



**CALIFORNIA
ENERGY COMMISSION**



**CALIFORNIA
NATURAL
RESOURCES
AGENCY**

Clean Transportation Program

FINAL PROJECT REPORT

Multicharge San Diego

Prepared for: California Energy Commission

Prepared by: ChargePoint, Inc.

August 2023 | CEC-600-2023-040



John Schott
Michael Jones
Primary Author(s)

ChargePoint, Inc.
254 East Hacienda Avenue
Campbell, CA 95008
(877) 370-3802
[ChargePoint's Website \(www.ChargePoint.com\)](http://www.ChargePoint.com)

Agreement Number: ARV-12-024

Taiying Zhang
Commission Agreement Manager

Elizabeth John
Branch Manager
Medium- and Heavy-Duty Zero Emission Technologies Branch

Hannon Rasool
Director
Fuels and Transportation

Drew Bohan
Executive Director

DISCLAIMER

This report was prepared as the result of work sponsored by the California Energy Commission (CEC). It does not necessarily represent the views of the CEC, its employees, or the State of California. The CEC, 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 use of this information will not infringe upon privately owned rights. This report has not been approved or disapproved by the CEC nor has the CEC passed upon the accuracy or adequacy of the information in this report.

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-11-602 to fund projects that establish infrastructure necessary to store, distribute and dispense alternative transportation fuels such as electricity. In response to PON-11-602, the recipient submitted an application which was proposed for funding in the CEC's notice of proposed awards August 16, 2012 and the agreement was executed as ARV-12-024 on June 30, 2013.

ABSTRACT

Electric vehicle owners living in multifamily buildings face unique challenges charging their vehicles since most electric vehicle owners charge at home. Multifamily building residents may not own or have a designated parking spot, or if they do, may not have authority to install a charging station. With roughly 50 percent of San Diego residents living in multifamily buildings, this has created a barrier to electric vehicle adoption.

The goal for this project was to establish electric vehicle ownership at multi-dwelling units in San Diego, create community awareness and support for electric vehicles, as well as to raise awareness of greenhouse gas emissions and the environmental benefits of electric vehicles. This will help the City of San Diego and the industry at large develop best practices for electric vehicle charging solutions in multifamily buildings.

The primary objective of installing 206 level 2 charging ports at multi-dwelling unit locations in the County of San Diego was achieved. Stations were provided at no cost to eligible buildings, leaving installation costs for the buildings to cover. While extensive outreach to building owners, property managers and electric vehicle drivers occurred, recruiting eligible buildings proved to be more difficult than expected for a variety of reasons. Lack of awareness and demand for electric vehicles, installation costs, and the disruption to parking operations were the main challenges faced in recruiting buildings.

While retrofitting existing buildings to accommodate electric vehicle chargers proved to be a significant challenge, progress can be made in the new construction market, where the incremental costs to incorporate charging stations is minimal. Also, incentives and rebate programs should be designed to be as flexible as possible, allowing buildings and site hosts the choice to select stations and install them in a way that works for their particular needs.

Keywords: electric vehicle, electric vehicle charging stations, multi-dwelling unit

Schott, John, Michael Jones. 2023. *Multicharge San Diego*. California Energy Commission. Publication Number: CEC-600-2023-040.

TABLE OF CONTENTS

	Page
Preface	i
Abstract	iii
Table of Contents	v
List of Figures	v
List of Tables.....	vi
Executive Summary	1
CHAPTER 1: Project Purpose and Approach	3
1.1 Project Purpose.....	3
1.2 Project Approach.....	3
CHAPTER 2: Activities and Results	5
2.1 EVSE Deployment.....	5
2.2 Media and Public Outreach.....	8
2.3 Load Research and Monitoring Pilot	8
2.4 Data Collection and Analysis.....	11
CHAPTER 3: Achievement of Goals and Objectives	16
CHAPTER 4: Conclusions and Recommendations	18
Glossary.....	19

LIST OF FIGURES

	Page
Figure 1: Location and Number of Ports Installed in San Diego County.....	5
Figure 2: Utilization of Deeded, Mixed and Shared Stations	10
Figure 3: Hourly Charging by Type of Charging Station by Year	11
Figure 4: Daily Charging Session from May – November 2016	12
Figure 5: Greenhouse Gas Emission Savings by Month.....	12
Figure 6: Energy Dispensed	13
Figure 7: Peak Daily Occupancy	13
Figure 8: Gallons of Gasoline Displaced	14
Figure 9: Charging Time vs Connected Time	15

LIST OF TABLES

Page

Table 1: Property Name and Number of Ports at Each Site 6

EXECUTIVE SUMMARY

The goal of MultiCharge San Diego was to establish electric vehicle ownership and usage at multi-dwelling unit locations within the City of San Diego, create community awareness and positive support for alternative-fueled vehicles, and raise awareness of greenhouse gas emissions. This would in turn help the San Diego community and the electric vehicle industry develop best practices for electric vehicle charging solutions in multifamily buildings, generating experience and data needed to make it easier for other multifamily buildings to accommodate electric vehicle charging in the future.

ChargePoint Inc. was awarded \$499,512 by the California Energy Commission to complete this project, and provided \$567,309 of match or in-kind contribution, for a total project cost of \$1,066,821. The project officially began on June 30, 2013, and while the original contract end date was January 31, 2014, three separate agreement amendments were executed, ultimately extending the agreement end date to March 31, 2017. The agreement amendments resulted from challenges in recruiting multifamily properties into the program, which stemmed from financial constraints at the multifamily properties, and a lack of perceived demand for charging stations.

The program's primary objective was to identify eligible electric vehicle charging station sites at multi-dwelling unit locations throughout the County of San Diego, ensure installation is scheduled and completed in a timely and professional manner, and provision the stations after installation is completed. While the project began in June 2013, the majority of charging stations were not installed until 2015 and 2016, since budgets for multifamily properties are typically developed at least a year in advance. Ultimately the project was successfully completed with 206 ports installed at 19 different multi-dwelling unit addresses throughout San Diego.

In order to recruit multifamily properties, a comprehensive media campaign and public outreach was performed. Raising awareness and educating potential site hosts about MultiCharge San Diego was effective and turned up numerous leads. Buildings owners that expressed interest were motivated by attracting high quality tenants, keeping occupancy rates high, distinguishing their properties, earning Leadership in Energy & Environmental Design points, as well as numerous other reasons.

However many of these leads were not able to install charging stations due to complexities with the management and operations of parking spaces, and the disruption it would cause to building tenants and owners. Moving or assigning parking spaces to accommodate charging stations proved to be problematic and disruptive to leasing contracts, as well as how to allocate costs for the electricity usage.

The cost of installation was another significant barrier. Budgets for multifamily buildings tend to be developed a year in advance or longer, and making the funds available, even just to cover the installation costs, could be a challenge.

Due to the variety in ownership structures in multi-dwelling unit i.e. condominiums, renters, and homeowner associations, differences in ways the buildings are managed, how parking spaces are deeded or shared, and who is making the investment and who reaps the benefit, it is clear that there is no one size fits all for all buildings. The solution for each building must be

property specific, and incentives or programs should be designed to be as flexible as possible to accommodate these differences.

CHAPTER 1:

Project Purpose and Approach

1.1 Project Purpose

The State of California and the federal government has recognized the role that electric vehicles can play in reducing greenhouse gas emissions and our dependence on fossil fuels. While many electric vehicle (EV) drivers have the convenience of charging overnight at home in their garages, individuals who live in multifamily buildings are at a disadvantage and face unique challenges when it comes to charging. Roughly 50 percent of San Diego residents live in multifamily buildings, posing significant barriers to EV adoption especially when workplace and public charging is not readily available.

Multifamily building residents often do not have their own parking spaces or may not have clear authority to install electrical equipment. Similarly, some multi-dwelling unit (MDU) locations may not offer parking spots. Additionally, the federal grant program that began in 2010 and was funded by the American Recovery and Reinvestment Act and administered by the Department of Energy ignored MDUs, leaving those residents currently with an EV underserved and creating a barrier for others considering the purchase of an EV. MultiCharge San Diego acknowledges these challenges and was created to work with MDU building owners to install common-use charging locations that will benefit EV drivers.

The goal of MultiCharge San Diego was to establish EV ownership and usage at MDU locations within the City of San Diego; create community awareness and positive support of alternative-fueled vehicles; and raise awareness of greenhouse gas emissions.

This project was designed to help the San Diego community and the EV industry develop best practices for EV charging solutions in multifamily buildings by generating experience and data needed to make it easier for other multifamily buildings to accommodate EV charging in the future.

1.2 Project Approach

The project approach was to identify eligible electric vehicle service equipment (EVSE) installation sites at MDU locations throughout the County of San Diego. ChargePoint, Inc. was to ensure that installation of the charging stations was scheduled and completed in a timely and professional manner and to provision the stations after installations were completed.

Provisioning is an information technology process that results in the stations being configured on the network and at the EVSE owner's option, viewable on the [nationwide station map](#) at www.chargepoint.com. A formal site survey for each identified installation location was completed to determine the installation design and permitting needs, and to facilitate generation of construction estimates and quotes.

Building owners received the EVSE at no cost but were responsible for covering installation costs. ChargePoint, Inc. also included two years of software and a two-year warranty at no cost to the site host.

Once a potential site host had been identified and expressed interest in moving forward, ChargePoint, Inc. was required to complete and submit a site assessment with each site owner. The site assessment was conducted by a MultiCharge San Diego approved installer who would define key technical elements, determine optimal positioning, identify electrical source location, measure wireless communication suitability, determine utility requirements if any, and general arrangement of units for optimal usage, convenience, and safety.

If the project participant was still able and interested in moving forward after the site assessment, a complete list of required permits for construction and operation, including relevant permitting agencies or individuals, would be developed. The site assessment would also be used to determine necessary materials and equipment, including a description of items needed for installation and cost estimates.

Building owners were required to select MultiCharge San Diego approved installers, or in some instances, complete the installation themselves provided they had staff with knowledge and expertise to do so. The installer was responsible for permitting, execution of the site contract, and scheduling for delivery and installation of the charging station. ChargePoint, Inc. was responsible for facilitating communication between the installer, site owner, and equipment supplier, monitoring the progress of the installation work, and providing technical support on an as needed basis.

After installation was complete, ChargePoint, Inc. would provide provisioning services to finalize station setup and configuration of the network. A final inspection would be conducted for each site, and a copy of the final inspection as well as the Customer Agreement for each site would be collected before the station could be turned on.

To be eligible to participate in this program, multifamily buildings had to meet the following guidelines:

- Multifamily buildings must be located within the County of San Diego
- One application per location, but can apply for multiple chargers
- Applicant must be property owner or agent (e.g. property manager, HOA representative, etc.)
- Building must have at least three residential units
- Must have dedicated parking locations that will ensure safe utilization of charging stations
- Must be willing to allow collection of charging data
- Must complete and submit MultiCharge San Diego Application
- California prevailing wage has to be paid for installation

ChargePoint, Inc. also provided training to site hosts on basic operation of the stations, how to configure pricing policies, and how to access reporting and data features in ChargePoint, Inc.'s Network Operating System.

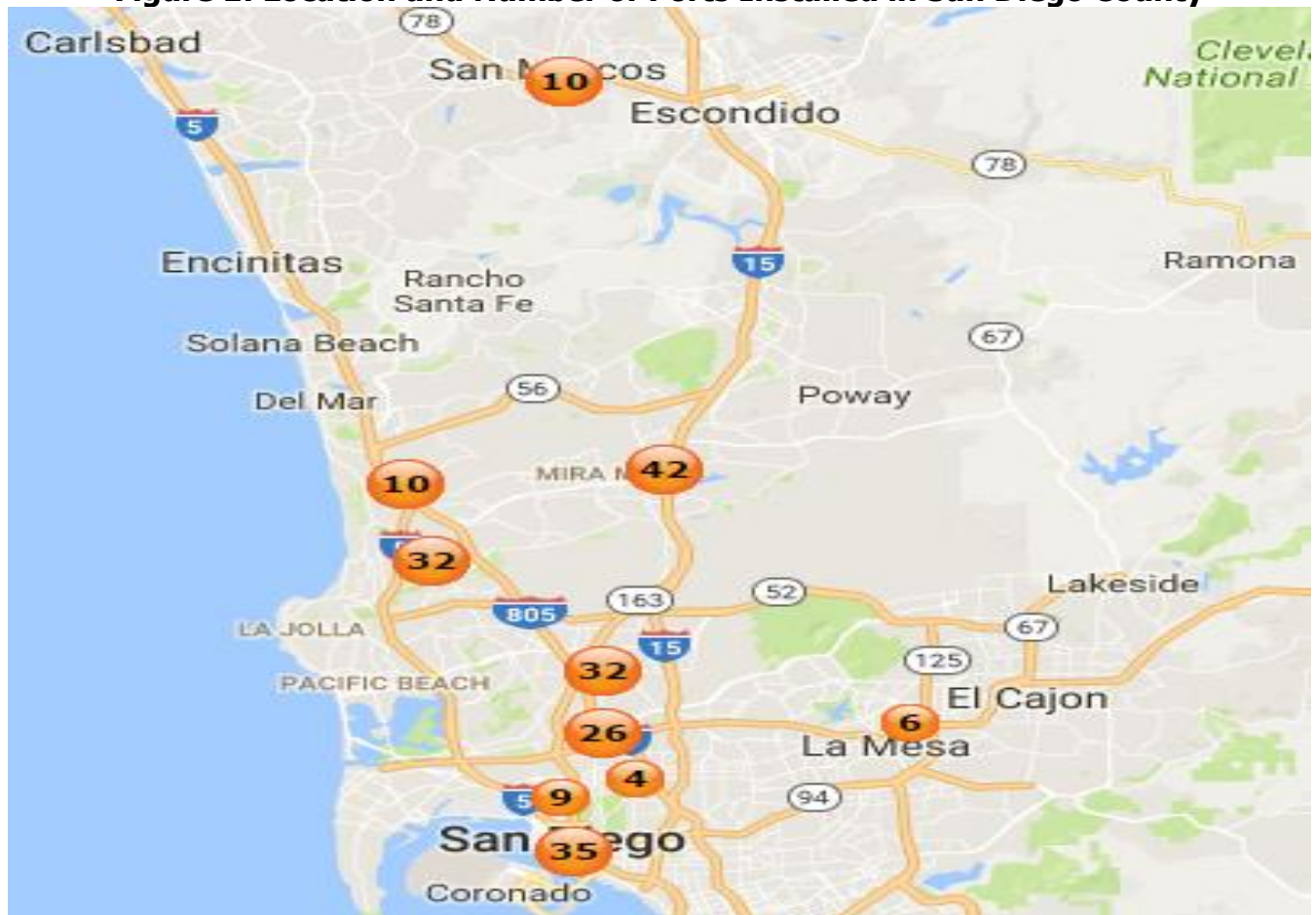
CHAPTER 2: Activities and Results

2.1 EVSE Deployment

ChargePoint Inc.'s own level 2 charging stations were installed at 19 different MDU addresses, ranging from a single station with one port to multiple stations with a collective total of 32 ports. A total of 206 level 2 charging ports were installed at MDU locations within the County of San Diego. Two different types of ChargePoint, Inc. stations were installed, the CT4000 and the CPF 25, both level 2 charging stations optimally suited to meet the needs of MDUs. The CT4000 is ideal for shared or public parking spaces. It allows for flexible pricing, access control, and an interactive system with a Liquid Crystal Display screen. The CPF 25 is ideally suited for personal charging in assigned or deeded parking spots. Both types of chargers can add up to 25 miles of range per hour and come with a standard Society of Automotive Engineers J1772 connector that can charge any electric vehicle on the road.

Figure 1 below shows the location and number of ports installed under this program.

Figure 1: Location and Number of Ports Installed in San Diego County



Source: ChargePoint, Inc.

The names of each multifamily property and number of ports installed at each site are shown in Table 1.

Table 1: Property Name and Number of Ports at Each Site

Multifamily Property	Address	Single Port EVSE (CPF25)	Dual Port EVSE (CT4000)	Total # of Ports
Presidio View	1440 Hotel Circle North, San Diego, CA 92108	1	2	5
Civita Master Plan Community	7840 Civita Blvd, San Diego, CA, 92108		10	20
San Marcos Apartments	205 E Carmel St, San Marcos, CA 92078		5	10
Promenade at Rio Vista	2185 Station Village Way, San Diego, CA 91208		3	6
La Jolla Crossroads & Crossroads 360	9090 Judicial Drive, University City, CA 9121	24		24
Torrey Gardens	10615 Calle Mar de Mariposa, Torrey Hills, CA 92129	8		8
Towers at Costa Verde	8775 Costa Verde Boulevard, University City, CA 92121	10		10
La Boheme	3950 Ohio Street, San Diego, CA 92104		2	4
Alterra Apartments	8727 Fletcher Parkway, La Mesa, CA 91942		1	2
Pravada Apartments	8727 Fletcher Parkway, La Mesa, CA 91942		2	4
Casa Mira View 1	9800 Mira Lee Way, Mira Mesa CA 92126	10	5	20
Casa Mira View 2	9800 Mira Lee Way, Mira Mesa CA 92126	10	6	22
Bayside Owners	1325 Pacific Highway San Diego, CA 92101		1	2

Multifamily Property	Address	Single Port EVSE (CPF25)	Dual Port EVSE (CT4000)	Total # of Ports
Broadstone Balboa Park #1	3288 5th Ave., San Diego, CA 92103	1	1	3
Broadstone Balboa Park #2	3230 5th Ave., San Diego, CA 92103	1		1
Broadstone Kearny Mesa	8601 Aero Drive, San Diego, CA 92123		16	32
El Cortez	702 Ash St. #1927 San Diego, CA 92101		1	2
ICON Owners Association	321 10th Ave., San Diego, CA 92101	1		1
Proxima 707	707 Broadway, San Diego, CA 92101		15	30
Total		66	70	206

Source: ChargePoint, Inc.

MDU properties were recruited through multiple channels including ChargePoint, Inc. sales representatives, existing partnerships with qualified installers, and third-party sources such as the CoStar Group. ChargePoint, Inc. invested in the CoStar analytics tool which provides the largest and most comprehensive multifamily property database coupled with cutting-edge analytic and forecasting tools. This national database provides detailed information on thousands of properties, and ChargePoint, Inc. used this resource to target eligible building types that might be a good fit for the program.

EV adoption in the multifamily sector is generally recognized as the most difficult segment of the EVSE market to enter. The education process associated with multifamily properties adds additional time to the traditional sales process typically seen with workplace and retail customers. Whereas as typical workplace or retailer may have a single individual or a team responsible for making decisions about EVSE, multifamily properties can have multiple decision makers, including property managers and condominium boards, who must weigh the importance and need for EVSE against other important capital improvement. Multifamily budgets are typically bound by annual budgets, which tend to be developed at least a year in advance. So items like EVSE installation, which is likely not included in the budget scope for next year, is unlikely to happen until the following year if there is sufficient interest and demand.

2.2 Media and Public Outreach

ChargePoint, Inc. sought to get the maximum project exposure for MultiCharge San Diego in the press and media. The following activities were performed to get maximum project exposure:

- Announcing the program through three public workshops, often held in conjunction with San Diego Gas & Electric
- Ribbon cutting events with media/press for station unveiling
- Marketing campaigns
- Preparing outreach marketing materials such as press releases, fliers, brochures, and social media

MultiCharge San Diego was also picked up and featured in numerous online articles including:

- EV Obsession
- Seaside Courier
- Emmes Realty Services
- San Diego Business Courier
- Fleets and Fuels
- DowntownSanDiego.org

These events and articles helped to create community awareness and support for electric vehicles, as well as to raise awareness of greenhouse gas emissions and the environmental benefits of electric vehicles.

2.3 Load Research and Monitoring Pilot

The original goal of this task was to develop and conduct a load research metering pilot and perform data analysis on up to 40 EVSE installations in MultiCharge San Diego. The goal of this task changed slightly throughout the course of this project, and instead of installing a separate utility meter on each charging station, ChargePoint, Inc.'s embedded meter within each station was utilized.

San Diego Gas & Electric (SDG&E) took the lead on this analysis and ChargePoint, Inc. provided SDG&E with 15-minute interval data for all 206 charging ports installed including individual session and transaction details, pricing rules, and a list of properties and stations. SDG&E's goal for this analysis was to look for the following patterns or trends:

1. Are there charging pattern differences when comparing the MultiCharge San Diego EV station usage with that of the station usage at single-family homes?
2. What are the changes in EV charging station utilization rates over time at MDU sites where stations are shared versus those that are dedicated to a single driver and vehicle? Is utilization influenced by the cost of charging?
3. How long does it take the EV charging station patterns to stabilize after stations are installed and drivers being using them? Do these patterns change over time and if so, what is causing these changes to occur?

SDG&E analysis first focused on removing data anomalies, summarizing the data using histograms and frequency tables, and then distinguishing patterns between key variables of interest.

SDG&E's analysis showed that there were different charging patterns between MultiCharge San Diego deeded EV stations versus EV stations at single-family homes. The general pattern seen was that EVs are charging at the MDU sites during residential on-peak times, whereas EVs at single-family homes are charging at off-peak times. For the MultiCharge San Diego stations, the type of station analyzed was restricted to just private charging stations for deeded parking spots, since this serves as the best point of comparison to single-family home chargers which typically just serve a single vehicle. The comparison group for single-family homes included 477 households that are on SDG&E's EV time of use rate, which encourages drivers to charge at off-peak hours by offering a lower price per kilowatt hour than on-peak charging hours.

Figure 2 below shows the total number of distinct charging sessions by year at each of the MDU sites in the program. MDU sites with private stations that served deeded parking spaces and a single vehicle, appear to have the highest utilization, as indicated by the highest count of Session Identification by type, followed by shared locations, and then mixed locations, sites that included both deeded and shared charging stations. This table also shows that charging station utilization was sparse between 2014 and 2015, but utilization increased significantly in 2016. Utilization is likely low in 2014 and 2015 for the MDU sites that had charging stations installed at that point, since it understandably takes time for residents to go out and purchase or lease an EV after charging spots have been introduced into their communities.

Utilization also appears to be influenced by the cost of driving. There are two types of pricing structures: flat (e.g., \$0.30/kilowatt hour) and variable (e.g., \$1.00/hour for first hour, \$2.00/hour thereafter). Drivers seem to stay plugged in longer at stations that have a flat pricing structure as opposed to a variable rate, evidenced by the fact that average kilowatt hours dispensed by stations with a flat fee structure was 12.33 kilowatt hours, whereas average kilowatt hours dispensed by stations with a variable fee structure was 10.29 kilowatt hours.

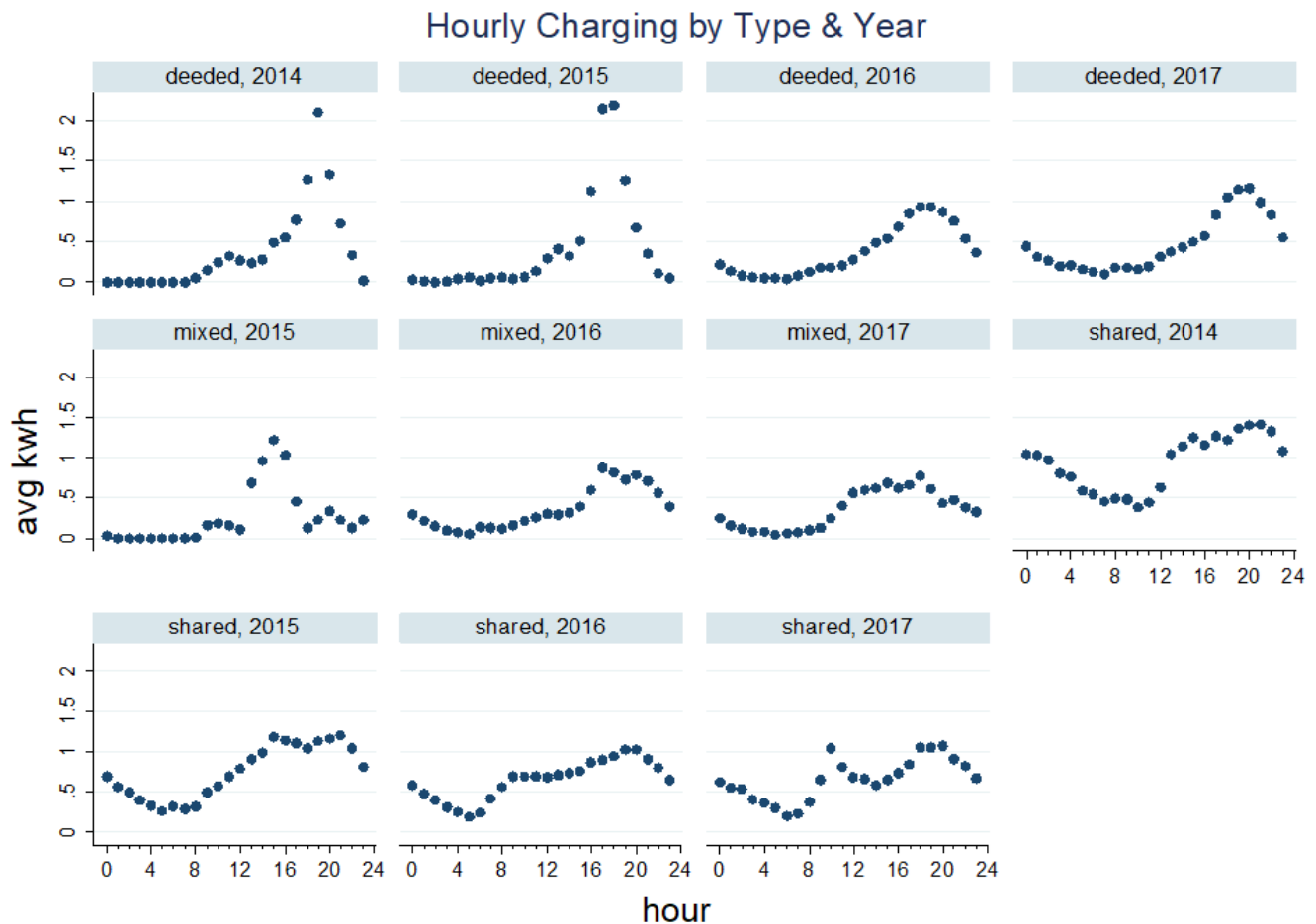
Figure 2: Utilization of Deeded, Mixed and Shared Stations

Distinct SessionID by Year						
	2014	2015	2016	2017	Grand Total	
Deeded	71	259	4002	655	4987	
Icon Owners Association	71	259	439	32	801	
La Jolla Crossroads & Crossroads 360			740	251	991	
Torrey Gardens			1725	205	1930	
Towers at Costa Verde			1098	167	1265	
Mixed		18	2226	285	2529	
Broadstone Balboa Park		18	350	19	387	
Casa 1			882		882	
Casa 2			250		250	
Casa Mira View			201	72	273	
Casa Mira View 1			285	138	423	
Casa Mira View 1 COMM			46		46	
Casa Mira View 2			182	47	229	
Presidio View			30	9	39	
Shared	170	644	2223	339	3376	
Bayside Owners Association	121	281	574	42	1018	
Broadstone Corsair		176	444	78	698	
El Cortez Owners Association	49	187	96	7	339	
La Boheme			110	26	136	
Promenade Rio Vista			58	28	86	
Proxima 707, LLC			710	120	830	
Sudbury - Civita HOA			231	38	269	
Grand Total	241	921	8451	1279	10892	

Source: ChargePoint, Inc.

Figure 3 below shows the difference in EV station usage, both session length and kilowatt hours dispensed (y axis) and time of day when charging occurs (x axis). Looking only at the 2016 data, which is when all 206 ports were installed, the deeded and mixed, both deeded and shared charging stations, charging happens between 4:00PM and 9:00PM, while the pattern for the shared stations is less distinguishable. The pattern for shared stations is likely less distinguishable since the behavior of a group of EV drivers compared to a single driver is less predictable and has greater variability. If an EV driver does not have a dedicated charging spot that they can count on when they get home from work for example, they might find other places to charge like at their workplace or at an available public station near work, since there is no guarantee they will be able to charge at home.

Figure 3: Hourly Charging by Type of Charging Station by Year



Source: ChargePoint, Inc.

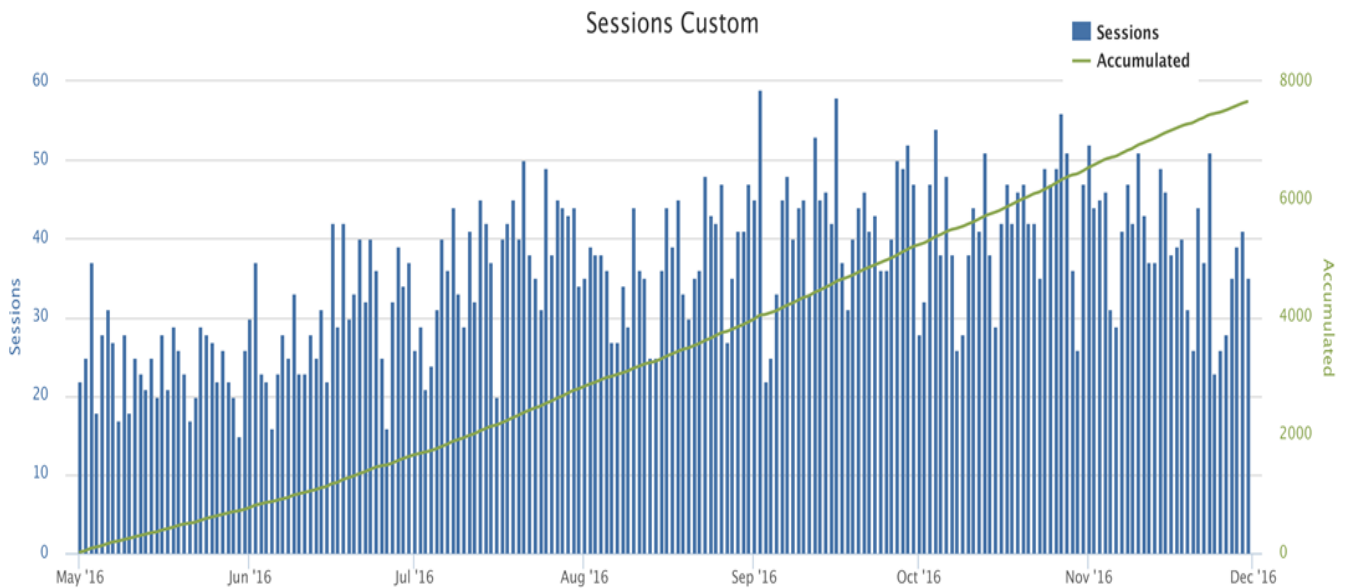
2.4 Data Collection and Analysis

Operation data from stations is continuously collected through ChargePoint, Inc.’s smart charging network and transmitted to ChargePoint, Inc.’s Network Operating System. This data has been analyzed for economic and environmental impacts. The Network Operating Systems is also made available to charging station owners so they can monitor and analyze usage patterns and trends.

Figure 4 shows the number of daily charging sessions from May 1, 2016 to November 30, 2016 for all 206 ports installed at the 19 different site addresses. This timeframe was selected since roughly 50 percent of the ports had been installed and were operating by May 1, 2016. There were no stations down or not functioning during this timeframe. A charging session is a single instance of a car plugging in to charge. Number of sessions, displayed on the y axis, shows that the number of sessions ranged from 15 to 59 sessions per day for all 206 ports over this seven - month timeframe. The total accumulated charging session, represented by the green line, shows total number of charging session were nearly 7,700 for all 206 ports, or roughly an average of 37 sessions per day across all 206 ports. While this number may seem low, many of the multifamily properties had the foresight to install enough charging stations to meet the expected future needs of their communities, and not only just what was needed today. Since many of the multifamily properties see EV charging as an amenity provided to

attract and retain high quality tenants, this approach seems logical and helps explain why utilization may be low today.

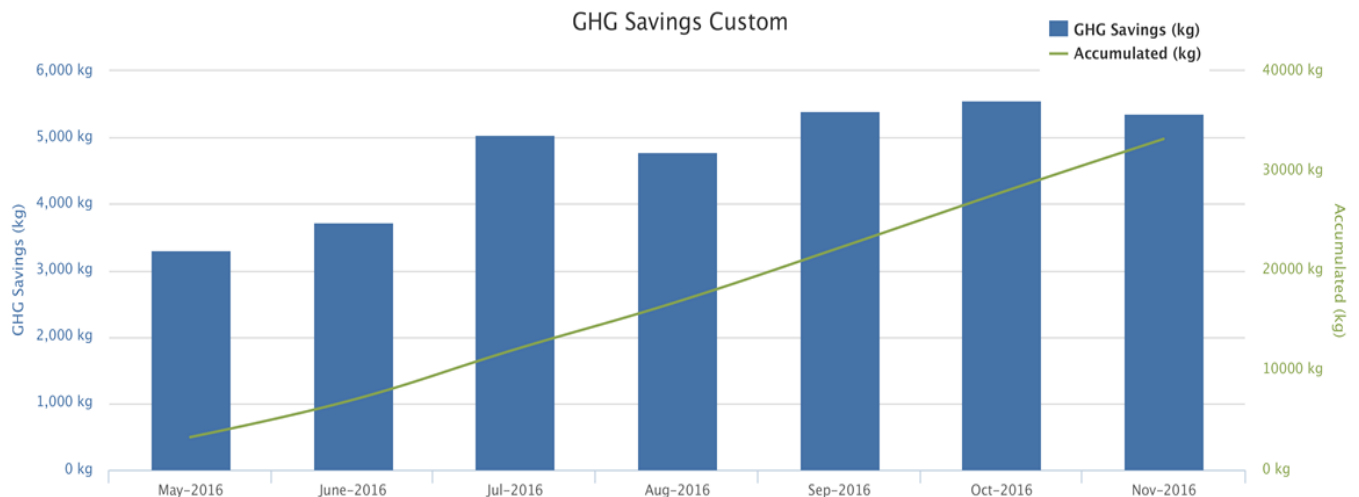
Figure 4: Daily Charging Session from May – November 2016



Source: ChargePoint, Inc.

The environmental benefits and greenhouse gas emission savings resulting from EVs are substantial as compared to conventional internal combustion engine vehicles. Figure 5 shows the greenhouse gas savings by month for all 206 ports combined. For the seven month time period from May 1st through November 30th, 2016, the accumulated greenhouse gas was approximately 33,000 kg, or roughly 4,700 kg per month. This equates to an accumulated 33 metric tons of carbon dioxide equivalent or roughly 4.7 metric tons per month.

Figure 5: Greenhouse Gas Emission Savings by Month

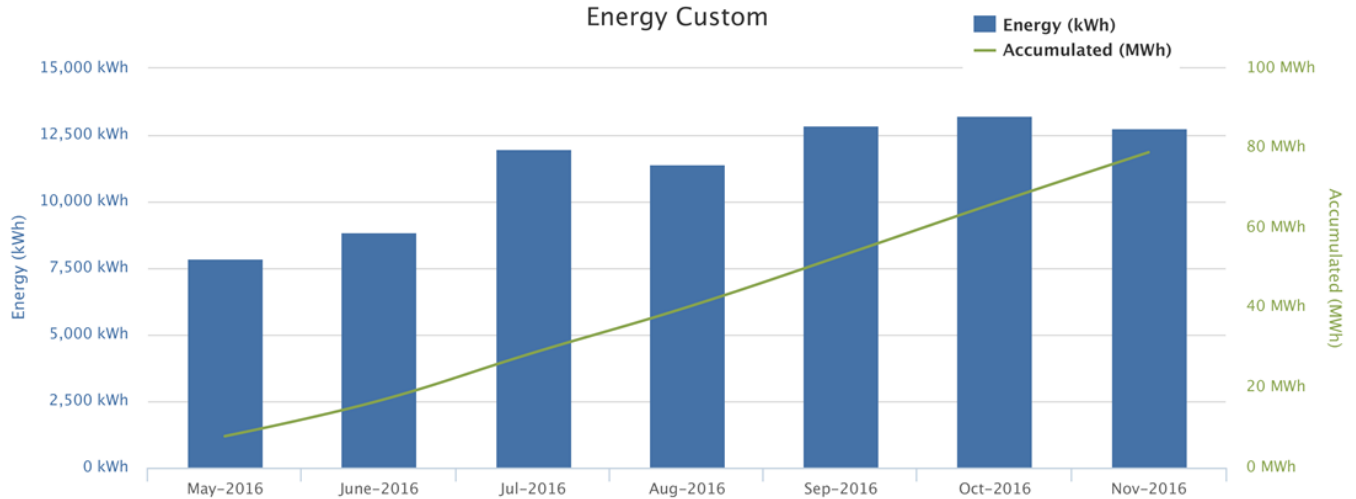


Source: ChargePoint, Inc.

Energy dispensed shows the total amount of electricity dispensed by all 206 ports in the seven months. Figure 6 below shows this data. The average amount of electricity dispensed over the

past seven months was roughly 11,000 megawatt hours per month. However the overall increase month over month in energy dispensed shown in this graph is not a result of greater utilization of stations. Rather it is due to the fact that not all 206 ports were online until September 7, 2016. The amount of energy dispensed is influenced by two factors, the number of charging sessions and the length of each charging session.

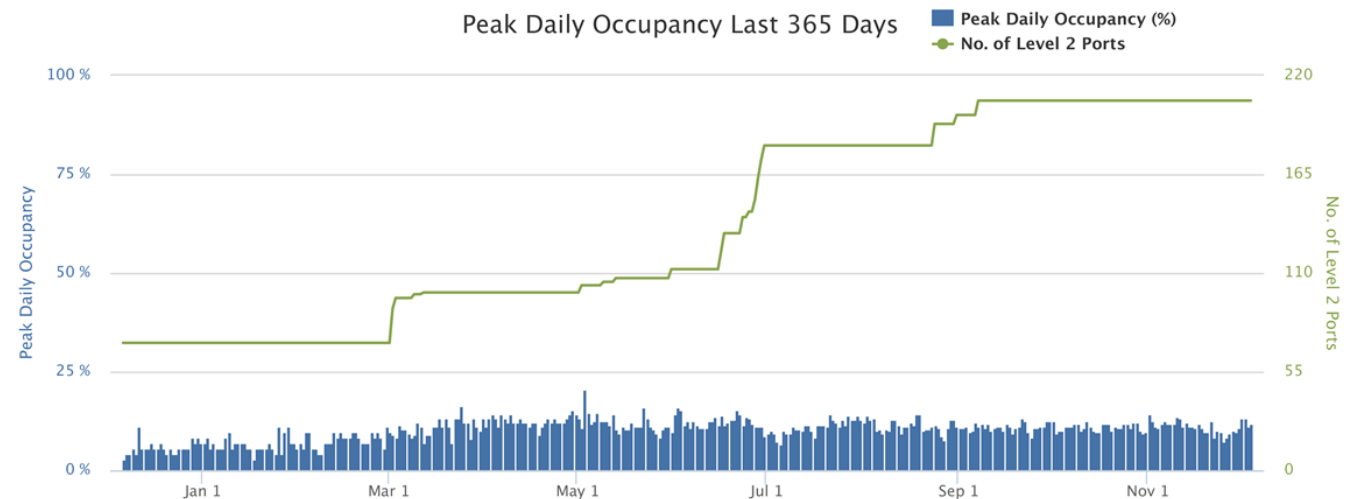
Figure 6: Energy Dispersed



Source: ChargePoint, Inc.

Peak daily occupancy is a measurement of peak utilization of the EVSE across all 206 ports. Data about peak daily occupancy can be seen in Figure 7 below. The green line represents the total number of ports included in this calculation, which started with 71 ports in December of 2015 and concludes with all 206 installed, which occurred on September 7, 2016. Peak daily occupancy averages around 12 percent, meaning that on any given day, no more than 12 percent of all ports are being utilized for charging. While this occupancy rate is rather low, as EV adoption increases across San Diego, we would expect the occupancy rate to increase. Also now having EVSE available at these MDUs will likely attract EV drivers to these properties and increase the utilization of stations.

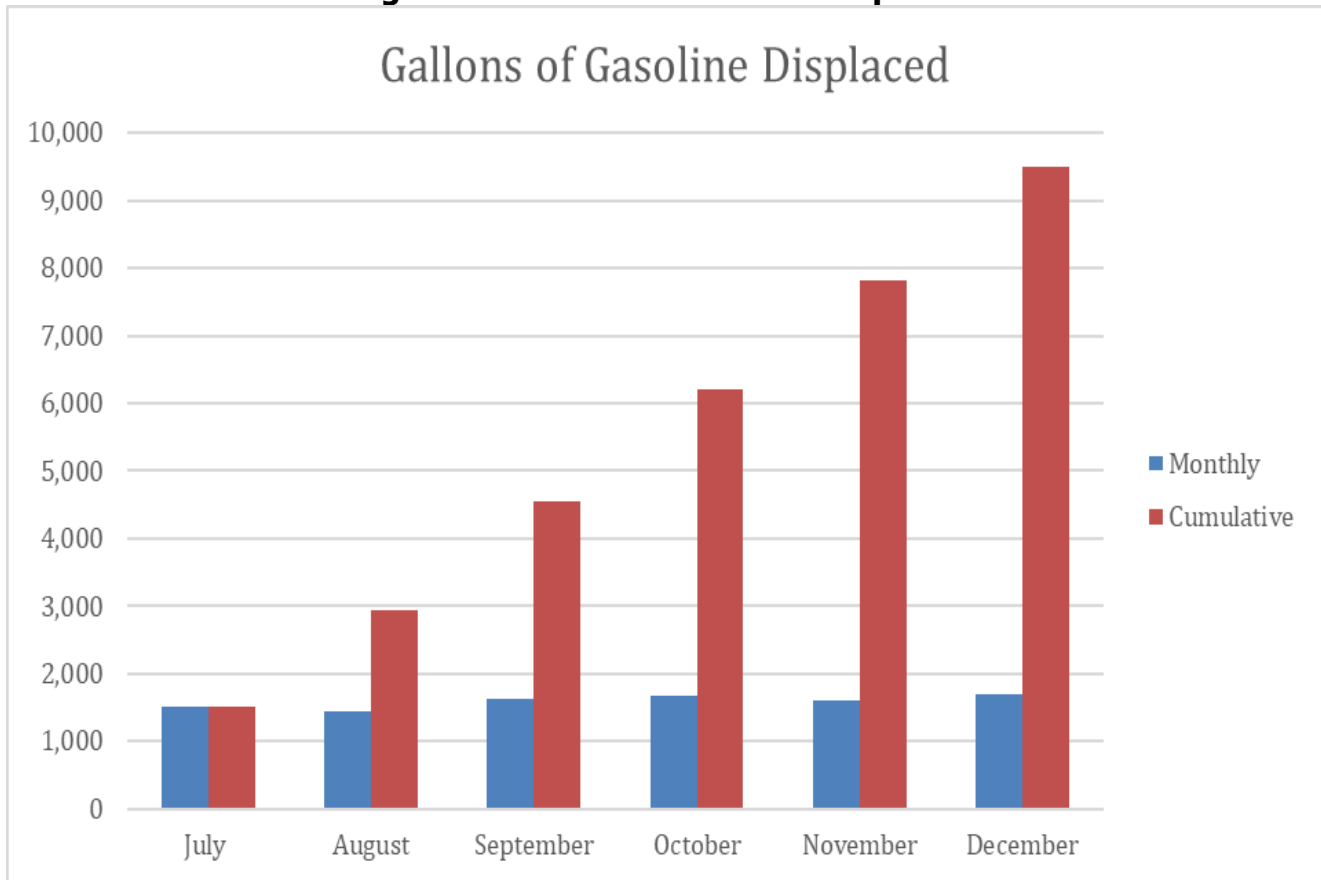
Figure 7: Peak Daily Occupancy



Source: ChargePoint, Inc.

Figure 8 shows the gallons of gasoline displaced or saved from all 206 ports from July through December 2016. The monthly average amongst these six months is approximately 1,600 of gallons displaced per month, although not all 206 stations were active until early September 2016. Cumulative gallons of gasoline displaced over these six months is approximately 9,500 gallons.

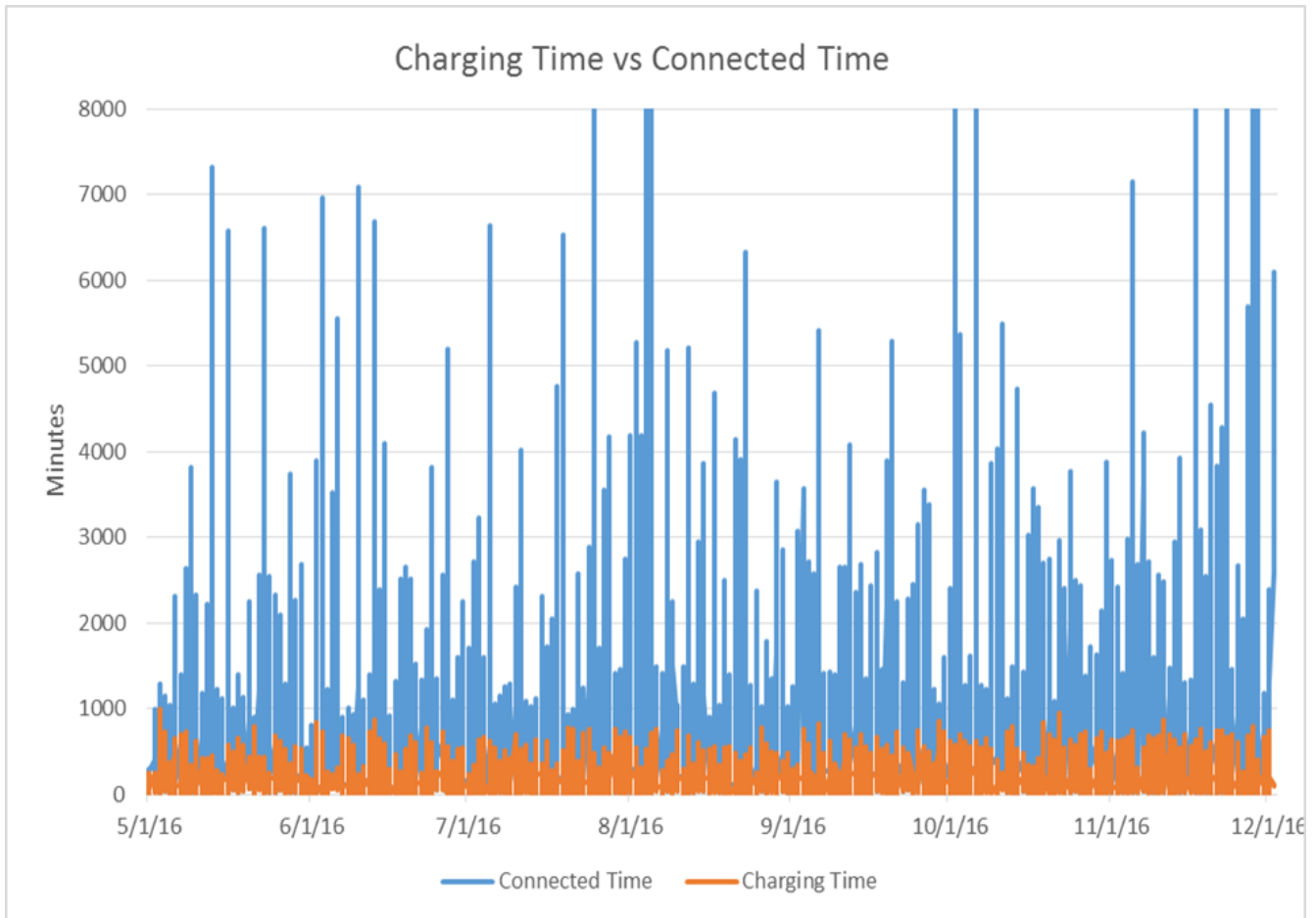
Figure 8: Gallons of Gasoline Displaced



Source: ChargePoint, Inc.

Figure 9 shows charging time relative to connected time. Charging time is the amount of time the vehicle is plugged in and the battery is charging, while connected time is the total amount of time the vehicle is plugged in, charging or not. What this chart shows is that vehicles are staying plugged in roughly 3.6 times longer than needed. From May 1, 2016 to November 30, 2016, vehicles were connected for an average of 542 minutes, but were only charging for an average of 148 minutes. While staying plugged after a vehicle is fully charged is not an issue or a concern for deeded parking spaces with private charging stations since that parking space and charging station is assigned to just a single vehicle 24/7/365, it could be an issue with public charging stations, preventing people from charging and resulting in under-utilized stations.

Figure 9: Charging Time vs Connected Time



Source: ChargePoint, Inc.

Pricing policies for ChargePoint, Inc.'s CT4000 stations, ChargePoint, Inc.'s solution for public and shared parking spaces, are determined and set by the station owner, the multifamily property manager or building owner in this instance. While a pricing policy was not a requirement for this program, it is considered a best practice and typically recommended for public stations. As of November 30, 2016, only one MDU site offered free charging for their CT4000 stations. Stations at all other multifamily properties charged either a flat rate per kilowatt hour, or had variable pricing based on length of time and kilowatt hour. The split was roughly 50/50 between stations that charged a flat rate versus stations with a variable pricing structure. Variable pricing can be a very effective tool for increasing utilization and ensuring EV drivers do not stay plugged in long after their vehicle has finished charging, since drivers will continue to pay for as long as they are connected.

CHAPTER 3:

Achievement of Goals and Objectives

The primary goals and objectives of MultiCharge San Diego were achieved. 206 ports at 19 different MDU addresses across the County of San Diego were installed. An extensive outreach campaign was performed to recruit multifamily building owners, property managers, EV drivers and other stakeholders to locate eligible properties and their decision makers, for possible enrollment into MultiCharge San Diego.

Recruitment of eligible MDUs was more challenging than expected for multitude reasons. Many properties that were interested in installing EVSE were unable to move forward after the site assessment due to physical challenges present at the site. Availability of capacity in the electrical panel was often a challenge. Without sufficient capacity in the electrical panel, expensive upgrades needed to occur in order to provide enough power to accommodate EVSE. Also the distances between utility meters, parking spaces, and unit electrical panels can be problematic. The greater the distance, the more cable and wiring is needed and trenching to bury the wires which adds considerable cost to the project. Many sites just are not able or willing to make the upgrades to the electrical panel and run cable across great distances due to the added cost and disruption to existing tenants and parking operations to accommodate EVSE.

Budgets for multifamily properties tend to be developed a year in advance. So even though EVSE was provided free of charge, coming up with the cost for installation was often not in the budget for that year. MDUs that were motivated and hampered by this issue would include installation costs in the next year's budget, but this had a dramatic effect on the lead time for recruitment and enrollment into the program. There was also a perceived lack of demand for EVSE among many building owners and property managers. While education and awareness can help, without the demand from existing or prospective tenants and owners, buildings may be reluctant to install EVSE as they do not see the value.

Installation costs vary widely and are driven by site conditions, the location of the stations, and availability of onsite power. While installation costs can range from a few thousand to hundreds of thousands of dollars, \$20,000 is a realistic average for MDUs when sufficient power is available or minimal electrical upgrades are needed to support charging station. The media and public outreach effort was also successful, as MultiCharge San Diego seemed to get decent traction in the media and press. Numerous media outlets including local news stations, websites, and automotive focused news outlets picked up and made mention of MultiCharge San Diego. ChargePoint, Inc. also held ribbon cutting events at MultiCharge San Diego projects, developed case studies, and dedicated resources and developed web content exclusively for the multifamily sector. Extensive MDU resident outreach was also performed to encourage greater adoption of EVs amongst MDU tenants. Residents were educated on the availability of tax credits, rebates and high-occupancy vehicle lane access for EV drivers. Residents were also educated on all of the features embedded in ChargePoint, Inc.'s smart charging and networked stations.

Overall the goals of the project were met. The project did, however, take considerably more time than expected due to the reasons outlined above and the difficulty in recruiting and contracting with sites. Three amendments to the grant agreement were made over the course of the project, extending the original end term data from January 31, 2014 to March 31, 2017.

CHAPTER 4:

Conclusions and Recommendations

The cost of installing EVSE, the disruption to parking operations, and lack of demand for EVs are the largest barriers preventing wider adoption of EVSE at MDUs. Electric vehicles account for approximately three percent of all light-duty vehicle sales in San Diego. While three percent is considered high as compared to the rest of the United States, this still equates to very few numbers of EVs on the road and a disproportionate share on the road that are owned by MDU residents. Until EV sales can achieve greater penetration and the number of public, workplace, and destination charging locations increases, demand for EVSE, particularly in MDUs is likely to remain low. California's Zero Emission Vehicles action plan set a goal of deploying infrastructure capable of supporting up to 1 million zero emission vehicles by 2020, and 1.5 million by 2025. If these goals can be achieved, the demand for EVSE in MDUs will likely grow.

As was experienced during the MultiCharge San Diego program, installing EVSE into existing MDUs can be challenging, and many site assessments performed concluded that it would either be cost prohibitive or technically unfeasible to install EVSE. Issues with capacity in the electrical panel and distances between utility meters, parking spaces and electrical panels, can be very expensive to upgrade in order install EVSE. As a result, numerous MDUs interested in EVSE dropped out after the site assessment and the estimate of installation costs was quantified.

Also the disruption to parking operations caused by EVSE presents a challenge in existing MDUs. Moving or assigning parking spots can be very disruptive to the leasing contracts that stipulate and assign private or shared public parking spaces.

For these reasons, installing EVSE in existing MDUs is likely to remain a challenge, and advancements in technology are unlikely to create pathways that will solve these major challenges. The new construction or substantial renovation MDU market however, present better and more convincing opportunities for installing charging stations. New construction projects are far more receptive since installation costs are lower, and parking spaces have not been deeded or assigned yet. Requiring or encouraging new construction multifamily buildings to stub out the infrastructure for electric vehicle service equipment will make it much easier to install charging stations as the demand for electric vehicles continues to grow.

In order to overcome the financial burden for MDUs to install EVSE, ChargePoint, Inc., a simple rebate program could be established that can help to offset the costs of installing EVSE, while ensuring that the property has skin in the game. A per port rebate of \$4,000, similar to the rebate program established by the Los Angeles Department of Water and Power, that allows the applicant to direct how funding is used could be very effective. As seen in the 206 ports installed under MultiCharge San Diego and all of the MDU properties that wanted to but were unable to move forward, there is no one size fits all for the multifamily vertical. The solution for EVSE at each site is property specific, and thus any rebate program should be designed to be as flexible as possible, to allow for properties to put in place an EVSE solution that that works for them, provides customer choice, and flexibility for their needs.

GLOSSARY

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.

MULTI-DWELLING UNIT (MDU)— Individual residential living units comprising multiple housing facilities, apartment buildings, condominiums, dormitories, and cooperatives.¹

SAN DIEGO GAS & ELECTRIC (SDG&E)—An electric and natural gas utility serving San Diego County and the southern Orange counties.²

¹ [Law Insider](https://www.lawinsider.com/dictionary/multiple-dwelling-units) (https://www.lawinsider.com/dictionary/multiple-dwelling-units)

² [San Diego Gas & Electric](https://www.sdge.com/more-information/our-company/about-us) (https://www.sdge.com/more-information/our-company/about-us)