



County of San Mateo Garage Smart Parking Pilot Parking
Prepared for SMC Labs by Strategy of Things
Updated January 25, 2019



STRATEGY OF THINGS

Use Case Deep Dive: Smarter Parking

Parking availability for electric vehicles and disabled citizens

Problem #1:

Drivers with disabilities may voluntarily limit their mobility to certain areas because they are not sure if they can park their car nearby.

Problem #2:

Drivers with electric vehicles may leave those cars at home and drive their gasoline powered vehicles because they don't know where the EV charging stations are, and whether it is available.

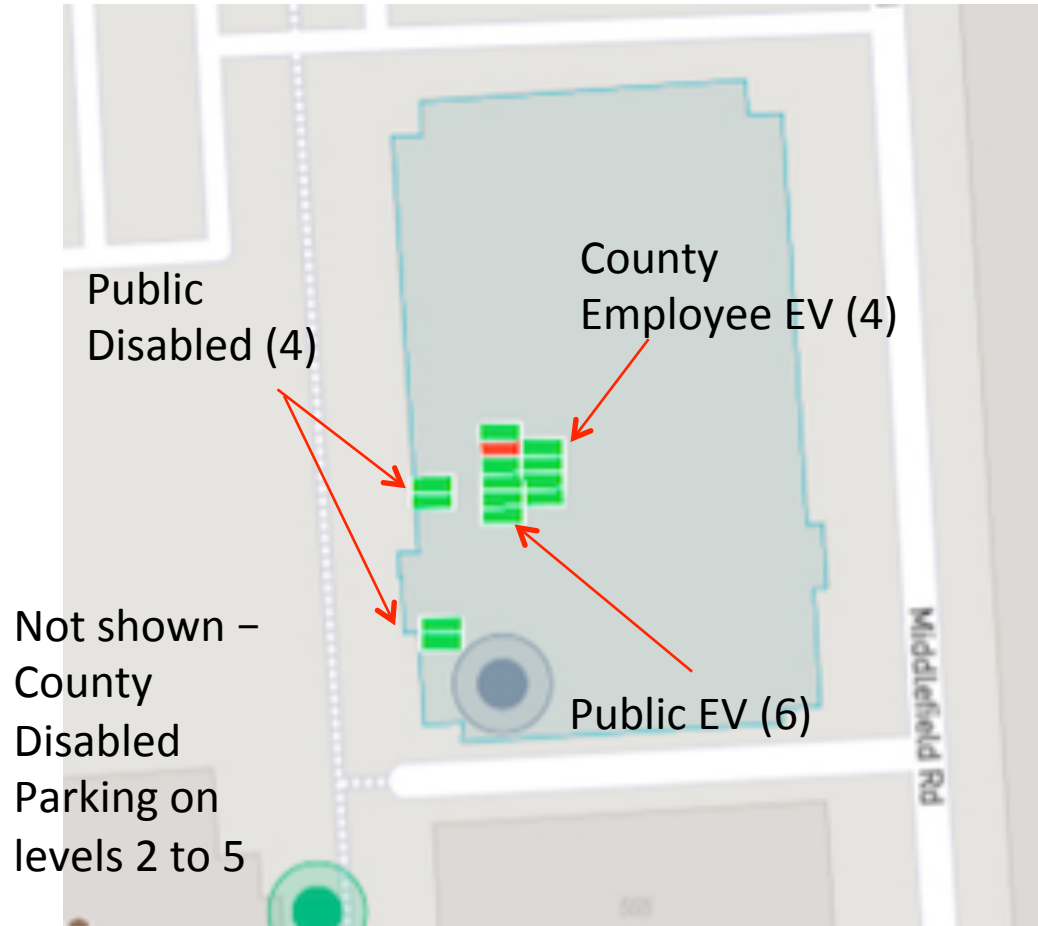
Solution Pilot:

- 22 in ground sensors deployed in SMC garage
 - 6 public EV
 - 4 employee EV
 - 4 disabled public
 - 8 disabled employee
- Fybr smart city platform
- 2 FybrRadio gateways
- Alexa voice integration

Learnings to date:

- Generally sufficient parking availability and turnover during core hours
- Must drive awareness of available parking to residents and downtown visitors during non-core hours
- Voice interface is a safe way to interact, but voice command needs maturing
- Coordinate sharing of parking information with Redwood City

Pilot Overview

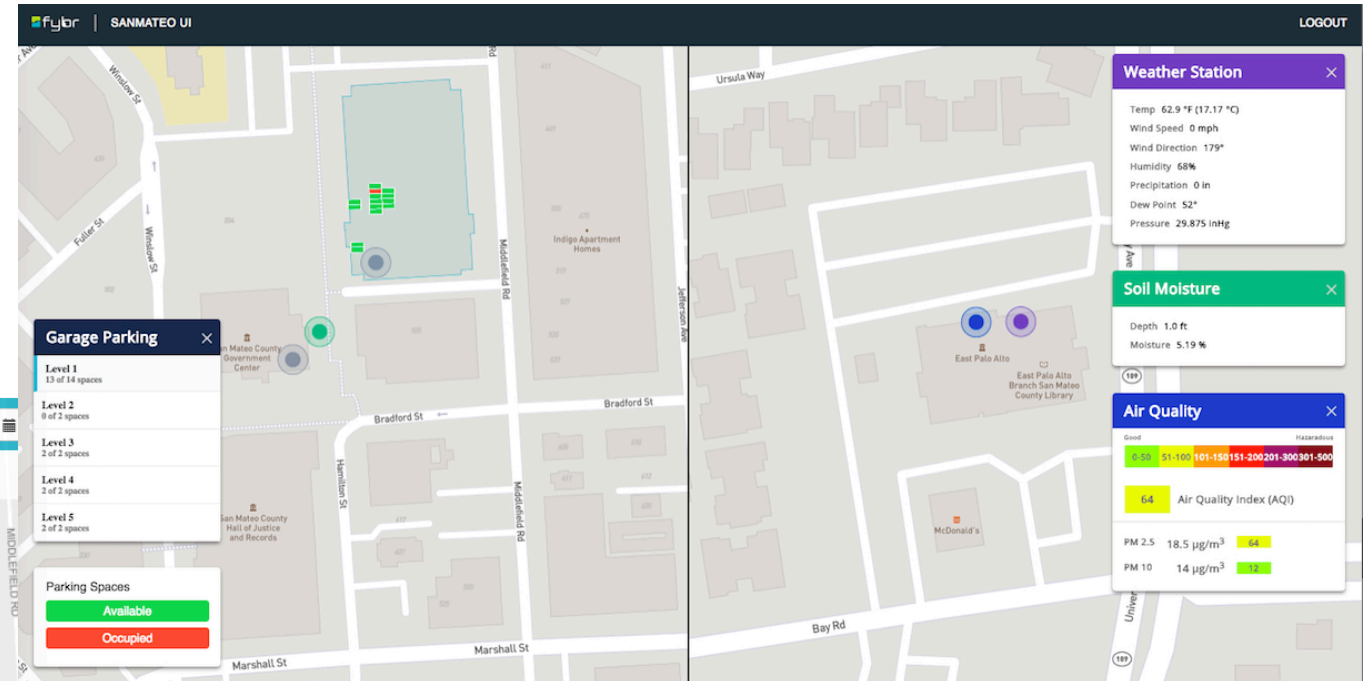
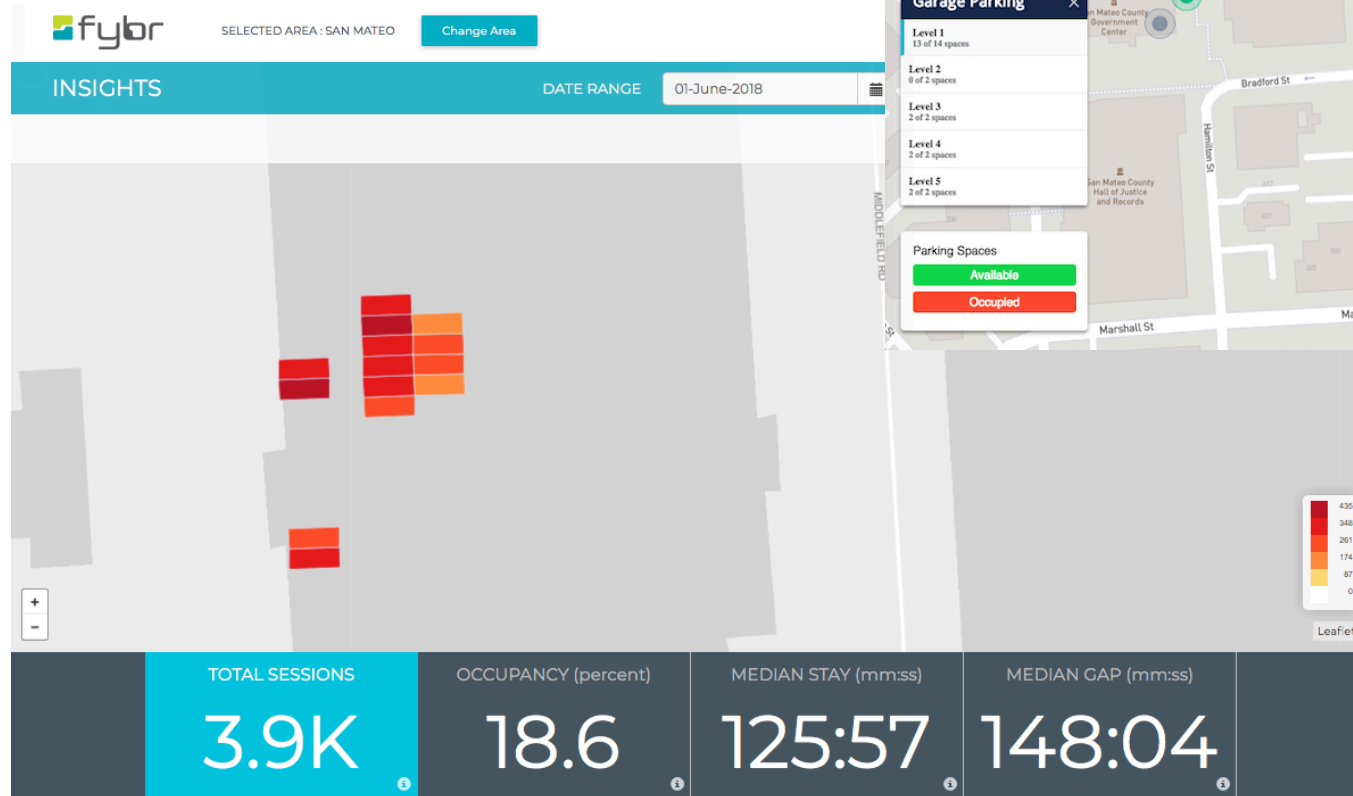


Pilot Overview



Real-Time Parking Dashboard

Parking Historical Analytics Dashboard



SMC County Government Center Parking Statistics



Period Covered: June 1 to December 22, 2018

Metric	Public EV	County Employee EV	Public Disabled	County Employee Disabled
Parking sessions (all times, all days)	1874	754	1312	792
Parking sessions (core hours) - public: M to F, 7 a.m. to 5 p.m. - employee: M to F, 7 a.m. to 5 p.m.	1583	612	1095	613
Busiest times during core hours? i.e. Most cars parking	8 – 10 am 1- 2 pm	7 – 9 am Noon - 1 pm	7 – 9 am Noon – 1 pm	7 – 10 am
Average parking session during core hours	2.0 hours	3.1 hours	3.0 hours	5.8 hours
Longest parking session (Mon – Fri, started during core hours of 7 am to 5 pm)	10.6 hours	10.1 hours	14.4 hours	15.1 hours
Average parking sessions per day (M-F, core) Average parking sessions per day per space (M-F, core)	11.4/day 1.9/space/day	4.4/day 1.1/space/day	7.9/day 2.3/space/day	4.4/day 0.62/space/dy

Public EV – 6 spots, Level 1
County employee EV – 4 spots, Level 1

Public Disabled – 4 spots, Level 1
County employee Disabled – 8 spots total, 2 spots each on Level 2, 3, 4, 5

SMC County Government Center Parking Statistics



Period Covered: June 1 to December 22, 2018

Metric	Public EV	County Employee EV	Public Disabled	County Employee Disabled
Busiest days during core hours (7 am – 5 pm), M-F	Wednesday	Tue, Wed, Thur	Thur, Fri	Tue, Thur
Overnight parking sessions	42	3	83	2
Overnight parking – average session	15.3 hours	15.8 hours	16.1 hours	16.4 hours
Overnight parking – longest time	20.7 hours	19.7 hours	21.25 hours	17.3 hours
When do most cars leave?	Noon to 1 pm 3 to 4 pm	10 to 1 pm	11 am – 1 pm 3 to 5 pm	2 to 5 pm
Parking space occupancy percentage (during core hours of 7 am – 5 pm)	45% (M-F) 8.9% (Sat/Sun)	35% (M-F) 2.9% (Sat/Sun)	78% (M-F) 11% (Sat/Sun)	32% (M-F) 0% (Sat/Sun)

Public EV – 6 spots, Level 1

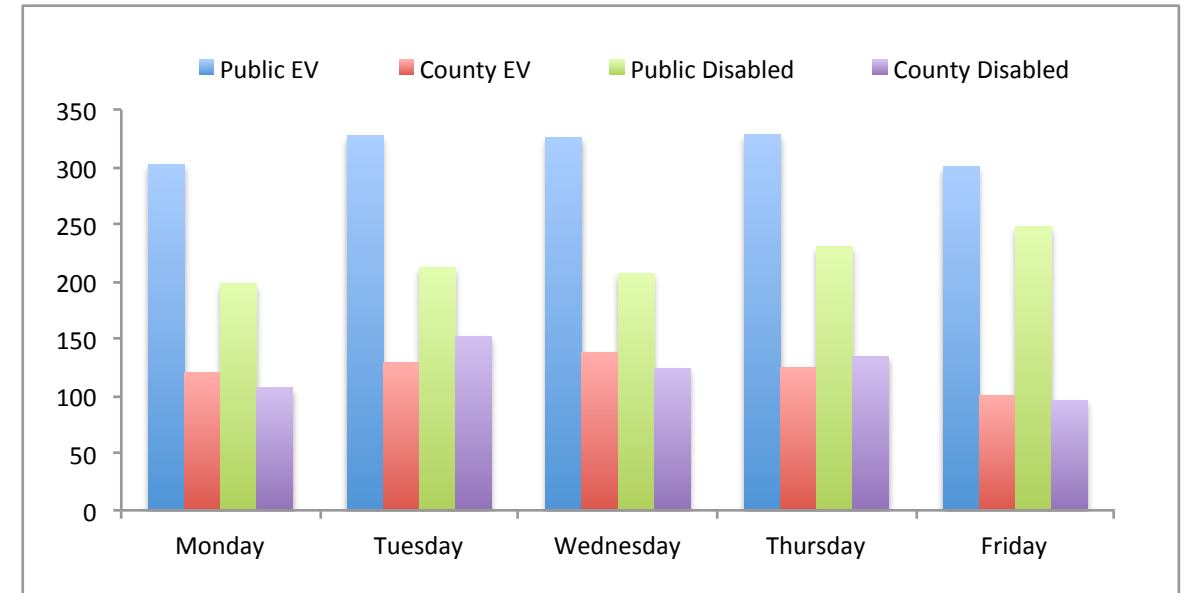
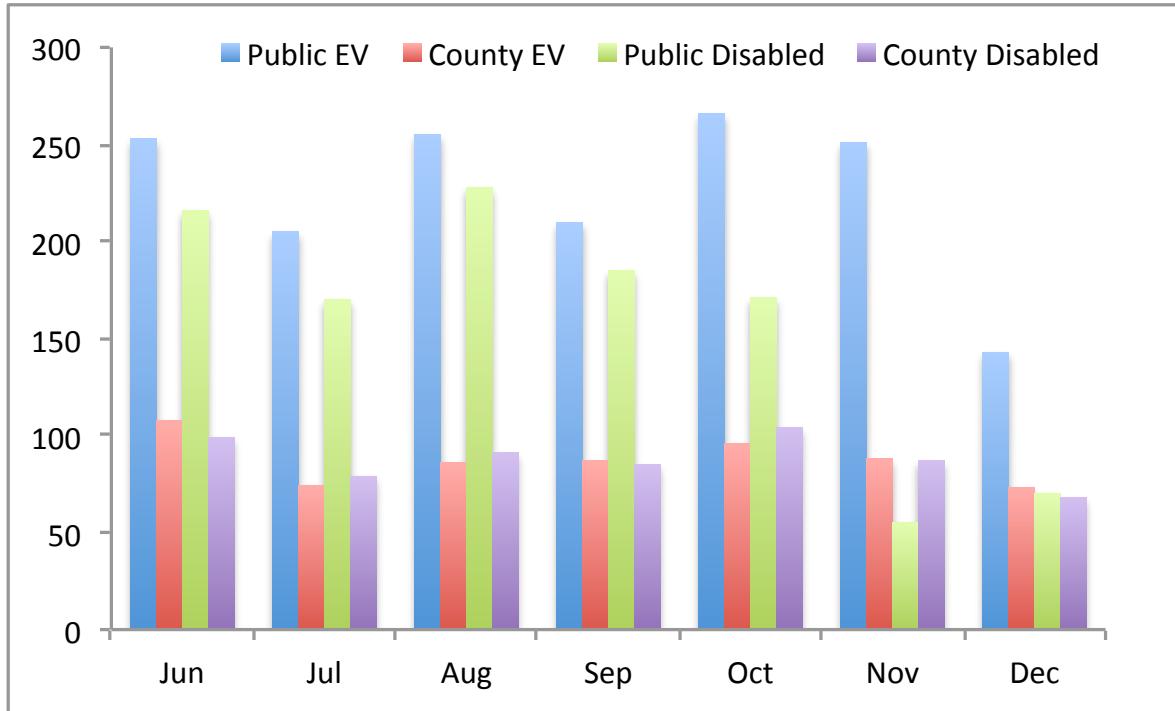
County employee EV – 4 spots, Level 1

Public Disabled – 4 spots, Level 1

County employee Disabled – 8 spots total, 2 spots each on Level 2, 3, 4, 5

Parking sessions activity

June 1 to Dec 22, 2018

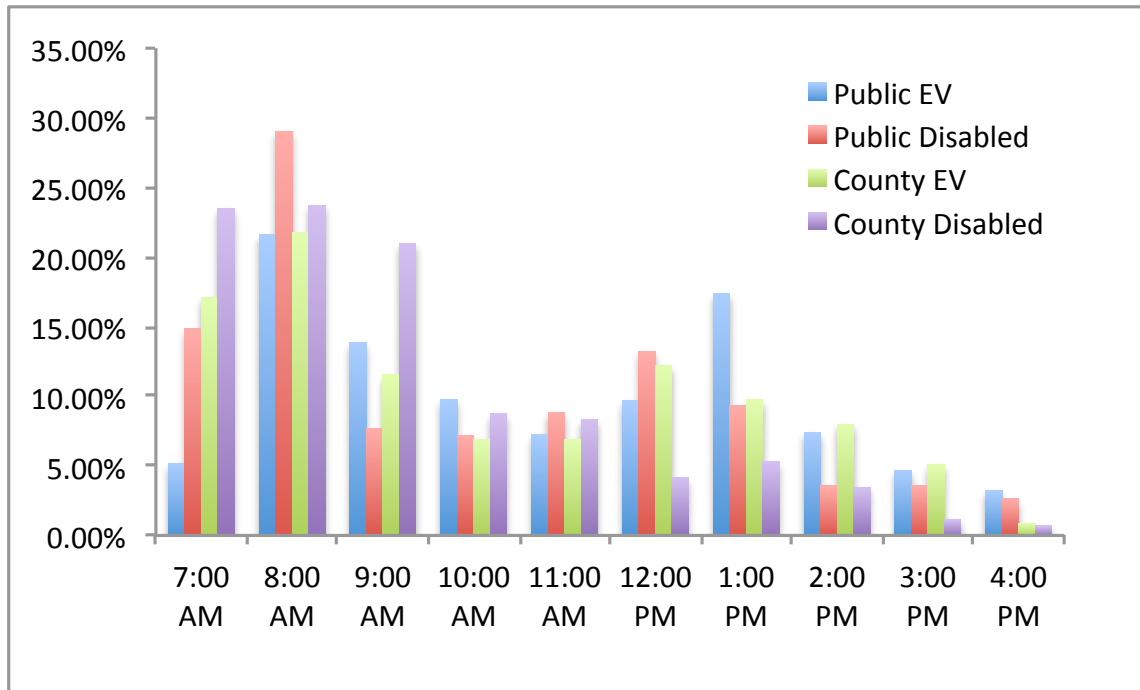


Parking sessions activity

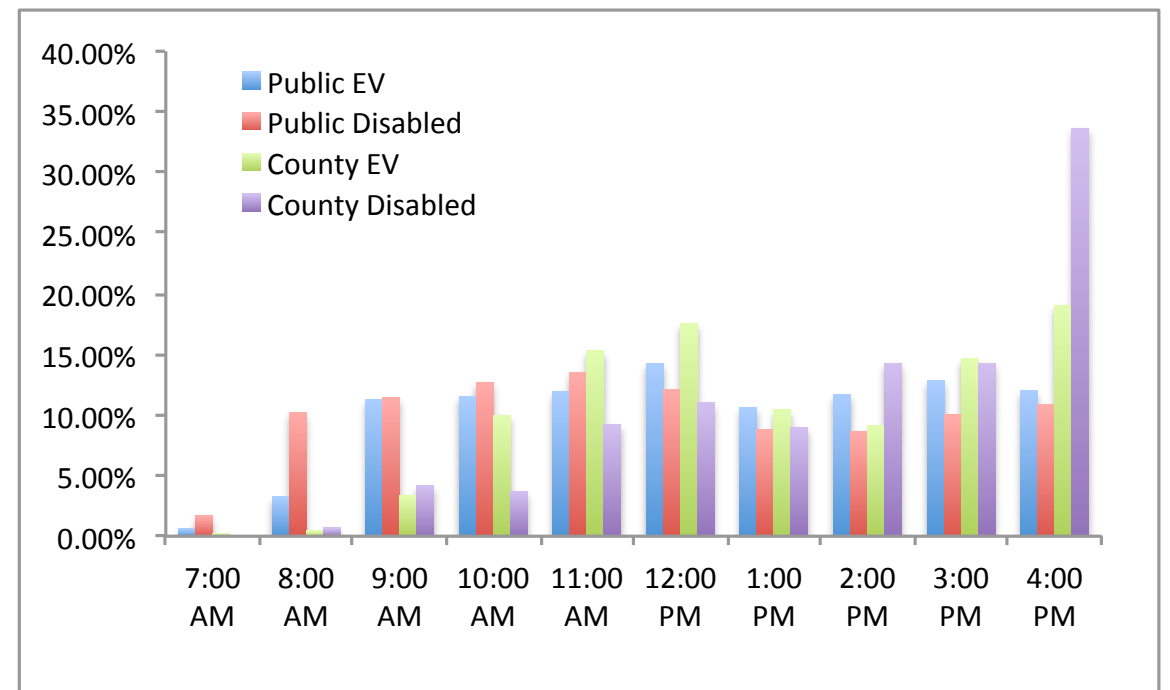
June 1 to Dec 22, 2018



What are the popular times to park?

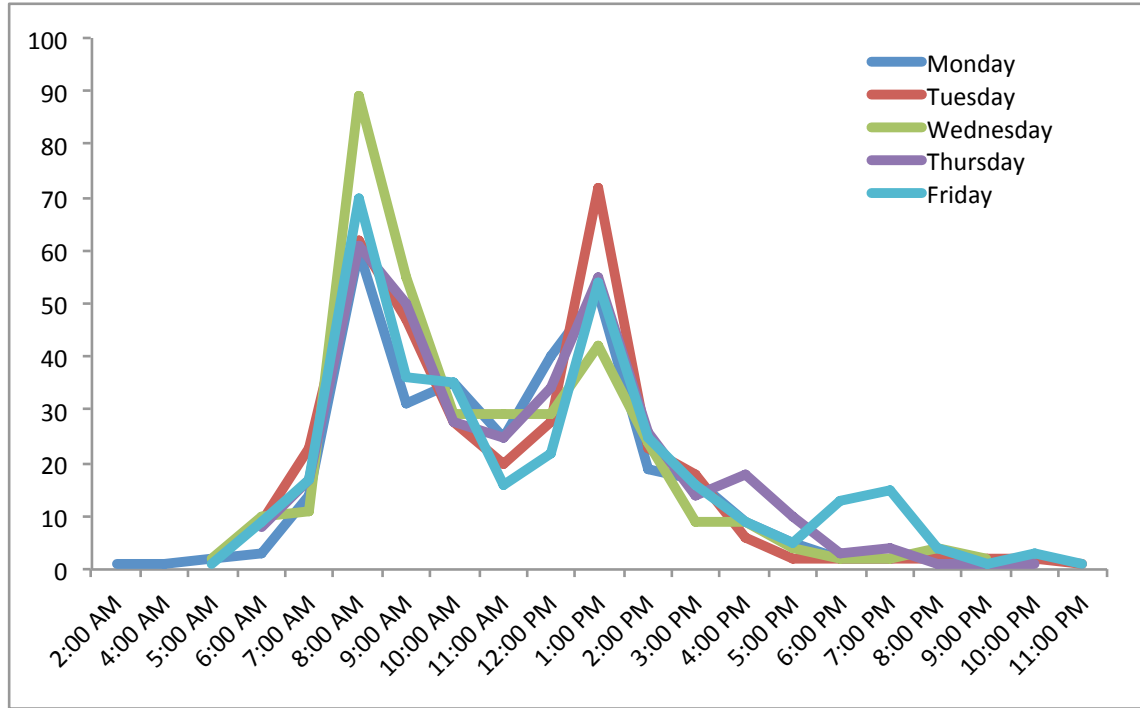


When do most people leave?

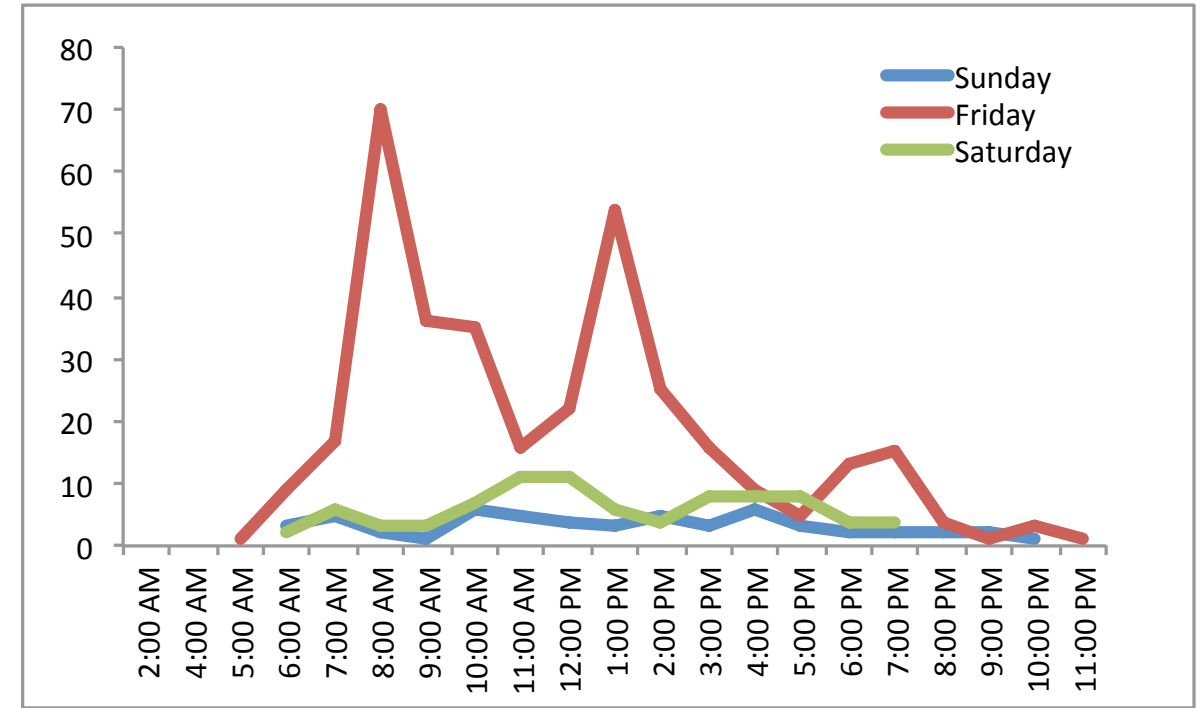


Public EV parking activity by time of day

June 1 to Dec 22, 2018



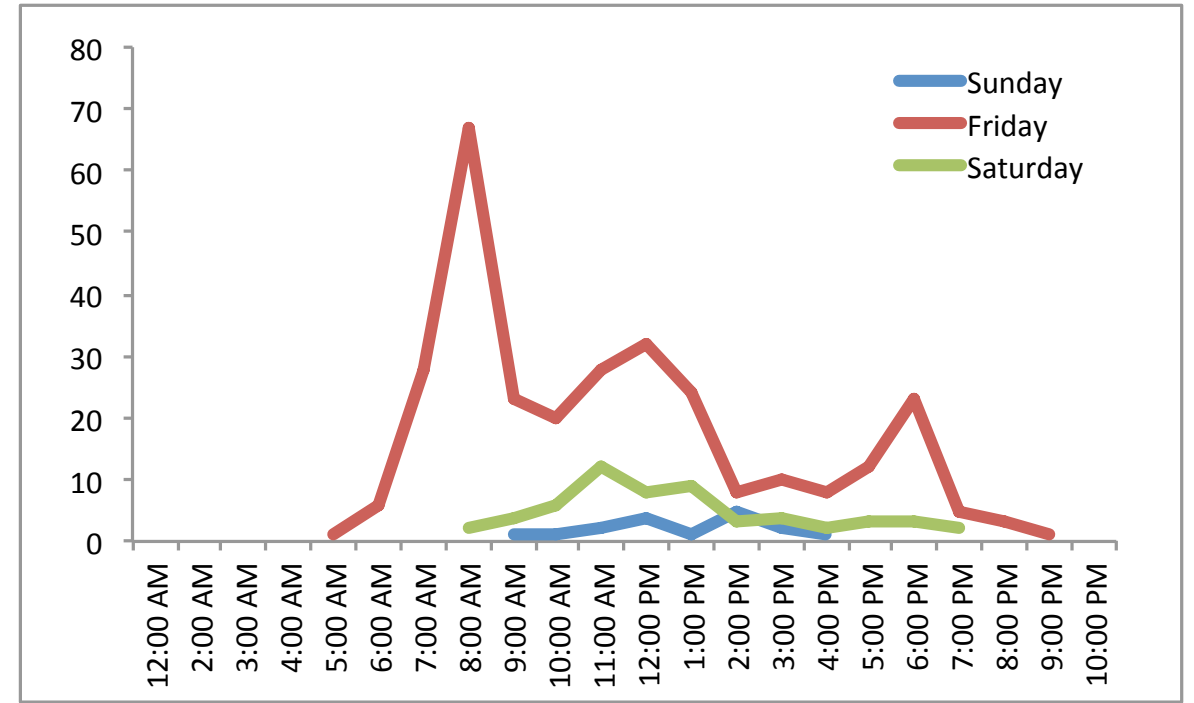
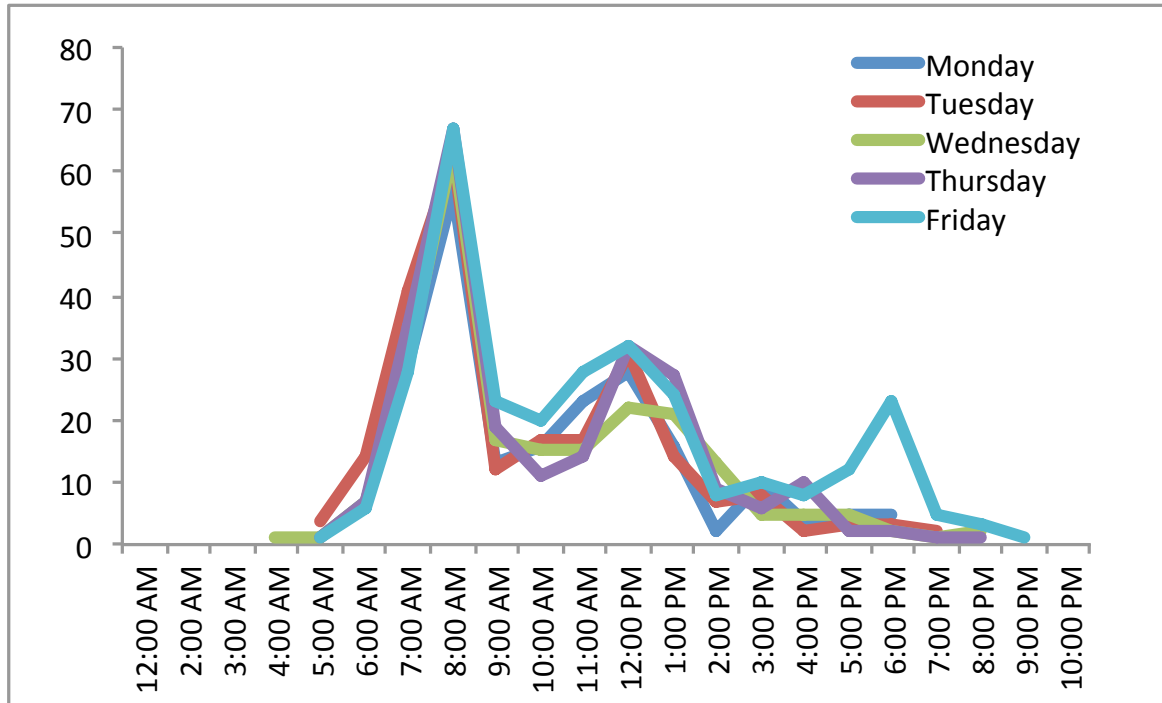
During the weekday, two spikes in when people were parking – around 8 am and at 1 pm. This coincides with getting in the morning, and getting back from lunch.



During the weekends, there is significantly less activity. In addition, the parking activity starts after 11 am. On Friday, we see people coming to downtown and parking around the dinner hours.

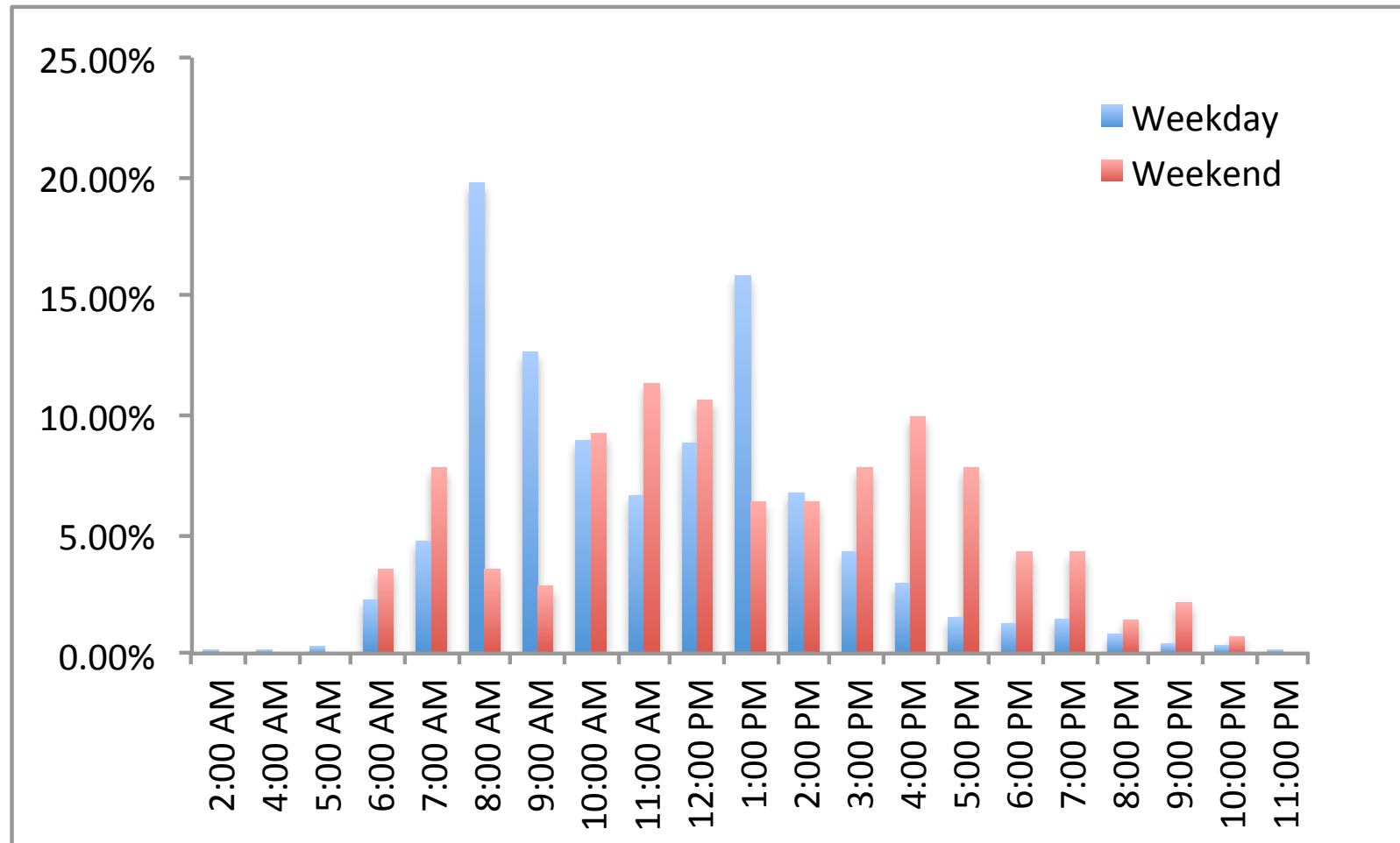
Public disabled parking activity by time of day

Parking sessions (June 1 to Dec 22, 2018)



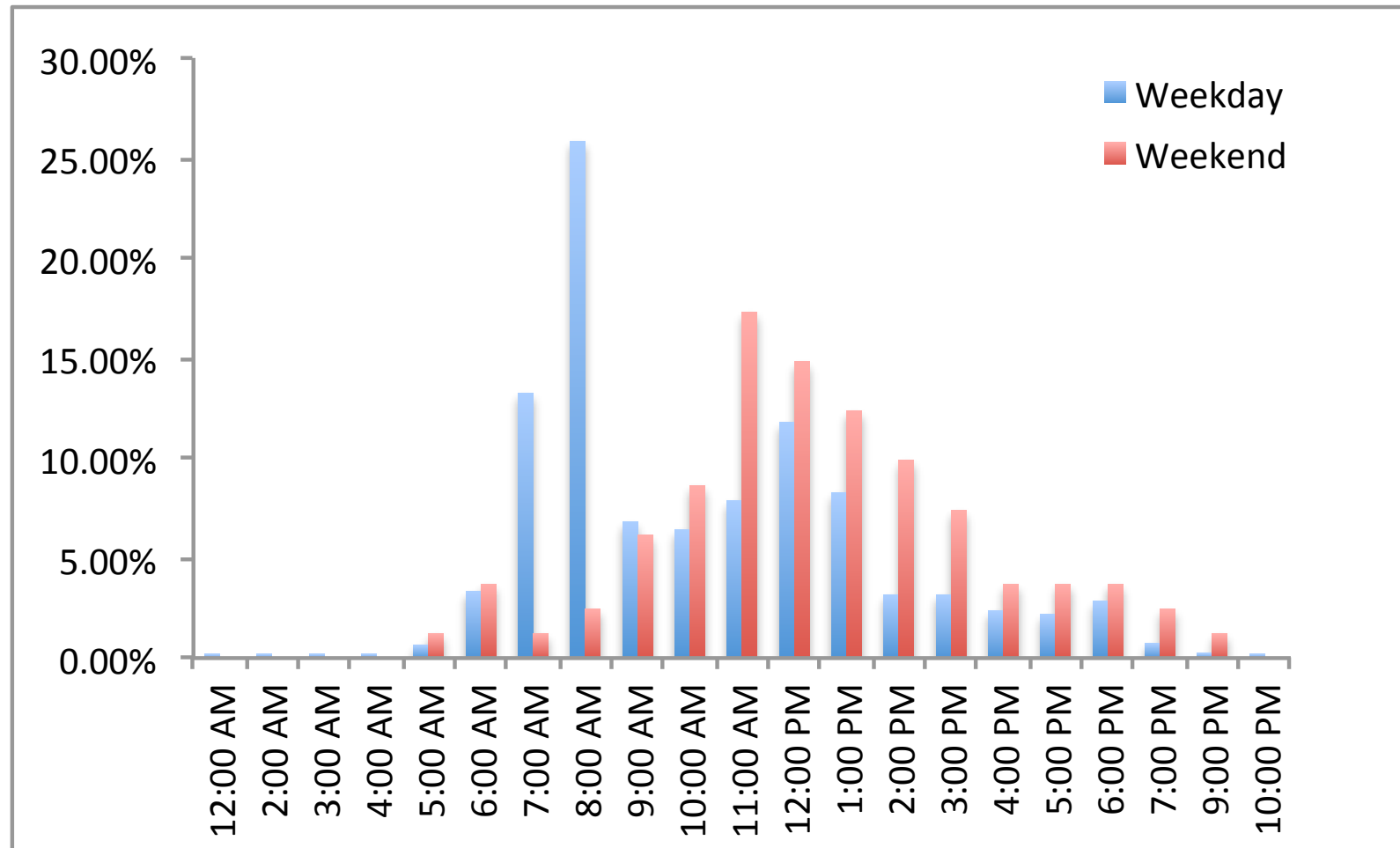
Public EV parking – weekdays vs weekends

% of a day's total parking sessions, June 1 to Dec 22, 2018



Public disabled parking – weekdays vs weekends

% of a day's parking sessions, June 1 to Dec 22, 2018



Summary of parking results



- Public EV and Disabled Parking
 - Number of parking spots and churn appear to be sufficient during core hours
 - These levels may not be sufficient as SMC communicates the availability of these spaces more broadly, or as the number of electric vehicles continue to increase in the future
 - Outside of core hours, parking spaces are underutilized
- County EV and Disabled Parking
 - Employee owned EVs appear to park about an hour longer than the public EV counterparts during core hours
 - There is less EV parking space churn. Unknown if there is demand for county EV parking that cannot be met because of the higher parking occupancy rate
 - Number of county employee disabled parking spaces are sufficient

Summary of observations – system setup



- Parking garages, with massive amounts of concrete and rebar, will affect RF signal propagation. Ground floor sensors require a second gateway to be located on the garage ground floor level. Upper floor sensors can be serviced by a separate gateway that is mounted on the roof of 455 building.
- In ground/under surface mounting of parking sensors may not be viable due to the presence of rebar in the concrete floors. Parking sensors were mounted above ground/top of surface but adhesion of sensor mounts to floor was problematic. We found sensor mounts loose and displaced. Several times we have to move the sensors back to the original location.
- One parking sensor (L3HC01 sensor stopped working in August), L1HC02 was missing sometime in November, L1HC04 was not showing data in November. These were either replaced and reintegrated, or started working again.
- Garage ground floor gateway stopped working on December 22. This was due to the GFCI circuit tripping on the power outlet. The outlet was reset in early January.
- Alexa voice integration generally works, but need to keep questions short to increase odds of user success (the longer the request, the higher the likelihood of an error). Alexa has a hard time understanding acronyms. It tries to spell it. For example, it tries to pronounce EV as eff.

Summary of observations – dashboard and app



- Analytics dashboard and metrics provided did not give us what we needed. We had to go into the raw data and create our own set of key metrics. This mean that we had to wait till month end for a CSV file before we can do any analysis.
- The real time dashboard met our basic needs, although the presentation and user interface and engagement needs to be rethought. Beyond the parking, the real time dashboard also showed the AQ, weather and soil moisture. The dashboard as designed for the pilot is not something we would recommend for operational use without some kind of re-thinking.
- There was a noted latency in what the real time dashboard indicated and what was the actual parking space situation. For example, the dashboard noted the parking space as occupied but in actuality the space was available. This was attributed to the location of the gateway (which was on top of the 455 building) which created significant latency in communicating with the sensors. This was the reason one of the gateways was relocated to the garage.
- We did not test the mobile app interface as there was not a need to. Unlike smart parking in a street location where the spaces are spread out, there is only one location for the garage parking. Locations/mapping and guidance are not applicable other than to get you to the garage.

Summary of observations – data



- Public disabled parking – there were significant instances where a vehicle was parked for more than 12 hours. This skewed the result on the occupancy rates. Not sure if this was a non-disabled county vehicle parking in that spot and effectively closed off that space.
- Several of the sensors came loose from their original mounting locations. Sometimes they ended up at the very top of the parking spot, and sometimes into another spot. We moved them back when we saw them, but not sure how this affected the actual parking sensing.
- Three sensors stopped working or stopped reporting data. Two were replaced and reintegrated into the system in December. However, this may bias some of the results, but potentially we have enough data to observe general trends.
- All the raw data was examined, and fixed prior to analysis. This included throwing out bad data, removing duplicates, and fixing “glitches”. These glitches include data that showed a parking session as two separate sessions (but were in fact, the same session).
- The current method of analyzing the data is not scalable for larger data sets. It is acceptable working at a pilot level, but at some point, should be automated or integrated into other tools.

Summary of observations - miscellaneous



- Fybr was in general a good vendor. Very professional and knowledgeable. The installation/deployment and setup process was very seamless. They were very responsive to questions, requests and issues during the operational phase of the pilot.
- The “as a Service” model wasn’t always seamless or uneventful. There were a couple of incidents in which Fybr initiated some actions in the back end, which impacted the pilot and system at SMC.
Two examples:
 - Fybr updated the real time mapping/dashboard on their side. This caused the SMC dashboard to not work (no parking space information)
 - Fybr initiated a software update to the gateways to change charging profiles. This took down the garage gateway. We are awaiting a replacement power supply.
- What the data doesn’t tell us is about unmet demand. For example, if all 6 public EV spots are taken at a certain point in time, we don’t know how many other EVs are looking for a place to park but were unable to.

Recommendations



- Investigate methods to better secure the sensors to the parking space. Investigate feasibility of mounting the sensors into the floor, or “bolting” the rubber mounting skirt into the floor.
- Investigate to see if it is possible to get end of charge data from the charging stations and correlate it with the parking information. This way we can determine the correlation between when the EV charge is complete and when people move their cars.
- Weekends and weeknights are underutilized for EV spots. Perhaps announce to residents and visitors in the neighborhood that there are EV charging stations available.
- Coordinate with Redwood City on parking availability. Perhaps integrate SMC garage parking information with the parking information provided by Redwood City. This can be done via a communication from the Public Affairs team.
- As county employee electric vehicle spaces are occupied an hour longer than the public EV parking, communicate to employees the need to move their vehicles in a timely manner so as to allow others to park.

Next Steps



- Continue to collect data. Once we address the issues with the sensors getting loose, and the faulty/missing sensors, we can compare the results with the previous five months.
- Identify other potential parking locations to collect information from. We can have Fybr install those on their next visit.
- Provide a link to the real time dashboard that can be viewed from the SMC Labs website.
- Determine if pilot data should be posted to open data portal. Initial recommendation is not to post the data collected as this data is pilot data and has “issues” (e.g. sensors not working, etc.). If we post, need to decide what format, cleansed or not, and who cleanses moving forward.
- Update SMC Labs website with some preliminary observations and project updates.
- Draft communications sharing progress of pilot that can be communicated internally and externally as appropriate.