# Demand for Electric Vehicle Charging Stations on Campus

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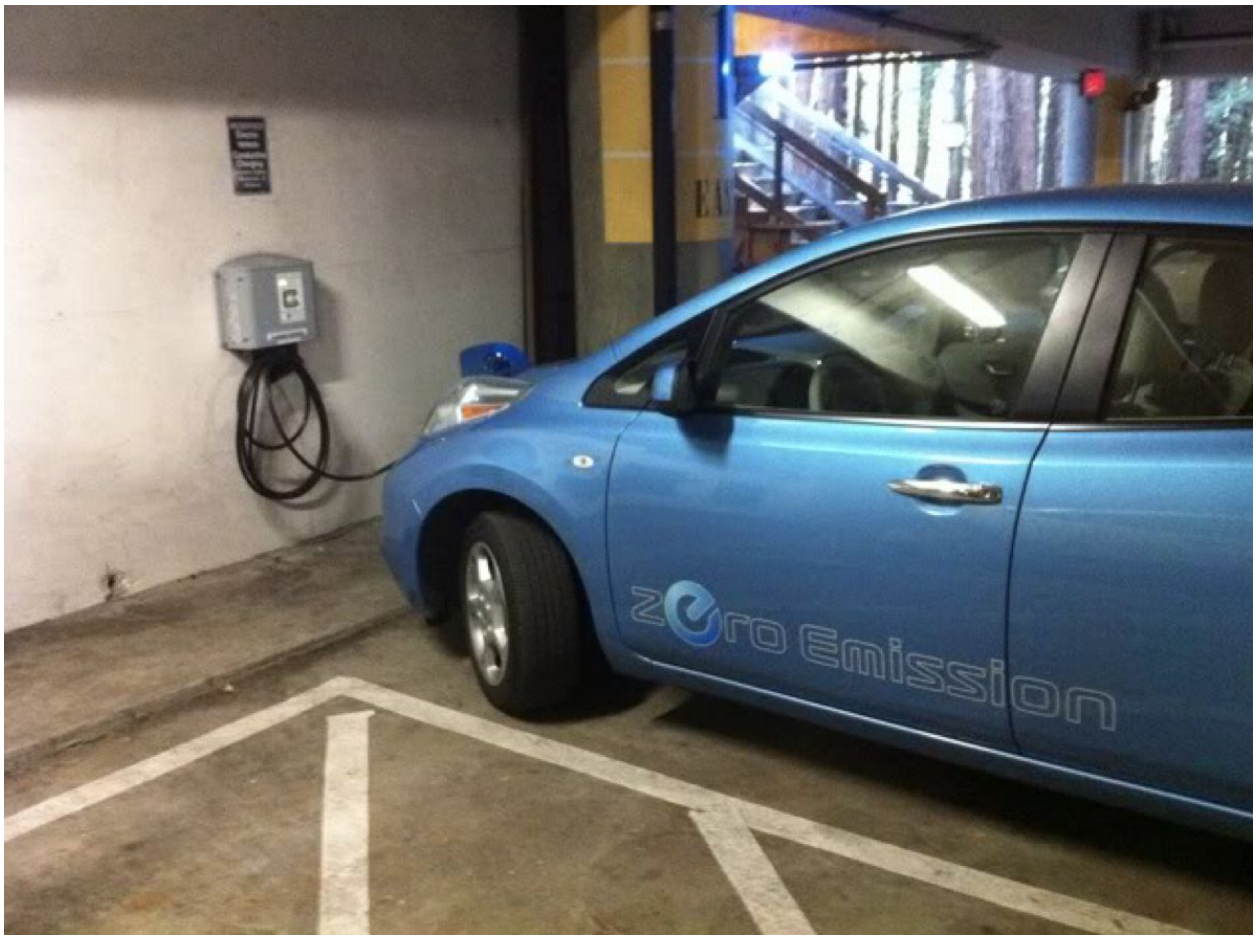

## Abstract

The purpose of this report is to assess the current demand for electric vehicle (EV) charging stations on campus as well as forecasting future demand in order to identify the best location for new charging stations. Currently, there is only one parking lot on campus with EV charging stations, Core West. This report will determine whether these charging stations are enough to meet current demand from EV drivers. In the case that more charging stations are needed, this report will suggest the best parking lots for new charging stations. The demand for charging stations is estimated from online surveys sent out through TAPS and parking lot surveys. Analysis was done on the relationship between the number of EVs and the required chargers to meet their charging needs. We found that the necessary ratio to accommodate demand is 5 chargers for every EV. With this ratio in mind, we conclude that there is currently a deficit of charging stations. Evidence of a shortage of chargers can also be seen from survey respondents who report a frequent lack of available chargers. We recommend that the pricing structure should be altered to shift charging to off-peak times, and/or that more chargers should be installed in identified lots.

## Introduction

In its 2017 Campus Sustainability Plan, UCSC aims to increase the proportion of electric vehicles (EVs) on campus, moving closer to its sustainability goal of a 4.5% share of zero-emission vehicles for personal commute by 2025. One potential constraint to EV usage is the availability of charging stations. UCSC currently has 9 charging portals on campus, all located in the Core West parking structure, and it is clear these facilities will not be sufficient to meet the charging demand as the campus moves towards its 4.5% goal.

This report presents an analysis of trends and patterns in EV usage at UCSC. By understanding the current demand for charging stations and estimating future demand, we can better implement new infrastructure to promote the use of electric vehicles. This can be done by strategically placing charging stations where they are most needed.

The data collected and analyzed in this report shows significant trends in demand, with an increase in the percentage of EVs on campus from 1.0% in 2016 to about 2.0% in 2018. These results mainly come from parking lot surveys and the online surveys sent out by UCSC's Transportation and Parking Service (TAPS). Interestingly, the survey results show that many EV drivers do not charge on campus or only charge occasionally. Most of them charge at home, and

their vehicles have sufficient range to get to and from campus with one full charge. From this we can assume that on-campus chargers provide a service for occasional rather than daily use. Given that not all EV drivers charge on campus, 1 charger for every 5 EVs is a ratio that appears necessary to accommodate EV user needs. As newer EV models are introduced with longer ranges, this ratio may decrease in the future.

## Methods

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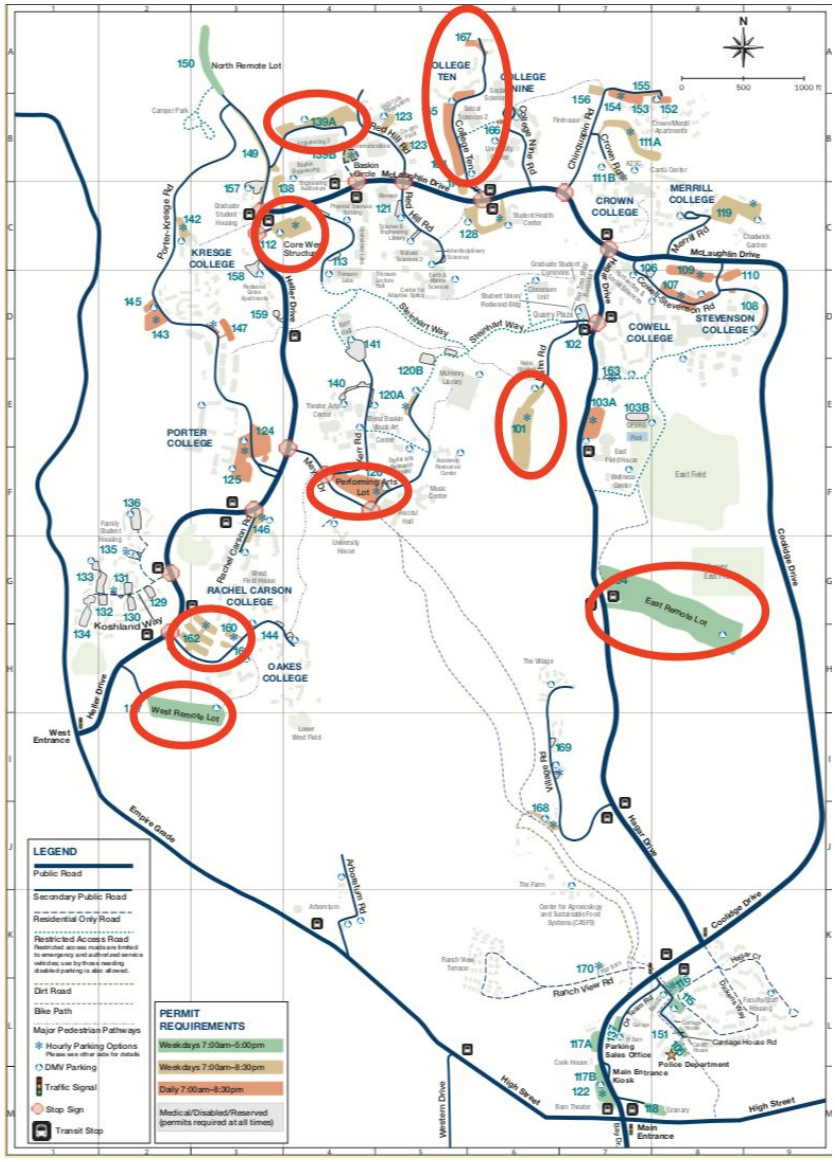
The data for this report was collected through two complementary surveys. First, I surveyed the number of EVs in parking lots on campus. The parking lots that were surveyed (shown in the map below) are: East Remote, West Remote, Parking Lot 160/162 (Rachel Carson College), Parking Lot 126 (Media Theatre), Core West, Parking Lot 165 (College 10), Hahn Student Services, and Engineering. The surveys give the total number of cars and the number of EVs per parking lot. This data will give an estimate as to where EVs are parking on campus. These surveys do not account for visitors. While only a sample of the largest lots was included in the study, it is reasonable to assume that the proportion of EVs is similar elsewhere on campus. To get a better measure of EVs on campus, future studies should include more parking lots in their sample.

Second, to get a better measure of the percentage of EVs on campus, I counted cars exiting and entering at both entrances during peak afternoon times. This data helps strengthen the parking lot survey results for the percentage of EVs on campus.

This report also summarizes data from a 2016 and 2018 EV survey as well as a 2017 travel survey that was sent out through TAPS. Both surveys were distributed to all students, staff and faculty. The EV survey has data on EV users and their habits such as distance traveled to get to campus, type of EV, and charging behavior. The EV survey data can be compared across years to estimate changes in EV use. The 2017 travel survey provides reported data for the trips made to campus by different transportation modes. This data is helpful for understanding commute patterns in a larger scale as well as identifying the percentage of respondents who commute by EV, and comparing the estimate to the lot and campus entrance surveys.

Data was also collected from the current EV charging stations. The stations have built in data analytics software that shows charging behavior – for example, how long EVs are plugged in, how often the stations are used, and when the stations are used. This data helps better understand how many EVs are actually charging on campus and their charging habits. Understanding current usage will help us determine if there is a supply deficit.

The data is presented in a sequence of questions that best show the current demand of EV charging stations. First, we estimate the proportion of EVs on campus by the driver's UCSC affiliation. This estimate is then used to find how many of the EVs on campus actually need to charge. Finally, we look at how the drivers that charge are using the charging facilities. These results are combined to formulate a set of recommendations that will support the expected growth of EVs on campus.




This is a highlighted map of the parking lots that were surveyed for EVs.

# Results

## How Many EVs are on Campus?

Quantifying the number of EVs on campus through lot surveys and counting the cars exiting campus as well as comparing survey responses can be useful for understanding the progress towards the campus sustainability plan. Not only will we look at the number of EVs on campus, but also how often they commute to campus. By combining these data sets we can get a better estimate of the demand for EV charging stations on campus. As shown in Table 1, the percentage of EVs on campus is relatively consistent for both the campus exit counts and the parking lot surveys, at 1.3-1.6%.

For comparison, the 2017 campus transportation survey, also reported in Table 1, shows that 2.3% of vehicle commute trips to campus are by electric vehicle. This result could be biased if EV owners are more likely to respond to the survey.

The EV survey does not enable the fraction of EVs to be determined, because survey respondents were limited to those who own or lease an EV, or were considering it. However, the survey (Table 2) does show upward trends in ownership and usage between 2016 and 2018. In 2018, 121 respondents drove an EV to campus, which is higher than the estimates in Table 1. However, campus commuters come to campus only three days per week on average (Table 3), which gives a figure in line with the data in Table 1 (73 of the 121 vehicles will be on campus on an average weekday).

**Table 1 Campus Exit and Parking Lot Surveys**

| Survey | Main Entrance | West Entrance | Parking Lots | Campus Transportation Survey (2017) |
|---|---|---|---|---|
| EVs counted | 5 | 5 | 36 | 154 |
| Vehicles counted | 393 | 307 | 2,308 | 6,728* |
| Percentage of EVs | 1.3% | 1.6% | 1.6% | 2.3% |
| Total EVs on campus** | 46 | 56 | 56 | 81 |

* Respondents who commuted by single- or multiple-occupant vehicle

** Estimate of the total number of EVs on campus on an average weekday, based on an average of 3,524 parking spaces utilized on campus from Monday to Friday per weekday.

**Table 2 EV Survey**

| EV Survey (2016/2018) | | | 75.63% of EV owners commute to campus |
|---|---|---|---|
| | Number of EV drivers | Number of EV drivers to campus | |
| 2016 | 827 | 20 | |
| 2018 | 124 | 87 | |

**Table 3 EV Trips to Campus (EV Survey)**

Table 3 shows a large percentage of EV drivers commute less than once a week to campus and less than half commute everyday. This could drive down the demand for charging stations since there will be less EVs on campus even if EV ownership increases.

| How often do you drive your EV to campus? (EV Survey) | | |
|---|---|---|
| Year | 2018 | 2016 |
| Everyday | 52 (36.9%) | 39 (38.2%) |
| 4 days a week | 18 (12.8%) | 11 (10.8%) |
| 3 days a week | 17 (12.1%) | 15 (14.7%) |
| 2 days a week | 15 (10.6%) | 12 (11.8%) |
| Once a week | 8 (5.7%) | 6 (5.9%) |
| > once a week | 31 (22%) | 19 (18.6%) |

## Analysis

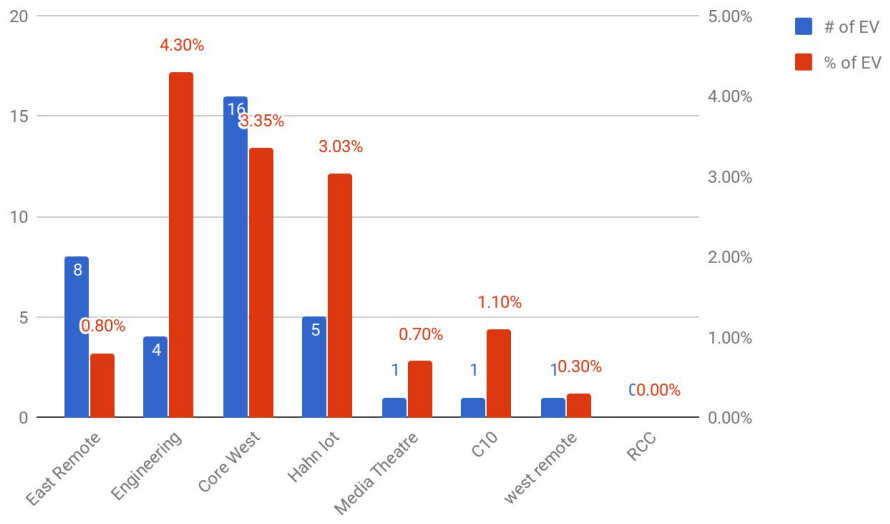
The increase in EVs reported from the data may be lower than the overall increase in EV ownership since not all EV owners commute to campus. Also, It is important to consider that this data does not account for visitors which might be more likely to use chargers depending on where they are commuting from. Overall, the key takeaway here is that on an average day we can expect 53 EVs on campus parking lots and 1.5% of trips made to campus are EV trips.

## Who is Driving EV to Campus?

Understanding who drives to campus will be useful in determining who needs to charge and where to install new charging stations. Comparing the results from the lot surveys across parking lots can give us insight as to who is driving by connecting parking permits to parking lots. Also, responses from the EV and transportation survey give us reported data as to who drives an EV.

### Lot Surveys

**Figure 1 Parking Lot Surveys**




The lot surveys show that the Engineering lot (restricted to "A" permit holders) had the largest percentage of EVs even though it has the smallest number of parking spots. This indicates that staff and faculty (table4) own the most EVs.

**Table 4 Parking Permits**

| Permit type | Eligibility | Parking lots surveyed |
|---|---|---|
| A | Staff/Faculty | All, but most permit holders use Engineering & Core West |
| B | Staff/Faculty, Graduate students | All, mainly Engineering, Core West & Hahn |
| C | Staff/Faculty, Eligible undergraduate students | RCC, Remote lots, Hahn, Core West, Media Theatre |
| R | Eligible students, Staff Faculty | Remote lots |

**Table 5 EV Commuters by Affiliation (Transportation Survey 2017)**

| Transportation Survey - Number of EV commuters | | |
|---|---|---|
| Faculty/Staff | 238 | 3.85% |
| Students | 31 | 0.3% |

## Analysis

Engineering had the largest percentage of EVs, followed by Core West and the Hahn lot. Given that staff and faculty mainly park in Engineering and Core West, we can assume they are the ones driving EVs to campus. Although there is an exception that allows R permit holders to park in Core West if they are plugged in to a charger, this only accounts for a small number of users.

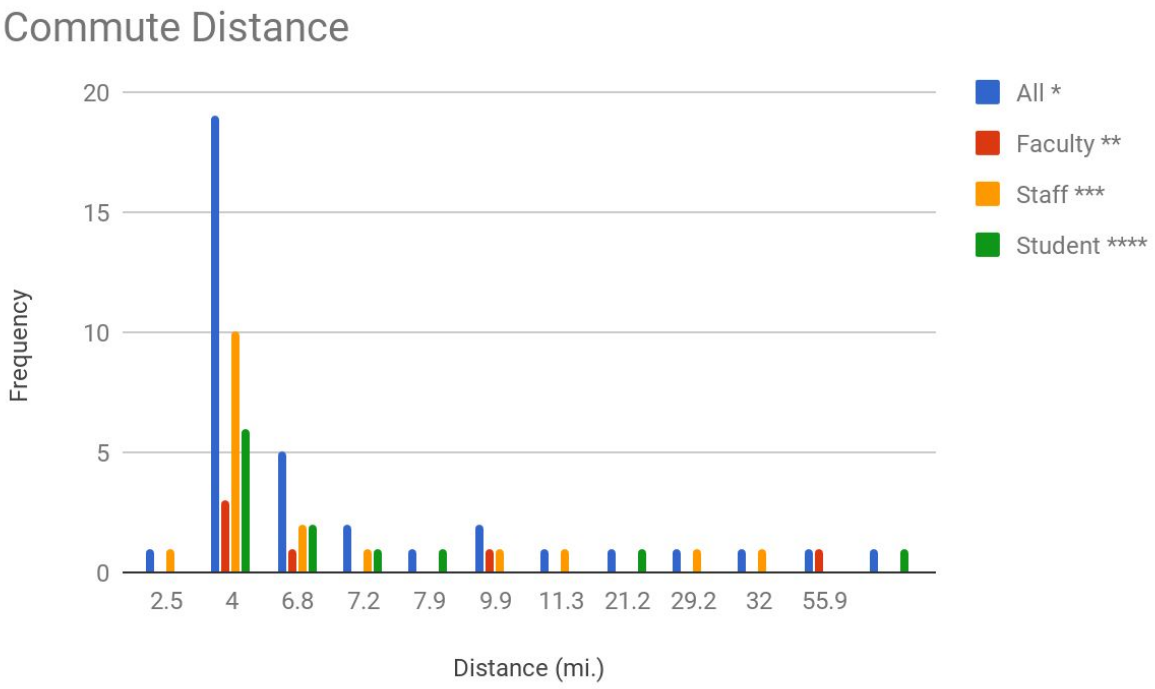
Other data also supports faculty and staff being the main EV users. The transportation survey results shows that faculty and staff have a higher percentage of EV commuters than students. One explanation for this is that many students live on campus and don't own a car. Also, EVs are relatively expensive making them less accessible to students, but as prices fall and students become more aware of discounts, this could change in the future.

## How Many Need to Charge?

Now that we have a general understanding of how many EVs are on campus and who is driving them, we can estimate how many vehicles need to charge on campus. As shown in the previous sections, a large percentage of EV users do not drive to campus daily and therefore do not need to charge. The EV survey will give us further information on charging habits. By combining the frequency with which EV drivers commute to campus, how often they charge on campus, their commute distance, and battery range we can obtain an estimate of how many drivers actually need to charge.

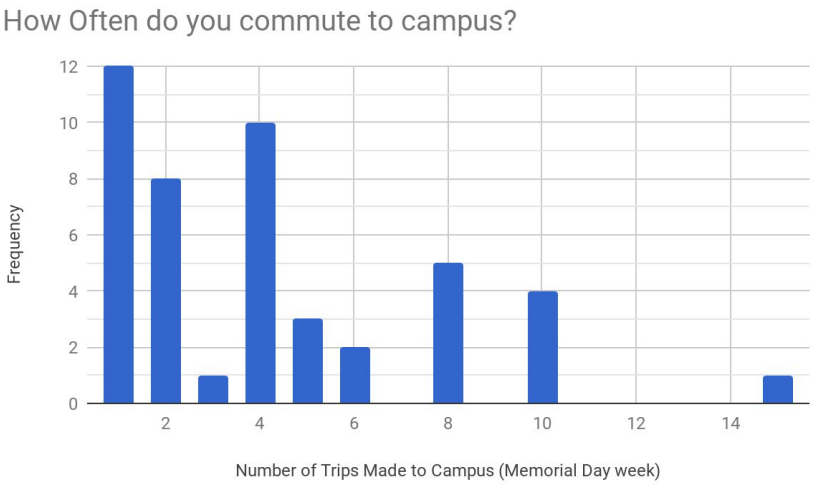
An important consideration in determining on-campus charging needs is the average commute distance to campus. According to the 2017 transportation survey, the one-way distance for EV drivers is 5.1 miles (6.2 miles for faculty and staff, and 5.5 miles for students), as shown in Table 7. This is consistent with the EV survey (Figure 2), which shows that more than half of respondents drive fewer than 10 miles to commute to campus.

**Figure 2 EV Trip Length (Transportation Survey)**




*EV Drivers average commute distance: 5.1 mi.
**Staff Average: 5.2 mi.
***Faculty Average: 4 mi.
****Students Average: 5.5 mi.

**Figure 3 Weekly EV commutes to Campus**




From the transportation survey (Figure 2), we can see that the majority of EV commuters are traveling at distances well within their EV range. The most common model of EV used to commute to campus, the Nissan Leaf (table 10), has a roundtrip range of at least 75 miles (Table 11), which permits a commute from as far away as San Jose or Gilroy (Figure 3). The exception is a minority (<15%) of commuters that travel longer distances, and will most need the EV chargers. Also, there are a large proportion of respondents that commute to UCSC less than 3 times a week (Figure 3), decreasing their need to charge on campus.

Not surprisingly, 40% of EV users never charge on campus, and only a small proportion (7.5%) charge on a daily basis (Table 9). In a typical week, on-campus charging facilities are used by fewer than 40 unique drivers, a figure which includes visitors. Given that campus chargers currently cost $1 per hour, it is more cost-effective for users to charge at home where possible.

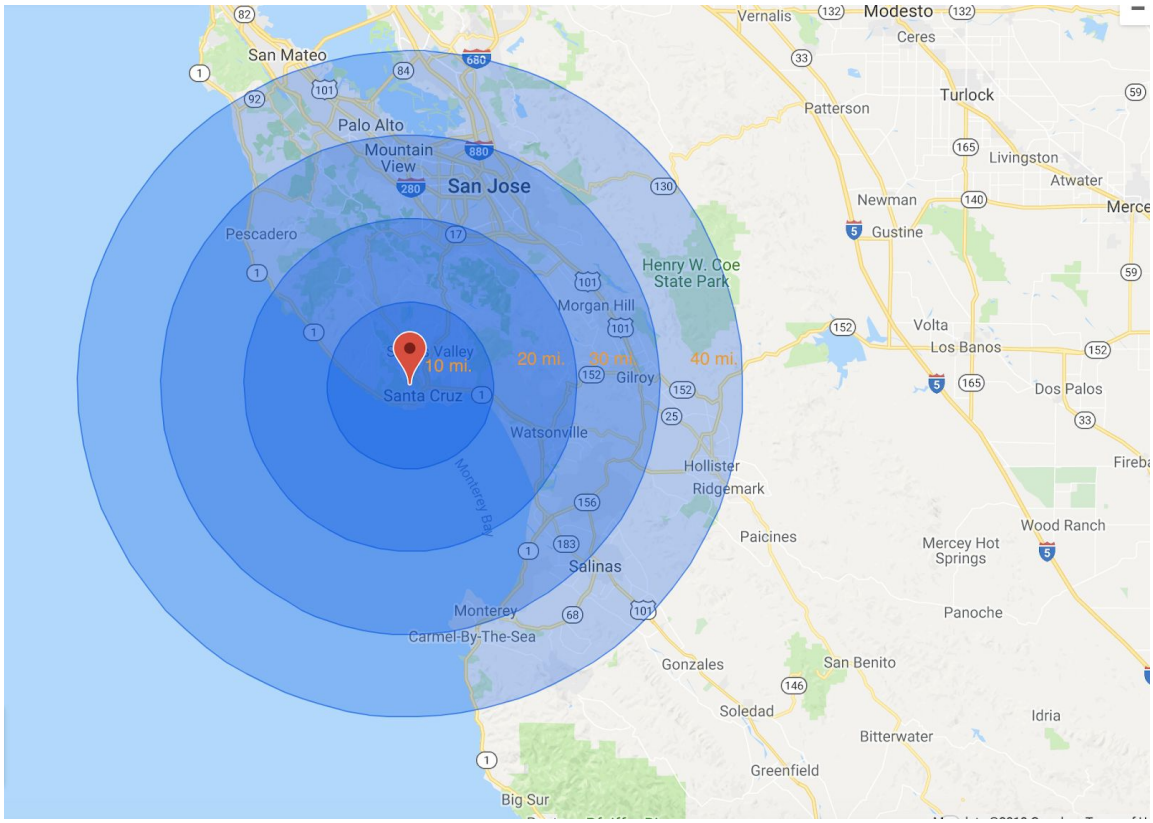
**Table 6 EV Type (EV Survey)**

| Year | 2018 | 2016 |
|---|---|---|
| Plug-in Hybrid | 55 (63.1%) | 37 (34.3%) |
| All-electric | 95 (36.9%) | 71 (65.7%) |

**Table 7 EV Commute Distance to Campus (EV Survey)**

| Year | 2018 | 2016 |
|---|---|---|
| <10 mi. | 76 (54.7%) | 45 (44.1%) |
| 10-20 mi. | 33 (23.7%) | 22 (21.6%) |
| 20-30 mi. | 7 (5%) | 10 (9.8%) |
| 30-40 mi. | 8 (5.8%) | 11 (10.8%) |
| > 40 mi. | 15 (10.8%) | 14 (13.7%) |

**Figure 3 Map Outlying Commute Distances**




*The distances shows are 10 mi., 20 mi., 30mi., and 40 mi.

**Table 8 Weekly Charging Usage (EV Survey 2018)**

| How often do you charge on campus? | | |
|---|---|---|
| Daily | 10 | 7.5% |
| Four days a week | 3 | 2.3% .0184 1.84 |
| Three days a week | 7 | 5.3% 0.0318 3.18 |
| Two days a week | 10 | 7.5% .03 3 |
| Once a week | 13 | 9.8% .0196 1.96 |
| Less than once a week | 37 | 27.8% .0139 |
| Never | 53 | 39.8% |

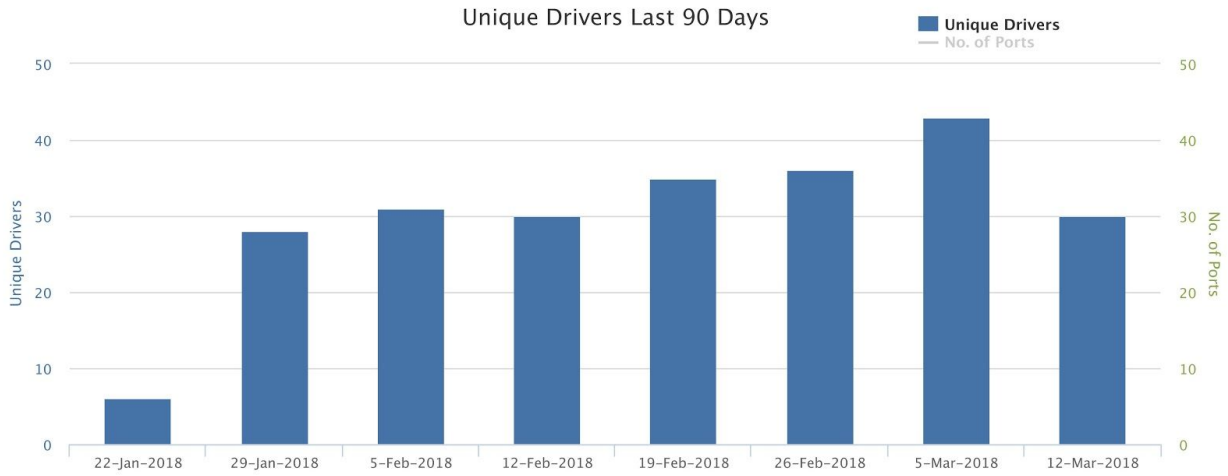
**Table 9 Charging Location (EV Survey 2018)**

| Where is your primary location for charging your EV? | | |
|---|---|---|
| Home | 106 | 79.1% |
| UCSC Main Campus | 12 | 9% |
| Other public charging stations | 16 | 11.9% |

**Table 10 EV Models (EV Survey 2018)**

| EV models on campus | | |
|---|---|---|
| Model | Count | Range |
| Nissan Leaf | 37 | 75-190 mi. |
| Chevy Volt | 29 | 238 mi. (gas and battery) |
| Chevy Spark | 1 | 132 mi. |
| BMW i3 | 8 | 114 mi. |
| Ford C-Max | 13 | 600 mi. (gas + battery) |
| Toyota Prius | 13 | 11 mi. (battery only) |
| Tesla | 13 | 335 mi. |
| Kia Soul EV | 1 | 110 mi. |
| VW E-Golf | 11 | 118 mi. |
| Audi E-Tron | 2 | 16 mi. (battery only) |
| Fiat e500 | 4 | 90 mi. |
| Chrysler Pacifica | 1 | 33 mi. (battery only) |

**Figure 4 Unique Drivers Using Charging Station (Chargepoint)**




Average of 30 unique drivers. It is important to consider the average because some of these users could be visitors.

## Analysis

### EV:Charger Ratio

According to the surveys reported in Table 1, 1.5% of 3,524 daily occupied parking spaces are EVs, and there is an average of 53 EVs parked on campus daily. From these 53 EVs, only 60% use the chargers, and most of these people do not charge every day. From Table 8, the average user charges on 18% of weekdays – less than once a week – and thus the nine chargers installed on campus should be able to meet current demand, given that charging typically takes three hours or less.

However, survey responses and charging data show that chargers are frequently fully occupied. Many survey respondents (27.9%) report that they frequently find chargers occupied (Table 13), and full capacity is reached at peak times on an average weekday (Figure 8). This is likely to be for two main reasons: (i) a concentrated pattern of demand, with chargers fully occupied at peak hours but underutilized for most of the day; and (ii) demand from visitors.

Given that nine chargers are barely meeting demand from the current 53 EVs on campus, I recommend a ratio of 1 charger: 5 EVs, suggesting a supply deficit of one charger.

## How Are Current Charging Stations Used?

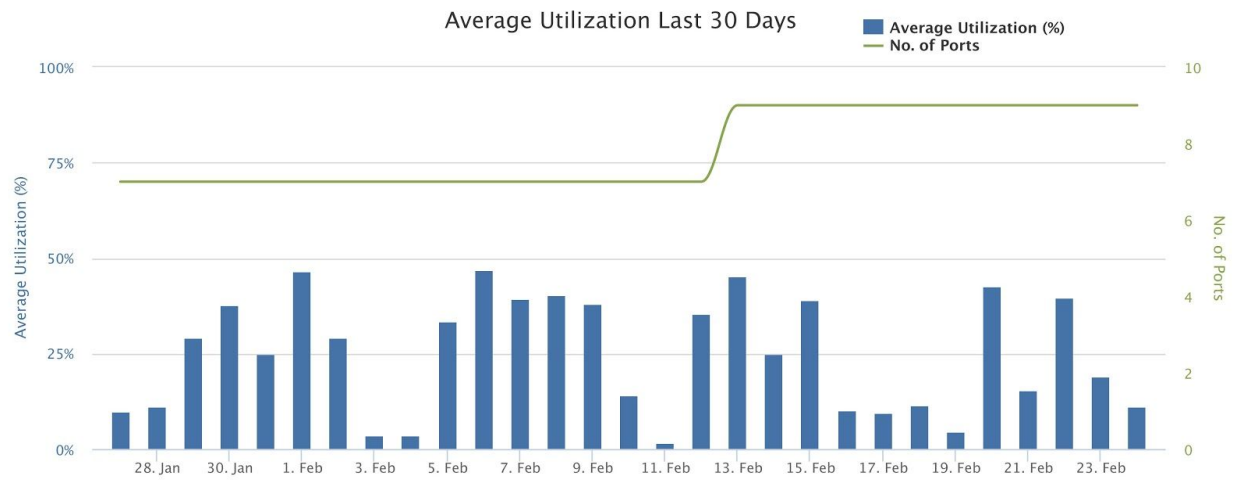
Understanding how current charging stations are being used will give us further insight into the desired charger to EV ratio. It might not be the case the more chargers are needed, but instead better regulation and pricing of charger use. Survey results and data from ChargePoint will be used to analyse current use habits.

## Survey results

**Table 11 Weekly Commute Trips to Campus (EV Survey)**

| Year | 2018 | 2016 |
|---|---|---|
| Daily | 10 (7.5% ) | 10 (10.6%) |
| Four days a week | 3 (2.3%) | 2 (2.1%) |
| Three days a week | 7 (5.3%) | 6 (6.4%) |
| Two days a week | 10 (7.5%) | 10 (10.6%) |
| Once a week | 13 (9.8%) | 9 (9.6%) |
| Less than once a week | 37 (27.8%) | 22 (23.4%) |
| Never | 53 (39.8%) | 35 (37.2%) |

**Figure 5 Weekly Utilization of Campus Charging Stations (Chargepoint)**

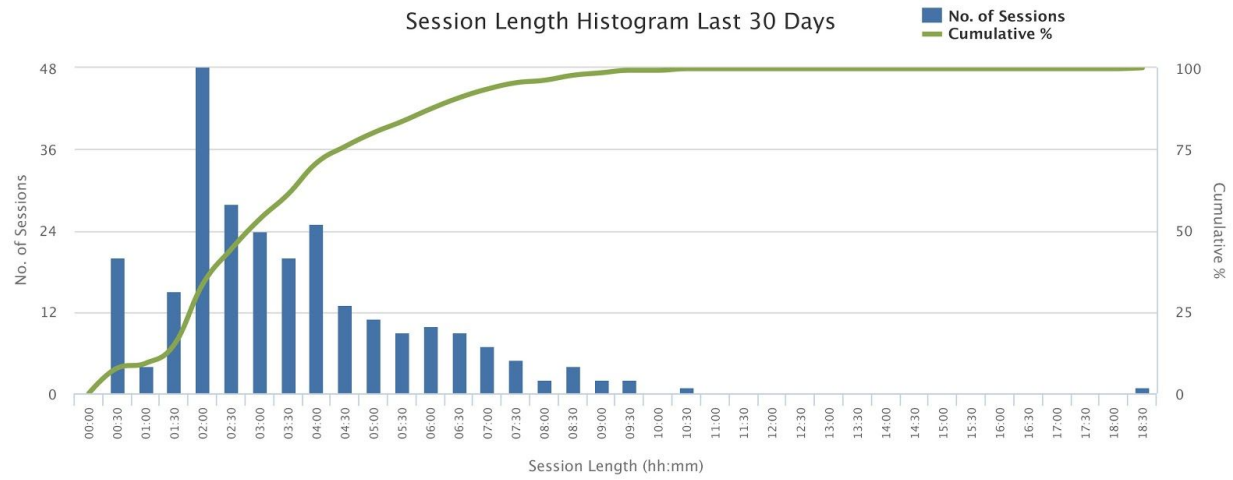



This graph shows a significant decrease in utilization on the weekends which makes sense since there are no classes and, consequently, less traffic on campus.

**Table 12 Charging Session Lengths**

| Year | 2018 | 2016 |
|---|---|---|
| More than four hours | 23 (21.5%) | 16 (21.9%) |
| Three hours | 32 (29.9%) | 20 (27.4%) |
| Two hours | 20 (18.7%) | 19 (26%) |
| One hour | 9 (8.4%) | 5 (6.8%) |
| > one hour | 23 (21.5%) | 13 (17.8%) |

**Figure 6 Charging Sessions Lengths (Chargepoint)**



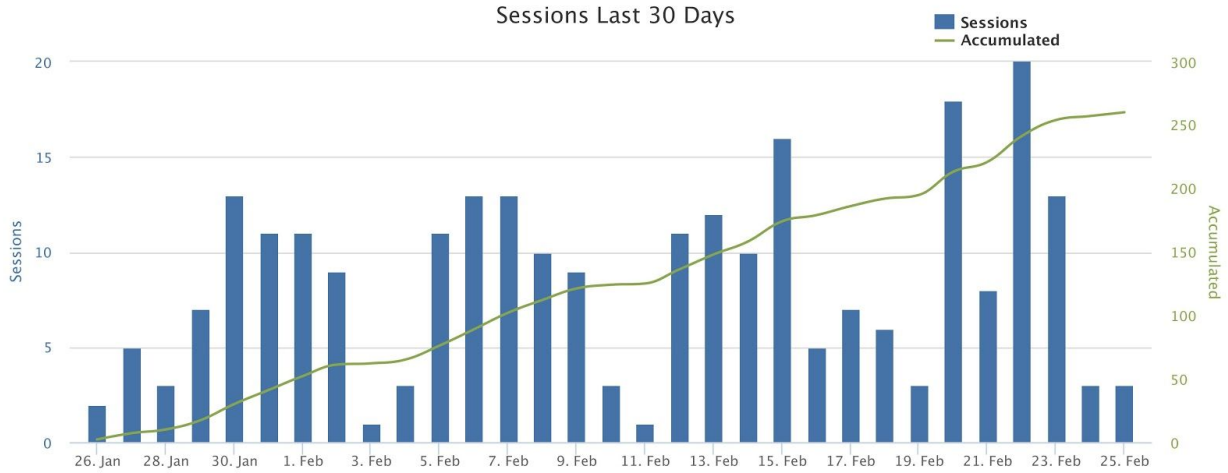

Average session length = 03 hr 18 min 59 sec

From the survey results and the chargepoint data, users are charging for longer than they need. Given that most drivers only commute about 20-30 miles, 3 hours is more than enough time to get enough charge to make it back home. This could be a reason as to why some are finding a the chargers occupied.

**Table 13 How Often Have you Found All charges occupied? (EV Survey)**

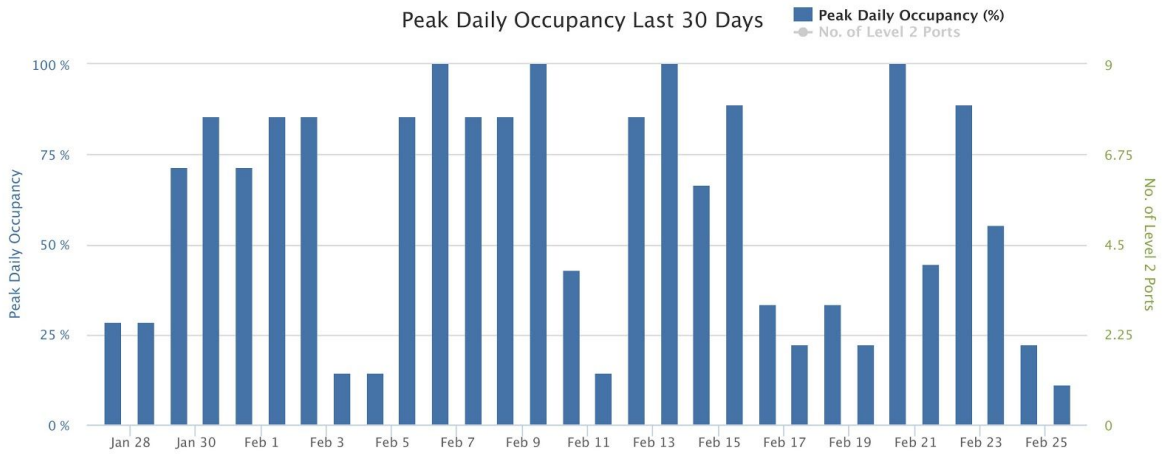
| Year | 2018 | 2016 |
|---|---|---|
| Frequently | 31 (27.9%) | 22 (28.3%) |
| Sometimes | 18 (16.2%) | 16 (20.5%) |
| Occasionally | 16 (14.4%) | 15 (19.2%) |
| Rarely | 22 (19.8%) | 11 (14.1%) |
| Never | 24 (21.6%) | 14 (17.9%) |

**Figure 7 Number of Charging Sessions (Chargepoint)**




Max 68 sessions reported from the charging station reports.

**Figure 8 Peak Daily Occupancy (Chargepoint)**




From this graph we only see 100% peak daily occupancy on certain days. We can assume these days are when users are finding the chargers occupied and when schedules line up so that there's more EVs on campus.

**Table 14 Individual Who Use Campus as Their Main Charging Source (EV Survey 2018)**

| Which of the following best describes your affiliation with UCSC | How often do you charge your EV at your UCSC site? | How far do you drive to reach UCSC? | Where do you live? |
|---|---|---|---|
| Faculty | Four days a week | 20-30 miles | Off campus |
| Faculty | Three days a week | Fewer than 10 miles | On campus |
| Grad student | Three days a week | 10-20 miles | Off campus |
| Staff | Two days a week | 10-20 miles | Off campus |
| Staff | Less than once a week | Fewer than 10 miles | Off campus |
| Staff | Daily | Fewer than 10 miles | Off campus |
| Staff | Less than once a week | Fewer than 10 miles | Off campus |
| Staff | Daily | 10-20 miles | Off campus |
| Staff | Four days a week | Fewer than 10 miles | Off campus |
| Staff | Two days a week | Fewer than 10 miles | Off campus |
| Undergrad | Three days a week | Fewer than 10 miles | On campus |
| Undergrad | Once a week | More than 40 miles | On campus |

Table 14 represents the 9% of individuals who reported UCSC's main campus as their primary charging source. From this we can see present demand for residential chargers for on-campus residents who drive EVs. To facilitate their charging needs, charging outlets can be installed in college parking lots. Although there are few on-campus residents in this graph, the projected increase in enrollment could drive up this demand with more freshmen and transfer students.

## Analysis

Currently there are 9 charging stations on campus located in the Core West parking lot, and they are available to all EV users regardless of the type of parking permit that they hold. The data shows that not many people are charging on campus but the stations are still highly utilized. One explanation for this could be the average length of each charging session (3 hrs); about 50% reported charging for 3 hours or more. With such long charging sessions, we can expect people to find the chargers occupied as shown by the EV survey responses.

One way to combat this issue is by implementing tiered pricing that increases the rate after a vehicle has finished charging (encouraging users to move their car to a regular parking space) or during peak hours (encouraging off-peak use). Pricing strategies could help accommodate an increase in EV usage on campus, without increasing demand for charging stations.

## Demand Trends

**Figure 9 Yearly Increase in Unique Users on Campus (Chargepoint)**

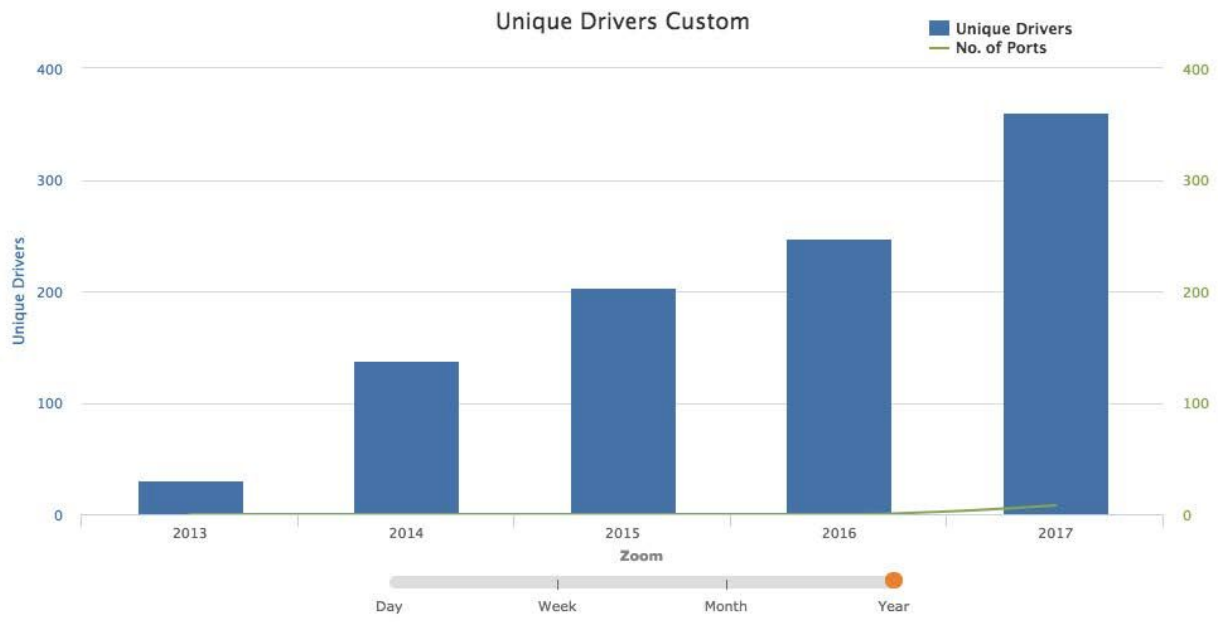
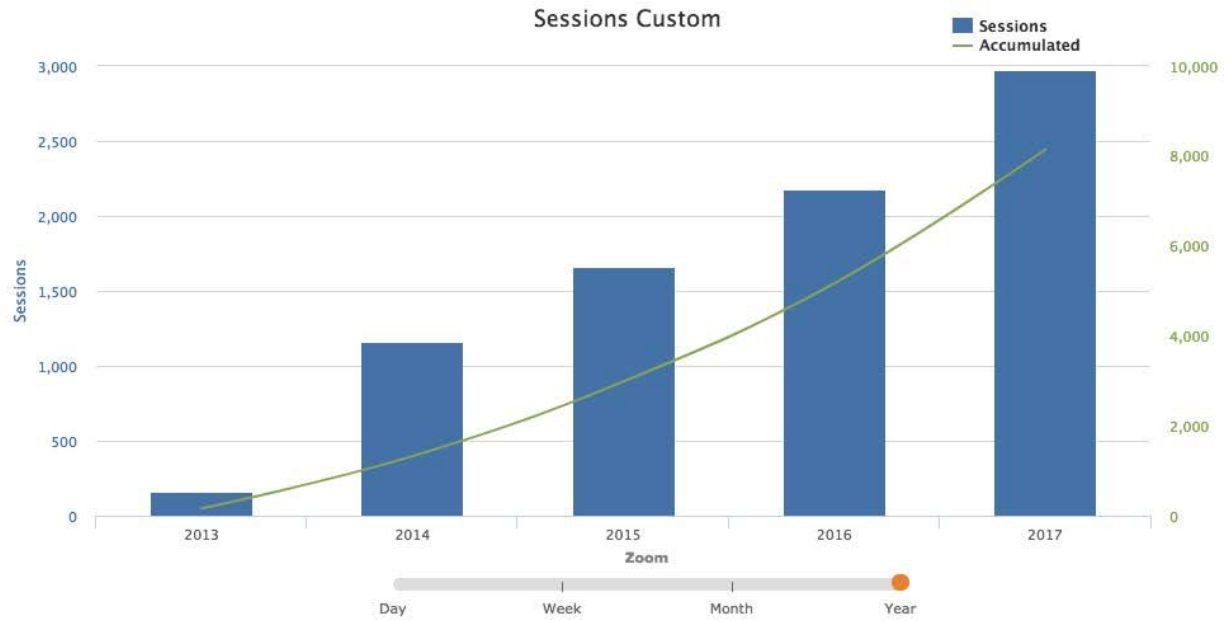



**Figure 10 Yearly Increase in Number of Charging Sessions (Chargepoint)**




## Analysis

The data presented earlier in this report shows that electric vehicle usage has increased over the past years and is now surpassing the 1% mark and approaching 2%. With this in consideration, charging station demand has also increased as shown by the increase in unique drivers and the number of sessions (Figures 9 and 10).

# Summary and Recommendations

The UCSC sustainability plan aims to increase the percentage of EVs commuting to campus to 4.5% by 2025. To accomplish this goal, the availability of charging facilities must be maintained. Even though most EV users do not need to charge on campus on a typical day, charging facilities can accommodate longer-distance commuters, and special circumstances such as continuing on a longer trip before or after work as well as visitors.

If electric vehicle usage is to increase further, there must be more charging stations on campus to accommodate the increasing charging demand. The lot surveys and the transportation survey show faculty and staff as the group most likely to own an electric vehicle (table 5), with 3.85% of the staff and faculty owning an EV compared to 0.3% of students owning an EV. Overall, the demand for charging station on campus can be yielded from the 9 available chargers and the ~53 EVs that park on campus and the 1charger:5EVs necessary ratio found earlier. These numbers imply that there is a shortage of one charging station on campus and this can further be seen with percentage of users that find charges occupied (table 13: frequently=27.9%, sometimes = 16.2%). From this we can conclude that in order to promote the use of electric vehicles on campus there must be more charging stations available on campus to supply the growing demand. With this in mind, it might be beneficial to install charging station in mainly staff parking lots since they yield the highest demand based on the percent ownership of electric vehicles. This approach may discourage students from owning electric vehicles or reduce their accessibility to chargers for those that already own EV. Taking this into consideration, Hahn lot may be a better place for new charging stations since both students and faculty park there and the existing charger at Core West will be more available for faculty since students with R permits won't be using them for long hours just to be able to park closer to class.

I make the following recommendations to maintain charging availability:

1. **Install more charging stations** to accommodate the expected increase in charging demand. A ratio of 1 charger for every 5 EVs is recommended. This ratio results from EV drivers not commuting to campus everyday and of those that do commute, only 60% reported they use the chargers.
2. **Install charging stations in the Hahn and/or OPERS lots.** Currently, all chargers are in the Core West parking structure, which mainly accommodates faculty, staff and graduate students (A and B permits). R permit holders are allowed to use the chargers in Core West, as long as they are plugged in, which may encourage R permit holders to occupy

chargers simply to obtain parking in close proximity to classes. Therefore, new chargers should be installed in the Hahn or OPERS lots, where paystations are available, allowing the Core West chargers to be more available to staff and faculty who have the highest rates of EV ownership, and serving all commuters who work on the east side of campus

3. **Install outlets for trickle charging.** Another consideration for installing new chargers is the expected growth in demand for residential charging with the expected increase in enrollment. To promote residential charging, outlets should be made available for EV users at residential parking lots –college lots, family housing, or east remote. With these outlets available, EV users could trickle-charge overnight as long as they have their own charger.
4. **Use prices to promote availability.** A final recommendation to improve charger availability is to install modest tiered pricing that would increase the rate once the EV battery is fully charged, and/or charge higher rates at peak times. This will make current chargers more available by decreasing the time spent plugged in.

Overall, the current 9 charging station are marginally meeting the current demand and could not accommodate an increase in EV drivers to campus. A quick solution is to install tiered pricing to prevent users from occupying chargers for longer than needed but this should be followed by installing new chargers in the lots mentioned to support and promote future EV ownership.

## Acknowledgements

Thanks to the Campus Sustainability Plan Grant program for funding support, and to Teresa Buika and Larry Pageler for providing data and for helpful input and comments. Finally, a special thanks to Adam Millard-Ball for facilitating this study and guiding the development of this report.

# Appendix

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Parking Lot Surveys

| Parking Lot | # of total cars | # of EV | % of EV |
|---|---|---|---|
| East Remote | 952 | 8 | 0.80% |
| Engineering | 93 | 4 | 4.30% |
| Core West | 477 | 16 | 3.35% |
| Hahn's | 165 | 5 | 3.03% |
| Media Theatre | 142 | 1 | 0.70% |
| C10 | 89 | 1 | 1.10% |
| west remote | 293 | 1 | 0.30% |
| RCC | 107 | 0 | 0% |

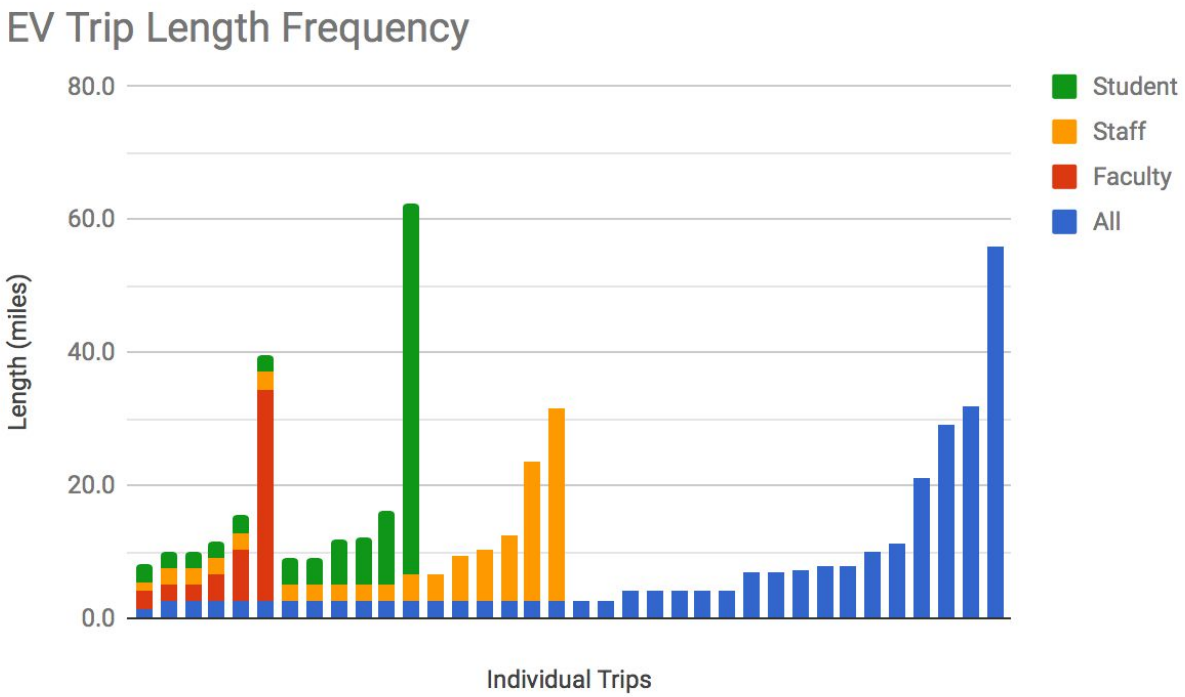
Exit Counts

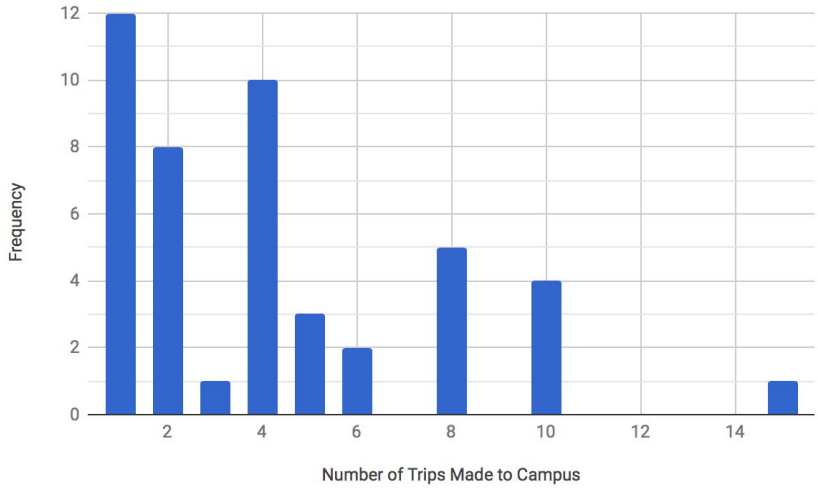
| | | |
|---|---|---|
| West Exit | 5 EVs | 307 total cars |
| Hagar Drive | 5 EVs | 307 total cars |

Transportation Survey (2017)

| Transportation Survey (2017) | |
|---|---|
| Commute Trips (SOV, MOV) | 45.28% (6,728) |
| EV Trips | 0.92% (154) |
| Unique EV Drivers (full electric + hybrid) | 53 |

| Transportation Survey - Number of EV commuters | | |
|---|---|---|
| Faculty/Staff | 238 | 3.85% |
| Students | 31 | 0.3% |




Electric Vehicle Survey 2018/2016

| EV Survey (2016/2018) | | | | 75.63% of EV owners commute to campus |
|---|---|---|---|---|
| | Do you drive an EV? | Do you drive your EV to campus? | Do you commute to the main campus? | |

| Year | 2016 | 2018 | 2016 | 2018 | 2018 | |
|---|---|---|---|---|---|---|
| No | 827 | 727 | 20 | 26 | 16 | |
| Yes | 124 | 160 | 87 | 121 | 124 | |

| How often do you drive your EV to campus? (EV Survey) | | |
|---|---|---|
| Year | 2018 | 2016 |
| Everyday | 52 (36.9%) | 39 (38.2%) |
| 4 days a week | 18 (12.8%) | 11 (10.8%) |
| 3 days a week | 17 (12.1%) | 15 (14.7%) |
| 2 days a week | 15 (10.6%) | 12 (11.8%) |
| Once a week | 8 (5.7%) | 6 (5.9%) |

What Type of EV do you Drive?

| Year | 2018 | 2016 |
|---|---|---|
| Plug-in Hybrid | 55 (63.1%) | 37 (34.3%) |
| All-electric | 95 (36.9%) | 71 (65.7%) |

Do you charge at your UC site?

| Year | 2018 | 2016 |
|---|---|---|
| Yes | 58 (44.3%) | 47 (50%) |
| No | 73 (55.8%) | 47 (50%) |

| How far do you drive to reach UCSC? (EV survey) | | |
|---|---|---|
| Year | 2018 | 2016 |
| <10 mi. | 76 (54.7%) | 45 (44.1%) |

| | | |
|---|---|---|
| 10-20 mi. | 33 (23.7%) | 22 (21.6%) |
| 20-30 mi. | 7 (5%) | 10 (9.8%) |
| 30-40 mi. | 8 (5.8%) | 11 (10.8%) |
| > 40 mi. | 15 (10.8%) | 14 (13.7%) |

How often do you charge on campus?

| | | |
|---|---|---|
| Daily | 10 | 7.5% |
| Four days a week | 3 | 2.3% |
| Three days a week | 7 | 5.3% |
| Two days a week | 10 | 7.5% |
| Once a week | 13 | 9.8% |
| Less than once a week | 37 | 27.8% |
| Never | 53 | 39.8% |

| Where is your primary location for charging your EV? | | |
|---|---|---|
| Home | 106 | 79.1% |
| UCSC Main Campus | 12 | 9% |
| Other public charging stations | 16 | 11.9% |

| EV models on campus (EV survey 2018) | | |
|---|---|---|
| Model | Count | Range |
| Nissan Leaf | 37 | 75-190 mi. |
| Chevy Volt | 29 | 238 mi. (gas and battery) |

| | | |
|---|---|---|
| Chevy Spark | 1 | 132 mi. |
| BMW i3 | 8 | 114 mi. |
| Ford C-Max | 13 | 600 mi. (gas + battery) |
| Toyota Prius | 13 | 11 mi. (battery only) |
| Tesla | 13 | 335 mi. |
| Kia Soul EV | 1 | 110 mi. |
| VW E-Golf | 11 | 118 mi. |
| Audi E-Tron | 2 | 16 mi. (battery only) |
| Fiat e500 | 4 | 90 mi. |
| Chrysler Pacifica | 1 | 33 mi. (battery only) |

How often do you charge on campus?

| Year | 2018 | 2016 |
|---|---|---|
| Daily | 10 (7.5% ) | 10 (10.6%) |
| Four days a week | 3 (2.3%) | 2 (2.1%) |
| Three days a week | 7 (5.3%) | 6 (6.4%) |
| Two days a week | 10 (7.5%) | 10 (10.6%) |
| Once a week | 13 (9.8%) | 9 (9.6%) |
| Less than once a week | 37 (27.8%) | 22 (23.4%) |
| Never | 53 (39.8%) | 35 (37.2%) |

| On average, how long does your EV stay plugged in when you charge at your UCSC site? | | |
|---|---|---|
| Year | 2018 | 2016 |
| More than four hours | 23 (21.5%) | 16 (21.9%) |

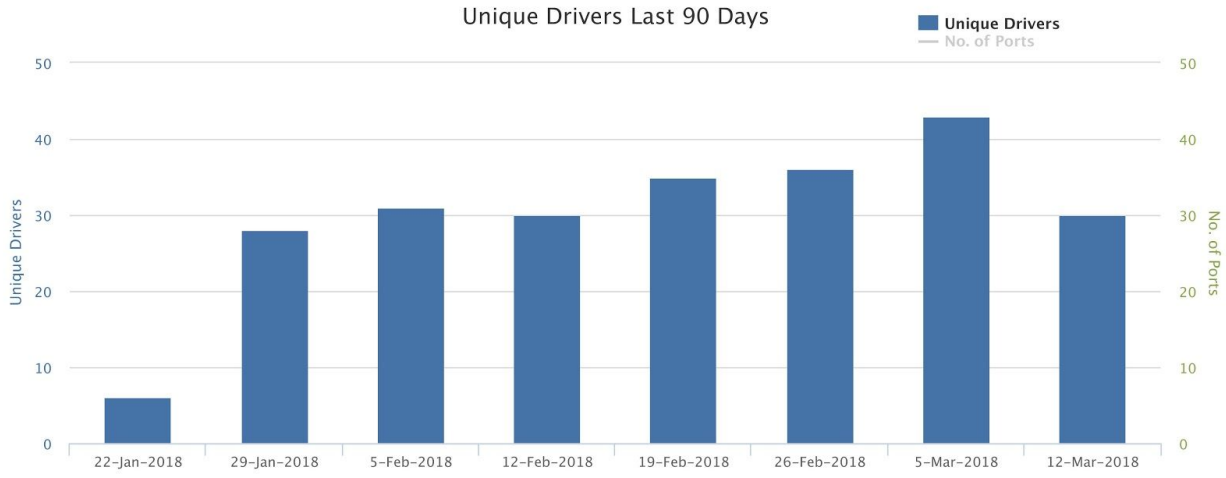
| | | |
|---|---|---|
| Three hours | 32 (29.9%) | 20 (27.4%) |
| Two hours | 20 (18.7%) | 19 (26%) |
| One hour | 9 (8.4%) | 5 (6.8%) |
| > one hour | 23 (21.5%) | 13 (17.8%) |

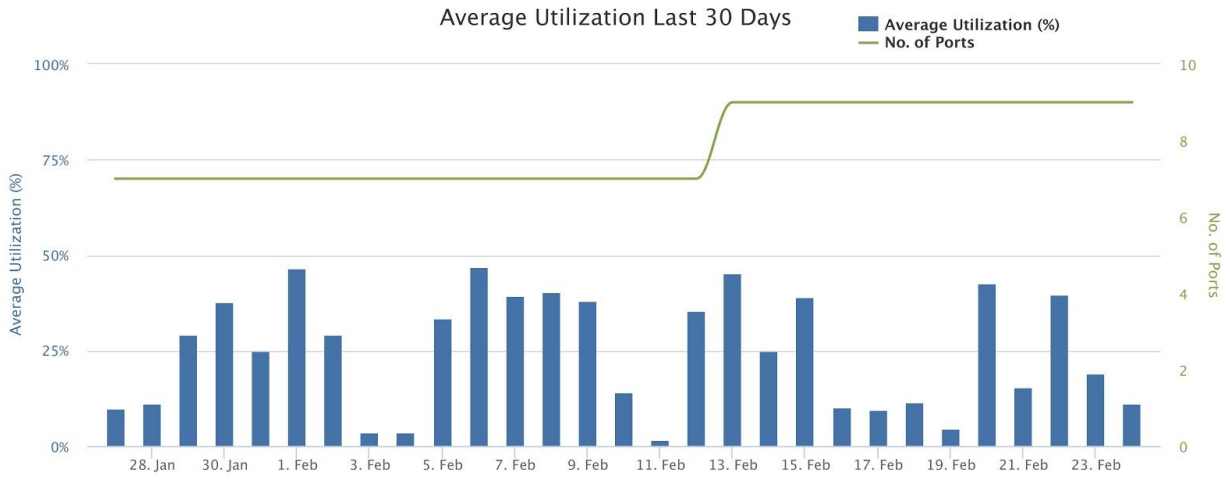
| How often have you found all the EV chargers full or in use when you arrive? | | |
|---|---|---|
| Year | 2018 | 2016 |
| Frequently | 31 (27.9%) | 22 (28.3%) |
| Sometimes | 18 (16.2%) | 16 (20.5%) |
| Occasionally | 16 (14.4%) | 15 (19.2%) |
| Rarely | 22 (19.8%) | 11 (14.1%) |
| Never | 24 (21.6%) | 14 (17.9%) |

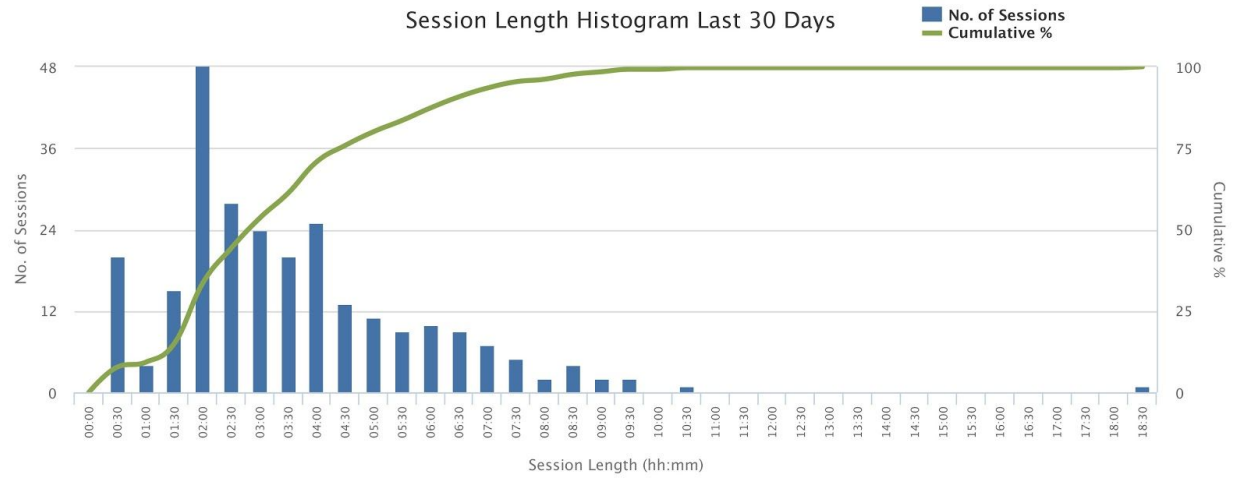
| People who's primary charging location is UCSC main campus | | | |
|---|---|---|---|
| Which of the following best describes your affiliation with UCSC: | How often do you charge your EV at your UCSC site? | How far do you drive to reach UCSC? | Where do you live? |
| Faculty | Four days a week | 20-30 miles | Off campus |
| Faculty | Three days a week | Fewer than 10 miles | On campus |
| Grad student | Three days a week | 10-20 miles | Off campus |
| Staff | Two days a week | 10-20 miles | Off campus |
| Staff | Less than once a week | Fewer than 10 miles | Off campus |
| Staff | Daily | Fewer than 10 miles | Off campus |
| Staff | Less than once a week | Fewer than 10 miles | Off campus |

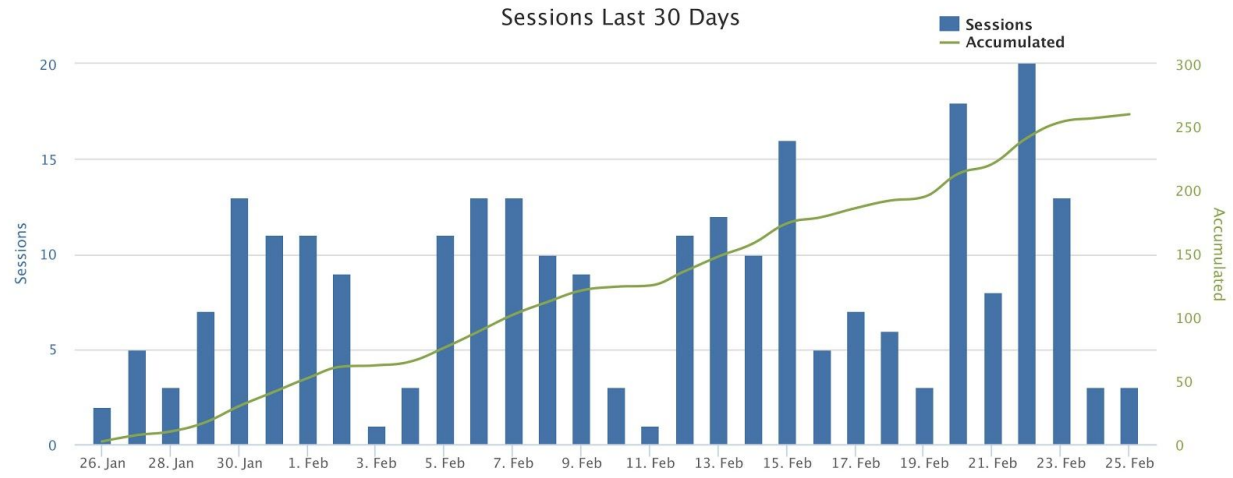
| | | | |
|---|---|---|---|
| Staff | Daily | 10-20 miles | Off campus |
| Staff | Four days a week | Fewer than 10 miles | Off campus |
| Staff | Two days a week | Fewer than 10 miles | Off campus |
| Undergrad | Three days a week | Fewer than 10 miles | On campus |
| Undergrad | Once a week | More than 40 miles | On campus |

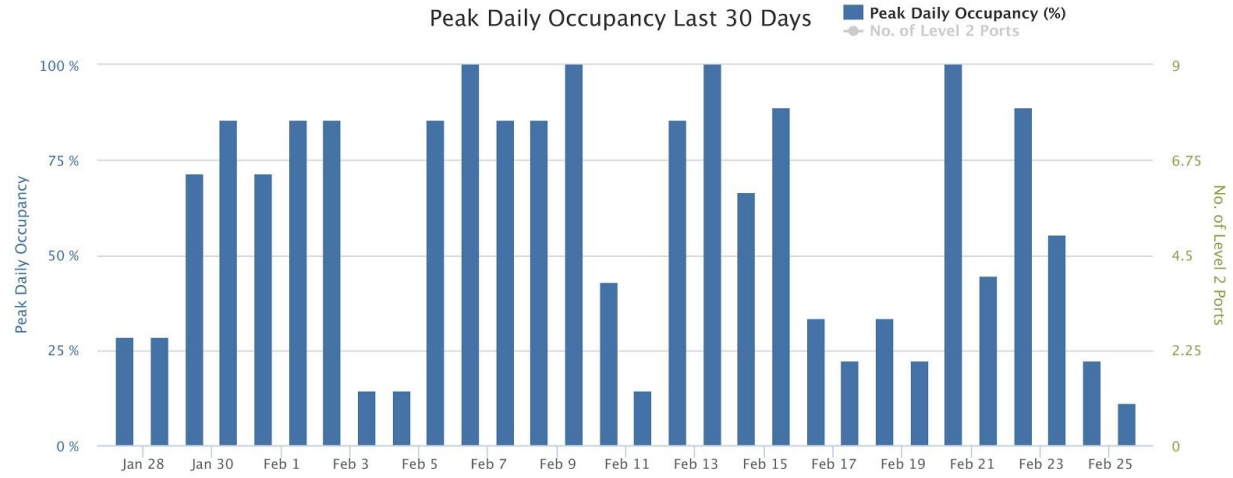
## Chargepoint

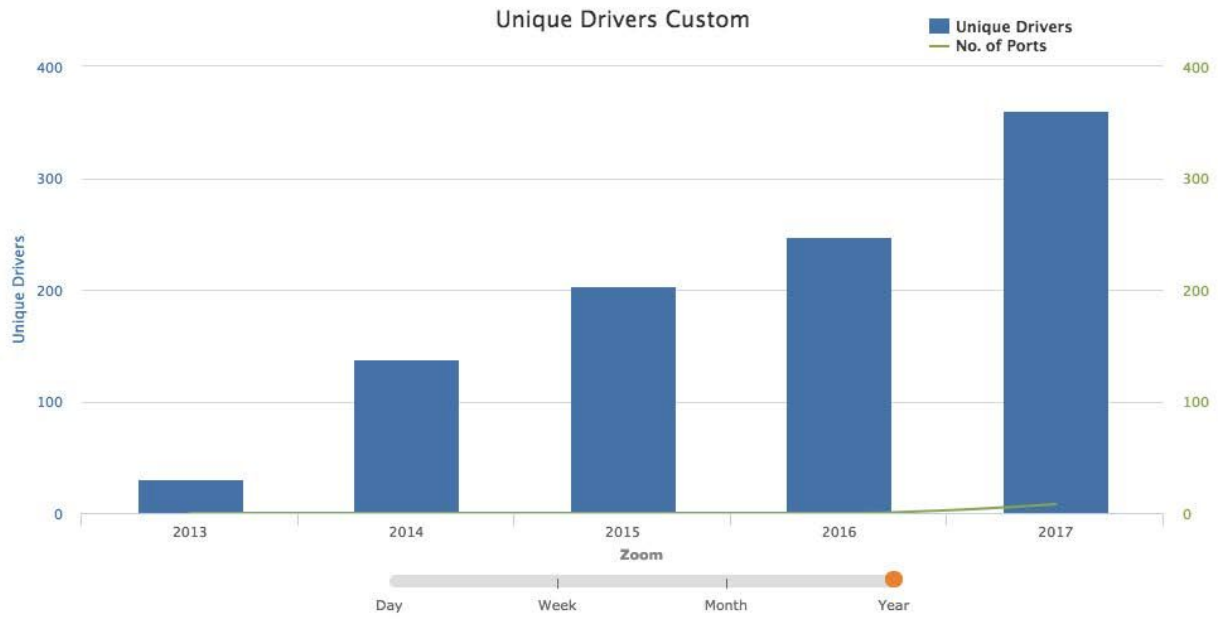


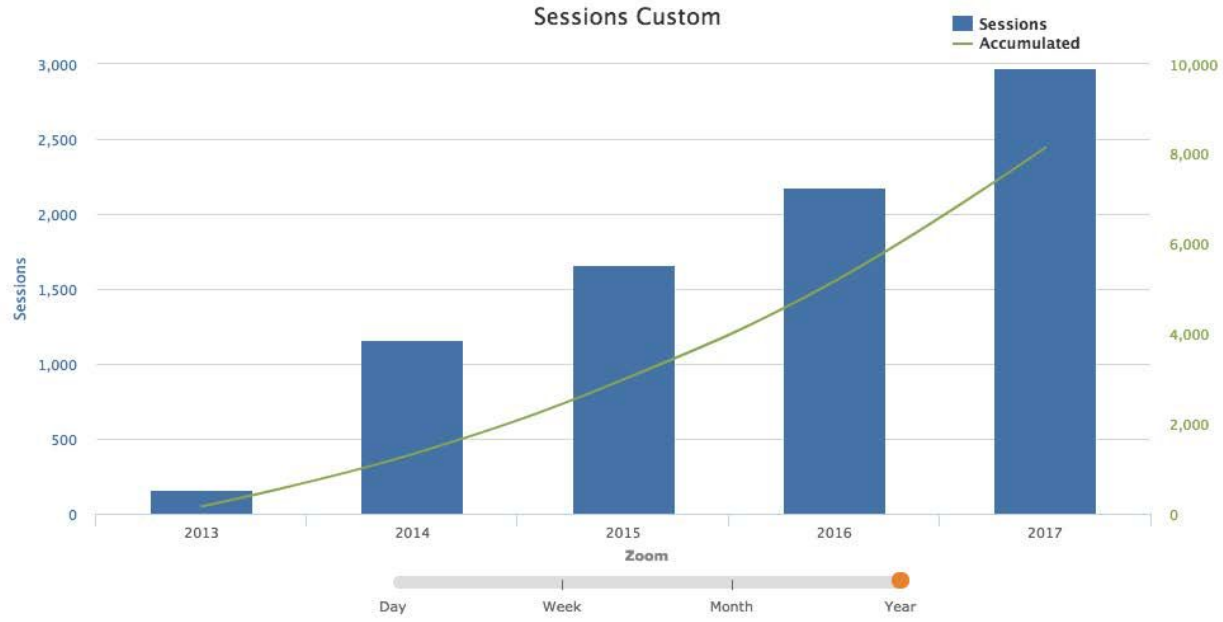




Session Length Histogram Last 30 Days
No. of Sessions
Cumulative %
No. of Sessions
Cumulative %
Session Length (hh:mm)


Sessions Last 30 Days
Sessions
Accumulated
Sessions
Accumulated


Peak Daily Occupancy Last 30 Days
Peak Daily Occupancy (%)
No. of Level 2 Ports
Peak Daily Occupancy
No. of Level 2 Ports


Unique Drivers Custom
Unique Drivers
No. of Ports
400
300
200
100
0
Unique Drivers
2013
2014
2015
2016
2017
Zoom
Day
Week
Month
Year


Sessions Custom
Sessions
Accumulated
3,000
2,500
2,000
1,500
1,000
500
0
Sessions
10,000
8,000
6,000
4,000
2,000
0
2013
2014
2015
2016
2017
Zoom
Day
Week
Month
Year

TAPS Parking Utilization Survey