requested that grant agreement ARV-13-024 be cancelled with only one of the three chargers installed. To ease the completion of the agreement, Granville declined the release of retention that was withheld for the one submitted invoice. Of the $25,886.00 budgeted for charger installation reimbursement, Granville invoiced for $12,582.02, with $1,258.20 withheld in retention. Additionally, Granville spent $4,433.99 of its $21,770.00 match share requirement. The agreement was terminated on February 15, 2018.

CHAPTER 3: Usage and Data Collection

Data collection started on October 15, 2016. The number of charging sessions per month for the charger was collected and recorded for 15 months. The tables below summarize the number of times the charger was used (Table 3), the number of kilowatt hours (kWh) that the charger used (Table 4), the number of gallons of gasoline equivalent (GGE) the charger displaced (Table 5), and the amount of GHG emissions reduced by the use of the charger (Table 6).

Over the course of the 15-month data collection period, the one dual-port charger was used 19 times for a total of nearly 112 kWh. To determine the amount of GGEs from kWh, multiply the kWh amount by 0.031[1]. Using the charger amounted to more than 3.0 GGEs. Multiplying the monthly GGEs by 19.59[2] determined that the charger displaced almost 68 pounds of GHG emissions.

Table 3: Number of Charging Sessions per Month

Month/Year	Number of Charges
October 2016	5
November 2016	0
December 2016	0
January 2017	3
February 2017	0
March 2017	1
April 2017	3
May 2017	0
June 2017	1
July 2017	1
August 2017	2
September 2017	2
October 2017	1
November 2017	0
December 2017	0
January 2018	0
Totals	**19 Charges**

1 CEC webpage for Gasoline Gallon Equivalents for Alternative Fuels (https://www.energy.ca.gov/almanac/transportation_data/gge.html)

2 United State Environmental Protection Agency Greenhouse webpage for Gas Emissions from a Typical Passenger Vehicle (https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle)

Source: Granville Homes

Table 4: Number of Kilowatt Hours Used Per Month

Month/Year	Kilowatt Hours
October 2016	44.90 kwh
November 2016	0
December 2016	0
January 2017	0
February 2017	0
March 2017	0.45 kwh
April 2017	0
May 2017	0
June 2017	7.20 kwh
July 2017	10.44 kwh
August 2017	15.18 kwh
September 2017	20.07 kwh
October 2017	13.42 kwh
November 2017	0
December 2017	0
January 2018	0
Totals	**111.66 kwh**

Source: Granville Homes

Table 5: Gasoline Gallons Equivalent Displaced

Month/Year	Gasoline Gallons Equivalent
October 2016	1.39 GGE
November 2016	0
December 2016	0
January 2017	0
February 2017	0
March 2017	0.01 GGE
April 2017	0
May 2017	0
June 2017	0.22 GGE
July 2017	0.32 GGE
August 2017	0.47 GGE
September 2017	0.62 GGE
October 2017	0.42 GGE
November 2017	0
December 2017	0
January 2018	0
Totals	**3.45 GGE**

Source: Granville Homes

Table 6: Greenhouse Gas Emissions Displaced

Month/Year	GHG Emissions (pounds)
October 2016	27.23 lbs.
November 2016	0
December 2016	0
January 2017	0
February 2017	0
March 2017	0.20 lbs.
April 2017	0
May 2017	0
June 2017	4.31 lbs.
July 2017	6.27 lbs.
August 2017	9.21 lbs.
September 2017	12.15 lbs.
October 2017	8.23 lbs.
November 2017	0
December 2017	0
January 2018	0
Totals	**67.60 lbs.**

Source: Granville Homes

CHAPTER 4: Observations, Challenges and Recommendations

This agreement was the first project where the CEC funded EV chargers at a multi-unit dwelling, and as is the case with many real estate transactions and construction projects, this one was faced with a great deal of difficulties and delays. Many multi-unit dwellings are constructed at what are known as infill sites, which are open spaces in urban areas. Many of the delays stemmed from local agencies' permitting processes, conflicts with the local utilities, the changes in the housing market, and the chosen site not having adequate electrical infrastructure, and other unknown variables.

If another grant opportunity with the CEC arises, Granville will be more aware of these issues and will ensure that it takes into consideration the challenges encountered during this agreement. It will ensure that permitting has already started before it applies for the grant, that projects are at or near the end of the local government review and approval period, and it will ensure that future properties will be properly planned to allow upgrades to its electrical system for the installation of EV charging stations.

CHAPTER 5: Conclusions

This project installed one dual-port level-2 charger at a multi-unit dwellings in downtown Fresno, CA. That charger was used 19 times for a total of nearly 112 kWh of charging. That is the equivalent of more than 3.0 gallons of gasoline and a displacement of almost 68 pounds of GHG emissions.

GLOSSARY

ALTERNATING CURRENT (AC) - 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.

ALTERNATIVE AND RENEWABLE FUELS AND VEHICLE TECHNOLOGY PROGRAM (ARFVTP)—Created by Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007), the program with an annual budget of about $100 million supports projects that develop and improve alternative and renewable low-carbon fuels, improve alternative and renewable fuels for existing and developing engine technologies, expand transit and transportation infrastructures, establish workforce training programs, conduct public education and promotion, and create technology centers, among other tasks.

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.

ELECTRIC VEHICLES (EV)—Vehicles that derive all or part of the related power from electricity supplied by the electric grid. They include all-electric vehicles and plug–in electric vehicles.

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE)—Also called EV charging station, is an element in an infrastructure that supplies electric energy for the recharging of plug-in electric vehicles.

GASOLINE GALLON EQUIVALENT (GGE) - is the amount of alternative fuel it takes to equal the energy content of one liquid gallon of gasoline. GGE allows consumers to compare the energy content of competing fuels against a commonly known fuel—gasoline. GGE also compares gasoline to fuels sold as a gas (natural gas, propane, and hydrogen) and electricity.

GREENHOUSE GASES (GHG)—any gas that absorbs infrared 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).

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.

PG&E - The acronym for Pacific Gas and Electric Company an electric and natural gas utility serving the central and northern California region.