



**CALIFORNIA
ENERGY COMMISSION**



**CALIFORNIA
NATURAL
RESOURCES
AGENCY**

Clean Transportation Program

FINAL PROJECT REPORT

County of San Diego Electric Vehicle Supply Equipment Installation Project

Prepared for: California Energy Commission

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California Energy Commission

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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 provide funding opportunities under the Clean Transportation Program for projects that expand alternative fueling infrastructure and fueling stations for public and workplace employee PEV owners. 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-14-017 on July 22, 2014.

ABSTRACT

Purpose

The County of San Diego established a goal in the 2013-2015 Strategic Energy Plan to “Install electric vehicle charging stations for public and County use at 10 County sites.” Through funding provided by this California Energy Commission grant, the County exceeded this goal by placing 37 new charging stations at 11 County owned properties, expanding the number of electric vehicle supply equipment available along major thoroughfares in San Diego county. The extension of the electric vehicle supply equipment network will encourage the broader adoption of electric vehicles in our region and reduce the amount of carbon dioxide equivalent contributed by vehicle miles travelled.

Scope

The installation project was structured as a partnership between the County, which was responsible for placing the electric vehicle charging infrastructure (“make-ready”), and the vendor ChargePoint, the County’s private partner in this project, who installed the charging equipment at the charging station stalls. County staff managed the infrastructure work of subcontractors who provided the work needed to deliver the electricity supply - the “make ready”- for each station location. Upon completion of this work ChargePoint will maintain, operate, and handle billing for all 11 sites.

Major Findings

Usage data for the six-month period after completion of all installations, October 2016 through March 2017, includes:

- Total Energy Consumed: 26.23 megawatt hours
- Total Sessions: 3,284
- Total Greenhouse Gas Avoided: 11,016 kg

Keywords: Charging station, County of San Diego, electric vehicle supply equipment, infrastructure,

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EXECUTIVE SUMMARY

Goals

The County of San Diego undertook the installation of electric vehicle supply equipment at several County sites in order to satisfy goals identified in the County of San Diego Strategic Energy Plan 2013-2015, the purpose of which was to provide high-level energy and sustainability objectives including, among others, the facilitation of alternative fuel vehicle deployment.

This effort to expand the network of vehicle charging opportunities in San Diego county supports the growth of electric vehicles as a conventional method of transportation and adoption of plug-in electric vehicles over a wide range of the county's population and socio-economic classes.

Process

Placing of the necessary infrastructure work to provide power to proposed charging stations, and coordination with the charging business vendor and the electric utility, was managed by County of San Diego project managers and inspectors over a period of 23 months at 11 locations. Design work was conducted by an architect/engineer team, and electrical and paving contractors were hired to install the work.

Deploying the infrastructure was intended to incentivize a charging business vendor to partner with the County. This partner was obtained through a proposal process, to provide the equipment and run the business of electric vehicle charging stations. The resulting public/private partnership is structured such that the County owns the property and the infrastructure that delivers electricity to the charging sites, while the charging business vendor owns the equipment and runs the business of selling and billing customers.

Results

The resulting completed project includes a total of 37 charging ports that are providing service to the public and County employees. Since the first stations went live in December 2014, the electric vehicle supply equipment supplied over 26-megawatt hours of electricity to electric vehicles and avoided emissions equivalent to 11,016 kilograms of greenhouse gas from vehicle tailpipes.

This partnership and resulting enhancement of the electric vehicle supply equipment network would not have been possible without the financial assistance from the California Energy Commission of \$500,000 through the Clean Transportation Program.

CHAPTER 1:

Project Goals

1.1 Introduction

The County of San Diego Board of Supervisors approved the County of San Diego Strategic Energy Plan 2013-2015 in July 2013, which was crafted to “lower operational costs, reduce energy and water consumption, and minimize greenhouse gas emissions.” The goal contained in the document that governs this implementation project, under the heading of Smart Building/Smart Grid Technology Deployment, was to “Install electric vehicle charging stations for public and County use at 10 County sites.” The Department of General Services, which is the administrator of the California Energy Commission (CEC) grant and the department responsible for operations and maintenance of County owned property, began scoping the project immediate after adoption.

1.2 Responsibility for Operations

County of San Diego sought to minimize risk to County taxpayers by eliminating responsibility for maintenance, liability, and the billing process. Therefore, the County solicited a partnership with a private vendor to own the equipment and run the vehicle charging business. Furthermore, it was desirable for the vendor to interface separately with San Diego Gas and Electric (electricity service provider) in order to avoid a fiscal situation which would require the vendor to reimburse the County for electricity drawn from County meters. Therefore, separate meters tied directly to San Diego Gas and Electric transformers were installed wherever possible, so that the customer of record would be the vendor and not the County.

1.3 Guidance for Compliance with Code

In 2014, when implementation of this project began, the only guidance for compliance with code, particularly accessibility code, from any authority having jurisdiction was a document published by the California Governor's Office of Planning and Research (Technical Policy 11B-1, Accessibility to Electrical Vehicle Charging Stations). Since no explicit regulations exist, local interpretation of code compliance goals was necessary.

CHAPTER 2:

Project Process and Schedule

2.1 Background

2.1.1 Shared Responsibilities

The partnership between the County and the vendor, ChargePoint, involved a two-stage installation process.

The first stage consisted of “make-ready” work conducted by the County (through a subcontractor) - the extension of electrical service, from electrical switch gear or from San Diego Gas and Electric transformer to the point of connection where the charging equipment would be installed.

ChargePoint provided the equipment onto the point of connection after all inspections were conducted at completion of the make-ready, which was the extent of stage 2 work.

Commissioning took place by County of San Diego staff after equipment was installed at each site.

2.1.2 Incremental Implementation

Installing Electric Vehicle Supply Equipment (EVSE) at County of San Diego owned sites had not been attempted by General Services prior to this project, so the implementation strategy involved completing one site at a time, thus allowing for lessons to be learned from the initial projects to expedite progress. Each site installation was considered a separate project.

2.2 Scope of Work

2.2.1 Installation Phases

Each project began with architectural and electrical engineering design. All installation sites were located at existing parking areas at County owned facilities, so designs included accessibility and way finding modifications as well as extension of electrical service. Construction documentation was necessary in order to provide the project construction team with accurate product and implementation instructions.

A contractor was then hired to implement the designed retrofit work. County of San Diego used our Disabled Veteran Business Entity program to hire the contractor for this work in order to expedite the contracting process (as opposed to a Request for Proposal process). Some work, where applicable, was let to an independent paving contractor from Department of General Services Job Order Contract pool.

All work was managed by County of San Diego’s owner’s representative (our own project management staff) with interface from the Energy and Sustainability team who insured that Strategic Energy Goals were carried throughout the project.

2.2.2 General Scope

The scope of the construction work, generally with some modifications at some sites, involved the following:

- Adapt the parking spaces to become charging stations by retrofitting with Americans with Disabilities Act (ADA) code compliant features such as: curb ramps, paving,

striping, protective bollards or wheel stops, and signage. At this time, compliance with ADA criteria is not a mandatory requirement by the California Building Codes.

- Run electrical wiring in conduit to the charging sites, either in trenches below existing paving or surface mounted to existing buildings. This work involved some demolition and repair of existing pavement or hardscape.
- Tie into new San Diego Gas and Electric meter in new meter cabinet adjacent to existing San Diego Gas and Electric transformer, or to County of San Diego switch gear behind the meter in the facility’s electrical room or closest existing subpanel.
- Install safety equipment (emergency disconnect switches) at each station
- Provide junction box for equipment mounting - mounting plates provided by ChargePoint
- Install charging equipment “by others” onto make-ready (“other” being ChargePoint under separate contract with the County – not paid through the CEC grant)
- Inspect and commission.

2.2.3 Locations

The initial grant application identified 35 stations to be installed at 10 locations. The final project, which included dual-port charging units, provided 17 Level 2 dual-port units (34 ports), one Level 2 single-port unit, and 2 Level 3 single port units, for a total of 37 ports at 11 locations. Figure 1 shows location names, addresses, and number of stations installed. Figure 2 shows a map of locations.

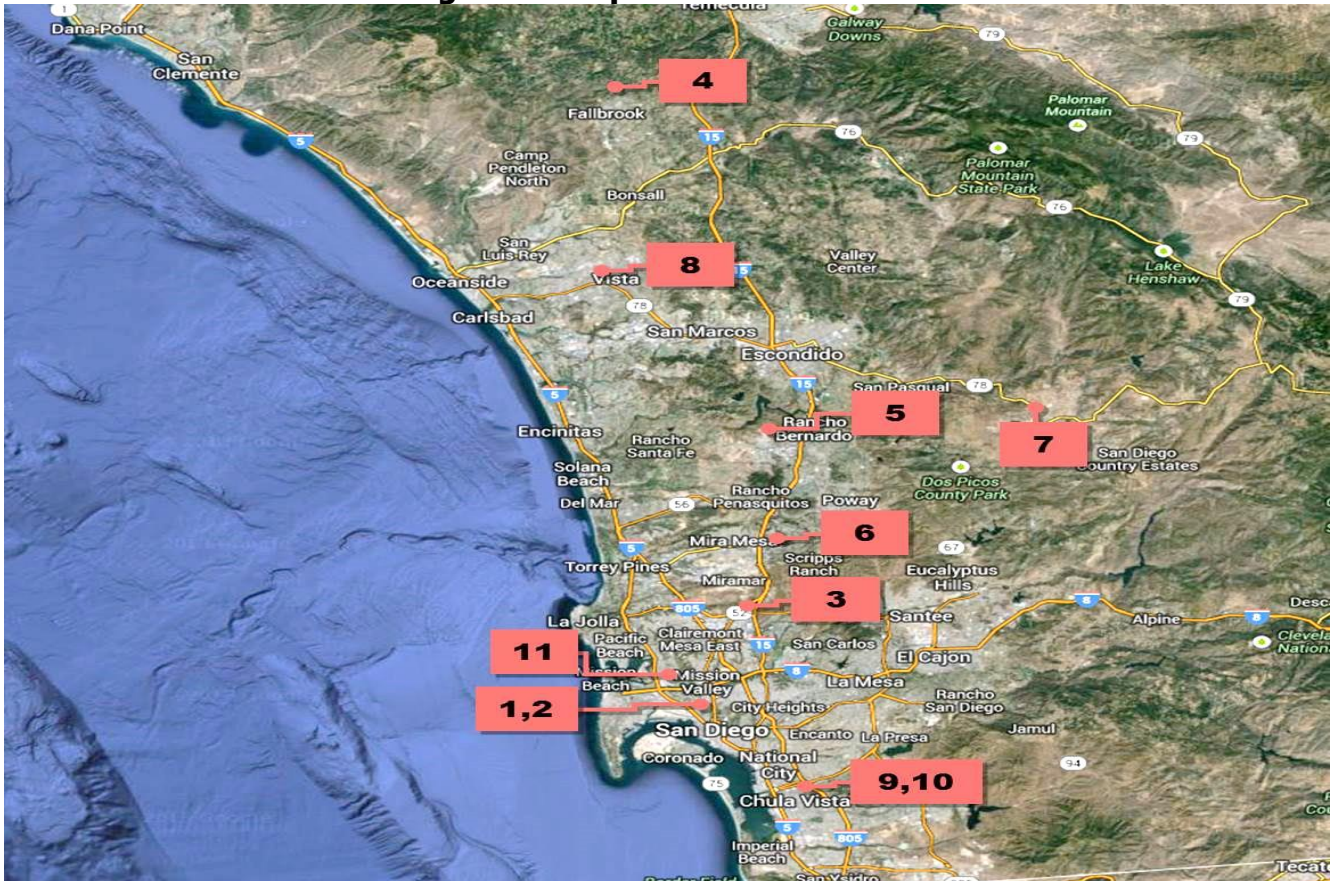
Figure 1: Roster of EVSE Locations

EVSE Sites		Site Address	# EVSE Ports	
			L2	DCFC
1	County Administrative Center	1600 Pacific Hwy, San Diego, 92101	4	2
2	Cedar Kettner parking structure	735 West Cedar Street, San Diego 92101	4	0
3	County Operations Complex	5515 Overland Avenue, San Diego, 92123	10	0
4	Fallbrook Library	124 South Mission Road, Fallbrook, 92028	2	0
5	4S Ranch Community Center	16118 4S Ranch Pkwy, San Diego, 92127	2	0
6	San Diego County Air Pollution Control*	10124 Old Grove Road, San Diego, 92131	1	0
7	Ramona Library	1275 Main Street, Ramona, 92065	2	0
8	North County Regional Center	325 South Melrose Drive, Vista, 92083	4	0
9	South Bay Regional Center	500 Third Avenue, Chula Vista, 91910	2	0
10	South Bay Assessor Records Clerk Center	590 Third Avenue, Chula Vista, 91910	2	0
11	Health Service Complex	3851 Rosecrans Street, San Diego, 92110	2	0

Total Installed Ports 35 2

Source: County of San Diego

Figure 2: Map of EVSE Locations



Source: County of San Diego

2.2 Implementation Challenges

There were many complexities involved in implementation that took time to prepare and execute, extending the amount of completion time for each project.

- County departments “own” the buildings they occupy and therefore have discretion over any physical changes, so General Services, the administrator of this implementation project, was required to manage a high level of user input and control over locating equipment. This coordination had an impact on scheduling of construction activities.
- The proposed locations of the 35 EVSE for the grant application were preliminary, based on findings of a feasibility study. Once the project commenced, further due diligence was necessary during the beginning of each site design in order to refine an understanding of optimal locations. This due diligence was conducted in order to: 1- satisfy the users’ needs (e.g., to minimize interruption of operations), and 2- fit within budget constraints (e.g., to minimize the distance from meters and/or switch gear to tie in electricity supply lines).
- Preparation of construction documents by an architect/engineer was necessary before construction could take place. This requirement lengthened the completion time needed for each installation.
- County inspectors made unforeseen changes to completed installations based on their interpretation of the Governor’s Office of Planning and Research guidance document. Some of these changes were time consuming.

- Tie into San Diego Gas and Electric transformers in order to install new meters was necessary for the vendor to have separate electricity accounts. This required interface with San Diego Gas and Electric inspectors, planners, and project managers, with inspections occurring on their schedule. The project schedule was lengthened to accommodate additional time to complete those installation projects where a separate meter was included.
- At the request of County executives, an 11th site was added to the scope which had an impact on the schedule. To satisfy this request, a change in one of the completed, nearby installations was modified and 2 EVSE were moved to the added site. The beneficial result of this change is that there is now an additional location for the public to access the EVSE funded by this grant.

2.3 Project Schedule

When this installation program began in 2014, the County anticipated that it would take 11 months to implement all stations at all 10 sites. In actuality the time that elapsed from when the first shovel hit the ground to when last installation went live was 23 months. Figure 3 shows the actual schedule of implementation.

The average installation project required approximately 38 weeks to complete. (NOTE: the 11th site is not included in this schedule because the scope of work only required a move of 2 EVSE from one location to another where the make-ready was already in place.) Governmental entities wishing to follow this model of EVSE acquisition can reasonably expect this time frame to be typical. This timeframe is broken down by phase below:

- Design and documentation: 8 weeks
- Bid from contractor and notice to proceed: 5 weeks
- Construction of make-ready: 20 weeks
- Scheduling and installation of EVSE through vendor: 3 weeks
- Inspection and commissioning: 2 weeks

The obvious exceptions to this average time frame were at the following sites:

- Shorter implementation times:
 - County Operations Complex and County Administrative Center: parking structures where interior surface mounted conduit was run from panel located close to charging stalls
 - Health Services Center: routing of conduit from panel to charging location occurred through attic space and did not require after-hours scheduling
 - South Bay Regional Center: shorter implementation was achieved by extending conduit and wire from the existing Assessor's site to directly adjacent parking stalls
- Longer implementation times:
 - 4S Ranch: extended time required to correct accessibility issue identified by County of San Diego inspectors

CHAPTER 3:

Project Results

3.1 Project Innovations

The underlying innovation that this project aimed to test is the viability of the public/private partnership as a means of contributing to the goal of broadening the Electric Vehicle (EV) charging network in San Diego County. The factors that make this partnership workable are the following:

- Public entities tend to own many properties throughout their jurisdiction and can control the land use at those properties
- Public entities have a mission to serve their citizens that is generally codified and carried out without variance
- Public entities have limited and predictable budgets
- Private EV charging companies, which sell electricity secondhand, provide EV drivers with a network of charging opportunities
- The business of EV charging is a young industry, not yet robust and resilient but stable and possibly growing

Combining the private business of offering electricity for sale through EVSE with the prevalence of well-attended publicly-owned sites creates a synergy that should be productive for the private companies, helpful to EV drivers, and useful for meeting County goals.

Although this innovation is not an advancement in science, any program that helps transition the market away from greenhouse gas producing technologies is advancing the State of California's energy goals.

3.2 Monitoring of Public Uptake of EVSE

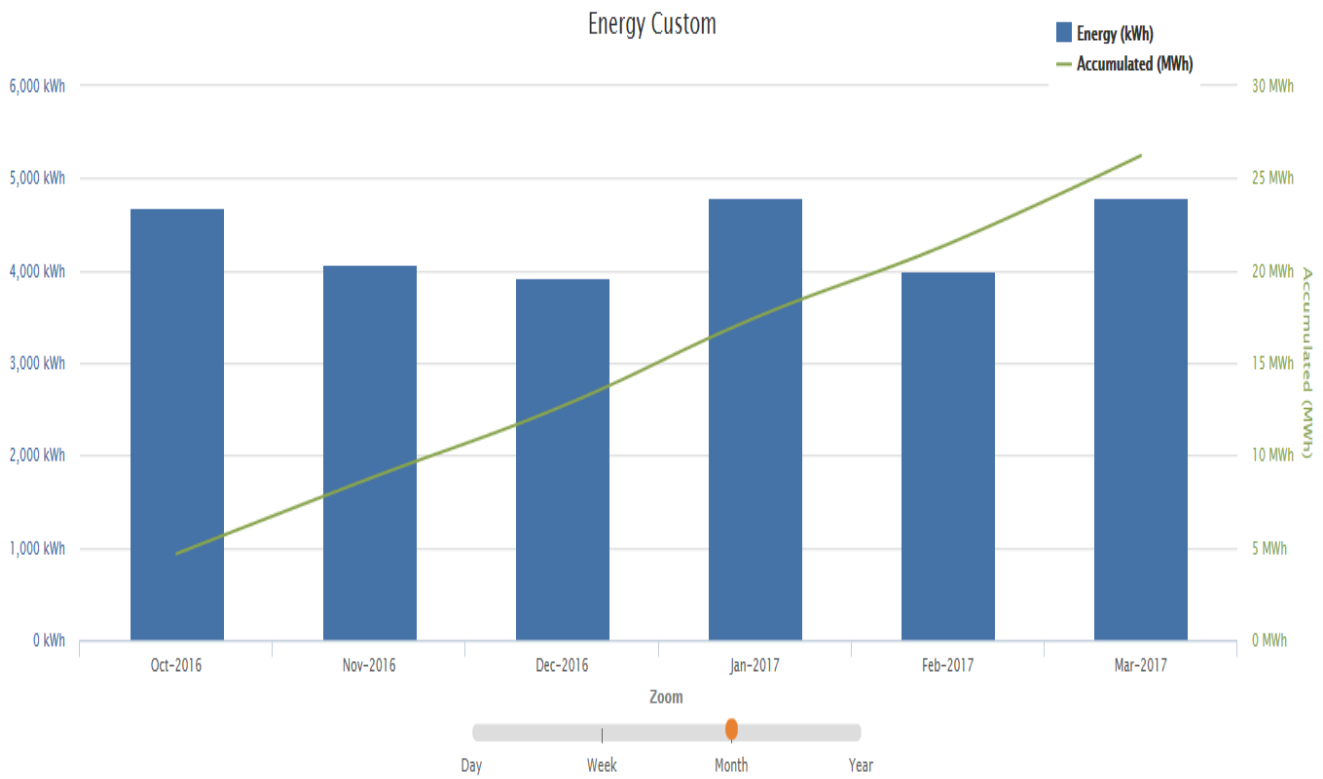
County of San Diego's monitoring of public usage of installed EVSEs began as soon as each site went live. Because this project was implemented one site at a time, most sites have provided more than six months of monitoring information. All sites have seen varying usage throughout the last six months, the official monitoring timeframe, but there has been a trend upward, showing a gradually growing user base and familiarity with the equipment locations. The following graphs show variations in overall usage during the final six months of monitoring.

Figure 4 shows overall usage trends. Usage has been variable during the winter but trending upward.

Figure 5 shows the greenhouse gas emissions saved through EV miles travelled supported by these charging stations.

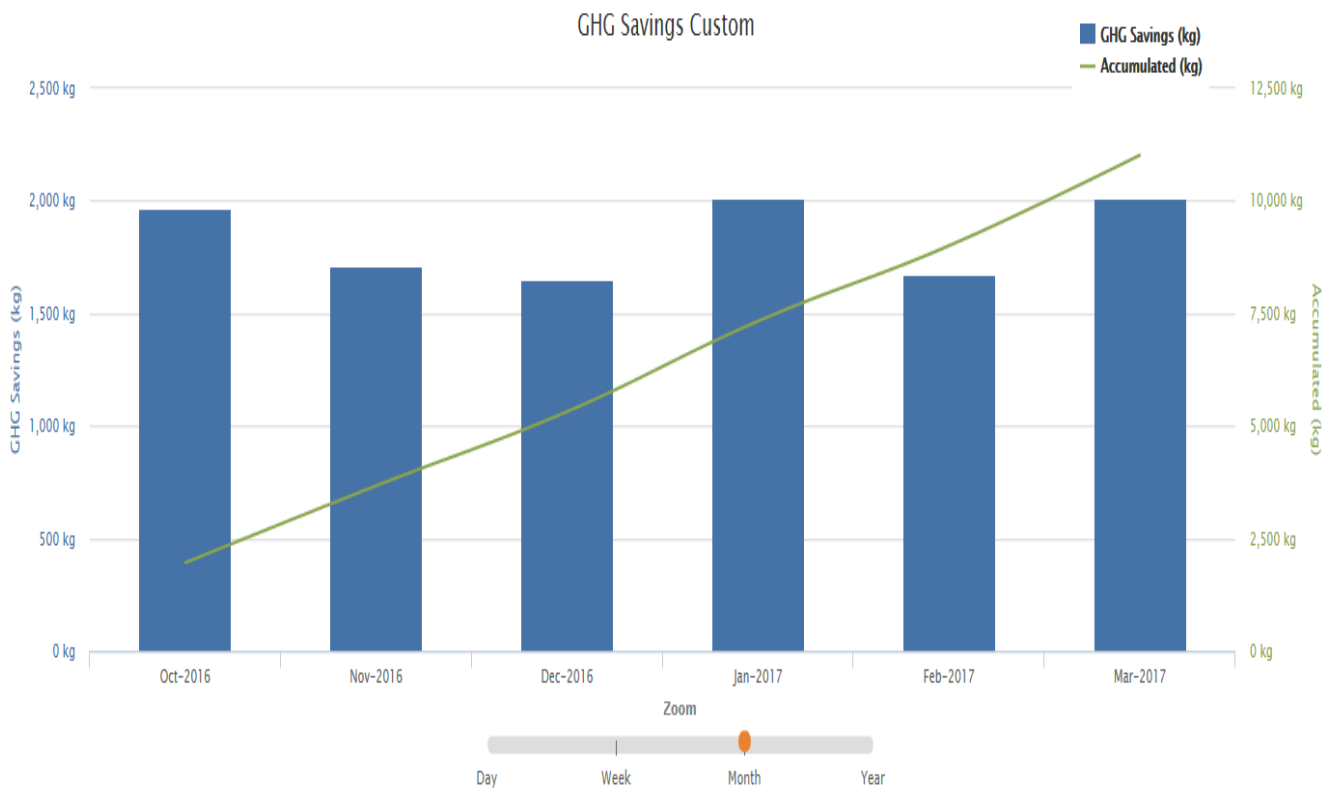
Figure 6 shows the number of sessions at all stations during the monitoring period. The last two graphs track closely with the overall energy usage graph.

Figure 4: Overall Usage Trends



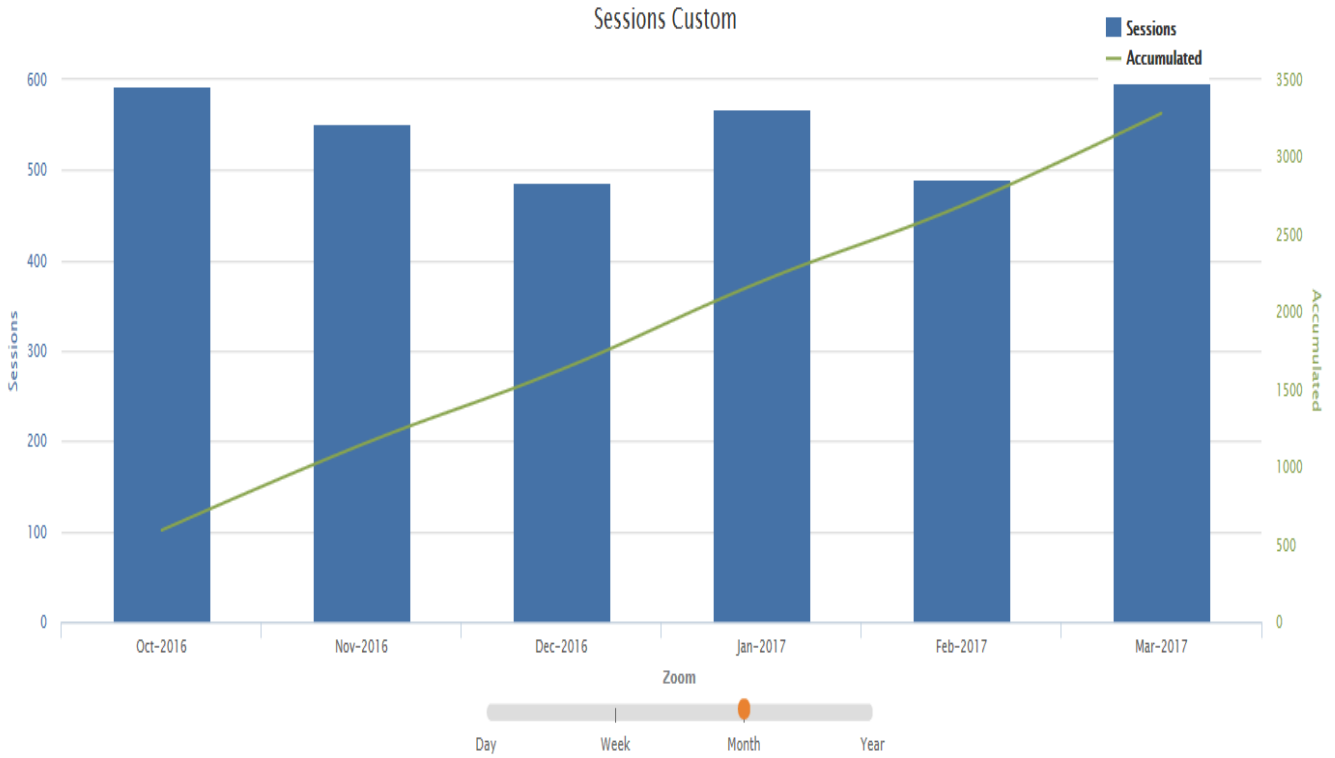
Source: ChargePoint

Figure 5: Overall Greenhouse Gas Savings



Source: ChargePoint

Figure 6: Overall Sessions



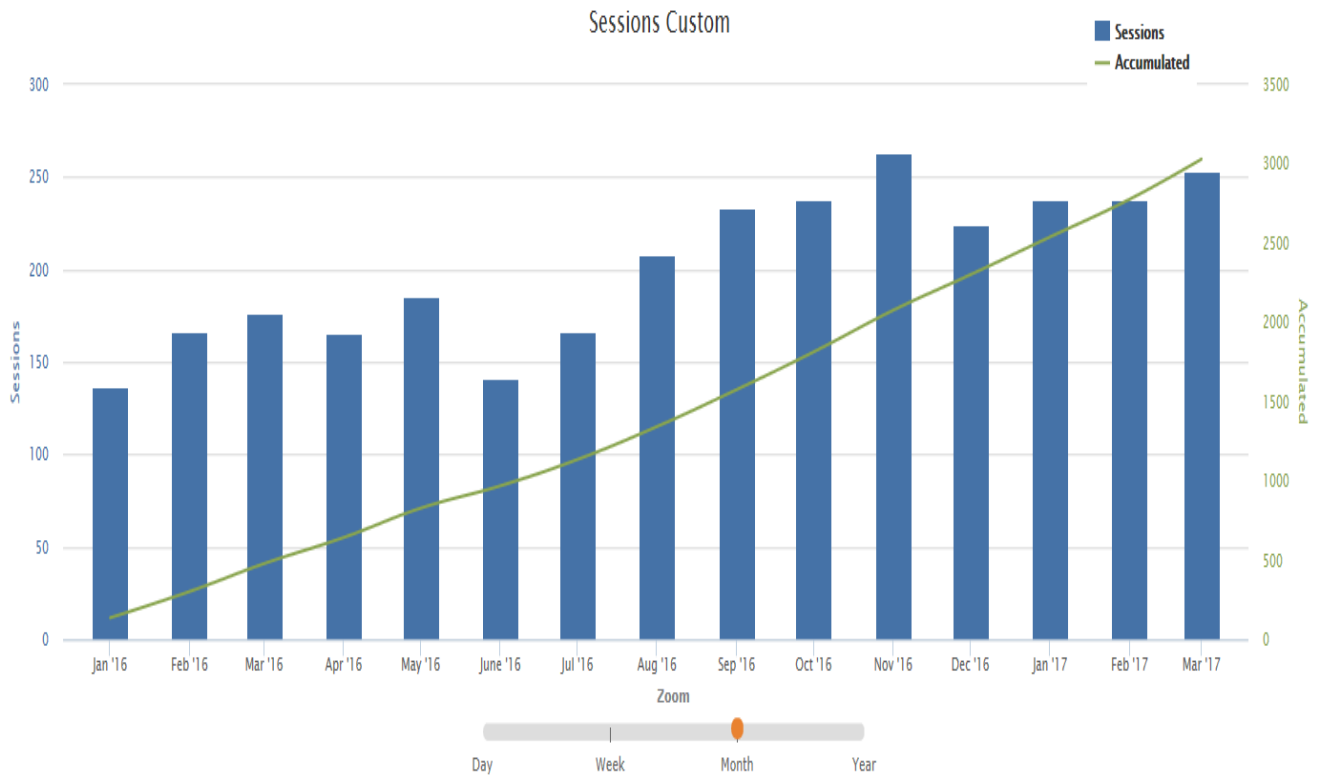
Source: ChargePoint

The following graphs show usage at sample individual sites.

Figure 7 of County Operations Complex Sessions shows a general trend upward in number of sessions per month. This site contains several charging stations that are used by County employees as well as public visitors to the operations campus.

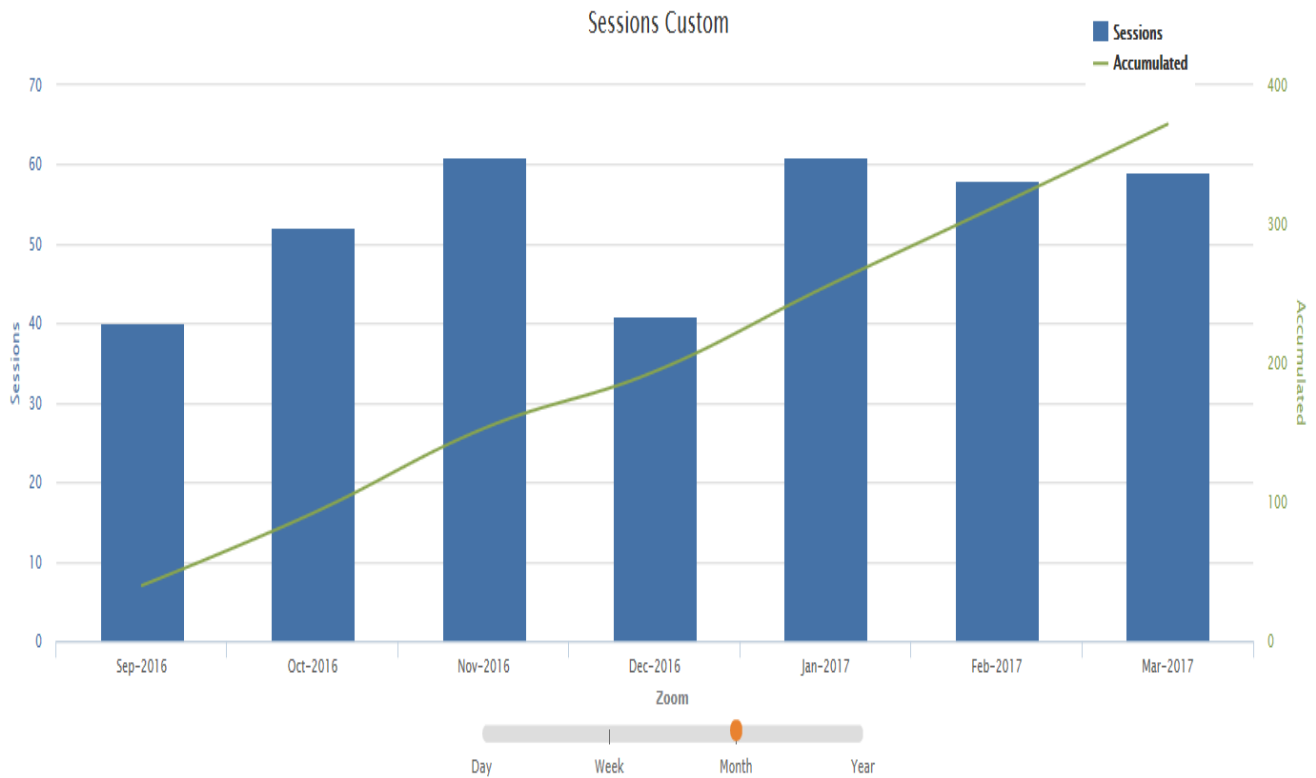
Figure 8 of North County Regional Center Sessions shows usage at the newest installation remaining strong. These charging stations are used primarily by visitors to the Courts and Law Library.

Figure 7: County Operations Complex Sessions



Source: ChargePoint

Figure 8: North County Regional Center Sessions



Source: Charge Point

Graphs for all sites showing the most recent 6 months of usage can be found in Appendix A.

CHAPTER 4:

Lessons Learned from this Project

4.1 Overview

When the County of San Diego embarked on the implementation of this project, it was breaking new ground with regard to our own experience with this type of project as well as the type of public/private partnership we envisioned. Our experiences gained during this process fall into two categories: methodology and operations, and market positioning.

4.2 Methodology and Operations

The lessons learned during the 2 1/2 years of implementation of this project can fill a guidebook but are summarized below.¹

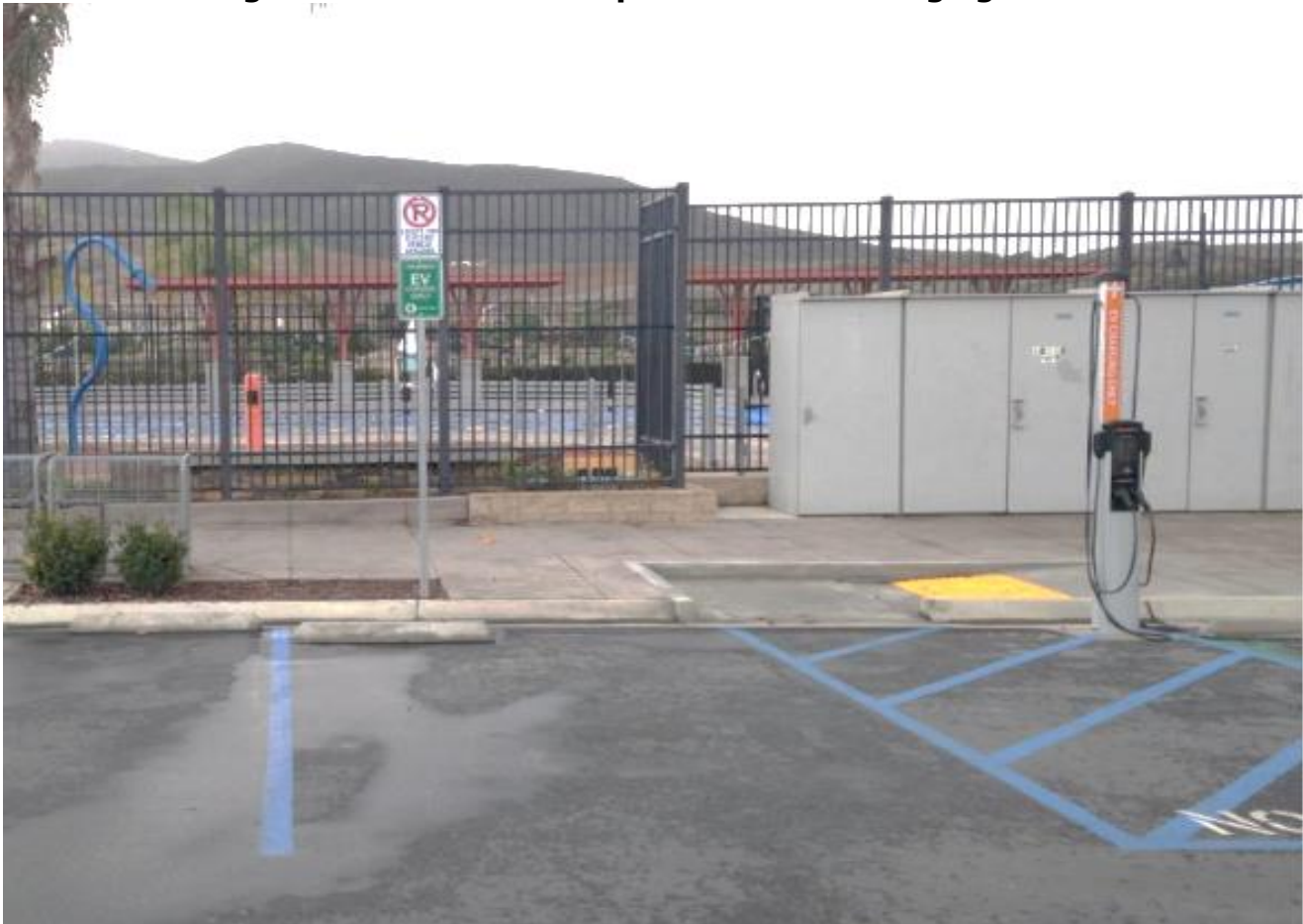
Salient recommendations to local governments who wish to implement a similar public/private partnership for electric vehicle charging are as follows:

1. Conduct a market assessment to determine potential sites. Installation of EVSE at existing developed sites is a financially significant undertaking. Although most local governments have a low threshold for risk tolerance, that consideration must be balanced with potential public uptake because an unsuccessful installation is worse than an expensive installation. Assessment should include analysis of factors that will have an impact on the desirability and marketability of EVSE at a given location, such as:
 - Daily vehicle trips within a ¼ mile radius
 - Trip attractors
 - Transit stops
 - Walkability
2. Conduct survey of charging service vendors to understand tolerance for proposed project (very few vendors we surveyed were interested in funding the make-ready work)
3. Seek funding assistance for make-ready work. It is expensive.
4. Produce design documents for installation to insure clear communication of design intent.
5. Seek a private partner that will install, own, and maintain the charging equipment and manage the charging operations.
6. License, not lease, the parking areas to the vendor; vehicle charging does not yet have a large profit margin.

¹ In an effort to share this wisdom with other local governments in the San Diego area, Department of General Services staff made a presentation to the San Diego Association of Governments Energy Working Group in May 2016, outlining the highlights of the project and recommendations for other local governments interested in installing EVSE. The full presentation slide deck is included in the Appendix.

7. Receive local inspectors' approval of your strategy for approaching implementation issues before starting construction. It is much more cost effective to satisfy their concerns in the design phase rather than after installation is complete:
 - Solve charging cable trip hazard regarding accessible charging stalls. Figure 9 illustrates the potential for charging cable trip hazard from improper placement of equipment at an accessible spot.
 - Select consistent and reasonable means of protection of equipment from vehicle impact (e.g., bollards, wheel stops). Figure 10 illustrates equipment protection at the Air Pollution Control District installation.
 - Establish electrical disconnect locations and how many ports each one will serve. Figure 11 illustrates disconnect installation at one parking structure (one disconnect for each port – too many?).
 - Establish consistent accessibility marking (painting on pavement and signage); get agreement that the charging station is not an ADA spot (reserved), it is a charging spot that is accessible
 - Surface marking color; is it white? Green? Blue? Those colors designate certain parking standards and you don't want to create confusion by using the wrong color.

Figure 9: Potential for Trip Hazard from Charging Cable



Source: County of San Diego

Figure 10: Equipment Protection



Source: County of San Diego

Figure 11: Electrical Disconnect Installation



Source: County of San Diego

8. Charging stations are for charging only, not for parking. Check zoning code-required parking capacity. If you cannot lose any spaces without risking non-compliance with code, new spaces will have to be created.
9. Solidify agreement with your vendor ahead of time regarding reimbursement for electricity used by vendor, if the vendor will not be purchasing electricity directly from the utility under a separate account. Kilowatt hours are not the only cost you will incur with the addition of EVSE to your account. Demand charges can have a significant impact on your electricity bill.
10. If your vendor will have an account directly with the utility, nearest location of utility transformer may have a greater impact on your final equipment location due to cost of demolition and placing conduit and wire. This may result in a location that is less than ideal for the vendor's marketing needs.
11. Coordination with the utility for final connection to transformer, installation of new meter, and inspection will have an impact on your construction schedule. Know who the utility contact person will be and put them on notice that you will require their participation.
12. Accessibility is required for at least one of your charging stations. It will be tempting to save space by having the access aisle to the accessible path of travel double as the accessible aisle to the charging station. This cannot be accomplished without creating a potential trip hazard. Be sure to map out travel routes away from the charging stations for both ADA and non-ADA customers and avoid stretching charging cable across those routes.
13. Carefully consider the need for Level 3 direct current fast chargers. They are more expensive, take up more space because they require an additional transformer, larger conduit and larger wiring, have specific locational needs (who will use a direct current fast charger, where, and when?), and cannot be universally used by all EV models.

4.3 Market Positioning

As electric vehicles become more prevalent on California's roads and charging stations appear on every corner, the impact on the electricity grid will be significant. Unlike the global market influence on the prevalence and marketing needs of gasoline stations, EVSE vendors have very different challenges.

1. The pricing of service is heavily influenced by local utility pricing and by time dependent valuation and associated demand charges. Furthermore, market demand for charging as a paid service is influenced by the relative affordability of home-charging. The industry of reselling electricity is fraught with complexities and can be marginally profitable.
2. EV charging during peak grid demand is unpredictable, affecting the stability of local circuits and the grid in general. It will become more of a challenge for the utilities to forecast and manage supply.
3. San Diego Gas and Electric is getting into the business of selling electricity directly to EV drivers at locations other than their homes, by delivering electricity through EVSE owned by and billed directly through the company. This process will have the effect of removing the "middleman" vendor (impacting that industry) and will allow the utilities to control supply to meters that specifically serve vehicle charging, potentially providing greater stability to the grid.

4. As the required Renewable Portfolio Standard continues to increase, and the advent of community and district based renewable generation creates more electrons closer to users, the relationship between Photovoltaic and EV will inspire greater opportunities for EV charging derived directly from Photovoltaic generated on site. This will also help to stabilize the grid at the circuit level.

GLOSSARY

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

CALIFORNIA 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 CEC'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.

Funding for the CEC's activities comes from the Energy Resources Program Account, Federal Petroleum Violation Escrow Account, and other sources.

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.

Appendix A: Supplemental Graphs

Figure 12 shows a slide of the presentation to the San Diego Association of Governments Energy Working Group about lessons learned from implementation project.

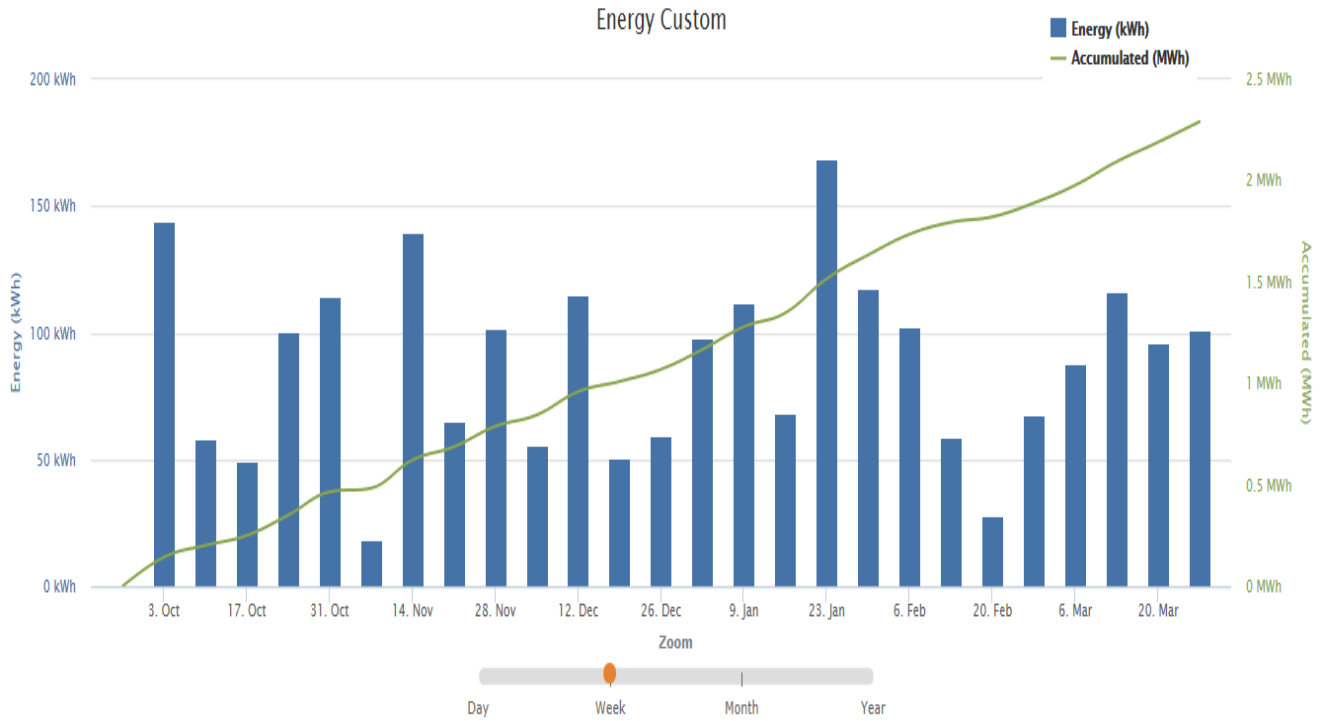
Figure 12: Presentation to San Diego Association of Governments Energy Working Group



Source: County of San Diego

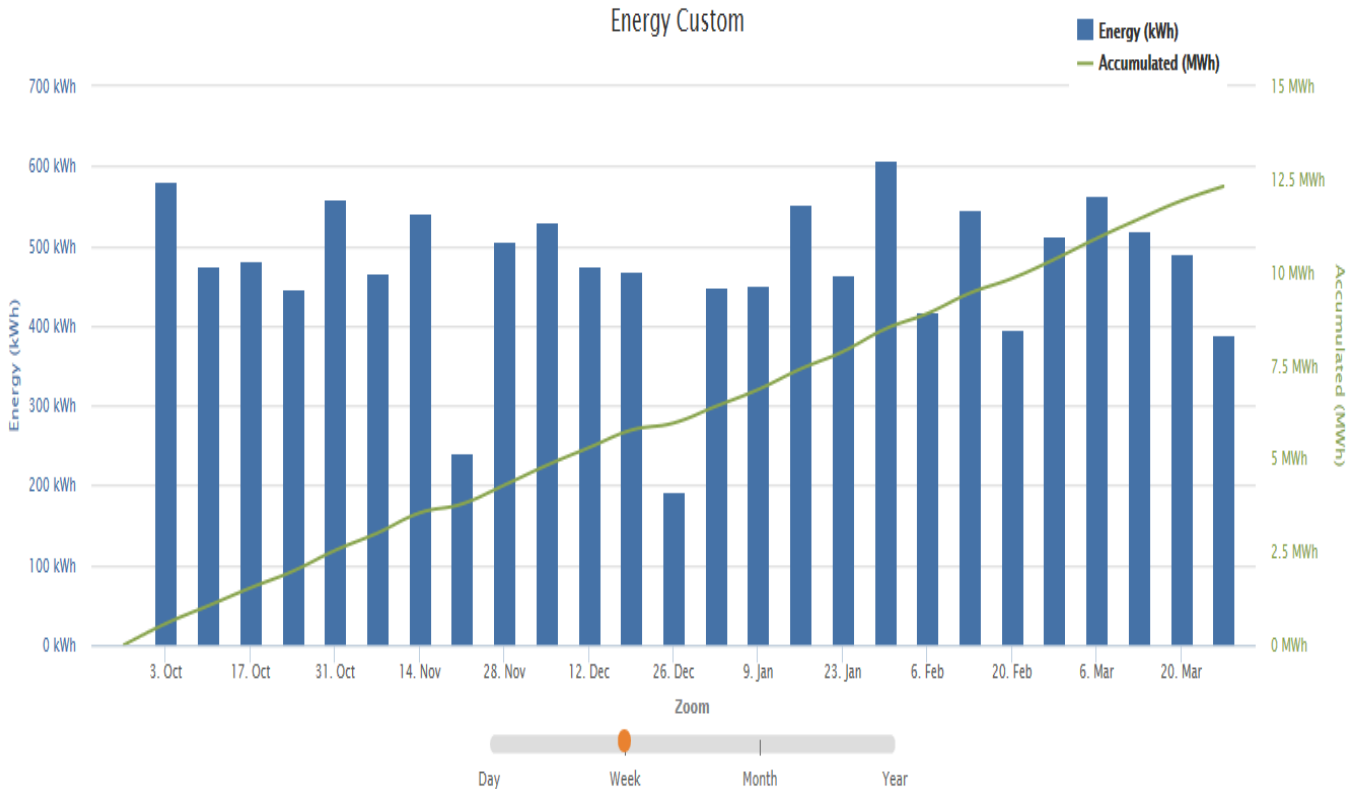
Figures 13 through 22 show usage graphs for all sites showing the most recent 6 months of data by week.

Figure 13: Six Months of Energy Use at County Administration Center



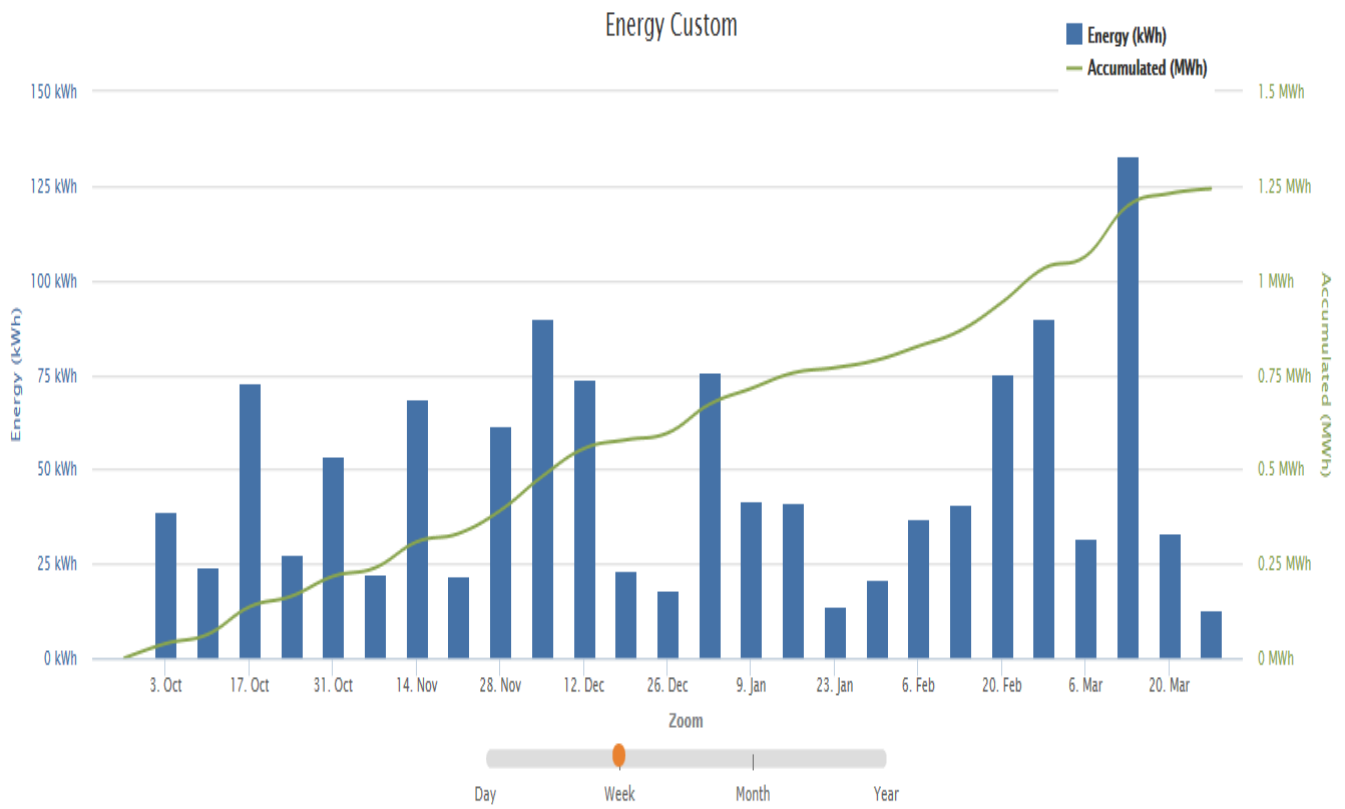
Source: County of San Diego

Figure 14: Six Months of Energy Use at County Operations Complex



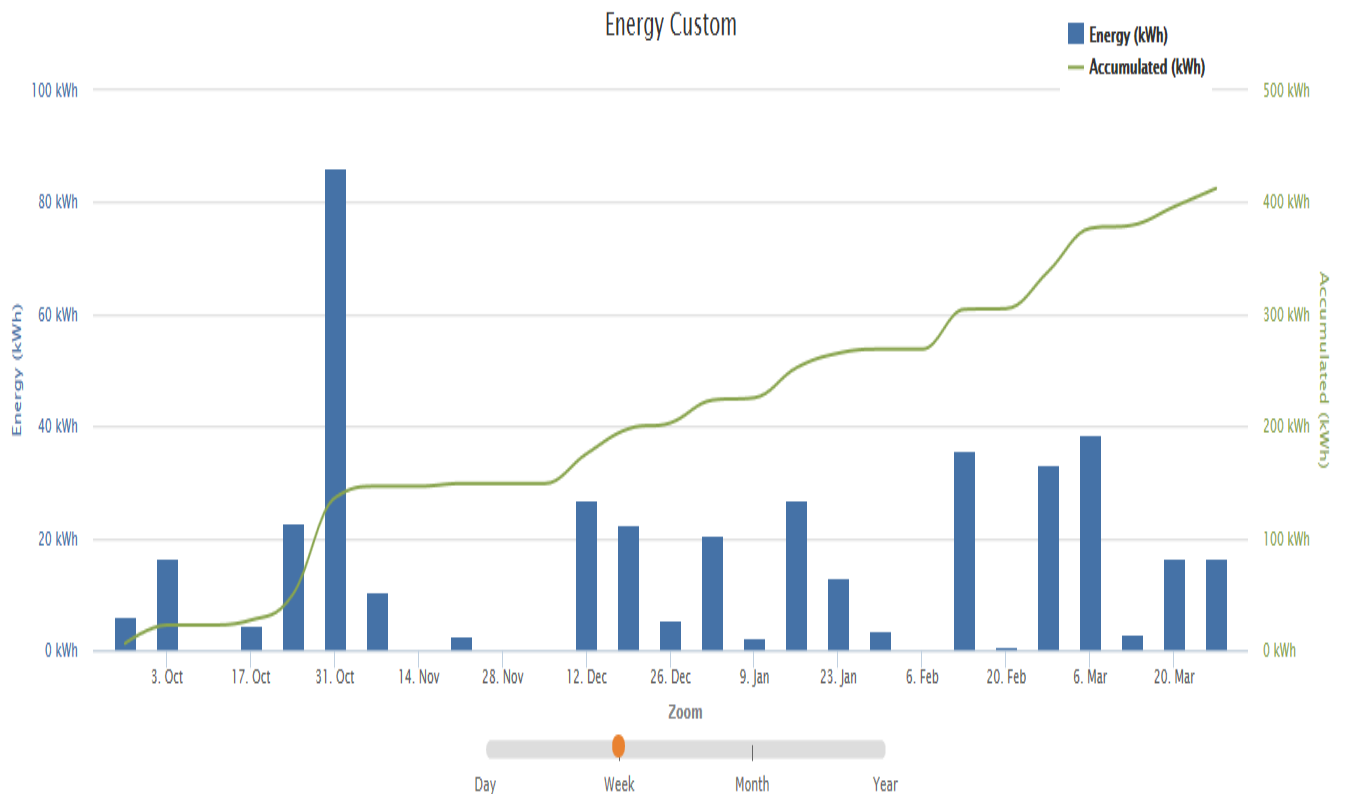
Source: County of San Diego

Figure 15: Six Months of Energy Use at South Bay Regional Center



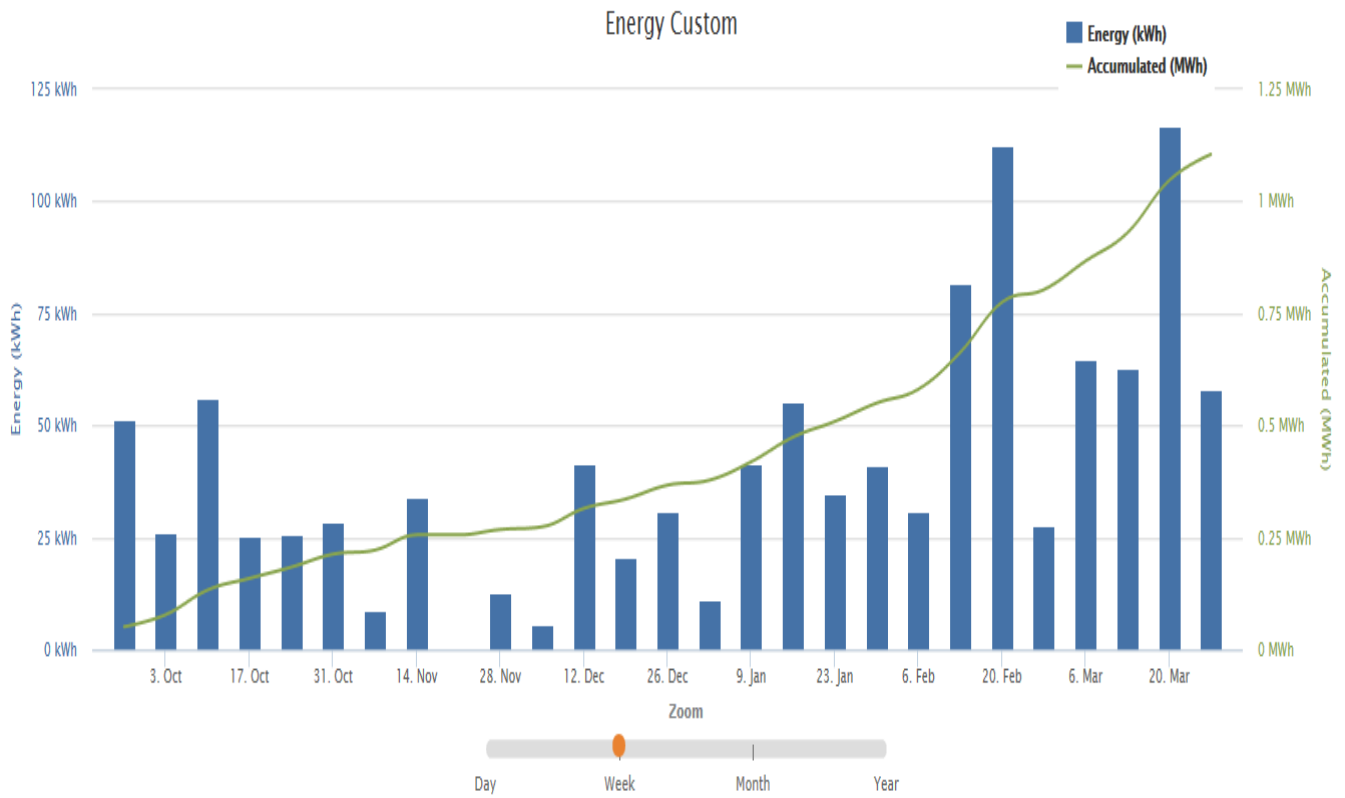
Source: County of San Diego

Figure 16: Six Months of Energy Use at Fallbrook Library



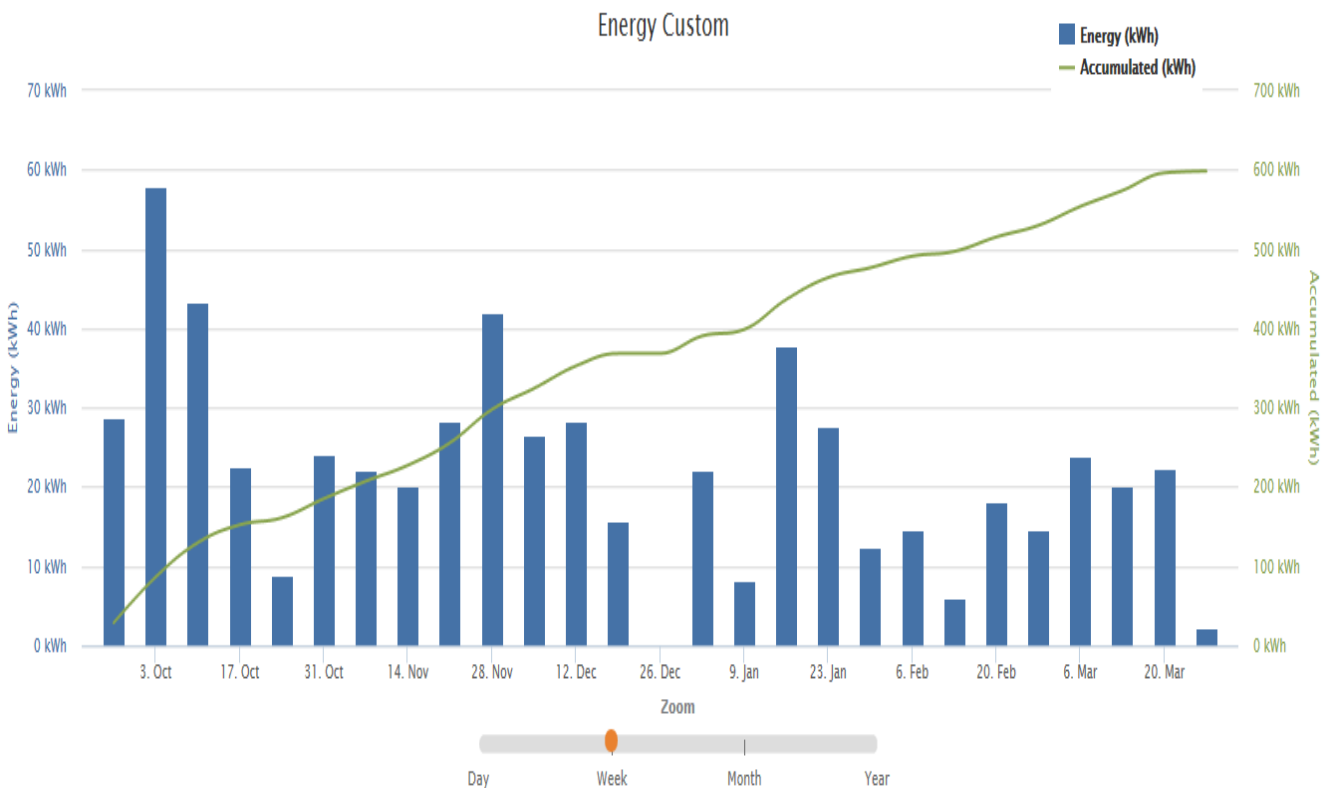
Source: County of San Diego

Figure 17: Six Months of Energy Use at Ramona Library



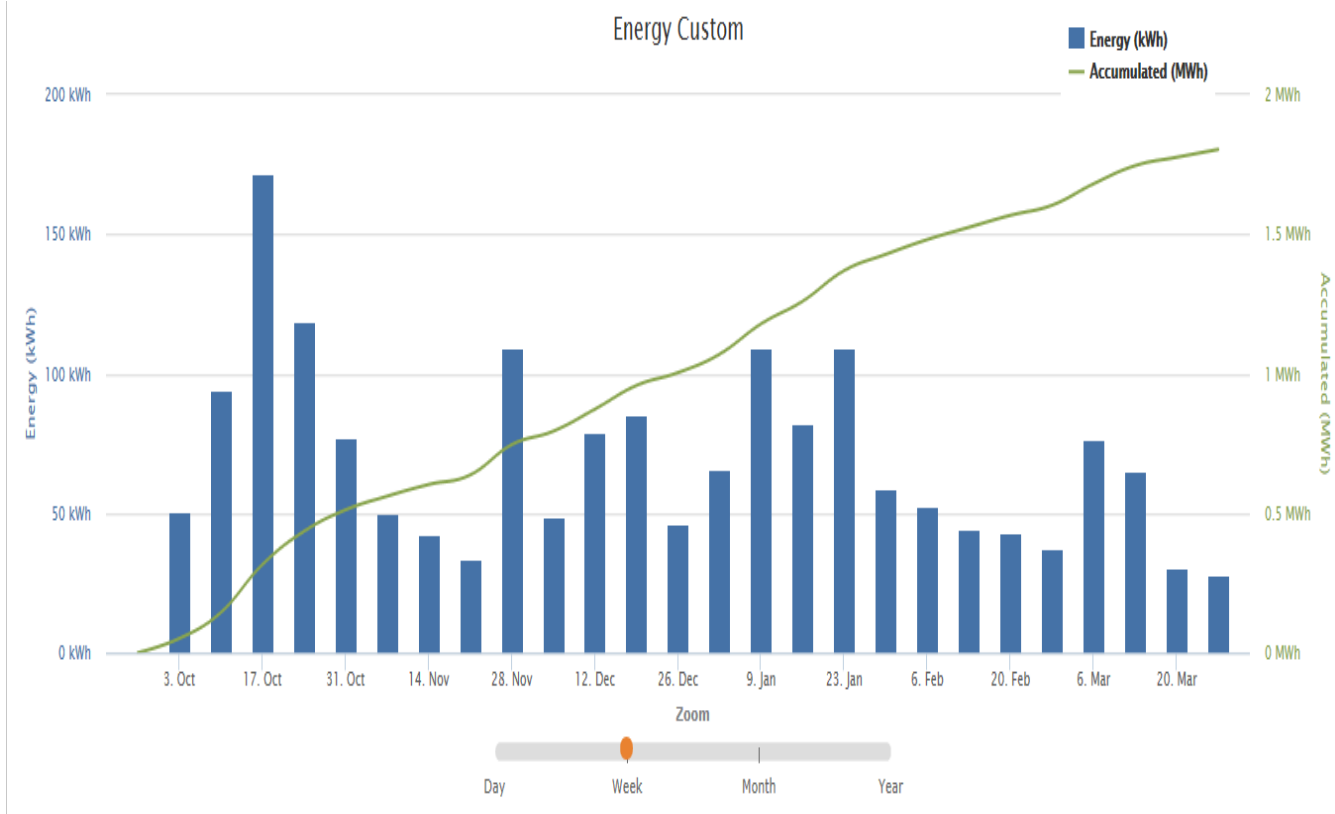
Source: County of San Diego

Figure 18: Six Months of Energy Use at Air Pollution Control District



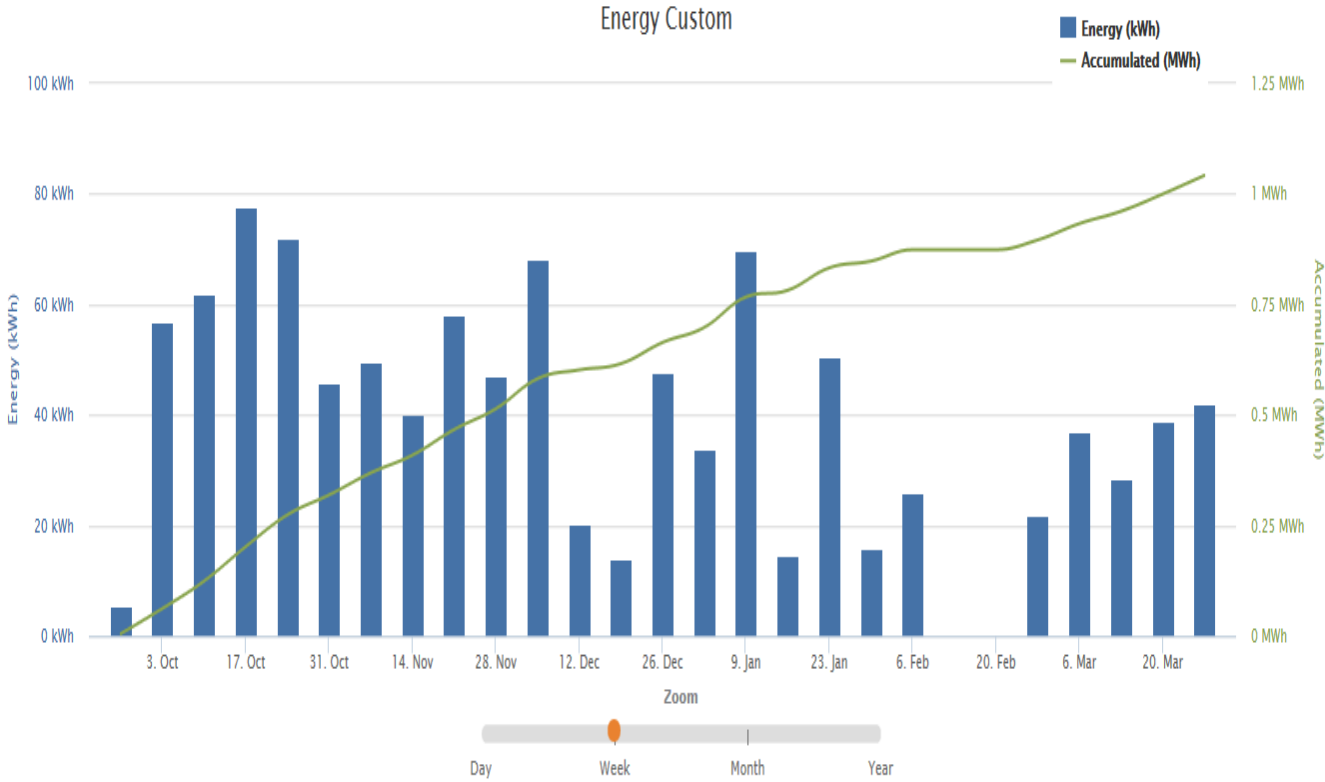
Source: County of San Diego

Figure 19: Six Months of Energy Use at Health Services Center



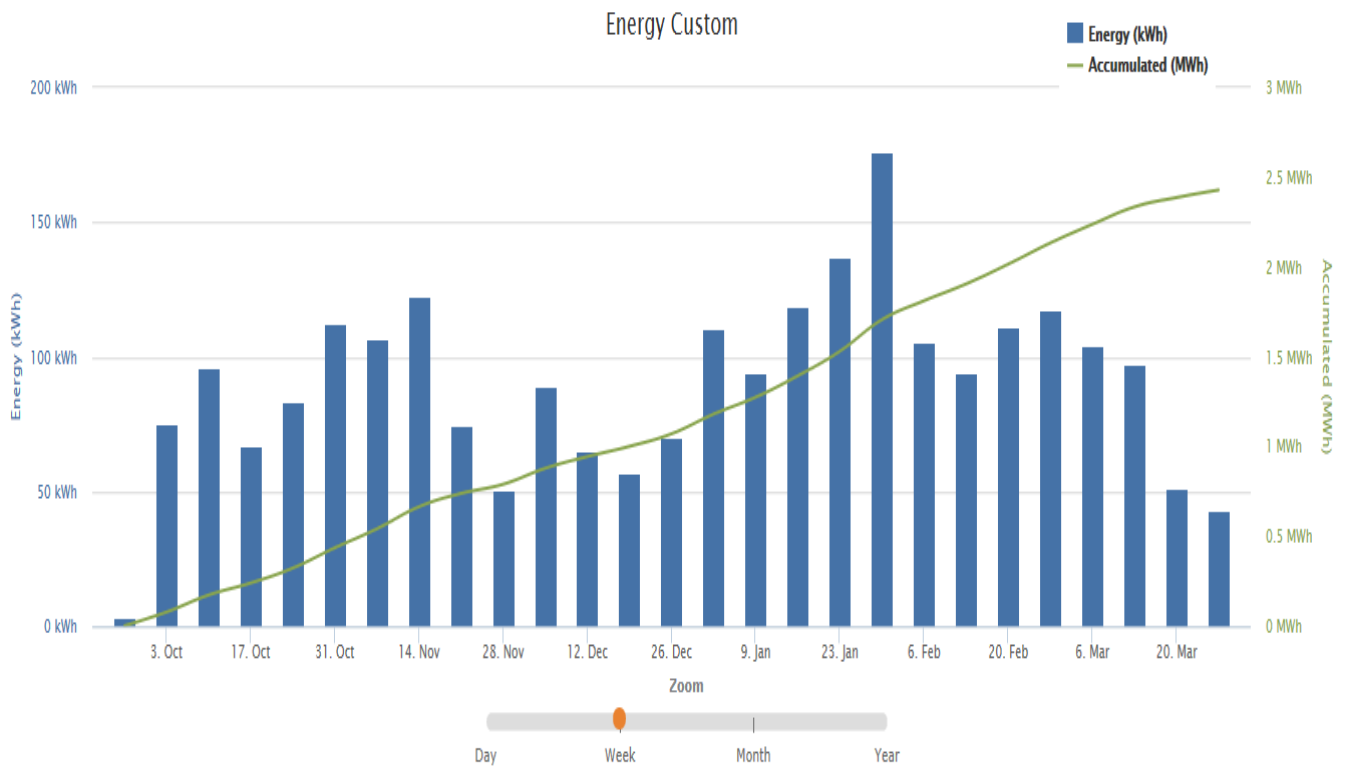
Source: County of San Diego

Figure 20: Six Months of Energy Use at 4S Ranch Community Center



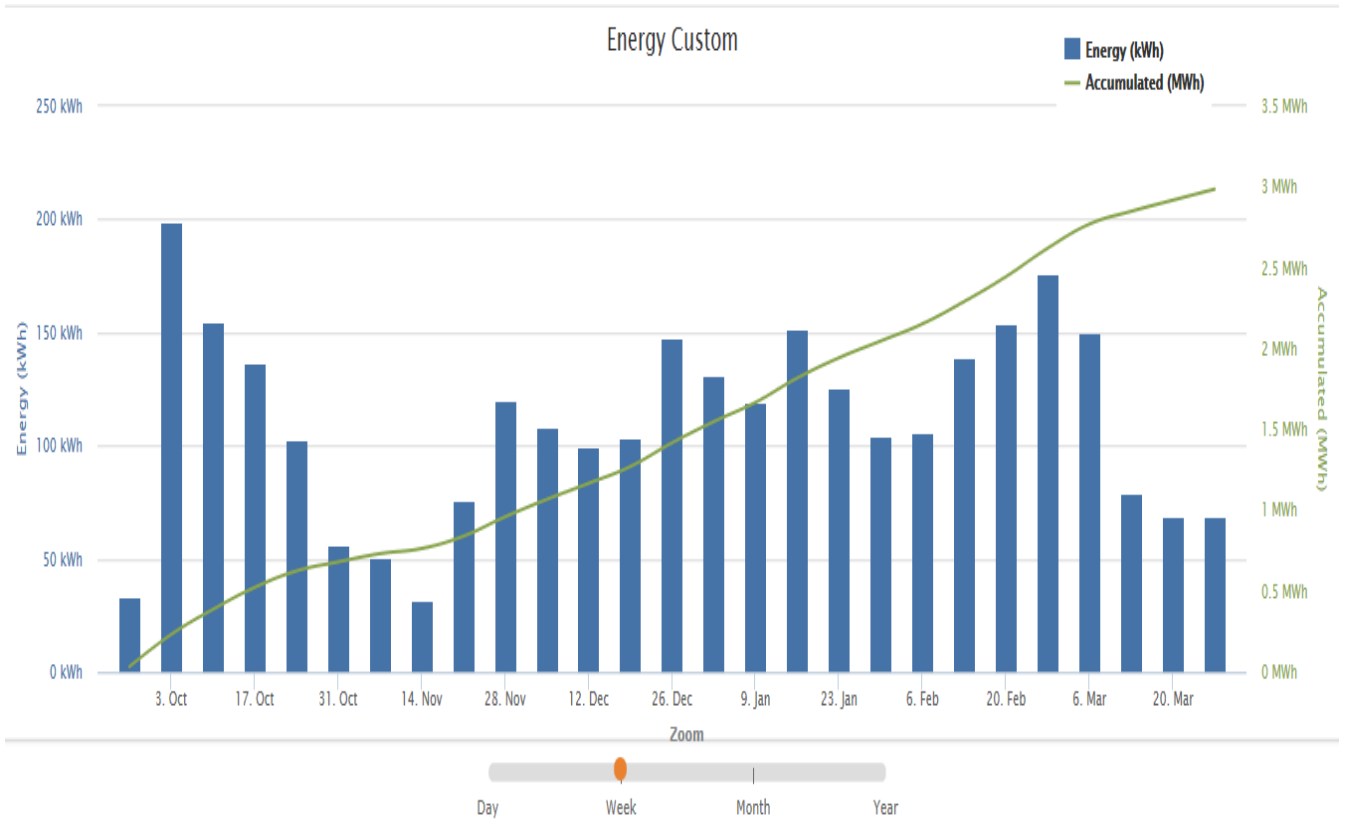
Source: County of San Diego

Figure 21: Six Months of Energy Use at North County Regional Center



Source: County of San Diego

Figure 22: Six Months of Energy Use at Cedar/Kettner Parking Structure



Source: County of San Diego