Excess Supply DR Pilot 2019 Summary and Findings (Public Version)

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1 Acknowledgements

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2 Executive Summary

This report summarizes the market context, project objectives, technical results and lessons learned for the Excess Supply Demand Response Pilot (XSP) from 2018-2019.

Background

California is rapidly making a transition towards a low carbon electric grid. This transformation and the rise of renewables, particularly solar, presents new operating challenges for grid operators. One challenge is an oversupply of renewable generation in the middle of the day, when supply exceeds demand. The two dominant tools in CAISO's toolbox today to mitigate oversupply conditions, include either curtailing renewables or exporting them using the real time energy market, the Energy Imbalance Market (EIM).[1] A second challenge associated with oversupply is increased ramping needs. The primary tool for the CPUC to solve ramping issues includes time-of-use (TOU) pricing where retail rates are aligned with wholesale grid conditions. However, retail rates are not always aligned with wholesale grid conditions because retail rates change much more slowly than the wholesale market transactions.

Figure 1 illustrates the significant growth trajectory of wind and solar curtailments within the CAISO balancing area. As previously mentioned, the EIM was designed to export otherwise curtailed energy and Table 1 shows the benefits that have materialized. The stark contrast in the order of magnitude between the two figures illustrates the important function that the XSP can serve.

[1] Examples of energy policies to manage oversupply include: curtailment, exports, demand response, alignment of time-of-use (TOU) rates with the wholesale market, electric vehicles charging at times that align with grid needs, additional flexible resources, and exploring policies to reduce minimum operating levels for existing traditional generators.

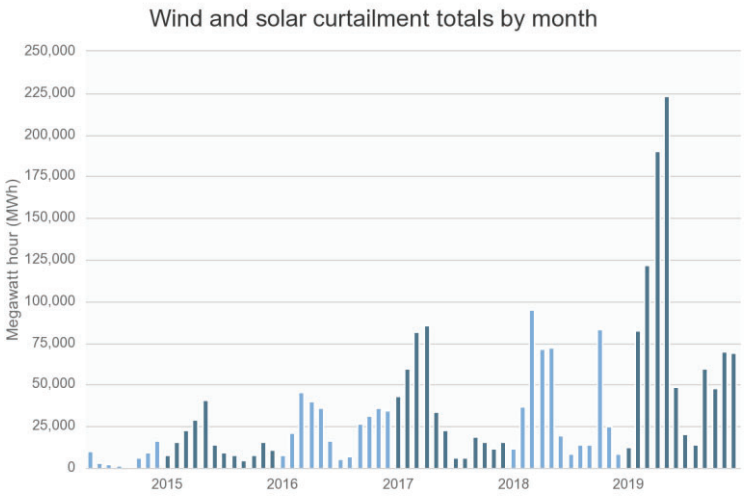

Figure 1: Renewable Curtailment[2]

Year	Quarter	MWh	Eq. Tons CO2
2018	1	65,860	28,188
	2	129,128	55,267
	3	19,032	8,146
	4	23,425	10,026
2019	1	52,254	22,365
	2	132,937	56,897
	3	33,843	14,485
	4	35,254	15,089

Table 1: Reduced Curtailment Due to Exports in the Real-Time Market (EIM)[3]

A significant amount of capacity in the CAISO interconnection queue are from variable-renewable resources. Left unmitigated, the renewable integration challenges related to oversupply and increased ramping needs will be exacerbated. The XSP serves to test a potential tool to address these integration challenges through assessing the ability of demand response participants to increase their loads above typical use in response to periods of over-supply. While many key accomplishments and important lessons have come out of the XSP, there are areas in which the

[2] CAISO Historical Curtailment. http://www.caiso.com/informed/Pages/ManagingOversupply.aspx.
[3] ISO – EIM Benefits Report. https://www.westerneim.com/Documents/ISO-EIMBenefitsReportQ4-2018.pdf.

XSP is limited in regards to the operational design of the pilot. These limitations stem from the lack of any existing dispatchable programmatic framework for load increase to draw from and the importance of maintaining a practical and testable framework such that complexity does not overshadow what is ultimately required to understand the feasibility of the XSP. As such, the pilot was:

- Not designed to require energy neutrality: Just as PDR in the wholesale market today only dispatches resources in one direction (load reduction), XSP dispatches were only in one direction (load increase or load decrease) without a directly corresponding opposite dispatch. Though the pilot did not require resources to be energy neutral, pilot participants still paid their full retail rates for the dispatched load increase, which was a disincentive to wasteful energy use as a response to an XSP event. Note that all resources were required to participate in load increase, with load decrease being added as an option for 2018.
- Not integrated into the CAISO market as a supply resource: Without a market model to use, the pilot was an out of market product, but designed in a manner to potentially enable market integration in the future.
- Not triggered by negative prices: Since the XSP was not bid into the wholesale market, pilot events were initially dispatched based on administrative decisions to test the overall construct of response to excess supply conditions. Instead, an over-supply trigger was implemented by PG&E as a method to dispatch resources based on forecasted grid conditions.

Key Accomplishments and Lessons Learned:

The following are key accomplishments and lessons learned from the pre-operational and operational phases of this pilot:

Pre-Operations

- Organizational Roles: The pilot helped in developing and establishing organizational roles and operational handoffs between different groups within PG&E as well as between PG&E and a third-party to administer the pilot.
- Enrollment: Through the pilot's enrollment process, administrators gained insights into why there was greater interest up front versus actual enrollment. Reasons for decreased enrollment versus interest may be attributable to: education, ability to provide load increase, alternatives which would prohibit participation due to dual participation rules, and the short-term nature of the pilot.
- Customer Classes: There was much more interest from larger commercial participants (customers and aggregators) than from residential or small commercial participants.

Operations

- Response: The pilot successfully demonstrated the use of participants to respond to excess supply events. In addition, certain participants were also able to respond to load decrease events within the same day (multiple starts per day).

- Managing Demand Charges: Multiple participants demonstrated their ability to avoid incremental demand charges through their bidding behavior by selecting an availability period that is not coincident with their current monthly maximum demand or peak demand for any of the time-of-use (TOU) periods (e.g., peak and part-peak) so that responding to an XSP event will not set a new monthly peak or TOU peak demands.
- Distribution Planning and Operations: Any excess supply product can have a positive or negative impact to the distribution system depending on multiple factors, including the location, size, duration, timing, composition, and concentration of the resources. A key concern for distribution planners is that distribution systems were designed to accommodate diverse loads where usage from similar devices, such as HVAC, is somewhat distributed and act independently from each other. Aggregating these small but numerous loads into a biddable product will require participants to react in the same manner at same time, which is not something that was anticipated and could cause issues for distribution planners and operators.

Recommendations:

For future potential initiatives and proceedings examining new DR models,[4] PG&E offers the following program and operational recommendations leveraging the experience of XSP.

Program Recommendations:

- Grid Needs: Any product should serve grid needs associated with renewable integration challenges and be compensated for the service it provides to the grid based on market prices.
- Technology Neutral: An excess supply product should be technology agnostic to enable any end use to provide excess supply. We acknowledge that like the existing DR model providing curtailment service today, some technologies may thrive using this new DR product while others may not.
- Not Energy Neutral: While suggested by some participants, an excess supply product should not necessarily be energy neutral, where the pairing of an equal amount of load increase with load decrease during a certain interval would be required. This does not appear to be either feasible in CAISO's optimization today or aligned with grid needs as there may be some days in which a load increase may be needed more than a load decrease

[4] Both the CPUC's Load Shift Working Group and the CAISO's Energy Storage and Distributed Energy Resources Initiative Phase 3 examined load shift or load increase products.

- The CPUC's Load Shift Working Group explored developing new models of a technology agnostic load shift product. More information is available on the facilitator, Gridworks' website: https://gridworks.org/initiatives/load-shift-working-group/
- CAISO's ESDER 3 initiative, among other enhancements a load shift product specific for behind-the-meter energy storage; noting this product may be deferred and reconsidered in the ESDER 4 initiative underway in 2019. More information is available on CAISO's ESDER website: https://www.caiso.com/informed/Pages/StakeholderProcesses/EnergyStorage_DistributedEnergyResources.aspx

product. In addition, as long as participants continue to be subject to retail energy charges, there is a disincentive to wasteful energy use as a response to a load increase event.

- Additional Discussion is Needed Regarding Aggregation Size: The aggregation size will need to find the right balance between the sub-lap requirement, which is generally considered too large to manage local grid conditions, and conversely too small of an area to aggregate customers. If the ultimate objective of an excess supply product is to also address local distribution system constraints, it could be that a geographically smaller aggregation based on local areas within a sub-LAP may better mitigate over supply at the distribution level.
- Participation payments are a requirement: The related project, the SSP, as well as the feedback from the LSWG, has provided clear data on the relatively low revenues to be achieved from CAISO market participation based on wholesale energy payments alone (noting that for load increase these energy payments stem from negative wholesale pricing). Without a participation incentive, participation in load increase programs cannot be incentivized sufficiently from such energy payments. Additionally, in order to achieve cost-effective results, the participation incentive should be correlated to actual grid needs, which include locational dependencies.

Operational Recommendations:

- Availability: Periods of availability should be based on grid needs—taking into consideration the participating resources location on the distribution system—with flexibility to reflect participants' abilities to respond. As part of this, participants should be allowed to specify their availability to provide load increase, though care should be taken to prevent load increase availability from interfering with any other market obligations. For example, a participant that is also providing load reduction for Resource Adequacy (RA) should not specify an availability period for load increase during the RA availability assessment hours.
- Most Valuable Days and Seasons: Not all days/months are equal in their value to the grid in providing support to reduce excess supply. Current grid conditions indicate that an excess supply product is more valuable to the grid on weekends and during the winter and spring months than on weekdays and during the summer. This is substantially different from the historical perspective that load reducing DR is most valuable during weekdays in the summer. Determining a way to incentivize this will be important to the future development of this product.
- Frequency: Frequency of dispatch should be based on the resource's capabilities, which is driven by the underlying customer abilities. The current XSP pilot recommends a maximum of once per day to align with the one start per day use limitation available to the CAISO's Proxy Demand Resource (PDR) product.
- Distribution Planning and Operations: Due to the potential impact of a load increase product on distribution planning and operations, it is imperative that development and

operation of this type of product be integrated with distribution planning and operations groups or as part of any future interconnection process (Rule 21).

Conclusion and Next Steps

The XSP has been successful in gaining learnings in a number of its key objectives and, in doing so, has directly and indirectly addressed multiple barriers to renewable integration challenges. In addition, these learnings have helped inform ongoing proceedings at the CPUC and CAISO. The XSP is also being looked at and utilized by other groups. For example, site hosts in PG&E's Electric Vehicle Charge Network (EVCN) program can meet the EVCN's load management plan requirement by participating in the XSP. Including EVCN participants in the XSP will enable the pilot to incorporate a technology (electric vehicles) and customer classes (smaller commercial and multi-unit residential) that have been absent from the program. While remaining technology agnostic, the inclusion of new types of technologies and customer classes will provide expanded learnings in understanding which technologies may thrive with this new DR model.

While much has been learned, there are still unanswered questions around what should trigger an excess supply event, the effects on local distribution planning and operations, and the interaction with other DR programs that provide load reduction. Based on feedback and learnings from the XSP so far, and as part of continuing to gain insights into the previously mentioned issues, the following efforts are being planned for the XSP:

- Continue to refine the event trigger mechanism to trigger events when excess supply situations are likely to occur and,
- Continue to provide real-world input into ongoing stakeholder efforts at the CPUC and CAISO;
- Evaluate the value of negative market prices to the incentive structure;
- Continue with the development of the EVCN participation option.
- Recruit new participants into XSP to robustly test the new XSP feature set delivered in 2018.

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3 Introduction

3.1 Regulatory Background

As part of the 2015-2016 DR funding bridge, the Commission approved the XSP in Decision (D.) 14-05-025, and the pilot was initiated in 2016. Since the pilot had been active for less than a year, which did not allow much time for testing, PG&E received approval from the Commission to continue the pilot through 2017 in D.16-06-029 and then from 2018 – 2020 in D.17-12-003.

Current California policies, new State renewable energy goals, and penetration of new end use technologies add complexity to future grid needs. A key example of such challenges is the California Independent System Operator (CAISO) is experiencing steep ramps during winter and spring with California's current Renewable Portfolio Standard (RPS) mandate of 60% by 2030 and 100% carbon-free generation resources by 2045[5].

There has been much written about the changing net load curve, where the "net load" is the total system load minus the renewable generation. This change from the conventional mid-day peak, due in large part to the increased penetration of renewables, dramatically impacts the system operational needs. This is often referred to as the "duck curve"; however, as PG&E has noted in previous presentations, "there are more than ducks in the zoo." Figure 2 shows this emerging reality with estimated net load curves for specific days in 2022.

[5] SB 100: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100

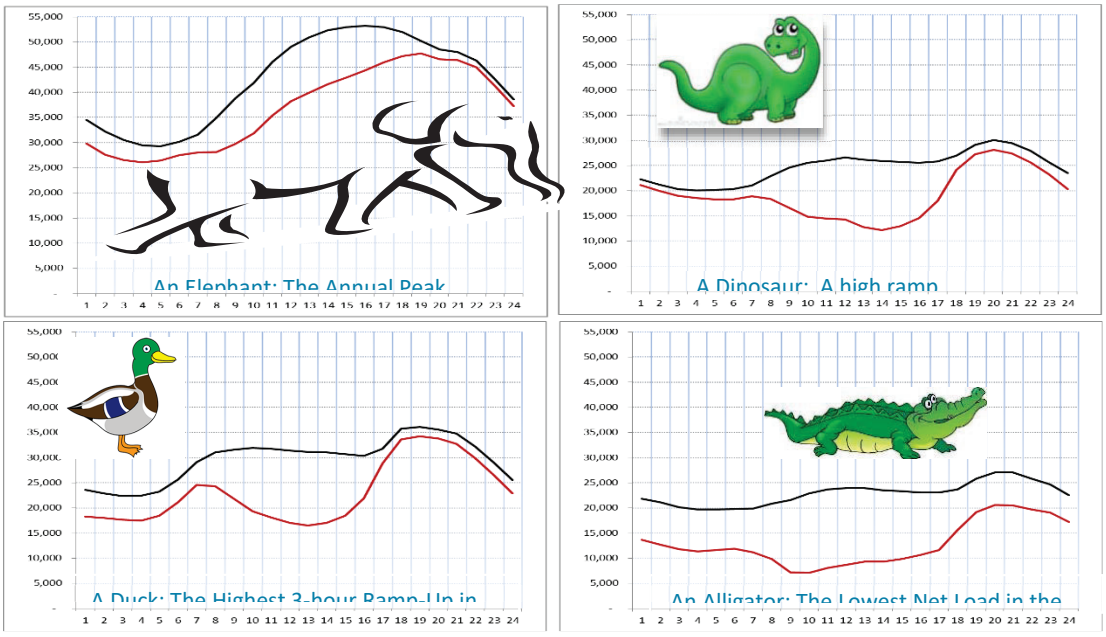


Figure 2: Many Animals in the Zoo

Figure 3 shows the average daily gross and net CAISO system load profile by month for 2013 - 2017. As seen in this figure, not only have the net load profiles changed in recent years, they fluctuate substantially over the course of a year. Unabated, it is expected that this trend will continue demonstrating the importance of a flexible solution that can be adapted to fit the ever-changing load profiles.

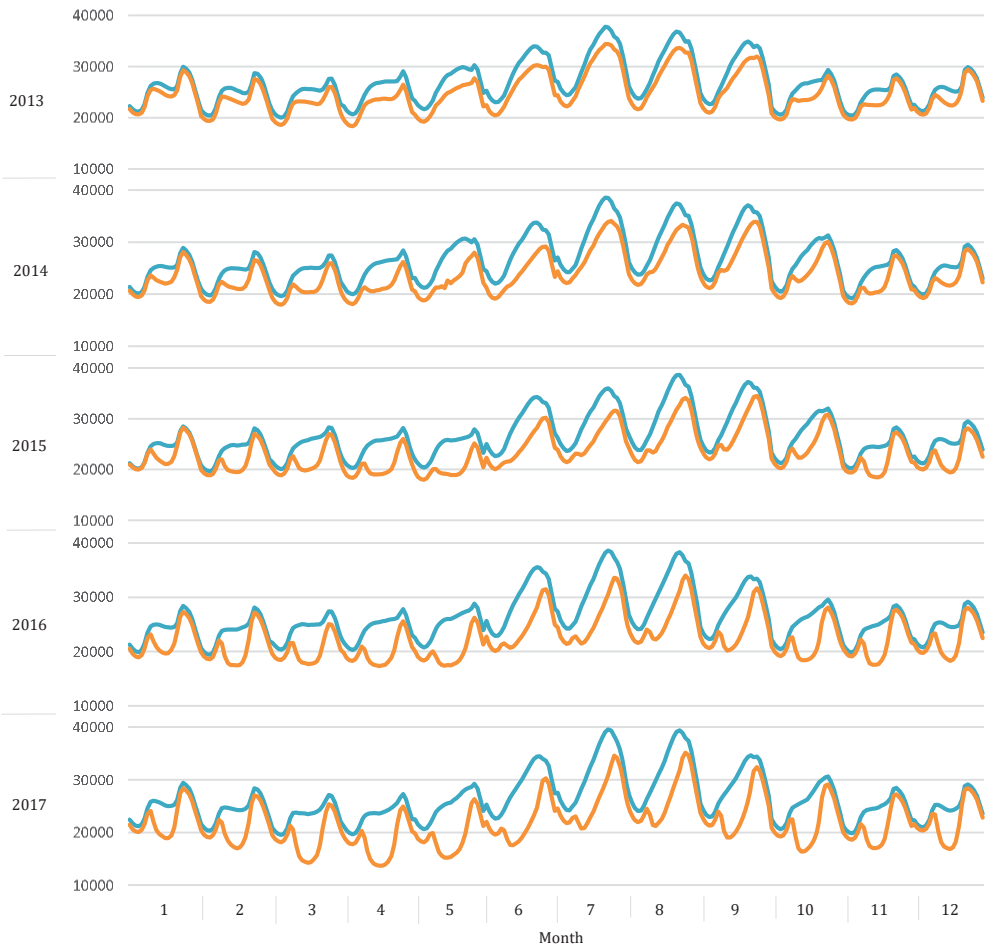


Figure 3: Average CAISO System Gross vs. Net Loads

These changes in net load, policy, and technology, create challenges to the grid in balancing against the capacity in transmission and distribution and require California to evaluate which market constructs and resources can address future grid needs. Examples of policy tools available to solve ramping issues include time-of-use (TOU) pricing where retail rates are aligned with wholesale grid conditions, exporting electricity during periods of excess supply, and curtailing renewable resources.

PG&E's Excess Supply DR Pilot (XSP) is investigating ways to incentivize customers to shift energy usage on demand as another possible way to mitigate these challenges. In the XSP, demand responsive loads are being considered as one of the many resources that can support in-state economical and reliability needs of the future grid. The XSP is a departure from other offerings in that it asks participants to shift energy usage to consume more energy at certain times to help mitigate situations of excess supply. By getting customers to shift their energy consumption to align with periods of excess supply, the XSP hopes to demonstrate that customers can actively assist with renewables integration and improve alignment of supply and demand. In 2018, the

XSP was expanded to support bidirectional demand responsive loads by giving participants the option to participate in load decrease events in addition to load increase events.

There is currently no mechanism for bidding load-increasing DR into the CAISO market, resulting in this pilot being an out-of-market program with simulated events. PG&E has been working with the CAISO and other stakeholders as part of the Energy Storage and Distributed Energy Resource (ESDER) initiative to expand the Proxy Demand Resource (PDR) product to allow demand response (DR) to provide load-increasing bids in the CAISO market. As of September 2018, the CAISO's proposed load shift product was approved by the CAISO Board of Governors, noting that at the time of the completion of this report the implementation phase has been deferred to at least 2020 with the prospect of revisiting its design. In addition, the CPUC assessed similar load increasing capabilities (i.e., Load Shift) as part of the Load Shift Working Group which published a report of recommendations drawing on lessons learned from the XSP.

The XSP also provides pathways for new technologies. PG&E believes that technologies adopted behind the customers' meters, such as storage or smart devices, have a vital role to serve as grid-responsive assets. DR programs will act as gateways for participants to provide their demand and energy shifts that are tied to when excess supply is occurring. Results of the XSP will help PG&E and the CPUC assess the benefits of DR as a gateway to grid needs and benefits and, in addition, provide an in-depth understanding of the benefits of technologies, like energy storage and electric vehicles.

In addition to traditional demand response that addresses summer peak shaving, new DR offerings must be constructed to meet future transmission and distribution grid needs. PG&E has a history of developing such offerings within pilots and then incorporating the learnings into full-scale programs, including this pilot as well as the recent and related Supply Side II DR Pilot (SSP II)[6].

3.2 Program Objectives & Progress

Captured below are the stated objectives of the XSP, as captured in PG&E's 2018 –2022 DR Application Supplemental Testimony[7], and the current progress of the pilot:

1. Inform the design of a future program by conducting field testing of the actions required from PG&E, customers, and third-party aggregators so that load can be increased when excess supply conditions exist:

   As part of D. 17-10-017, the CPUC ordered the formation of the Load Side Working Group with the objective of defining and developing potential new load shift participation models enabling bi-directional DR resources. The CAISO is

[6] The SSP II has been testing aspects of integrating load reduction DR resources in the CAISO market while also providing distribution needs.

[7] A. 17-01-012, Supplemental Testimony titled PROPOSED IMPROVEMENTS TO EXISTING PG&E-IMPLEMENTED PROGRAMS AND PILOTS, Section D, at pp. 2-A2-2 to 2-A2-3 (February 3, 2017).

concurrently engaging stakeholders in the development of a load shift product (PDR-LSR) through the ESDER 3 initiative. The XSP has directly informed or been referenced in the discussions in these proceedings and technical working groups as it is able to provide key learnings and considerations from actual implementation of a load increase participation model.

The XSP has also been a test-bed for maturing and nascent technologies. Electric vehicles have long been referenced for their demand responsiveness potential which is significant as the number of EVs, and their associated electricity demand, continues to grow. Many insights into the ability of passenger and commercial EVs to respond to load increase or decrease signals have been gained through the inclusion of the EVCN-LMP and PUSD programs into the XSP. As the efforts to manage oversupply continue to evolve and mature, the work done in the XSP can and will continue to provide value to those efforts.

2. Assess what triggers, other than CAISO energy market pricing, can be used to call events as early as possible to allow a sufficient amount of time to notify participants of an event:

   An initial focus of the XSP was to understand whether participants would be able to respond to frequent load increase dispatches, thus the decision was made to trigger events administratively. This ensured that a target number of events could be called per month. This target would have been much more difficult to achieve consistently using a market-based trigger. With the administrative trigger, participants were provided dispatch instructions by 1pm on a day-ahead basis, which aligns with the CAISOs award publishing timeline.

   In May 2018, the XSP began implementing PG&E's oversupply forecast to trigger XSP events. The forecast was provided on a day-ahead basis and is an hourly probability of oversupply on PG&E's system. A probability percentage trigger was set administratively and XSP events would be called if the trigger was met. Seasonal variability in the oversupply projections necessitated a dynamic trigger. A trigger that worked for the Spring season does not work for the Winter season, thus had to be adjusted downward in the Winter season.

   In August 2018, Participants were given the option to be expand the services their resource could provide and be economically dispatched for load decrease. As a result, 2 triggers had to be assessed before delivering dispatch instructions. This lengthened the notification timeline to 5 PM on a day-ahead basis.

3. Experiment with compensation methodologies to participants and the interactions with retail rates;

   Similar to existing DR programs, the XSP compensated participants by providing a monthly capacity payment ($/kW-month) which is then adjusted based on the participant's monthly event performance. To disincentivize wasteful energy use in response to XSP events, Participants were not compensated or charged for energy as part of the XSP. In the recruitment phase, a notable concern brought up by prospective participants was the effect of XSP events on retail demand charges. To address this concern, a demand charge offset—which offset a portion of

incrementally incurred TOU demand charges—was added as part of the Pilot compensation structure, which ultimately led to greater participation in the XSP. Additionally, the XSP has shown that Participants can mitigate demand charges by strategically selecting their nomination period such that their availability period does not coincide with their usual monthly maximum and TOU demand charges. New TOU periods were adopted for non-residential customers in D. 18-08-013. This shifting of the Peak TOU period away from times of oversupply will likely be another positive mitigating factor for participating in an XSP-like program.
Additionally, efforts are underway in 2020 to implement an updated compensation methodology in the EVCN-LMP program as a way to address the poor event performance that has been seen in the program early on. To contrast with the currently implemented capacity payment, an energy only payment will be provided as an option to participants. Given that capacity payments are, in essence, compensation for reliability, the lack of reliability from EVCN-LMP participants has led to a reevaluation to better align reliability to compensation. Insights into site hosts and EVSPs will be gained by observing whether the energy only payment will be favored over the capacity payment.
In addition to compensation methodologies, the allocation of monies between the stakeholders involved is also crucial to influencing the desired result. The current allocation of incentive monies between stakeholders is another hypothesis for the poor event performance.

4. Factor the local distribution constraints systematically in the XSP's operations to ensure that, when situations of excess supply occur at the CAISO's Sub Load Aggregation Point level, the actions taken by participants do not create congestion on the distribution system;
   As part of the enrollment process, the pilot team worked a with distribution engineer to compose an ad-hoc report that studied the distribution impact based on participant's location, usage, existing generation and expected load shift-consumption changes. The ad-hoc report evaluated existing base cases studying the bank's capability, peak load and existing generation across various seasonal peaks. The distribution engineer would then evaluate the participant's assumptions and test against various study screens such as (a) penetration and overload tests, (b) substation bank overloading, (c) feeder and device penetration and (d) variety of voltage and power quality assessments. If the participant's assumptions did not have a negative impact, it would proceed and activate. As BTM technologies mature and proliferation of customer adoption increases, re-occurring assessment may be needed to ensure no harm is done to the various assets that make up the distribution system.
5. Explore baseline methodologies and evaluate whether they lead to an understanding of the performance of a DR resource that is asked to consume more energy.
   - To poise the XSP for use as a market integrated resource, the Pilot adopted the CAISO 10-in-10 baseline methodology, which has traditionally been used

to calculate load decreasing DR. The 10-in-10 methodology has yielded good results for the XSP however, it is not without its shortcomings. Challenges with the multiplicative adjustments were found in cases where the load was positive during the adjustment period, but the profile used to calculate the day-of adjustment was negative. Frequent dispatches also pose a challenge to the 10-in-10 methodology when acceptable baseline days cannot be found, resulting in the use of past event days in the baseline.
Note that in November 2018, the CAISO established several new baseline methodologies including:

- A residential specific day-matching baseline, called a "5-in-10" baseline.
- A weather matching baseline that uses actual temperature data to determine baseline usage.
- A control group methodology

These new baseline methodologies can be explored as appropriate taking into account the customer sector and underlying demand response technology.

3.3 Pilot Roles and Responsibilities

The pilot team roles and responsibilities are identified in Figure 4. Both single customers and aggregators are eligible to participate in the XSP. Olivine serves as the pilot administrator enabling participation through the Olivine DER software platform. Olivine provides the primary interface between participant and pilot, including development of informational and educational material, participant recruitment, enrollment and registration; nominations; award and dispatch notifications; meter data aggregation; resource certification; and calculation of settlements and payments. In addition to the pilot sponsor, PG&E is the overall program manager and is responsible for tasks such as leading program design, managing the overall pilot budget, approving informational and educational material, working with Olivine on participant education and recruitment, approving participant applications, developing the quantitative assessment of when to trigger pilot events, and managing meter data delivery to Olivine. PG&E is also responsible for overall policy and strategy development that became the basis for the pilot.

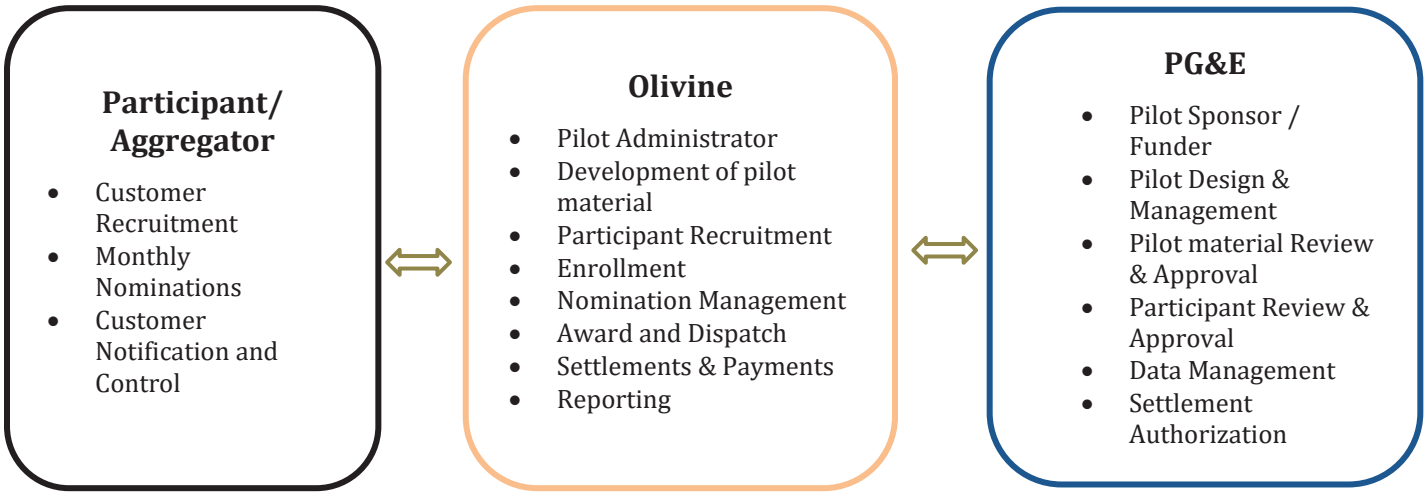


Figure 4: Entities Involved in the Pilot and their Roles

4 XSP Participation

To participate in the XSP, participants need to meet several requirements for eligibility and enrollment, detailed in this section. For the XSP, the term "participant" refers to the party that enrolls in the pilot and makes decisions related to when to participate and how to respond to events. Participants can be:

- Retail non-residential customers with individual locations that meet minimum load requirements,
- Retail non-residential customers with multiple locations, or
- Third-party aggregators that aggregated a group of individual retail and/or residential customer loads.

4.1 Customer Eligibility

The term "customer" refers to the retail end-customer (i.e., the entity that has a service agreement (SA) with PG&E). Initially, the XSP was only open to residential and small commercial customers who were on retail rates that did not include a demand charge component[8]. This was to avoid the possibility of increasing the customers' demand charges due to responding to a load increase event. However, due to low interest in participation from these customers classes and high interest from larger non-residential customers, pilot eligibility was expanded to include large non-residential customers.

The XSP is open to PG&E bundled retail customers as well as unbundled retail customers who receive energy procurement services from a Community Choice Aggregator (CCA) or Electric Service Provider (ESP).

4.2 XSP Resource Composition

The XSP organizes customer locations into aggregations called resources. To poise the pilot for use as a market integrated product in the future, many of the resource requirements mimic how the CAISO defined its proxy demand resource (PDR). While not strictly necessary for the XSP, this resource organization is maintained within the XSP for two reasons:

1. Any future CAISO product that would support increased demand would very likely maintain these resource characteristics; and,
2. Originally, to facilitate multiple participation in the related Supply Side II DR Pilot (SSP II); however, with the addition of the load decrease option in the XSP in 2018, multiple participation is no longer allowed.

An XSP resource is composed of either a single customer location or an aggregation of customer locations. For example, an aggregator can assemble a collection of commercial or residential

[8] In general, residential and small commercial customers are not exposed to the demand charges.

customers into a resource that can then participate in the XSP. A large customer may also directly enroll one or more locations, if the set of locations meets the eligibility requirements. In general, each participant in the XSP is allowed to enroll a single resource that needed to meet the requirements detailed in the following sections. On a case-by-case basis, participants can enroll additional resources if PG&E determined that the additional resource was unique in some way that is not already reflected in pilot participants and could benefit the pilot. Reasons for allowing additional resources include new customer types, geographic areas, or methods/technologies used to respond to events.

4.2.1 Minimum Load Increase

In the original XSP, resources were required to be able to achieve a minimum of 30 kW load increase for up to 2 hours over a participant-defined 4-hour period. This size requirement was chosen to enable dual participation with the SSP II pilot. Note that this requirement allowed for the participant to achieve this increase at any time of day to meet this requirement. As part of the rule changes to the XSP in August 2018, participants now have to achieve a 30 kW increase for 2 hours during a contiguous 5-hour period between 8 AM – 4 PM. See section 4.3.1 for more information on the performance measurements.

4.2.2 Minimum Load Decrease

The Load Decrease option was introduced as part of the XSP rule updates, that came into effect on August 2018, to enable participants the ability to also be dispatched for load decrease events. Resources partaking in load decrease can be wholesale market integrated under the CAISO PDR product, if the resource can meet CAISO requirements. Regardless, the operations are designed with active wholesale market participation in mind. XSP resources that also elect to participate in load decrease are required to be able to achieve a minimum of 30 kW load decrease for up to 4 hours between 4 PM and 9 PM on weekdays, corresponding to the CAISO system RA availability assessment hours. Upon the publication of the day-ahead market clearing prices, resources whose bids cleared were granted an award and subsequent dispatch.

4.2.3 Single Sub-Load Aggregation Point (sub-LAP)

A sub-LAP is a geographically defined area. As with PDR today, all locations within the XSP resource must be located within a single sub-LAP. Therefore, a resource cannot contain locations from both the East Bay and San Francisco. The need for a locational requirement stems from the fact that over-supply concerns may be localized on the transmission and distribution grid. The decision to use the sub-LAP as the area of localization stems from the following:

- If excess supply was a specific CAISO market product for behind-the-meter DER, it is reasonable to assume that resources offering the product would be constrained within Sub-LAP regions.
- Sub-LAP data on customers is relatively easily available from PG&E systems.
- Allowed XSP resources to also participate in the SSP; however, this option for multiple participation was ended in 2018.

Note there is a tension between the sub-LAP being too large of a geographic area to resolve distribution level constraints and too small of a geographic area for enrolling enough customers to meet minimum size requirements. This consideration is expanded upon in 6.4.6.

4.2.4 Dual Participation

Customers in the XSP are not allowed to participate in any other DR program, including Critical Peak Pricing (CPP) programs (SmartRate and Peak Day Pricing). If a customer already enrolled in another DR program wanted to enroll in the XSP, the customer had to unenroll in the other DR program first. While part of the reason was to prevent XSP participants from being in violation of the CPUC's established rules regarding participating in multiple DR programs (dual participation), the primary purpose was to reduce the administrative burden on the pilot. Administration of the XSP (including dispatches, performance calculations, and settlement calculations) were done by Olivine outside of the PG&E system. As such, there was no direct link between the systems that dispatch pilot events (and calculate the subsequent performance) and those that dispatch other PG&E DR program events (and calculate the subsequent performance). Having to establish and maintain this link would have been manual and an additional administrative burden. Therefore, dual participation was generally not allowed to ensure that there were not conflicting signals between the pilot dispatches and dispatches from other DR programs. Similarly, although not a CAISO-integrated product, customers participating in the XSP also could not be enrolled in a CAISO resource to avoid a conflict between wholesale market and out of market pilot dispatches.

As noted elsewhere, an exception to this prohibition on dual participation existed between the XSP and the SSP II; however, this practice was ended in 2018 with the addition of a load-decrease option to XSP.

4.2.5 Single Load Serving Entity (LSE)

The LSE is the entity responsible for procuring electricity for their customers. For bundled utility customers, the LSE is PG&E. For unbundled / Direct Access (DA) customers, the LSE is an Energy Service Provider (ESP) or Community Choice Aggregator (CCA).

As mentioned above, bundled as well as unbundled utility customers can participate in the XSP. However, while not required for the XSP, keeping consistent with the CAISO rules for PDRs, it was preferred that all enrolled customers in an XSP resource be served by one LSE. In November 2019, the single LSE requirement for CAISO resources was removed as part of the implementation of the ESDER Phase 3A stakeholder initiative.

4.3 XSP Rules

Aside from the eligibility requirements enumerated above to enter the XSP, participants have several requirements for qualification and ongoing participation to earn a participation payment. This is outlined in the following figure:

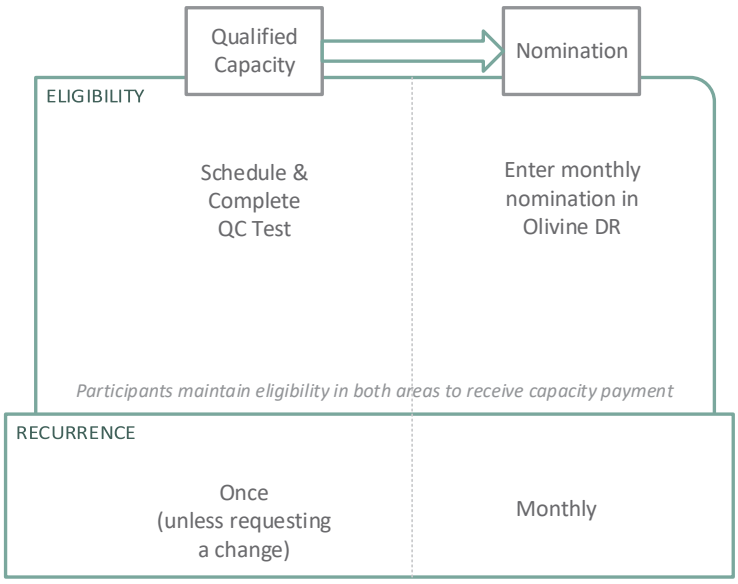


Figure 5: Participant Operational Tasks. Courtesy of Olivine, Inc.

The following sections walk through the various XSP rules, starting with performance methodology as this is a key to participation and drives the result of the qualified capacity test. The XSP underwent an update to participation rules in August 2018 to better align the operations of the XSP to the objectives. Table 2 summarizes the changes made and the rationale for the change. A detailed explanation of each change can be found in the subsequent sections below.

	Original Rule	Current Rule	Reason for Change
Nomination Options	4-hour (or two 2-hour) contiguous blocks during any time outside of 7-9 AM and 6-8 PM.	5-hour contiguous block between 8 AM-4 PM. Optional Load Decrease nomination during 4-9 PM.	Constrain the availability hours to better match with hours with highest likelihood of over-supply and introduce load decrease option.
Number of Events	Expected number of events capped at eight per month.	Expected number of events capped at 10 per month.	Continue to test how frequently participants are willing to be dispatched
Payment Amount and Calculation	Maximum base participation payment is $10/kW-month. Monthly event performance factor	Maximum base participation payment is $8/kW-month for load increase and $2/kW-month for	More closely link resource event performance to ultimate payment amount. Incorporate

	includes a 25% and 50% bucket.	load decrease. Monthly event performance factor buckets removed.	and incentivize the load decrease options

Table 2: Summary of XSP Rule Changes

4.3.1 XSP Baseline and Performance Methodology

To measure performance, the XSP utilizes the ISO Type 1[9] baseline methodology, which is a long-established baseline methodology set forth by the CAISO for the PDR product. The XSP utilizes the whole-premise meter data (i.e. no sub-metering). The baseline is a "10-in-10" calculation that takes the average of a target number of the most recent similar day-type non-event days, subject to a morning-of adjustment with a ± 20% cap. Below is a detailed example of the baseline calculation process for a trade date where both load increase and decrease events occurred. The ISO Type 1 baseline methodology is similarly used to measure performance for load decrease events.

1. Identify the target number of previous similar day-type non-event days
   - Day-types are defined as weekdays (Monday – Friday) and weekends/NERC holidays.
   - The target number of days for each day-type are,
     - Weekdays: 10 days
     - Weekends/holidays: 4 days
   - Previous event days are excluded.
   - The maximum look-back window is 45 days.
   - If 10 non-event "Weekdays" cannot be identified within the 45-day look-back window, but at least 5 days can be identified, the baseline is calculated using the available days.
   - If at least 5 non-event Weekdays or 4 non-event Weekends/holidays cannot be identified in the look-back window, the highest usage prior event days within the look-back window are then included as needed to reach the minimum number of days.

[9] The ISO Type 1 methodology is based on the North American Energy Standards Board (NAESB) Baseline Type-I methodology which is described in the NAESB WEQ Business Practice Standards WEQ-015, Measurement and Verification of Wholesale Electricity Demand Response.

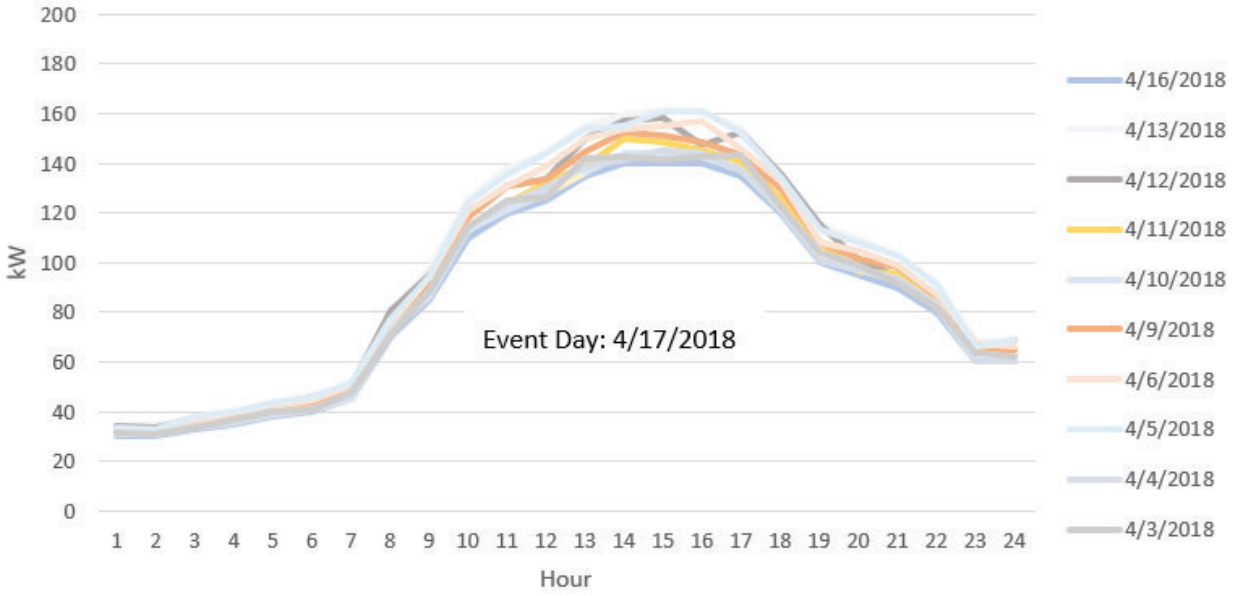


Figure 6: Identify 10 Similar Non-Event Days. Courtesy of Olivine, Inc.

2. Calculate average profile

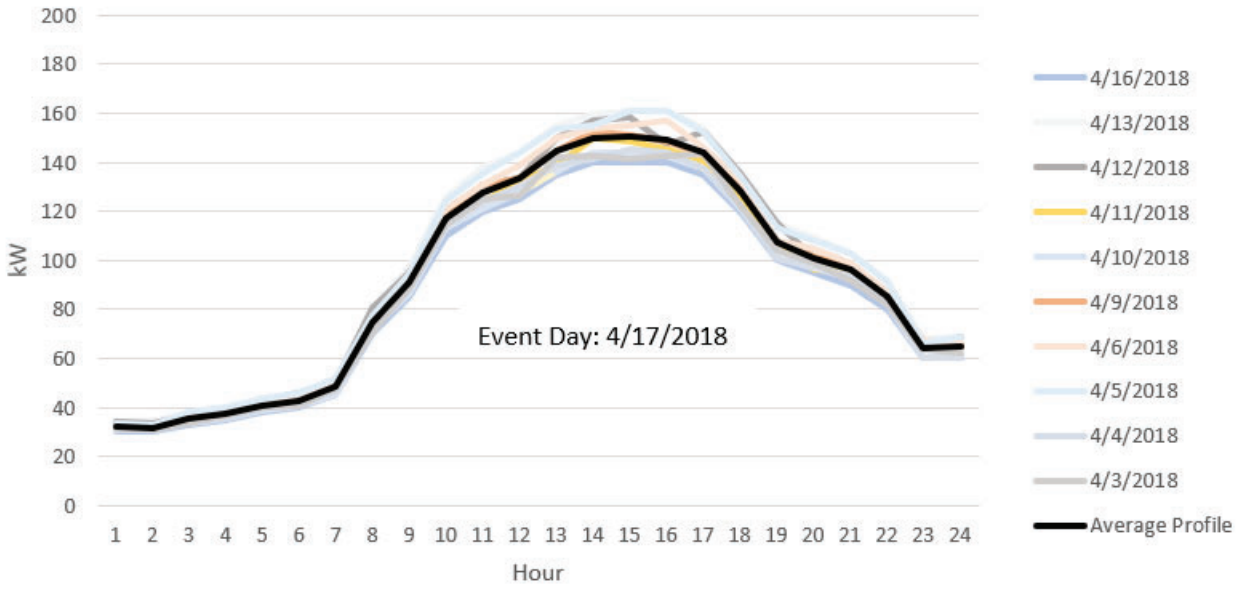


Figure 7: Calculate Average Load Profile. Courtesy of Olivine, Inc.

3. Determine day-of adjustment
   - The day-of adjustment is based on the first three of the four hours prior to the event.

- The day-of adjustment is a multiplier that equals the ratio of the average load for these three hours on the event day to the average load for these three hours of the average profile.
- The day-of adjustment is bi-directional (i.e. may be positive or negative) and is capped at ± 20%.
- Note that event days with both load increase and load decrease events only utilized a single day-of adjustment. See Section 6.4.1 for additional details.

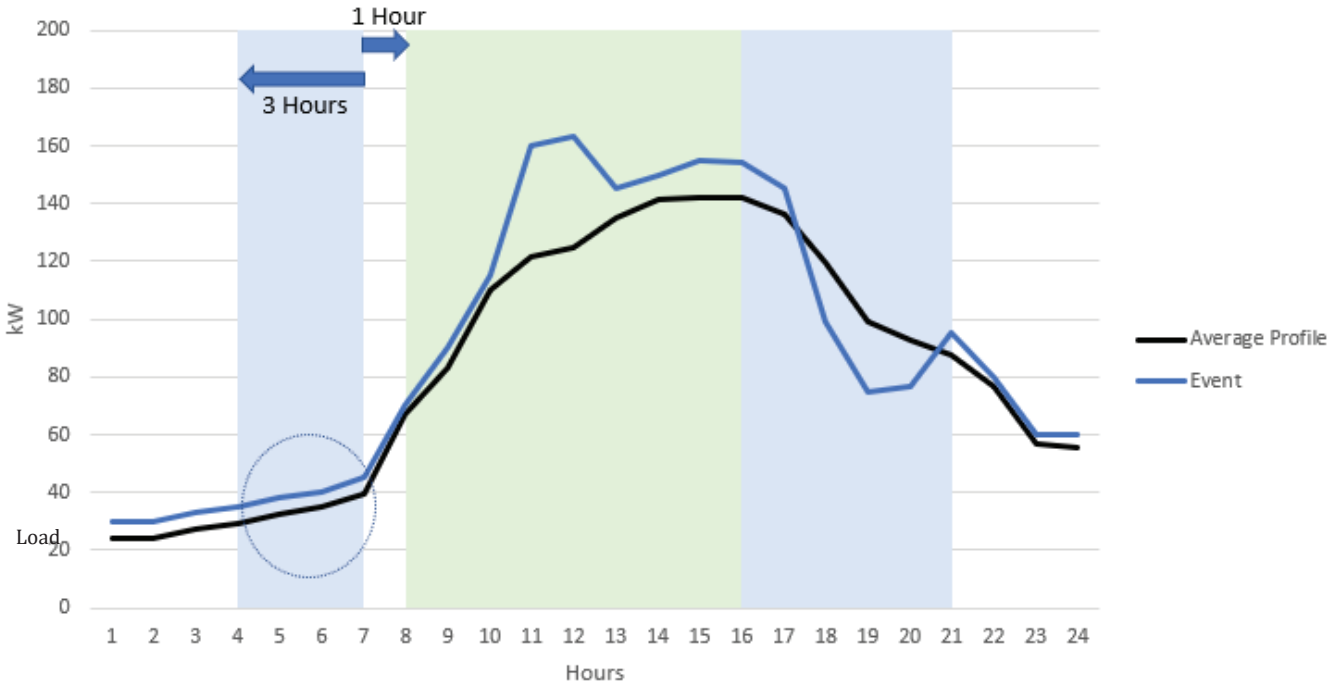


Figure 8: Determine Day-Of Adjustment. Courtesy of Olivine, Inc.

4. Apply day-of adjustment to create baseline
   - The day-of adjustment multiplier is applied to the average profile for all hours of the event to produce the baseline.

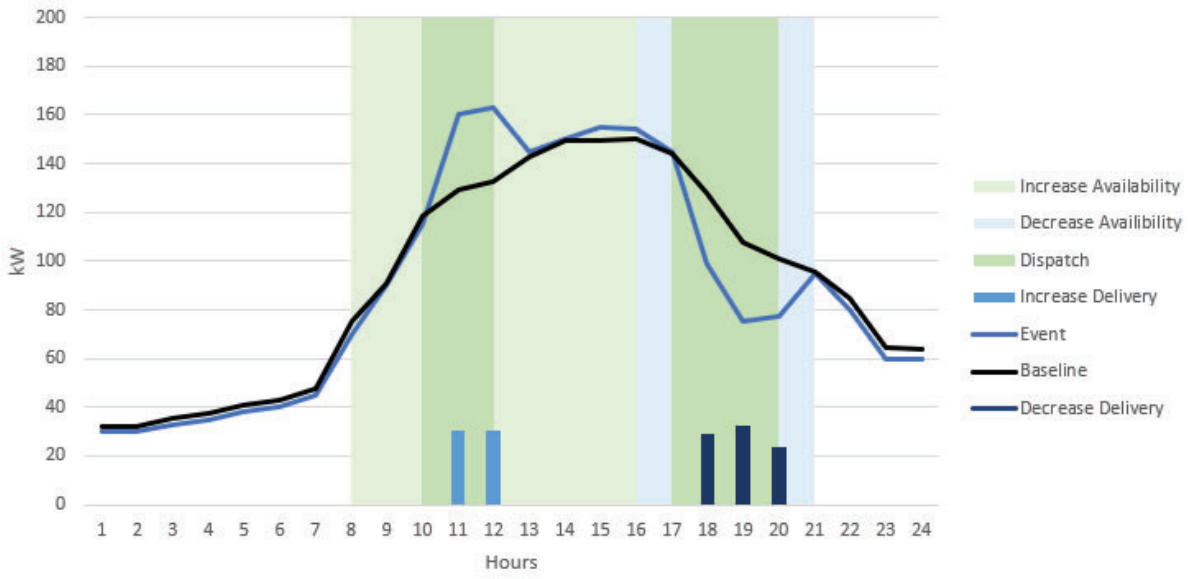


Figure 9: Apply Day-Of Adjustment to Create Baseline and Calculate Event Performance. Courtesy of Olivine, Inc.

5. Calculate the event performance

- Finally, the excess load is determined by subtracting the actual event day load from the new base inline as shown in Figure 9..
- The excess load calculated in this way is the hourly performance for the XSP. The decrease in load in the evening is calculated in the same manner.

4.3.2 Qualified Capacity (QC)

Before enrollment in the pilot is considered complete, Participants are tested for the ability to meet the 30 kW increase capacity requirement. The tested delivery relies on the hourly performance calculations as described in the previous section. The test result is computed as the average energy delivered over a two-hour period in excess of the computed baseline, identified in kilowatts. This value becomes the Load Increase Qualified Capacity (QC) for the resource. The QC is the maximum quantity that may be nominated into the pilot and is the basis for participation payments.

For participants who also elect to participate in load decrease, a separate Load Decrease QC value is determined through an additional four-hour period test to measure average energy reduction against the PDR baseline.

Note that there are no incentives associated with pre-operational qualifying tests.

4.3.3 Nominations

In the XSP – as in many conventional demand response programs – a nomination is a capacity commitment made by the participant. XSP nominations are for a calendar month and can be changed monthly. For example, a participant may nominate 100 kW for a specific month with the expectation that if they are dispatched that they will be able to deliver 100 kWh per hour.

Different from conventional programs, the XSP provides flexibility in choosing availability hours. Originally these hours were open throughout most of the day, but later were refined to target hours where excess-supply is likely. As such, nominations in the XSP include a capacity quantity as well as days and times of availability using the following rules:

Original XSP

- The nominated capacity could not exceed the Qualified Capacity.
- Nominations had to include 4 hours of availability per day.
- The 4-hour requirement could be made up of either one block of 4 contiguous hours or two blocks of 2 contiguous hours
- Blocks could not span midnight
- Blocks could not overlap with 7-9 AM nor 6-8 PM
- There are 2 product options, each option containing two groupings of event days.

	Day Group 1	Day Group 2
Option 1	Monday – Friday	Saturday - Sunday
Option 2	Monday - Thursday	Friday – Sunday

Table 3: Original XSP Nomination Day Grouping Options

- For either option, the participant could choose to nominate availability for Group 1, Group 2, or both.
- The Participant could choose different availability hours for each day group.

Excluding the 7-9 AM and 6-8 PM periods was designed to avoid conventional peak ramping periods, noting that actual peak ramping periods can shift considerably from these conventional hours due to weather and season. The decision to keep them fixed was designed to simplify the pilot rules to ease participation.

Current XSP

As a part of the addition of the load-decrease option, the load-increase hours were further constrained to better align with times that excess supply is more common. As such, the rules were updated as follows:

- The nominated capacity cannot exceed the Qualified Capacity.
- Nominations must include 5 contiguous hours of availability per day between the hours of 8AM-4PM
- There are 2 availability options
    - 7 Days a week

    - 5 Days a week (Weekdays)
- Optionally, load decrease availability requirements hours are 4-9PM.

EXAMPLE 1: Following are valid examples of nominated time periods into the XSP with the current rules:

- A participant nominates 100 kW load increase Monday through Friday: 8 AM to 1 PM
- A participant nominates 100 kW load increase Monday through Sunday: 11 AM to 4 PM
- A participant nominates 100 kW load increase Monday through Friday: 9 AM to 2 PM; load decrease 4 PM to 9 PM

4.3.4 Base Participation Payment and Number of Events

Unlike conventional DR programs, it is important that the XSP have regular events to test out the ability of participants to provide excess load. As a result, XSP events are called for all participants every month, and the number of events called per month is dependent on the nomination period selected. Given the changes in nomination options, the incentive levels varied between the original and current XSP:

Original XSP

Incentives for the XSP were based on a monthly Base Participation Payment (BPP), with the BPP also dependent on the nomination period selected. Table 4 shows the relationship between the nomination period, expected number of events per month, and BPP.

Nomination Period (Available Days per Week)	Number of Available Days per Week	Base Participation Payment ($/kW-month)	Expected Number of Events per Month
Saturday-Sunday	2	$5	2 - 3
Friday-Sunday	3	$6	3 - 4
Monday-Thursday	4	$7	4 – 5
Monday-Friday	5	$8	5 – 6
Monday-Sunday	7	$10	7 – 8

Table 4: Original XSP Nomination Periods and Associated BPP

Current XSP

As part of the August 2018 XSP rules update, the BPP was updated in accordance to the new nomination periods and whether the participant opts to participate in load decrease.

Number of Available Days Per Week	Base Participation Increase Payment ($/kW-month)	Base Participation Decrease Payment ($/kW-month)	Expected Number of Events per Month
5	$6	$2	8
7	$8	$2	10

Table 5: Current XSP Nomination Periods and Associated BPP

Load increase events dispatched through the pilot are either 1 or 2-hours in duration. The duration of load decrease events can range anywhere from 1 to 5-hours, depending on the participant's energy bids and market clearing prices[10]. Event dispatch notifications are delivered at 5 PM one day ahead.

4.3.5 Participation Payment Calculation

Participation payments are the product of the Monthly Adjusted Performance Factor (MAPF), the nomination amount, and the BPP. Calculation of the MAPF is outlined below. The payment calculation changed in the 2018 rules update as follows:

Original XSP

1. Calculate the hourly Raw Event Performance Factor (REPF). The REPF is the ratio of the performance each hour, as described in Section 4.3.1, to the nomination amount.
2. Map each hourly REPF to an hourly Average Event Performance Factor (AEPF). Table 6 shows the mapping between REPF and AEPF.

Raw Event Performance Factor	Adjusted Event Performance Factor
$x > 0.50$	1.00
$0.25 < x \leq 0.50$	0.50
$0 < x \leq 0.25$	0.25
$x <= 0$	0

Table 6: Original XSP REPF to AEPF Mapping

3. Calculate the MAPF by averaging all the hourly AEPFs that month.

The nomination amount was then multiplied by the MAPF and the BPP to determine the participation payment for the month.

Current XSP

[10] Note that a participant must be available for 5 hours and if awarded for all hours must respond to at least 4 hours consistent with resource adequacy rules for demand response.

As part of the XSP rules update, the payment calculation methodology was revised to more accurately reflect the participant's performance in the pilot.

A simple average of the resource's hourly raw event performance for the month is taken to determine the REPF. The hourly performance has a no zero floor, meaning load decrease during a load increase event – or vice versa – can result in a negative number that is reflected in the REPF. The REPF is then mapped to the Adjusted Total Event Performance Factor (ATEPF) in accordance to Table 7.

Raw Event Performance Factor	Adjusted Total Event Performance Factor
$1.00 < x$	1.00
$0.20 < x \leq 1.00$	x
$x \leq 0.20$	0

Table 7: Current XSP REPF to ATEPF Mapping

The nomination amount was then multiplied by the ATEPF and the BPP to determine the participation payment for the month.

The incentive payment for load increase and load decrease events were calculated separately.

4.3.6 Joint XSP / SSP Participation Option

Prior to the introduction of load decrease in the XSP in August 2018, participants could enroll in both the XSP and the SSP II. In that case, the following additional requirements also applied:

- The XSP and SSP II resources must be composed of the identical set of customer locations.
- The SSP resource may not bid within 4 hours of the XSP resource nomination periods. For example, if the nomination period for the XSP is 8 PM – 12 PM, then the SSP II bids cannot be later than the hour ending at 4 PM. This is to ensure there is no impact on baseline calculations from events on either pilot to the other.

The first joint participation occurred in late 2017 when one of the XSP participants enrolled its XSP resource in the SSP II (enrollment completed in December 2017 with participation beginning in 2018). This joint resource participated in both the XSP and SSP II simultaneously starting in 2018 until the introduction of the new XSP rules, which eliminated joint participation. This participant did ultimately remain in the XSP and elect to also respond to load decrease dispatches.

4.3.7 Demand Charge Mitigation

As discussed previously, due to high interest from large non-residential customers, even though these customers were on retail rates that included demand charges, pilot eligibility was expanded to include these customer classes. As a result, all customers that participated in the XSP were on retail electric rates that included TOU demand charges. While most participants were able to mitigate the impact of pilot participation on their TOU demand charges through their nomination

behavior, some did incur additional TOU demand charges due to responding to XSP events. Those participants that did incur additional TOU demand charges were eligible for an additional pilot payment (referred to as a Demand Charge Offset payment) to offset a portion of these incrementally incurred demand charges. Such an offset was added to the base Pilot participation payment and was not a reduction in the retail billed demand charges.

The justification for implementing this additional adjustment is that the current retail TOU periods do not align with the periods of highest and lowest wholesale market prices, resulting in low wholesale prices occurring in the middle of the day during retail Peak and Part-Peak TOU periods. As retail TOU periods are shifted to later in the day over the next several years, these retail periods should better align with wholesale market peaks, reducing the conflicting signals created by asking a participant to increase load due to excess supply in the wholesale market during a retail peak TOU period. As a result, the Demand Charge Offset is a temporary solution that has been implemented exclusively for the pilot and is not meant to be a long-term solution or applied outside of the XSP. In addition, while the Demand Charge Offset is used to offset all or part of the incremental TOU demand charges, monthly maximum demand charges were excluded from this calculation. Monthly maximum demand charges are excluded because even when retail TOU periods are better aligned with wholesale price trends, monthly maximum demand charges, which are independent of TOU periods, will not change.

For unbundled customers, the demand charge offset excluded the generation portion of the demand charge rate. This is because unbundled customers receive a Generation Credit from PG&E which credits them back all generation related demand and energy charges.

To calculate the demand charge offset, the amount of increased demand charge that is attributable to XSP events must be determined. To do this, the underlying customer was required to provide to Olivine the retail customer bill and device-level sub-metered data for the specific asset or assets used to respond to the XSP events[11]. Olivine then performed the following steps to compute the demand charge offset:

1. For each event day, perform a 10-in-10 baseline calculation on the sub-metered data. This will not include a day-of adjustment.
2. Calculate the per-event sub-metered performance data.
3. Subtract the per-event sub-metered baseline data from the whole-premises meter data.
4. Calculate what the TOU demand charges would have been if not for the XSP events.
5. Subtract the actual demand charges taken from the customer bill from the calculated demand charges.
6. Cap this value at the participation payment. For example, if the payment is $10/kW-month and the nomination is for 1 MW, then the demand charge offset cannot exceed $10,000.

[11] The types of assets that can be sub-metered include batteries, PV systems, EV chargers, chillers, and pumps.

Any incurred demand charges more than what is covered by the XSP are the responsibility of the participant.

Example

Below is an example of how this process is performed. For simplicity, the example makes the following assumptions:

- There is only one event for the month,
- All demand charges are set on the same day as the event,
- The month is during the SUMMER season,
- The customer is on the E-19P rate,
- The customer nominated a load increase amount of 100 kW with an availability of 7 days per week.

1. For each event day, perform a 10-in-10 baseline calculation on the sub-metered data.

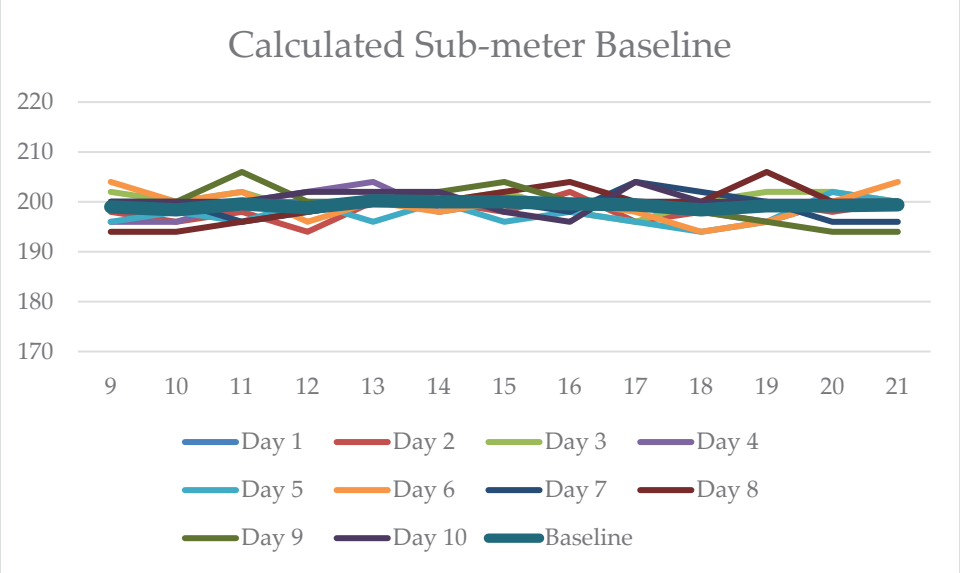


Figure 10: Demand Charge Mitigation: 10 Similar Non-Event Days

The 10-in-10 baseline is calculated using a similar procedure to how it is calculated for incentive payments, except sub-meter data is used instead of whole-premise meter data and no day-of adjustment is applied.

2. Calculate the per-event sub-metered performance data.

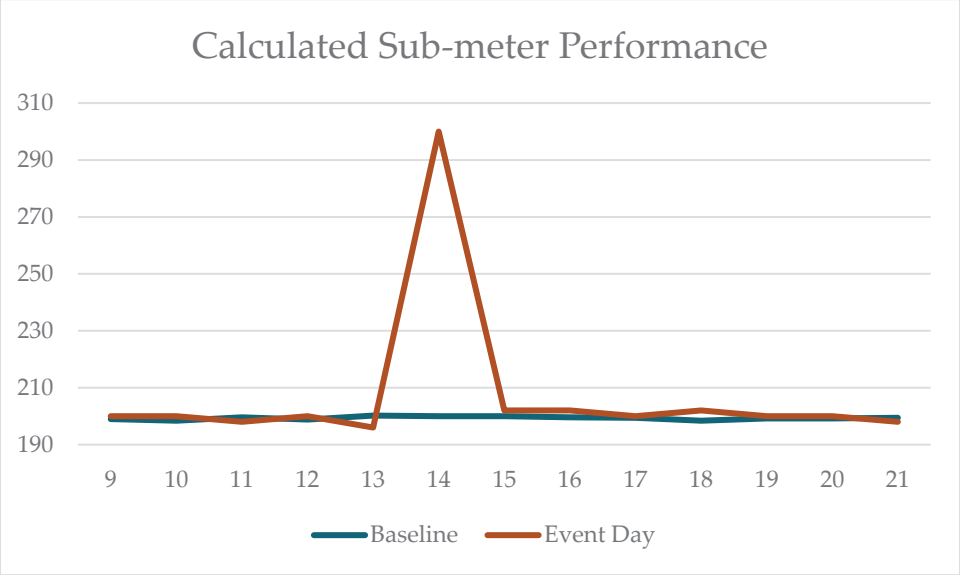


Figure 11: Demand Charge Mitigation: Calculate Sub-Metered Performance

In this example, the load increase event was a one-hour event from 2 pm – 3 pm. The load increase, using sub-metered data was calculated to be 100 kW (the difference between the measured 300 kW load and the calculated baseline of 200 kW load).

3. Subtract the per-event sub-metered performance data from the whole-premises meter data.

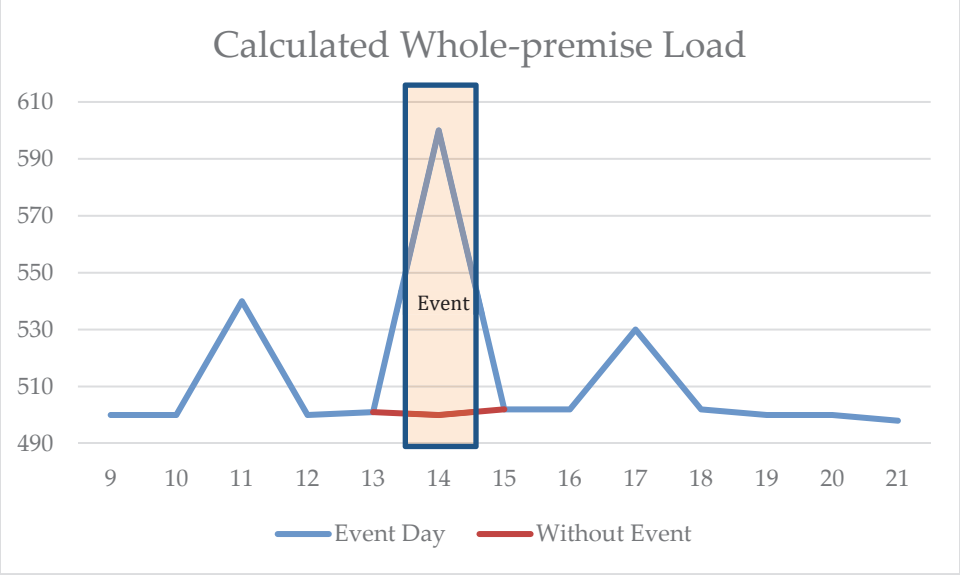


Figure 12: Demand Charge Mitigation: Whole-Premise Load

In this example, the calculated event contribution (red line) is subtracted from the whole-premise load on the event day (blue line).

4. Calculate what the TOU demand charges would have been if not for the XSP events.

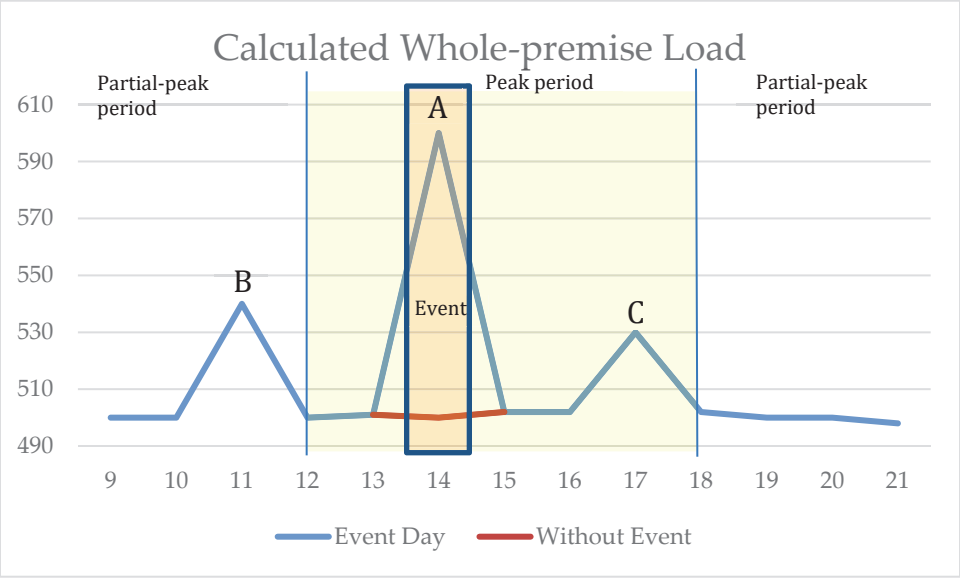


Figure 13: Demand Charge Mitigation: Calculate Contribution of Event to Demand Charge

These TOU demand charges are the Maximum Peak Demand Summer, Maximum Part Peak Demand Summer, and Maximum Part-Peak Demand Winter demand charges. As mentioned above, because the Demand Charge Offset is only meant to be a short-term solution until retail TOU periods are adjusted, and changes to the retail TOU periods will not impact the monthly maximum demand charges, this calculation the Demand Charge Offset does not compensate for any incremental monthly maximum demand charges (Maximum Demand Summer or Maximum Demand Winter) incurred due to responding to any XSP events.

In this example, had there not been an XSP event, the maximum peak-period demand would have been 530 kW (peak C) and the maximum partial-peak demand would have been 540 kW (peak B). For a customer on the E-19P rate, the demand charges would therefore be,

Period	Demand Charge Rate ($/kW)	Maximum Demand (kW)	Demand Charge ($)
Maximum Peak Demand Summer	16.60	530	8,798.00
Maximum Part-Peak Demand Summer	4.53	540	2,446.20
Total TOU Demand Charges ($)			11,244.20

Table 8: Demand Charge Mitigation: Example Demand Charge Calculation 1

5. Subtract the actual demand charges taken from the customer bill from the calculated demand charges.

Due to the XSP event (peak A) the actual maximum peak demand charge is 600 kW. There is no change to the maximum part-peak demand. Therefore, the actual TOU demand charges on the customer bill would be,

Period	Demand Charge Rate ($/kW)	Maximum Demand (kW)	Demand Charge ($)
Maximum Peak Demand Summer	16.60	600	9,960.00
Maximum Part-Peak Demand Summer	4.53	540	2,446.20
Total TOU Demand Charges ($)			12,406.20

Table 9: Demand Charge Mitigation: Example Demand Charge Calculation 2

The difference between the actual demand charge and the calculated demand charges without XSP is $12,406.20 – $11,244.20 = $1,162.00.

6. Cap the Demand Charge Offset at the participation payment.

Since the customer had a nominated load increase of 100 kW with an availability of 7 days per week, the maximum monthly participation payment would be $10 / kW x 100 kW = $1,000. Therefore, though the Demand Charge Offset was calculated to be $1,162.00, it would be capped at $1,000.00.

4.4 Electric Vehicle Charge Network-Load Management Plan (EVCN-LMP) Rules

The EVCN-LMP program was introduced into the XSP in 2018 as a way to leverage the operational knowledge that processes that were already in place in the XSP for load increase and decrease dispatches. Electric Vehicle Service Providers (EVSPs) who choose to implement custom pricing at their site(s), such as free charging or a flat flee, were required to participate in the EVCN-LMP. The inclusion of the EVCN-LMP into the XSP has enabled the addition of a new technology type (electric vehicles) and customer classes (smaller commercial and multi-unit residential) into the pilot which had been absent thus far. As intended, much of the rules and requirements for participation were drawn from the standard XSP with slight variations, which are outlined below.

4.4.1 EVCN-LMP Baseline and Performance Methodology

The performance calculation used for the EVCN-LMP events utilized "10-in-10" baseline calculation with the exception that the day-of adjustment was set to zero with the rationale that

EVSE usage is highly variable, thus the day-of adjustment would have introduced more uncertainty.

4.4.2 EVCN-LMP Qualified Capacity & Nominations

Among the differences are the nomination options available to EVSPs. Instead of performing a QC test, the QC is set administratively by taking the product of the number of EVSE on the site and their respective nameplate maximum charge rating. This QC in turn was set as the fixed capacity nomination.

The availability hours were also more prescriptive with mandatory load increase availability for 5 contiguous hours between 8 AM to 1 PM and mandatory load decrease availability for 5 contiguous between 4 PM to 9PM, 7 days per week.

4.4.3 EVCN-LMP Base Participation Payment

Given the fixed availability hours, the Base Participation Payment (BPP) is set for $5/kW-month for load increase and $5/kW-month for load decrease, thus the participant can potentially earn up to $10/kW-month. Note that this incentive appears as a bill credit on the customer's retail electricity bill.

A simple average of the resource's hourly raw event performance for the month is taken to determine the Raw Event Performance Factor (REPF). The hourly performance has a no zero floor, meaning load decrease during a load increase event – or vice versa – can result in a negative number that is reflected in the REPF. The REPF is then mapped to the Adjusted Total Event Performance Factor (ATEPF) in accordance to Table 10.

Raw Event Performance Factor	Adjusted Total Event Performance Factor
$1.00 < x$	1.00
$0.20 < x \leq 1.00$	X
$x \leq 0.20$	0

Table 10: EVCN Adjusted Performance

The nomination amount is then multiplied by the ATEPF and the BPP to determine the participation payment for the month.

4.5 Pittsburg USD School Bus Renewable Integration Pilot

Funded separately by a PG&E EV infrastructure project, Olivine operates the Pittsburg USD School Bus Renewable Integration Pilot. Among its goals is to understand how medium and heavy-duty fleet vehicles can act as distributed energy resources during periods of high renewable penetration and how to adapt charging schedules to better align the profiles of charging and renewables generation. As part of the PUSD Pilot, participation in the XSP was identified as a means of gaining insight into these goals. PUSD was granted modifications on some of the

participation requirements because the standard XSP participation requirements would have been infeasible due to the operational needs of the electric school buses.

4.5.1 Modified Rules for PUSD Participation

Resource Size

The XSP requires participants to achieve 30 kW of load increase to participate. With only two buses available for participation at the start of the XSP participation, the 30 kW increase may be infeasible. As such, this requirement was waived. PUSD nominated 30 kW initially – though the nomination can be lowered if necessary – and will be measured against that nomination amount. If additional buses are added, then the nomination can be raised.

Availability Hours

PUSD will be unable to participate for a contiguous 5-hour block due to the scheduling of the morning and afternoon routes. The buses will be available in the depot between 9 am and 1 pm. Therefore, PUSD's availability hours will be from 9am – 1pm. As a result of the shortened availability, the capacity incentive payment will be decreased proportionally to $6.40/kW-month.

5 Pilot Operations

5.1 Enrollment Process

Potential participants filled out a declaration of interest (DOI) and provided detailed information on customer locations and excess supply amounts. In the case that the participant was not a direct customer, the participant also provided customer-executed agreements authorizing PG&E to release customer data to the participant. These forms, called customer information service-request forms (CISRs), also acknowledged that the customer was interested in enrolling in the pilot.

Once submitted, Olivine reviewed the enrollment materials and submitted them to PG&E for final review. PG&E proceeded with manual validation of the CISRs and checked eligibility of customers for enrollment, including identifying Sub-LAP and LSE membership. Ultimately the participant would acknowledge the enrollment of the eligible customers with the intention of placing them into a single PDR for participation, or in the case of the 30-kW option, a simulated PDR.

Following the enrollment, the participant signed a participation agreement with Olivine. Two training sessions were held: one on the rules, requirements and process of the pilot, and one on using the Olivine DER system to place bids and manage the participant's resource. A qualified capacity test was then arranged to ensure the participant could meet the minimum curtailment requirements. Potential participants started out by providing Olivine with a declaration of interest.

5.1.1 Enrolled Participants

Table 11 and Table 12 summarize the active participants in 2019, the capacity nomination into the XSP and the underlying technology used to deliver the demand response.

[redacted]

5.2 Event Dispatch Trigger

Events in the XSP were initially set administratively as it was critical that the XSP have regular events to test out the ability of participants to respond to load increase dispatch signals. In May 2018, the XSP began implementing PG&E's day-ahead over-supply forecast as a way of triggering dispatches. The forecast is an hourly probability of oversupply on PG&E's distribution system. Analysis was done on PG&E's historical over-supply forecast to determine an optimal trigger that would ensure both that dispatches were during hours of high probability of over-supply and the number of dispatches per month continued to meet the set standard.

The trigger for a dispatch was initially set to hours where the probability of over-supply was 50% or greater. If there were more than two intervals which met the trigger, the hour(s) with the highest probability were selected. Throughout 2018 and 2019, the trigger was adjusted multiple times – due to seasonal correlation with oversupply – within the range of 30-50% probability of over-supply to ensure that dispatches were routine.

In 2019, over 95% of XSP event hours corresponded to actual renewables curtailment as reported by the CAISO. Despite this high correlation, it should be noted that the CAISO curtailment data is at a system level, which is geographically much larger than the area an XSP resource could affect at the distribution circuit level.

Participants who also elected to partake in load decrease dispatches entered price bids and were economically dispatched based on CAISO market clearing prices. Note that none of the XSP resources were wholesale market integrated for load decrease, so the economic dispatch only simulates market activity.

The EVCN and PUSD programs utilized the same overgeneration trigger for load increase events. The EVCN program instituted a set clearing price trigger of $95/MWh to trigger load decrease events as opposed to EVSP's entering their own bids. The PUSD program did not partake in load decrease events.

5.3 Example Events

[redacted]

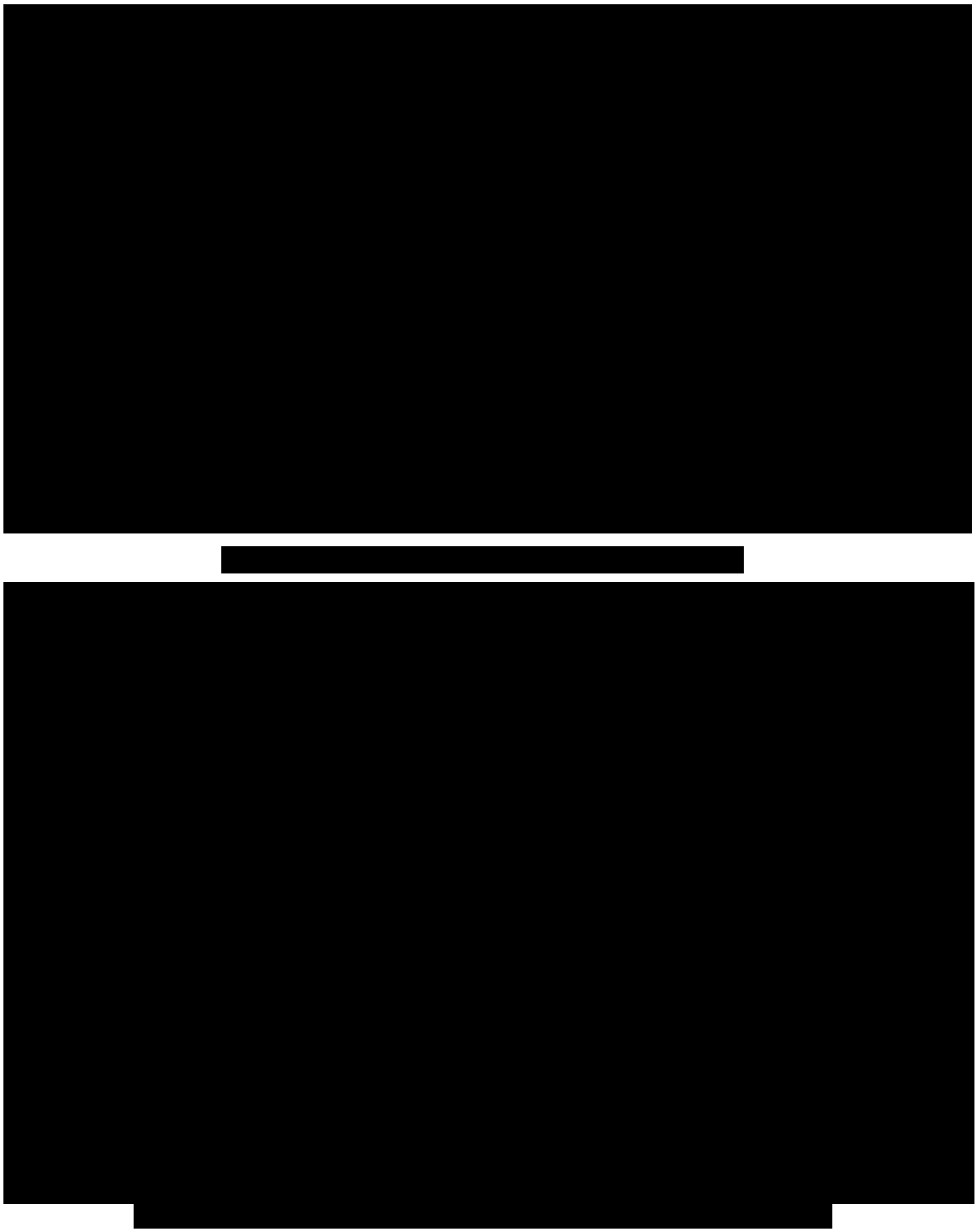
[redacted]

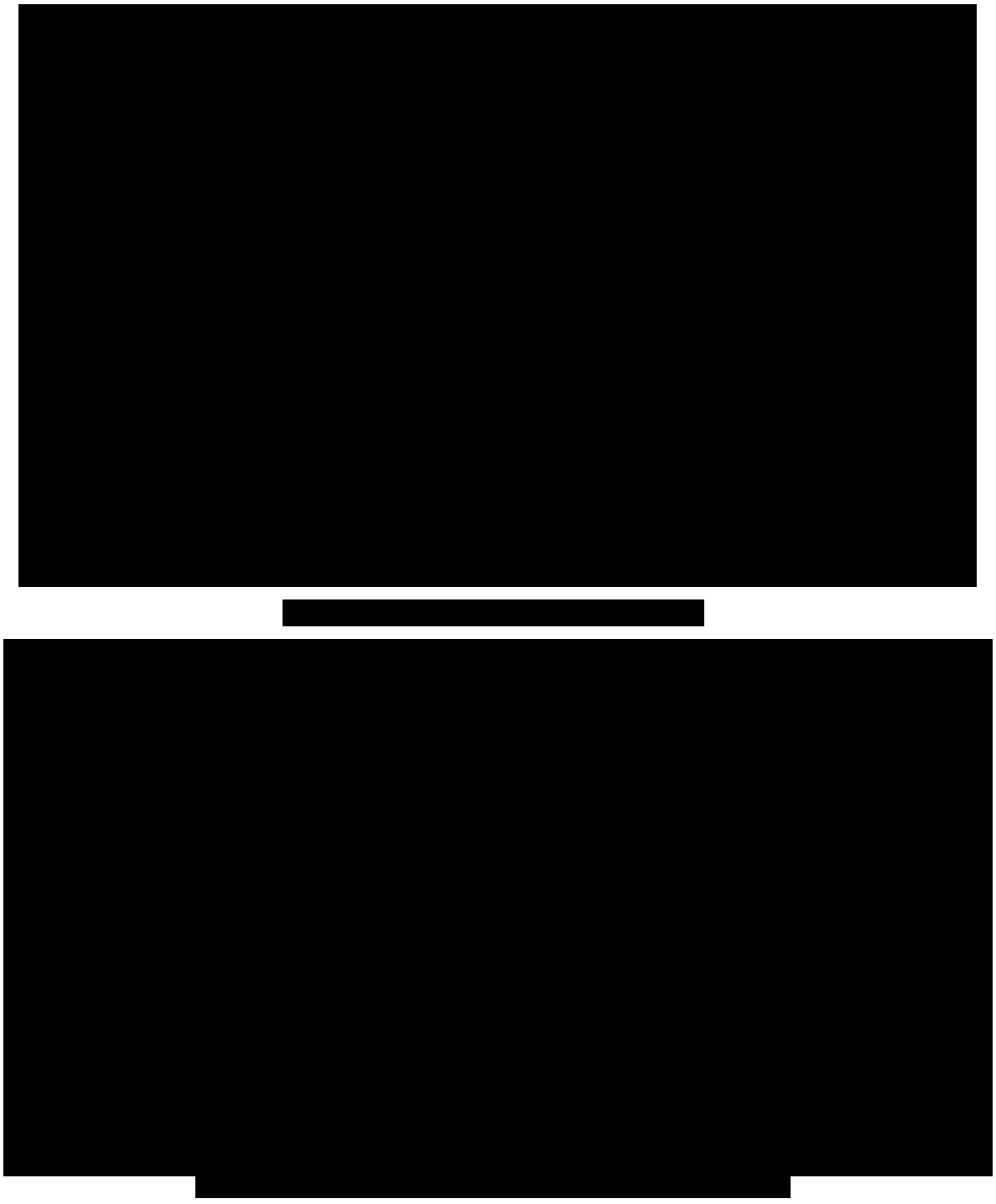
[redacted]

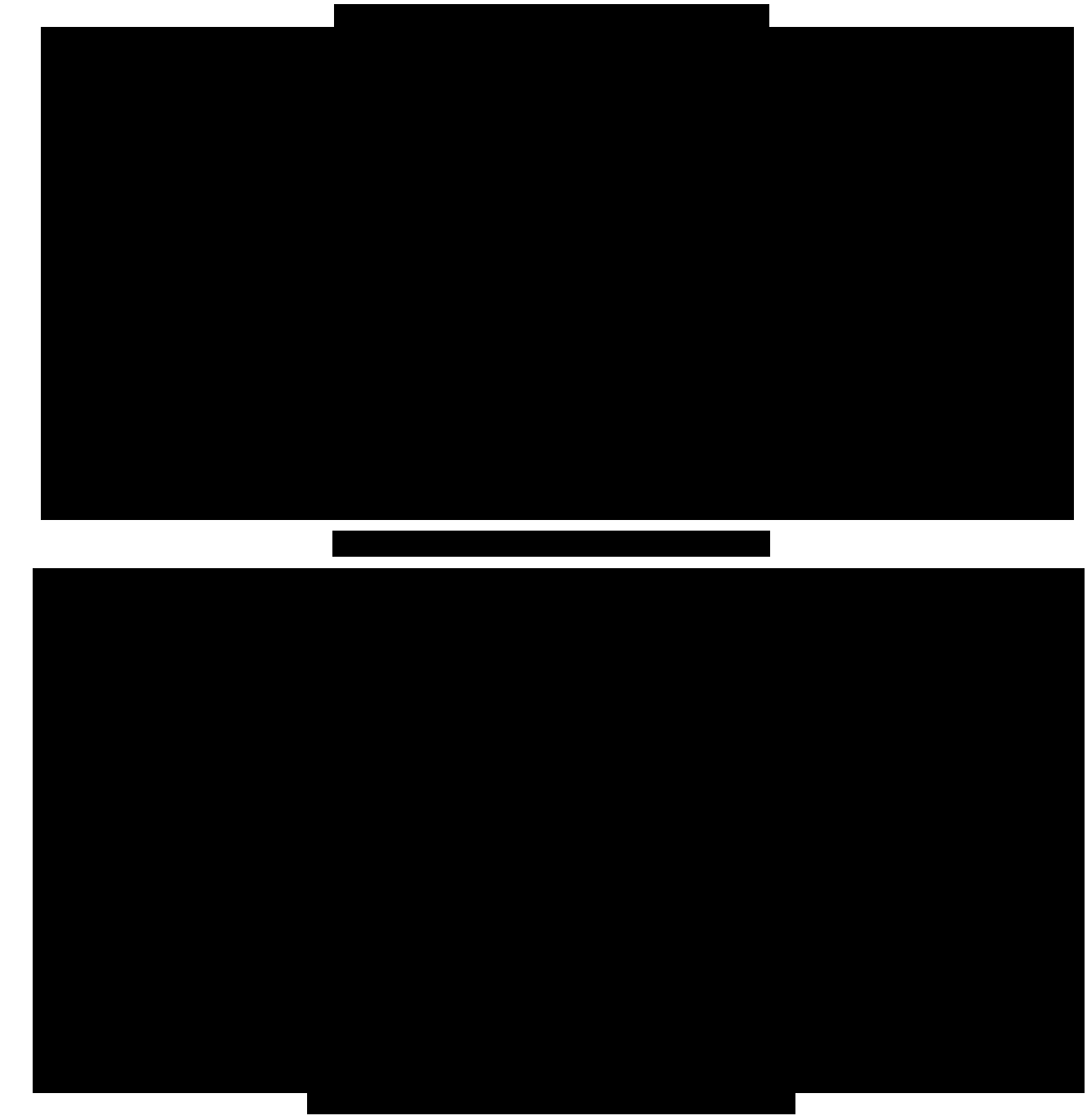
Finally, the green line identifies the actual load during that time. In the case of the load increase event, the load is greater than the target indicating successful delivery of the requirement. Similarly, the load in less than the target for the load decrease event.

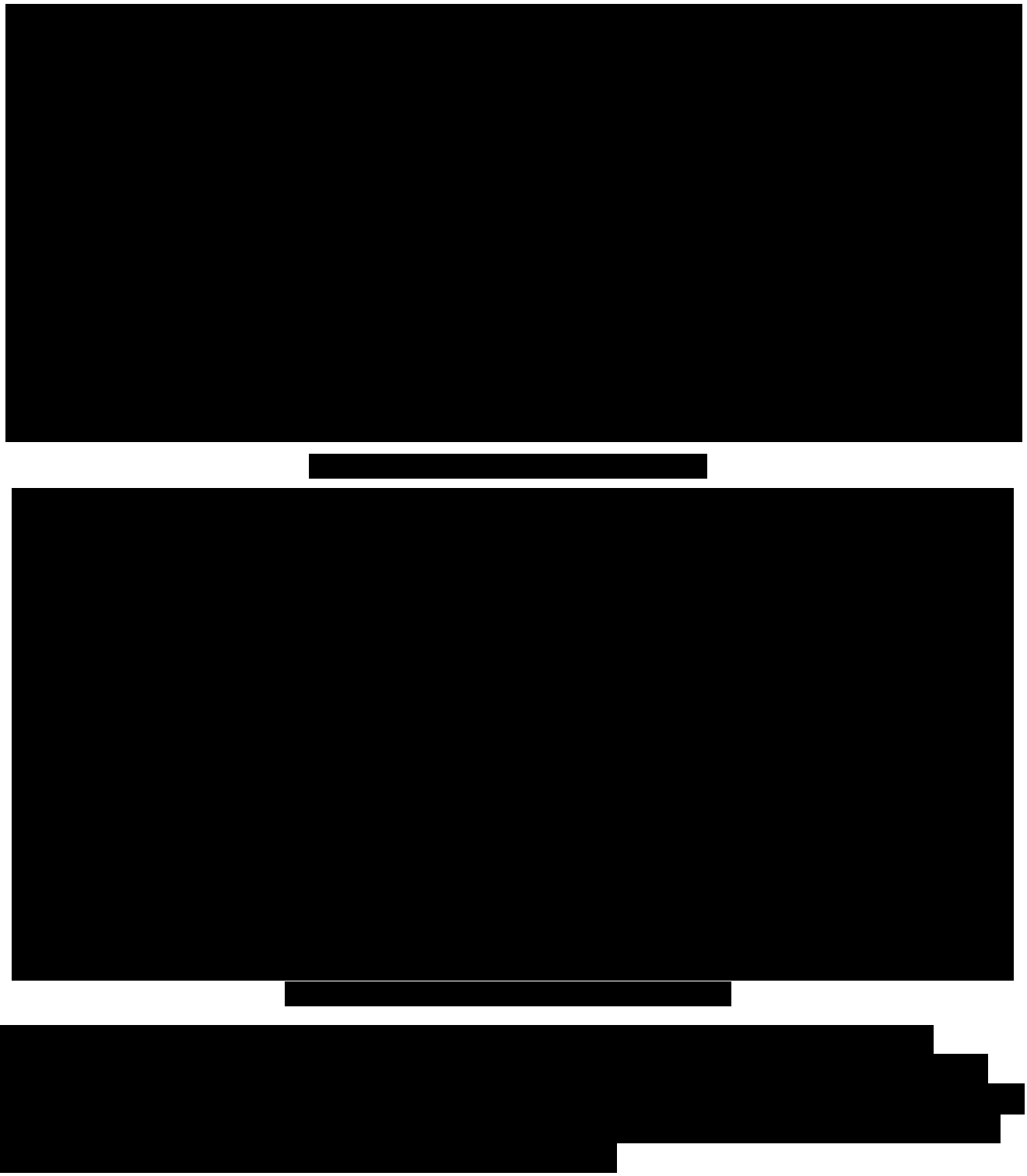
5.4 Resource Operations

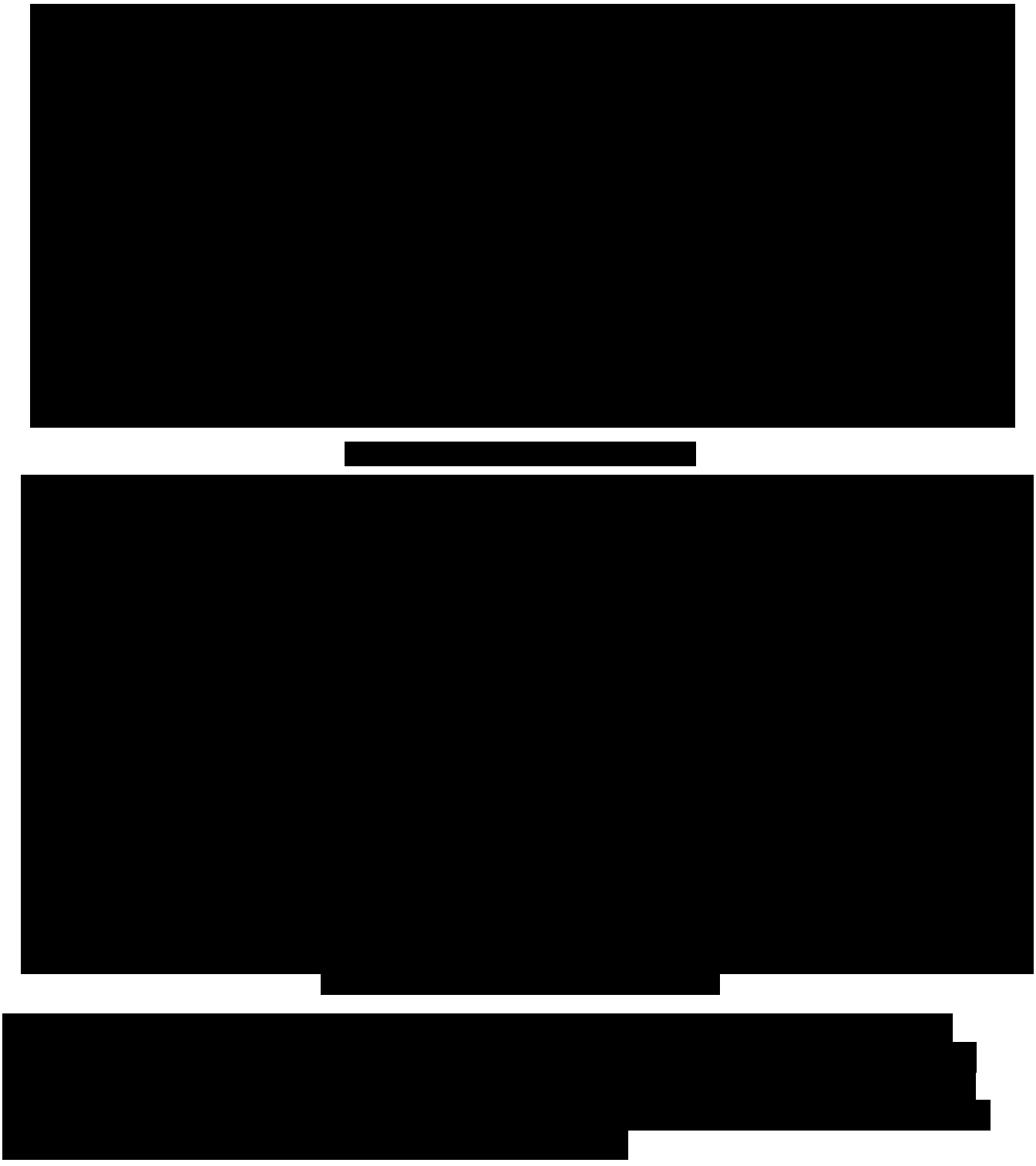
[redacted]











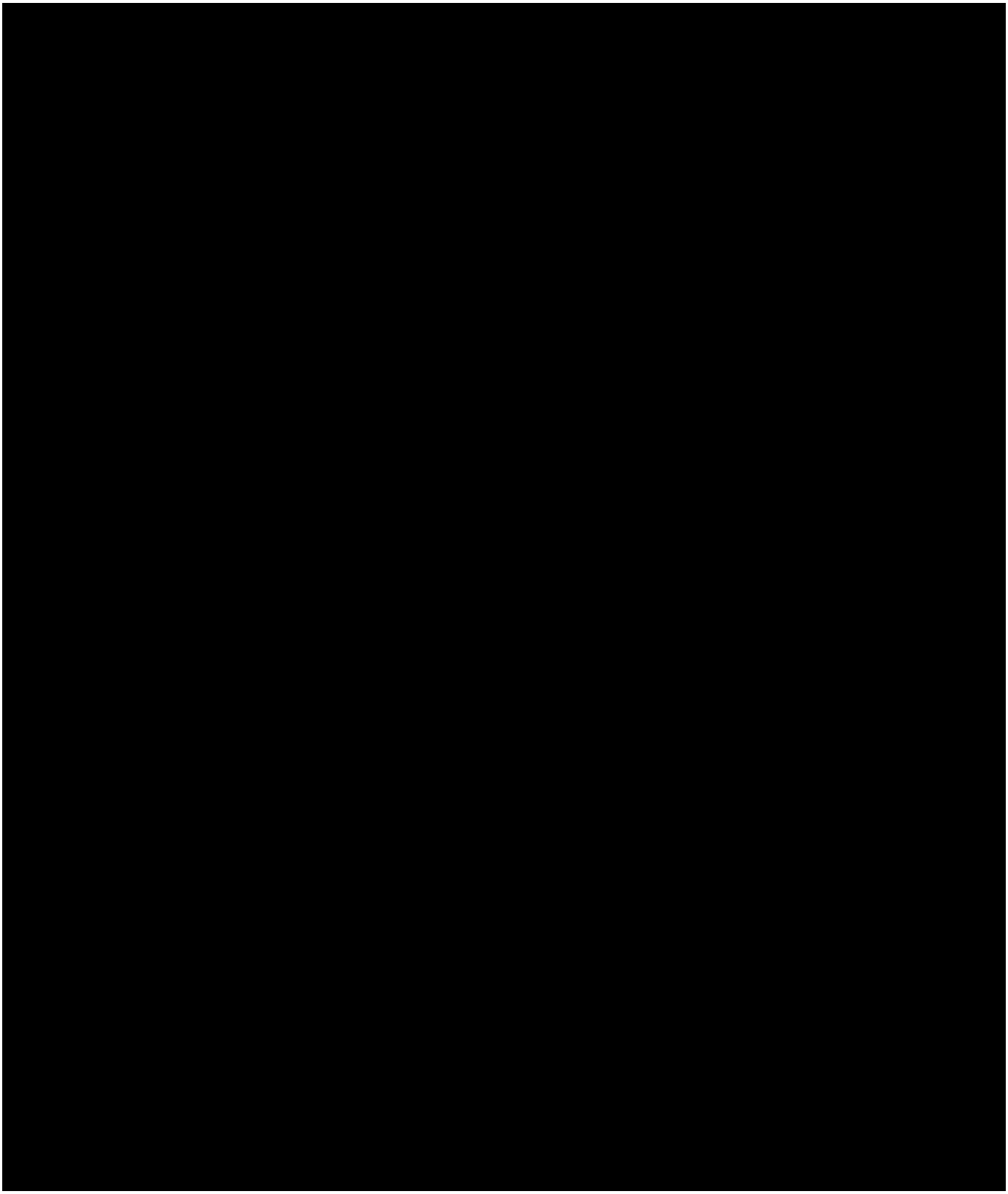
[redacted]

[redacted]

5.4.3 Electric Vehicle Charge Network – Load Management Plan

Dispatches for EVCN-LMP began in October 2019 with 3 participating EVSPs. Table 13 summarizes event performance of the EVSP's resources.

[redacted]



5.5 Value of Participation

Each participant received participation incentives for each month they nominated. Table 15 summarizes incentive payments received by each resource based on its participation. Note that the XSP did not have to pay out any demand charge offset in 2019. Appendix B: Monthly Incentive Payment Details lists the monthly breakdown of incentive payments for each resource.

6 Lessons Learned

This section outlines the lessons learned throughout implementation of the XSP. The lessons learned are categorized into enrollment, demand charge mitigation, value to participants, and operational feasibility. In addition, lessons from the inclusion of the EVCN-LMP and PUSD pilot into the XSP are shared.

6.1 Enrollment

There was initially much interest from parties to learn about the XSP, though not as much follow through as one might hope. This can be attributed to several factors:

- Some prospects engaging in early pilot discussions genuinely do not know if their company and/or customers are a good match for such pilots or are very early stage. As such, a common theme is a declaration of interest but ultimately with no actual customers to enroll.
- Other prospects engaging in such discussions are tasked with keeping abreast of market activities and/or gaining competitive intelligence and may have no actual interest in participation.
- Some prospective participants were dependent on additional funding mechanisms (e.g. SGIP) to help them fund enrollment of customer deployments into their own energy management service offerings. While these parties expressed interest in the XSP, they ultimately did not receive the additional funding, resulting in the prospective participants not being able to deploy their technology at the customer sites.
- While the DRAM is a demand reduction opportunity, the high visibility of that pilot created either an alternative for some prospects, or at least an alternative for evaluation. This had the effect of forestalling prospects because of their belief that they would get a DRAM contract, or for those who were awarded a contract, forestalling XSP participation while fulfilling the DRAM. Generally speaking, there is an opportunity cost to participants for participating in any pilot or program. Prospective participants likely have multiple pilots or programs available to them of which they may choose only one.

Some prospective participants were concerned with the limited duration of the XSP and the risk that the pilot might not be extended beyond 2017. As a result, they felt that the investment in time and equipment needed to qualify for and participate in the pilot was not worth the potentially short duration, particularly when weighted against participating in other DR programs. Though the continuation of the XSP was ultimately granted in December of 2017, throughout the year, PG&E and Olivine were very clear with parties that there was no guarantee that the Commission would approve the XSP beyond 2017 at the time. Some prospective participants felt as the year progressed that the chance of approval to continue the pilot into 2018 was reasonable enough (and the potential short-term benefits were large enough) to take a chance on enrolling prior to a final decision from the Commission. All told, regulatory certainty is a crucial piece to participant's due diligence efforts when evaluating whether to enroll in a pilot/program. Since enrollment in

the XSP was very low in 2016, various changes to the XSP were discussed and implemented for 2017 to increase enrollment, including:

- Implementation of a Demand Charge Offset as an additional component of the XSP participation payment to cover at least a portion of any calculated increase in TOU demand charges due to responding to XSP events. This additional payment is meant to compensate for the fact that current retail TOU periods do not align with wholesale market trends, resulting in XSP participants potentially being asked to increase load due to excess supply or low wholesale market prices during the peak retail TOU period. New TOU periods were adopted for non-residential customers in D. 18-08-013 that have better alignment with wholesale market trends. As customers adopt these new TOU periods, the need for the Demand Charge Offset diminishes substantially.
- Updated marketing materials on eligibility and the value of the XSP to the participant as well as the grid.
- An outbound email campaign to all participants of SSP II and XSP, plus any other known contacts provided by PG&E, utilizing these new materials and describing these new rules.

In general, larger commercial customers, and 3rd parties aggregating larger commercial customers, were more interested in participating in the XSP than small commercial and residential customers, particularly after implementation of the TOU demand charge offset.

6.2 Mitigating Demand Charges Through Bidding Behavior

An additional issue for some parties was the risk of increased demand charges due to responding to XSP events. Some analysis performed by Olivine and PG&E has shown that the increased demand charges for larger commercial customers can easily exceed the potential participation payments for any individual customer. Customers can avoid this impact by selecting a pilot availability period that is not coincident with their monthly peak demand or peak demand for any of the TOU periods (e.g. peak and part-peak) so that responding to an XSP event will not set a new monthly peak or TOU peak demands. Additional methods of mitigating the impact of pilot participation on demand charges include avoiding shifting load from a lower TOU demand charge period to a higher TOU period (e.g. shifting load from partial peak to peak) or avoiding the highest TOU demand charge periods altogether.

However, even though it was possible for a customer to mitigate or even eliminate any impact on demand charges, many prospective participants subject to demand charges felt they would either not be able to utilize the above methods or there was too much risk. Implementation of the Demand Charge Offset acted as a "safety net" and reduced the concern of incurring additional TOU demand charges enough to convince multiple larger commercial participants to enroll in the pilot. In addition, through the pilot we have learned that many participants that were concerned about incurring additional demand charges have been able to mitigate the risk of additional TOU demand charges in their bidding behavior, which alleviated the concern of a negative impact from demand charges.

6.3 Value to Participants

Participants received up to $10/kW-month year-round for participating in the pilot, with details of the monthly payments for each participant included in Appendix B. This compares favorably to other DR programs. As discussed in the previous section, this incentive payment could easily be dwarfed by increased demand charges which can exceed $20/kW-month during the peak months and periods. Figuring the interdependency between DR program incentive levels and impact of DR participation on retail bills will be instrumental for enrollment in the XSP of customers with the most potential (i.e., larger commercial) to help realign supply and demand.

6.4 Operational Feasibility

6.4.1 Baselines

The pilot was successful in calculating performance based on an inverse CAISO 10-in-10 baseline methodology for load increase events. As outlined in Section 4.3.1, load decrease events also utilize the CAISO 10-in-10 baseline methodology. For event days where there are both load increase and decrease dispatches, the later decrease event utilizes the same day-of adjustment from the afternoon increase event. This was implemented to avoid potential overlap between the afternoon event hours and the evening hour adjustment hours. For example, a 12 PM – 1PM load increase event and a 4 PM – 6 PM load decrease event could be dispatched on the same day. If the evening event were to have its own day-of adjustment factor, the adjustment hours used in the calculation (12 PM – 3 PM) would overlap with the 12 PM – 1PM increase event.

The frequency of dispatches is also worth considering as it has ramifications for the calculation of the baseline. If XSP-like events will be more prominent in the future and dispatched on a daily basis, the ability to identify 10 non-similar, non-event days becomes a challenge to the extent that 10 days are not able to be identified within the 45-day look back period.

In 2017 there were cases where the load was a positive value (net import) during the adjustment period, but the average profile used to calculate the day-of adjustment was a negative value (net export) for some hours. This poses a challenge in computing multiplicative adjustments because inherent to such factors is that there be a common floor: typically, 0 MW for load. One possible solution for this would be to set a common floor for a net exporter as the absolute possible export (e.g., -1 MW) rather than 0. In that case the absolute value (or distance) from the load or profile would be used, not the distance to 0. However, this would require that net export be explicitly allowed. Because the XSP is modelled after PDR whenever possible, and since net export is not currently allowed in PDR, choosing a negative floor is not an accepted practice. As such, no adjustment is performed in such cases in the XSP.

6.4.2 Availability

The initial phase of the XSP was very flexible for participants, providing them nearly complete freedom to choose hours of availability. While reasonable to test the construct, it did reduce the chance that participant availability would be coincident with actual excess-supply need. For the

XSP to expand into an at-scale program, it is critical to ensure there is availability of participation across a broad range of hours. There are several ways this might be accomplished:

- Define several fixed availability windows similar to the statewide Capacity Bidding Program (CBP). Different periods of time could have different incentive levels depending on value to the grid.
- Continue to provide freedom to participants and expect scale of the program to naturally cover the hours of need.

As part of the August 2018 program design updates, the availability hours were set to 8 AM to 4 PM which align with the former approach.

6.4.3 Qualified Capacity

Inherent in program constructs which require a capacity commitment is the notion that a resource be able to reliably deliver a specified capacity reduction when needed. As such, the ability to set a QC that is reflective of what the resource can reliably deliver is paramount to the effectiveness of the program. The CAISO also recognizes this need as it addresses this issue in its ESDER 4 stakeholder initiative[12]. The XSP currently implements a one-time capacity test for resources prior to becoming operational. While a capacity test is an effective way to determine or validate resource's capability, it is not a solution that is conducive to ensuring consistency in event performance. Particularly for resources that are weather sensitive or can only operate at discrete levels (e.g. all on or all off). In such cases, deviations from the dispatched operating target—in both under-delivery and over-delivery—is commonplace.

6.4.4 Energy Payments

Unlike the SSP II where participants have access to wholesale market energy payments, XSP participation does not include any energy payment component. This was due to the XSP not being integrated into the wholesale market (thus not having access to negative energy prices). However, in the future, as more pilot events are based on actual wholesale market conditions and as new DR products are developed, another program design aspect – and possible source of funding – could be to provide payments/credits to enrolled customers when their response to an XSP event reduces the energy costs to the LSE. This could take the form of:

- A wholesale energy payment for increasing load during negative wholesale prices (the way PDR resources currently receive a wholesale energy settlement for reducing load) for resources that are integrated into the wholesale market,
- A retail energy payment or retail credit to the participant (directly to the customer or to a 3rd party aggregator) based on the reduced amount of costs incurred by the LSE for reduced generation expenses and/or not having to pay to curtail renewable resources.

[12] http://www.caiso.com/StakeholderProcesses/Energy-storage-and-distributed-energy-resources#phase4

If a retail energy payment were incorporated into the XSP, an assessment would have to be done to determine how the energy payment could complement the capacity payment or whether the energy payment would replace the capacity payment entirely. The capabilities and reliability of different technologies is another avenue of exploration for energy payments. Certain technologies that have less reliability and would otherwise not be incentivized by a capacity payment, may view an energy payment as favorable in a pay-for-performance model.

6.4.5 TOU Demand Charge Offset Payments

As mentioned throughout this section, compensating customers for retail bill impacts due to potential increased TOU demand charges because of participating in the XSP is one way to increase customer interest. However, this was always intended to be a temporary "safety net" solution exclusively for the pilot and not meant to be implemented long term. As efforts are being made to redesign rate tariffs and shift TOU periods later in the day, retail peak TOU periods should better align with wholesale market peaks, reducing the conflicting signals created by asking a participant to increase load due to excess supply in the wholesale market during a retail peak TOU period. The Demand Charge Offset can then be discontinued. PG&E is commencing the rollout of TOU rates in 2020. However, it is worth noting that even with the benefits of coincident TOU periods with CAISO peaks, retail rate tariffs alone are limited in their ability to address more granular distribution constraints.

In addition, as demonstrated by many of the pilot participants, it is possible, even with current retail TOU periods, for many commercial customers to increase load without incurring additional TOU demand charges. We would expect this trend to increase as participants get more comfortable with the concept of shifting load to the middle of the day and refine their bidding behavior.

Not having to calculate the Demand Charge Offset will be helpful for administration of a program with a large number of participants. Having to calculate program performance in addition to TOU demand charges incurred in response to XSP events in and of itself is an operational challenge because it requires another calculation process as well as additional data related to the customer's retail billing process.

6.4.6 Geographic Granularity

From the perspective of over-supply on the distribution grid, the sub-LAP is likely too large of a regional construct, plus distribution constraints can differ substantially from circuit to circuit which is too granular to be handled at the sub-LAP level. To address these issues, granularity of dispatch at the feeder level would be a better construct. However, in various proceedings and stakeholder processes, in addition to experience gained from working with various parties as part of the XSP, parties have been clear that even at the sub-LAP level, there can be challenges with the size of the potential customer pool, thus making it harder to enroll enough customers to meet a reasonable minimum load. As such, the sub-LAP has been deemed a compromise for the XSP.

6.4.7 Effects of Multi-Use on DR

Battery energy storage systems (BESS) have been touted for their ability to stack a multitude of services that may benefit the customer and grid. Based on public marketing collateral and interviews with pilot participants, demand charge management is currently a significant driver from a financial aspect to incentivize customers to adopt BESS. As a result, BESS operators will prioritize delivering demand charge management. The ability for that same BESS to then deliver demand response is non-trivial. Event performance from BESS resources and Participant interviews illustrate this challenge. Points of uncertainty regarding the ability of BESS to be multi-use include:

- Variable battery capacity after providing DCM
- Reliability of the integration which delivers operating instructions to the BESS.

6.5 EVCN Lessons

An EVCN Load Management Plan was introduced utilizing a variant of the XSP. The roles in this variant are different from the XSP in that the electric vehicle service provider (EVSP) acts as the participant in the pilot, while the customer – also identified as the *site host* – is the recipient of benefits. Several lessons have come from the onboarding and operations phase:

- Because the EVSPs engaged with the EVCN are not directly incentivized to be responsive to XSP events, there appears to be a hesitancy for the EVSPs to perform this service. This may be an issue with the ultimate design of the EVCN program or specifically of the load management option. For example, one EVSP has indicated that they are a technology provider to the EVCN, not an aggregator. Ultimately the EVSPs can be expected to respond to XSP signals, but without proper incentives may not commit to developing strategies to ensure good performance in response to such signals.
- Because the EVCN option to the XSP was designed to limit changes to the overall XSP paradigm and to limit costs, various aspects, including the participation agreement, were left intact from the XSP. Considering the previous point that the EVSP is not a perfect match for the XSP participant, there has been some confusion by EVSPs about whether the participation agreement is suitable for this purpose. This has caused some significant delays, noting that the resolution was to keep with the original agreement, noting that more training of the EVCN team and participants may have mitigated this issue.
- A related issue, that could have been mitigated through additional training, is that site-hosts are required to execute an XSP authorization form; however, the specific party responsible for acquiring these signatures and getting the forms fully executed with the EVSP has been unclear and has caused some delay.
- Throughout the development of this EVCN option, it has been an open question as to whether the different roles were a good match for the XSP and if more significant changes would be in order to support the load management objectives of the EVCN. The activities and reactions of stakeholders to date has kept this an open question.

The event performance of both load increase and load decrease dispatches have not been visible relative to the nomination quantity. No resource has been able to clear the minimum 20% monthly event performance in order to qualify for any incentive payment. The lack of performance suggests that there are technological as well as behavior barriers to implementing demand response with EVSE. For example, the lack of control and visibility EVSPs have regarding EV driver charging behaviors reduces the likelihood that load will even be available during an event. From the technological side, the ability to increase load is a capability that one EVSP has explicitly stated is a limitation and through evaluation of event performance, this limitation does not appear to be unique to a single EVSP.

- The current methodology for determining the Qualified Capacity for a resource in the EVCN-LMP is to take the sum of the nameplate capacity rating for all of the EV chargers on site, in lieu of a capacity test. This methodology proved to greatly overestimate the amount of capacity a site could deliver due to the low utilization of EV chargers on site. Even discounting the low utilization, the charge rate of EV chargers usually does not operate at full capacity and the charge rate is even dictated by the EV in some cases.

6.6 PUSD Lessons

The Pittsburg USD School Bus Renewable Integration Pilot was incorporated into the XSP in August 2019 as a way to understand how medium and heavy-duty fleet vehicles can act as distributed energy resources during periods of high renewable penetration and how to adapt charging schedules to better align the profiles of charging and renewables generation. BEBs were an ideal resource for participation as their daily schedules—and thus their energy requirements—are fairly fixed. Therefore, there was a high level of certainty that the BEBs would be available for charging during potential excess-supply hours. Despite this certainty, noteworthy challenges emerged that negatively affected event performance.

- Technical integration issues – The integration necessary to be able to reliably control the EV chargers is non-trivial. Significant effort was spent with the charge vendor configuring and troubleshooting the integration that allowed the chargers to be remotely controlled. In addition, buses from different bus manufacturers have different managed charging capabilities which can prohibit managed charging. The issues here speak less to the feasibility of BEB responding to load increase dispatch signals, but rather highlight the other technological barriers that are required for implementing a managed charging strategy.
- Bus Operational Constraints – The District encountered operational needs that prohibited the use of the BEBs consistently. As a result of the lack of bus utilization, there were instances where the BEBs were not able to respond to load increase signals as the batteries were already at full capacity. Additionally, the District has seen some minor defects with the BEB itself, which as a result had to spend significant time being repaired before becoming operational again.

7 Conclusion and Next Steps

The XSP has been successful in gaining learnings in a number of its key objectives and, in doing so, has directly and indirectly addressed multiple barriers to renewable integration challenges. In addition, these learnings have helped inform ongoing proceedings at the CPUC and CAISO. The XSP is also being looked at and utilized by other groups such as the EVCN-LMP and PUSD Pilot. However, there are still some unanswered questions around the interactions with other DR services and TOU rates which influence load. Early stage operational challenges have been identified in the EVCN-LMP program and proposed measures to address are outline below. Moving forward, PG&E aims to ensure that pilot priorities align well with broader state goals, specifically the feasibility of implementing real-time pricing for different customer classes. Pilots provide an ideal environment to test potential real-time pricing tariffs.

7.1 Next Steps

While much has been learned, there are still some unanswered questions around the effects on local distribution planning and operations, and the interaction with other DR programs that provide load reduction.

- Continue to refine the event trigger mechanism to trigger events when excess supply situations are likely to; and,
- Continue to provide real-world input into ongoing stakeholder efforts at the CPUC and CAISO;

Proactive efforts are being made to re-evaluate the design of the EVCN-LMP program. Although participation in the program only became operational in October 2019, initial assessment of the performance data shows consistent gaps that should be address to better incentivize EVSP and Site Host participation. PG&E is also looking to draw lessons from similar EV programs (e.g. SCE Pilot). Items that are undergoing discussion include:

- Energy only compensation structure—in addition to the capacity compensation structure—to align reliability of resource to compensation.
- Payment delivery method. Evaluate whether the current incentive payment delivery method – bill credit to Site Host – is sending the proper price signals to EVSPs.
- Development of new marketing collateral to communicate new program features as well as educate EVSPs and Site Hosts of the goals and objectives for the pilot.
- Gaining insight into motivating factors for EVSPs and Site Hosts to participate in the EVCN-LMP program.

Appendix A: Participant Performance Details