SVCE GridShift: EV Charging

Final pilot report

December 2021

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1. Executive Summary

In October 2020, Silicon Valley Clean Energy (SVCE) launched the GridShift pilot, which leverages vehicle telematics to control and optimize residential customers' electric vehicle (EV) charging at home. The goals of the GridShift pilot were to (A) help customers save money on their home energy bills by automatically charging their EVs during the cheapest off-peak hours on their rate plan; and to (B) align EV charging with off-peak hours of low-carbon generation powered by renewable power producers under contract with SVCE and other California load-serving entities.

Launched in the middle of the COVID-19 pandemic and stay-at-home orders, GridShift was able to harness the additional flexibility of residential customers' EV charging schedules as they stayed plugged in for nearly twice as long as they did pre-pandemic (an average of 20.2 hours plugged in at home vs. 12.2 pre-pandemic); remaining plugged in during daytime hours was especially important to be able to charge vehicles with abundant solar power on the California grid. SVCE on-boarded 72 customers with 79 EVs onto the GridShift mobile app, and after a period of primarily optimizing charging for cheaper off-peak hours, launched a trial period of low-carbon events in March and April 2021 with push notifications and the chance to earn a $10 bill credit to incentivize customers to plug in and allow charging during especially low-carbon times that took place during off-peak hours on their rate plan.

The impact of cost-optimization was that GridShift pilot participants saved $24 per month on average on their energy bills vs. charging immediately upon plug-in; savings varied by rate plan and were as high as $46 per month for some customers and as low as $8 per month for others. Following the introduction of low-carbon events, 42% of all EV charging on a day with a low-carbon event called was scheduled for the lowest-carbon hours, helping GridShift participants to avoid 4,000 lbs of CO_2 grid emissions vs. unmanaged charging. In all, 70% of pilot participants took part in at least one low-carbon event, and 30% participated in the minimum number of events (8) required to earn a $10 credit on their energy bill.

To support the California grid during Summer 2021, SVCE decided to pilot "Critical GridShift Hours" in which customers received push notifications prior to CAISO FlexAlerts and other SVCE-defined events, encouraging them to either avoid plugging in, or to enable smart-charging to reduce strain on the grid. Between August and October 2021, six such reliability events were called and GridShift was able to shift 98% of total EV charging outside the event hours, with participants entered into a giveaway to win one of five $100 energy-bill credits.

Following a successful pilot, SVCE has begun scaling up the GridShift program. Key considerations are to expand hardware compatibility to more vehicle OEMs as well as to networked EVSEs, to streamline the customer on-boarding flow, and to ensure equity of access to front-line communities. Looking ahead to Summer 2022, SVCE can also consider expanding the Critical GridShift Hours feature to additional event types, including ELRP events, and to further gamify participation through community leaderboards, badges for achievements, and other features.

2. Pilot Performance

A. Customer enrollment

Customer enrollment into the GridShift pilot was done in two phases. Between September and October 2020, SVCE emailed customers on the EV and EV2 rates to announce the GridShift pilot, collect interest, screen customers for eligibility, and obtain a signed Participation Agreement. On October 26, 2020, 85 customers in this first cohort received emails from ev.energy inviting them to download the SVCE GridShift mobile app for iOS & Android, of which 53 opened the email, 50 clicked on the button to download the app, and 45 created a GridShift account in the mobile app and successfully on-boarded into the pilot.

In November 2020, SVCE expanded eligibility to customers on the E-6 and Time-of-Use (TOU) rates, and emailed these customers, collected their interest, screened them for eligibility, and obtained a signed Participation Agreement. On December 4, 2020, 51 customers in this second cohort received emails from ev.energy inviting them to download the SVCE GridShift mobile app for iOS & Android, of which 33 opened the email, 30 clicked on the button to download the app, and 27 created a GridShift account in the mobile app and successfully on-boarded into the pilot.

In total, 72 SVCE customers with 79 vehicles enrolled in the pilot program. Customers had their EV charging optimized according to three key criteria in a hierarchical order, which ev.energy's algorithm used to calculate an optimal charging schedule:

i. The customer's ready-by time as set in the GridShift app: ev.energy's algorithm will always begin charging such that the customer's vehicle is charged to the battery level they specify (outside the GridShift app, usually done in-vehicle) by the ready-by time they have set in the app, even if some charging during on-peak or part-peak hours is required;
ii. The off-peak hours of the customer's TOU or EV rate: if there are more hours during the off-peak period between the customer's plug-in and ready-by times, than there are hours of charge required (dependent on the vehicle's battery level as obtained via the vehicle telematics), then ev.energy will schedule the customer's charging to occur during the cheapest off-peak hours on their TOU or EV rate; and
iii. The forecast carbon intensity of electricity within CAISO: if there is further potential to optimize within the customer's off-peak window, then ev.energy will schedule the customer's charging to occur during hours with the lowest forecast carbon intensity (measured in g CO_2/kWh) based on CAISO's publicly-available generation forecasts.

B. Customer energy bill savings

Overall, pilot participants saved an average of $24 per month on their energy bills. Savings varied by customer and was largely driven by their rate plan: rates with a larger spread between peak and off-peak pricing offered greater customer savings than rates with a smaller spread. For example, customers on the EV2-A rate saved an average of $46 per month (or $555 per year in annualized savings)

due to the large difference between off-peak pricing (18¢/kWh) and peak pricing (37¢/kWh during winter months and 49¢/kWh during summer months). By contrast, customers on the TOU-C rate saved an average of $8 per month (or $98 per year in annualized savings) due to the smaller difference between off-peak pricing (30¢/kWh) and peak pricing (32¢/kWh during winter months and 41¢/kWh during summer months).

C. Carbon emissions reduction

Carbon-emissions reduction was offered as a secondary optimization criterion during the GridShift pilot, and was implemented in two phases. In the first phase, carbon optimization was passively implemented as the secondary optimization without any customer alert or engagement to alter charging behaviors. As a result, with TOU being the dominant optimization criterion, most charging was scheduled for cheaper off-peak hours between 11 p.m. and 7 a.m., when the carbon-intensity of electricity in the CAISO is highest (see Figure 1 below).

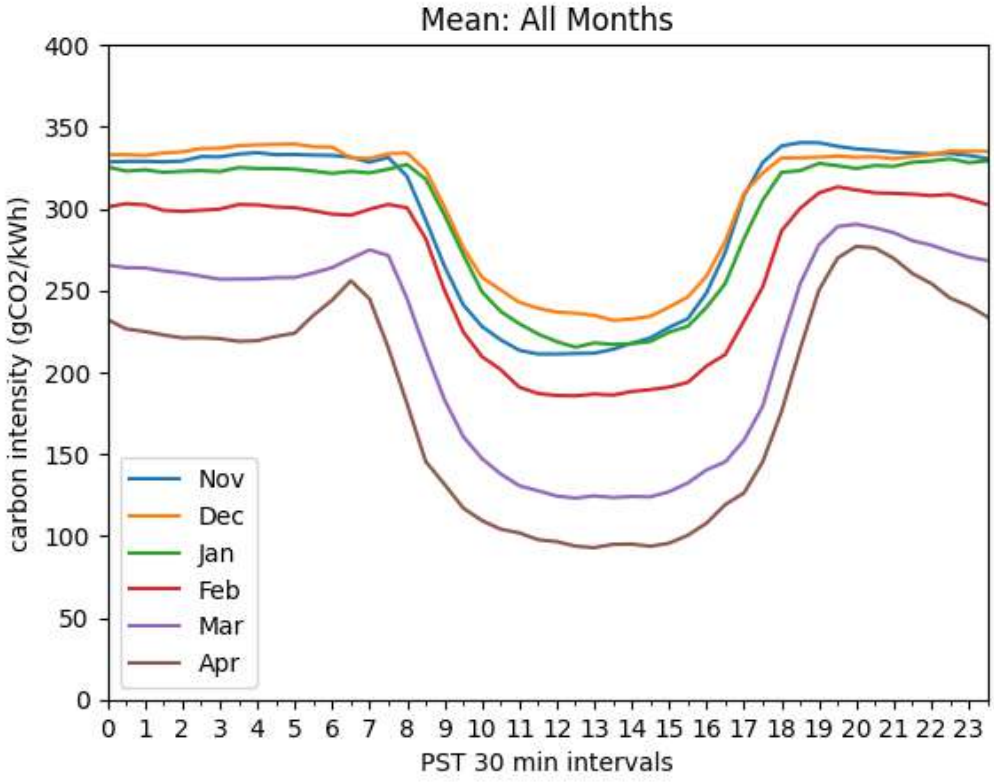


Figure 1. Average CAISO intensity during the GridShift pilot months across 24 hour intervals.

Beginning in March 2021, SVCE and ev.energy began testing “low-carbon events” to try and shift customers’ charging behavior to allow for more daytime charging. To deliver this, ev.energy's managed charging algorithm obtained 96-hour and 24-hour generation forecasts from CAISO to predict the lowest-carbon hours in a given week. When the carbon intensity of a consecutive 2-hour period fell below 50% of the average in a given calendar month, pilot participants received a push notification via the GridShift app alerting them of the "low-carbon event" within the next 12-24 hours and encouraging them to plug in their vehicle beforehand, as shown in Figure 2 on the next page.

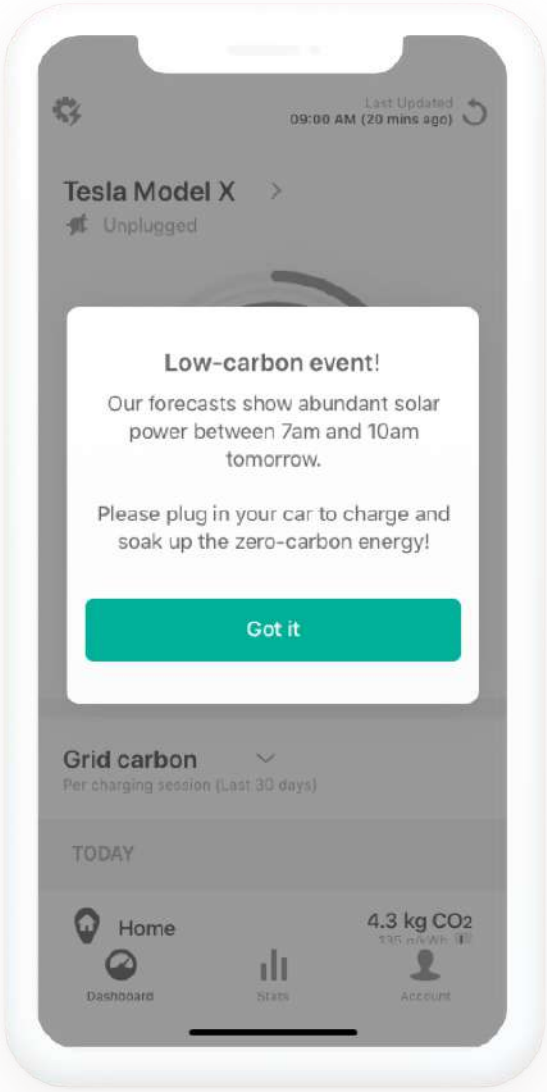


Figure 2. Example of a low-carbon event received by a customer in the GridShift mobile app

To incentivize customers to respond to low-carbon events, the pilot implemented a gamification technique whereby a customer received 1 point if they were plugged in before or during a low-carbon event, and had not yet charged (i.e. there was still room in the battery to do low-carbon charging). Customers who earned at least 8 points over the 2-month trial between March and April 2021 were then automatically granted a $20 bill credit, which was administered by Calpine.

To ensure that participating in low-carbon events was cost-neutral for GridShift pilot participants, the events were only called during off-peak hours on a customer's rate plan. More specifically, push notifications were targeted based on a customer's rate cohort, in line with the goal of ensuring that customers were encouraged to charge only during the off-peak hours of their rate plan so as not to result in higher energy bill costs. Participants' rate plans included EV-A, EV- B, EV2-A, TOU-B, TOU-C, TOU-D, and E-6. If, for example, a low-carbon event

were forecast between 12 p.m. and 2 p.m. on a Monday, EV-A participants would not receive a notification and would be excluded from this event because those hours are defined as part-peak on the EV-A rate plan.

With the goal of shifting EV charging to lower-carbon daytime hours within a customer's off-peak window, ev.energy's algorithm calculated an optimal charging schedule for participants based on a number of factors, including the vehicle's battery level at plug-in, the customer's desired battery level, the number of hours between plug-in and the customer's desired ready-by time, the structure of the customer's rate, and CAISO's 24-hour forecast generation mix. The impact of this load-shifting is shown in Figure 3 below.

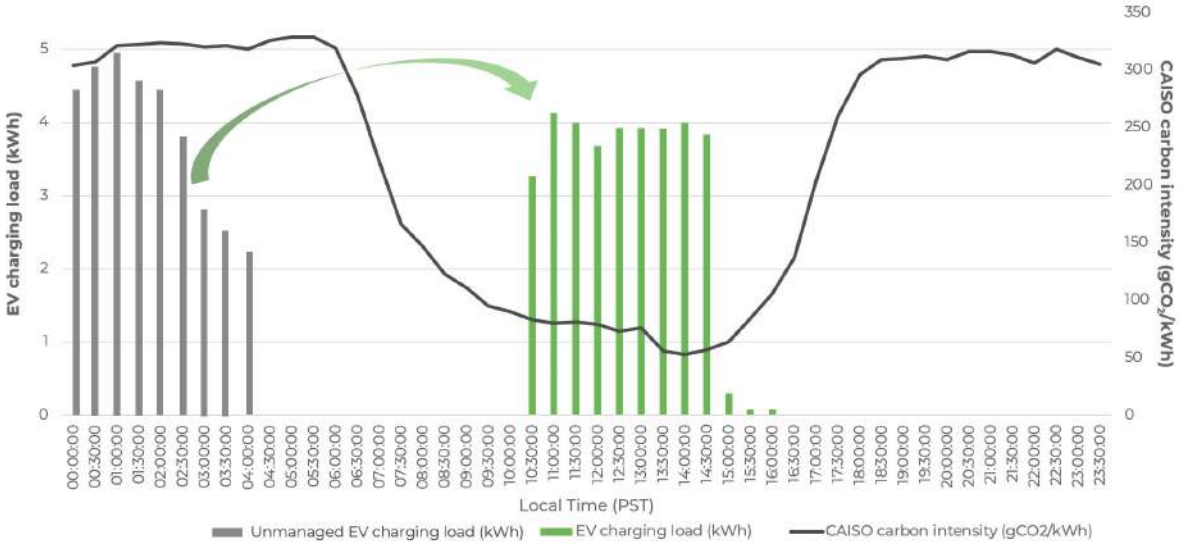


Figure 3. An SVCE customer's EV charging load profile during a low-carbon event on April 3, 2021. Energy consumption is shown on the left-hand axis, with unmanaged EV charging load in grey (had the customer not participated in the low-carbon event), and managed EV charging load shown in green following the customer's opt-in to the event. Average carbon intensity of electricity as reported by CAISO is shown on the right-hand axis.

Overall, 70% of GridShift participants plugged in before at least one low-carbon event, and 30% plugged in before eight or more low-carbon events (required to earn the $20 bill credit).

The low-carbon events occurred over 10 weekends and seven weekdays; weekend participation tended to be 10-15% higher than weekdays, presumably due to a number of factors including greater availability of off-peak hours across all rate plans, greater customer flexibility to plug in, and higher customer engagement with non-work matters. Saturdays saw the highest participation levels, with as many as 50% of GridShift participants plugging in during a low-carbon event. On one weekend, back-to-back events were called on both Saturday and Sunday; while the Saturday event saw a 40% increase in customers plugging in during the low-carbon event hours (vs. the average for the same hours in the four prior Saturdays), the Sunday event saw a 30% decrease in customer plug-ins, presumably due to strong participation the day prior.

Given overall high participation levels, the low-carbon events were able to shift a significant amount of EV load to low-carbon hours during March and April 2021.

On average, 110 kWh of EV load was shifted from overnight hours to daytime hours during a low-carbon event, and on a given day when a low-carbon event was called, 42% of the total EV charging load within the day's 24-hour window occurred during the lowest-carbon hours. The impact of the low-carbon event trial across March and April 2021 was approximately 4,000 lbs of CO_2 avoided by participating customers allowing GridShift to shift their charging schedules from overnight periods to lower-carbon daytime hours.

D. Summer 2021 reliability events

Between August and October 2021, GridShift trialled 6 reliability events, called "Critical GridShift Hours." During these events, push notifications were sent to customers 24 hours in advance via the GridShift app alerting them of the event, and incentivizing them to avoid charging their vehicles during specified hours the following day (see example in Figure 4 at right). Customers were offered either 5 or 10 points per event in which they did not Boost charge; each point was converted into a "ticket" for a giveaway of five $100 bill credits that was conducted in November. On the back end, ev.energy's algorithm avoided charging during the event's hours for any customers who were plugged in with smart-charging enabled; if a customer chose to 'Boost' however, ev.energy would deliver a charge during the event.

Figure 4. Screenshot of a Critical GridShift Hours push notification sent to customers on September 7, 2021.

The impact of GridShift's demand-response service is illustrated in Figure 5 below, which shows aggregate EV charging for all GridShift customers during a CAISO Flex Alert on September 9, 2021. Between 4 p.m. and 9 p.m. ev.energy paused charging on most EVs, and the charging that was otherwise scheduled to occur is illustrated in the striped blue bars. This charging was instead shifted until after the event ended around 9 p.m. / 10 p. m. as illustrated in the solid blue bars which represents actual charging delivered to these EVs. A small amount of unshifted load is shown in grey; these were GridShift customers

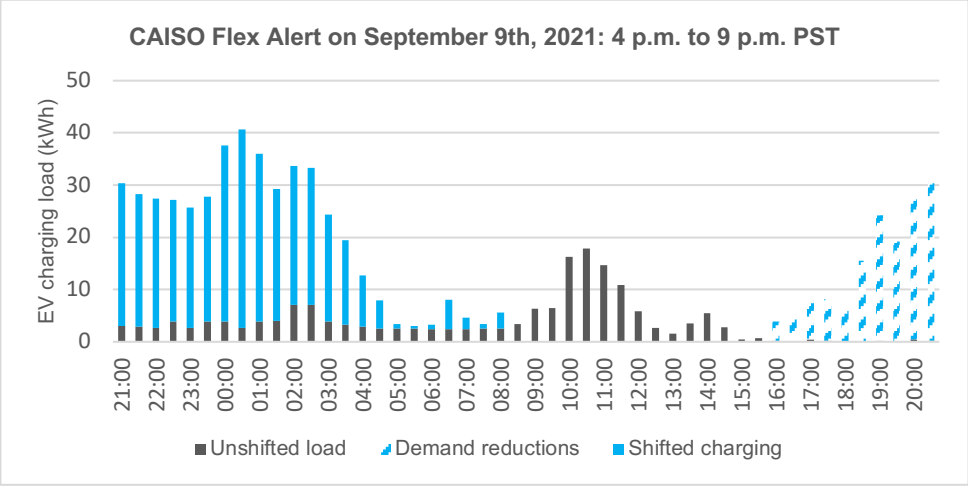


Figure 5. EV charging during a CAISO Flex Alert on September 9, 2021

whose target battery levels required continuous charging that could not be shifted or paused in order to be charged before their desired ready-by times. In total, 98% of EV loads were shifted outside of the CAISO Flex Alert window.

Across Summer 2021, six such reliability events were called and a summary of their performance can be found in Table 1 below. Overall, no customers boosted during the event and GridShift was able to shift 95-98% of EV charging outside of the 4 p.m. – 9 p.m. hours.

Table 1. Summary of Critical GridShift Hours performance, Summer 2021						
	Aug. 27, 2021- SVCE 4 p.m. - 9 p.m.	**Sept. 8, 2021 – CAISO 4 p.m. - 9 p.m.**	**Sept. 9, 2021 – CAISO 4 p.m. - 9 p.m.**	**Sept. 25, 2021 – SVCE 4 p.m. - 9 p.m.**	**Oct. 11, 2021 – SVCE 4 p.m. - 9 p.m.**	**Oct. 26, 2021 – SVCE 4 p.m. - 9 p.m.**
# customers plugged in	61	61	55	57	75	69
# customers who Boosted	0	0	0	0	0	0
kWh of unshifted load during event	2.72	9.09	3.21	3.55	10.49	6.37
kWh of counter-factual charging during event	71.74	155.18	135.7	127.76	308.63	199.45
% of counter-factual charging shifted outside event	97%	95%	98%	97%	97%	97%

E. Customer charging behavior & patterns

The GridShift pilot launched in the middle of the COVID-19 pandemic, which resulted in a profound shift in lifestyle patterns, energy consumption levels, and EV charging behaviors. With many customers tending to work from home in 2020 and 2021, EV drivers were staying plugged in for longer, including during the daytime hours. As seen in Figure 6, data from the ev.energy platform showed that while the most common plug-in time shifted only one hour from 5 p.m. in January 2020 to 6 p.m. in January 2021, the most common unplug time for an EV driver shifted from 8 a.m. to 3 p.m. over the same period. The result of this was an increase in the average duration that an EV remained plugged in while parked at home from 12.2 hours in January 2020 to 20.2 hours in January 2021: effectively, a shift to working from home nearly doubled the length of the window during which a charge could be delivered to the vehicle. The average charging session duration was 2.5 hours, indicating a high level of flexibility for SVCE and ev.energy to optimize charging schedules to low-cost and/or low-carbon hours.

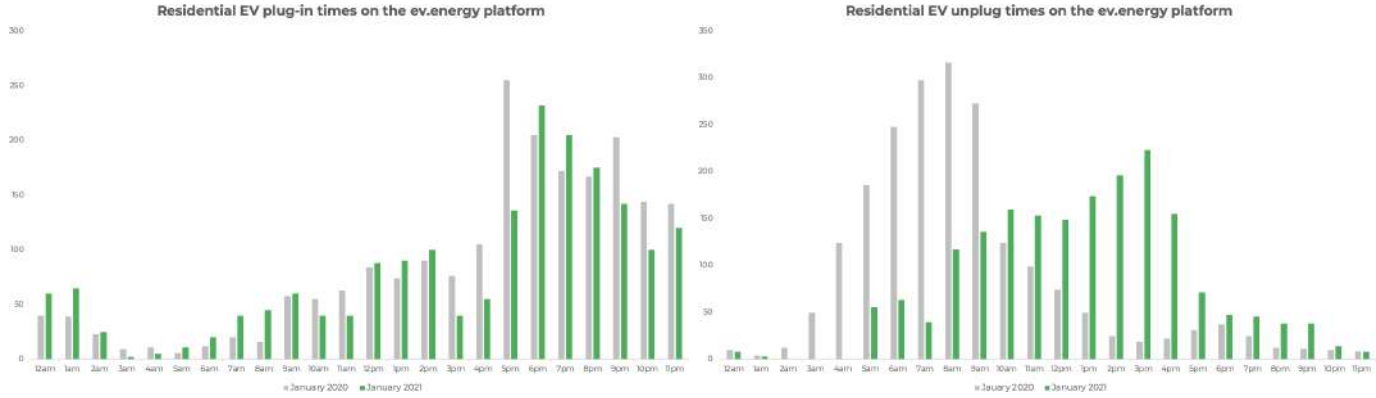


Figure 6. Count of plug-in and unplug time from residential EVs in California during January 2020 & January 2021

The map of GridShift pilot charging sessions shown in Figure 7 below suggests that certain neighborhoods in SVCE's service territory saw more home charging sessions than others; for example, Mountain View, Sunnyvale, Cupertino, Saratoga and Los Gatos saw notably more home charging sessions than Milpitas, Los Altos or Unincorporated Santa Clara County. Further social equity considerations can be found in Section 3.

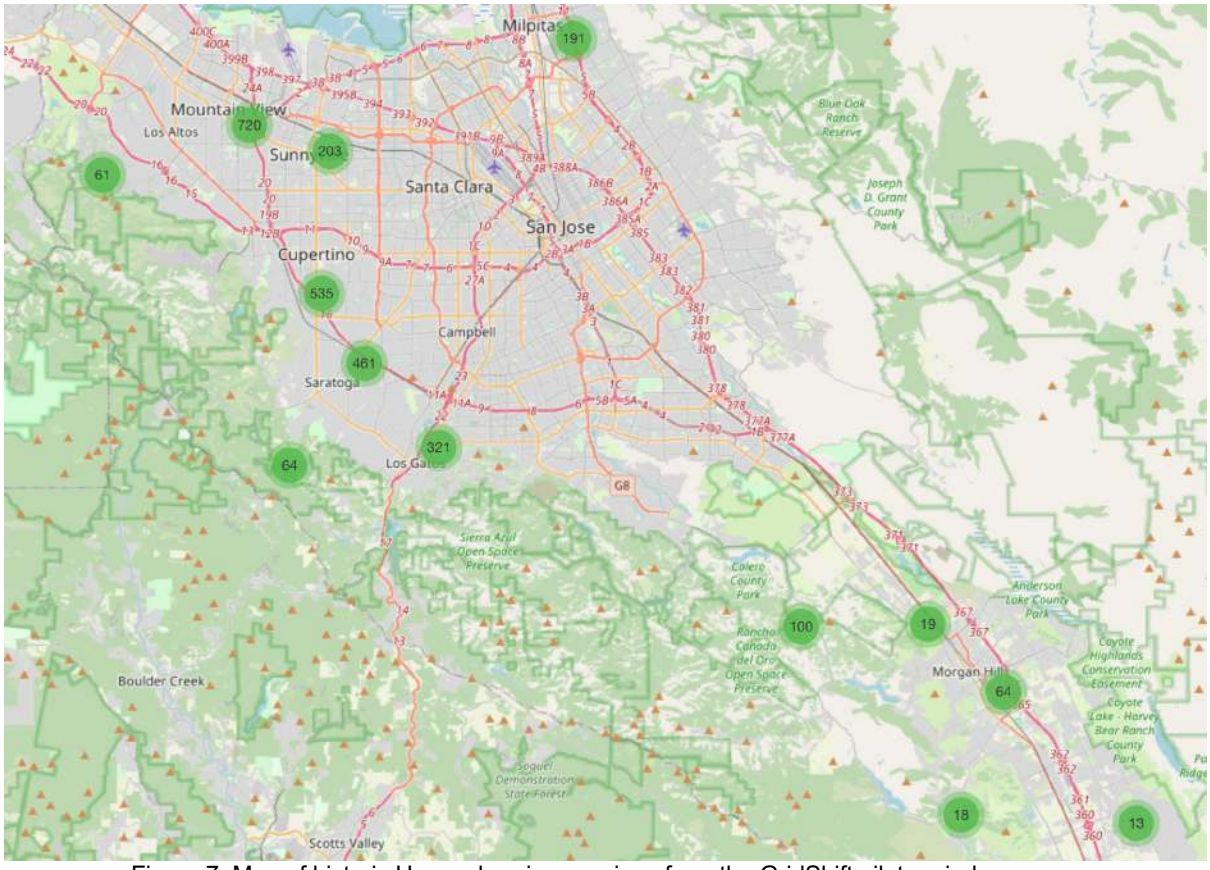


Figure 7. Map of historic Home charging sessions from the GridShift pilot period.

3. Lessons Learned

A. Customer recruitment/enrollment

The GridShift pilot provided a number of learnings of customer recruitment that can be applied to the program's scale-up.

First, an offline participation agreement can lead to friction in the customer's on-boarding journey. The pilot phase required interested SVCE customers to sign and return a PDF version of the GridShift pilot participation agreement, which led to attrition levels of >50% between registration of interest and agreement signature. A digital, in-app version of the Participation Agreement which customers agree to as part of the on-boarding process would address this issue and reduce customer attrition.

Second, a closed/restricted app in Apple Test Flight and Google Play may have

led to additional attrition due to the additional steps that some customers needed to take in order to access and download the GridShift mobile app. For example, customers using iOS first had to download Apple Test Flight in order to access the GridShift pilot app via the link emailed to them. Similarly, customers using Android needed to have their Google Play account emails pre-uploaded to ev.energy's hidden storefront; their Google Play account emails were sometimes different from the email they provided to SVCE which required manual customer support intervention to resolve.

Third, relying on direct emails to SVCE customers can be effective but limited in reach. While GridShift welcome emails had moderately high open rates (~45%), the remaining ~55% of emails may have been sent to "spam" email accounts that customers rarely check. For example, several customers registered with email handles that included pge@, svce@ and usps@, indicating that these were not their primary email accounts – emails to these customers were never opened. In addition, approximately 15 emails that were sent to customers who indicated interest in the pilot bounced back, indicating a potential typo in the email the customer provided.

B. Impact of COVID-19 and shelter-in-place

The GridShift pilot took place entirely during the COVID-19 pandemic and the pilot phase overlapped significantly with state-wide and local shelter-in-place orders. On March 19, 2020, California Governor Gavin Newsom issued Executive Order N-33-20 2020, which required all residents of the state of California to shelter in place for all but essential activities. On December 4, 2020, Santa Clara county extended shelter-in-place orders for its residents, which were not lifted until June 2021. As a result, GridShift pilot participants presumedly did less driving, which is reflected in fewer kWh of charge delivered per charging session, as seen in the histogram in Figure 8 on the next page. Data is compared to California EV drivers using ev.energy's native app prior to the COVID-19 pandemic. More specifically, the average charging session fell from 24 kWh in January 2020 to 16 kWh in January 2021.

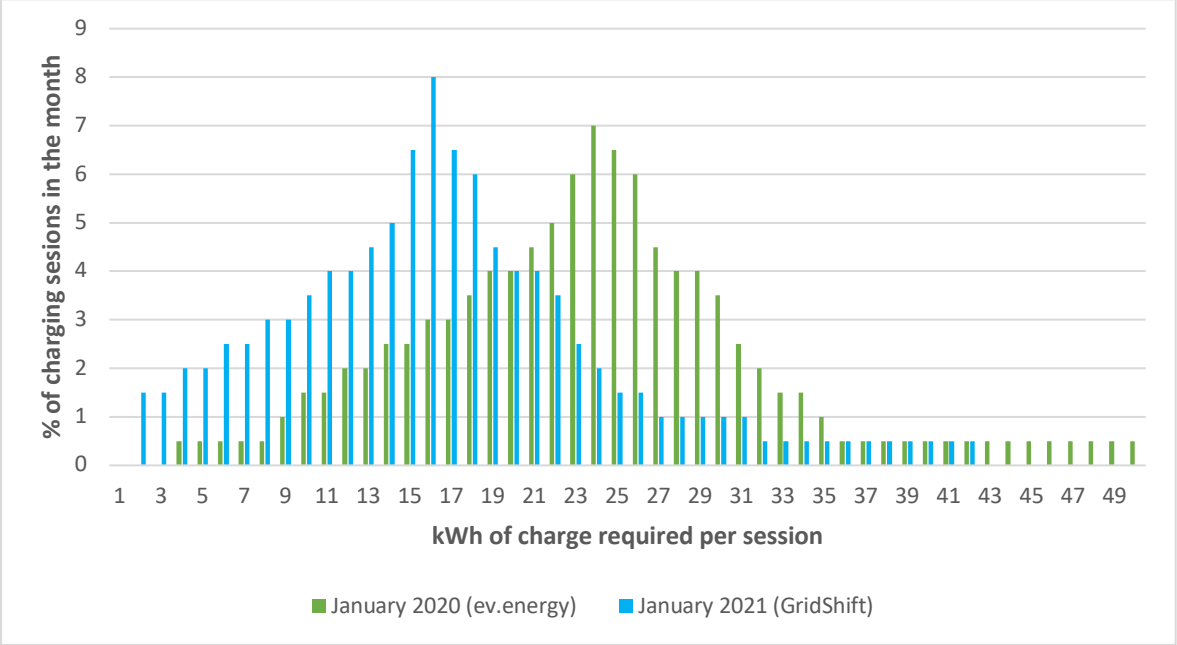


Figure 8. Histogram of charging sessions taking place on the ev.energy app in January 2020 and the GridShift app in January 2021, distributed by total kWh of charge required per session. Pre-pandemic data from the ev.energy app shows notably higher levels of kWh delivered per charging session, than data from January 2021 in the middle of COVID-19 and Santa Clara county's shelter-in-place order.

Shelter-in-place orders also meant that GridShift pilot participants did more of their EV charging at home, as opposed to their office, a shopping mall, or other public charging station. This data is compared to California EV drivers using ev.energy's native app prior to the COVID-19 pandemic, and can be found in Figure 9 below.

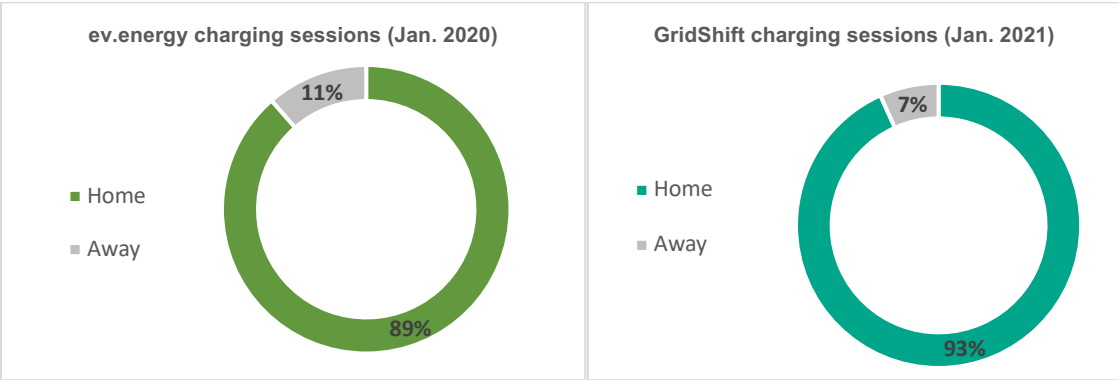


Figure 9. Pie charts comparing the share of at-home vs. away-from-home charging sessions among EV drivers in California using ev.energy's app in January 2020, alongside GridShift pilot participants in January 2021.

C. Qualitative feedback from SVCE customers

Qualitative feedback from SVCE customers, emailed to ev.energy support, generally fell into three categories: TOU optimization/cost savings, low-carbon events, and product/data/reliability feedback.

An email survey to GridShift pilot participants administered by ADM Associates noted that energy-bill savings was the primary motivator for SVCE customers to

participate in GridShift. This motivation was reflected in feedback from GridShift participants, who wrote to ev.energy that they appreciate the cost-savings the app provided. Due to a bug that was later fixed, ev.energy incorrectly charged 5 GridShift participants' vehicles during on-peak hours, resulting in an average of $3.06 in higher energy bill costs for those customers. Several of these customers proactively reached out to SVCE/ev.energy support to complain. SVCE provided these customers with a bill credit that exceeded the additional on-peak costs they incurred through GridShift. Following the introduction of the "only charge off-peak" feature, one GridShift participant expressed his support for the feature, noting that they always sought to charge their vehicle as cheaply as possible. This feedback highlights that EV drivers can be very price-sensitive and expect reliable, low-cost, off-peak charging as a core part of the proposition from their CCA or utility. Indeed, 67% of respondents in ADM's email survey noted that automatically saving on energy costs was a large benefit of the GridShift program.

The ADM email survey also noted that using lower-carbon energy was a close second motivator for SVCE customers to participate in GridShift. This was reflected in the high level of customer participation during the low-carbon events that were run in March & April 2021, with as many as 29 customers (or 40% of all participants) plugging in during a single low-carbon event (9 a.m. – 3 p.m. on Saturday April 3, 2021) which reflected 3x the number of customers plugged in during an average Saturday in February 2021 during the same hours, and used 75% lower-carbon electricity vs. six hours of charging from 12 a.m. – 6 a.m. the previous night. However, a low-carbon event called the next day saw much lower levels of participation, suggesting customer fatigue when low-carbon events were called back-to-back in subsequent days (or reduced charging frequency/requirements due to lower levels of driving during the COVID-19 pandemic). Most qualitative feedback from SVCE customers sent to ev.energy related to impatience around the immediacy seeing low-carbon event participation translated into bill credits, due to the bill credits not being issued on-bill until May 2021.

Customer feedback on the product (i.e. mobile app and design) was largely positive, and reflected results from the ADM email survey which found that 86% of respondents reported an easy set-up/on-boarding process within the GridShift app. When it came to smart-charging, several customers wrote to ev.energy to ask why their vehicle did not start charging immediately at 12 midnight when off-peak hours kicked in on the EV2-A rate; this would imply a lack of understanding that the secondary optimization criterion of CAISO carbon-intensity had been applied, and charging scheduled for the lowest-carbon hours between the start of the off-peak period and the customer's ready-by time. For example, one customer provided the feedback that the GridShift app should make it more clear to the customer why EV charging doesn't start exactly at midnight. Other customers wrote to ev.energy support due to data discrepancies in the kWh/consumption displayed in the GridShift app vs. other third-party Tesla apps such as Teslafi. A lack of trust in the new technology was reflected in one customer's feedback, which noted that they go to their garage to check on the car periodically to ensure the car was actually charging as expected.

4. Scale-up roadmap

A. GridShift program enrollment targets

With over 32,000 EVs on the road within its service territory, SVCE has the potential to grow GridShift into a Virtual Power Plant with hundreds of megawatts of load-shifting potential. Based on the OEM mix of EVs within SVCE's customer base shown in Figure 10 below, GridShift already provides compatibility with over 50% of the EVs on the road.

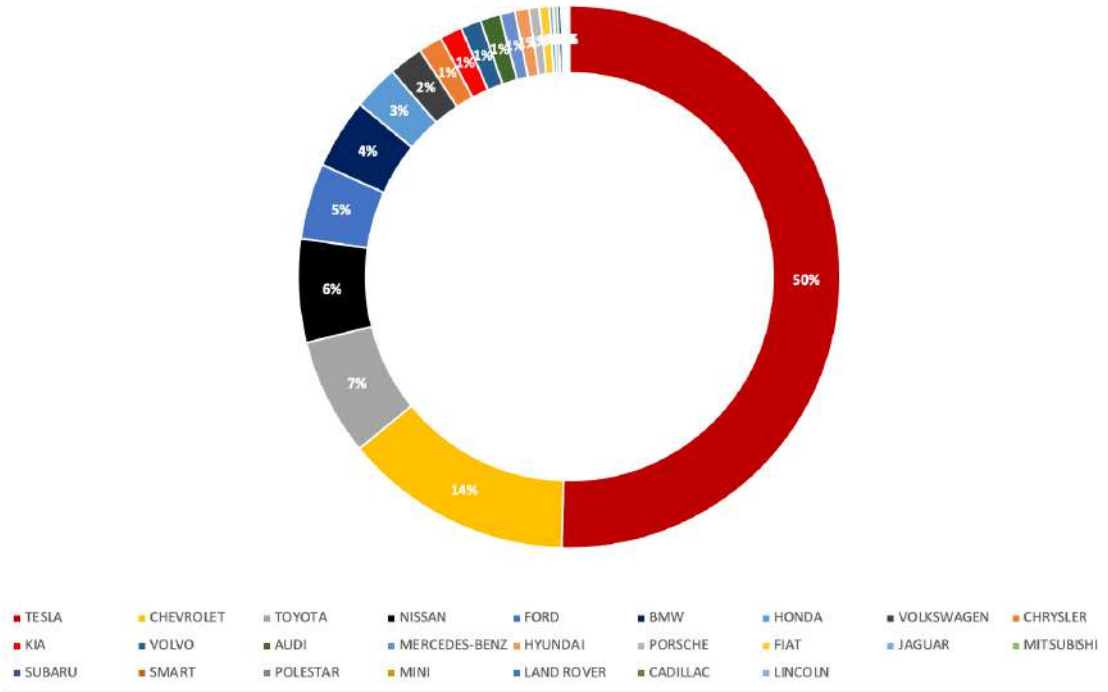


Figure 10. Breakdown of Electric Vehicles registered in SVCE's service territory (source: California DMV data provided by SVCE as of January 2021).

Given ev.energy's planned integrations for Chevrolet, Ford and BMW EVs over the course of 2021-2022, GridShift compatibility should expand to ~70% of EVs, or approximately 22,400 vehicles. Using ev.energy's 10% market share in other territories (e.g. the United Kingdom) as a benchmark, the GridShift program could target as many as 2,200 vehicles enrolled in the program at scale. This is a conservative estimate given that EV adoption is accelerating rapidly and more EV deliveries should be expected since the last DMV report-out in January 2021.

The first step to achieving this milestone would be to expand the GridShift program from the initial 79 vehicles enrolled in the pilot to ~200 vehicles, representing a 1% share of the ~16,000 Teslas registered to SVCE customers.

The next step to achieving this milestone would be to target ~500 vehicles enrolled in GridShift, representing a 2% share of the ~25,000 EVs that would become compatible with ev.energy once the Chevrolet, Ford and BMW integrations are deployed.

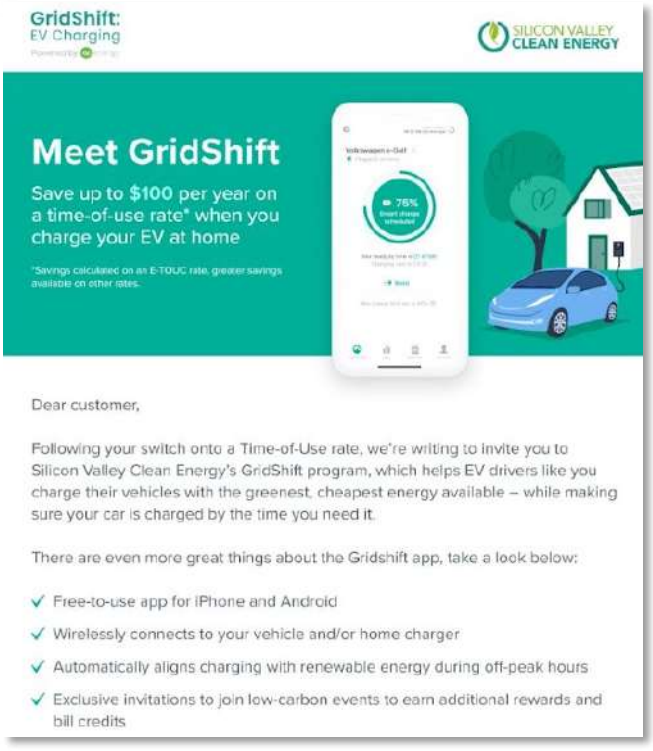
Ahead of summer 2022, GridShift could target a 5% market share or ~1,500 EVs enrolled in the program. A cohort of this size would provide SVCE with ~2 MW of load curtailment for PG&E's ELRP and Market Access programs.

B. Optimized enrollment & on-boarding process

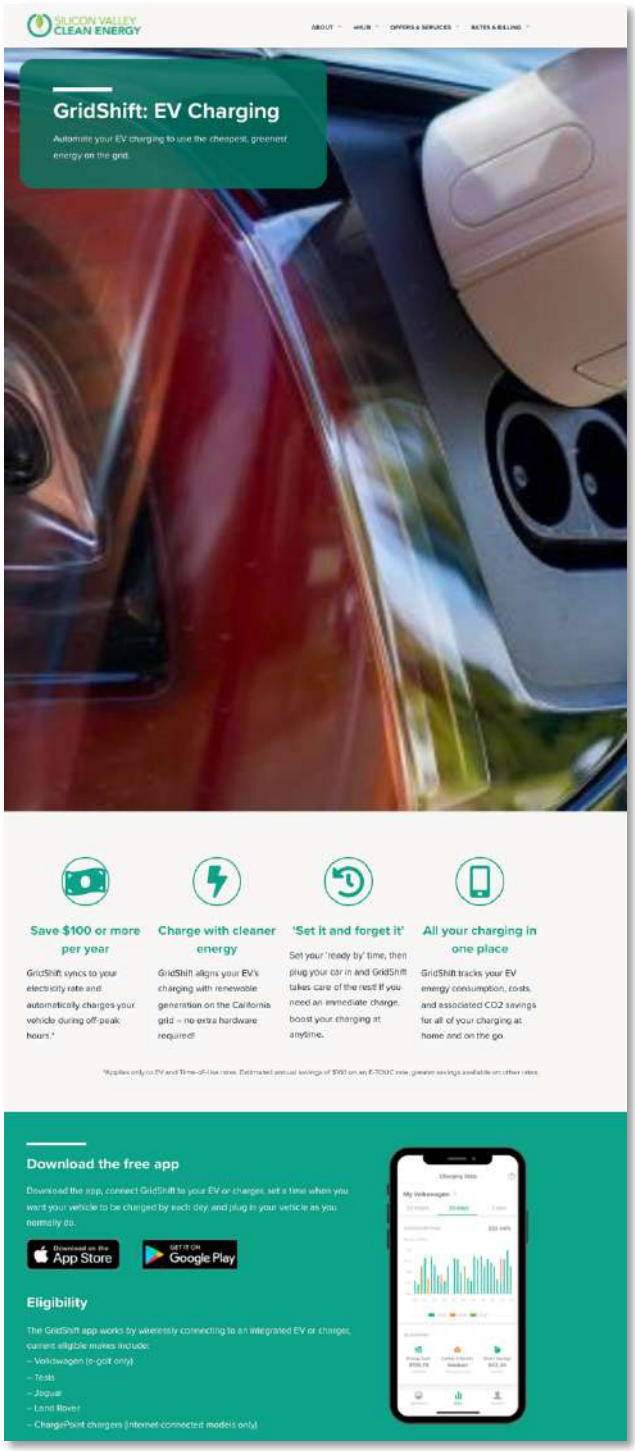
As described in Section 1A, there were a number of aspects of the customer enrollment and on-boarding process from the pilot phase that could be improved upon for a full-scale GridShift program. These include:

- A GridShift program landing page with full details on the program's goals, financial incentives, and benefits;
- A publicly-available app that does not require TestFlight or Google Play private access to download; and
- An in-app participation agreement that customers must agree to in order to proceed with on-boarding.

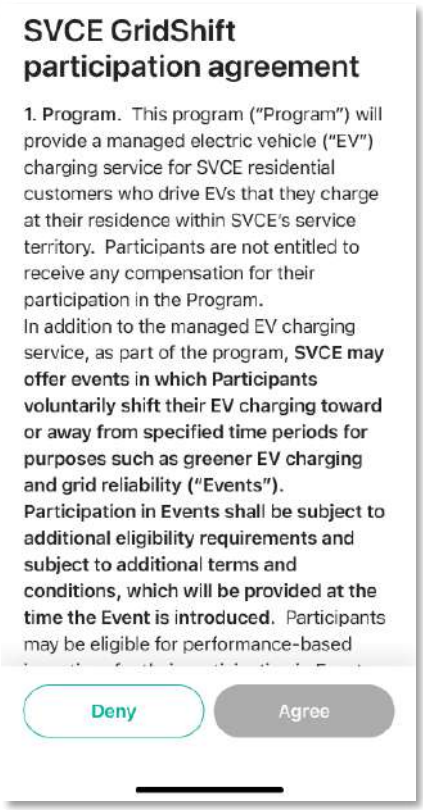
With the above changes in place, a prospective SVCE GridShift customer will go through the following on-boarding journey:



1. Receive an email or other digital communication introducing them to the GridShift program and its benefits



2. Be directed to the GridShift landing page, which contains links to download the publicly-available app from the App Store and Google Play; and



3. Agree to the GridShift participation agreement within the app, in order to proceed with on-boarding. ev.energy saves the time and date that each customer agrees to the participation agreement on its back end.

C. Additional event types

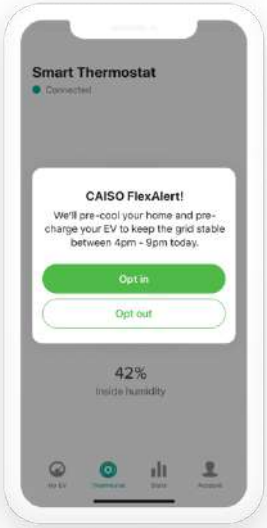
The low-carbon events trialled in March-April 2021 proved that EV customers could successfully be engaged and incentivized to alter their charging behavior during discrete events, and that active load management could shift charging into or away from the event as desired by the CCA.

As the California energy market continues to evolve, with the CPUC putting increasing pressure on the IOUs and CCAs to provide resource adequacy and other grid services during the summer months, GridShift should seek to test and deploy additional "summer grid resiliency" events in response to:

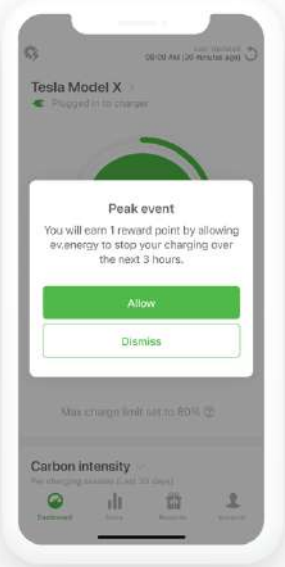
- CAISO Flex Alerts
- PG&E-defined ELRP dispatches
- PG&E-defined PSPS events
- SVCE-defined events, e.g. through a Market Access Program.

To deliver the above events, ev.energy could leverage integrations with the CAISO as well as an SVCE admin portal to schedule and dispatch events, with the ability to specify event start/stop time, the text that will be shown to customers via a push notification, and the time the notification will be sent out. Any "turn down" events such as CAISO Flex Alerts or ELRP dispatches would result in a modification to ev.energy's optimization algorithm that avoids as much charging as possible during the event window, with the customer still able to over-ride by pressing the Boost button. Any "re-dispatch" events such as a PSPS event would result in a modification to the optimization algorithm that seeks to schedule and complete charging e.g. before a Public Safety Power Shut-off.

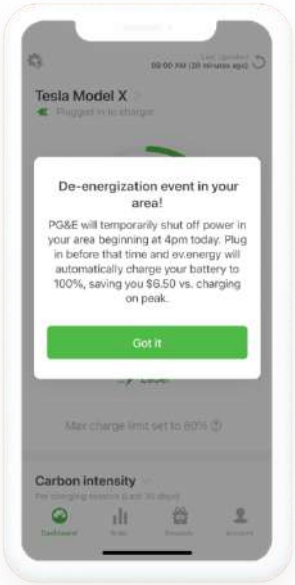
Mock-ups of how these events could be deployed to customers via the GridShift app, with a range of different language and opt-in/opt-out capabilities, are shown below.



In this example, a CAISO Flex Alert would notify a customer that their charging schedule will be modified to avoid energy consumption during the event, with the ability for the customer to opt in (i.e. modify charging schedule) or opt out (i.e. charge as normal).



In this example, an ELRP event would be messaged to customers as a “Peak event,” and customers would have the ability to earn 1 point by opting into charge curtailment. Points could either be exchanged for tickets into a raffle for a larger bill-credit prize (e.g. $100 off your energy bill) or could instead be redeemed via an SVCE-defined exchange rate (e.g. 5 points = $5 bill credit, maximum one redemption per month).



In this example, a PSPS event would be messaged to customers as a “de-energization event” and customers will be notified that their vehicle would automatically be charged to their specified battery level prior to the power shut-off. When possible, the charging would take place during off-peak hours and savings would be communicated as part of behavioral nudging.

D. Equity considerations

SVCE’s service territory generally scores low (<60) on CalEnviroScreen’s 4.0 methodology, with notable exceptions in Milpitas, Morgan Hill and Gilroy (see Figure 11 below).

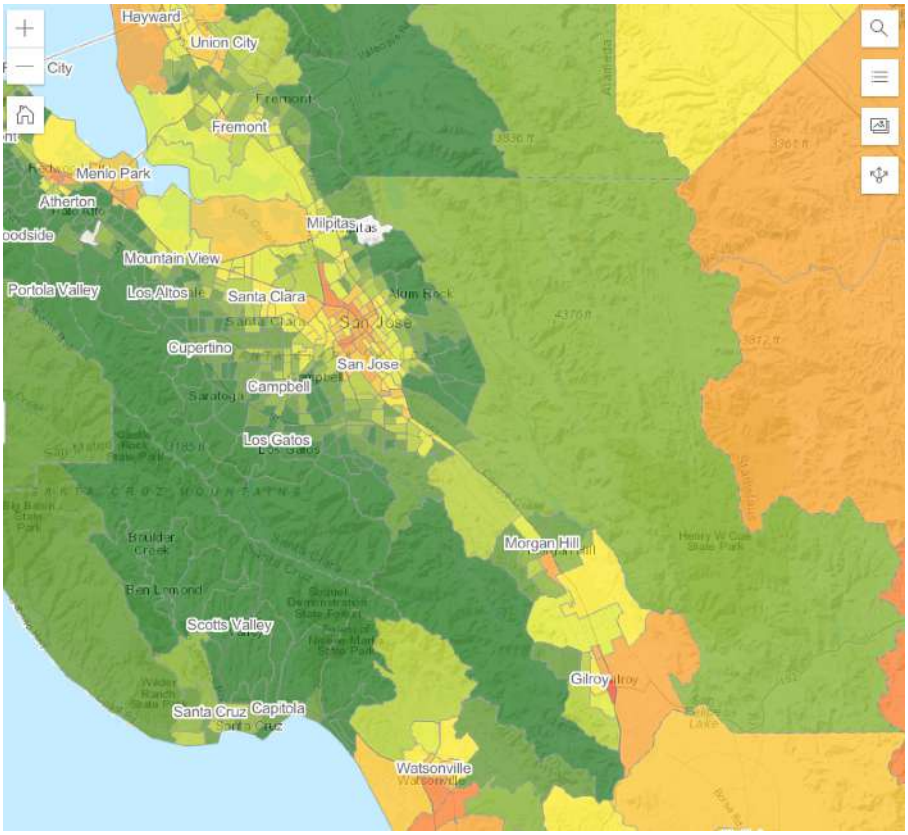


Figure 11.CalEnviroSCreen 4.0 scores across SVCE service territory

Milpitas contains neighborhoods with CalEnviroScreen scores of 67-80, suggesting a community that is disproportionately burdened by multiple sources of pollution and with population characteristics that make them more sensitive to pollution. More specifically, Milpitas is characterized by a high (>90%) traffic density percentile, meaning that the city's traffic density is higher than 92% of the census tracts in California (see Figure 12 below).

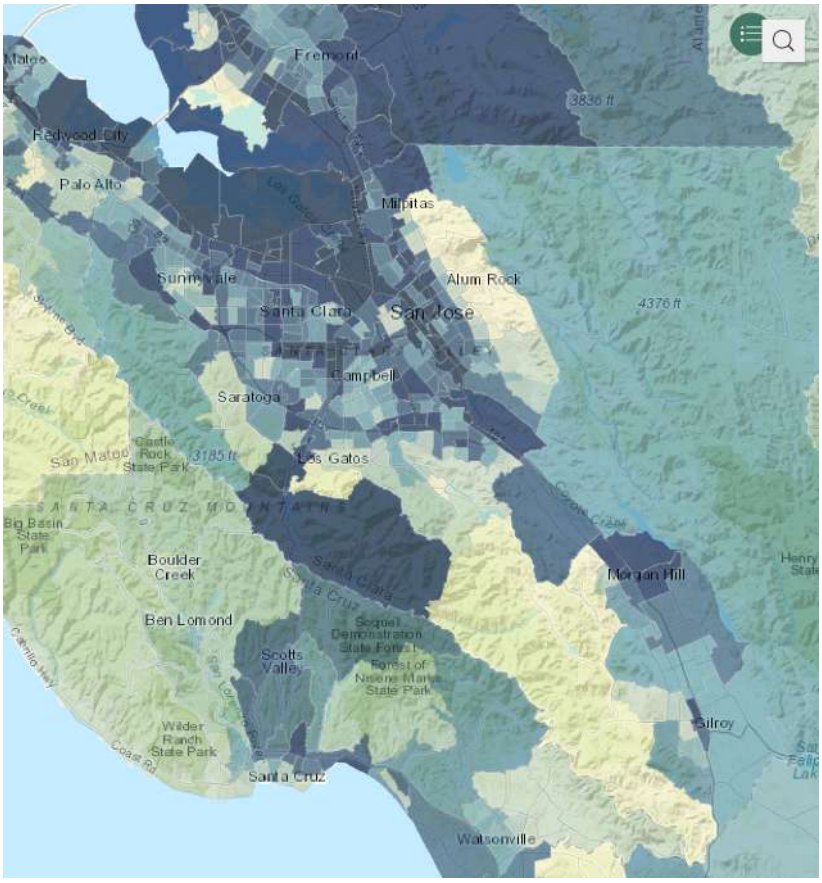


Figure 12. CalEnviroScreen 4.0 traffic census

Similarly, Morgan Hill is characterized by a CalEnviroScreen score of 72, and a traffic density percentile of 84. Gilroy is also characterized by a high CalEnviroScreen score of 93 and traffic density percentile of 83.

Taking these considerations into account, the GridShift program could be leveraged in order to (i) lower barriers for EV adoption for the residents of Milpitas, Morgan Hill and Gilroy, thereby reducing the air pollution particulate matter arising from high traffic density in these neighborhoods and (ii) ensure equity of access to GridShift's benefits, including off-peak charging and monthly bill credits. Combined with SVCE's EV assistant, residents of these front-line communities could be encouraged to transition to electric vehicles, and even offered EV purchase rebates for income-qualifying customers (see for example MCE's EV rebate program). To ensure equity of access to the GridShift program, income-qualifying residents of these communities could receive one-time enrollment incentives and/or rebates for compatible EVSEs in the SVCE Appliances Assistant marketplace.

Beyond neighborhoods and communities, it is also important to consider customer eligibility and equity of access to the GridShift program as defined by hardware compatibility. To analyze whether EVs registered in ZIP codes with higher environmental burdens (also known as “front-line communities”) are more likely to skew towards a certain make or model, data from CalEnviroScreen 4.0 and the California DMV was analyzed. Given that SVCE’s service territory generally scores low (<60) on CalEnviroScreen indicators, SVCE provided SEVI (SocioEconomic Vulnerability Index) scores that were normalized to the relative affluence of its service territory. SEVI scores ranged from 0 to 1, with 1 indicating the highest levels of housing burden, linguistic isolation, poverty, and unemployment.

The data shown in Figure 10 on p.13 above reflects all currently-registered electric vehicles with the California DMV as of January 2021. Non-residential makes, for example BlueBird buses and GEM golf carts, were excluded from the analysis. Figure 10 therefore serves as an important reference point in this analysis; a point of comparison for ZIP codes with high SEVI scores.

Figure 13 below shows the breakdown of currently-registered electric vehicles in ZIP codes with SEVI scores in the 3rd and 4th quartiles within SVCE territory (i.e. SEVI scores of 60 and above). As with Figure 10, non-residential vehicles were excluded from the analysis. Figure 13 shows that, even among SVCE customers living in communities with higher SEVI scores, Tesla remains the dominant OEM with 45% of all vehicles registered. The 5 percentage-point difference between the 3rd/4th quartile group and all SVCE customers is accounted for by 1 percentage-point higher market shares of Chevrolet, Toyota, Nissan and Ford vehicles.

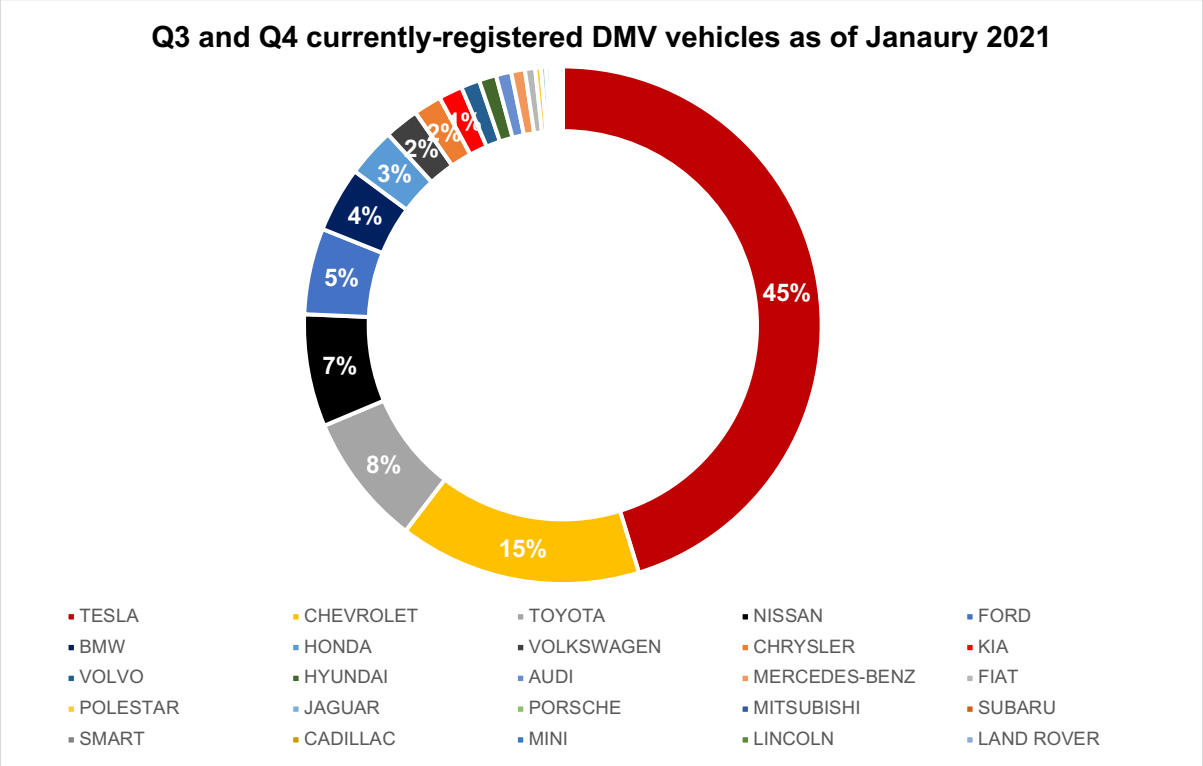


Figure 13. Breakdown of electric vehicles registered in SVCE ZIP codes with SEVI scores of 0.6 or higher.

For comparison with Figures 10 and 13, Figure 14 below shows the breakdown of currently-registered electric vehicles in ZIP codes with SEVI scores in only the 4th quartile (i.e. SEVI scores of 0.8 and above). The data in Figure 14 shows a notably lower market share of Teslas, with correspondingly higher market shares of Chevrolet, Toyota, Ford, and Nissan vehicles. Looking only at 4th quartile EVs, Ford overtakes Nissan in terms of market share, while Chevrolet and Toyota display slightly larger market shares than for 3rd/4th quartile EVs (Figure 13), and all EVs (Figure 10).

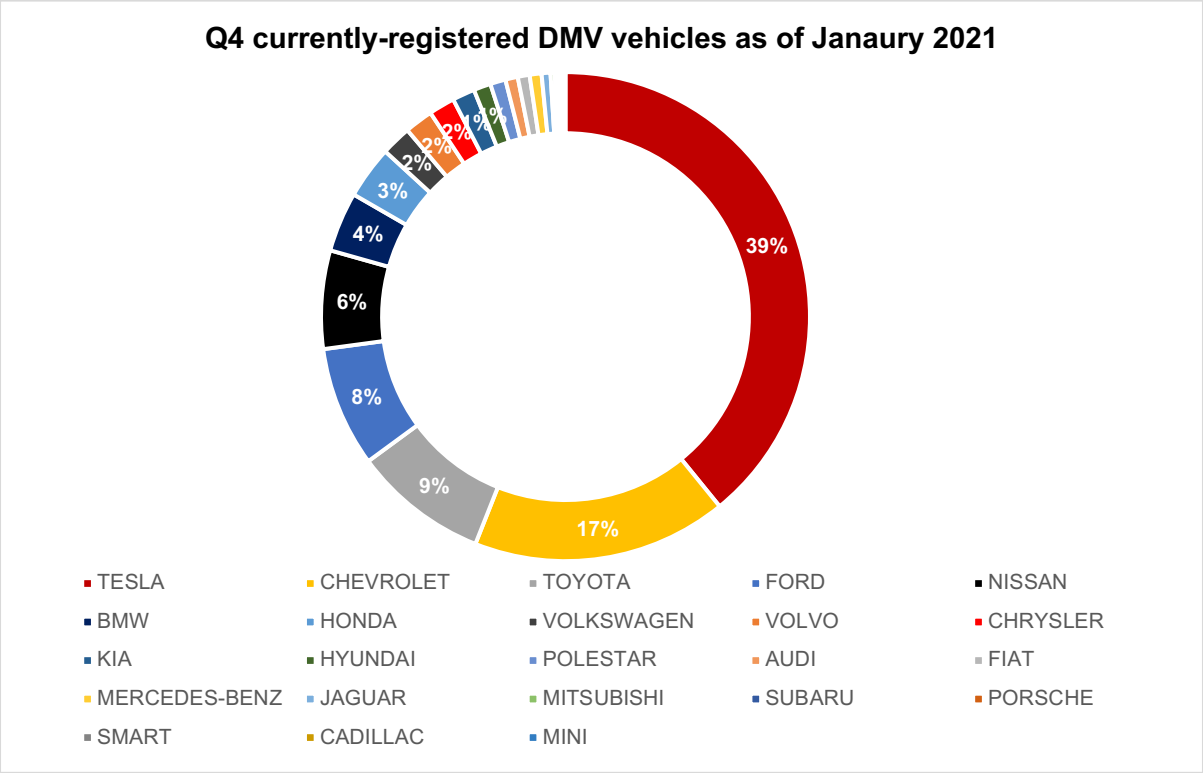
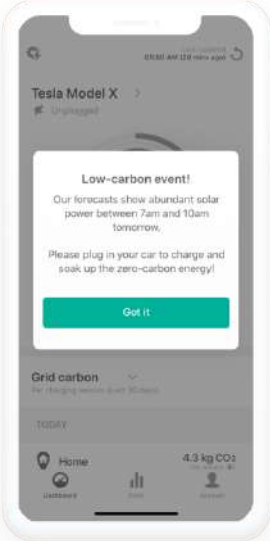


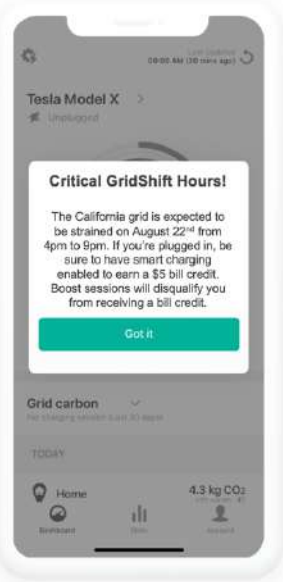
Figure 14. Breakdown of electric vehicles registered in SVCE ZIP codes with SEVI scores of 0.8 or higher.

The above data suggests that GridShift's existing compatibility of Tesla and Volkswagen vehicles provides coverage to about 41% of SVCE customers living in communities with SEVI scores of 0.8 or higher. Looking forward, to further expand front-line community residents' eligibility for the GridShift program, integrations with Chevrolet, Nissan, Ford, Toyota and BMW vehicles would be highest priority. Given ev.energy's OEM integration roadmap that includes Chevrolet, Ford and BMW by early 2022, it can be expected that 70% of SVCE customers living in front-line communities will become eligible for the GridShift program.

E. Three customer propositions to deploy



The GridShift pilot demonstrated the success of low-carbon events and it is recommended that this proposition be continued as GridShift is scaled up. Low-carbon events enjoyed high levels of participation during the pilot: 70% of the GridShift pilot participants participated in at least one low-carbon event, with 30% sustaining long-term levels of participation such that they were eligible to receive a $20 bill credit in May 2021. The gamification element of the low-carbon events, in which customers earned 1 point per low-carbon event they participated in and points displayed in the 'rewards' panel of the app, seemed to resonate with customers: several customers wrote to ev.energy asking when they would receive their bill credit once they reached 8 points. However, the financial sustainability of such an incentive needs to be aligned with the value delivered to SVCE and to the planet. It is clear that low-carbon events should be included in the GridShift scale-up, and there is potential to have the budget for this program funded from the incremental LCFS credit claims generated through the data and reporting done by ev.energy and 3Degrees. SVCE may also want to test a lower level of incentives (e.g. maximum $5 of bill credits per month instead of an average of $10 per month during the pilot) and compare customer participation levels to assess customer price elasticity.



In Summer 2021, Critical GridShift Hours were piloted to test customers' willingness to respond to demand-response events, and to test ev.energy's ability to shift EV charging outside of the event hours. Given GridShift's success in shifting 95-98% of EV loads outside of the six event hours over the course of Summer 2021, with no customer boosting/opting-out of the events, it is recommended that this proposition be scaled up ahead of Summer 2022. Given the CPUC's proposed decision in the R.13-11-005 proceeding setting up a Market Access Program for Summer 2022, and SVCE's potential to administer a FLEXmarket, it is recommended that Critical GridShift Hours continue for summer 2022. However, the incentive structure will likely need to be altered to reflect the economics of the FLEXmarket, whereby a pot of money is set aside based on the estimated funds that would be disbursed based on Recurve's methodology, and said money is divided by the approximate number of customers forecast to participate to result in a total expected financial reward per customer over the Summer 2022 period. A dollar- or points-based incentive structure (e.g. $5 per event, or 1 point per event whereby 10 points = $50 bill credit) would likely establish an immediately visible and appealing financial reward for GridShift customers.

A third potential customer proposition not tied to seasonal events, but with potential to be incorporated to GridShift year-round, would be an anonymous community leaderboard that awards and congratulations GridShift customers who lead in SVCE's desired behaviors, e.g. off-peak charging, low-carbon charging, responsiveness to peak events, etc. Such leaderboards have been demonstrated to be highly effective gamification tools on fitness platforms such as Peloton and Strava, but also in community programs such as American Cancer Society relays and local fundraisers. A leaderboard could be established within the GridShift app through trophies or badges that are awarded to users upon completion of an SVCE-defined milestone, e.g. avoiding charging during 5/5 Critical GridShift Hours or being in the top 10% of SVCE customers in terms of grid emissions avoided through low-carbon charging. By leveraging behavioral science and positive messaging, such a leaderboard would not necessarily require any additional program budget or financial incentives from SVCE in order to reward desired charging behavior. Moreover, by keeping awards personal to the user, this design avoids having to publicly share any sensitive personal customer data. Examples of such leaderboard badges can be found below.