



# Excess Supply DR Pilot 2015-2016 Summary and Findings (Public Version)

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Date  
May 12, 2017

## 1 Acknowledgements

The work described in this report was funded as part of PG&E's Excess Supply Demand Response Pilot (XSP), which was proposed by PG&E as part of its 2015 – 2016 Demand Response (DR) bridge filing and approved by the California Public Utilities Commission (CPUC) in Decision (D.) 14-05-025.

The authors would like to thank all the participants for their support and continued engagement through the pilot, and the California Independent System Operator and California Public Utilities Commission for their ongoing guidance and support.

The authors would also like to thank Laura Mameesh of Olivine for her support on this report.

## 2 Abstract

The Excess Supply DR Pilot (XSP) is a PG&E Pilot focused on testing the capabilities of demand-side resources to increase load as a service to the grid during the times of over-generation on transmission and/or distribution lines as well as in the case of negative prices. Consistent with CPUC policy, the Pilot does not intend that Participants simply use more energy during such periods; instead, it is intended that Participants will utilize XSP events to shift energy usage. Due to the lack of a relevant product type at the CAISO, the XSP Pilot does not register nor bid resources into the wholesale markets. Note that while negative prices and actual over-generation do exist in practice, Pilot events were dispatched based on administrative decisions to test the overall construct of response to excess supply conditions, not based on actual grid conditions.

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## 3 Introduction

### 3.1 Background

New California policies, establishment of new state goals and penetration of new end use technologies continuously add complexity to future grid needs. In addition, the California Independent System Operator (CAISO) identified that with a 33% penetration of renewables, net load to be served will have steep ramps during winter and spring. These changes in net load, policy and technology, require California to evaluate which resources can address future grid needs. In this project, demand responsive loads are being considered as one of the many resources that can support economical and reliability needs of the future grid. In addition to traditional demand response that addresses summer peak shaving, new demand response offerings must be constructed in order to meet future transmission and distribution grid needs. PG&E has a history of developing such offerings within pilots, including the recent and related Supply Side Pilot.

The Excess Supply Demand Response Pilot (XSP) was proposed by PG&E as part of its 2015 – 2016 Demand Response (DR) bridge filing and was approved by the California Public Utilities Commission (CPUC) in Decision (D.) 14-05-025. PG&E subsequently received approval from the CPUC in D.16-06-029 to extend the XSP through 2017. The XSP is a departure from other offerings in that it asks participants to shift energy to consume more power at certain times. Without relevant wholesale market products for triggering greater usage of demand, the XSP has been implemented as an out-of-market program with simulated events.

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 1, which is based on data from a prior PG&E Long Term Procurement Plan, shows this emerging reality with estimated net load curves for specific days in 2022.

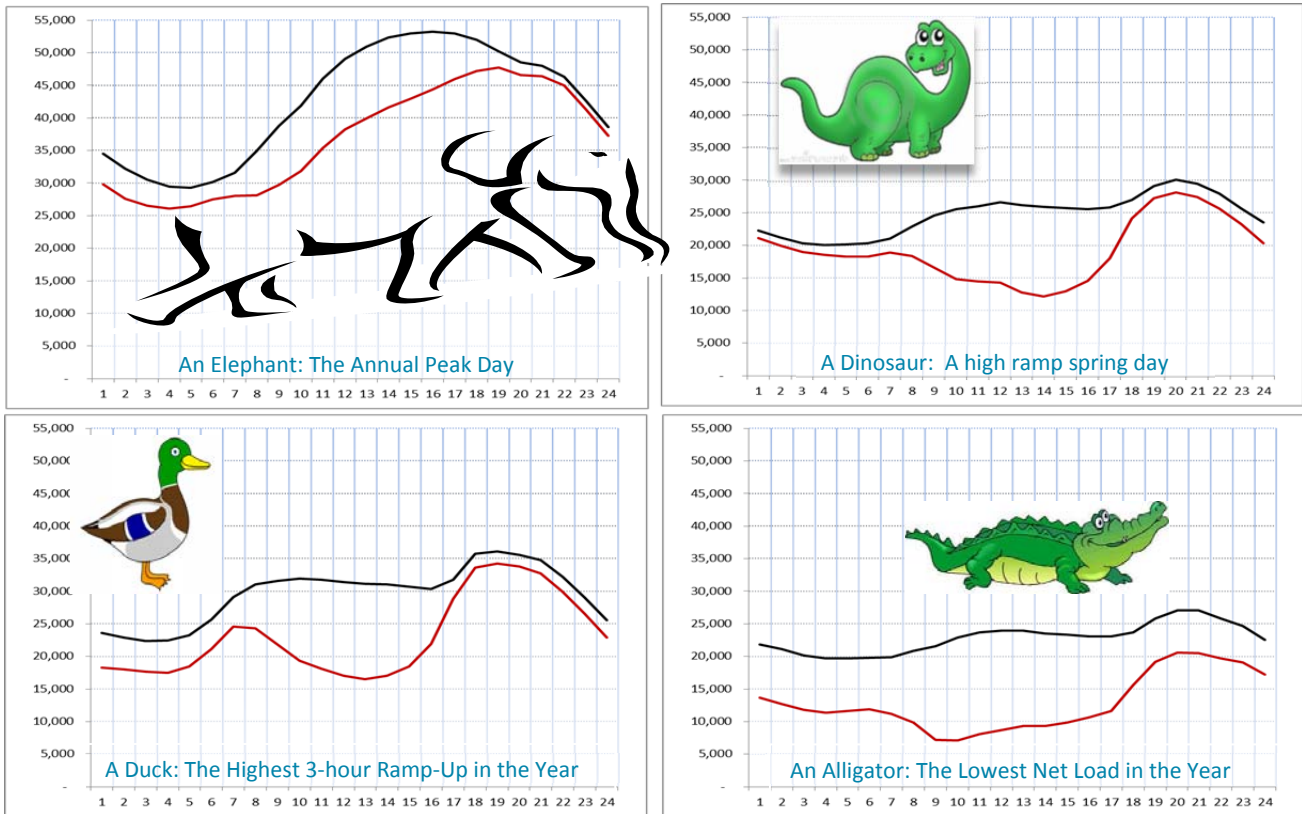


Figure 1: Many animals in the zoo

These new net load shapes create challenges to the grid in balancing against the capacity in transmission and distribution. The primary goal of the XSP is to investigate ways to shift energy usage to mitigate these challenges.

Figure 2 shows how the CAISO system net load shape has changed over multiple years, and these “animals” have become more prevalent.

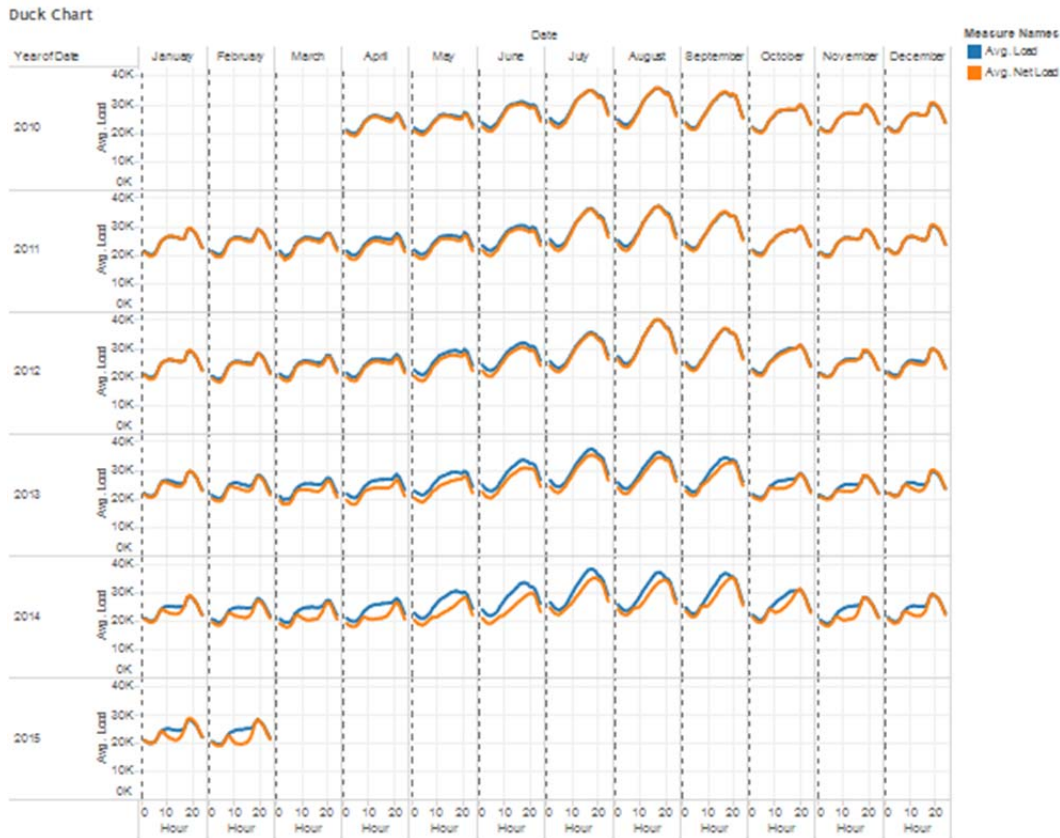


Figure 2: Average CAISO system gross vs. net loads

The XSP was initially scheduled to run from 2015 through 2016 and, upon approval by the CPUC, has since been extended through 2017.

The pilot team roles and responsibilities are identified in Figure 3. Both single customers and aggregators were eligible to participate in the XSP. Olivine serves as the pilot administrator enabling participation through the Olivine DER software platform. Olivine provides the sole interface between participant and pilot, including participant recruitment, enrollment and registration; nominations; award and dispatch notifications; meter data aggregation; resource certification; and settlements and payments.



Figure 3: Entities involved in the pilot and their roles

## 4 XSP Participation

To participate in the XSP, participants needed to meet several requirements for eligibility and enrollment, detailed here.

### 4.1 Customer Eligibility

The initial concept of the XSP was that it would only be open to residential customers. As discussion progressed with prospective participants throughout 2015, this decision was revisited by PG&E. With the initial intention being to avoid customers that had a demand component to their rate, it was first decided to expand to small commercial. This is because such customers are on rates at or below 20 kW and are therefore not exposed to the demand charge. Ultimately it was decided that any customer class would be eligible.

### 4.2 XSP Resources

The XSP organizes customer locations into aggregations called resources. There is a parallel between these resources and the CAISO definition of a resource. 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. To facilitate multiple participation in the related Supply Side DR Pilot (SSP).

The 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 customers into a resource that can then participate in the XSP. A large customer may also directly enroll one or more locations, as long as the set of locations meets the eligibility requirements. For consistency, Olivine used the term *participant* to indicate the party that enrolls in the Pilot (i.e., the aggregator or the direct customer). The term *customer* identified end-customers (i.e., the aggregator's customers).

In general, each participant in the XSP was allowed to enroll a single resource, composed of an aggregation of one or more customer locations, but needed to meet the requirements detailed in the following sections.

#### 4.2.1 The resource must meet a minimum of 30 kW of load increase

XSP resources are required to be able to achieve a minimum of a 30 kW load increase. Note that this requirement allows for the participant to achieve this increase at any time of day to meet this requirement. See section 4.3.1 for more information on the testing requirements.

#### 4.2.2 Customers must be located within a single Sub-LAP

All of the locations within the resource must be located within a single Sub-LAP. A Sub-LAP is a geographically defined area, such as PG&E East Bay or PG&E San Francisco. Thus, 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.
- To participate in the related SSP, Sub-LAP location is a requirement.

Note that from the perspective of over-supply on the distribution grid, the Sub-LAP is likely too large of a regional construct; however, in various proceedings and stakeholder processes, parties have been clear that the Sub-LAP creates challenges because it narrows the enrollment pool. As such, the Sub-LAP has been deemed a compromise for the XSP.

#### **4.2.3 Customers must not be enrolled in any other DR program or rate**

PG&E and the CPUC generally limit customers to a single utility demand response program or rate. As such, customers were not allowed to enroll in the XSP if they were on another program or on the “demand-response”-like rates of SmartRate or Peak Day Pricing. Although not a CAISO-integrated product, customers also could not be enrolled in a CAISO resource.

Note that there was an exception to this that a customer could participate in the SSP and the XSP as long as the resource met certain criteria. This condition did not occur during the 2015-2016 SSP but it is expected it will in the 2017 extension. See section 4.3.6 for specific requirements.

#### **4.2.4 It is preferred that customers be served by one Load Serving Entity (LSE)**

The LSE is the entity responsible for procuring electricity for their customers. For vertically-bundled utility customers, the LSE is always Pacific Gas & Electric. For Direct Access customers, the LSE is an Energy Service Provider (ESP) or Community Choice Aggregator (CCA).

Keeping consistent with the CAISO rules for PDRs, it is preferable that enrolled customers for an XSP resource be served by one LSE. This eases dual participation between XSP and SSP; however, it is not a requirement of the pilot.

### **4.3 XSP Rules**

Aside from the eligibility requirements enumerated above to gain entry into the Pilot, Participants had several requirements for qualification and ongoing participation to earn their capacity payment. This is outlined in the following figure:

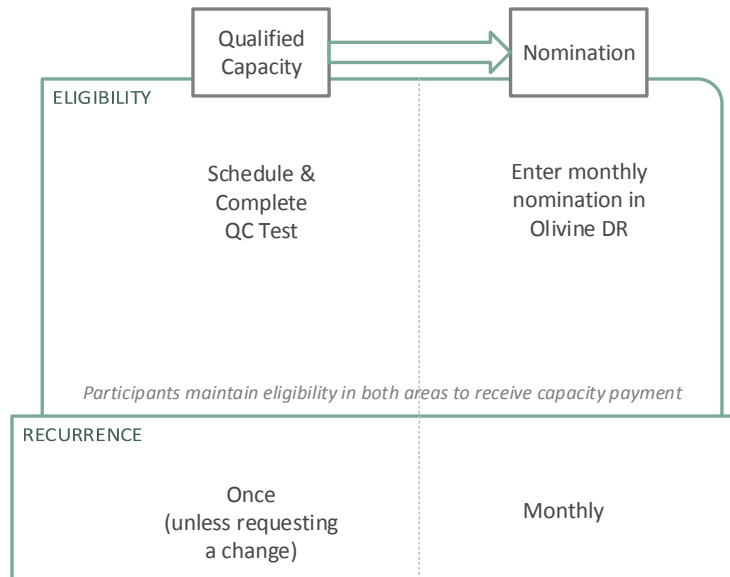


Figure 4: Participant Operational Tasks. Courtesy of Olivine, Inc..

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.

### 4.3.1 XSP Baseline and Performance Methodology

To measure performance, the XSP utilizes a historical 10 in 10 baseline that is identical to the CAISO Proxy Demand Response baseline. This algorithm uses the following algorithm:

- Locate the previous ten similar non-event days and compute an average profile of those days utilizing whole-premises meter data.
- Calculate a day of adjustment using the ratio of event-day usage compared to the average profile. This ratio is computed using the 3 hours preceding 1 full hour before the first event hour, as shown in the following diagram:

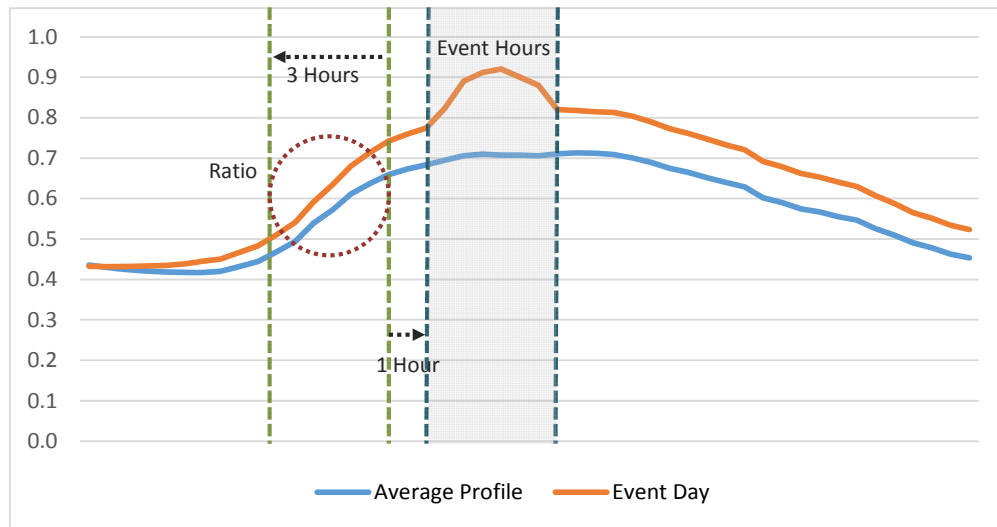


Figure 5: Day of adjustment. Courtesy of Olivine, Inc..

- The ratio is capped at +/- 20% and is then applied to the average profile to produce the baseline. In the example in the diagrams, this results in baseline with higher quantities than the average profile.
- Finally the excess load is determined by subtracting the actual event day load from the new baseline as shown in the following diagram.

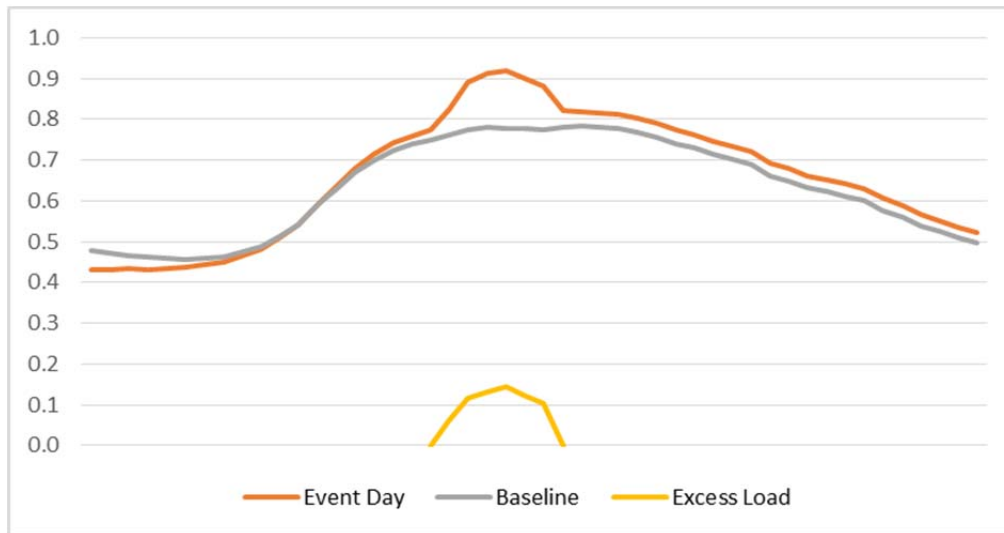


Figure 6: Excess Load. Courtesy of Olivine, Inc..

- The excess load calculated in this way is the hourly performance for the XSP.

### 4.3.2 Qualified Capacity (QC)

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

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

### 4.3.3 Nominations

In many conventional demand response programs, a nomination is a capacity commitment made by the participant. Often the nomination will hold for one 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 of the event.

Different from conventional programs, the XSP provided much flexibility in choosing availability hours to emphasize participation over a specific grid need. As such, nominations in the XSP included not just a capacity quantity but also days and times of availability indicating at 4-hours of availability per day using the following rules:

- The nominated capacity could not exceed the Qualified Capacity.
- 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.

- Monday through Friday; Saturday and Sunday
- Monday through Thursday; Friday through Sunday
- For either option, the participant could choose either one of the two groupings or both.
- The Participant could choose different hours for each grouping.

Excluding the 7-9 AM and 6-8 PM periods was designed to avoid conventional peak ramping periods, noting that actual periods can and do 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.

Following are valid examples of nominated time periods into the XSP:

- A participant nominates 30 kW for Monday through Friday: 8 PM to Midnight; weekends: 4 AM to 8 AM.
- A participant nominates 30 kW for Monday through Thursday: 8 PM to Midnight; weekends: 4 AM to 8 AM.
- A participant nominates 30 kW for Monday through Thursday: 8 PM to Midnight.
- A participant nominates 30 kW for weekends: 4 AM to 8 AM.

Note that this approach is designed to enable participants to offer flexibility and learning value to the Pilot. Also note that each grouping will be tested each month.

#### 4.3.4 Incentives and Dispatch

Incentives for the XSP are based on a monthly capacity price, with the capacity price dependent on the nomination periods selected. This is shown in the following table:

	# of days	\$/kW-month	Expected Events
Saturday-Sunday	2	\$5	2
Friday-Sunday	3	\$6	3
Monday-Thursday	4	\$7	4
Monday-Friday	5	\$8	5
Monday-Sunday	7	\$10	7

*Table 1: Capacity Prices*

Events dispatched through the pilot were either 1 or 2-hours in duration, and only one event per day with notification delivered by 2 PM one day ahead. Unlike conventional DR programs, it was critical that the XSP have regular events to test out the ability of participants to provide excess load. The number of such events was also dependent on the nomination periods, as shown in the previous table.

#### 4.3.5 Capacity Settlements

Capacity incentives in the XSP were paid to the participant, and payments were the product of monthly performance, nomination amount and the capacity incentive. This monthly settlement was based on monthly performance calculated mapping their raw event performance to an adjusted event performance. Raw event performance is the average performance each hour as described in section 4.3.1. Table 2 shows the mapping between raw event performance and adjusted event performance.

Raw Performance	Adjusted Performance
> 0.50 and ≤ 1.00	1.00
> 0.25 and ≤ 0.50	0.50
> 0 and ≤ 0.25	0.25
≤ 0	0

*Table 2: Adjusted Performance*

A monthly performance value is then calculated as the average of each adjusted hourly performance. This monthly performance value was then applied towards the monthly nominated capacity payment to determine the capacity settlement payment.

#### 4.3.6 Joint XSP / SSP Participation Option

As noted above, participants were allowed to enroll in both the XSP and the SSP. In that case, the following additional requirements also applied:

- The XSP and SSP 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 bids cannot be later than the hour ending at 4PM. This is to ensure there is no impact on baseline calculations from events on either pilot to the other.
- While the SSP allows a sub-100 kW option, in the dual participation case, the SSP resource must achieve the 100 kW reduction requirement.

## 5 Pilot Operations

### 5.1 Recruitment and Enrollment

The first step in recruiting participants into the pilot was to perform a marketing outreach effort to as many appropriate entities as possible.

A list of 32 possible organizations and their contacts was drafted using participation list including SSP prospective participants, from other PG&E programs, and from Olivine contacts. The contacts on the list were notified in this outreach phase, both via email and phone. While the XSP had been introduced at earlier SSP meetings, it was on December 16, 2015, that an XSP-focused kick off meeting was held at the PG&E Pacific Energy Center with many participating by phone. This meeting included specific participation rules, enrollment steps and materials were outlined for prospective participants.

#### 5.1.1 Enrollment Process

Potential participants filled out a declaration of interest (DOI), and provided detailed information on customer locations and excess supply capacity. 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.

#### 5.1.2 Enrollment Details

A list of 32 possible organizations and their contacts was drafted using participation lists from previous pilots, and from other PG&E programs, and additional PG&E and Olivine contacts. The contacts on the list were invited to the kickoff meeting, both via email and phone.

From this original list of 32 organizations, 8 distinct organizations attended the meeting in addition to PG&E and Olivine staff:

- EnergyHub
- SolarCity
- Comverge
- Earth Networks dba WeatherBug Home (now Whisker Labs)

- Green Charge Networks
- Stem
- Electric Motor Werks
- Johnson Controls

In addition, Green Lots and Marin Clean Energy – a Community Choice Aggregator – showed interest in the pilot after this kickoff meeting<sup>1</sup>.

Of these 10 organizations, 4 submitted a declaration of interest:

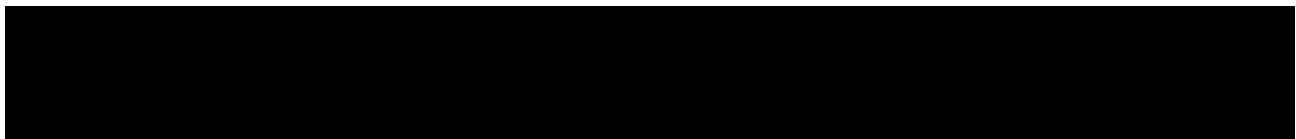


Of the 16 potential participants with whom Olivine had ongoing discussions over several months, one participant fully enrolled in the pilot. There were varying reasons some of the sites or entities could not participate in the pilot including the following:

- The prospective participant actually had no customers, or no customers suitable for providing excess load.
- The prospective participant was in the business of reducing demand charges for their customer(s) and therefore felt the XSP would not be cost effective considering that it could increase demand charges.
- The prospective participant was dependent on other funding sources that were not procured (e.g., SGIP) and therefore did not proceed with deployment of the controls and systems that could support the XSP.
- The prospective participant was focused on delivering to the PG&E Supply Side Pilot or to the California-wide Demand Response Auction Mechanism (DRAM) and either did not have the company bandwidth to support XSP or did not have enough customers to support both activities.

### 5.1.3 Enrolled Participants

Table 3 summarizes the amount of reduction and the sources used to deliver these reductions by participant.



*Table 3: Participants, their qualified capacity and end uses*

<sup>1</sup> Note that other parties provided declarations of interest for 2017 participation, but are not counted here.

## 5.2 Example Events

The following figures show example event dispatches under the XSP.

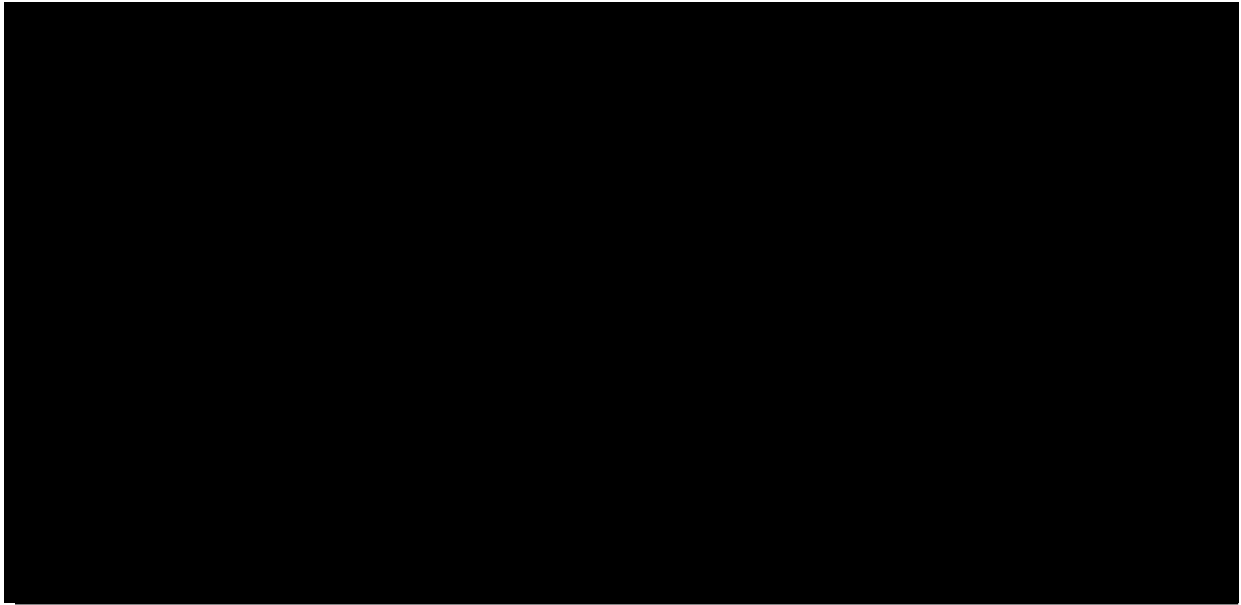


Figure 7: [Redacted]

Figure 7 shows the measured load and calculated baseline along with the 1-hour delivery of the [Redacted]. The light blue line identifies the baseline calculated per the rules as defined in Section 4.3.1. The dark blue line identifies the target increase to achieve the [Redacted] nomination. Finally, the green line identifies the actual load during that time, noting that in this case the load is greater than the target indicating successful delivery of the requirement.

## 5.3 Resource Operations

[Redacted] participated in the XSP from March 2016 through December 2016. They were available every day of the week for nominations. Their nomination indicated consistent availability from [Redacted]

[Redacted] The following table shows the performance of the resource throughout the participation.



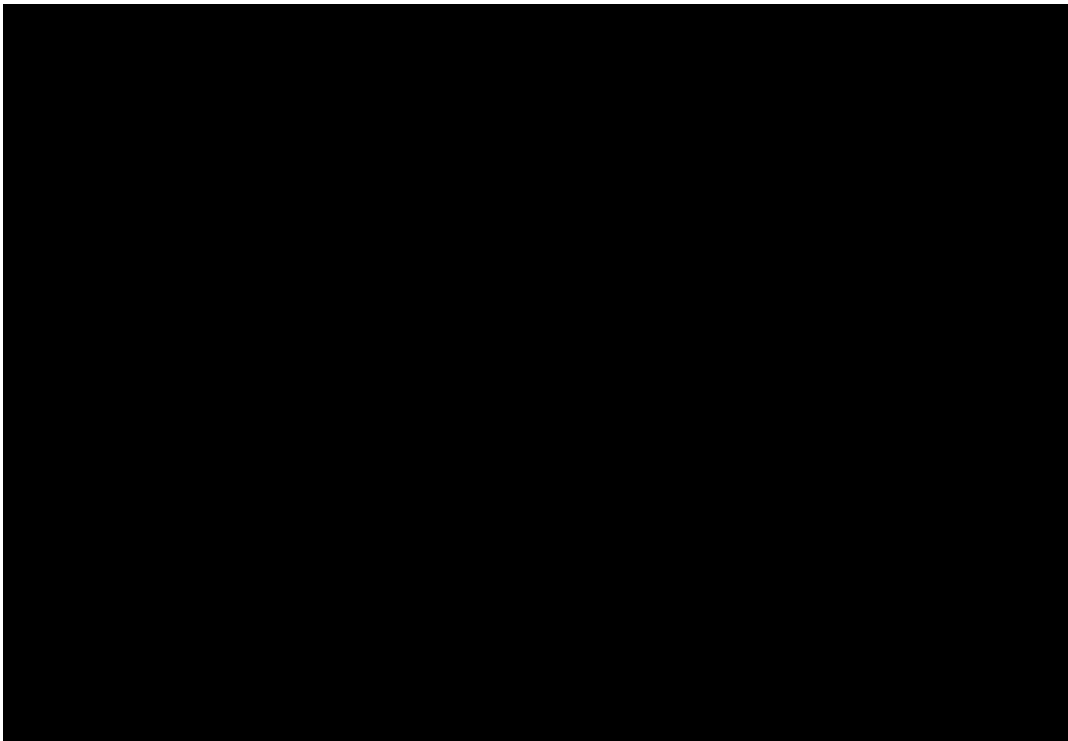


*Table 4: Summary of Awards and Performance, 2016*

This table shows clearly that, on average, the raw performance of the resource over-performed expectations. Note that because the adjusted performance is capped at 100% and measured on an hourly basis, any under-performing hour will reduce the average adjusted performance value. Section 4.3.5 details the difference between raw and adjusted performance.

#### **5.4 Value of Participation**

Each participant received capacity incentives for each month they nominated. Table 5 summarizes capacity settlements received by each individual resource based on its participation.



*Table 5: Total payments to participants*

## 6 Lessons Learned

In this section, we outline the lessons learned throughout the pilot implementation.

We categorize the lessons learned in this pilot into customer acceptance, market transformation challenges, technical and operational feasibility, and value to participants.

### 6.1 Enrollment

There was much interest from parties in 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 are looking for funding mechanisms that would help them fund enrollment of customer deployments into their own energy management service offerings. As such, a common theme is a declaration of interest, but ultimately the prospect does not get funded (e.g., through the Small Generation Incentive Mechanism, or SGIP). For example, this was the case for [REDACTED] and their battery storage team as identified previously.
- 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 incorrect belief that they would get a DRAM contract, or for those who were awarded a contract, forestalling XSP participation while fulfilling the DRAM. For example, this was the case for [REDACTED].
- Some prospective participants were concerned with the limited duration of the XSP (initially approved for 2 years with a subsequent 1-year extension) and the risk that the pilot might not be extended further. 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.

An additional issue for some parties was the risk of increased demand charges due to responding to XSP events. While the pilot was originally opened only to residential and subsequently to sub-20 kW customers to avoid an impact on customers' demand charges, it ultimately opened up to any party. During the 2015 to 2016 period, this was with the assumption that any increased demand charges would be the responsibility of the underlying customers. Some analysis performed by Olivine and PG&E has shown that the increased demand charges for larger commercial customers can easily exceed the potential capacity payments for any individual customer. Customers can avoid this impact by selecting a pilot availability period that is not coincident with their current monthly peak 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. 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, most felt they would either not be able to utilize the above methods or there was too much risk.

In addition to the potential financial impacts of participating in the XSP on demand charges, the changing eligibility requirements may have created confusion among prospective participants.

Because enrollment in the XSP was very low, Olivine recommended and discussed with PG&E various changes for 2017 and beyond to improve enrollments:

- New requirements and rules for an additional component of the XSP incentive to cover at least a portion of any calculated increase in TOU demand charges due to responding to XSP events.
- 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 and XSP plus any other known contacts provided by PG&E utilizing these new materials, and describing these new rules.
- Increased visibility with respect to the future of the XSP beyond 2017.

## 6.2 Value to Participants

The value delivered to the participant is detailed in Section 5.4, with a total of [REDACTED], but more generally as \$10/kW-month year-round. This compares favorably to other DR programs. As discussed in the previous section, this capacity 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 (larger commercial) to help realign supply and demand.

## 6.3 Operational Feasibility

The pilot was successful in calculating performance based on an inverse CAISO 10-in-10 baseline methodology for load increase events. However, because there were no participants that participated in both SSP and XSP, the feasibility of calculating a baseline for load increasing and load decreasing events that occur in close proximity to each other could not be tested.

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 greatly reduce the chance that participants would be available coincident with actual excess-supply need. For the XSP to expand into an at-scale program, it would be 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 capacity prices 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.

An additional aspect of this is to consider that the value of XSP might differ greatly by location, and that the CAISO-centric Sub-LAP construct is likely far too large of a regional definition to be suitable.

Another aspect for consideration here – and possible source of funding – could be to provide credits to enrolled customers when their response to an XSP event reduces the energy costs to the LSE.

As mentioned throughout this section, compensating customers for retail bill impacts due to potential increased TOU demand charges as a result of participating in the XSP is one way to increase customer interest. However, 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.

## 7 Conclusion and Next Steps

In this pilot project, one resource participated to provide demand shifting and received payments for participation. In the process, there were lessons learned, both from the participant's perspective, and the SC's perspective. These lessons are summarized in Section 6.

### 7.1 Next Steps

The continuation of this pilot through 2017 is underway, and PG&E proposed in its 2018 - 2022 DR application to continue the XSP through the 2018 - 2022 period. While continuing to support the 2015-2016 rule set, the following items are being addressed for 2017:

- Incorporate day-of as well as day-ahead event notifications to test if participants can respond with less notification.
- New program material with additional information on value of the XSP to the participant as well as the grid. This material includes more background on the impacts of increased renewables penetration and potential consequences such as excess supply situations and the need for increased flexibility.
- Additional outreach, utilizing the new material, to all participants of SSP and XSP, PG&E customer service representatives, industry groups, and any other known contacts provided by PG&E.
- Commercial participants that are available during the day (vs. at night) are eligible to receive the capacity payment plus an additional amount (up to the amount of the capacity payment) to help with TOU demand charge impacts incurred due to responding to XSP events.
- Recruit customers to dually participate in the XSP and SSP (renamed the SSP II in 2017) to test bid strategies as well as baseline and settlement interactions between load increasing and load decreasing events.
- Expand the pilot to explore distribution issues, including how to proceed with integrating bid/award information into distribution operations as well as if XSP resources can be utilized as a tool to resolve excess supply at the distribution level.

Appendix A

