



**CALIFORNIA
ENERGY COMMISSION**



California Energy Commission
Clean Transportation Program

FINAL PROJECT REPORT

Public Electric Vehicle Charger Installation at Fort Mason and Stinson Beach, Golden Gate National Recreation Area

Prepared for: California Energy Commission

Prepared by: Golden Gate National Parks Conservancy

Gavin Newsom, Governor
November 2019 | CEC-600-2019-046

California Energy Commission

Tom Odgers, Golden Gate National Parks Conservancy

Laura Castellini, United States National Park Service

Primary Author(s)

Golden Gate National Parks Conservancy

Building 201, Fort Mason

San Francisco, CA 94123

(415) 561-3000

<https://www.parksconservancy.org/>

Agreement Number: ARV-13-041

Marc Perry

Project Manager

Elizabeth John

Office Manager

Advanced Fuel Production Office

Kevin Barker

Deputy Director

FUELS AND TRANSPORTATION

Drew Bohan

Executive Director

Disclaimer

Staff members of the California Energy Commission prepared this report. As such, it does not necessarily represent the views of the Energy Commission, its employees, or the State of California. The Energy Commission, the State of California, its employees, contractors and subcontractors make no warrant, express or implied, and assume no legal liability for the information in this report; nor does any party represent that the uses of this information will not infringe upon privately owned rights. This report has not been approved or disapproved by the Energy Commission nor has the Commission passed upon the accuracy or adequacy of the information in this report.

ACKNOWLEDGEMENTS

The Golden Gate National Parks Conservancy in partnership with the Golden Gate National Recreation Area recognizes the California Energy Commission for its support of this project. Furthermore, the conservancy would like to acknowledge the following organizations; their assistance was critical in the successful implementation and completion of this project:

- Adopt-a-Charger
- Pacific Gas and Electric Company, Inc.
- CleanPowerSF

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-13-606 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 CEC's notice of proposed awards April 4, 2014 and the agreement was executed as ARV-13-041 on June 26, 2014.

ABSTRACT

This final report documents the planning, budget, specifications, and usage of battery-electric vehicle chargers installed at the Golden Gate National Recreation Area of the United States National Park Service and operated by the Golden Gate National Parks Conservancy. This was made possible through the California Energy Commission grant ARV-13-041. This report also provides an overview of the data collected from January 27, 2016 to November 2, 2016, as well as various observations and challenges faced during the project.

The project results show that the installation of the charging stations provided a critical addition to the availability of charging stations in San Francisco and Marin County. The stations were designed to provide workplace charging service not only to the employees of the Golden Gate National Recreation Area, but also to the park visitors.

Keywords: Golden Gate National Recreation Area, Golden Gate National Parks Conservancy, City of San Francisco, electric vehicle charging, workplace charging

Please use the following citation for this report:

Odgers, Tom, Laura Castellini, Golden Gate National Parks Conservancy. 2019. *Public EV Charger Installation at Fort Mason and Stinson Beach, Golden Gate National Park Recreation Area*. California Energy Commission. Publication Number: CEC-600-2019-046.

TABLE OF CONTENTS

	Page
Acknowledgements	i
Preface.....	ii
Abstract	iii
Table of Contents.....	v
Executive Summary.....	1
CHAPTER 1: Project Introduction	3
Background.....	3
Project Description.....	3
Problem Statement	3
Goal of the Agreement.....	3
Chapter 2: Installation and Deployment	4
Chapter 3: Data Collection, Usage, and Analysis	6
Results.....	8
Economic Benefits	9
Chapter 4: Observations and Challenges	10
Chapter 5: Conclusions.....	11
GLOSSARY.....	12

LIST OF FIGURES

	Page
Figure 1: Chargers at Fort Mason Building 32	4
Figure 2: Chargers at Fort Mason Bay Street Parking Lot	5
Figure 3: Chargers at Stinson Beach.....	5
Figure 4: Cumulative Electrical Usage at Fort Mason Bay Street Chargers	6
Figure 5: Cumulative Electrical Usage at Fort Mason Building 32 Chargers	7
Figure 6: Cumulative Electrical Usage at Stinson Beach Chargers	7

LIST OF TABLES

	Page
Table 1: Level-2 Charger Usage at Fort Mason Bay Street	8
Table 2: Level-2 Charger Usage at Stinson Beach	8
Table 3: Level-1 Charger Usage at Fort Mason Building 32	8

EXECUTIVE SUMMARY

This final report prepared for the California Energy Commission meets the reporting requirement of Agreement ARV-13-041 with the Golden Gate National Parks Conservancy. This project installed and operated within the Golden Gate National Recreation Area two level-1 dual-post electric vehicle chargers at Fort Mason's Building 32 parking lot, two dual-post level-2 electric vehicle chargers at Stinson Beach, and two dual-post level-2 electric vehicle chargers at Fort Mason's Bay Street parking lot, for a total of 10 chargers. The level-1 electric vehicle chargers can recharge an average plug-in battery-electric vehicle in about 7.5 hours, and the level-2 electric vehicle chargers can recharge in about 2.5 hours.

This project also served to satisfy the Golden Gate National Parks Conservancy's responsibility and goals to make the Golden Gate National Park Recreation Area battery-electric vehicle-friendly and to reduce greenhouse gas emissions at the popular destinations.

CHAPTER 1:

Project Introduction

Background

The California Energy Commission awarded the Golden Gate National Parks Conservancy (GGNPC) grant agreement ARV-13-041 to install battery-electric vehicle chargers (chargers) for public and employee use at three locations within the Golden Gate National Recreation Area (GGNRA): Fort Mason's Building 32 and Bay Street parking lots in San Francisco, and Stinson Beach in Marin County.

Project Description

The GGNPC was the applicant and the project manager for the project. The City of San Francisco, County of Marin, and the United States National Park Service supported the project. Construction cost was \$79,995. Of this amount, Pacific Gas and Electric Company (PG&E) contributed \$25,000 in match funding. The project included the deployment of two level-1 dual-post chargers (two plugs per charger) at Fort Mason's Building 32 parking lot, two dual-post level-2 chargers at Stinson Beach, and two dual-post level-2 chargers at Fort Mason's Bay Street parking lot, for a total of 10 chargers.

Problem Statement

With the increase in plug-in battery-electric vehicle (PEV) and plug-in hybrid battery-electric vehicle (PHEV) ownership, it became noticeable that there was not enough charging infrastructure for battery-electric vehicles at popular destinations within the GGNRA to recharge visitors' and employees' PEVs and PHEVs. Stinson Beach and Fort Mason were selected as the installation locations for this agreement because Fort Mason and Stinson Beach are popular tourist destinations with thousands of visitors annually, with more than more than 300 employees combined, and there were no chargers at either location. Additionally, there were no public chargers along California State Route 1 where it splits from United States Route 101 in Mill Valley until Point Reyes Station (a distance of nearly 30 miles). Perceived range anxiety also prevented more visitors who are driving PEVs.

Goal of the Agreement

The goal of this agreement is to increase the number of public and employee PEV and PHEV chargers in the GGNRA and to promote the use of electric vehicles as a solution for reducing greenhouse gas emissions. In addition to installing the chargers, this agreement demonstrates the GGNRA's commitment to promoting electric vehicles that will reduce Greenhouse Gas (GHG) emissions, reduce its carbon footprint, educate the public about the benefits of PEVs, reduce range anxiety by showing the public where electric vehicles can be taken to recharge, and will lead to more PEV purchases.

Chapter 2: Installation and Deployment

The specifications for the chargers were developed in consultation with Adopt-a-Charger, which created the solicitation proposal and provided technical expertise in PEVs and the chargers. PG&E provided the financial support for the installation and free electricity usage for three years. The project was approved on June 26, 2014. In late 2015, the GGNPC replaced Adopt-a-Charger with Auto Charge Electric or AC Electric, a company that had been assisting in installation. Construction began shortly after the contract between the GGNPC and AC Electric was signed.

Construction on Fort Mason Building 32 was completed on December 16, 2015. The installation did not require any trenching, layout changes, or infrastructure upgrades. These chargers were commissioned and put into service on January 27, 2016. Figure 1 shows the deployment of the chargers.

Figure 1: Chargers at Fort Mason Building 32

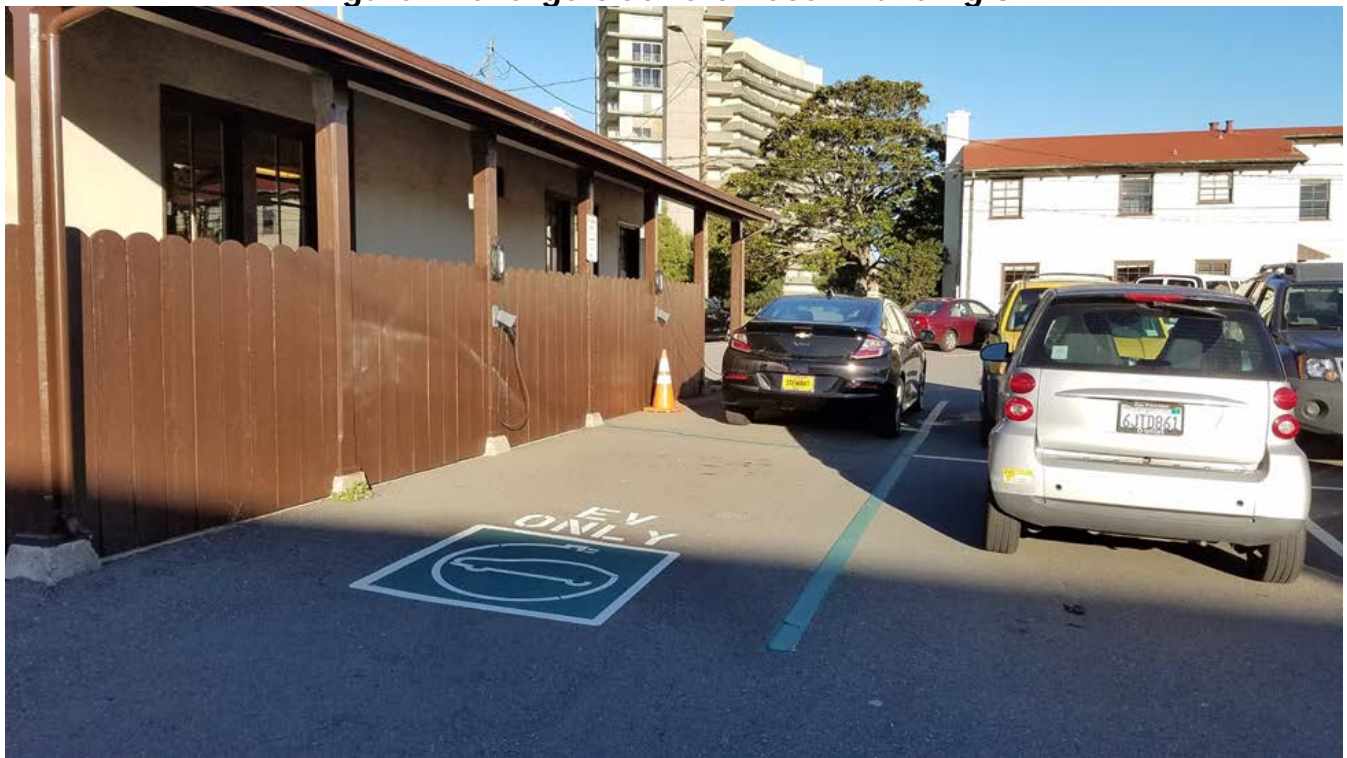


Photo Credit: Golden Gate National Parks Conservancy

Construction on the Fort Mason Bay Street chargers also began on December 15, 2015 and were put into service on January 27, 2016. Figure 2 shows the chargers at the Fort Mason Bay Street parking lot.

Figure 2: Chargers at Fort Mason Bay Street Parking Lot



Photo Credit: Golden Gate National Parks Conservancy

Construction on the Stinson Beach chargers began on February 19, 2016 and was completed on April 11, 2016. These chargers were commissioned and put into service on May 1, 2016 and are shown in Figure 3.

Figure 3: Chargers at Stinson Beach



Photo Credit: Golden Gate National Parks Conservancy

Chapter 3:

Data Collection, Usage, and Analysis

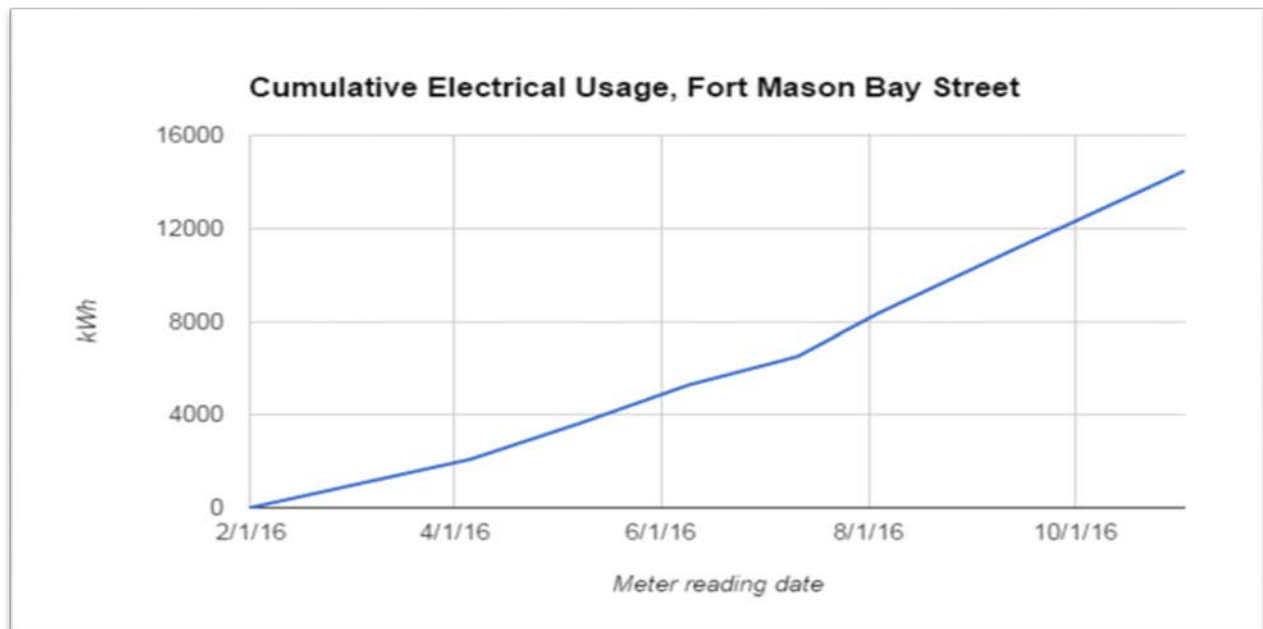
Data collection started in January 27, 2016 and ended November 2, 2016 at all the charging stations.

The users of the chargers were US National Parks Service employees and visitors at Fort Mason and Stinson Beach.

GGNPC collected data monthly by gathering information on kilowatt hours (kWh) used by the chargers and compiled this data to calculate the number of charging sessions at each location, as well as the gallons of gasoline displaced by vehicles using the chargers. The number of visitors using PEVs and PHEVs was measured by tracking the usage of the chargers. It was assumed that an increase of electricity used over time corresponded to an increase in the number of EVs using the chargers.

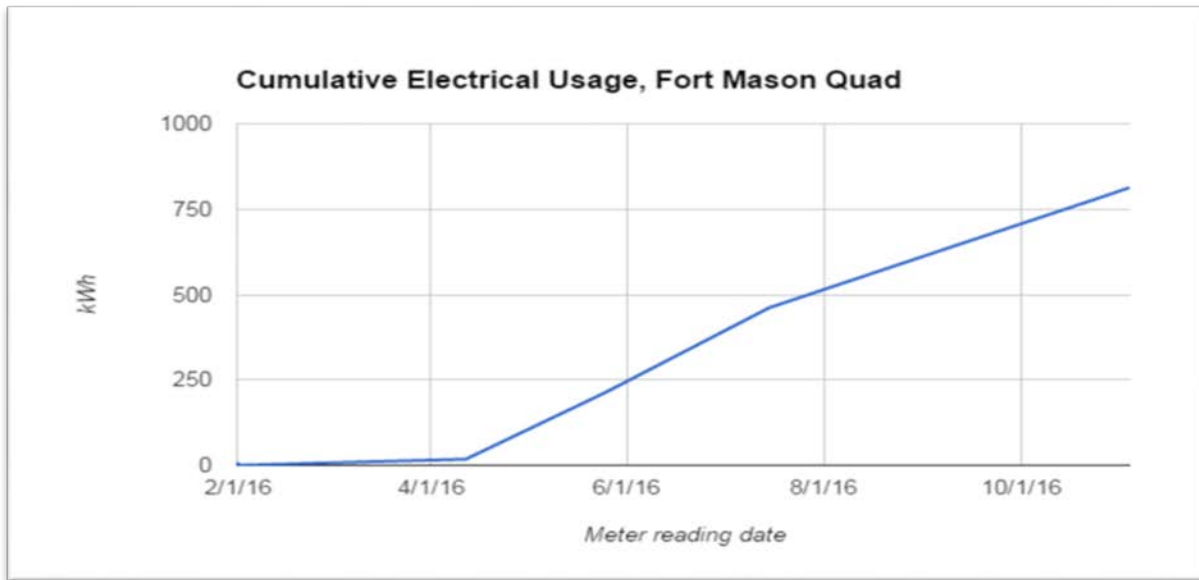
Figure 4 through Figure 6 show the cumulative usage in kWh at the various charging stations.

Figure 4: Cumulative Electrical Usage at Fort Mason Bay Street Chargers



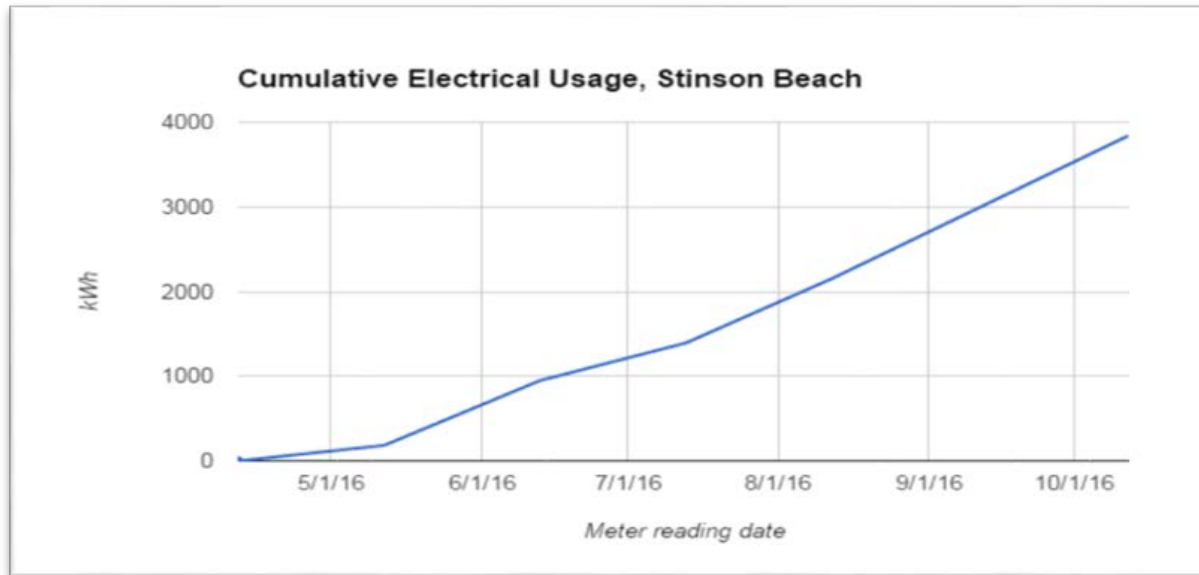
Source: Golden Gate National Parks Conservancy

Figure 5: Cumulative Electrical Usage at Fort Mason Building 32 Chargers



Source: Golden Gate National Parks Conservancy

Figure 6: Cumulative Electrical Usage at Stinson Beach Chargers



Source: Golden Gate National Parks Conservancy

To calculate the number of charging events, GGNPC observed the kWh usage for all 10 chargers and compared that to the number of kWh it takes to fully charge an average electric vehicle when the battery is completely depleted. The vehicles used as models to calculate charger usage were a 2013 Chevy Volt PHEV and a 2017 Nissan LEAF PEV. The Volt has battery range of nearly 38 miles, and it is assumed that most Volt batteries will have a near-zero charge upon arriving at the chargers. Based on verbal communications with Fort Mason

staff, it was estimated that drivers of standard PEVs, such as the Nissan LEAF (with its range of up to 124 miles) would have a battery that is half-charged upon arrival to the chargers.

Table 1 summarizes the approximate number of charging events at the level-2 chargers at Fort Mason Bay Street based on data collected from January to November 2016.

Table 1: Level-2 Charger Usage at Fort Mason Bay Street

Charger Usage 1/27/16 – 11/2/16	Average Output of Charger	Estimated Hours of Use	Time to Charge EV/PHEV 10.8 kWh	Estimated Number of Charging Events
14,474 kWh	4.8 kWh	3,015 hours	2.25 hours	1,340 events

Source: Golden Gate National Parks Conservancy

Table 2 summarizes the charging events at Stinson beach based on the data collected from April 2016 to November 2016 from this project.

Table 2: Level-2 Charger Usage at Stinson Beach

Charger Usage 4/11/16 – 10/12/16	Average Output of Charger	Estimated Hours of Use	Time to Charge EV/PHEV 10.8 kWh	Estimated Number of Charging Events
3,841 kWh	4.8 kWh	800 hours	2.25 hours	1,340 events

Source: Golden Gate National Parks Conservancy

Table 3 summarizes the charging events at Fort Mason Building 32 based on the data collected from January 2016 to November 2016 from this project.

Table 3: Level-1 Charger Usage at Fort Mason Building 32

Charger Usage 1/27/16 – 11/2/16	Average Output of Charger	Estimated Hours of Use	Time to Charge EV/PHEV 10.8 kWh	Estimated Number of Charging Events
813 kWh	1.4 kWh	580 hours	7.7 hours	75 events

Source: Golden Gate National Parks Conservancy

Results

More than 550 gallons of gasoline were displaced during the data collection period. To calculate the gallons of gasoline displaced, the GGNPC used the United States Environmental Protection Agency formula in which 33.7 kWh of electricity is equivalent to one gallon of gasoline. To calculate the gallons of gasoline displaced, the GGNPC used the data from all ten chargers combined, which was 19,128 kWh of energy. That amount was then divided by 33.7 kWh per gallon.

This calculation resulted in showing that the amount of tailpipe GHG emissions diverted during the 6-month data collection phase was 23,328,360 grams, or 23.33 metric tons. To determine the emissions reductions, GGNPC used the approximate number of miles driven annually by the EV and PHEVs that used the chargers during the course of this project. Using the metrics determined by the United States Department of Energy, an electric vehicle uses 33.7 kWh per

100 miles, which is 0.337 kWh/mile. The average light-duty passenger vehicle emits 411 grams of carbon dioxide (CO₂) per mile. Using the data accumulated from the 10 chargers combined, 19,128 kWh ÷ 0.337 kWh/mile = 56,760 of electric vehicle miles traveled. Using the EPA's GHG metric, there are nearly 411 grams of CO₂ emitted per gallon of gasoline; therefore, 56,760 miles traveled multiplied by 411 grams of CO₂ per mile is equal to 23,328,360 grams, or about 23.33 metric tons of CO₂.

Economic Benefits

The installation of the chargers at Fort Mason and Stinson Beach provided nearly 10 temporary high-paying construction jobs in San Francisco and Marin County. This also contributed to increasing revenues for California companies engaged in electric vehicle supply equipment, such as Auburn, California-based Clipper Creek. Having more chargers should encourage more people to purchase electric vehicles. PEV and PHEV drivers will save money by purchasing electricity over gasoline or diesel and will be able to use that savings to spend elsewhere, increasing the local economy.

The GGNPC collaborated with local company CleanPowerSF for the charger locations in Fort Mason, and all of those chargers were powered by CleanPowerSF's SuperGreen 100 percent renewable energy option that uses California sources of wind and solar power. For the chargers at Stinson Beach, approximately 50 percent of the energy provided is renewable. This reduces the use of traditional energy suppliers that increase their rates during peak hours.

Chapter 4:

Observations and Challenges

Construction on Fort Mason Quad Building 32 was completed without any complications. The installation did not require any trenching, layout changes or infrastructure upgrades.

Installation of chargers at the Fort Mason Bay Street was complicated because the Presidio Trust Utilities Group or Presidio Trust, not PG&E, manages the electrical service. It was necessary to enter into a separate subcontract with Presidio Trust in order to implement tests and perform the work needed to complete the project. Additionally, the existing electrical infrastructure at the Bay Street site lacked enough capacity for the addition of the new charging stations. Therefore, the infrastructure needed to be upgraded, and all infrastructure work had to be incorporated into the grant. Subsequent installation was delayed as the new transformer, new overhead wires, and a utility pole were put into place.

At Stinson Beach, there was an existing PG&E electrical transformer that was not able to power the new chargers. However, an infrastructure project was already under way at the location of the new chargers: repaving and restriping the parking lot would also place new electrical requirements on the existing transformer. In order to ensure coordination between AC Electric and the contractors repaving the parking lot, GGNPC and AC Electric decided to contract with the parking lot project's engineering consultant, Holladay Engineering Co. They did this to make sure that all of the trenching and conduit installation was coordinated between the two projects. The charger installation needed to be based on the parking stall layout of a future parking lot. They did this by contracting with a surveyor to precisely identify the locations of the future parking stalls using the parking lot project's designs and layout.

Chapter 5: Conclusions

The project has been successful, not only for the GGNPC, but for all stakeholders including the GGNRA, the City of San Francisco, and the County of Marin. The partnership of public and private entities has also made this project a success. The GGNPC and team members thank the Energy Commission for the award and the support of growth of electric vehicles as a conventional method of transportation.

This project was completed on time and within budget, and the GGNPC was able to meet the goals and objectives to increase the number of electric vehicle chargers throughout the GGNRA. Through this project, the GGNPC and the GGNRA also promoted electric vehicles as viable transportation, reduced the greenhouse gas emissions, and reduced the GGNRA's carbon footprint.

GLOSSARY

ALTERNATIVE AND RENEWABLE FUELS AND VEHICLE TECHNOLOGY PROGRAM (ARFVTP) – Also known as the Clean Transportation Program, was created by Assembly Bill 118 (Nunez, 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, and establishing 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.

CARBON DIOXIDE (CO₂) - 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. CO₂ is the greenhouse gas whose concentration is being most affected directly by human activities. CO₂ also serves as the reference to compare all other greenhouse gases (see carbon dioxide equivalent).

GOLDEN GATE NATIONAL PARKS CONSERVANCY (GGNPC) - The Golden Gate National Parks Conservancy is the nonprofit membership organization created to preserve the Golden Gate National Parks, enhance the experiences of park visitors, and build a community dedicated to conserving the parks for the future.¹

GOLDEN GATE NATIONAL RECREATION AREA (GGNRA) - Golden Gate National Recreation Area is one of more than 400 national park units across the country.²

¹ [Golden Gate Parks Conservancy](https://www.parksconservancy.org/) (https://www.parksconservancy.org/)

² [Golden Gate National Park](https://www.nps.gov/goga/index.htm) (https://www.nps.gov/goga/index.htm)

GREENHOUSE GASES (GHG) – Any gas that absorbs infra-red radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), halogenated fluorocarbons (HCFCs), ozone (O₃), perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

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.

PLUG-IN ELECTRIC VEHICLE (PEV) - is a general term for any car that runs at least partially on battery power and is recharged from the electricity grid. There are two different types of PEVs to choose from - pure battery electric and plug-in hybrid vehicles.

PLUG-IN HYBRID ELECTRIC VEHICLE (PHEV) - PHEVs are powered by an internal combustion engine and an electric motor that uses energy stored in a battery. The vehicle can be plugged in to an electric power source to charge the battery. Some can travel nearly 100 miles on electricity alone, and all can operate solely on gasoline (similar to a conventional hybrid).