CALIFORNIA ENERGY COMMISSION

CALIFORNIA NATURAL RESOURCES AGENCY

California Energy Commission

Clean Transportation Program

FINAL PROJECT REPORT

Best Practices for Installation of DC Fast Charging Corridors

South Coast Air Basin DC Fast Charging Network

Prepared for: California Energy Commission

Prepared by: South Coast Air Quality Management District

January 2022 |CEC-600-2022-011

California Energy Commission

Patricia Kwon, South Coast Air Quality Management District
Jonah Eidus, EVgo
Enid Joffe, Clean Fuel Connection, Inc.
Jaime Nack, Three Squares, Inc.
J.R. DeShazo, University of California, Los Angeles Luskin Center for Innovation
Primary Author(s)

South Coast Air Quality Management District
21865 Copley Drive
Diamond Bar, CA 91765
(909) 396-3065
South Coast Air Quality Management District Website (http://www.aqmd.gov)

Agreement Number: ARV-13-026

Sharon Purewal
Commission Agreement Manager

Mark Wenzel
Office Manager
ADVANCED VEHICLE INFRASTRUCTURE OFFICE

Hannon Rasool
Deputy Director
FUELS AND TRANSPORTATION

Drew Bohan
Executive Director

ACKNOWLEDGEMENTS

The authors wish to acknowledge the efforts of the following individuals in participating in this Project or providing information for this final report:

Deborah Allen, City of Rancho Cucamonga
Ali Ames, Three Squares, Inc.
Leslie Baroody, California Air Resources Board
Scott Briasco, Los Angeles Department of Water and Power
Ed Burtch, Goss Engineering
Daniel DeGarmo, City of Palm Springs
Robyn Eason, City of West Hollywood
Alex Farassati, City of Calabasas
Amy Ho, City of Monterey Park
Clement Jimenez, City of Moreno Valley
Kevin Kelleher, EVgo
Micele Mician, City of Palm Springs
Marvin Moon, Los Angeles Department of Water and Power
Terry O'Day, EVgo
Frankie Riddle, City of Palm Desert
Fabian Villenas, City of Rancho Cucamonga
Steven Weiss, Mel's Diner Santa Monica and West Hollywood
Dale West, City of Temecula

PREFACE

Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) created the Clean Transportation 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 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 fund electric vehicle charging infrastructure to support growth of electric vehicles as a conventional method of transportation and adoption of plug-in electric vehicles over a wide range of California's population and socio-economic classes. 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-13-026 on June 16, 2014.

ABSTRACT

For this project, the South Coast Air Quality Management District is partnering with EVgo, Clean Fuel Connection, Inc., University of California Los Angeles Luskin Center for Innovation, and Three Squares, Inc. The South Coast Air Quality Management District team is already working on several projects to construct a robust direct current fast charger network along major freeways. Existing projects focus on the greater Los Angeles, Orange, and San Diego Counties. The proposed new project will extend the growing east-west direct current fast charging corridor to four locations in Riverside County, further connecting the metropolitan areas of Los Angeles, San Diego, Santa Barbara and Palm Springs. The evolutionary landscape for fast charging has evolved considerably since this project was initially funded in 2014 and a significant amount of learning and best practices have been developed. This report will discuss the overall deployment of seven fast chargers to the existing fast charging network in the greater Los Angeles region and best practices in the areas of siting and site selection, hardware, installation, networking software and services, and education outreach so that other jurisdictions and agencies implementing fast charging in their region may benefit.

Keywords: DC fast charging, public charging

Please use the following citation for this report:

Kwon, Patricia, Jonah Eidus, Enid Joffe, Jaime Nack, J.R. DeShazo. 2022. *Best Practices for Installation of DC Fast Charging Corridors*. California Energy Commission. Publication Number: CEC-600-2022-011.

TABLE OF CONTENTS

Page

Acknowledgements i

Preface ii

Abstract iii

Table of Contents v

List of Figures vi

Executive Summary 1

CHAPTER 1: Overview 3
- Project Eligibility 5

CHAPTER 2: Siting and Site Selection 7
- Project Site Justification 7
- Lessons Learned 7

CHAPTER 3: Hardware 9

CHAPTER 4: Installation 10
- Overview 10
- Lessons Learned 10
  - Disabled Access for EV Charging 10
  - Power Availability 11
  - Metering and Demand Charges 11

CHAPTER 5: Networking Software & Services 12
  - Networking 12
  - Acceptable Forms of Payment 12
  - Customer Service/Support 13
  - Maintenance 14
  - Demonstrated Results 14

CHAPTER 6: Education Outreach 15
- Outreach Events 15
  - Calabasas City Hall 15
  - Palm Desert City Hall & Palm Springs Visitors Center 17
  - Mel's Diner West Hollywood 18
  - Other DCFC Station Launch Events 19
  - Social Media Coverage 20
  - Feedback 21

CHAPTER 7: 23
- Conclusions 23

Glossary 25

APPENDIX A: Utilization A-1

LIST OF FIGURES

Page

Figure 1: South Coast DC Fast Charging Network Map 4
Figure 2: BTC Power DC Fast Charger 9
Figure 3: Customer Call Center Performance 13
Figure 4: Customer Satisfaction Scores for Fast Charging 14
Figure 5: Calabasas Ribbon Cutting Event 16
Figure 6: Calabasas DC Fast Charging Station Ribbon Cutting Postcard Design 16
Figure 7: Palm Desert and Palm Springs Awareness Event 17
Figure 8: Electrical Vehicle Button on Coachella Website 18
Figure 9: #ChargeUp Postcard Design 18
Figure 10: #ChargeUp Postcard Design 19
Figure 11: #ChargeUp Social Media Coverage 20
Figure 12: #ChargeOnSunset Social Media Coverage 21
Figure A-1: City of Calabasas A-1
Figure A-2: City of Palm Desert A-2
Figure A-3: City of West Hollywood A-3
Figure A-4: City of Palm Springs A-4
Figure A-5: City of Moreno Valley A-5
Figure A-6: City of Temecula A-6
Figure A-7: City of Monterey Park A-7

EXECUTIVE SUMMARY

For this project, the South Coast Air Quality Management District is partnering with EVgo, Clean Fuel Connection, Inc., University of California Los Angeles Luskin Center for Innovation, and Three Squares, Inc. The South Coast Air Quality Management District team is already working on several projects to construct a robust direct current fast charger network along major freeways.

Existing projects focus on the greater Los Angeles, Orange, and San Diego Counties. The proposed new project will extend the growing east-west direct current fast charging corridor to four locations in Riverside County, further connecting the metropolitan areas of Los Angeles, San Diego, Santa Barbara and Palm Springs.

The evolutionary landscape for fast charging has evolved considerably since this project was initially funded in 2014 and a significant amount of learning and best practices have been developed. This report will discuss the overall deployment of seven fast chargers to the existing fast charging network in the greater Los Angeles region and best practices in the areas of siting and site selection, hardware, installation, networking software and services, and education outreach so that other jurisdictions and agencies implementing fast charging in their region may benefit.

CHAPTER 1:
Overview

This final project report is a compilation of best practices for the siting and use of direct current (DC) fast chargers, economic and vehicle range tradeoffs between availability of charging infrastructure and onboard battery capacity, changes in vehicle operator behavior, and necessary elements to include in community outreach and education programs.

As background information for the need for public DC fast charging infrastructure to support plug-in electric vehicles, California expects to be the largest U.S. market for Plug-In Electric Vehicles (PEVs), especially in the greater Los Angeles region with over 44 percent of the state's population and a historic and ingrained car-centric culture. The South Coast Air Quality Management District (SCAQMD), the California Air Resources Board and the Southern California Association of Governments recognize that in order to meet 2014 and 2023 federal Particulate Matter 2.5 and ozone standards and achieve the statewide greenhouse gas reduction targets, the use of zero-emission technologies, such as PEVs, will be required in the South Coast Air Basin. The SCAQMD is currently demonstrating and implementing many zero-emission technology projects in the light-, medium-, and heavy-duty transportation categories.

For this project, SCAQMD is partnering with EVgo, Clean Fuel Connection, Inc., University of California Los Angeles (UCLA) Luskin Center for Innovation, and Three Squares, Inc. The project team is already working on several projects to construct a robust DC fast charger network along major freeways. Existing projects focus on the greater Los Angeles, Orange, and San Diego Counties. The proposed new project will extend the growing east-west DC fast charging corridor to four locations in Riverside County, further connecting the metropolitan areas of Los Angeles, San Diego, Santa Barbara and Palm Springs. The evolutionary landscape for fast charging has evolved considerably since this project was initially funded in 2014 and a significant amount of learning and best practices have been developed. This report will discuss the overall deployment of seven fast chargers to the existing fast charging network in the greater Los Angeles region and best practices in the areas of siting and site selection, hardware, installation, networking software and services, and education outreach so that other jurisdictions and agencies implementing fast charging in their region may benefit.

Each of the team members has expertise in an area key to the overall success of the project. EVgo will own, operate, and maintain the DC fast chargers. EVgo has been installing DC fast chargers in California, Texas and Washington, D.C. and currently has the nation's largest network of DC fast chargers in the nation. EVgo brings its national network of private retail partners to provide a cohesive network of charging stations along the major freeway transportation corridors.

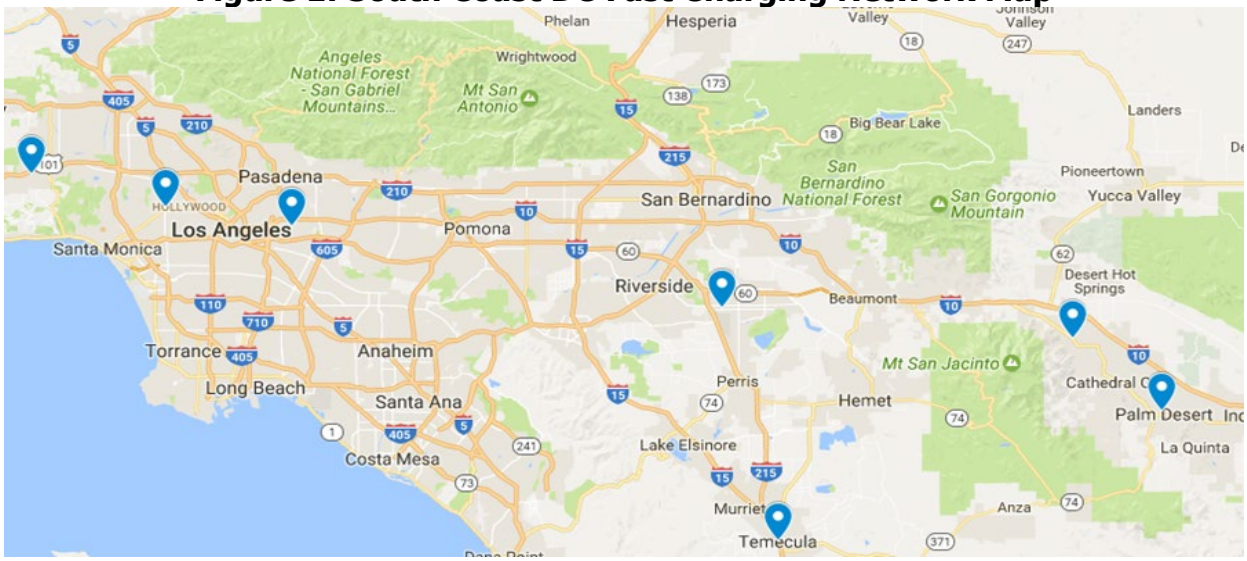
By partnering with EVgo, the nation's largest competitive power producer and investor/operator of solar power in the U.S., and with Clean Fuel Connection, Inc., one of the most experienced installer of public electric vehicle supply equipment (EVSE) in southern California, a fast charging infrastructure network necessary to transition to alternative, clean fuel sources is being created. In supporting mass market penetration of zero emission vehicles, SCAQMD is fulfilling its mission to undertake all necessary steps to protect public health from air pollution, with sensitivity to disproportionate impacts of air quality on local

communities and businesses. This project includes the installation of seven DC fast chargers at the following locations located less than a mile of a busy Southern California freeway:

1) Station 1—City of Calabasas—City Hall Calabasas City Hall, 100 Civic Center Way, Calabasas, CA 91302
2) Station 2— City of Palm Desert—City Hall Palm Desert City Hall, 73-510 Fred Waring Drive, Palm Desert, CA 92260
3) Station 3—City of West Hollywood—Mel's Diner, 8585 Sunset Blvd, West Hollywood, CA 90069
4) Station 4— City of Palm Springs—Visitor Center Palm Springs Convention Center, 2901 N. Palm Canyon Drive, Palm Springs, CA 92262
5) Station 5—City of Moreno Valley—Moreno Valley Electrical Utility 14331 Frederick Street, Moreno Valley, CA 92252
6) Station 6— City of Temecula—Farmers Market 41952 6th Street, Temecula, CA 92590
7) Station 7—City of Monterey Park—City Hall 320 W Newmark Avenue, Monterey Park, CA 91754

Below, Figure 1 shows a map of the aforementioned locations.

Figure 1: South Coast DC Fast Charging Network Map



These stations are part of a regional plan developed by SCAQMD, which, in its first phase, installed seven DC fast chargers along major transportation corridors in greater Los Angeles and within a mile to the nearest freeway. The majority of these stations are sited at grocery stores or similar destinations to reduce or offset demand charges from on-peak electricity usage. Data shows that trips to these destinations are typically taken during off-peak hours. In the next phase, charging stations will be installed at other EVgo retail partners such as coffee shops, convenience stores, drug stores, or shopping malls, focusing on Los Angeles and filling in gaps in infrastructure in the South Coast Air Basin. This project is being coordinated with a California Energy Commission (CEC) funded project by the Southern California Public Power Authority in order to increase corridor charging opportunities within jurisdictions served by municipal owned utilities.

Project Eligibility

This project meets all of the minimum requirements for project eligibility for PON-13-606 and does not contain any confidential information. Technology for DC fast chargers is changing rapidly. In 2010, Japanese Original Equipment Manufacturers (OEMs) Toyota, Nissan and Mitsubishi partnered to develop DC fast chargers with the Charge de Move quick charging standard with charging speeds of 40-60 kilowatts (kW) and speeds of up to 100 kW. Nissan Leaf, Mitsubishi iMiEV, and Kia Soul use the Charge de Move connector. In 2011, a Society of Automotive Engineers (SAE) Combined Charging System standard for fast charging was adopted by U.S. and European OEMs, with similar charging speeds and capable of charging up to 350 kW. The Chevy Spark, BMW i3, Volkswagen e-Golf, and Chevy Bolt, use the Combined Charging System connector. Tesla also has its own proprietary connector standard which can only be used by its vehicles. In 2016, Tesla joined Charging Interface Initiative e.V., a consortium of OEMs and suppliers which also includes Audi, BMW, Daimler, Ford, Mennekes, Opel, Phoenix Contact, Porsche, TUV SUD and Volkswagen, to support adoption of the Combined Charging System connector. Audi, BMW, Ford, Mercedes, and Porsche announced plans in late 2016 to build a network of 350 kW DC fast charging stations with Combined Charging System connectors in Europe.

There are DC fast chargers with approval from a nationally recognized testing laboratory (Underwriters Laboratories or Electrical Testing Laboratories), with both Charge de Move and Combined Charging System connectors. The ABB DC fast chargers is Underwriters Laboratories listed while the Efacec DC fast chargers is Electrical Testing Laboratories approved. Electrical Testing Laboratories is a commonly recognized certification that tests to the same standards as Underwriters Laboratories but typically on an expedited timeline; it is increasingly being accepted by local jurisdictions in the U.S. The certification process is sufficiently expensive and time consuming that DC fast charger manufacturers will only choose one nationally recognized testing laboratory to pursue certification of their charger. Other DC fast chargers manufacturers include AeroVironment and BTC Power.

In order to support the greatest number of PEVs and avoid any danger of obsolescence while two connector standards for fast charging exist, the project team installed dual DC fast chargers with Charge de Move and SAE Combo connectors as required by CEC. EVgo issued a Request For Information to identify the current state of technology, including DC fast chargers, battery energy storage systems, and other options. Based on that feedback, EVgo designed bid specifications and issued an Request For Proposal for the purchase of equipment to obtain the most competitive pricing, and worked with the provider to integrate EVgo's software. In addition, EVgo meets the Open Charge Point Protocol, an application protocol for communication between EVSE and a central management system of charging station network. This would enable the operation of the DC fast charger network by any Open Charge Point Protocol compliant network provider and avoid a situation where the absence of a network provider would mean that installed hardware would no longer be operational and would require replacement.

In summary, this project includes the following attributes:

- Charging provides both DC fast charging connector standards, including Charge de Move and Combined Charging System, and may include Level 2 charging with SAE J1772 connectors.

- Charging sites are located in accessible parking lots and available for public use. If fees are charged for parking, free or reduced parking charges are offered if a vehicle is only parking for the purpose of obtaining a DC fast charge.
- Charging sites are located within a 1-mile driving distance of a major highway or freeway, preferably in close proximity to populated areas or destinations.
- The appendix includes documentation of support for this project from various municipal government agencies, site hosts and the local Plug-in Electric Vehicle Coordination Council representatives including Southern California Association of Governments and Coachella Valley Association of Governments.
- Per the siting analysis performed by the UCLA Luskin Center for Innovation and the plan for outreach to the surrounding communities, the project will add value to PEV drivers traveling along these major transportation corridors.
- Charging sites chosen for their easy freeway access and ability to provide safe, well-lit charging environments for PEV drivers in the region.
- Project includes a plan for ongoing operation, maintenance and reliable customer service at each location should there be any unforeseen equipment breakdowns.
- Each station accepts credit cards as payment and be Open Charge Point Protocol compliant. Credit card support is available through the EVgo call center. Additionally, customers can put a credit card on file with their EVgo user account and receive an RFID card (On The Go plan with no monthly fee on a pay per use basis).
- EVgo equipment will not require a subscription fee or membership in any proprietary network as a condition of use.
- DC fast chargers use an open source protocol such as Open Charge Point Protocol as a basic framework for purposes of network interoperability.
- Installation will ensure that the site location has adequate power and transformer capacity available

CHAPTER 2:
Siting and Site Selection

Site selection methodologies implemented in this project were based largely on EVgo's historical experience, both in California and nationwide. The UCLA Luskin Center for Innovation also provided significant input into site selection, via its Innovation PEV Program.

Project Site Justification

Much of the input on site locations came from UCLA Luskin Center for Innovation's sophisticated PEV adoption modeling software, identifying travel patterns between census tracts where PEV drivers reside, work and shop. The UCLA Luskin Center for Innovation's site selection model combines land use data on local densities of workplaces, Municipal Utility Districts and retail establishments with locations of existing charging stations. Finally, demographic data and the characteristics of the local transportation system are used as described in the Southern California PEV Readiness Plan (written by the UCLA Luskin Center for Innovation and winner of the 2013 Planning Excellence Award by the Los Angeles section of the American Planning Association). EVgo, Clean Fuel Connection, Inc., Nissan, and General Motors also provided input on the site selection and site substitution process. The UCLA Luskin Center for Innovation analyzed the South Coast Air Basin and selected suitable locations at existing host location partners to maximize the effectiveness of the overall DC fast charging plan.

The original project sites were selected because these sites are situated alongside major freeways linking urban areas on heavily traveled routes and highly visible locations. Seven additional sites outlined in this project serve to extend the network further east to Riverside and Palm Springs and further west towards Calabasas.

Based on these regional parameters, EVgo and Clean Fuel Connection, Inc. targeted primarily grocery store and city government locations in these regions. Unfortunately, the grocery chain identified as an early partner unexpectedly backed out, and EVgo and Clean Fuel Connection, Inc. needed to identify alternative site hosts in addition to the city government locations already selected.

Lessons Learned

The past four years have seen significant changes in electric vehicle (EV) charging landscapes, and the lessons that EVgo has learned from this project and the data collected have been able to provide critical insight to key players across the industry, including utilities, regulators, OEMs, host partners and other EV service providers.

In many cases, these experiences and data have refuted much of the conventional thinking and expert hypotheses that helped shape the early years of this industry. Driver usage patterns, capital and operational cost structures, site acquisition challenges and host site qualifications have led EVgo to change significant portions of their business strategy.

Specifically, EVgo found that the type of host properties, as well as the specific regions and even sub-regions, can have an exponential impact on the amount of usage that the site receives. For example, EV drivers overwhelmingly prefer that DC fast charging stations be

located adjacent to retail properties, so that they can run errands while they charge. Moreover, the type of retail can make a significant difference. In general, grocery stores see significantly more usage than any other type of retail, followed by pharmacies/convenience stores, coffee shops and certain types of big box stores (i.e. Walmart). Locations like municipal lots, specialty stores (i.e., a store that only certain people would shop at such as a pet store), colleges/universities, restaurants, or public parking available at workplace/multifamily residential sites tend to see significantly lower utilization than a regionally comparable grocery/convenience store/coffee shop. In many cases, this ratio can be as much as 4:1 or 5:1 in favor of relevant retail.

On a regional basis, charging locations that have seen the most utilization tend to be in high urban densities, with additional weight based on proximity to the highway. However, EVgo has seen that proximity to a highway alone is not nearly as valuable as EVgo and much of the industry had suspected. For example, many locations on the east side of Los Angeles and into the Inland Empire, in close proximity to highways, are showing much lower utilization than locations on the west side, even those not close to highways. Moreover, we have high value location types (i.e. grocery stores) in the Inland Empire that show significantly lower usage than west side grocery store counterparts.

Other factors that are proving to be barriers to driver usage are parking fees and access barriers such as gated parking. Both factors are correlated with lower usage even in desirable locations.

The entire EV industry has always argued, and still maintains, that locations along highway corridors connecting dense urban zones are critical to the success of EV adoption. Even though these locations are still critical to the industry success as a whole, there is a limit to how many loss leader locations EVgo can support, and for how long. Both the utilization and the growth rate at these types of stations are significantly below what much of the EV industry had originally assumed.

Low utilization sites, especially those where EVgo pays utility demand charges, can be extremely expensive to operate, and the cost to serve a single driver can well exceed what is considered reasonable to bill that driver for a charge. While several of the sites in this program are performing adequately, most of the locations, specifically those located at city government properties in less densely populated areas, are performing well below what it costs EVgo to operate.

Another factor that slowed progress was the length of time required for site assessment and contract execution. Once a site was identified and expressed interest, a site assessment was performed to determine if the installation could be completed within the project budget. In several cases, contract negotiations were lengthy and all contracts had to be approved by the city councils of the respective local governments, leading to further delays in deploying fast charging infrastructure.

CHAPTER 3:
Hardware

EVgo and Clean Fuel Connection, Inc. selected BTC Power as the hardware manufacturing partner for this program through a Request For Quotation to identify the best performing and most cost effective 50 kW DC fast charger for this project.

With over 600 DC fast charger units deployed, BTC Power is the largest U.S. based manufacturer of DC fast chargers commercially available since 2013. BTC Power DC fast chargers are built for a lifespan of 15 years, with minimal maintenance requirements other than bi-annual product maintenance.

The BTC Power EVFC-50-5 DC fast charger can be installed on either 208 volts (V) service or 480V service (Model EVFC-50-5-208 or EVFC-50-5-480, respectively). These voltage options allow for additional installation flexibility at the site level.

BTC Power's 50kW DC fast charger can be configured as a single charger, with either a Charge de Move or SAE connector, or a dual charger with both a Charge de Move and SAE connector integrated into a single unit, capable of charging a wide variety of EV's. The dual connector configuration has been selected for this program. Figure 2 shows a picture and specifications of the charger.

Figure 2: BTC Power DC Fast Charger

DC Fast Charger: EVFC-50-5

BTCPOWER
www.btcpower.com

Model	EVFC-50-5-208	EVFC-50-5-480
Power Rating	50 kW	50 kW
Input Power	208 VAC, 3-Phase	480 VAC, 3-Phase
Input Power Breaker	200 A	100 A
Input Current	160 A	70 A
Required Power Capacity	58 kVA	58 kVA
Max. Output DC Current	50 A	50 A
Max. Output DC Voltage	50-500 V	50-500 V
Frequency	50 Hz / 60 Hz	
Efficiency Rating	>90%	
Connectors	CHAdeMO, SAE Combo	
Network	EVP, Credit Card, OCPP	
Storage Temperature	-20°C to +55°C	
Operating Temperature	-30°C to +55°C	
Relative Humidity	90%	
Safety Compliance	ETL Listed for USA and Canada; Complies with UL 2594, UL 2231-1, UL 2231-2, NEC Article 625, FCC Part 15, Class A, ADA Compliant	

Product Dimensions:
43"[w], 73.5"[h], 32.19"[d]

Source: South Coast Air Quality Management District

CHAPTER 4:
Installation

Overview

All installations were completed on time and within budget by Clean Fuel Connection, Inc. using in-house electrical crews. The amount of time required for each installation ranged from two weeks to several months, depending on timeframes for material deliveries, city permitting, and utility work/approvals. Installation work included the following scope of work:

- Site design and engineering
- Permitting with the local authority having jurisdiction
- Trenching, installation of conduit and wire
- New meter pedestal and electrical panel where required
- Transformers where required
- New utility service where required
- Pouring concrete bases for DC fast chargers and any pedestals or transformers
- All final connections to DC fast chargers
- Striping, safety bollards and EV charging stenciling and signage
- Utility interconnection where required
- Final inspections by local authority having jurisdiction and/or utility where required
- Network connection to EVgo

Some sites had 480V power but other sites only had 208V power available. Fortunately, BTC Power hardware can be configured to work with either type of power.

Installation costs varied by site, ranging from $30,000 to $65,000. In two instances, cities provided additional match funding because the installation cost exceeded the amount budgeted in the CEC grant.

Lessons Learned

There were a number of issues that slowed progress on the project. While most of the installations were not particularly complicated, there were significant challenges and barriers to installation that needed to be overcome at each site.

Disabled Access for EV Charging

Compliance with the Americans with Disability Act guidelines for disabled access for EV charging as defined by the California Division of the State Architect was a significant challenge during this project. During the period of construction under this contract, disabled access for EV charging was governed by the Interim Disabled Access Guidelines for Electric Vehicle Charging Stations 97-03 dated June 5, 1997. These guidelines were subject to varying interpretations by local authorities having jurisdiction, and in several cases, the project design went through several iterations in order to comply with local interpretations of California

accessibility requirements. Some of the ambiguity of the 1997 Guidelines has been resolved with the issuance of the 2016 California Building Code, Chapter 11B, effective January 2017, but compliance with disabled access remains challenging for EV charging installations. In many cases, it can significantly increase the cost of installing Level 2 or DC fast charging infrastructure by triggering requirements for accessible charging spaces, even with the installation of the first charger at a site. These additional accessibility requirements include limitations on slope, standards for an accessible path of travel from the charging space to the nearest entrance of the facility, and wider space requirements for regular vehicle and van accessible charging spaces.

Power Availability

The BTC Power 50kW DC fast chargers require a substantial amount of 208V or 480V power. Many locations were eliminated because they did not have adequate electrical capacity and the required upgrades would have exceeded the project budget. In other locations, the power that had been available during the initial assessment was no longer available at the time of construction. After load testing, multiple load calculations, and consulting an electrical engineer, Clean Fuel Connection, Inc. was able to find a workable solution for each location. However, the process was laborious and time consuming.

Metering and Demand Charges

As described in Chapter 2's Siting and Site Selection section, the thinking about optimal DC fast charging locations has been shifting as more data is collected on actual driver usage and the economics of charging. EVgo's original business model called for each fast charger to be on a separate utility meter so that electricity costs could be easily tracked. Unfortunately, based on the current utility rate structure, a portion of the electricity costs is fixed, regardless of actual usage. This portion of the monthly electricity bill is the demand charge and is based on the highest single use during the month. Given the 50 kW requirement of the BTC Power DC fast charger, EVgo is billed for 50 kW of demand, regardless of whether one driver uses the charger or 1,000 drivers use it. Usage of each of the installed DC fast chargers started low and ramped up over time. As a result, revenue from driver fees in the early months does not cover the cost of electricity. Even after many months of operation, the monthly cost of electricity exceeds the revenue stream at some locations. Unfortunately, this is not a sustainable business model.

Midway through the project, EVgo adjusted their business model to select locations where the DC fast charger could be added to an existing utility meter. This had the result of spreading the monthly demand chargers over more kilowatt hour usage, reducing the negative impact of demand chargers. EVgo negotiated a reimbursement rate for each site host based on a blend of expected demand charges and kilowatt hour costs.

CHAPTER 5:
Networking Software & Services

EVgo provides comprehensive networking, service, and maintenance for all DC fast charging stations in this program. As the largest public DC fast charging service provider in North America, EVgo has extensive experience managing and operating DC fast charging stations.

Networking

EVgo's attention to customer needs led to the implementation of a new network system operating platform in June 2017. This platform is based on the software service from Driivz. Founded in 2012, the Driivz platform is currently used to manage the largest public EV charging networks in Europe with over 9,000 charging connectors on more than 60 different types of charging stations used by over 140,000 EV drivers.

Importantly, with the EVgo and Driivz operating experience, its systems are built from real customer requirements. EVgo and Driivz have worked with many different EV related stakeholders throughout the world including automaker partners, OEMs, utilities, EV drivers, site hosts, service providers, mobility providers, and government agencies. Each stakeholder has their own sets of requirements for their needs and those of their customers. EVgo chose Driivz as the network developer based on their success, and together with Driivz have developed a multifaceted platform that serves all of these stakeholder needs.

The EVgo/Driivz platform offers a multitude of functionalities, including real-time remote diagnostics, remote service and maintenance (when possible), driver billing, metering and monitoring, reporting, facilitation of host reimbursement, as well as a comprehensive driver portal and mobile app complete with mobile application charger authentication.

The first six months of operation under the new EVgo/Driivz have proven to be an upgrade in networking functionality, improving EVgo's service level and customer satisfaction.

Acceptable Forms of Payment

EVgo offers a number of ways to pay for each charge.

- Credit Card – All EVgo charging stations offer payment via credit card. All stations deployed under this program have a credit card reader capable of accepting all major credit cards.
- EZ-Charge – All new Nissan LEAF drivers receive an EZ-Charge card, which entitles drivers to two years of free charging on the EVgo network (as well as other selected networks). EVgo developed EZ-Charge in conjunction with Nissan. The program provides drivers with an RFID card that can be registered on multiple networks. This process is facilitated by a jointly managed website that allows EV drivers to register their card and the networks of their choosing. All major networks participate in this program, with the exception of ChargePoint.
- BMW ChargeNow – All purchasers of new BMW i3 vehicles receive a ChargeNow card to access all EVgo stations. To implement this project, EVgo works with the ChargeNow administrator (ChargePoint) to authenticate each transaction.
- EVgo Mobile App – Customers are able to pay through EVgo's mobile app

Customer Service/Support

EVgo chargers are fully networked, enabling real-time status updates for EV drivers and EVgo technical staff to ensure maximum uptime, and their best-in-class Call Center (help desk) is available at all times. If the chargers experience any error, Network Operations is notified instantly. Once an error is flagged, trained staff diagnose the error appropriately and dispatch a technician for repair if needed. Through the Call Center, chargers can also be quickly started and reset remotely.

EVgo's comprehensive approach to customer service comes originally from the company's origin with NRG Energy. As the retail electricity provider for over three million customers, NRG and its retail companies (Reliant, Cirro, and Green Mountain Energy) built systems and processes to handle approximately 6.5 million calls per year. Figure 3 below shows data about customer call center performance.

Figure 3: Customer Call Center Performance

Call Center Performance	
	Simply Smart Solutions
Call Offered (NCO)	9764
Calls Handled (NCH)	9562
Calls Abandoned (NCA)	202
Service Level (SL)	97.0%
Average Speed of Answer (ASA) (in seconds)	9
Average Handle Time (AHT) (in seconds)	344
Max Delay (in seconds)	1016

Source: South Coast Air Quality Management District

EVgo's call center representatives are dedicated to the needs of EV drivers and currently handle approximately 8,000 calls per month, with average waiting times of less than twenty seconds per call.

EVgo regularly monitors customer satisfaction through a variety of channels, including detailed operational metrics, as well as phone and internet surveys to ensure customers are satisfied with the service EVgo delivers. All customer issues are monitored through an internal tracking system. This system tracks customer issues by multiple variables, including EV model, location, charger type, and issue, so that trends can be easily detected, resolved quickly, and proactively addressed. This system allows EVgo to evaluate practices and policies to avoid the recurrence of preventable issues.

EVgo's Call Center regularly ranks in the top service category compared to their peers. Specific metrics include average speed of answer, calls abandoned rate, issue resolution time and customer satisfaction in order to constantly improve the customer experience.

Although many routine customer questions and concerns can be resolved on the phone, EVgo's operations team also continuously monitors all of their charging equipment so that action can be taken before issues arise. Their Network Operations Center can remotely reset chargers via the Open Charge Point Protocol network, and their network is programed to avoid outages or offline chargers with the inclusion of a default setting to free vend in the event of a

communication error or loss of status, enabling customers to charge their vehicle despite a loss of communication.

Maintenance

Good maintenance practices are critical to a quality customer experience. Having operated the nation's largest DC fast charging network at high levels of availability (currently exceeding 98 percent uptime), EVgo understands how to implement a robust maintenance operation. A number of EVgo operational employees come from power plant or utility backgrounds and bring that expertise to their high-speed EV charging network.

EVgo is committed to providing the most reliable charging network in America and maximizing the uptime of the charging network by ensuring all equipment and systems undergo regular, timely, and high-quality maintenance. EVgo has multiple partners to perform service, preventative maintenance, and corrective maintenance for EVgo's nationwide infrastructure. All maintenance on EVSE, electrical supply equipment, network infrastructure, and non-core equipment is performed in conformance with local, state, and federal fire and electrical regulations, and in accordance with all OEM recommendations and requirements. All sites undergo regular preventative maintenance including visual inspection, performance testing, cleaning, and functional validation. All maintenance is fully documented, and summary reports will be available on request.

Demonstrated Results

PlugScores from PlugShare are an objective measure of customer satisfaction levels, and are developed via direct user feedback based on station uptime, customer service, and overall quality of the site location. Figure 4 below shows national PlugScores for EVgo's DC fast charging network and industry partners' charging networks, and two of the cities in the U.S. with the largest networks. EVgo's operating standards and customer-centric service model produce the highest customer satisfaction scores in the industry.

Figure 4: Customer Satisfaction Scores for Fast Charging

PLUGSCORE COMPARISON

	EVgo	ChargePoint	Blink	Greenlots	Other
National Average DC Network PlugScore	9.0	7.7	5.5	6.8	7.0
# DC Charging Sites - Los Angeles	64	24	6	17	28
Average DC PlugScore - Los Angeles	9.3	8.2	5.6	7.7	7.9
# DC Charging Sites - San Francisco	52	19	30	8	10
Average DC PlugScore - San Francisco	8.5	8.3	5.6	6.3	7.4

Source: South Coast Air Quality Management District

CHAPTER 6:
Education Outreach

Involving local stakeholders in PEV readiness is crucial to the successful deployment of DC fast charging stations. Drivers and charging site hosts need help understanding the benefits of driving PEVs and having public fast charging in their communities, the economic value proposition that PEV driving and/or charging holds for them, and correct procedures for using DC fast charging stations.

An education and outreach campaign has been developed to facilitate PEV readiness in DC fast charging station communities by engaging the following stakeholder groups:

- Site hosts (owners/employees/students);
- Local businesses (owners/employees);
- Local homeowners and commuters;
- Local governments, associations, and media; and,
- PEV advocacy groups

Three Squares Inc. has served as the Project Community Outreach and Education Lead. In this role, they have designed a comprehensive outreach strategy to raise awareness about the new DC fast charging stations throughout their surrounding communities.

Three Squares Inc. is a Santa Monica-based environmental consulting firm that has been directly involved in the development of California's PEV infrastructure as a contractor to the SCAQMD and to several PEV manufacturers. From organizing alternative fuel vehicle tradeshows, expos, and ride and drive events, to working directly with PEV manufacturers on their marketing and communications plans, Three Squares Inc. has extensive experience engaging the public's interest in PEVs. Three Squares Inc. has also developed community outreach and education campaigns for the SCAQMD to increase awareness about PEVs and created the CleanCarChoices.org online calculator to showcase the benefits of switching from a gasoline-powered vehicle to a PEV.

Outreach Events

Three Squares Inc. has developed a series of DC fast charging station launch events to raise awareness about new station locations. This ranged from traditional press events to awareness events held in conjunction with another scheduled event or site host promotional opportunity.

Calabasas City Hall

The City of Calabasas hosted a ribbon cutting ceremony at the new DC fast charging station located in the parking lot of the Calabasas City Hall on August 10, 2016. The ribbon cutting ceremony and press event featured remarks by Calabasas Mayor James R. Bozajian, Councilmember of Rolling Hills Estates and SCAQMD Board member Judith Mitchell, and Sharon Purewal of the California Energy Commission.

To promote the event and raise awareness about the SoCalFast network, Calabasas DC fast charging station Grand Opening and Ribbon Cutting Ceremony postcards were designed and

distributed to the Calabasas City Hall, libraries, local grocery stores, and other community outlets.

Two Three Squares Inc. staff members, one SCAQMD staff member, and one Clean Fuel Connection, Inc. technical staff member were on site at the ceremony to support the event. Figure 5 below shows Calabasas Mayor James Bozajian charging a vehicle at the event and Figure 6 shows a postcard for the event.

Figure 5: Calabasas Ribbon Cutting Event

Source: Three Squares Inc.

Figure 6: Calabasas DC Fast Charging Station Ribbon Cutting Postcard Design

Source: Three Squares Inc.

Palm Desert City Hall & Palm Springs Visitors Center

As an alternative to a traditional ribbon cutting and press events, Three Squares designed a fast charging awareness campaign to take advantage of those attending the Coachella Valley Music and Arts Festival for two weekends. A #ChargeUp campaign was developed to announce the launch of the Palm Desert City Hall and Palm Springs Visitors Center DC fast charging stations, which included:

- A welcome event at the Palm Desert City Hall station on April 13, 2017.
- Free DC fast charging at the Palm Desert City Hall and Palm Springs Visitors Center stations over two weekends: April 13-16, 2017 and April 21-23, 2017.

The launch for these stations was held in conjunction with the annual Coachella Valley Music and Arts Festival. This festival attracted 250,000 people to the Coachella Valley over two weekends and featured concerts, art installations, and unique activations. #ChargeUp encouraged festival goers to drive their EVs to the event. Figure 7 below shows a picture of one of the chargers at the event.

Figure 7: Palm Desert and Palm Springs Awareness Event

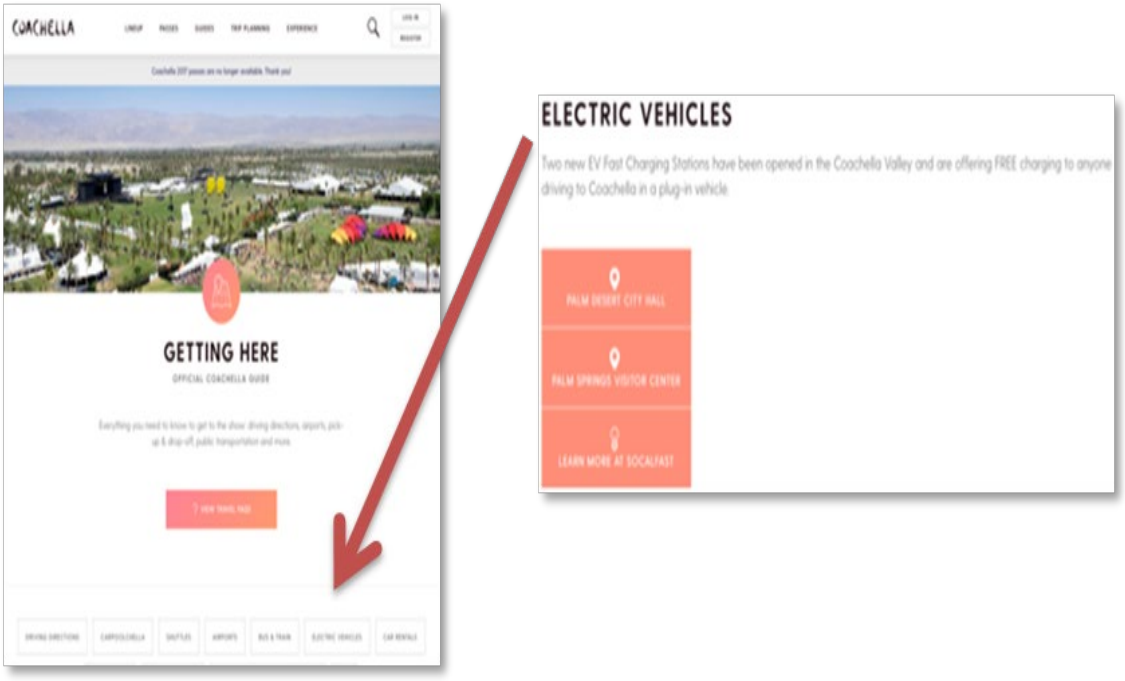
Source: Three Squares Inc.

To promote the event and raise awareness about the SoCalFast network, Three Squares worked with Coachella organizers to get an 'Electric Vehicles' button added to the official concert website. The button directed traffic to the SoCalFast website and encouraged EV drivers to 'charge up' at the new DC fast charging stations on their way to and from the concert. This marked the first time Coachella included a section for EV drivers on their 'Getting There' page. Additionally, #ChargeUp postcards were designed and distributed to the Palm Desert City Hall, the Palm Springs Visitors Center, and other community outlets. #ChargeUp graphics and promotional language were also distributed via the online channels of Plug In

America, SoCal EV, BMW i3 SoCal, and the Desert Tesla Club. Figures 8 and 9 below show some of the promotional materials.

Two Three Squares staff members, one SCAQMD staff member, and one Clean Fuel Connection, Inc. technical staff member were on site to support the welcome event.

Figure 8: Electrical Vehicle Button on Coachella Website



Source: Coachella Valley Music and Arts Festival

Figure 9: #ChargeUp Postcard Design

Source: Three Squares Inc.

Mel's Diner West Hollywood

The new DC fast charging station at Mel's Diner in West Hollywood was promoted through a #ChargeItUp awareness campaign on July 18, 2017. Mel's Drive-In is a well-known California

restaurant chain. Several of its locations have been featured in movies. Most famously, its San Francisco location on Van Ness Avenue was highlighted in the movie American Graffiti. The Mel's Drive-In on Sunset Boulevard in West Hollywood is located in a highly trafficked section of the Sunset Strip. The campaign included:

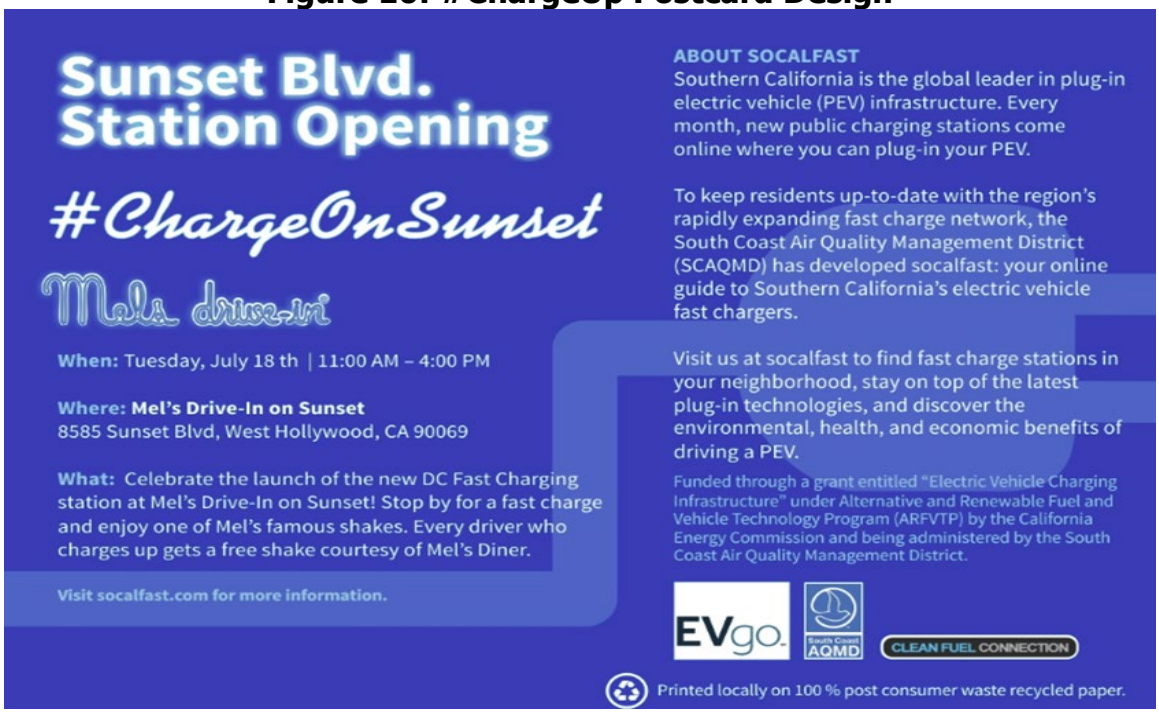
- A launch event at Mel's Diner in West Hollywood
- Free DC fast charging at the Mel's Diner in West Hollywood station on the day of the launch event
- Free milkshake for every driver who charged up, courtesy of Mel's Drive-In

The launch event encouraged EV drivers to stop by the new station to learn about SoCalFast network.

To promote the event and raise awareness about the SoCalFast network, Three Squares worked with the managers of Mel's Diner in West Hollywood to get information about the launch event and a link to the SoCalFast website added to the official Mel's Diner website. Additionally, #ChargeItUp postcards were designed and distributed to Mel's Diner in West Hollywood and other community outlets. #ChargeItUp graphics and promotional language were also be distributed via the online channels of partner organizations. Figure 10 below shows a picture of the postcard.

Two Three Squares Inc. staff members, one SCAQMD staff member, and one Clean Fuel Connection, Inc. technical staff member were on site to support the launch event.

Figure 10: #ChargeUp Postcard Design



Source: South Coast Air Quality Management District

Other DCFC Station Launch Events

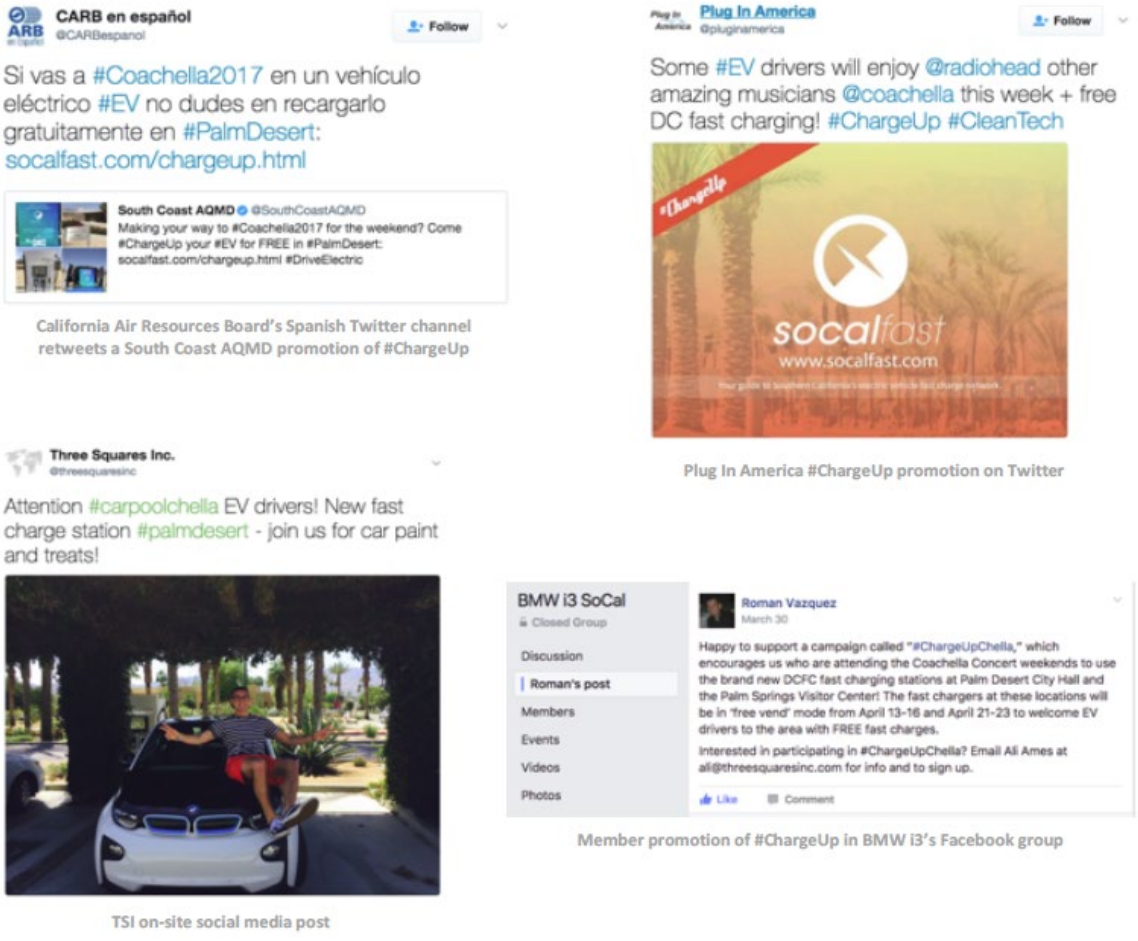
Three Squares Inc. is developing a series of other launch events for DC fast charging stations in the SoCalFast network. Launch events for some or all of the following stations from ARV-12-053 will be completed by June 30, 2018:

- La Kretz Innovation Campus in Downtown Los Angeles
- LADOT Hollywood & Highland Metro Station in Hollywood (Los Angeles)
- LADOT Chinatown Metro Station in Chinatown (Los Angeles)
- LADOT Broxton Avenue Parking in Westwood (Los Angeles)
- Victoria Gardens Mall in Rancho Cucamonga
- Mel's Diner in Santa Monica
- South Coast Air Quality Management District in Diamond Bar

Social Media Coverage

For the Coachella Valley and Mel's Diner West Hollywood awareness events, Three Squares engaged in more social media outreach to increase awareness for DC fast chargers and the SoCalFast network. Figure 11 below shows a picture of the social media coverage for the #ChargeUp events.

Figure 11: #ChargeUp Social Media Coverage

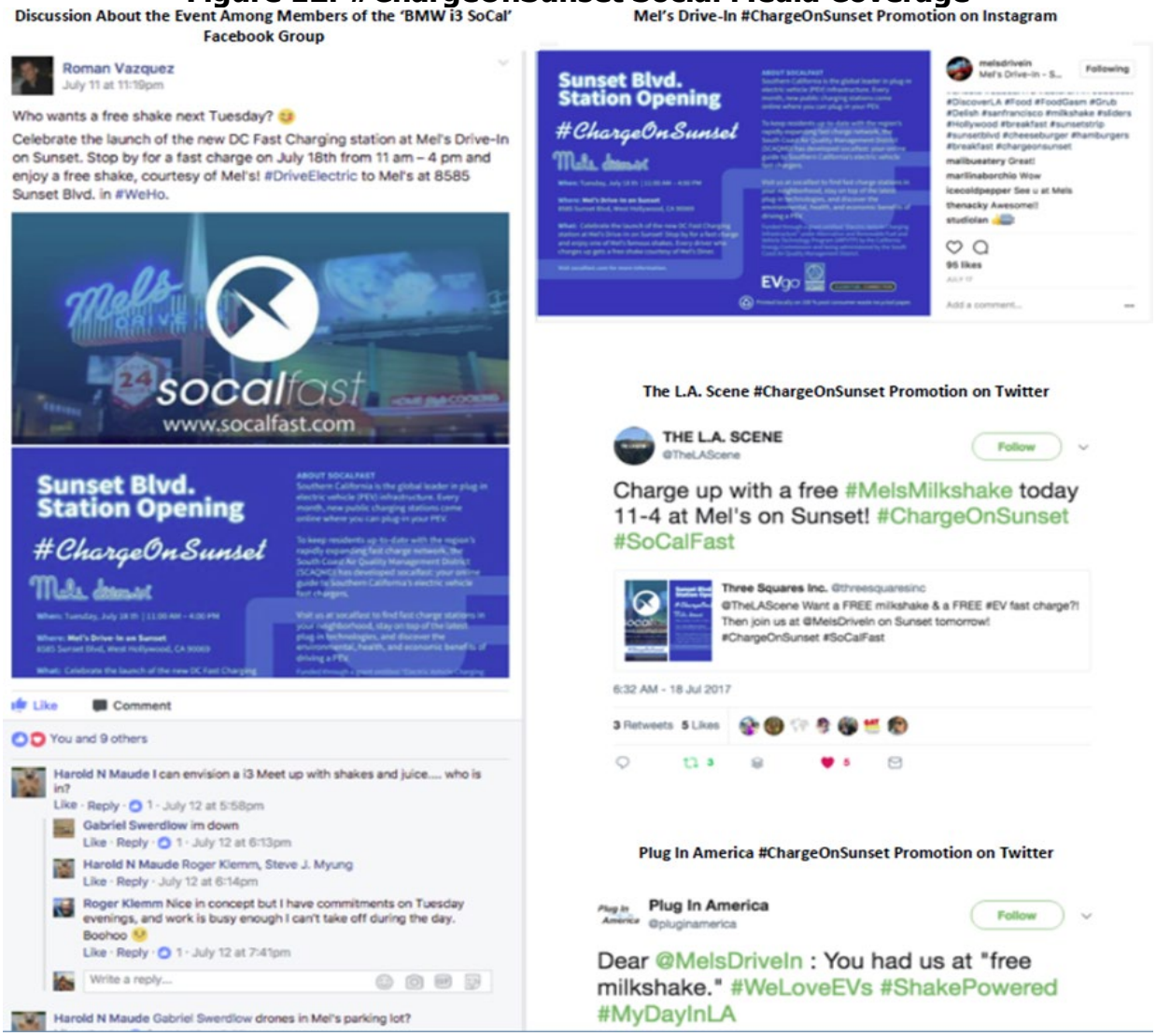


Source: South Coast Air Quality Management District

For the ChargeUp event held in conjunction with the Coachella Music Festival weekends, Three Squares reached out to Plug In America (11,400 followers), SoCalEV (15,000+ followers), BMW i3 SoCal (865 followers), and Desert Tesla Club (25 followers). SCAQMD also tweeted about the event through its social media accounts and California Air Resources Board re-tweeted through its social media accounts in English and Spanish. This is in addition to the 250,000 people who participated in the Coachella Music Festival.

Figure 12 shows the various social media posts about the #ChargeOnSunset event.

Figure 12: #ChargeOnSunset Social Media Coverage



Source: South Coast Air Quality Management District

For the ChargeItUp event held at Mel's Diner, Three Squares' digital outreach was 482,000 people including: The L.A. Scene (288,000 followers), Gay West Hollywood (137,000 followers), Plug Share (20,000 followers), Plug In America (11,400 followers), SoCalEV (15,000 followers), Mel's Drive In (4,300 followers), Electric Auto Association (2,000 followers), JMPR Public Relations (1,100 followers), and BMW i3 SoCal (950 followers). SCAQMD also tweeted about the event through its social media accounts and California Air Resources Board re-tweeted through its social media accounts in English and Spanish.

Feedback

Three Squares has gathered feedback on the outreach events conducted thus far. To date, outreach efforts have included a traditional press event and two awareness events. Based on the results from these past outreach events, Three Squares will design a future outreach event at the La Kretz Innovation Campus to increase the number of members of the general public who learn about the benefits of fast charging and other performance metrics. Based on

observations from the last two events, Three Squares identified the following challenges with hosting outreach efforts for fast charging:

1) Charging Time – Since there is only one charger capable of charging one vehicle at a time, only 1-2 vehicles per hour can be accommodated at an outreach event. For a 5-hour event, this means only 6-10 vehicles can be charged at the station. For instance, one vehicle (a Chevy Bolt) charged for almost an hour at the Mel's Diner event. Hence, the audience size for each event is limited because of the charging time to at most 10 vehicles per event.
2) Site Host Limitations – The owner of Mel's Diner was supportive of the event as long as they held it during their slowest times (Monday or Tuesday during lunch hour) as their parking lot is full at all other times. Although this time slot was not ideal, there was no other option. The owner also expressed concern that he did not want too many vehicles waiting in a line to charge since they could only charge one vehicle at a time.
3) Audience Target – For the #ChargeUp events, their on-site audience is limited to only those drivers who have fast charge capable vehicles that live in the area or find it convenient to pass by the station. This is a limited number of people. However, since the event cannot accommodate more than 10 vehicles, it is almost a match.
4) Outreach Target – Since many vehicles cannot be accommodated on site at each event, the goal is to reach a large audience online via partnership promotions and outreach efforts. Three Squares was successful in increasing views of both SoCalFast.com and in raising awareness that this new network of fast chargers exists in the South Coast Air Basin. For example, getting the "Electric Vehicle" button on the Coachella concert website, which linked back to the SoCalFast.com site and promoted the two charging stations, was a big outreach win. For the Mel's Diner event, outreach efforts were magnified by several social media accounts linked to West Hollywood accounts. If the goal of these events is to raise awareness about these new DC fast charging stations to encourage the adoption and purchase of EVs, this type of online outreach allows hundreds of thousands of viewers to be informed about these stations.
5) Other Outreach Activities – In the future, the intent is to focus on outreach activities near the station to reach the desired audience versus focusing on the 10 vehicles charging during the event period. For example, future events could explore having a booth or table setup at the Temecula Farmer's Market to promote SoCalFast to attendees at the market and point them in the direction of the fast charging station in the garage.

CHAPTER 7:

Conclusions

There have been significant changes in technology and awareness of what is needed to successfully install EV infrastructure since this CEC grant was first awarded in 2013, in response to a Program Opportunity Notice issued in 2012. Hardware manufacturers and network providers have become dominant players in the EV charging landscape but also several prominent companies have declared bankruptcy and withdrawn as a result of not being able to make a successful financial and business case for continued operation in the charging sphere. These include Blink which was later replaced by Blink CarCharging, 350Green, Better Place, and other companies. Those companies that continue to provide EV charging services have done so by continuing to evolve and adapt and improve their technology, installation, software, and networking platforms to accommodate the changing needs of EV drivers, OEMs, and EVSE manufacturers.

EV charging has become an amenity for early adopters who were the first to purchase and drive limited range EVs with an 80 mile – 100 mile electric range starting with the advent of the Nissan Leaf in 2011 to the first plug-in EV with the Chevy Volt, later in 2011. This was followed by the release of the Tesla Model S in 2012, which was the first long range EV of 160 – 265 miles.

Along with these evolutionary jumps in vehicle technology to incorporate larger size batteries and EVs with greater range comparable to a conventionally fueled gasoline vehicle, these were accompanied by corresponding technology gains in EV charging infrastructure. Level 1 (120V) charging was replaced by Level 2 (240V) charging and then DC fast charging (480V). DC fast charging has continued to improve. Initial DC fast chargers were 50 kW and only had Charge de Move connectors for Asian fast charging vehicles. SAE adopted its own Combined Charging System in 2011 and 50 kW fast chargers with Charge de Move and Combined Charging System connectors became commercially available starting in 2013 with the Efacec and ABB 50 kW fast chargers. As part of the Volkswagen Settlement and other fast charging networks, such as EVgo, Chargepoint and Greenlots, there has been increased activities surrounding Underwriters Laboratories or Electrical Testing Laboratories safety certification of higher powered fast chargers including 150 kW and 350 kW fast chargers. Combined Charging System connectors are capable of accommodating up to 350 kW fast chargers and these have been deployed in limited numbers within Europe and in the United States (i.e. EVgo has installed a 350 kW demo fast charger in Baker, California).

On an independent track, Tesla started deploying its own 90 kW fast charging network using its proprietary connector in 2012, and then 120 kW and 145kW fast chargers were later installed within the Tesla network.

All of these indicators show that there will be continued growth in technology and increased specialization of providers offering services to site hosts and EV drivers. Network providers will continue to expand their respective networks and, at the same time, collaborate on common standards and protocols, such as open roaming and interoperability protocols that allow EV drivers to use a single network's Radio-frequency Identification card across multiple networks in the same way that consumers can use ATM cards at multiple banks or use their cell phones

internationally across multiple service providers. This builds upon the open standards protocols for software platforms controlling EV chargers to allow hardware to be operated by multiple network providers and software platforms. There is also continued progress on open demand response protocols for energy management of EV chargers at a host site such as Open Automated Demand Response Protocol, Open Smart Charging Protocol, and Open Charge Point Interface. The development of these open standards will also help ensure that there continues to be technology that evolves and avoids proprietary technology and standards that cannot be flexible and adapt to changing EV charging needs.

This paper serves to encapsulate the learning of installing EV infrastructure from multiple perspectives: a regional government agency attempting to direct public investments towards early deployment of fast charging corridors in communities underserved by chargers, a network provider utilizing a combination of public and private funding to strategically expand key charging corridors within their established and growing networks, an installer who has extensive field and local experience in installing infrastructure in commercial, government, and residential settings, a university economic research group with experience on PEV readiness issues and the ability to use its site modeling software to optimize site host locations, and an outreach organization with significant experience in designing and hosting effective education outreach events for environmental technologies targeted to the general public and residents in environmental justice or disadvantaged communities. This paper also serves as a historical footnote to record the learning over the past five years on the installation of DC fast charging infrastructure.

GLOSSARY

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:

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

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

ELECTRIC VEHICLE (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 EVs. EVSE can charge a wide variety of EVs, including BEVs and PHEVs.

KILOWATT (kW)—One thousand 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 4 kW each hour.

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.

PLUG-IN ELECTRIC VEHICLE (PEV)—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.

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)—A global association of more than 128,000 engineers and related technical experts in the aerospace, automotive, and commercial-vehicle industries. The leader in connecting and educating mobility professionals to enable safe, clean, and accessible mobility solutions.[99]

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)—The air pollution control agency for all of Orange County and the urban portions of Los Angeles, Riverside, and San Bernardino counties. This area of 10,740 square miles is home to over 17 million people—about half the population of the whole state of California. It is the second most populated urban area in the United States and one of the smoggiest. Its mission is to clean the air and protect the health of all residents in the South Coast Air District through practical and innovative strategies.

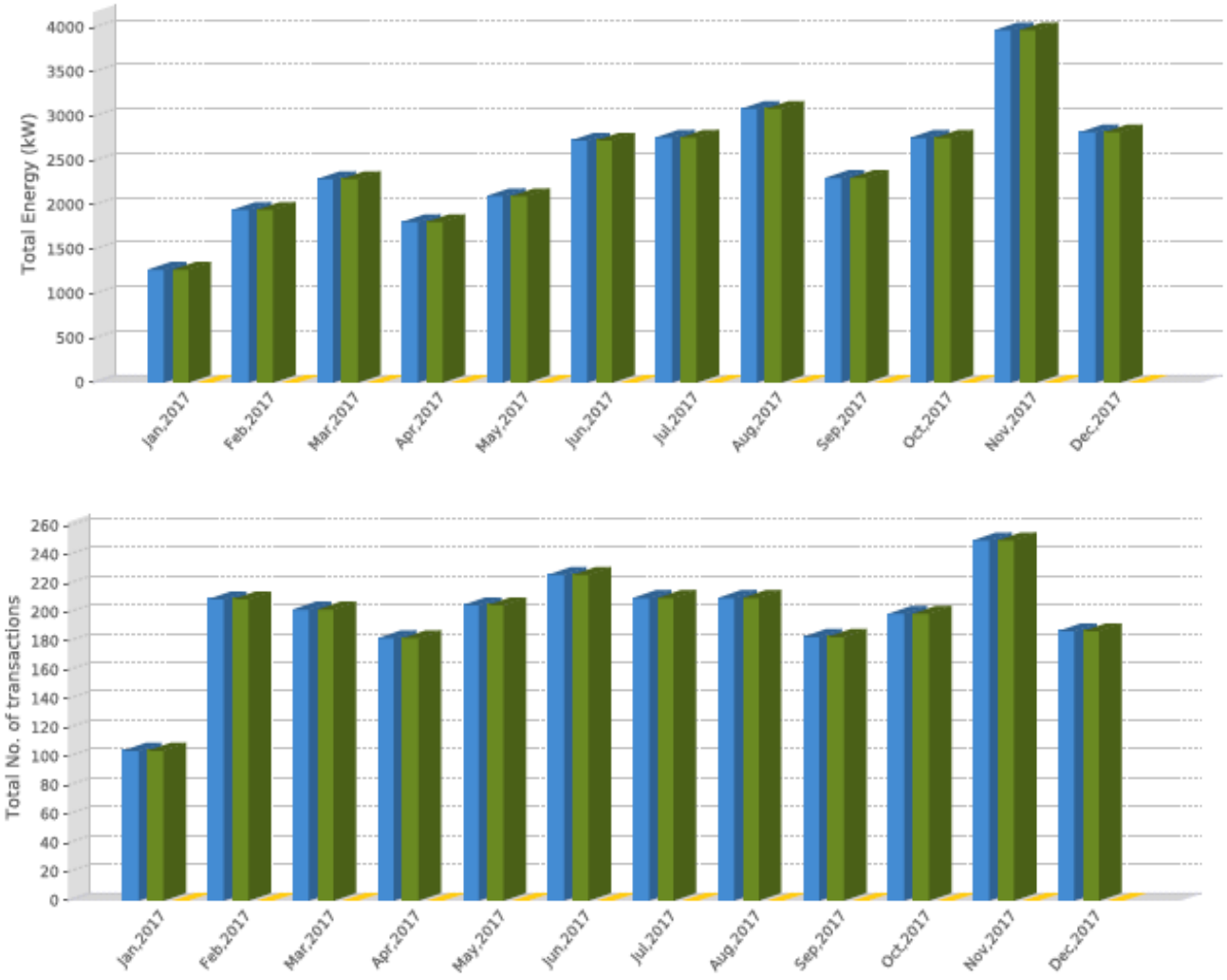
UNIVERSITY OF CALIFORNIA LOS ANGELES (UCLA)—A public research university located in Los Angeles, California. It is one of the 10 campuses in the University of California (UC) system.

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 offices have 120 volts.

APPENDIX A:
Utilization

Figures 1 through 7 indicate the total energy and total number of transactions from January 2017 through December 2017.

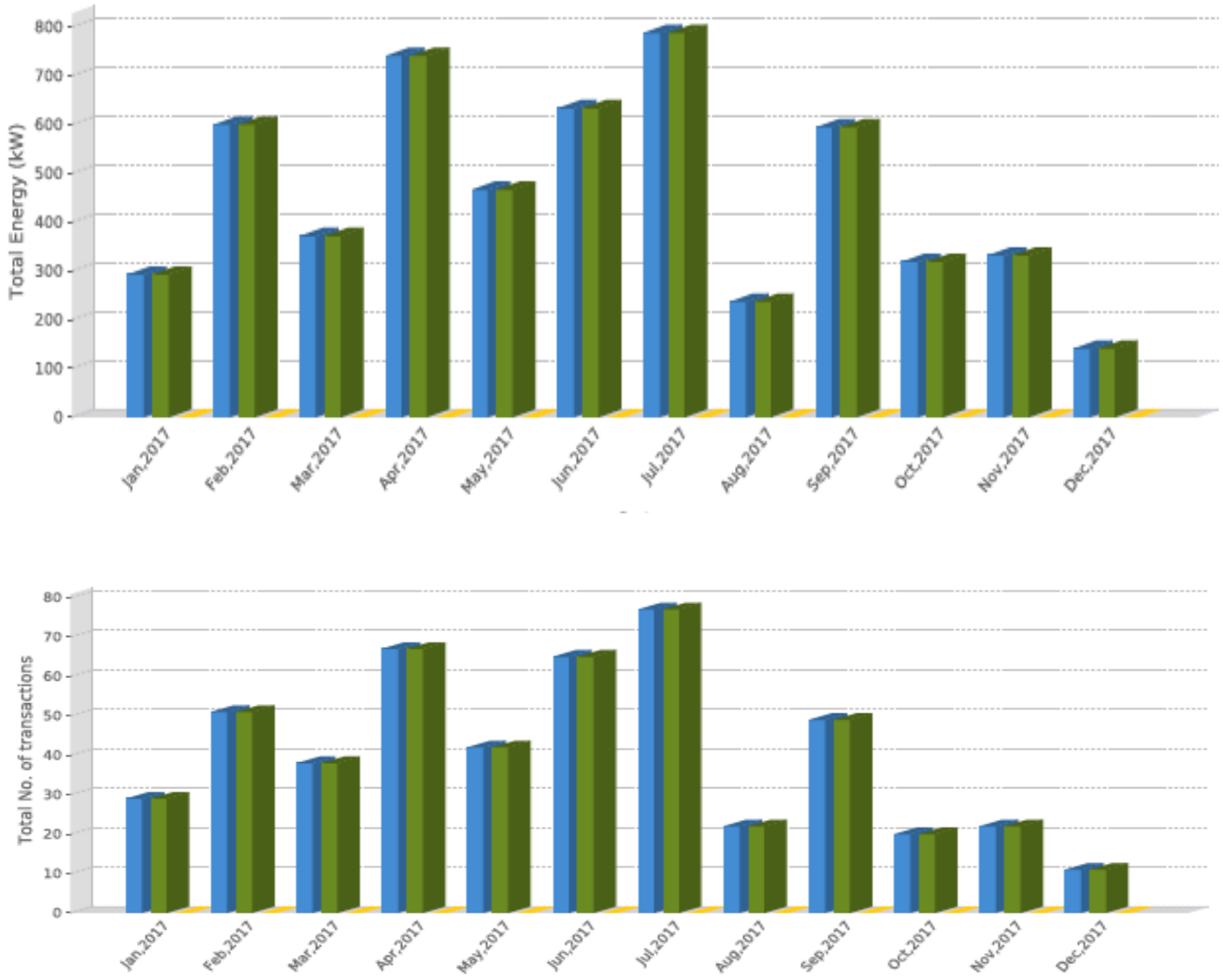
Figure A-1: City of Calabasas



City Hall Calabasas City Hall, 100 Civic Center Way, Calabasas, CA 91302

Source: South Coast Air Quality Management District

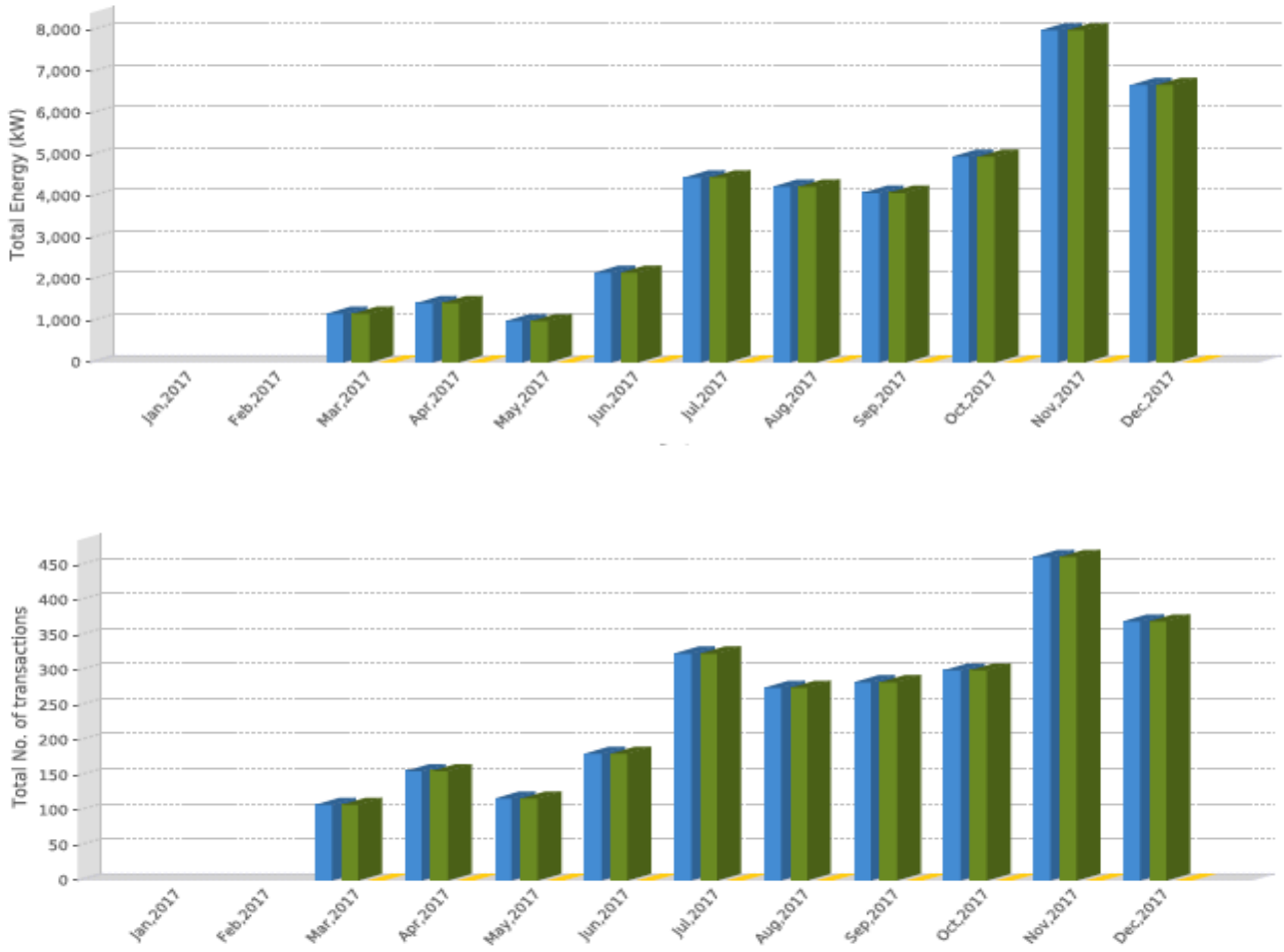
Figure A-2: City of Palm Desert



City Hall Palm Desert City Hall, 73-510 Fred Waring Drive, Palm Desert, CA 92260

Source: South Coast Air Quality Management District

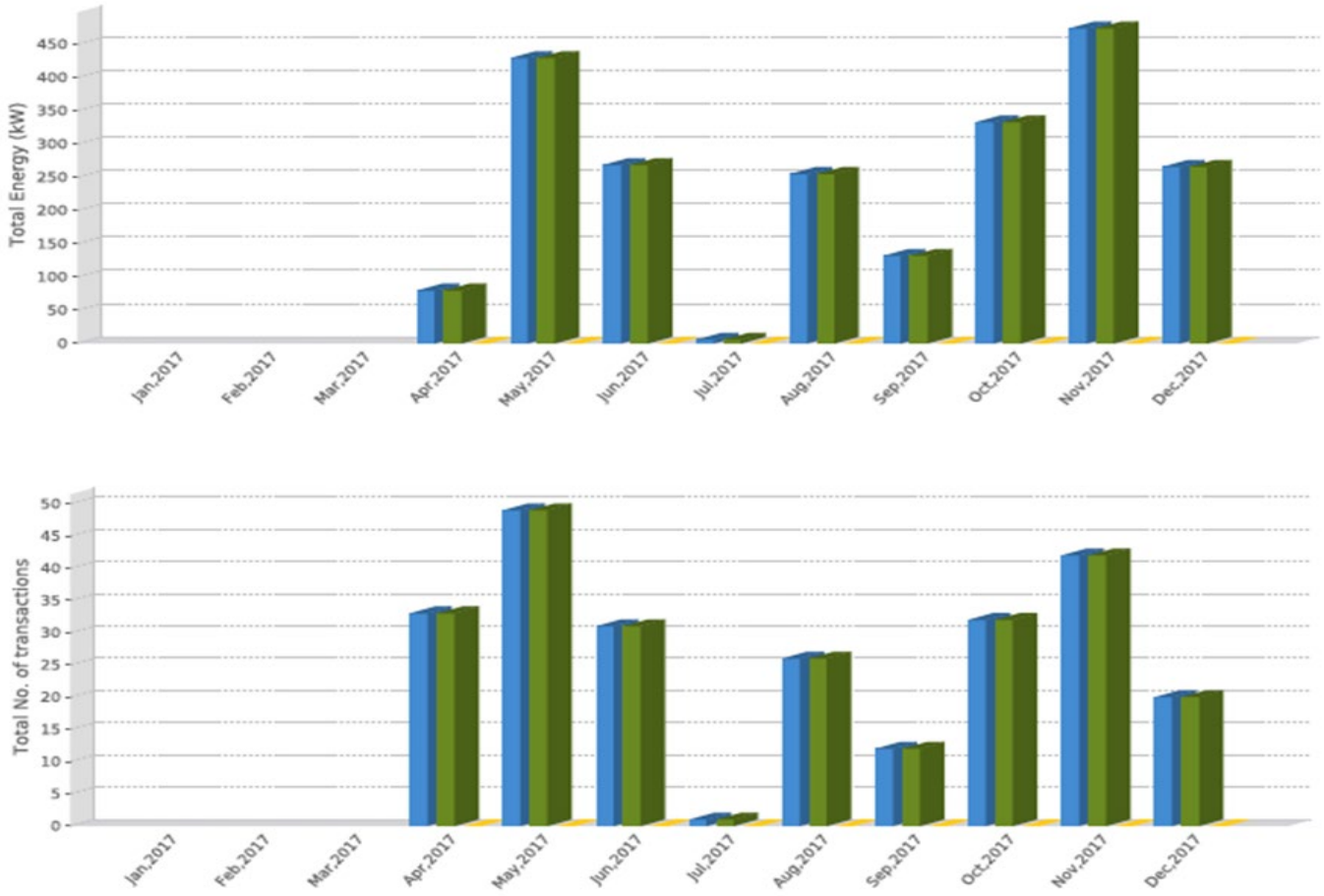
Figure A-3: City of West Hollywood



Mel's Diner, 8585 Sunset Blvd, West Hollywood, CA 90069

Source: South Coast Air Quality Management District

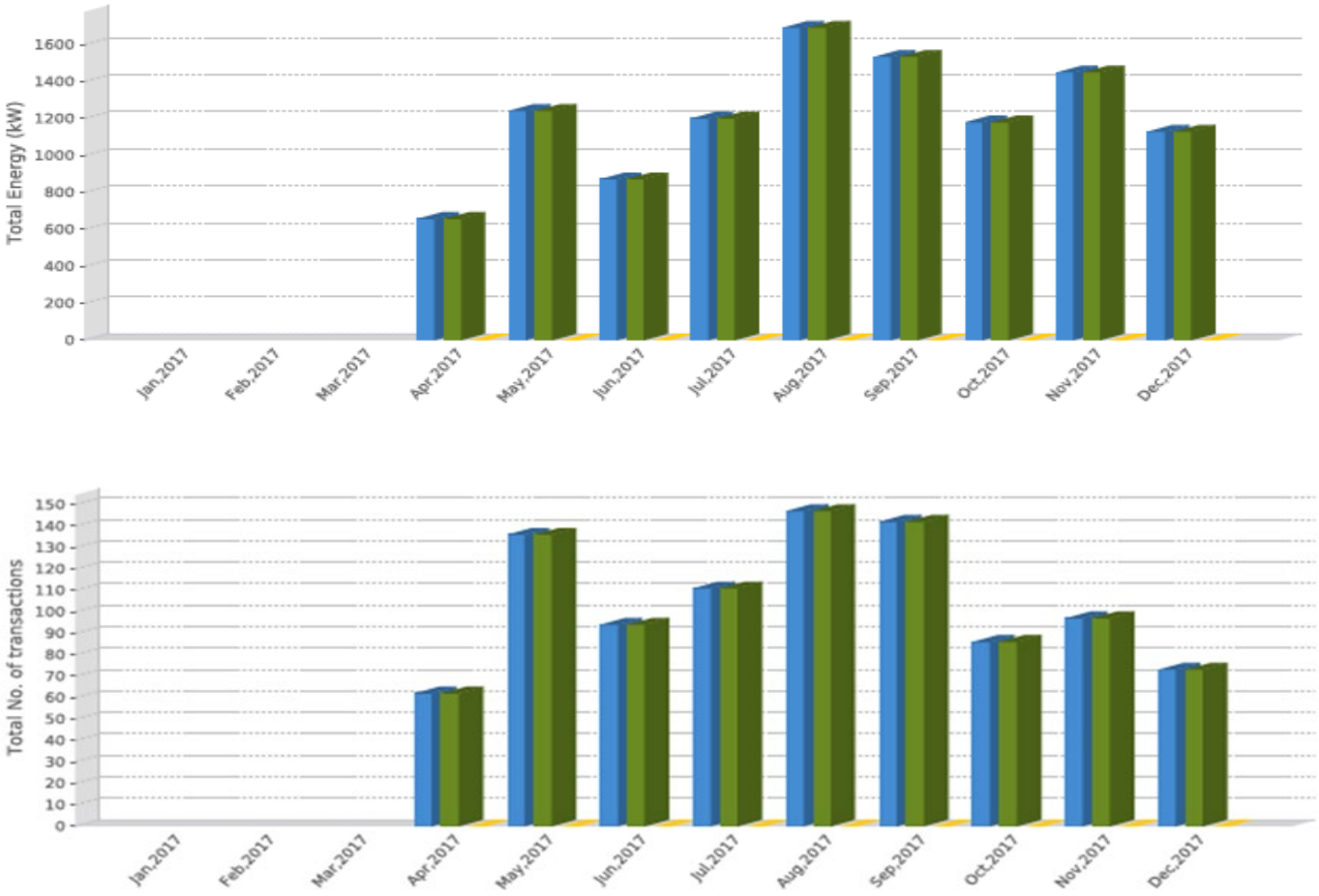
Figure A-4: City of Palm Springs



Visitor Center Palm Springs Convention Center, 2901 N. Palm Canyon Drive, Palm Springs, CA 92262

Source: South Coast Air Quality Management District

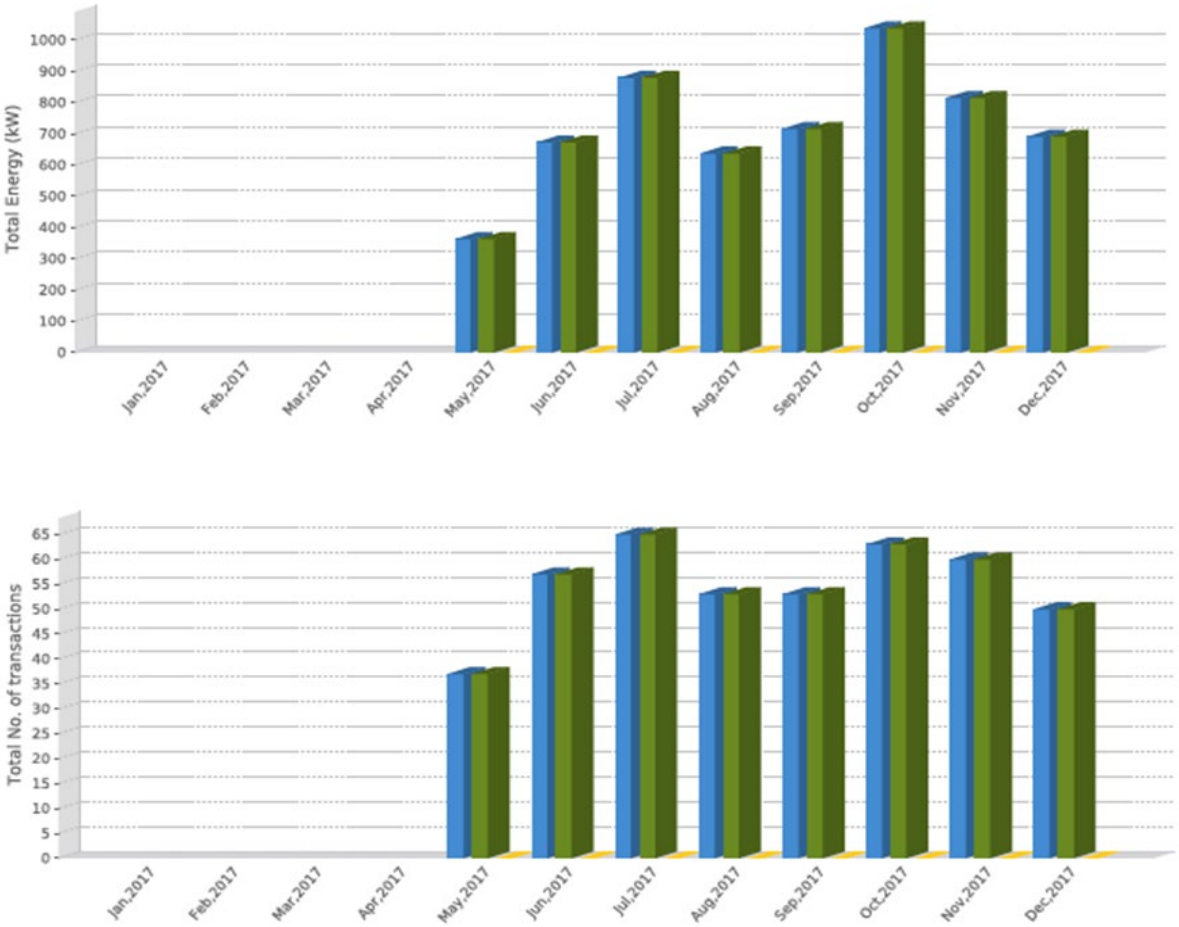
Figure A-5: City of Moreno Valley



Moreno Valley Electrical Utility 14331 Frederick Street, Moreno Valley, CA 92252

Source: South Coast Air Quality Management District

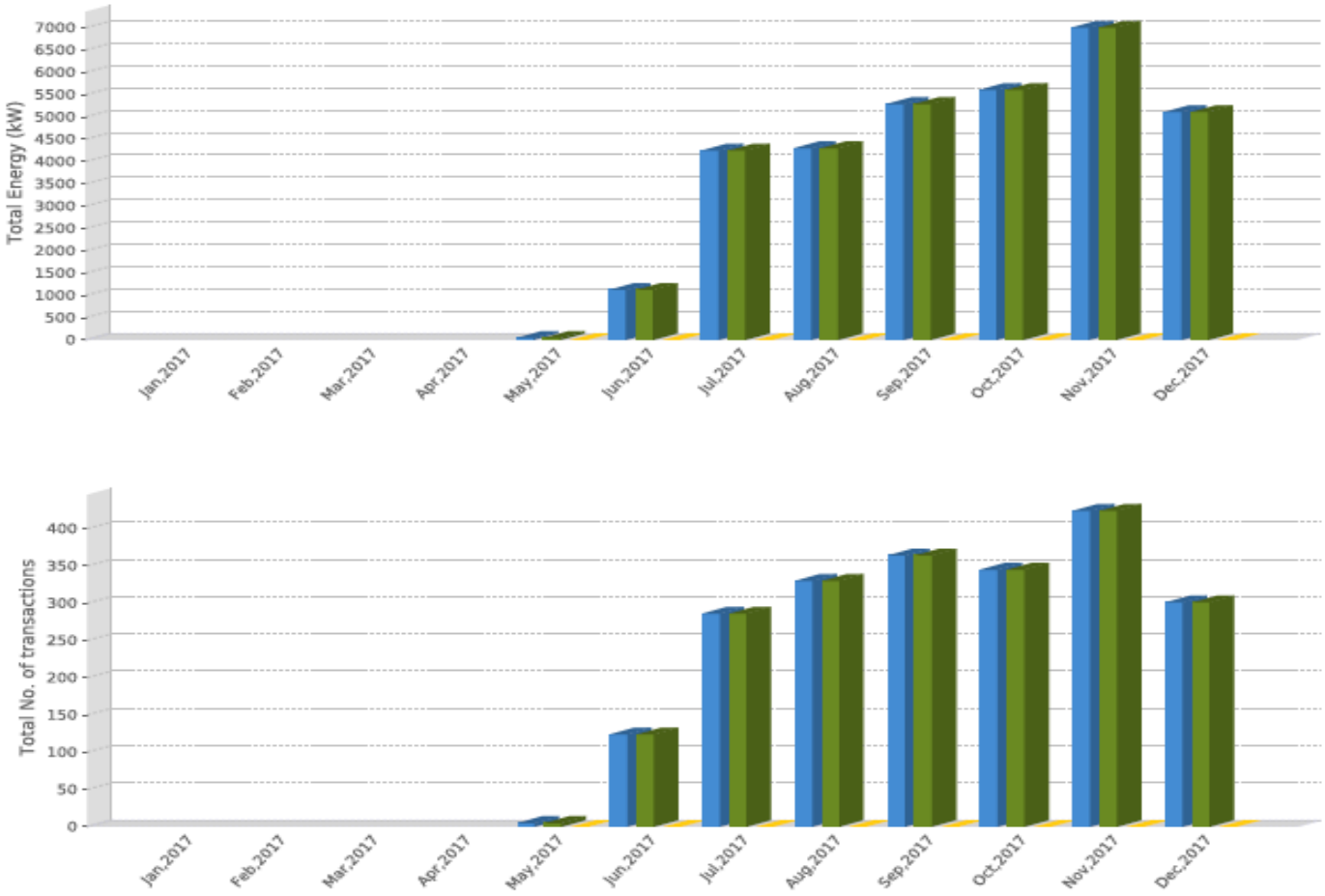
Figure A-6: City of Temecula



Farmers Market 41952 6th Street, Temecula, CA 92590

Source: South Coast Air Quality Management District

Figure A-7: City of Monterey Park



City Hall 320 W Newmark Avenue, Monterey Park, CA 91754

Source: South Coast Air Quality Management District