# SAN DIEGO GAS & ELECTRIC COMPANY
# Participating Load Pilot
## 2009 Evaluation


**February 1, 2010**
**Version 1.0**

# 1 Executive Summary

## 1.1 Pilot Description

The San Diego Gas and Electric (SDG&E) Participating Load Pilot (Pilot) allowed Commercial and small Industrial customers to aggregate as a single Participating Load resource to interface with the CAISO wholesale market. The Pilot was available to commercial and industrial customers, greater than 200 kW, receiving Bundled Utility service, Direct Access ("DA") service or Community Choice Aggregation ("CCA") service, and being billed on a Utility commercial, industrial or agricultural rate schedule. Pilot participants nominated a dispatchable amount of load on a monthly basis from August to December as one of two products: load that could be interrupted weekdays 11 AM to 7 PM (Weekday Peak), and load that could be interrupted any day and any hour (All Day). Each of these products required interruption with 10 minutes notice. The Pilot tariff[1] filed with the California Public Utilities Commission (Commission) paid a monthly capacity payment dependent on the product for which capacity was nominated with a reduction to that payment if the load did not perform as expected during an event.

On a daily basis, the dispatchable portion of the participating customer's load was bid into the CAISO Day Ahead Market as Non-Spinning Reserve, a contingency resource that is expected to fully respond to a real-time energy dispatch within 10 minutes of notification. Dispatch of capacity for contingency events is relatively rare in the CAISO market so a number of test dispatches were called to assure exercise of all systems end to end. There was no distinction between actual contingency dispatches and test dispatches for the Pilot participants who received no prior notice of test events and were expected to respond on every occurrence.

While the design and implementation contemplated that both SDG&E bundled service customers as well as DA customers would be eligible for participation, only bundled customers participated in the Pilot during 2009. The Pilot was also indifferent as to whether customers were represented by demand response aggregators (Aggregators) or participated directly (Directly-enrolled Participants). To assure that dispatch mechanisms would be exercised and a reasonable amount of data could be collected for analysis, the Pilot dispatched the Participants a minimum of three times each month. To provide some certainty that participants would not be over used, a monthly maximum of five events was established.

## 1.2 Pilot Objectives

The intent of implementing the Participating Load Pilots was to develop an understanding of the issues, systems and effort required to fully integrate utility demand response programs into the CAISO market. In order to make this effort as effective as possible SDG&E focused on implementing a Pilot reflective of the 'real world' with Pilot specific objectives focused on practical understanding of an Aggregator based model.

SDG&E's goal was to be agnostic to end-use telemetry solutions so as to work with third party aggregators to aggregate various types of participant's load. The Pilot implementation required the design, installation, and testing of near real-time telemetry from Pilot Participants to the CAISO such

[1] SDG&E Schedule PLP, Participating Load Pilot Demand Response Program. See http://www.sdge.com/tm2/pdf/ELEC_ELEC-SCHEDS_PLP.pdf.

that the CAISO is able to monitor curtailments in real-time. Participants included both Directly-enrolled Participants and Aggregators, both with and without AutoDR (Automated Demand Response) capabilities and with a number of end-use customers representing the various customer types in the marketplace.

Using this 'real world' design, Pilot specific objectives included:

- Identifying and assessing the costs, barriers and necessary incentives to provide technology for required telemetry and AutoDR capabilities.
- Determining and assessing program design, systems and processes required to support full scale integration into CAISO MRTU market.
- Assessing capabilities of different customers and load types to perform effectively.

## 1.3 Implementation

Implementation of the Pilot was an extensive effort that was compressed due to the mandate delivered in the Commission Decision (D) 0812038 adopted December 18, 2008 (Decision Adopting Bridge Funding for 2009 Demand Response Programs) to be operational for the summer of 2009. To ensure that the Pilot would be operational by summer 2009, detailed design and technical development phases overlapped. This required some iterative work to assure that the tariff reflected all elements of the Pilot as implemented.

A high level overview of the activities during 2009 is shown in Figure 1.

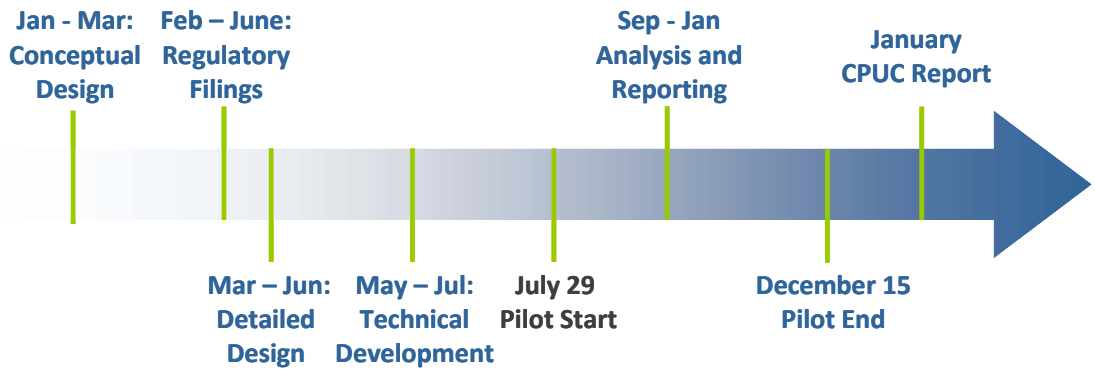


**Figure 1: Pilot Chronology**

The initial conceptual design elements were established in conjunction with the CAISO which was ordered by the Federal Energy Regulatory Commission (FERC), through Order 719, to perform an assessment of the technical feasibility and value to the market of using ancillary services from small demand response units.

The Pilot tariff was consolidated under a supplemental advice letter filed with the Commission on June 10, 2009 that provided clarifications and elaborations to an original tariff filing that preceded the final design and development phases. To establish standing and eligibility in the CAISO wholesale market, SDG&E executed a Participating Load Pilot Agreement with the CAISO which in turn was filed with the Federal Energy Regulatory Commission on June 26, 2009 for an effective date of June 29, 2009.

Prior to actual system development for Pilot specific applications, an inventory of existing SDG&E Demand Response applications was undertaken to determine if any could be leveraged due to the compressed implementation timeframe. Several elements and applications from the Capacity Bidding

Program were leveraged to meet the needs of the Pilot. Development work for new applications specific to the Pilot focused on telemetry and event notification. All development work to provide functional applications for operation of the Pilot was completed prior to the Go-live date.

SDG&E participated in the CAISO Participating Load Pilot Market Simulation from June 29 to July 10 2009. The market simulation was run in conjunction with the other utility pilots and provided an opportunity to see the "bid to bill" process function within the CAISO markets. This critical step provided the assurance that Pilot processes and practices as well as the CAISO systems were production ready for operation in the financially binding CAISO markets.

Pilot participants were brought into the testing process in July with telemetry connectivity testing followed by telemetry end to end testing. These were completed prior to the final functional load response test, which was performed on July 22, 2009 to assure that the participants could respond to a curtailment notification with load drops visible through real-time telemetry.

The final step prior to being accepted as a Participating Load (PL) resource capable of bidding Non-spinning reserves into the wholesale market was an Ancillary Services certification test with the CAISO. This test was successfully completed on July 23 and demonstrated that the CAISO had telemetry visibility to an actual load drop within 10 minutes of issuing a dispatch instruction.

The SDG&E Pilot commenced operations on the CAISO Participating Load Pilot start date of July 29, 2009 with the self scheduling of the underlying load of the participating customers as required by the CAISO Participating Load Design. The capacity available for curtailment was first bid in and accepted as Non-Spinning Capacity Reserves on August 6, 2009 and continued through December 15, 2009.

## 1.4 Summary Conclusions

The Pilot was implemented and successfully operated during the summer of 2009 meeting the established objectives for the first year of the Pilot. It was demonstrated that small Commercial and Industrial customers could be aggregated into a single real-time dispatchable resource meeting the minimum load size of 1 MW for presentation to the CAISO wholesale market. It was further demonstrated that a telemetry solution could be enabled to collect disparate installations and locations into a single aggregated signal for delivery to the CAISO although the value and cost effectiveness of an end to end telemetry is still debatable.

Event analysis establishes that the aggregated resource can perform in real-time as a contingency resource capable of curtailing load within 10 minutes of a dispatch instruction from the CAISO through the use of an automated notification system to the participating customer.

While not obvious at the Pilot's inception, it became evident that there are opportunities for different products to be included in subsequent phases to better align capabilities of specific customer segments with the needs of the wholesale market and to make Demand Response more cost effective than some traditional Demand Response programs.

The Pilot provided valuable experience to all the Participants, including participants at SDG&E providing an opportunity to understand firsthand what was required for further integration with the CAISO. Throughout the Pilot there was evidence of the importance of education in such a transformative endeavor. Such a significant undertaking should be managed with implementations on smaller scales allowing for adjustments to support a fuller scale implementation. The Pilot has been turned into a Case Study example to train and educate the different stakeholders within SDG&E and is planned to be used as a basis to develop additional customer outreach efforts in preparation for further integration and the January 2011 filing for 2012-2014.

# 2 Pilot Participation

The Pilot divides participants into two enrollment types: directly-enrolled and aggregator-led. While all participants were aggregated into a single resource for interaction with the CAISO wholesale market, there were distinctions and challenges associated with each type. There was one Directly-enrolled Participant in the Pilot that incurred the obligation to provide a monthly nomination, telemetry connectivity and the ability to receive and respond to curtailment notifications in real-time. The two Aggregator Participants in the Pilot were bound to the same requirements, providing a single monthly nomination, combined telemetry for their customers in aggregate as well as the responsibility to notify their customer of Pilot events. The Aggregators had an existing telemetry design to be leveraged, as well as processes in place to monitor and respond to dispatches in real time.

## 2.1 Recruitment

Recruitment for Pilot participation presented challenges due to the timing of the approval of the Pilot tariff and the start date for the Pilot. The three most significant obstacles were:

- Difficulties in implementing and testing telemetry in time for pilot participation.
- Unknown effort or misinterpretation of effort involved to meet requirements.
- Effort involved in the face of uncertainty regarding length of pilot.

Aggregators which already participated in other Demand Response programs were particularly well suited for the Pilot. Based on their existing relationships with customers, Aggregators readily understood the response capabilities of existing loads and typically had existing technology in place to support two-way communications, thus giving them a head start on meeting telemetry requirements and established notification processes. The suitability to the 11-7 product stems from participation in traditional DR programs designed to meet peak load needs. Further, by having the ability to combine various customers, a smoother and more predictable dispatchable load could be nominated into the Pilot. Therefore, Aggregators who had existing contracts for other DR programs with SDG&E were contacted to identify their desire and capability for participation in the pilot.

Additionally, there was a limited marketing outreach to Aggregators and directly to utility customers through SDG&E Account Executives. Key bundled customers who were not currently enrolled in a program with an Aggregator were identified for targeted outreach.

The response from Aggregators was strong. Aggregators which have been following the evolution of DR within the market and were interested in preparing strategically were particularly enthusiastic about participating in the pilot. All of the Aggregators initially indicated that there would be minimal impact to their operations.

Candidates for direct participation expressed much more concern about the impact to their operations as did the end-use customers enrolling with the Aggregators. Those enrolling with Aggregators put a high reliance on the Aggregators' ability to limit impacts to their operations.

In order to focus on success, general criteria were identified for acceptance into the Pilot. Those expressing interest were assessed against these criteria for acceptance and those that appeared unlikely to meet the criteria were dissuaded from participation. Key elements of the criteria included:

- Experience and understanding of demand response programs and processes
- Identification of end-use customers

- Ability to provide required telemetry within the specified timeframes
- Ability to meet SDG&E's credit requirements

## 2.2 Enrollment

There were two Aggregator Participants and one Directly-enrolled Participant enrolled in the Pilot. Together, these Participants comprised 8 customers consisting of 9 unique sites[2]. As is illustrated in Figure 2 below, the Hotel / Entertainment segment represented the largest number of sites in the Pilot, consistent with SDG&E's service territory. The customer mix for the program was rather varied nonetheless with civic/community spaces, office buildings, retail and small industrial.

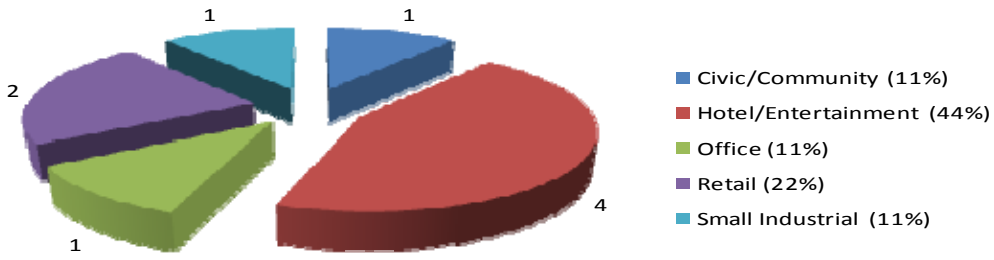


**Figure 2: Distribution of Enrolled Sites by Segment**

7 of the 8 customers participated in the Pilot via an Aggregator, with the one Directly-enrolled Participant being a light-industrial customer with primary voltage service and the ability to shed from 1.2 MW to over 3 MW of load for the Pilot. This customer was representative of a small number of identified customers in SDG&E's territory that may have atypical parameters, but may have a significant level of load available for curtailment. While inclusion of this customer presented a number of complications, it also presented a number of learning opportunities.

A majority of customers were enrolled in the first two months of the Pilot, with one customer added in October. Note that one customer left the program at the end of October. Table 1 shows the number of enrolled customers for each Participant.

| | August | September | October | November | December |
|---|---|---|---|---|---|
| **Aggregator 1** | 2 | 2 | 2 | 2 | 2 |
| **Aggregator 2** | 2 | 4 | 5 | 4 | 5 |
| **Directly-enrolled Participant** | 0 | 1 | 1 | 1 | 1 |
| | **4** | **7** | **8** | **7** | **8** |

**Table 1: Enrolled Sites by Month**

[2] These premises consisted of 15 service accounts and 17 utility meters.

Curtailable load represented by Pilot customers is shown in Figure 3. Note that this chart groups some segments because Aggregator nominations were not customer-specific.

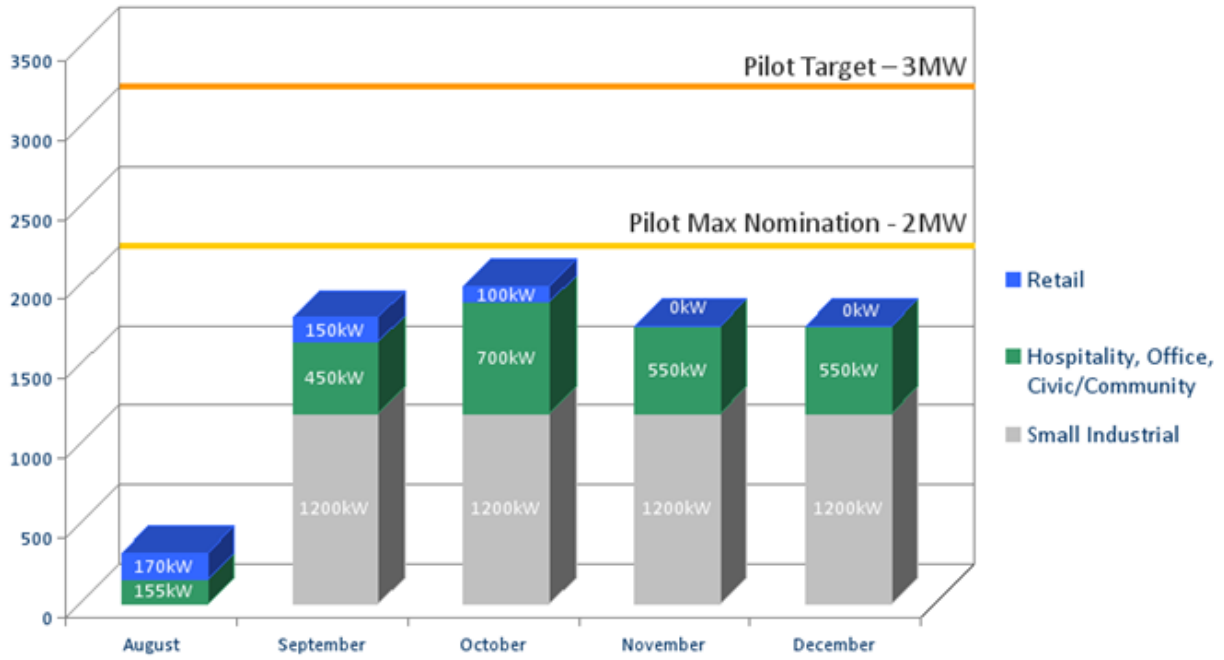


**Figure 3: Pilot Nominations by Segment**

# 3 Implementation and Operation

## 3.1 Nominations and Scheduling

The Pilot was designed to operate in the CAISO market as a Participating Load (PL) resource. To facilitate processing in the market systems, CAISO PL resources have both a load and generation location modeled in the CAISO system. The load is modeled in the CAISO network to represent the specific location(s) as a Custom Load Aggregation Point (CLAP) and becomes the basis for energy settlement A pseudo generator that represents the dispatchable portion of the load is also modeled and used within the CAISO market systems to accept and settle capacity bids and as a target of dispatch orders. The pseudo generator for the Pilot was modeled for a maximum dispatchable load of 3.0 MW. These issues are discussed in further detail in section 4.6.1.

In order to accommodate both Bundled and Direct Access customers in the Pilot, two separate pseudo generators and CLAPs were established and registered to separate Scheduling Coordinators. Based on enrollments during Phase 1 only bundled customers participated in the Pilot and only the resources registered to the Scheduling Coordinator ID SDG3 were scheduled with the CAISO. Resources to support Direct Access customers were established and registered with the CAISO to the Scheduling Coordinator ID APXY.

### 3.1.1 Participant Nominations

The Nomination process was modeled after the Capacity Bidding Program (CBP), with formal capacity nominations provided by Participants by the 25$^{th}$ calendar day of each month for the following month. Given that the nomination was static for each hour of the product period and for the entire month, rather than on a next day basis, any risks needed to be factored into the total nomination. The small number of end-use customers within each of the aggregation groups meant that a lack of performance by even a single customer would have a significant impact on performance. The need for the resource to respond quickly made it especially difficult for the group to mitigate impacts from one individual customer, or address the deviations in load that occur throughout the day or as a result of weather.

Participants found themselves providing nominations much lower than they might have otherwise made if there was a more dynamic option that mirrored the wholesale market bidding process which is done daily and is variable each hour. Participant nomination models had to assume the lowest level of demand that would be available throughout each Month would be the amount to nominate to the Pilot.

Figure 4 illustrates nominations for the Pilot.

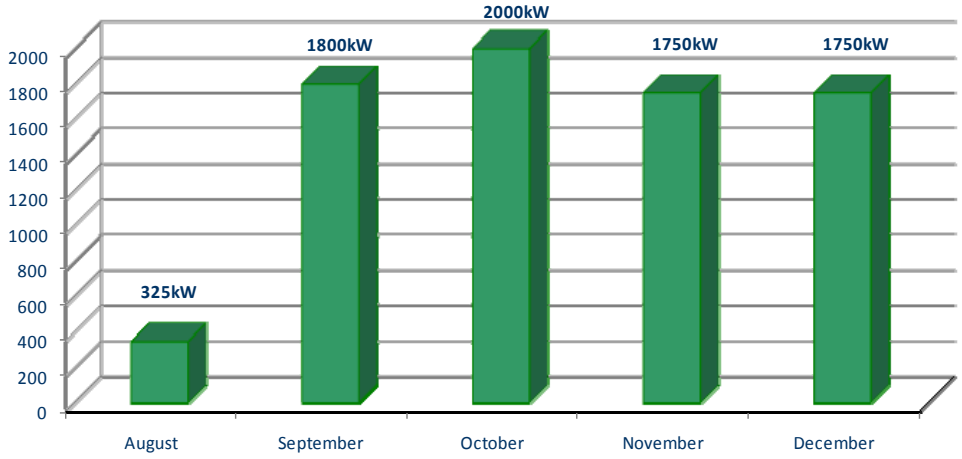


**Figure 4: Monthly Total Pilot Participant Nominations**

### 3.1.2 Scheduling and Bidding Management

#### 3.1.2.1 Load Forecasts

There were two distinct issues associated with load forecasting due to the structure of the CAISO Participating Load (PL) requirements and the design of the SDG&E Pilot. The structure of the CAISO PL requires that the entire underlying load, not just the dispatchable portion, associated with a meter be contained and scheduled in a custom load aggregation for the purpose of scheduling demand. The dispatchable portion of a Participating Load is scheduled and bid as a supply resource and treated as such by the CAISO. SDG&E used a standard forecasting process to forecast the demand to be scheduled at the custom load aggregation and relied on Participants to determine the amount of curtailable, or dispatchable, load that would be presented as a supply resource in the nomination process.

To derive the hourly load forecast for the underlying load to be scheduled at the custom load aggregation, SDG&E retrieved interval data from the meter list of current Pilot enrollees and ran a regression model to produce a forecast of the total load of the Pilot bundled customers. Although the customers may have only nominated for the 11-7 weekday Pilot product, an hourly load forecast for 24x7 was produced. This was based on the requirement by the CAISO to have Participating Load scheduled and metered at the custom load aggregation location defined in the CAISO network model. No Direct Access customers participated in the Pilot during 2009, so the process designed to acquire hourly load forecasts for Direct Access customers was not utilized.

While a forecasting process would typically be used to determine the Load Reduction to be offered to the market, the design of the Pilot required Participants to communicate this reduction through their nominations. The Aggregators in the Pilot used their own forecasting methodologies to determine their nominations. SDG&E aggregated the nominations by product type, 11-7 and 24x7, and used those values as the basis for bidding Non-Spinning capacity into the CAISO market. Each Participant was left to its own method to determine the amount of Load Reduction to nominate on a monthly basis. Any overly optimistic or conservative forecasts made by Participants would result in an impact to retail settlement calculations for Participants as well as potential wholesale settlement penalties for SDG&E.

### 3.1.2.2 Bidding and Scheduling

The forecast, nomination, event and customer operating information were used to present bid and schedule data to the CAISO market. The forecast of the underlying load was self-scheduled at the custom load point. The aggregated amount nominated by the Participants was used to develop the bid at the pseudo-generation location. Load Reduction bid amounts were suspended if the maximum number of events allowed by the Pilot were reached.

To facilitate the scheduling of the underlying load at the custom load point, a unique demand location (CLAP_BUNDLD_DRL) was created in the CAISO full network model at the Custom Load Aggregation Point (CLAP). The hourly load forecasts included Participants in both Pilot products and became the MW values for the self-scheduled (price-taker) quantities. Based on CAISO PL requirements, the load associated with the enrolled customers was self-scheduled at this location all days and all hours for the duration of the pilot.

The monthly quantities submitted by the Participants became the basis for the Non-Spinning bids submitted to the CAISO at the pseudo generation resource. To reflect the specific products and the operational behavior of the clients, bids were developed such that the bid information submitted to the CAISO was accurate. To reflect the participation levels of the two products, the quantities and hours bid were neither static nor continuous throughout the day. The typical bid pattern for the 24x7 product covered 10 PM to 6 AM period, while the 11-7 product bids corresponded to the product hours of 11 AM to 7 PM. This pattern is represented graphically in Figure 5 below.

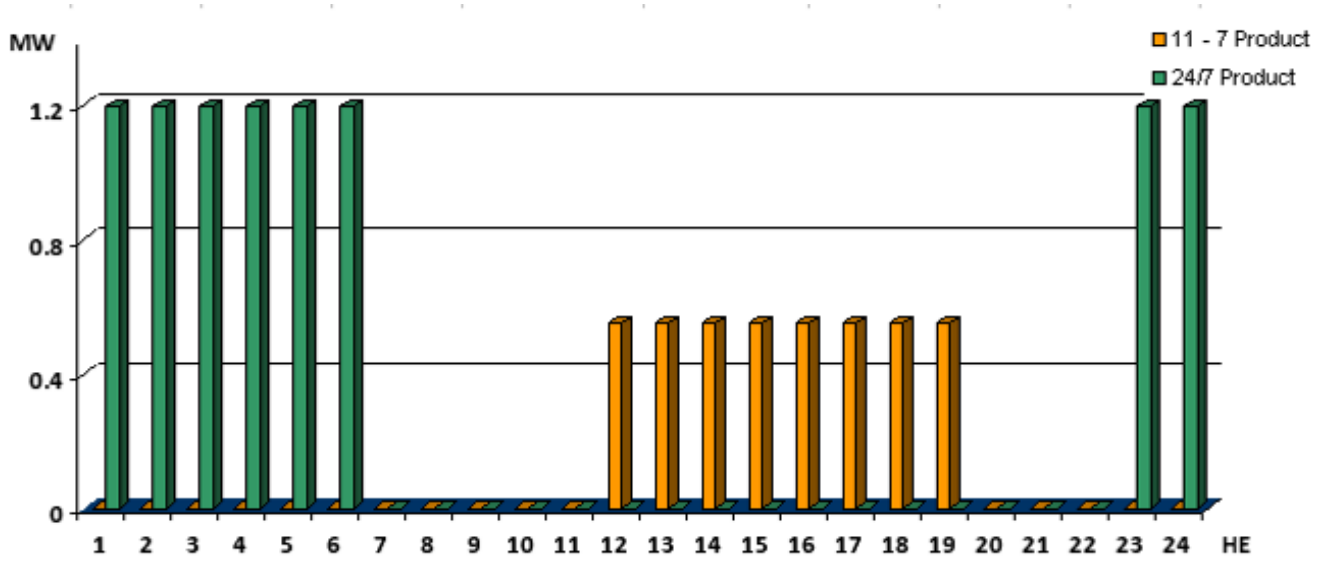


**Figure 5: Typical Bid Pattern**

### 3.1.2.3 Bid Prices

The prices applied to the bids were developed to increase the likelihood of capacity bids being accepted by the market and to generally minimize the chances of being dispatched for energy outside of a test or true contingency situation. The purpose of this strategy was to meet the objectives of the pilot to make DR capacity available to the wholesale market while meeting the requirements of the Pilot tariff.

To ensure that the capacity portion (Ancillary Services Non-Spinning Reserves) of the bids would likely clear the Day Ahead market, the capacity price was set at $0.01 (one cent). This was equivalent to

bidding as a price-taker without the risk of being selected if the capacity prices were negative. Once notification was received that the capacity bid cleared the market, real-time energy bids were submitted with a $500 price to minimize the chance of being dispatched for energy except in the case of a true system contingency. In the case of a scheduled CAISO test, the energy bid for the test hour was reduced to $1.00 to avoid any appearance that the Pilot was being used to extract monies inappropriately from the market. To execute such tests, a contingency dispatch was issued which assures that the resource will be selected out of merit order and paid its bid price or better.

### 3.1.3 Scheduling and Bid Submittal

Once monthly nominations were received and approved, a monthly capacity Bidding Plan was created. Further, hourly load forecasts, corresponding to the meters associated with the monthly nominations, were created and submitted. On a daily basis, SDG&E submitted the Load Schedule at the custom load aggregation as a self-schedule, and the AS bid quantities on the pseudo generator into the CAISO Scheduling Infrastructure and Business Rules (SIBR) application.

After the Day Ahead market results were published and the next day Real-time markets were open for bid submittal, energy bids (per the Bidding Plan) were submitted for the amount of AS Non-Spinning Capacity awarded each hour. Submittal of Real-time energy bids was necessary, since, in the absence of a bid, the CAISO SIBR software creates default energy bids for capacity awards. Automatically-created default energy bids would have resulted in an energy bid price of $2.00 (no registered default bid amounts were submitted in the Resource Data Template for the Pilot), potentially facilitating unwanted energy dispatches.

## 3.2 Telemetry

A major difference between the Pilot and typical utility DR programs is its telemetry requirement. The telemetry data provided the CAISO the ability to observe load drops during delivery and the opportunity to determine if enough load reduction is available before dispatch.

For the Pilot, all Participant telemetry data was measured directly with equipment installed on premises. Each enrolled customer needed new equipment installed for this purpose. Design and installation of the telemetry was provided for the directly-enrolled customer; however, each Aggregator designed and installed a proprietary telemetry solution for their own customers. The exact equipment installed and communications medium depended upon specific on-site conditions as well as Aggregator preference.

Each of the 9 sites had telemetry installed for the Pilot. Each installation consisted of a single telemetry meter with the exception of one installation that required 3 such devices, for a total of 11 used for the Pilot. As described below, the Directly-enrolled Participant had a pre-existing meter suitable for telemetry.

For the telemetry data to be of use to CAISO operations, it was combined to the same level as the capacity bids were submitted (i.e., to the CLAP[3] modeled for the Pilot). To support this requirement and provide 24x7 operations, APX acted as a concentrator for all telemetry data for the Pilot – receiving telemetry from the Aggregators, directly-polling the directly-enrolled Participant, combining

[3] Note that the Pilot design allowed for a bundled CLAP and an unbundled CLAP, but only bundled participants were enrolled in 2009.

all telemetry to the CLAP, and finally making these data available to the CAISO. Just as APX performed these functions, the Aggregators were also required to combine their own telemetry values to the CLAP. This layered "fan-in" approach allowed for increasing standardization and streamlining the closer the data came to the CAISO.

Together, these requirements resulted in a wide range of tasks including design and implementation of customer-side solutions, development of Web services for Aggregators to submit telemetry, as well as systems programming and configuration for point combination and interface with the CAISO.

The following sections detail the implementation and operations for telemetry in the Pilot.

### 3.2.1 Overview

Figure 6 provides an overview of telemetry and systems used for each step from the customer to the CAISO. Note that the arrows indicate push or pull interactions, all telemetry data flow is from left to right.

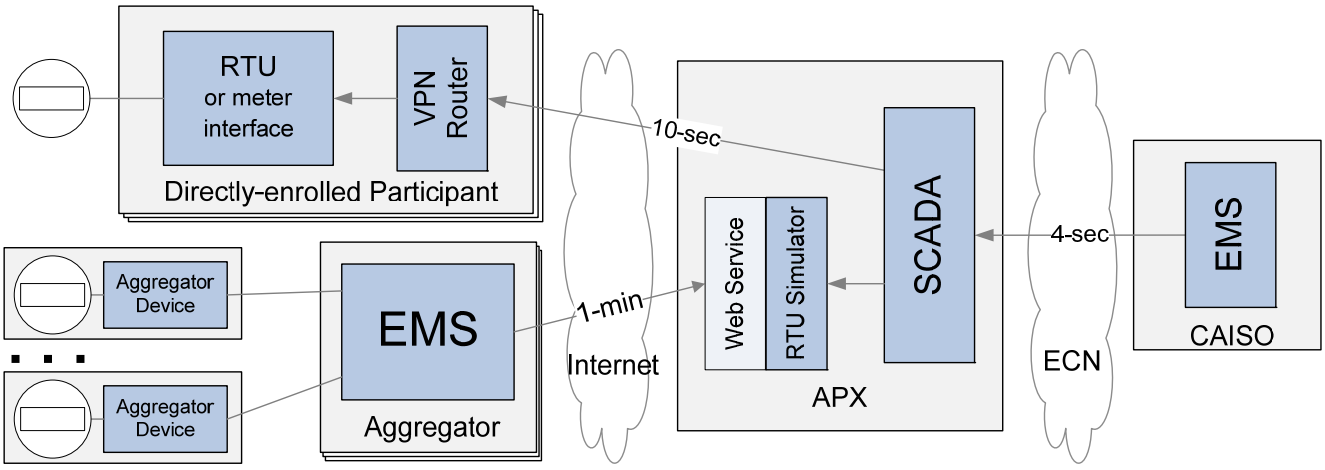


**Figure 6: Telemetry Overview**

As is shown in the figure, the directly-enrolled Participant was polled by the existing APX SCADA system. Each of the two Aggregators in the Pilot designed their own disparate solutions for collecting and processing telemetry. To simplify interfacing with the Aggregators, a Web service was implemented to provide a standard interface for sending telemetry to APX. Data submitted to the Web service was forwarded to an RTU that was polled by the SCADA system. All telemetry points were combined in the SCADA system for retrieval by the CAISO EMS over the Energy Communication Network (ECN).

### 3.2.2 Telemetry Points

Pilot telemetry was combined to a Custom Load Aggregation Point (CLAP) to match the location modeled specific to the Pilot resource(s) used in the CAISO market systems.

For each CLAP, there were two points:

- Total Delivered Power across all Participants. An analog point provided in megawatts to two decimal places.
- Connectivity status of the resource (UCON). This is a binary point defined to be 0 if no telemetry was being retrieved for any resource; otherwise, a 1.

The Pilot distinguished between two resources: one for SDG&E Bundled customers and one for Direct Access customers. As a result, there were two CLAPs defined; however, since no Direct Access customers participated in 2009, the points for the Direct Access resource reported 0.00 MW and 0 UCON.

Further details on how these points were calculated for the Pilot are provided in section 3.2.5.2.

The CAISO required that telemetry for the Pilot resource be scaled up by appropriate distribution loss factors (DLFs). Such factors account for energy loss in the distribution system. DLFs are forecasted day-ahead for each voltage level resulting in a specific factor for each Participant. For the purposes of the Pilot it was decided that a single factor would be used for each voltage level:

| Service Level | Pilot Distribution Loss Factor |
|---|---|
| **Primary voltage** | 1.011 |
| **Secondary voltage** | 1.048 |

**Table 2: Distribution Loss Factors used in the Pilot**

The decision to use one factor per voltage level was made to simplify the implementation required by the Aggregators considering that these numbers change very little in the SDG&E territory.

### 3.2.3 Direct Enrolled Participant

The directly-enrolled Participant was a light-industrial customer with primary voltage service. Further description of this customer is in section 2.2.

Telemetry for the directly-enrolled Participant was polled by APX. This solution extended the reach of the APX SCADA system over a persistent virtual private network (VPN) directly to the customer site. In this way, the end point was directly interrogated using Modbus or DNP protocols irrespective of the underlying network topology. The VPN connection was made over the public Internet and maintained between existing APX-side equipment and a customer-side Cisco 1841 Integrated Services Router (ISR). The ISR was connected at the customer premises directly to a pre-existing GE PQM II meter. The SCADA system directly polled this meter every 10 seconds using the Modbus/RTU protocol. The network connectivity was installed specifically for the Pilot and is provided over satellite. Figure 7 shows an overview of this telemetry solution with specifics in the following sections.

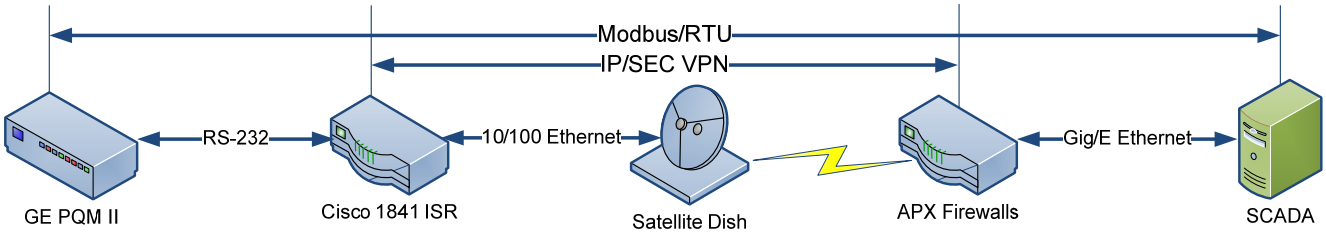


**Figure 7: Customer Equipment**

Hardware and labor for the telemetry equipment was approximately $10,000. The costs for installation were much higher than would typically be expected due to customer requirements that a particular vendor be used for onsite work.

Note that this communication was one-way – notifications to the customer were through a phone call.

In addition, there was a recurring service charge of $130 per month for satellite connectivity.

#### 3.2.3.1 Communications

When looking at connectivity for customers in the Pilot, there was a strong bias towards simplicity and low cost. This resulted in the following prioritization of the different options[4], in order:

1. Existing Internet connectivity
2. Cable or DSL
3. Satellite

The Pilot customer already had Internet connectivity. Using this existing connectivity was acceptable to the customer; however, the distance between the 15 kV switch gear and existing networking hardware was prohibitive. Wireless networking was also ruled out due to concerns of interference and proximity. As a result, use of the existing Internet connection was ruled out.

Due to the location of the customer and the large area of the facility, Cable and DSL were also ruled out. Effectively, adding one of these wired solutions would not have solved the initial problems of proximity.

Satellite connectivity provided by HughesNet was chosen. This service provides a persistent connection to the Internet at speeds of up to 512Mbp/s. This solution resolved the proximity issues nicely, because it was able to be installed on a shed in close proximity to the switch gear. Note that this solution was only used for telemetry – event notifications to this particular customer were by direct telephone call to on-site operators.

#### 3.2.3.2 Measurement Equipment – GE PQM II

The Pilot customer already had its own measurement equipment installed on premises. This is not uncommon for industrial customers since energy is often a major cost for such customers. This installation included the relevant 3-phase inputs to a GE PQM II for measuring instantaneous 3-phase real power for the plant. This meter was used to provide telemetry to the Pilot.

The GE PQM II has several communication ports for data retrieval and control and supports both the Modbus/RTU and DNP 3.0 protocols. For the Pilot, the meter was connected to the Cisco 1841 ISR using a custom RS-232 cable. Communication with the meter used the Modbus/RTU protocol.

The total power for the customer was retrieved from the appropriate Modbus/RTU register. The connectivity status (UCON) for this customer was derived in SCADA based on its ability to get valid readings over Modbus/RTU. Connectivity failures of any kind between SCADA and the meter resulted in a UCON value of 0 for this customer.

### 3.2.4 Aggregator Participants

There were two Aggregators enrolled in the Pilot. SDG&E did not direct the Aggregators on how to implement telemetry for their end-customers. SDG&E did require that each Aggregator retrieve their customer telemetry and combine those data to the CLAP for submission to an APX-hosted Web service. Details on the Web service can be found in section 3.2.5.1.

[4] Leased lines (e.g., a T1 or T3) were never seriously considered for the pilot considering the high installation and service cost.

Each Aggregator took a different approach to the design and implementation of their telemetry solutions. While specific details on these approaches are considered proprietary to the Aggregators, an overview of the approaches taken can be found in the following sections. Note that Aggregators have made the point on several occasions that they will always install their own parallel measurement equipment regardless of the capabilities of a pre-existing utility metering.

#### 3.2.4.1 Telemetry Points

Each Aggregator was required to submit one set of points for the bundled CLAP as detailed in Table 3.

| Item | Detail |
|---|---|
| **ID** | Per-Aggregator ID for this set of points. |
| **ReadTime** | Time the underlying readings were combined. |
| **TotalAdjustedDemand** | Total demand for all customers, adjusted with Distribution Loss Factors (DLF). |
| **TotalDemand** | Total demand for all customers |
| **IncludesActual** | *True* if at least one underlying customer read is actual (i.e. not estimated nor substituted); otherwise, false. This corresponds to the CAISO UCON status. |
| **IncludesEstimate** | *True* if at least one underlying customer read is an estimate; otherwise, *false*. |
| **EarliestActualReadTime** | Read time of the earliest actual read incorporated in the total demand; otherwise, *nil* if no read is actual (i.e., when IncludesActual is *False*). |

**Table 3: Aggregator Points**

The Aggregators were directed to:

- Read their end-customer measurement equipment at least once per minute.
- Read either instantaneous demand or average demand over a short interval, whichever was more feasible based on the selected measurement equipment.
- Submit the combined measurements – the points listed in Table 3 – to the Web service at least once per minute.
- Collect and submit telemetry 24x7.
- Substitute estimated values for the underlying customers if there was a loss of connectivity. This was in line with expectations of the CAISO that zero values would not be submitted.

Note that the Pilot did not require Aggregators to synchronize their underlying readings before combining them. This topic is covered in more detail in section 4.3.1.2.2.

#### 3.2.4.2 Aggregator 1

Aggregator 1 employed an all-in-one device for telemetry collection at customer premises. This device recorded measurements from current transformers installed on the main electrical service and communicated with the Aggregator's central location using an integrated cellular WAN solution. The Aggregator would have preferred to use the existing Internet connectivity at the customer sites; however, their customers' policy was prohibitive. The measurement used by the Aggregator was average demand over the previous minute, submitted to their central location once per minute. Note

that this communication was one-way – dispatch occurred through a notification to customer email addresses.

The Aggregator needed to build new systems for archiving and combining the telemetry data for submission to the Telemetry Web service.

Hardware and labor for the telemetry equipment was approximately $4,000 per site. In addition, there was a recurring service charge of $60 per month for the cellular connectivity.

#### 3.2.4.3 Aggregator 2

Aggregator 2 already had the telemetry design, systems, and operations in place for implementing telemetry for the Pilot. This was anticipated since their business model relies on AutoDR and as such requires frequent monitoring of customer energy usage. They did need to make some adjustments to support the level of frequency required for the Pilot as well as to support point combination and submission through the Web service.

On-site the Aggregator installed a meter and their own proprietary hardware collector to read instantaneous kW measurements every several seconds. In one case, the Aggregator installed 3 of their collectors at one site while in all other cases only one was installed per site. All connections in the Pilot sites were over physical wiring. At least every 30 seconds, the measurements were communicated back to the Aggregator using existing customer corporate networks and Internet connections. Note that this communication was one-way – dispatch occurred through separate AutoDR systems.

Measurements were stored in the Aggregator's EMS. Once per minute, these data were retrieved from the EMS, combined, and submitted to the Web service.

Hardware and labor for the telemetry equipment was approximately $4,000 per installation with no recurring service charge. These dollar figures do not include costs for AutoDR. Note that the Aggregator used TI/TA funds to mitigate AutoDR installation costs.

### 3.2.5 Central Systems

There were two main central systems involved in telemetry collection and delivery: the Participant Telemetry Web Service and the APX SCADA system, each discussed in turn in the following sections.

#### 3.2.5.1 Web Services

Aggregators submitted their telemetry data to the Pilot's Participant Telemetry Web Service. This was designed to provide a simple interface to submit telemetry readings for the Pilot using standard and secure technologies. Submissions into the Web service were passed along to a live storage system for retrieval by SCADA over Modbus/RTU.

Mutual authentication, integrity, and confidentiality for the Web service were ensured through the use of mutual X.509 certificates. Participants were provided with the necessary certificates for these purposes. In addition to the certificates, the Aggregators were provided with documentation on the Web service API, WS-Metadata Exchange endpoints for tool support, as well as sample code for service submission.

### 3.2.5.2 Point Combination

The APX SCADA system stored all current telemetry and combined them into the points required by the CAISO (see section 3.2.2).

Point combination was required to aggregate the different retrieved points into a single pair representing the Pilot resource. To do this, SCADA was programmed to directly sum the Aggregator demand values with a synthesized value representing the Pilot customer's demand. This flow is shown in Figure 8.

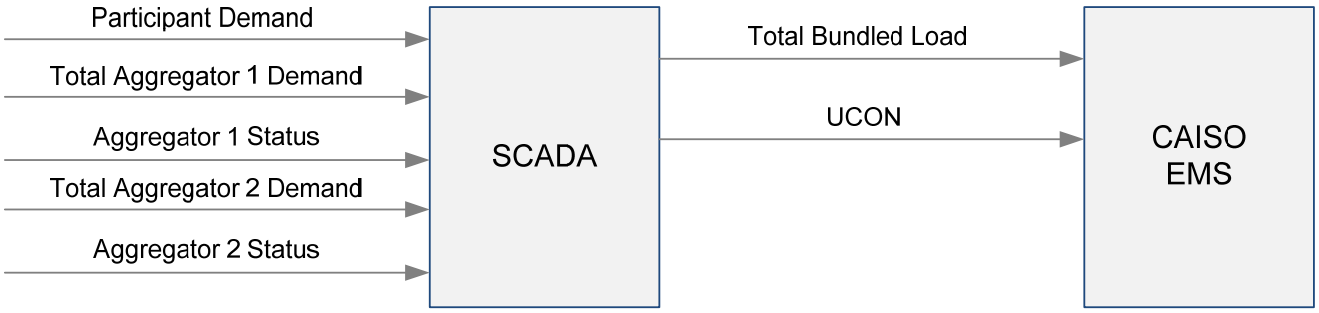


**Figure 8: Telemetry Points**

Aside from the need to apply distribution loss factors to this value, it also was capped to control for its high variability (see section 4.3.1.4 for more on this topic). Figure 9 shows a representation of this point combination.

$$kW_{TOTAL} = kW_{A1} + kW_{A2} + \min(kW_C \cdot DLF_C, MAX_C)$$

**Figure 9: Total Demand Presented to CAISO**

In addition to combining the demand values, the CAISO UCON value was also synthesized as represented in Figure 10.

$$UCON_{TOTAL} = UCON_{A1} \vee UCON_{A2} \vee badQuality(C)$$

**Figure 10: Composite UCON Presented to CAISO**

Incoming points were polled every 10 seconds. For the directly-enrolled customer, this resulted in data no older than 10 seconds; however, since Aggregator points were submitted once per minute, their values remained constant until subsequent update. The CAISO EMS polled for the latest values every 4 seconds.

Once per minute, current telemetry values were archived for later analysis. Figures and analyses in this document that use telemetry are based on these archived data.

## 3.3 Dispatch

One of the objectives of the SDG&E Pilot was to allow and explore the aggregation of many small loads into a single resource to meet the minimum MW size to qualify as a Participating Load in the CAISO market. The Pilot tariff as written did not require Participants to submit a price threshold for dispatch and, as such, there was no need to submit price differentiated bids at the wholesale level. CAISO dispatch instructions are delivered on a resource level and only provided a Dispatch Operating Target (DOT) quantity without any corresponding bid segment information.

Since a single CAISO resource ID was used in the Pilot, quantities from each Participant were aggregated when presented to the wholesale electricity market. Since Participant nominations were fixed for an entire month and it was necessary to submit on a single resource, bids to the CAISO were effectively an "all or nothing" submittal on an hourly basis. The all or nothing nature of the bids submitted to the CAISO was reflected in dispatch instructions as only a single energy bid segment could be dispatched by the CAISO. There was no possibility for the CAISO to issue a dispatch for a particular Participant in the aggregation.

On the one occasion that the CAISO dispatched an energy quantity lower than the total capacity bid, no effort was made to allocate a proportional share to Participants when providing curtailment notifications. For any given event, the Participants were expected to curtail their full monthly nominated amount.

Because the Pilot aggregated multiple resources into one pseudo-generation resource, it was necessary to disaggregate CAISO dispatch instructions into notifications directly to the appropriate Participants. As such, individual Participants received notifications that indicated the amount they were required to curtail an amount equal to their monthly nomination. The Pilot notification software contained intelligence that only delivered such messages to Participants that were in effect for the given hour of the dispatch. For example, if a dispatch occurred at 11PM, only the 24x7 Participants would be notified and the 11-7 Participants would not receive a curtailment notification.

Of particular interest in this Pilot was the ability to achieve the load drop within the 10 minute requirement of the CAISO. Figure 11 provides a graphic representation of the dispatch data flow as well as the timing for the different stages in notification.

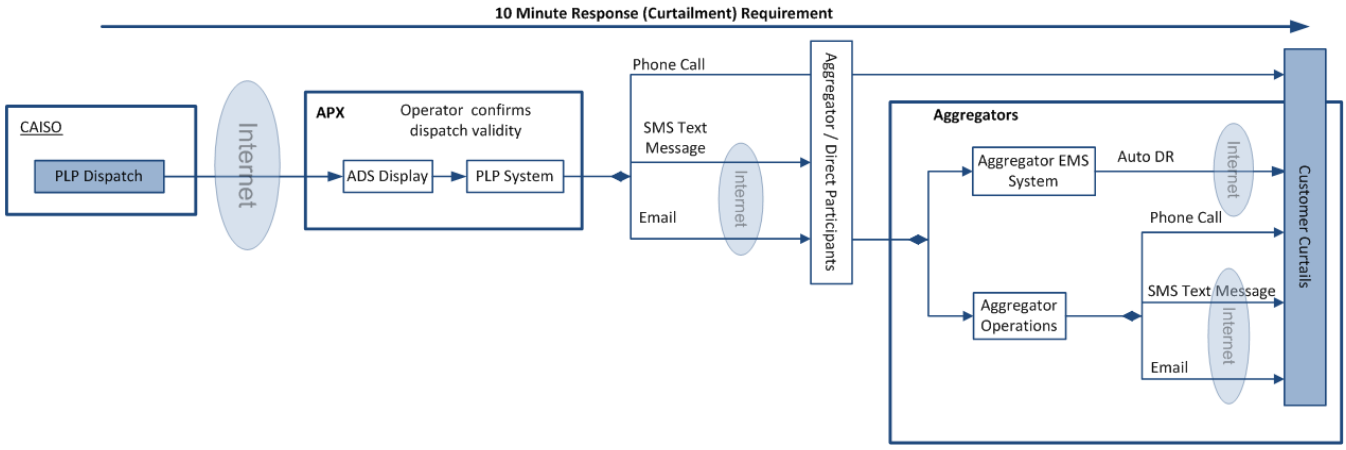


**Figure 11: Dispatch Data Flow**

Response to the notification varied from manually curtailing load to the automatic control of on-premises energy management systems (EMS). The specifics depended on the Participant, and if applicable, the Aggregator. Further details are provided and the following sections.

Note that in the first phase of the Pilot, SDG&E enrolled Participants into a single pseudo-generation resource identified by ELCAJN_6_DRGEN1. For brevity, this is referred to as the Pilot Resource.

### 3.3.1 CAISO ADS Dispatches

The CAISO initiated events for the Pilot through their Automated Dispatch System (ADS). This software application is provided by the CAISO for market Participants to securely monitor relevant instructions.

Authentication, confidentiality, and integrity for ADS communication with the CAISO are provided using industry-standard PKI encryption technology. ADS was monitored 24/7 for Pilot dispatches.

The capacity provided by Pilot Participants was bid into the CAISO Ancillary Services market daily as Non-Spinning Capacity Reserves. As such, dispatches for the Pilot held the same characteristics as dispatches for generators. Load provided by Participants was visible to the CAISO as a single pseudo-resource with a bid for this product. During Exceptional and Contingency Dispatches, the Pilot Resource was dispatched by the CAISO for a MW value up to the value bid in for that hour by SDG&E.

The PLP Resource was available for CAISO Contingency as well as Exceptional Dispatches. These dispatches are summarized in Table 4.

| Dispatch Type | Description |
|---|---|
| **Contingency Dispatch** | A Contingency Dispatch typically entails a strain of some type on the grid, calling for the CAISO to dispatch additional resources to meet current energy needs. A Contingency Dispatch is generally triggered for a resource according to the CAISO's resource loading order. |
| **Exceptional Dispatch** | The CAISO may trigger an Exceptional Dispatch independently of resource loading order and as an override to the market dispatch software if network needs are not met. |

**Table 4: CAISO Dispatches Employed in the Pilot**

The Pilot handled two Contingency Dispatches throughout the duration of the pilot, one on August 18th, and the other on December 7th with the remaining 12 CAISO initiated events being Exceptional Dispatch.

Typically, an Exceptional Dispatch requires manual intervention. This dispatch type was the preferred method for Pilot test events as it allowed SDG&E, APX and the CAISO to coordinate a predetermined event time and megawatt quantity. It is important to note that Participants were not made aware of the test schedule.

See section 7.2 for Pilot event details.

### 3.3.2 Retail Event Notifications

After receiving a dispatch from the CAISO, or upon initiating a non-CAISO test event, Participants in the Pilot were notified of the event. Given the 10 minute performance requirement for resources bidding Non-Spin Ancillary Services in the CAISO market, the notification functionality was built with a focus on speed and simplicity. Note that neither the initiator of the event nor the type of ADS dispatch was relevant to the Participants and therefore had no impact on the notification methodology or message delivered to the Participants.

The PLP notification is summarized in the Figure 12.

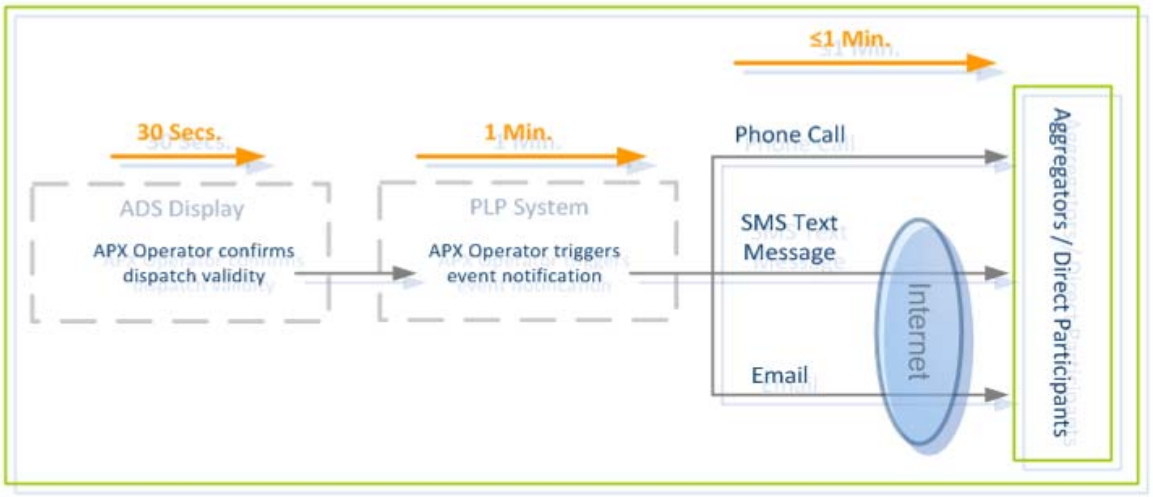


**Figure 12: Pilot Notification Summary**

The full process, from receiving the ADS dispatch to confirming a notification was typically completed in less than 90 seconds.

As illustrated in Figure 11 previously, APX operators received notice of CAISO Pilot dispatches through the CAISO ADS. During the Pilot, there was no automated interface between ADS and the notification system and APX Operators received training in order to identify if a dispatch met all the appropriate requirements. This precaution was implemented since errant instructions – 68 of which were dispatched during the Pilot – could create unnecessary client notifications. Operators performed a rapid verification of the validity of a Pilot dispatch and then proceeded to trigger the notification process.

In addition to Operator monitoring, validations were built into the notification system to limit errors that could violate the SDG&E PLP tariff. Notably this ensured that the time, duration and number of events per month and per day were in compliance with tariff rules.

As illustrated in Figure 12, Participants were notified using different technologies. The two Aggregators used a combination of email and SMS text messages, both sent over the Internet. In the case of the directly-enrolled customer, manual phone calls were placed to on-site plant personnel.

Participants handled the automated notification messages in different ways depending on the level of automation of their own notification processes and on the level of integration with their end-use customers. One Participant received PLP notifications automatically to a system which parsed the message and triggered an automatic process (i.e., AutoDR). Another Participant received notifications in an operations center where an operator interpreted the message and notified end-use customers.

To assist in the automated processes, standard notification message formats were developed for the Pilot – one format for email messages and another for SMS[5] messages. These formats accommodated both automated and manual response to the message.

In the event of a notification system failure, procedures were put in place such that the text of the SMS message would be sent to Participants via both email and SMS. Although outside of the PLP system,

[5] SMS, or Short Message Service also commonly referred to as *text messaging*.

this contingency message was created automatically to reduce the risk of erroneous information being communicated to Participants. This was particularly important as one of the Aggregators relied on parsing SMS messages for initiating AutoDR – an ad hoc message would not guarantee message field consistency and would have been rejected by the Aggregator system.

## 3.4 Metering

SDG&E meters provided the Settlement Quality Meter Data (SQMD) used for all settlements in the Pilot. This included both retail settlements with the participants as well as wholesale settlements with the CAISO. In addition, the SQMD was used as inputs into scheduling and forecasting.

All Pilot customers used existing interval meters recording 15-minute kWh usage. Customers without such metering in place were not considered for the Pilot due to the lead times required for installation. 5-minute metering – even when possible by reprogramming the installed meters – was determined not to be feasible for the Pilot.

Meters were read once per day by the SDG&E metering department through remote interrogation.

For scheduling and settlement purposes with the CAISO, the Participants needed to be removed from the SDG&E Default Load Aggregation (DLAP) and assigned to the Pilot Custom Load Aggregation (CLAP). The SQMD was used for this purpose. Meter data submitted for the CLAP was converted to 5-minute intervals as required by the CAISO for Participating Loads. The CLAP data was uploaded to the CAISO Operational Meter Analysis and Reporting (OMAR) system with the same process used to submit SQMD for the DLAP. Figure 13 provides a high level schematic of the various processes applied to meter data for the Pilot.

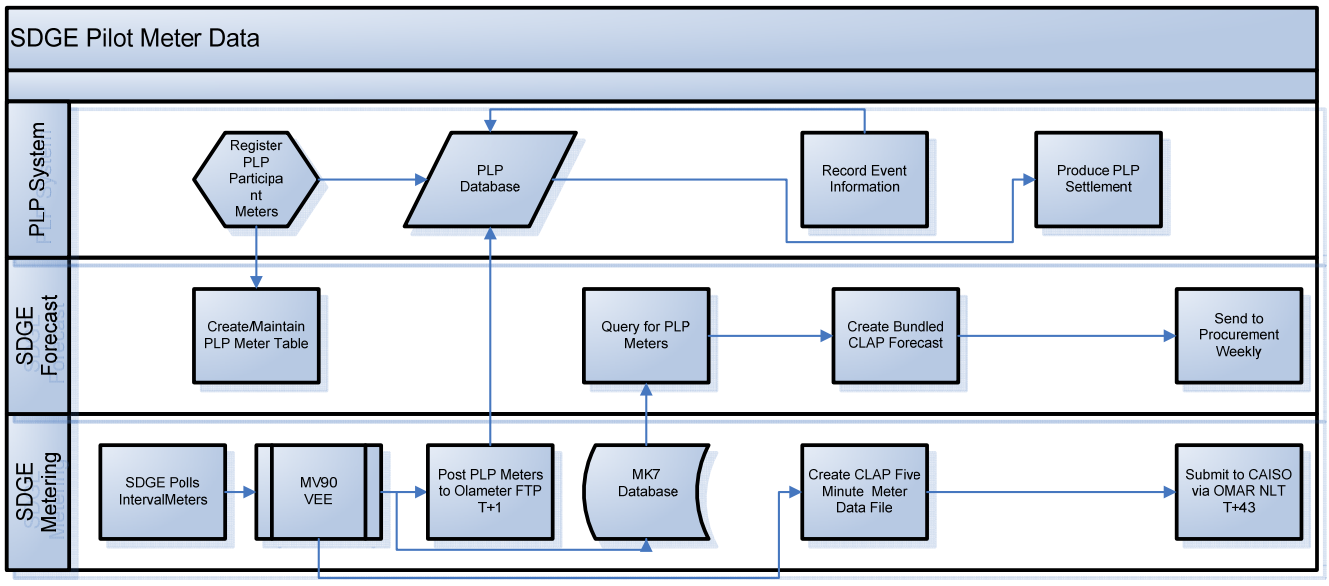


**Figure 13: Meter Data Flow**

For retail settlement purposes, the meter data was converted to 10-minute intervals as required by the tariff.

## 3.5 Settlement

### 3.5.1 Retail Settlement

Participants of the Pilot were paid monthly capacity payments based on their average performance for each event occurring in that month.

The tariff set a $/kW capacity payment rate for each month of the Pilot. The operational period of the Pilot ended December 15, 2009 resulting in a proration in the December payment.

| Product | Capacity Incentive ($/kW - month) | | | | | |
|---|---|---|---|---|---|---|
| | July | August | September | October | November | December |
| 2 hours, 11a - 7p Only | $ 20.10 | $ 20.10 | $ 20.10 | $ 20.10 | $ 20.10 | $ 10.05 |
| 2 hours, 24x7 | $ 21.50 | $ 21.50 | $ 21.50 | $ 21.50 | $ 21.50 | $ 10.75 |

**Table 5: Load Reduction Incentive Payment**

For each event:

- The *potential capacity payment* was calculated by multiplying the Participant's nomination and the $/kW Capacity Incentive rate for the month, divided by the number of events for the month.
- The *baseline* was equal to the 15-minute interval ending at or preceding the CAISO dispatch.
- The *actual reduction* was the average of the *baseline* minus the actual metered load over the event.
- The unadjusted performance factor was the actual reduction divided by the nomination.
- The adjusted performance factor was derived from unadjusted performance factor as follows:
    - 100% or above, the adjusted performance factor was 100%
    - Between 25% and 100%, there was no adjustment.
    - Below 25%, the adjusted performance factor was 0%.
- The capacity payment was calculated by applying the adjusted performance factor to the potential capacity payment.

The total monthly capacity payment was the sum of the event capacity payments.

For the Pilot, retail settlement calculations were performed manually to allow for extensive review of calculation details.

The Settlement Quality Meter Data (SQMD) was converted from 15-minute interval data to 10-minute interval data as required for settlement calculations per the tariff.

### 3.5.2 Wholesale Settlement

CAISO settlements for the wholesale market are completely independent of the retail settlement process. The CAISO settles with the Scheduling Coordinator (SC) at the resource level. Wholesale settlement data comes at 7, 38 and 51 business days after the dispatch day. For this report the most recent data was considered, but due to the timing of data availability, not all data was reconciled to the same data set.

The Pilot had two distinct locations in use for the Pilot, CLAP_BUNDL_DRL for load and ELCAJN_6_DRGEN1 for the pseudo-generator, within the CAISO system to identify the two resources. While the CAISO has over 130 Charge Codes associated with Wholesale market activity, approximately

25 applied to the Pilot resources and the majority of those are associated with administrative or load share allocations. The CAISO assigns a name and a numeric value to each Charge Code to allow the identification of charges associated with each resource and related market activity.

Three charge codes associated with the pseudo generator resource, ELCAJN_6_DRGEN1 provide the information used to analyze the resource performance in the wholesale market. These are summarized in the following table:

| Charge Code | Description |
|---|---|
| **Day Ahead Non-Spinning Capacity Reserve Settlement** | Indicates the quantities, prices and dollar amounts of capacity payment. |
| **No Pay Non Spinning Reserve Settlement** | Indicates the amount of capacity payment rescinded due to performance issues. |
| **Real Time Instructed Imbalance Energy Settlement** | Indicates the energy payment for dispatched capacity. |

**Table 6: Main Wholesale Charge Codes for the Pilot**

The CAISO determines dispatch performance and subsequent No Pay settlement by reviewing the dispatch notices and comparing them to meter data. Meter data for the five minute interval before the dispatch notice is compared to the meter data for each subsequent five minute for the duration of the dispatch. If the meter data shows a reduction equal to or greater than the amount of MW dispatched, no capacity payment is rescinded. If the meter data shows a reduction of 90 percent or less of the dispatched MW, a corresponding portion up to the full amount of the capacity payment is rescinded.

A portion of market performance is captured in the real-time energy settlement of the load resource, CLAP_BUNDLD_DRL, in the Charge Code for uninstructed energy (Real Time Uninstructed Imbalance Energy Settlement). Real-time uninstructed energy includes differences between Day Ahead scheduled quantities (forecasting error) and metered amounts co-mingled with real-time deviations. Since different types of uninstructed energy are co-mingled within the single charge code and real-time dispatch energy contributions to the charge code are a small percentage of the overall charge, the effort to disaggregate data was not deemed justified for the purpose of this report.

## 3.6 Security and Protection of Customer Data

APX's role in the Pilot warrants a summary of APX system security. APX's business model is based upon providing services to clients on an outsourced basis, requiring that customer information be secure and fully protected. APX's data centers are protected using industry-standard equipment and access methods to ensure that the data is kept fully confidential and without corruption. Data exchanged between SDG&E and APX is done through SSL using 128-bit encryption keys. No customer data were available to unauthorized personnel, and no such data were transferred between sites without encryption. All databases and applications associated with the PLP are fully segregated and are password protected. They are configured to allow only the appropriate access to records depending on the individual's requirements. Customer data was only used after the proper authorization forms were filed with SDG&E and then were only used for settlement calculations and analyses for Pilot reporting.

# 4 Observations and Lessons Learned

As expected, the Pilot provided a wealth of lesson learned. This section contains details on these lessons as well as other observations related to the Pilot. These learnings are summarized in Table 7.

| Section / Topic | Lessons Learned Overview |
|---|---|
| **4.1 Program Design** | |
| | Meter before / meter after baseline may not be sufficient for longer retail events. |
| | Fixed monthly nominations reduced nominated capacity, leaving DR "on the table". |
| | The 24x7 Product was a mixed success as it modeled actual needs of the CAISO without necessarily fitting customer requirements. |
| **4.2 Participation** | |
| **4.2.1 General Observations** | Tight timelines between tariff filing and the beginning of Pilot Operations created a challenge for all parties, in particular, with regards to effective coordination on Participant enrollment. |
| **4.2.2 Recruitment** | Understanding PL and Pilot requirements, concerns about effort to install telemetry, reluctance to be involved in a Pilot all impacted customer recruitment. |
| **4.2.3 Enrollment** | While Aggregators are familiar with DR programs in general, there is a large knowledge gap at the customer level with regards to enrollment information and operational requirements for Pilot participation. Increased customer education and program information is necessary in the early stages of the program. |
| **4.2.4 Customer Suitability** | Customers transferring from other programs that have not historically been called did not understand the operational requirements of this Pilot; Customer did not necessarily see their involvement in the Pilot as a commitment to curtail, more as an ongoing business decision with a cost/benefit analysis. |
| **4.2.5 Customer Satisfaction** | Participants were generally satisfied. Most of their issues are covered in other sections. Those that are not: desire for tariff premium for Aggregators; desire for some marketing collateral for use in recruitment. |
| **Telemetry** | |
| **4.3.1 CAISO Requirements** | |
| **4.3.1.1 Demand versus Pseudo-Generation** | Pseudo-generation values reflecting curtailable load would be more valuable in real time for the CAISO than total demand. |
| **4.3.1.2 Telemetry Measurement Requirements** | Telemetry measurement requirements were flexible for the Pilot; however, the impact of different measurement techniques, latencies, and clock synchronization need to be evaluated and specific guidelines for measurement need to be established. |
| **4.3.1.3 24x7 Requirement** | Implementing 24x7 telemetry presents technology and staffing costs for Participants, and may not be necessary when the resource is not bid in to the market. Discussions with the CAISO need to continue regarding the need for 24x7 telemetry as well as implementation of an outage reporting mechanism. |
| **4.3.1.4 High Variability** | Customers with high variability create complexity for CAISO Operators using telemetry to inform dispatch decisions. The implementation of pseudo-generation could help resolve this issue. |
| **4.3.2 Site installation variables** | Characteristics of the customer site greatly impact telemetry design and costs. A general plug-and-play solution for telemetry is currently not available but attempt could be made to define a set of standardized solutions. |
| **4.3.3 Aggregator Issues** | The implementation of 24x7 combined telemetry poses a challenge for some Aggregators. Simplification of requirements for aggregator submission as well as ensuring cross-platform support could ease such challenges. |
| **4.4 Dispatch** | |
| **4.4.1 ADS Lessons Learned** | There were some challenges interpreting ADS instructions in the context of DR. Automation of the dispatch response based on Dispatch Operating Targets (DOTs) will reduce the risk of such misinterpretation. |
| **4.4.2 Notification Lessons** | Manual intervention within the notification process increased the potential for errors |

| | |
|---|---|
| **Learned** | or delays. An automated notification system tied to ADS would ensure on time and accurate notifications. |
| **4.5 Metering** | |
| **4.5.1 Impact of 15-minute Metering** | The use of 15-minute interval meters can negatively impact Participant performance. 5-minute interval meters should be preferred for this type of program. This effect would be exacerbated by shorter event times as proposed for a future Pilot phase. |
| **4.5.2 Impact of Clock Drift** | SDG&E's policy allows for a +/- 3 minute variation in meter clock time. The impact of this policy is within accepted norms and presented no particular issue for the Pilot. |
| **4.6 Wholesale Market** | |
| **4.6.1 Model build delays** | Updates to the CAISO Network Model are infrequent and require a 60 day lead time which constrains adding new Participants to the Pilot. Adding Participants to the Pilot resource would be simplified by the addition of default resource location in the CAISO Proxy Demand Resource. |
| **4.6.2 Settlements Issues** | Given the manual nature of CAISO test dispatches for the Pilot, there were unexpected inconsistencies between wholesale settlements and ADS dispatch times. |
| **4.7 Multiple Participation** | Dual participation – in this case with CPP-D – greatly increases the complexity of Pilot operation in ensuring that customers within mixed aggregated portfolios are not called for both a Pilot and CPP-D event. This will continue to be an issue and will need to be carefully considered in the future of the Pilot and other DR programs. |

**Table 7: Summary of Lessons Learned**

## 4.1 Program Design

Wherever possible the Pilot adopted existing standards and elements that were familiar and could be implemented quickly. During the Pilot a number of these design elements were reviewed for applicability in the future.

A "meter before, meter after" baseline was chosen for the Pilot. This simple to understand baseline was intended to accurately assess the load reduction and its impact on the grid similar to baselines used with generation. In order to mirror current retail demand response programs, providing customers with an event duration that they could plan for, the Pilot used the CAISO Non Spinning Reserve maximum of two (2) hours as a standard for all Pilot events. Subsequent analysis would indicate that while this baseline meets the planned objectives, a "meter before, meter after" baseline may not be the optimal baseline for the financial settlement of events as long as two hours. An analysis of alternate baselines appears in section 5.4.

Similarly, the monthly nomination process which required Participants to designate a single quantity for a product for an entire month was used for the Pilot consistent with other retail demand response programs. While this allowed for a simple nominating process, the single quantity did not allow for any daily shaping which resulted in the nomination of the lowest amount available during the time period. During months such as September and October where the weather can vary substantially, Participants noted that a significant amount of capability was not nominated to protect them against a "worst case situation." Allowing nominations to be changed during the month, whether daily or with hour-to-hour variability, would provide the flexibility to add or drop Participants during the month or adjust nominations to reflect changes to physical capability but would add to the administrative overhead.

Since system contingencies can occur any time, 24x7, using DR for system emergencies provides an opportunity for DR to be used in the wholesale market in a manner atypical of its historical use. The Pilot included a 24x7 product with the CAISO Non Spinning Reserves procurement practices in mind. However, this doesn't necessarily match up with the DR capabilities of customers who are able to participate outside of traditional DR timeframes. As the Pilot demonstrated, there are customers with

off-peak loads that can perform on 10 minutes notice, but that load may not be available all days and all hours. In consideration of the fact that the CAISO procures Non-Spinning reserves outside of traditional DR timeframes, a product that allows nomination and participation any days and any hour is prudent, especially if it is designed to provide Non Spinning Reserves. Enabling dynamic nominations that would allow for participation nominations to vary not only by day but also by hour, consistent with the CAISO market would provide the flexibility to include incorporate these customers.

## 4.2 Participation

### 4.2.1 General Observations

To leverage the experience of existing program staff, the Pilot administrative processes were modeled on the existing SDG&E Capacity Bidding Program. Nevertheless, given its pilot status and the limited systems available for program administration, the enrollment process did differ from the CBP with a number of new and unique steps.

Given the tight timeframe between the Pilot tariff filing and the first operational month, customer recruitment and setup needed to occur with much less time than would have been ideal. It was important nonetheless to recruit a sufficient number of customers for the Pilot to have a curtailable load level that would be practical for CAISO Ancillary Services and to offer a sufficiently-large mix of customers to be useful for Pilot analysis. As a result additional criteria and approval for acceptance into the Pilot were required (see section 2.1 for these criteria).

Although paperwork was collected by Aggregators for customer enrollment in time for the beginning of live Pilot operations, the limited time for the enrollment process, coupled with the lack of customer and Aggregator experience and familiarity with Pilot requirements resulted in the need for a number of adjustments to the enrollment information provided. In several instances customers transitioned from a different DR program and/or Aggregator in order to participate in the Pilot creating a need for additional validation steps.

The need to continually adjust and improve administrative processes during live Pilot operations compounded some of the issues in the early stages of customer enrollment. The most important consequences of these issues were delayed enrollment and/or the need for corrections in enrollment information during the Pilot.

### 4.2.2 Recruitment

The limited marketing outreach to Aggregators and customers through direct contact was effective in bringing Bundled customers to the Pilot. However, given the limited time for customer recruitment this approach was unable to address customers who were not able to quickly meet requirements or required significant education. Customers who had extensive approval processes dependent upon outside funding such as with the TI/TA program or Direct Access customers that required coordination with an Energy Service Provider (ESP) were not addressed.

Several Aggregators and customers showed early interest in enrolling in the Pilot and several informal discussions were commenced to discuss Pilot requirements. Many of these discussions ended in a "wait and see" decision from the prospects. There were several reasons impacting this:

- Some reluctance to engage until the tariff was fully approved

- Concern that the Pilot might not extend beyond 2009 therefore putting the pay-back on the investment at risk
- Concern that the telemetry requirements were too complex or costly to install
- Questions as to whether requirements would change significantly subsequent to the Pilot

Once the tariff was approved, some of the reluctance dissipated.

The primary issue for participation by Aggregators in particular was in assessing the effort involved to meet the Pilot requirements and the expected return on investment. It was clear that many of them are not prepared to deliver telemetered resources on an ongoing basis. Two Aggregators appeared to be prepared to meet the requirements in the long run, but were unable to meet them within the time frame required for the Pilot.

### 4.2.3 Enrollment

It was observed throughout the Pilot that while Aggregators are familiar with DR programs, they are not necessarily familiar with PL or the CAISO markets. This coupled with the knowledge gap among end use customers regarding DR and their own utility account information resulted in erroneous or incomplete information being provided to SDG&E through customer enrollment documents. For possible future phases of the Pilot, additional effort would have to be made by SDG&E and Aggregators to increase understanding by all parties involved of the requirements and constraints for participation in such a DR program.

Three major enrollment issues arose during the Pilot period:

- Submission of incorrect meter IDs
- Missing meter IDs
- Submission of ineligible meters or those participating in other DR programs

While the issues surrounding eligibility verification are not specific to PLP's enrollment process the impacts associated with these issues can be significant for customers. One such example of this related to a transition of a customer between Aggregators and programs. As a result, the customer's enrollment in PLP, which had been planned for November and December, was delayed until the final two weeks of the Pilot.

### 4.2.4 Customer Suitability

The directly-enrolled customer is an interesting case study in customer suitability. When they are operational they can curtail anywhere from 1.2 to over 3 MW. As they operate off-peak, such load shed can be very useful in a contingency. Due to their operating schedule, they were enrolled in the 24x7 product. This was the best fit for the Pilot because they do not operate during peak times; however, they were not truly operational around the clock. This mismatch posed some challenges in the Pilot. Note that the upper bound of possible curtailment was impacted by their highly variable load which poses several challenges (see section 4.3.1.4 for more on this topic).

One other enrollee turned out to be unsuitable for the Pilot. This Civic / Community customer -- enrolled by Aggregator 2 -- successfully lobbied to be removed from the Pilot and exited at the end of October. There were two reasons identified for why the customer wished to leave the Pilot:

- A part of the customer agreement with the Aggregator was to program the on-site EMS for AutoDR. Due to some technical difficulties the EMS was not properly handling the end of events without a

manual override. While the Aggregator worked to get this issue resolved, the customer was unwilling to work through this issue.

- This customer had previously been on the SDG&E Base Interruptible Program (BIP) which has historically been very rarely called by SDG&E. It appears that the customer was interested in gaining an economic benefit for participating DR programs, but was not willing to suffer any inconvenience. The inconvenience associated with having to work through technical issues coupled with the inconvenience associated with more frequent events resulted in a desire to exit the Pilot.

Neither of these two issues is directly related to the status of this project. While these two issues are different they represent the types of challenges regularly seen. Installation and configuration issues can be complex and take time to work through and many customers expect that there will be no effort required on their part with no impact for participation. The issue of free ridership, where customers enroll in programs for an economic benefit with the expectation that they will never get dispatched arises frequently.

While the aggregated nature of the Pilot obscures some specifics about how different customer classes performed there are still several lessons to be learned about customer performance.

- Customers with AutoDR performed better than those without. This was demonstrated through the early parts of the Pilot where Aggregator 1 with no AutoDR curtailed late and often continued curtailing beyond the end of the event. This is in contrast to Aggregator 2 where curtailment began and ended on time with the assistance of AutoDR.
- More sophisticated Customers performed better than those who were not. This was demonstrated by the multi-site retailer who worked with Aggregator 1 and with Pilot administrators directly to resolve operational issues manifested by the lack of AutoDR. This is in contrast to the Directly-enrolled Participant who was operationally unable to respond to some events due to operator schedules and language issues. This is also in contrast to the customer then dropped out of the Pilot due to the inconveniences presented through participation.
- Challenges arising during the recruitment and enrollment process reinforced the perspective that a significant amount of education is necessary for all of the various stakeholders. Even some simple communications were challenging due to differences in terminology and perspectives. Use and implications of terms such as service accounts, sites, meters and customers varied.

Another interesting related aspect of customer suitability is how the customers viewed involvement in the Pilot. Virtually all customers viewed the activity as a commercial transaction with an understanding that their performance (or lack thereof) was an ongoing economic decision. Throughout the Pilot decisions regarding participation were driven by economic concerns included the decision to perform – is it better to curtail load or to ignore the notification? This evaluation clearly differs from a commitment to shed load when requested to support grid reliability.

### 4.2.5 Customer Satisfaction

Throughout the Pilot, open communication was maintained with the Participants to obtain regular feedback for possible improvement. This approach culminated with debriefing discussions at the end of the Pilot.

The overall feedback from Aggregators regarding the Pilot has been positive with the two Aggregators intending to participate in future phases of the Pilot. All of the Aggregator-represented customers also intend to continue, excepting for the customer which left the Pilot in November (see section 4.2.3 for details regarding that customer's unsuitability). The Directly-enrolled Participant would also like to

continue in the Pilot; however, such continued participation may require enhancements to the 24x7 product as discussed in section 4.1.

There is agreement that this type of program is valuable and that the incentive level is appropriate to ensure success. There is an interest in the inclusion of PDR into the Pilot as the lack of a telemetry requirement will simplify Pilot costs and offer Aggregators a larger pool of potential customers. Having both products within one Pilot will provide flexibility and evaluation opportunities without requiring significant additional infrastructure.

During the Pilot there were two specific items that were raised by one of the Aggregators in regard to design.

- The Aggregators voiced the concern that the Pilot tariff included no premium for Aggregators over direct enrollment of customers. The fundamental concern is that with no premium in place, Aggregators must offer their customers less money for participation than the customer could get through direct enrollment with the utility. While this was not cited as an issue for the Pilot, it was identified as an issue for the future.
- A related item was the level of support that third party Aggregators should receive on an ongoing basis. While Aggregators expect to be the interface with their customers there was a desire to be provided with additional marketing and management support. In particular, Aggregators expressed interest in receiving support from SDG&E and/or the Commission for marketing materials to support enrollment. Generally speaking, a mass market education initiative is not seen as crucial and more PLP-specific materials, including Pilot requirements and generic incentive and cost information would be useful.

Other Participant feedback is enumerated here and integrated in other sections of this report:

- The enrollment process, similar to CBP is extremely manual. Streamlining the process with a possible online component would ease this process significantly.
- Nominating once per month poses challenges and creates risk that is mitigated through lower nominations. Shortening the nomination periods would allow more DR to be made available.
- The approach to telemetry in the Pilot was considered to be reasonable and comparable to other programs.
- The manual step required to interpret ADS and notify Participants was a concern in that it added variability to the advance notice time and added a latency that reduced the required response time. Participants are more comfortable with being provided a specific time to curtail consistent with current retail programs.
- The reliability of SMTP-based notifications was suitable for the Pilot and consistent with other DR programs however there was a desire to see this process improve and evolve for other programs as well as PLP. There is a consensus from Aggregators that the use of Web services would be a more secure and reliable solution.

## 4.3 Telemetry

### 4.3.1 CAISO Requirements

Once implementation of the Pilot was underway, the project team worked closely with the CAISO regarding requirements. Since the published telemetry requirements modeled existing Participating Load, they did not directly correlate with the aggregated nature of the SDG&E Pilot. As a result, many of the requirements needed to be detailed or modified. Some of these modifications are applicable in

a larger implementation for a full-fledged program while others were specific to the Pilot. This section reviews these items as a first step toward codifying the guidance from the CAISO for future implementations.

#### 4.3.1.1 Demand versus Pseudo-Generation

One purpose of the Pilot was to model DR as generation for the wholesale market. Wholesale settlement for the Pilot was performed by calculating quantities that represent this pseudo-generation. This approach was not followed for telemetry in the Pilot; instead, the telemetry reported the total load at the CLAP resource. The reasons for this decision are covered below, but in practice, it would be more useful for the CAISO to receive telemetry modeling pseudo-generation. This is because the total demand obscures the actual available capacity and as such it was not used by the CAISO for operational decisions. As a result, the telemetry provided in the Pilot was more of an opportunity to learn lessons about equipment installation and delivery than to provide operational value to the CAISO.

Total load and pseudo-generation might seem to be opposites, but they are not. Total demand varies based on any underlying usage, but pseudo-generation only varies by usage of the curtailable portion of the load. To illustrate the differences imagine a 15 MW load with a peak curtailable amount of 1.5 MW. For simplification, these diagrams assume that the load is flat between intervals and has the same values before and after the event.

The blue bars in the following figures show two examples of total load before, during, and after an event. Figure 14 shows a case where the entire 1.5 MW is available to curtail. Figure 15 shows an example where only 1 MW is available. The important point is that one cannot determine the available curtailment at time *T+1* based on the information available at time *T*.

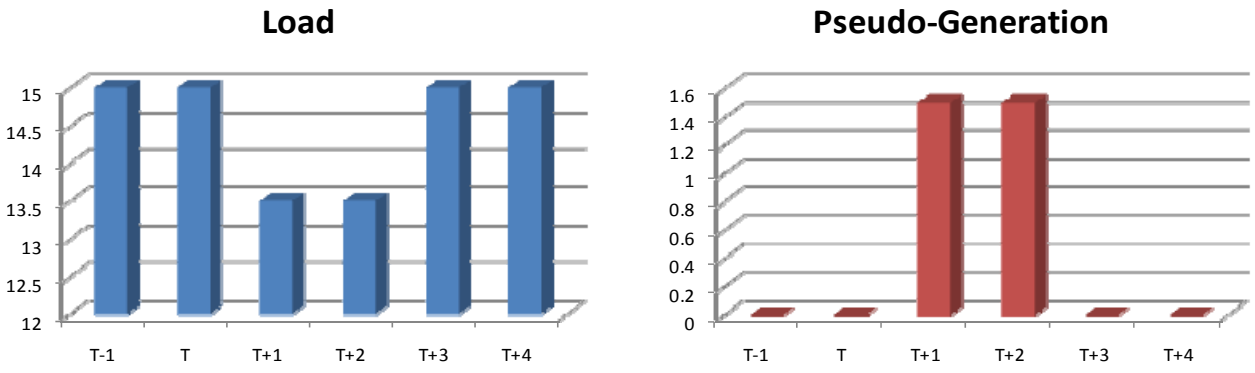


**Figure 14: Load versus Pseudo-Generation with 1.5 MW Available**

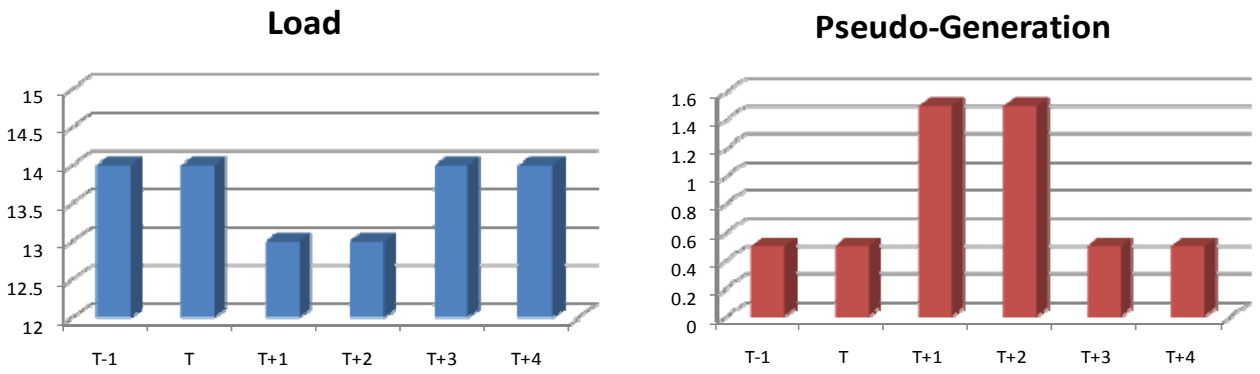


**Figure 15: Load versus Pseudo-Generation with 1.0 MW Available**

Looking at the companion charts with red bars, one can see that this is not the case. That is, at *T* it is clear how much is curtailable at *T+1*. This approach is consistent with the requirements and data that is delivered for a generation resource, in that it allows the CAISO to "see" what portion of a resource bid is actually available for dispatch.

The primary motivation for using total demand instead of pseudo-generation was the underlying complexity of the problem. For settlement, the CAISO models pseudo-generation based on a meter-before, meter-after approach. This approach is suitable for settlement because it does show what was actually delivered, but does not provide value in advance of dispatch. Modeling pseudo-generation for the aggregate resource requires modeling or estimating pseudo-generation for the underlying customers. To do this for a specific customer one needs to know if there is capacity for curtailment and how much of that capacity is unused. In general, this is a difficult problem to solve though there are solutions that can be applied in different situations, for example:

- By interfacing with an on-premises EMS, one can determine which end-uses are available to be controlled. Depending on the measurement capabilities of such a system a very good estimate of available capacity can be determined. Conceptually this is easy but in practice it becomes a per-customer integration project.
- For certain types of customers – the directly-enrolled customer in the Pilot is a perfect example – the pseudo-generation available can be determined with a simple mathematical gate function applied to their real-time metered demand. This is because when their load exceeds a certain threshold, a known quantity or portion of a quantity is available for curtailment. This type of customer may only be found in industrials; however, it is conceivable that there are some commercial customers that would also fit this profile.

The CAISO is aware of these limitations in the telemetry for the Pilot and would like to investigate ways to have pseudo-generation modeled if possible.

#### 4.3.1.2 Telemetry Measurement Requirements

Initial requirements for the Pilot were that demand measurements be instantaneous and read at least once per minute. Requirements did not address aggregation of telemetry reads and as such there was no specific requirement for clock synchronization to ensure they be aligned in real time. The issue of instantaneous readings and reading alignment each posed challenges to the Pilot.

#### 4.3.1.2.1 Instantaneous versus Averaged

One of the two Aggregators raised the concern that their measurement equipment could not provide instantaneous measurements. While certainly special hardware could have been chosen for this purpose, the issue led to a conversation with the CAISO about the significance of the instantaneous requirement. Considering that the readings themselves needed only to be submitted once per minute, SDG&E argued that average demand over a short interval was sufficient. The CAISO agreed that either instantaneous or averaged demand could be used for the Pilot. As covered in section 3.2.4, one Aggregator used averaged demand reads while the other Aggregator and the directly-enrolled customer used instantaneous reads.

#### 4.3.1.2.2 Reading Alignment and Telemetry Freshness

Ensuring that readings across the many disparate sites were time-aligned would require clock-synchronizing all site telemetry equipment, time stamping all readings, and finally, combining readings along aligned time stamps. Due to the "fan-in" design of the telemetry for the Pilot, this would have required the Aggregators to build systems that could perform time-aligned combination. While conceptually a straight-forward problem, in reality with different systems and system latencies, such systems can be difficult to build correctly. It was decided to simplify the approach and have the Aggregators provide the most recent combined values no less frequently than once per minute.

Considering the latencies between the different systems, this meant that the telemetry from an Aggregator's customer might be reflected at the CAISO up to 2 minutes after the read.

#### 4.3.1.2.3 Purpose of UCON

The value of the UCON measurement point is in question. Pilot requirements indicated that UCON should present a truth value – specifically a 1 – if any of the underlying loads was connected. For aggregated loads such as used in the Pilot, the cases where this was possible were relegated to internal APX routing failures or greater problems in Internet connectivity. In a hypothetical case where only 1 of the 20 or so sites reported valid data, UCON would have continued to report a 1. The CAISO has itself raised the issue of determining whether there should be a different approach to handling such aggregated loads.

### 4.3.1.3 24x7 Requirement

The CAISO requirement that telemetry be delivered 24x7 raised some issues in the execution of the Pilot ranging from increased cost to develop "always on" systems to greater staffing costs. These issues directly impacted Aggregators.

The requirement for 24x7 telemetry, at all resource levels, regardless of schedule should be reviewed:

1. In the Pilot, the CAISO will not dispatch energy outside of accepted capacity bids. Why is telemetry required during times when there are no bids?
2. If Aggregators participate only in an 11-7 product should telemetry be required 24x7?

There were several times during the pilot when different services needed to be upgraded (e.g., the Web service was under active development in the beginning of the Pilot) or other aggregator-side maintenance needed to be performed. While this activity was scheduled outside of the 11-7 window the impacts of a 24x7 requirement were highlighted.

Informal discussions with the CAISO indicate that there may be some future flexibility available. As program such as this Pilot or others are implemented in the future, it would be beneficial for there to

be a clear understanding of actual requirements for telemetry delivery as well as an outage reporting mechanism to clearly communicate both planned and unplanned outages.

#### 4.3.1.4 High Variability

Customers demonstrating high variability can pose a significant problem when real-time demand measurements are used for operations. The results can be misleading if the measurements are being used for operational decisions (e.g., when determining available capacity). Figure 16 shows an example from the Pilot directly-enrolled customer. One can see that the telemetry shows a highly variable load jumping around from over 4 megawatts to below 250 kilowatts.

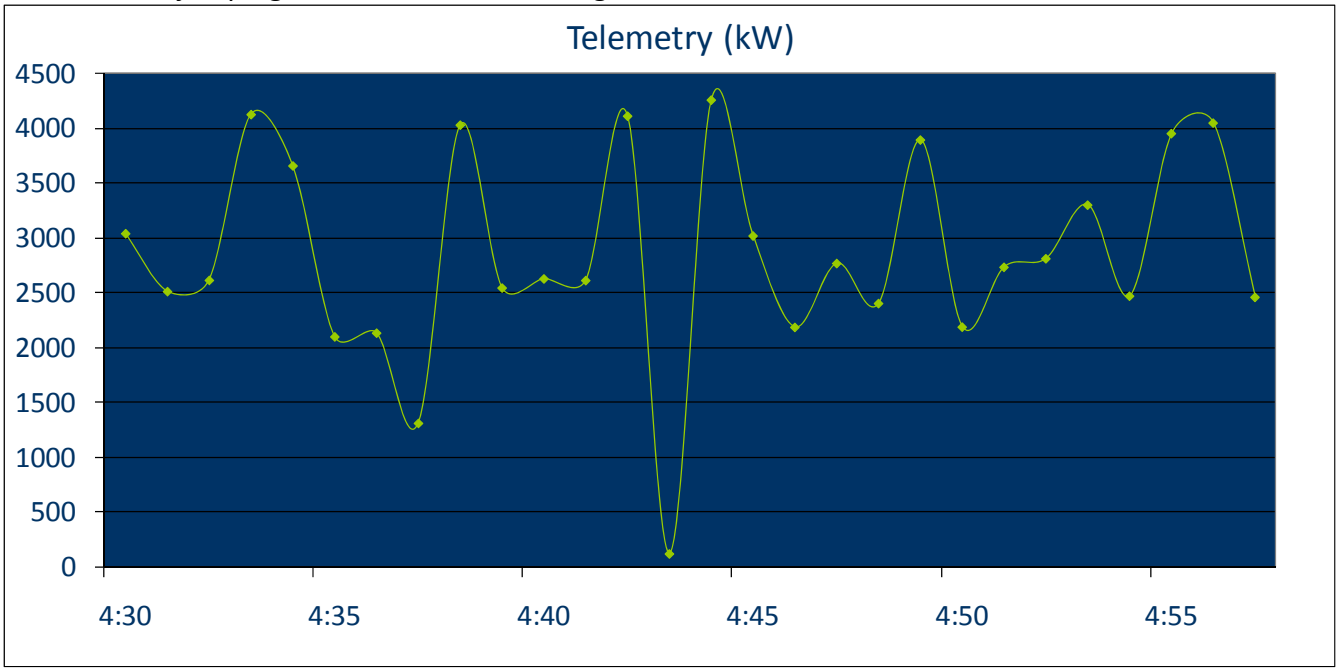


**Figure 16: High variability of Directly-enrolled Customer**[6]

If the CAISO used telemetry as an operational input to dispatching Pilot capacity, the variability would confuse the operators, possibly stopping such a resource from ever getting a dispatch. In addition, there is a question as to how much load can be curtailed. The instantaneous readings are highly variable, but the settlement is performed on a much smoother dataset: averaged kW over the metered interval (15-minutes for the Directly-enrolled Participant).

To mitigate these issues, the CAISO requested that highly-variable Pilot loads be smoothed. Note that if pseudo-generation were modeled in telemetry instead of total load (see section 4.3.1.1), this smoothing would not be necessary.

After some discussion about the best means to achieve this smoothing, it was decided to implement a simple cap on the telemetered demand for this customer. The rationale for this was that when telemetry indicated at least 1400 kW, then the plant was in operation and, as such, the corresponding capacity was available for curtailment. Other solutions that were discussed included averaging the value over a time interval or choosing the median value over a moving window. These solutions were dismissed due to the complexity of implementing such solutions in typical SCADA systems.

[6] This charts minutely total demand collected from the directly-enrolled Pilot customer during September 30th.

This particular solution was reasonable for the Pilot – somewhat mirroring pseudo-generation for this customer – however, it is not a general solution to such a problem:

- The load for this customer occasionally dropped below 1400 kW during operation as shown in Figure 16.
- This solution would not generally apply to other highly variable loads with different operating characteristics.

This issue will need to be revisited in a possible future version of this Pilot or other Participating Load programs.

### 4.3.2 Site installation variables

Characteristics of the customer site greatly impact telemetry design and costs. Most of the on-premises telemetry design and implementation for the Pilot was performed by the Aggregators – direct experience of the Pilot administrators was limited to the light industrial customer. Commercial installations such as those enrolled by the Aggregators tend to have simpler requirements; however, the issues that came up during the installation for the directly-enrolled customer are informative on a broader scale.


**Figure 17: Three Components of Site Equipment**

In many ways the directly-enrolled customer is not atypical of high-voltage installations. For example, many such industrial customers already have in-place metering technologies or EMS that could support telemetry. This is due to the importance of energy – and its associated costs – to their operations. They also will generally have a different level of safety concerns when integrating with or near high-voltage equipment. This was a clear issue with the directly-enrolled customer: while it was expected the customer would require staff with certain certifications to work near the high-voltage equipment, they went a step further and required that a specific engineering company perform the work. There is also a higher likelihood of intra-site connectivity issues and Internet access issues due to the possibly large area of an industrial site. As discussed in section 3.2.3, these latter issues drove the decision for installation of new Internet connectivity over satellite for this customer.

This highlights some of the issues for light industrial customers, but in general the issues apply to any customer and together provide the greatest challenge to broad implementation of telemetry: that each and every installation requires a site survey and implementation design. Certainly standardized solutions can be developed to fit different scenarios, but that is a leap from customer being able to self-install a plug-and-play solution. Some of the issues that come up in a site survey are enumerated in Table 8.

| Measurement | Existing Device |
|---|---|
| | Is there an existing device capable of providing required demand reads? |
| | Does the device have an output port available from which to get these reads? |
| | What protocols are supported by the device? |
| | **Existing EMS** |
| | Is there an EMS from which to get the demand reads? |
| | What protocols are supported by the EMS? |
| | **No existing device** |
| | Need to select and install new measurement device (perhaps, all-in-one measurement and gateway) |
| **Gateway** | **An existing gateway device?** |
| | Does it integrate with the measurement device? |
| | Is it capable of supporting centralized solution? |
| **Connectivity** | **Existing Internet Connectivity** |
| | Does customer policy allow 3rd party access? |
| | Does the central technology require a persistent connection? |
| | If a static IP is necessary, is one available? |
| | **Need New Internet Connection** |
| | What types of service / providers are available at site? |
| | Is a static IP necessary? |
| | Perhaps use cellular technology for all-in-one device? |
| **Space / Proximity** | Where will the equipment be placed? |
| | What are the distances required between the different components? |
| | Are there cable-length issues at the required distances? |
| | Are the locations secure / what kind of security is in place? |
| **Personnel** | Does the customer require a site survey design? |
| | High voltage expertise? |
| | Insurance issues? |

**Table 8: Various Site Telemetry Issues**

### 4.3.3 Aggregator Issues

While both of the Aggregators prefer a Web service interface, both did experience some technical challenges building their Web service interfaces for the Pilot. While the Web services were implemented to be WS-* standards compliant using the Windows Communication Foundation (WCF) in Microsoft .NET 3.5, the Aggregators' tools of choice were not capable of supporting these newer standards. For Aggregator 1, this simply required the use of WCF services over their preferred use of the older style ASMX services. This was a bigger issue for Aggregator 2 as they adopted Microsoft Visual Studio where they would have preferred the Java language and associated tools. In a future phase of the Pilot, it would make sense to develop client samples in Java to ensure that this popular alternative is also supported.

The Pilot required Aggregators to provide combined telemetry through the Web service as an appropriate separation of concerns; however, this required substantial software development for one

of the Aggregators. This issue was exacerbated by the 24x7 requirement imposed by the CAISO on telemetry. This was possibly also impacted by the unintended requirement of using specific development tools mentioned previously.

Regardless of the overall successes of the Aggregators in providing telemetry to the Pilot, it should be noted that software development is not necessarily a core competency of Aggregators in general and could continue to prove challenging in a future possible phase of the Pilot. One way to mitigate this would be to allow Aggregators to submit telemetry for their individual customers without performing combination; however, this would put a burden on an administrator to manage additions and removals of telemetry points, substitute for missing data, and other issues.

## 4.4 Dispatch

### 4.4.1 ADS Lessons Learned

The CAISO Automated Dispatch System (ADS) is primarily designed to provide operating instructions to generators, and some instructions presented challenges for the dispatch of curtailable demand. Due to the constrained timeline to implement the Pilot, an increased reliance of manual actions added to these challenges. Further, to facilitate a robust test regime, manual intervention was also required on behalf of the CAISO. As a result, ADS issues experienced were a mix of the expected learning curve of interpreting ADS instruction for this type of program, manual error in configuring Exceptional Dispatches and miscellaneous CAISO system issues.

The Pilot provided extensive learning for Pilot staff in terms of the application of ADS dispatches to a load based resource. Below are some examples of unexpected dispatch instructions received through ADS and the lessons learned during the Pilot.

- Start up / Shut down instructions: As a resource in the CAISO resource stack, the Pilot received start up and shut down instructions daily which are not applicable to a DR resource. Such instructions were ignored for the Pilot.
- Dispatch Operating Target (DOT): For each dispatch issued by the CAISO in ADS, it was expected that the Pilot resource would receive a corresponding Dispatch Operating Target (DOT) represented as the MW output level. There were instances during the pilot when a dispatch was received with no DOT, or when a DOT was received with no corresponding dispatch.

As a result of these types of ambiguity in ADS instructions, it was determined in the Pilot that Operators would only act if a DOT was received for the resource. This best ensured that Participants were only instructed to curtail load if the CAISO actually requested energy dispatch from the Pilot resource.

One advantage to having Operators manually intervene in this process was to validate and interpret dispatches prior to Participant notification. The disadvantage was that in addition to introducing latency to the process, there isn't always a consistent interpretation of the ADS instructions. Moving forward to a future possible implementation of Web services between ADS and the PLP System would streamline the notification process and provide consistency of the dispatch instructions that are passed forward. In addition this would greatly reduce the potential for incorrect notification and notification delays due to human error.

The assumption that Participants should only be notified if a DOT is received through ADS would likely continue. This operating principle allows for more straightforward design of a fully automated notification process. Operators may retain override capability to allow for human interpretation and if known issues occur during Pilot operating hours.

### 4.4.2 Notification Lessons Learned

Notifications were transmitted on-time to Participants throughout the Pilot with one exception. Within this context of success, there were several areas in the process of transferring ADS instructions to the Participant that can be assigned to three distinct causes: manual intervention, operational issues and technology.

The notification process required that Operators log into a secure system and issue notifications following validation of a dispatch of the Pilot resource. The need to log on to the system during this time-constrained event introduced a small latency that could be addressed with further automation. In one instance, this latency became significant due to an Operator failing to logon to the system in a timely manner.

During the Pilot there were several instances where Participants were unable to curtail load due to either unexpected changes to the load level at which they were operating, or personnel responsible for shutting off load were not present when a curtailment notification was issued. The design of the Pilot did not provide a feature that allows a Participant to indicate if the nominated load was unavailable. Telemetry could provide this detail if it excluded uncontrolled load (see section 4.3.1.1 for a discussion of total demand versus pseudo-generation).

AutoDR systems present an effective solution to situations where they can replace physical intervention by site personnel. Despite some Participant's expectations that AutoDR would not be necessary to meet Pilot requirements, it became evident during the course of the Pilot that there was a resulting performance difference. If AutoDR is not a requirement for participation, other operational requirements should be put in place such that customer staff with the ability to curtail load be present during all product hours if a technology solution is not in place or practical for remote curtailment. AutoDR not only impacts event response times but also post-event return-to-normal. In one particular example, a customer without AutoDR was unaware that an event ended and therefore continued to curtail beyond the end of the event (see section 5.4.1). AutoDR also needs to be configured correctly to ensure return-to-normal as was not the case for the customer who dropped out of the Pilot (see section 4.2.4).

Several technological issues occurred during the Pilot due to the various methods of delivering curtailment notifications. The primary method of notification was through email and/or SMS text messages, both sent using SMTP. The use of SMTP can introduce unpredictable delays in notification and may result in a negative impact to Participant performance due to late curtailment. This is because SMTP servers can suppress or delay messages in the fight against spam and also because of other delays and latencies inherent to mail distribution. There were a few issues where notifications were incorrectly delayed or treated as spam, but notifications still occurred due to the dual reliance on email and SMS text messages. Notifications through Web services was identified as the preferred approach to eliminate these delays. In addition, Web services would eliminate the exposure of unsecured email.

The directly-enrolled Pilot customer required telephone calls for notification. In general this process worked as expected with two notable exceptions. In one example, the customer operator was non-

English speaking and was unable to understand the notification instructions. This was resolved by escalating to other customer staff. In another example, there was no answer at the customer site due to the staff being on break. Phone calls are not an efficient method for notification and it would be reasonable to require Participants to have a pager or other such device to mitigate such issues.

Given the mix of notification processes and varying levels of manual intervention across all Participants in the Pilot, backup notification processes presented an issue in the early stages of the Pilot. In the case of a system failure various levels of contingency notifications must be issued to all Participants, including manual notifications in the case of any total system breakdown. The Pilot consequently designed a contingency notification message that would provide useful information which could be interpreted by all recipients, including systems. A short SMS notification text, sent over SMTP, was used as a first level contingency message. This preserved a fast notification process by sending a single message, which human users as well as systems could easily interpret.

## 4.5 Metering

### 4.5.1 Impact of 15-minute Metering

With 5-minute interval meter data not readily available, 15 minute interval meters were used during the Pilot, consistent with other retail DR programs. 5-minute interval data is required by the CAISO – consistent with generation – Pilot meter data was disaggregated to 5-minutes. One lesson from the Pilot is that if 5-minute interval meters were required for participation in PL, the meter submittal process to the CAISO could be streamlined as well as the accuracy of the data increased. The retail settlement would benefit as well by the simplification and accuracy afforded by 5-minute interval data.

The fundamental issue at hand is the accuracy of settlement calculations when events begin or end within a 15-minute interval. For reference to the Pilot, this was the case for 20 of the 22 events (i.e., only 2 events were aligned on 15-minute interval boundaries).

The use of 15-minute metering can favor either the Participant or the market; however, cases where the Participant is favored are limited to when the Participant may be late performing but makes up for that within a short time frame. Of more concern are the times when the Participant performs perfectly but their performance is discounted because of this metering issue.

One way to analyze this latter case is to compare performance for an event not aligned on a 15-minute meter between hypothetical exact 100% compliance versus how that compliance would be metered.

Such a case is depicted in Figure 18, showing a Participant curtailing from 1200 kW down to 400 kW for an event that begins 10 minutes after the hour. The event is highlighted by the orange box. The blue bars indicate actual performance aligned on 5-minute intervals. The brown bars indicate how that performance would be measured by a 15-minute interval meter. The event starts at time *T* with the first interval ending at *T+5*, the customer achieves 400 kW, and the 15-minute meter reports 933 kW. Looking at the end of the event at time *T+120*, the customer returns to 1200 kW in the following interval, but the 15-minute meter reports 667 kW.

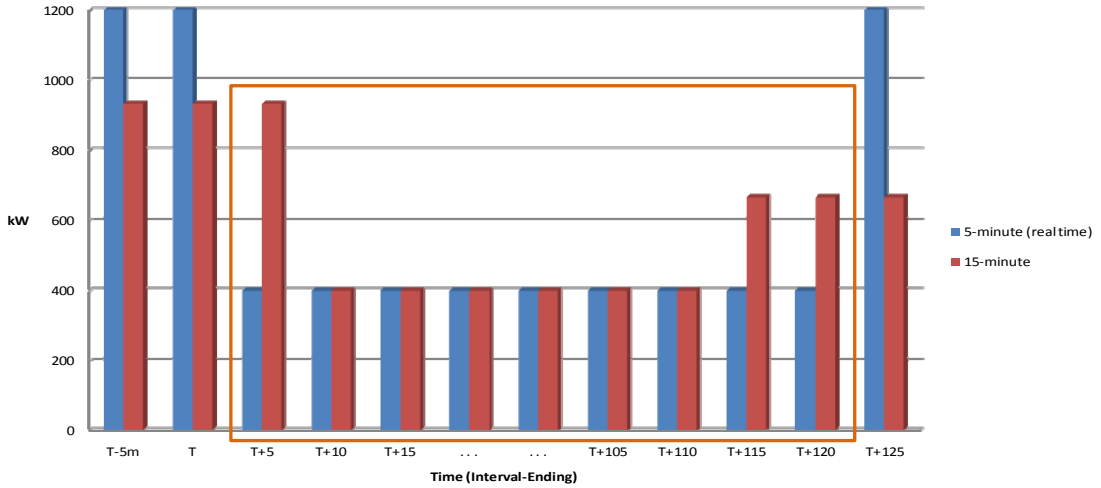


**Figure 18 Worst-case depiction of 15-minute Metering with 5-minute Start Interval**

This depicts the worst-case for the Participant (i.e., the worst possible negative impact given perfect compliance). This can be computed to be a 5.6% negative impact to the Participant performance and ultimately to the per-event settlement calculation for the Participant.

Note that the actual drop is not important for this comparison. It is significant that the event lasts 2 hours – longer or shorter events yield different results. For example, if the event were an hour in length, the worst-case negative impact goes up to 11.1%.

In the wholesale environment, the worst case is more severe as it could result in taking away a significant portion of capacity payment by indicating that the load drop wasn't achieved in the required time frame. The CAISO dispatches real-time energy on a five minute basis almost always on the five minute mark. If a dispatch is issued in the 10$^{th}$ minute of a 15 minute interval, the average of the three 15 minute interval would result in an 18.2% negative impact. Note that shifting the event start time back by 5 minutes, results in the same retail settlement, though that case could obtain a better wholesale result as it skews the drop towards a lower averaged value.

### 4.5.2 Impact of Clock Drift

SDG&E has a policy that interval meters must be within +/- 3 minutes of system time. Any such discrepancy has limited impact in typical billing scenarios; however, the Pilot is unique in that it creates an opportunity to see the impact of such discrepancies given the telemetry component.

Following a similar methodology of hypothetically perfect compliance as is used in section 4.5.1, Figure 19 shows an example of a Participant curtailing at exactly the correct time as noted in the blue bars. The brown bars indicate the time lag associated with the meter being 3 minutes behind schedule. The green bars show how this lag would be recorded by a 5-minute interval meter. The orange region indicates the beginning of the event – the end of the event is kept off of the chart to enhance readability.

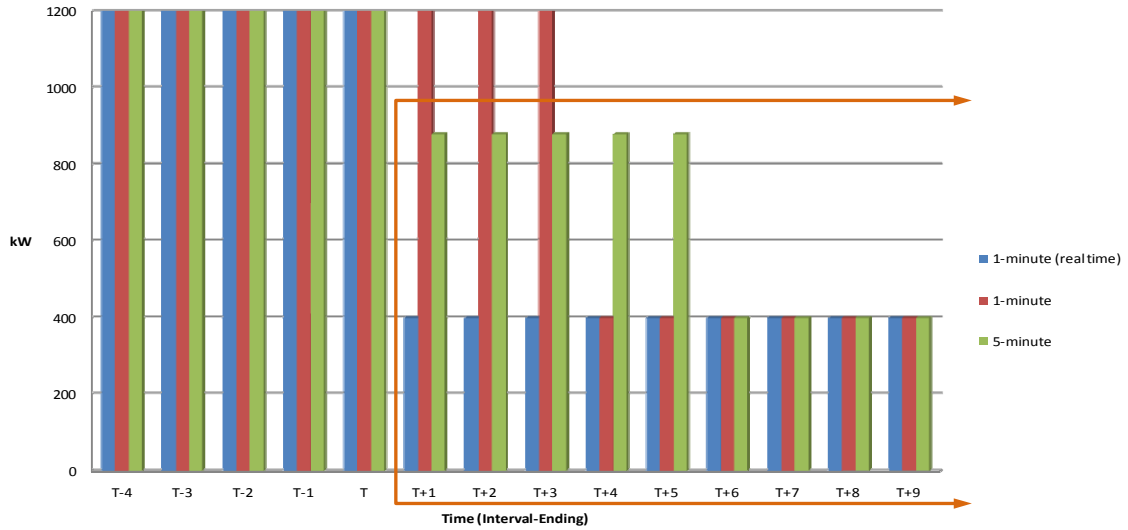


**Figure 19: Worst-case Depiction of 3-minute Metering Lag**

This depicts a worst-case with an impact of 2% on performance. Note that if the clock was out of synchronization 3 minutes before system time, the effect would be the same, but would occur at the tail-end of the event.

When meters are closer to perfect synchronization, this worst-case is linearly reduced. For example, the directly-enrolled customer had a clock that was 73 seconds fast. The potential impact for this customer would be approximately 2% x (73 seconds / 180 seconds) = .8%.

For the Aggregators, it is more difficult to analyze this issue since the overall impact of clock offsets depends greatly on the contribution of particular meters to the overall reduction. During the Pilot, the average magnitude of clock offset for Aggregator 1 was 71 seconds and Aggregator 2 was 47 seconds.

The potential impact of clock synchronization is not significant – it is no more or less relevant to the Pilot than to typical billing scenarios.

## 4.6 Wholesale Market

### 4.6.1 Model Build Delays

The existing CAISO Participating Load (PL) requirements are predicated on the notion that loads in each PL resource are easily identified at the grid bus locations and precisely modeled in the full network model. Model updates are relatively infrequent and require approximately 60 days lead time from submittal to the CAISO to actual deployment into the market software. For example, the announced dates of two planned model builds to be promoted to production for summer 2010 are April 28, 2010 and June 30, 2010 with data submittal deadlines of early February and early April respectively. Because of such lead times – and the fact that customers were not enrolled so many months in advance of the Pilot start date – it was impractical to precisely model the individual DR resources for the CAISO. While this was an initial limitation at the beginning of the Pilot since the customers that would participate were not known early enough, the fact the Pilot allowed new enrollments to be submitted 5 calendar days prior to an operating month would always leave open the possibility that customers would join the aggregation fewer than 60 days in advance. The CAISO allowed an

accommodation that modeled the DR resource pseudo-generator and Custom Load Aggregation Point as distributed resources across the SDG&E system.

One outcome of the experience in the Pilot is that the CAISO is creating default resource locations for the Proxy Demand Resource that are distributed across each SubLAP therefore providing the flexibility to create PDR Resource IDs without the burden of being encumbered by the timing of the Model Build process.

### 4.6.2 Settlements Issues

There were instances where the wholesale settlements of the Pilot resources were inconsistent with test dispatches in the market, as well as what can be considered spurious dispatches (i.e., dispatches received when not expected, or dispatches that were not based on market economics). Due to the manual nature and set-up required by CAISO operations for the test dispatches, some of the Exceptional Dispatches appear to not have been transferred into the data stream for settlements and this would not be expected to be an issue during normal market operations.

One instance where it appears that the CAISO didn't transfer data from a test dispatch to the settlement system was on August 13, 2009. This appears to be an error in the CAISO ADS system which propagated an exceptional dispatch for every interval from 10:45 through 14:35 for a total of 46 intervals instead or the two 5 minute intervals that were the basis for the test. At a minimum, the Settlement for this date should have shown Instructed Energy payment for the two 5 minute intervals of the test. It would also be expected that some Non Spinning Reserve payments would have been rescinded since the full amount of load drop wasn't achieved in 10 minutes.

For the October 15, 2009 test which was initiated by the CAISO through and Exceptional Dispatch, no Non Spinning Reserve capacity payments were rescinded. Log notes indicate that the customer indicated that they were not able to perform which was confirmed by the submitted meter data. It was expected that the entire amount of Non Spinning Reserves capacity payment would have been rescinded due to these circumstances. CAISO records indicate that the Capacity Award was not present in their system for a short portion of the hour leaving no Capacity payment to process for rescission. The Exceptional Dispatch for the test would have been predicated on the Capacity Award and, after discussion with the CAISO it is not clear why the Capacity Award was missing in the data sent for settlement.

While spurious dispatches were treated as discussed in section 4.4.1 settlement data, predominantly in the form of Instructed Energy payments, appeared on settlement statements for these events. Since the energy settlement for dispatches has a corresponding settlement component in Uninstructed Energy charges, (i.e., any Instructed Energy payment is taken away in the Uninstructed Energy charge for non performance), the financial implications with the CAISO netted out.

## 4.7 Multiple Participation

It is desirable to allow customers to participate in multiple DR programs to provide the maximum amount of curtailable load. Multiple-program participation creates many challenges that fundamentally revolve around the same issue: avoid duplicate payments to customers. The exact methods to avoid duplicate payment vary depending upon the specific programs in which a customer participates.

The Pilot did not allow multiple participation in other programs with the exception of customers on the Capacity Peak Pricing Default rate. The Pilot included customers that were simultaneously enrolled under CPP-D. The tariff defined how to address this occurrence:

- If Customers enrolled in both the Pilot and the CPP were notified the day before of a CPP event, those customers should not to be notified for Pilot events if possible.
- When Pilot and CPP events overlapped, such customers received a reduced Pilot payment based on the ratio of overlapping event hours to total available Pilot hours.

On an individual customer basis, such an implementation is conceptually straightforward although it does imply a high degree of systems and operational integration. This is a fundamental concern for the implementation of any multiple participation solution. In general, many different and orthogonal systems and personnel are in involved in running the programs and, as a result, various issues arise when trying to implement such a solution.

The necessary processes surrounding the calling of a Pilot event illustrates one such example:

1. Adjustment of Bid

   The total capacity nominated by Participants defines the bid for the Pilot. If one or more Participants were to be unavailable due to a CPP event, then the wholesale capacity bid should be reduced to avoid submitting a bid for which it is known that a portion of the capacity is not available for real-time reduction. This requires interactions between of systems and processes that are not currently integrated.

2. Timing

   CAISO capacity bids are due at 10:00 AM the day prior to the operating day while CPP events are called at 3:00 PM and there is no current mechanism to indicate a reduction of PL capacity after the day ahead market (generators can communicate changes to availability after the Day Ahead market via the Outage Management protocols).

3. Aggregation

   An additional set of issues presents itself for aggregated customers. The basic problem in the Pilot comes about because aggregators nominated capacity and dispatched load, based on the aggregate. The capacity bid cannot be reduced correctly unless the Aggregator has provided a per-customer nomination or if the dual Participants' nominations are clearly separated from other nominations. Similarly, for dispatches, separation or distinction of customer's participating in other programs would be required.

Because of the complexity of this issue, the approach taken for the Pilot was to attempt to completely avoid the overlap of such events. In practice, this became difficult to implement because of the different organizations and systems involved in the Pilot and CPP administration. On September 24 both a CPP and Pilot event were called. Although this event only impacted one of the customers for Aggregator 2, its occurrence underscores the issues surrounding management of multiple participation.

# 5 Performance and Analysis

## 5.1 Events

Overall the resources performed as designed; delivering demand response within 10 minutes of CAISO dispatch and maintaining a load reduction for 2 hours. Performance can be broken down into three components, initial response, holding the reduction and quantity of reduction. Initial response is impacted by the efficiency of the notification process and there were a few instances where the curtailment was achieved, but it took slightly longer than 10 minutes. This can be observed by looking at the differences between the wholesale (CAISO) performance factor and the retail performance factors in Table 9.

Based on experience, the level of performance during events is in range with other resources providing Non Spinning Reserves. The wholesale performance factor chosen for this report is a measurement of how much capacity payment was rescinded for failing to achieve full delivery of the capacity bid within 10 minutes of dispatch. This metric is more granular than the performance metrics reported by the CAISO which looks at overall availability, not just dispatch performance. When compared to the CAISO standard, the Pilot resource performance was above 99%, exceeding the CAISO system-wide performance that is historically in the mid to upper 90 percent range on an annual basis

While a generator that is online with unloaded capacity and directly connected to ADS might perform at a level close to 100% during an event, an off-line combustion turbine (CT) is more comparable to a demand response resource. Both DR and CT resources are exposed to start up and notification processes that introduce latency that can result in not achieving the full dispatched energy quantities within 10 minutes. The Pilot resource only had one instance where it failed to provide any response, which is analogous to a CT failing to start when dispatched. Overall, the performance of the Pilot resource during events demonstrated that it was capable of contributing to the CAISO recovery from contingency events on par with similarly situated generation resources.

The retail performance factors look at the full two hours of an event as well as the quantity of curtailment achieved during an event. Since the retail performance looks at the event over the entire 2 hour period, a slight delay in achieving the curtailment within 10 minutes is muted in the performance measurement generally resulting in a higher performance factor than wholesale. The retail Performance can exceed 100% if the quantity of curtailment delivered is greater than the nominated amount and provides a sense of how much hedging was included in Participant nominations. The adjusted performance is capped at the nominated amount since payments to Participants could not exceed their nomination.

## SDG&E PL Pilot

Below is a summary table of all SDG&E Pilot Events.

| | Wholesale Event | | | Retail Event | | | | |
|---|---|---|---|---|---|---|---|---|
| Date | Dispatch Time | Notes | MW | Start Time | End Time | Performance | Adjusted Performance | Wholesale Performance |
| 8/13 | 14:00 | Exceptional Dispatch | 0.3 | 14:10 | 16:10 | 159.31% | 100.00% | N/A |
| 8/20 | 13:55 | Exceptional Dispatch | 0.3 | 14:05 | 16:05 | 94.59% | 94.59% | 0% |
| 8/27 | 13:55 | Exceptional Dispatch | 0.3 | 14:05 | 16:05 | 166.68% | 100.00% | 83% |
| 9/10 | 14:00 | Exceptional Dispatch | 0.6 | 14:10 | 16:10 | 136.68% | 100.00% | 85% |
| 9/17 | 13:55 | Exceptional Dispatch | 0.6 | 14:05 | 16:05 | 92.70% | 92.70% | 92% |
| 9/18 | 15:55 | Contingency Dispatch | 0.6 | 16:20 | 18:10 | 132.60% | 100.00% | 67% |
| 9/23 | 23:35 | Test | 1.2 | 23:45 | 1:45 | 197.42% | 100.00% | N/A |
| 9/24 | 13:55 | Exceptional Dispatch | 1.8* | 14:05 | 16:05 | 158.77% | 100.00% | UNK** |
| 9/30 | 4:55 | Exceptional Dispatch | 1.2 | 5:05 | 7:05 | 250.52% | 100.00% | 100% |
| 10/1 | 13:55 | Exceptional Dispatch | 0.8 | 14:05 | 16:05 | 96.47% | 96.47% | 100% |
| 10/9 | 11:25 | Exceptional Dispatch | 0.8 | 11:35 | 13:35 | 35.96% | 35.96% | 100% |
| 10/14 | 12:35 | Exceptional Dispatch | 0.8 | 12:45 | 14:45 | 78.09% | 78.09% | 80% |
| 10/15 | 4:55 | Exceptional Dispatch | 1.2 | 5:05 | 7:05 | 0.80% | 0.00% | UNK** |
| 11/16 | 15:00 | Test | 0.6 | 15:10 | 17:10 | 103.42% | 100.00% | N/A |
| 11/18 | 1:00 | Test | 1.2 | 1:10 | 3:10 | 41.43% | 41.43% | N/A |
| 11/19 | 12:06 | Test | 0.6 | 12:20 | 14:20 | 66.34% | 66.34% | N/A |
| 11/24 | 15:00 | Test | 0.6 | 15:10 | 17:10 | 73.60% | 73.60% | N/A |
| 12/2 | 4:00 | Test | 1.2 | 4:10 | 6:10 | 111.90% | 100.00% | N/A |
| 12/3 | 14:55 | Exceptional Dispatch | 0.5 | 15:05 | 17:05 | 68.53% | 68.53% | TBD*** |
| 12/7 | 18:25 | Contingency Dispatch | 0.5 | 18:35 | 19:00 | 30.66% | 30.66% | TBD*** |
| 12/11 | 2:00 | Test | 1.2 | 2:10 | 4:10 | 33.67% | 33.67% | N/A |
| 12/15 | 2:30 | Test | 1.2 | 2:40 | 4:40 | 170.13% | 100.00% | N/A |

**Table 9: SDG&E Pilot Events**

*This bid includes the Directly-enrolled Participant. See section 5.2.1.1 and the detail for this event in section 8.8 for more information.

**Unknown: September 24th and October 15th settlements were improperly processed by CAISO.

***To be determined: December Recalculation Statements not published until mid February.

The retail performance numbers exclude the 24x7 Directly-enrolled Participant from events that occurred in the 11-7 timeframe. This is discussed in section 5.2.1.1.

Note that the some of these events were initiated by the Pilot management and were not dispatched from the CAISO. Such events have no CAISO performance data. Participants were neither informed of who initiated an event nor, if applicable, the CAISO dispatch type. As a result, retail performance was not impacted by such details. Participants were also not provided with advance notice of an event. As such, there is no bias in the performance analysis that would come from pre-cooling or other behavior that might be associated with advance notice.

## 5.2 Retail Event Analysis

### 5.2.1 Performance Summary

#### 5.2.1.1 Product Performance Summary

There were two products defined in the Pilot Tariff. One, the "11-7 Product" was a typical on-peak product. The other, the "24x7 Product" was an all-hours product. Since these two products were combined into the Pilot resource, the 24x7 product enrollee was notified for all Pilot events. This had a negative impact on their retail settlement because the enrollee was unavailable to curtail between the hours of 11-7 based on their production schedule. To not skew the performance reporting accordingly, the following summaries for the "11-7 Product" exclude the 24x7 enrollee. Therefore, all analysis of event performance for the "11-7 Product" is referred to as "On-Peak" as distinguished from the remaining hours which are referenced as "Off-Peak."

Note that after the September 24th event, capacity bids were adjusted to reflect that the 24x7 enrollee did not have actual capacity from 11-7, effectively excluding the 24x7 nomination from wholesale compliance.

##### 5.2.1.1.1 On-Peak Event Performance Summary

Aggregators participating in the On-Peak Product performed generally well throughout the duration of the Pilot. As is illustrated in Figure 20, performance often reached 100% (8 out of 15 events). Furthermore, performance was above 60% for 13 of the 15 On-Peak events.

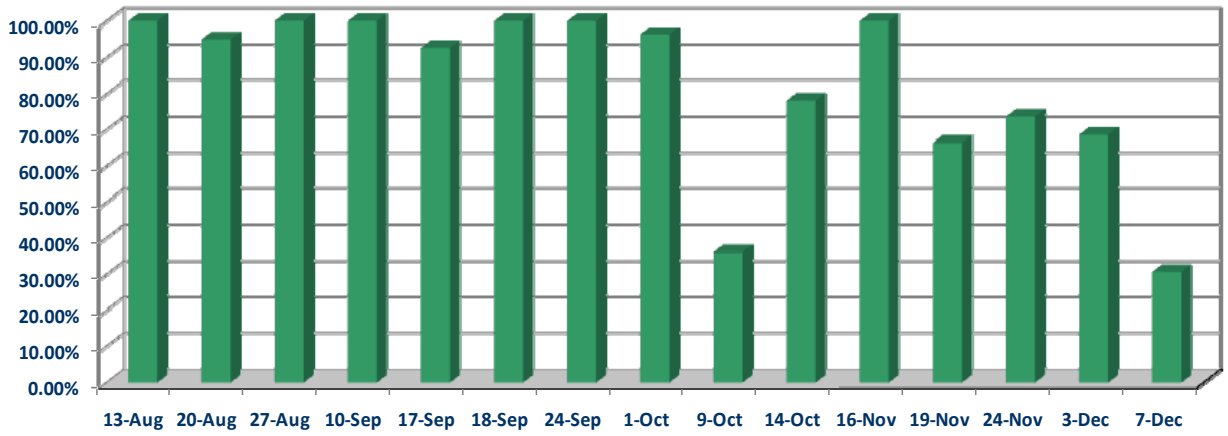


**Figure 20: On-Peak Retail Performance (Tariff Adjusted)**

| Date | Curtailment Amount (kW) | Start Time | End Time | Performance | Adjusted Performance |
|---|---|---|---|---|---|
| 13-Aug | 325 | 14:10 | 16:10 | 159.39% | 100.00% |
| 20-Aug | 325 | 14:05 | 16:05 | 94.59% | 94.59% |
| 27-Aug | 325 | 14:05 | 16:05 | 166.67% | 100.00% |
| 10-Sep | 600 | 14:10 | 16:10 | 136.68% | 100.00% |
| 17-Sep | 600 | 14:05 | 16:05 | 92.70% | 92.70% |
| 18-Sep | 600 | 16:20 | 18:10 | 132.44% | 100.00% |
| 24-Sep | 600 | 14:05 | 16:05 | 158.77% | 100.00% |
| 1-Oct | 800 | 14:05 | 16:05 | 96.47% | 100.00% |
| 9-Oct | 800 | 11:35 | 13:35 | 35.96% | 35.96% |
| 14-Oct | 800 | 12:45 | 14:45 | 78.09% | 100.00% |
| 16-Nov | 550 | 15:10 | 17:10 | 103.42% | 100.00% |
| 19-Nov | 550 | 12:20 | 14:20 | 66.34% | 66.34% |
| 24-Nov | 550 | 15:10 | 17:10 | 73.60% | 73.60% |
| 3-Dec | 550 | 15:05 | 17:05 | 68.53% | 68.53% |
| 7-Dec | 550 | 18:35 | 19:00 | 30.66% | 30.66% |

**Table 10: On-Peak Retail Performance**

However, during the latter months of the Pilot period performance degraded. The reduction in performance in the later months of the Pilot is largely attributable to two factors:

- Aggressive Nominations: In the early stages of the Pilot Aggregators nominated conservatively to limit their risk. As the Pilot progressed and the Aggregators saw strong performance many times in significant excess of the nomination they increased their nominations to more accurately reflect their potential load shed. However this reduced their margin for underperformance and with a small number of customers in their aggregation unit incurred a significant impact to their performance metrics with even small issues.
- Decrease in Capability: During the later months of the Pilot with changes in weather and a reduction in base load at many clients, there was less overall load available to shed. Aggregators are unable to accurately forecast and handle this type of variability within a single month and the minimal margin for underperformance impacted the results.

#### 5.2.1.1.2 Off-Peak Event Performance Summary

Off-peak event performance fluctuated throughout the duration of the pilot with a performance of 100% for 4 out of 7 events. This is reflective of the high load variability of the single Directly-enrolled Customer providing capacity during events occurring in off-peak hours. As is detailed in section 4.4.2, a number of operational issues also reduced performance for specific events (such as absent staff or site shut down).

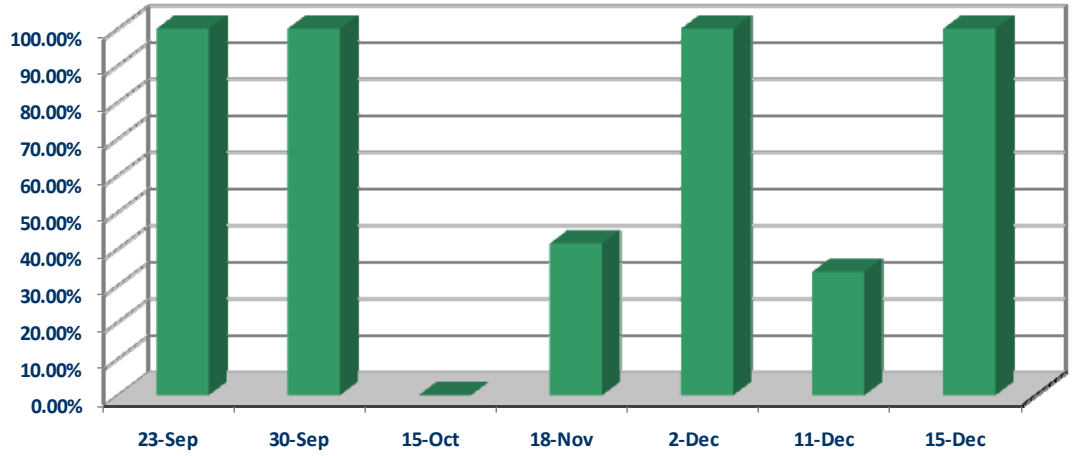


**Figure 21: Off-Peak Retail Performance (Tariff Adjusted)**

| Date | Curtailment Amount (kW) | Start Time | End Time | Performance | Adjusted Performance |
|---|---|---|---|---|---|
| 23-Sep | 1,200 | 23:45 | 1:45 | 197.42% | 100.00% |
| 30-Sep | 1,200 | 5:05 | 7:05 | 250.52% | 100.00% |
| 15-Oct | 1,200 | 5:05 | 7:05 | 0.00% | 0.00% |
| 18-Nov | 1,200 | 1:10 | 3:10 | 41.43% | 41.43% |
| 2-Dec | 1,200 | 4:10 | 6:10 | 111.90% | 100.00% |
| 11-Dec | 1,200 | 2:10 | 4:10 | 33.67% | 33.67% |
| 15-Dec | 1,200 | 2:40 | 4:40 | 170.13% | 100.00% |

**Table 11: Off-Peak Retail Performance**

### 5.2.1.2 Participant Event Performance Summary

Performance in the aggregate is important at the wholesale level in that the CAISO only "sees" a single resource bidding in and performing in the wholesale market. While there were further aggregations at the Participant level (i.e., both Aggregators had more than one customer), the retail settlement looks only at performance at the Participant level to calculate settlement. What is not observable in the aggregate – and therefore to the CAISO – is whether one or more Participants were responsible for failing to achieving the DOT in 10 minutes. Conversely it was not observable to the CAISO if the DOT was achieved because one or more Participants exceeded their curtailment.

One event in particular, September 18, illustrates the effect of over-performance by one Participant compensating for under-performance of another. The overall event performance at the retail level was 98% despite the fact that Aggregator 1 only achieved 30% performance in this instance. The fact that Aggregator 2 performed at 166%, while raising aggregated retail performance to nearly 100%, was only enough to raise the wholesale performance to 67%. Despite 67% being relatively poor wholesale performance, it demonstrates the value of the aggregation which would have been 30% or lower if Aggregator 1 bid into the CAISO market separately.

#### 5.2.1.2.1 Aggregator 1 Event Performance Summary

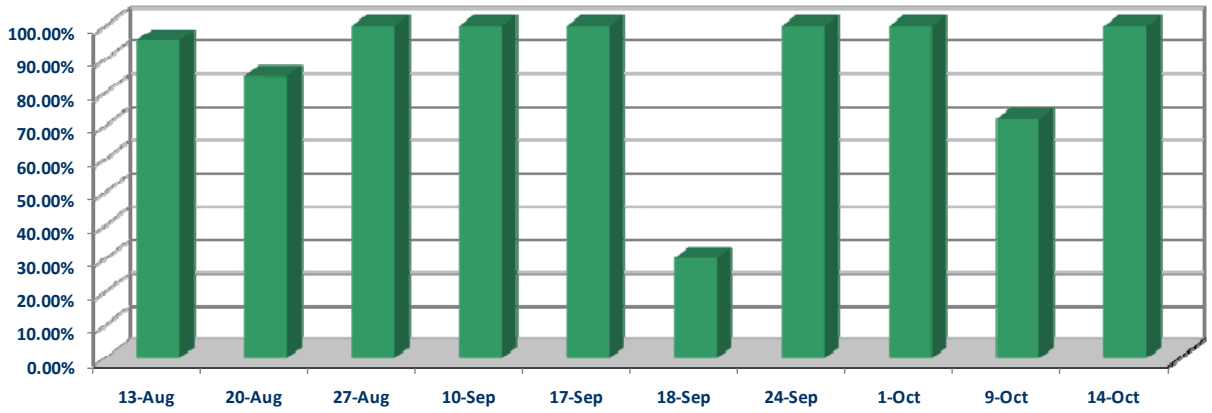


**Figure 22: Aggregator 1 Retail Performance (Tariff Adjusted)**

| Date | Curtailment Amount (kW) | Start Time | End Time | Performance | Adjusted Performance |
|---|---|---|---|---|---|
| 13-Aug | 170 | 14:10 | 16:10 | 95.64% | 95.64% |
| 20-Aug | 170 | 14:05 | 16:05 | 84.87% | 84.87% |
| 27-Aug | 170 | 14:05 | 16:05 | 100.03% | 100.00% |
| 10-Sep | 150 | 14:10 | 16:10 | 136.92% | 100.00% |
| 17-Sep | 150 | 14:05 | 16:05 | 130.54% | 100.00% |
| 18-Sep | 150 | 16:20 | 18:10 | 30.09% | 30.09% |
| 24-Sep | 150 | 14:05 | 16:05 | 145.16% | 100.00% |
| 1-Oct | 100 | 14:05 | 16:05 | 176.94% | 100.00% |
| 9-Oct | 100 | 11:35 | 13:35 | 72.00% | 72.00% |
| 14-Oct | 100 | 12:45 | 14:45 | 169.97% | 100.00% |

**Table 12: Aggregator 1 Retail Performance**

#### 5.2.1.2.2 Aggregator 2 Event Performance Summary

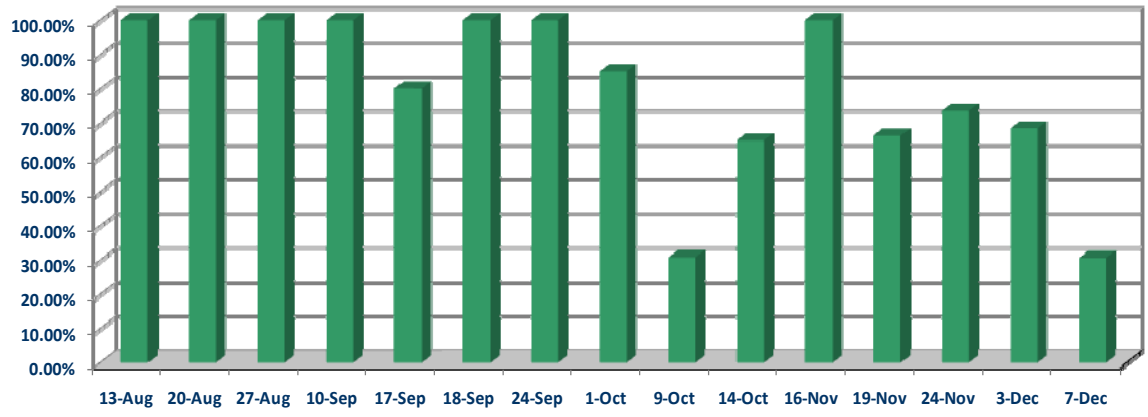


**Figure 23: Aggregator 2 Retail Performance (Tariff Adjusted)**

| Date | Curtailment Amount (kW) | Start Time | End Time | End Time | End Time |
|---|---|---|---|---|---|
| 13-Aug | 155 | 14:10 | 16:10 | 229.14% | 100.00% |
| 20-Aug | 155 | 14:05 | 16:05 | 105.25% | 100.00% |
| 27-Aug | 155 | 14:05 | 16:05 | 239.77% | 100.00% |
| 10-Sep | 450 | 14:10 | 16:10 | 136.60% | 100.00% |
| 17-Sep | 450 | 14:05 | 16:05 | 80.09% | 80.09% |
| 18-Sep | 450 | 16:20 | 18:10 | 166.77% | 100.00% |
| 24-Sep | 450 | 14:05 | 16:05 | 164.30% | 100.00% |
| 1-Oct | 700 | 14:05 | 16:05 | 84.97% | 84.97% |
| 9-Oct | 700 | 11:35 | 13:35 | 30.81% | 30.81% |
| 14-Oct | 700 | 12:45 | 14:45 | 64.96% | 64.96% |
| 16-Nov | 550 | 15:10 | 17:10 | 103.42% | 100.00% |
| 19-Nov | 550 | 12:20 | 14:20 | 66.34% | 66.34% |
| 24-Nov | 550 | 15:10 | 17:10 | 73.60% | 73.60% |
| 3-Dec | 550 | 15:05 | 17:05 | 68.53% | 68.53% |
| 7-Dec | 550 | 18:35 | 19:00 | 30.66% | 30.66% |

**Table 13: Aggregator 2 Retail Performance**

#### 5.2.1.2.3 Directly-enrolled Customer Event Performance Summary

Since the Directly-enrolled Customer was the only off-peak customer, its performance is shown in Figure 21 and Table 11 above.

### 5.2.2 Monthly Capacity Payment

The tables below provide the summary capacity payments to each Participant for each operational month of the Pilot. Total potential Pilot payout based on aggregated nominations totaled $147,083.00 while actual payouts based on performance were $62,315.74.

#### 5.2.2.1 Aggregator 1

Please note that Aggregator 1 did not nominate capacity in the months of November and December due to the nature of the end-use customers' businesses. As retail establishments, although interested in the payments associated with the Pilot, they were concerned about any loss of sales during this economic climate and elected not to nominate. As a result, Aggregator 1 did not receive Capacity Payments for those months and this fact is reflected in the total potential payout calculation.

| Month | Product | Nomination (kW) | Capacity Price ($/kW) | Total Potential Capacity Payment | Total Adjusted Capacity Payment |
|---|---|---|---|---|---|
| August | 11am-7pm | 170 | $20.10 | $3,417.00 | $3,194.94 |
| September | 11am-7pm | 150 | $20.10 | $3,015.00 | $2,488.04 |
| October | 11am-7pm | 100 | $20.10 | $2,010.00 | $1,822.40 |
| | | | Total | $8,442.00 | $7,505.38 |

**Table 14: Total Monthly Capacity Payments, Aggregator 1**

#### 5.2.2.2 Aggregator 2

| Month | Product | Nomination (kW) | Capacity Price ($/kW) | Total Potential Capacity Payment | Total Adjusted Capacity Payment |
|---|---|---|---|---|---|
| August | 11am-7pm | 155 | $20.10 | $3,115.50 | $3,115.50 |
| September | 11am-7pm | 450 | $20.10 | $9,045.00 | $8,594.77 |
| October | 11am-7pm | 700 | $20.10 | $14,070.00 | $8,476.84 |
| November | 11am-7pm | 550 | $20.10 | $11,055.00 | $8,841.86 |
| December | 11am-7pm | 550 | $20.10 | $11,055.00 | $2,741.28 |
| | | | **Total** | **$48,340.50** | **$31,770.24** |

**Table 15: Total Monthly Capacity Payments, Aggregator 2**

#### 5.2.2.3 Direct Enrolled Customer

| Month | Product | Nomination (kW) | Capacity Price ($/kW) | Total Potential Capacity Payment | Total Adjusted Capacity Payment |
|---|---|---|---|---|---|
| September | 24x7 | 1200 | $21.50 | $25,800.00 | $10,320.00 |
| October | 24x7 | 1200 | $21.50 | $25,800.00 | $0.00 |
| November | 24x7 | 1200 | $21.50 | $25,800.00 | $2,672.45 |
| December | 24x7 | 1200 | $10.75 | $12,900.00 | $10,047.67 |
| | | | **Total** | **$90,300.00** | **$23,040.12** |

**Table 16: Total Monthly Capacity Payments, Direct Enrolled Customer**

### 5.2.3 Post-event Bounce-back

An analysis of Participant behavior immediately following Pilot events uncovered evidence of "bounce-back", whereby Participant load was raised to atypical levels for periods ranging from 1 to 3 hours. This post-event recovery can be attributed to several factors, including:

- Additional energy consumed to bring building temperature back to normal levels once thermostats are restored to their original levels after being overridden during DR events (weather sensitive Participants, such as office, retail, hotel and entertainment).
- Additional energy consumed to meet production targets/quotas during a business day or shift (industrial customers).

Measuring the bounce-back effect is not straightforward, due to the lack of an exact methodology for determining a facility's load profile in the hours after an event, had the event not taken place. The tables below use the Adjusted PDR algorithm (average of last 10 similar days, adjusted by the ratio of the 3 hours ending an hour prior to the event) to approximate the Participants' expected load profiles. This algorithm was chosen, because it models expected load better than other algorithms used in California (see section 5.4).

For the purposes of estimating the post-event bounce-back energy and its relationship to energy curtailed during the event, the difference between baseline and metered energy was computed for the event period, as well as the two-hour period immediately after each event. For comparison purposes, the same calculation was performed for the two-hour period preceding each event. The last column in the data tables displays the ratio between bounce-back and curtailed energy.

Events during which Participants failed to meet their capacity commitment by a wide margin were excluded from this analysis and are omitted from the tables.

Considering that the Directly-enrolled Participant had no post-event recovery based on their operational profile, no bounce-back analysis was done for that customer.

| Participant | Date | 2 hours Before (kWh) | 2 hours During (kWh) | 2 hours After (kWh) | After/During Ratio |
|---|---|---|---|---|---|
| **Aggregator 1** | 8/13/2009 | -4.79 | 297.43 | 136.86 | 46.0% |
| **Aggregator 1** | 8/20/2009 | -8.84 | 298.55 | 1.75 | 0.6% |
| **Aggregator 1** | 8/27/2009 | 16.45 | 387.26 | 89.04 | 23.0% |
| **Aggregator 1** | 9/10/2009 | -30.54 | 327.96 | 10.41 | 3.2% |
| **Aggregator 1** | 9/17/2009 | 8.41 | 269.19 | -154.85 | -57.5% |
| **Aggregator 1** | 9/24/2009 | 7.35 | 416.24 | -24.90 | -6.0% |
| **Aggregator 1** | 10/1/2009 | -31.51 | 256.12 | -22.78 | -8.9% |
| **Aggregator 1** | 10/9/2009 | 14.48 | 267.18 | -103.62 | -38.8% |
| **Aggregator 1** | 10/14/2009 | 26.83 | 430.00 | -4.77 | -1.1% |

**Table 17: Aggregator 1 Bounce-Back Summary**

Even though the data for Aggregator 1 shows possible evidence of bounce-back on September 18 and October 9, other days do not exhibit such evidence, which points to the conclusion that for the most part, customers associated with Aggregator 1 did not require post-event catch-up consumption.

The data for Aggregator 2, on the other hand, shows ample evidence of bounce-back consumption on the majority of event days:

| Participant | Date | 2 hours Before (kWh) | 2 hours During (kWh) | 2 hours After (kWh) | After/During Ratio |
|---|---|---|---|---|---|
| **Aggregator 2** | 8/13/2009 | -102.71 | 499.74 | 300.39 | -60.1% |
| **Aggregator 2** | 8/20/2009 | 35.14 | 360.98 | -256.11 | -70.9% |
| **Aggregator 2** | 8/27/2009 | -67.52 | 509.87 | -449.77 | -88.2% |
| **Aggregator 2** | 9/10/2009 | 184.93 | 1,010.56 | -183.58 | -18.2% |
| **Aggregator 2** | 9/17/2009 | 137.48 | 948.96 | -722.78 | -76.2% |
| **Aggregator 2** | 9/18/2009 | -34.27 | 950.94 | -448.16 | -47.1% |
| **Aggregator 2** | 9/24/2009 | -183.56 | 1,090.77 | -345.19 | -31.6% |
| **Aggregator 2** | 10/1/2009 | -84.83 | 935.78 | -772.59 | -82.6% |
| **Aggregator 2** | 10/9/2009 | 169.82 | 825.28 | -994.44 | -120.5% |
| **Aggregator 2** | 10/14/2009 | 49.88 | 896.68 | -657.22 | -73.3% |
| **Aggregator 2** | 11/16/2009 | 124.23 | 925.74 | 159.32 | 17.2% |
| **Aggregator 2** | 11/19/2009 | 45.53 | 666.72 | -444.92 | -66.7% |
| **Aggregator 2** | 11/24/2009 | -60.46 | 346.33 | 79.58 | 23.0% |
| **Aggregator 2** | 12/3/2009 | 49.23 | 329.58 | -442.92 | -134.4% |

**Table 18: Aggregator 2 Bounce-Back Summary**

The September 18 event for Aggregator 2 illustrates a very clear bounce-back of the load in the hours after the event is over.

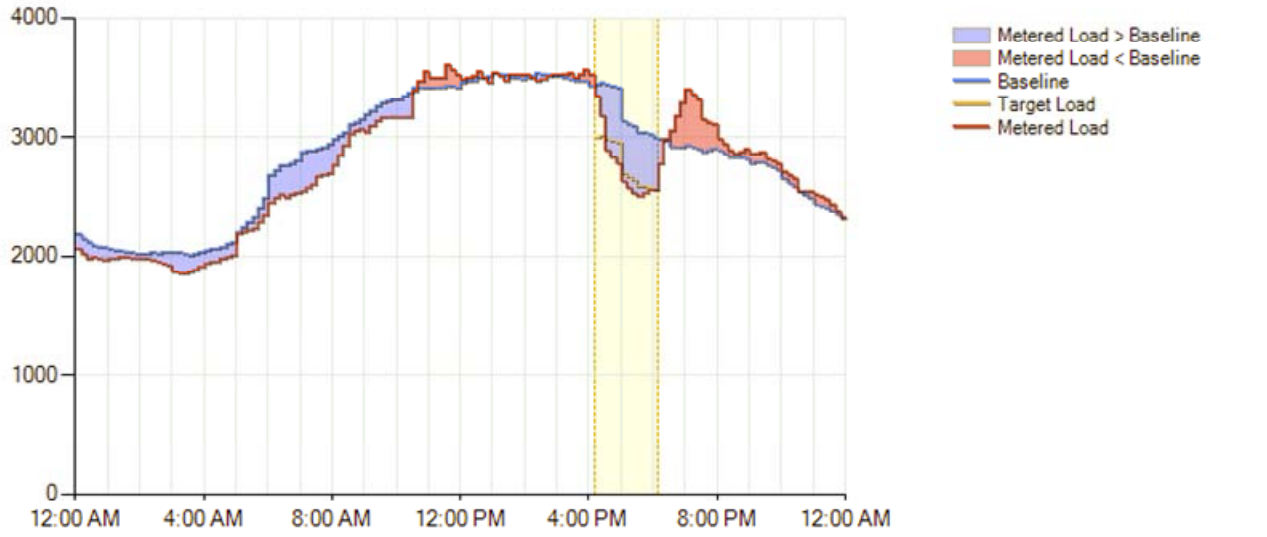


**Figure 24: Bounce-back for September 18th, Aggregator 2**

### 5.2.4 Did Weather Impact Performance?

Data for Aggregator 2 was analyzed to determine if weather and, in particular, temperature affected event performance, nominations, post-event load bounce-back and other aspects of the Pilot. Aggregator 1 was not used for this purpose because it ended nominations at the end of October and so did not contain large temperature variations, nor enough events to draw any conclusions. The Directly-enrolled Participant was also dismissed for the purposes of this study, because its metered load did not exhibit any correlation to historical temperature measurements.

The accounts represented by Aggregator 2 were in San Diego or neighboring coastal cities. In October, 6 additional accounts associated with a single hotel/entertainment customer were added to the mix, while in December an additional hotel/entertainment customer was also added. The latter two customers are in the inland valleys northeast of San Diego. The following table lists maximum temperatures for the two regions above on the 11-7 product event days:

| | Max. Temperature (°F) | |
|---|---|---|
| | San Diego | Temecula |
| 13-Aug-09 | 72 | |
| 20-Aug-09 | 74 | |
| 27-Aug-09 | 89 | |
| 10-Sep-09 | 80 | |
| 17-Sep-09 | 76 | |
| 18-Sep-09 | 76 | |
| 24-Sep-09 | 84 | |
| 1-Oct-09 | 81 | 92 |
| 9-Oct-09 | 70 | 80 |
| 14-Oct-09 | 75 | 75 |
| 16-Nov-09 | 72 | 73 |
| 19-Nov-09 | 68 | 74 |
| 24-Nov-09 | 75 | 74 |
| 3-Dec-09 | 64 | 64 |
| 7-Dec-09 | 60 | 53 |

**Table 19: Maximum Temperatures on Event Days**

The total monthly consumption for all accounts associated with Aggregator 2 during any part of the Pilot is shown below. The load pattern is consistent with increased consumption during the hot months of the year:

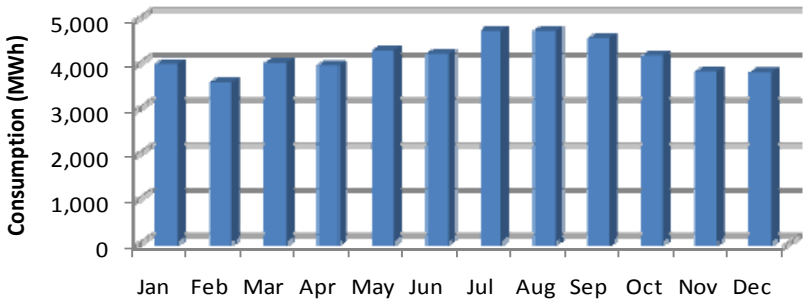


**Figure 25: Monthly consumption of accounts associated with Aggregator 2**

The consumption of individual accounts represented by Aggregator 2 was in some cases significantly temperature-dependent (e.g., one account had a variation of 60% between the hottest and coldest month), while in others did not appear to be affected by seasonal weather patterns at all. None of the aggregated accounts showed evidence of increased load in cold months, so only maximum temperatures and cooling degree days were taken into account in this study.

Figure 26 overlays load profiles for Aggregator 2, representing typical event days in each of the five months of the Pilot. Note that with some inconsequential exceptions, the event days omitted from the chart had similar load levels and other attributes to the included days from the same month. The event hours are clearly visible in each profile around mid-afternoon. At first it may appear strange that the hot August and September event days have the lowest daily consumption, but disaggregation of the load into its component accounts shows that the primary factor affecting load levels was the number and size of accounts included in the aggregated load in each month, rather than differences in temperature.

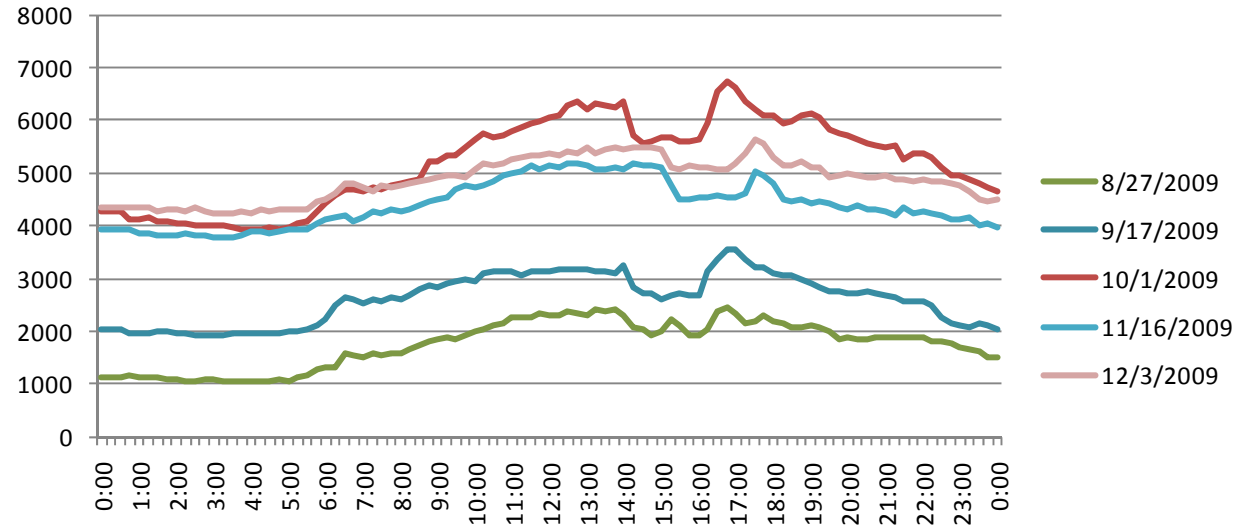


**Figure 26: Aggregator 2 load profiles on select event days**

Minor temperature-related seasonal variations can be observed between events in the same month (not depicted above), but they are minor and are restricted to the magnitude of the general load profile, rather than affecting the event performance factor, event load reduction, or bounce-back.

Further analysis of individual accounts included in the Aggregator 2 portfolio shows that a portion of them shed more load during events on hotter days. This seems to be an indication that the load reduction for these accounts was achieved by raising thermostat settings during event hours. Some of these accounts seem to be responsible for most of the observed post-event bounce-back load, but this was not always the case.

In general, the temperature-related patterns observed in a few individual accounts are not evident in the aggregated load. It is natural that the diversity of the aggregated accounts obscured such patterns to a great degree, but it is also likely that Aggregator 2 did a good job of setting the nominated load, monitoring telemetry data and controlling load in real time to mitigate the effects of seasonal temperature variations.

## 5.3 Wholesale Event Analysis

An event analysis from the wholesale market perspective was performed for each of the 14 events that were dispatched by the CAISO, as well as for the subsequent notifications sent to the Participants. The results are included in the appendix in section 8. There were several instances where the CAISO issued dispatches that were determined to be spurious or in error and no subsequent notification to curtail was issued to Participants. The wholesale market settlement results of all CAISO dispatches are included in the monthly statistics in this section. Overall the CAISO settlements accurately reflect the scheduling, bidding and dispatch activity of the Pilot in the wholesale market.

The data for wholesale analysis comes from the CAISO settlement statements. No special treatment was given to Pilot resources in the wholesale settlement process and performance and results were based on the same protocols as any Participating Load. One limitation of the wholesale settlement was the use of 15 minute interval meter data that was used to create the 5-minute SQMD required for Participating Load resources. As noted in section 4.5, 5-minute data was created by dividing 15-minute

kWh intervals by three which can obscure the actual load drop on which wholesale settlement calculations are based.

In the cases where the CAISO issued dispatches, whether they were tests via Exceptional Dispatch or Contingency Dispatch, the load drop was measurable and provided the basis for wholesale settlements. The Participating Load resource size was registered with the CAISO for a maximum bid of 3 MW, adequate for the CAISO minimum size requirement of 1 MW. The market software accommodates bid segments to two decimal places (i.e., X.XX MW) and settlement quantities are returned at that level as well. Note that all compliance with the CAISO used the SQMD from the utility meter and not the telemetry data which was only used during the certification test to confirm resource response within 10 minutes to meet the requirement for Non Spinning Reserves.

Figure 27 summarizes per-event CAISO dispatch compliance. Note that events after 10/14 are not included due to incomplete CAISO settlement information at the time this report was finalized.

### 5.3.1 Performance Summary

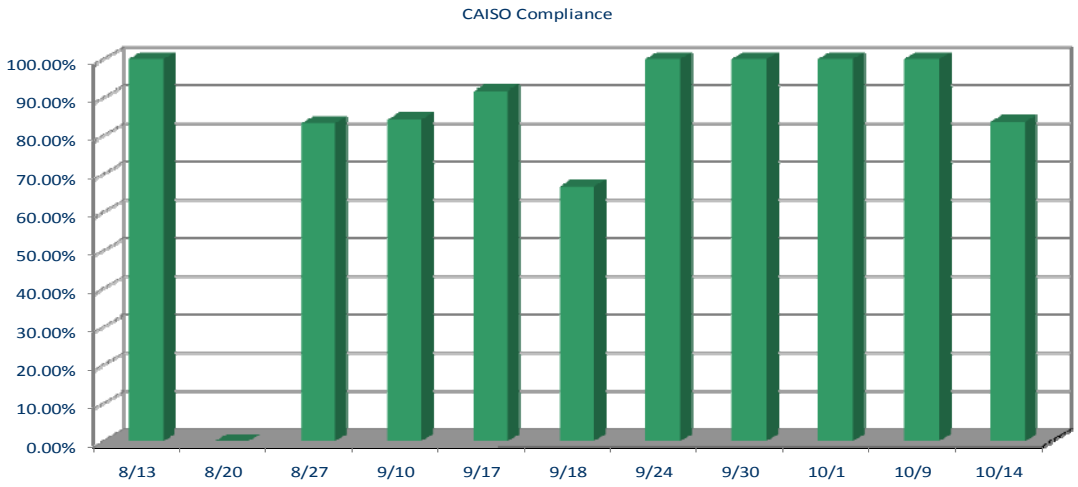


**Figure 27: CAISO Dispatch Compliance**

### 5.3.2 Delivered Capacity

The Pilot demonstrated that small aggregated resources were capable of providing Ancillary Services capacity to the CAISO market. While the quantities may not be significant in the context of the entire CAISO market, the fact that a small sample of Commercial and Industrial customers was able to bring contingency reserves to the market provides a basis for researching the scalability of the methods adopted for the Pilot.

| Month | August | September | October | November | December | Total |
|---|---|---|---|---|---|---|
| **Capacity Awarded Quantities (MW)** | 34.20 | 279.60 | 340.00 | 252.40 | 144.80 | 1051.00 |
| **No Pay Quantities (MW)** | 0.55 | 0.44 | 0.13 | 0.00 | TBD | 1.12 |
| **Delivered Quantities (MW)** | 33.65 | 279.16 | 339.87 | 252.40 | 144.80 | 1049.88 |

**Table 20: Wholesale Performance**

### 5.3.3 Event Performance

The aggregated monthly performance of the Demand Response resource during events can be measured at the wholesale level by determining what portion was deemed successfully delivered during events. To measure this, only the capacity quantities for the hours that the CAISO issued dispatches are considered and the no pay quantities (periods where the CAISO calculated non performance) include dispatches that were not forwarded to the Participants. The no pay quantities are unknown for December since recalculated settlement statements containing quantities and amounts will not be published by the CAISO until mid February 2010.

| Month | August | September | October | November | December |
|---|---|---|---|---|---|
| **Event Capacity Quantities (MW)** | 1.2 | 4.2 | 3.60 | 0.00 | 1.00 |
| **No Pay Quantities (MW)** | 0.55 | 0.44 | 0.13 | 0.00 | TBD |
| **Delivered Capacity** | 54% | 88% | 95% | N/A | N/A |

**Table 21: Dispatched Capacity**

### 5.3.4 Total Wholesale Revenue

Relatively small returns were garnered from wholesale market revenues. The capacity payments are the sum of the product of the hourly capacity awards and the hourly capacity price. During the Pilot period, the price for Non Spinning Reserves capacity hovered around $1 or less with a few hourly spikes into the $10 to $20 range. Little if any revenue was returned from energy dispatch (Instructed Energy) associated with dispatched capacity in part due to the short duration of CAISO dispatches, typically 10 minutes.

| Month | August | September | October | November | December | Total |
|---|---|---|---|---|---|---|
| **Capacity Payment** | $126.60 | $614.47 | $271.36 | $161.83 | $105.05 | **$1279.31** |
| **No Pay** | ($1.14) | ($1.96) | ($0.16) | $0.00 | $0.00 | **($3.26)** |
| **Instructed Energy** | $138.02 | $83.54 | $22.65 | 0.00 | $24.21 | **$268.42** |
| **Total** | **$263.48** | **$696.05** | **$293.85** | **$161.83** | **$129.26** | **$1544.47** |

**Table 22: CAISO Market Revenue**

## 5.4 Alternate Baselines

The Pilot used a meter-before/meter-after baseline. The specific implementation of this baseline selects the first metered interval ending at or before the time of dispatch from the CAISO. The following sections compare Pilot performance using alternate baselines including the new Proxy Demand Resource (PDR) 10 in 10 adjusted and non-adjusted algorithms as well as the 2009 CBP 3 in 10 algorithm.

The following tables show the event performance under the Pilot compared to the other baselines for each Participant. The alternate baselines perform well for the aggregated customers with the Adjusted PDR showing the highest level of performance; however, they are inappropriate for the industrial Directly-enrolled Participant. That customer is included here for completeness and to illustrate this point. In these tables, note:

- Baseline effectiveness is calculated by averaging the absolute value of the metered load divided by the baseline (i.e., ABS((*baseline/load*) - 1)) for each interval, excluding the event and the two hours after it (to remove the effect of bounce-back). The number represents how close the baseline matches the metered load.
- The meter before/meter after baseline is not included in the Baseline Effectiveness section, because this algorithm is only effective as a performance baseline during event hours and only for relatively short events.

| | | | Unadjusted Event Performance | | | | Baseline Effectiveness* | | |
|---|---|---|---|---|---|---|---|---|---|
| Participant | Product | Events | PLP | PDR | Adjusted PDR | CBP (3 in 10) | PDR | Adjusted PDR | CBP (3 in 10) |
| Aggregator 1 | 11am-7pm | 8/13/2009 | 95.6% | 104.1% | 87.5% | 131.7% | 8.6% | 5.3% | 8.7% |
| Aggregator 1 | 11am-7pm | 8/20/2009 | 84.9% | 85.2% | 82.7% | 107.3% | 7.5% | 7.4% | 6.6% |
| Aggregator 1 | 11am-7pm | 8/27/2009 | 100.0% | 37.7% | 106.3% | 71.5% | 9.4% | 13.2% | 5.7% |
| Aggregator 1 | 11am-7pm | 9/10/2009 | 136.9% | 125.3% | 109.3% | 160.6% | 5.0% | 3.8% | 7.0% |
| Aggregator 1 | 11am-7pm | 9/17/2009 | 130.5% | 122.8% | 88.2% | 151.9% | 5.9% | 5.3% | 10.1% |
| Aggregator 1 | 11am-7pm | 9/18/2009 | 30.1% | -19.5% | 4.0% | 16.2% | 3.8% | 4.5% | 5.2% |
| Aggregator 1 | 11am-7pm | 9/24/2009 | 145.2% | 102.9% | 135.6% | 135.2% | 11.0% | 10.2% | 10.0% |
| Aggregator 1 | 11am-7pm | 10/1/2009 | 176.9% | 169.1% | 122.0% | 256.1% | 12.1% | 9.1% | 14.6% |
| Aggregator 1 | 11am-7pm | 10/9/2009 | 72.0% | 219.3% | 125.7% | 317.2% | 21.6% | 16.2% | 34.2% |
| Aggregator 1 | 11am-7pm | 10/14/2009 | 170.0% | 157.8% | 209.6% | 219.7% | 6.2% | 5.7% | 5.4% |
| | | | **114.2%** | **110.5%** | **107.1%** | **156.7%** | **9.1%** | **8.1%** | **10.8%** |

**Table 23 Alternate Baseline Performance for Aggregator 1**

| | | | Unadjusted Event Performance | | | | Baseline Effectiveness* | | |
|---|---|---|---|---|---|---|---|---|---|
| Participant | Product | Events | PLP | PDR | Adjusted PDR | CBP (3 in 10) | PDR | Adjusted PDR | CBP (3 in 10) |
| Aggregator 2 | 11am-7pm | 8/13/2009 | 229.1% | 118.7% | 161.2% | 189.2% | 6.6% | 6.8% | 6.7% |
| Aggregator 2 | 11am-7pm | 8/20/2009 | 105.3% | 181.1% | 112.0% | 289.8% | 4.0% | 3.4% | 8.9% |
| Aggregator 2 | 11am-7pm | 8/27/2009 | 239.8% | 77.7% | 162.6% | 131.8% | 10.3% | 11.3% | 10.4% |
| Aggregator 2 | 11am-7pm | 9/10/2009 | 136.6% | 137.8% | 112.3% | 196.5% | 6.2% | 4.8% | 9.7% |
| Aggregator 2 | 11am-7pm | 9/17/2009 | 80.1% | 188.1% | 104.1% | 232.7% | 10.5% | 3.0% | 20.8% |
| Aggregator 2 | 11am-7pm | 9/18/2009 | 166.8% | 118.1% | 101.2% | 166.5% | 5.0% | 3.9% | 14.2% |
| Aggregator 2 | 11am-7pm | 9/24/2009 | 163.3% | 134.6% | 118.0% | 176.5% | 7.3% | 6.7% | 9.6% |
| Aggregator 2 | 11am-7pm | 10/1/2009 | 85.0% | 103.1% | 66.6% | 159.2% | 4.3% | 2.5% | 6.3% |
| Aggregator 2 | 11am-7pm | 10/9/2009 | 30.8% | 74.1% | 59.9% | 153.7% | 3.8% | 4.1% | 4.4% |
| Aggregator 2 | 11am-7pm | 10/14/2009 | 65.0% | 69.6% | 64.0% | 122.0% | 1.0% | 1.1% | 4.3% |
| Aggregator 2 | 11am-7pm | 11/16/2009 | 103.4% | 102.0% | 84.2% | 132.2% | 2.8% | 1.8% | 3.9% |
| Aggregator 2 | 11am-7pm | 11/19/2009 | 66.3% | 100.7% | 60.6% | 136.4% | 3.2% | 1.6% | 4.6% |
| Aggregator 2 | 11am-7pm | 11/24/2009 | 73.6% | 65.0% | 31.5% | 108.1% | 4.3% | 1.6% | 7.8% |
| Aggregator 2 | 11am-7pm | 12/3/2009 | 68.5% | 48.6% | 32.7% | 79.5% | 1.1% | 1.3% | 1.8% |
| Aggregator 2 | 11am-7pm | 12/7/2009 | 30.7% | 77.1% | 27.7% | 79.7% | 3.6% | 3.1% | 4.6% |
| | | | **109.6%** | **106.4%** | **86.6%** | **156.9%** | **4.9%** | **3.8%** | **7.9%** |

**Table 24: Alternate Baseline Performance for Aggregator 2**

| | | | Unadjusted Event Performance | | | | Baseline Effectiveness* | | |
|---|---|---|---|---|---|---|---|---|---|
| Participant | Product | Events | PLP | PDR | Adjusted PDR | CBP (3 in 10) | PDR | Adjusted PDR | CBP (3 in 10) |
| Customer | 24/7 | 9/10/2009 | 0.3% | 0.4% | -0.1% | 1.1% | 49.0% | 45.6% | 35.5% |
| Customer | 24/7 | 9/17/2009 | 1.1% | 0.1% | -0.1% | 0.2% | 731.4% | 677.7% | 728.5% |
| Customer | 24/7 | 9/18/2009 | 0.0% | 0.2% | 0.1% | 0.4% | 1052.6% | 999.6% | 1026.0% |
| Customer | 24/7 | 9/23/2009 | 197.4% | 136.9% | 165.9% | 107.4% | 82.1% | 97.3% | 49.6% |
| Customer | 24/7 | 9/30/2009 | 250.6% | 38.0% | 44.2% | 38.4% | 88.5% | 97.9% | 19.0% |
| Customer | 24/7 | 10/1/2009 | 0.7% | -0.5% | -0.2% | -0.1% | 52.3% | 53.7% | 24.7% |
| Customer | 24/7 | 10/9/2009 | -0.3% | -0.3% | -0.1% | 0.2% | 1017.8% | 1064.8% | 1105.3% |
| Customer | 24/7 | 10/14/2009 | -0.3% | -1.1% | -0.6% | -0.7% | 244.5% | 272.5% | 112.2% |
| Customer | 24/7 | 10/15/2009 | 0.8% | 37.0% | 45.0% | 26.0% | 389.8% | 464.1% | 308.8% |
| Customer | 24/7 | 11/16/2009 | 2.9% | -0.4% | -0.6% | -0.1% | 1726.5% | 1516.5% | 2068.9% |
| Customer | 24/7 | 11/18/2009 | 41.4% | -5.6% | 14.6% | 24.8% | 16.6% | 19.3% | 18.4% |
| Customer | 24/7 | 11/19/2009 | -0.3% | 0.3% | 0.5% | 0.8% | 257.9% | 275.6% | 273.7% |
| Customer | 24/7 | 11/24/2009 | 0.2% | 0.1% | 0.0% | 0.3% | 160.0% | 152.9% | 158.0% |
| Customer | 24/7 | 12/2/2009 | 111.9% | 69.1% | 83.7% | 100.7% | 69.5% | 88.7% | 22.7% |
| Customer | 24/7 | 12/11/2009 | 33.7% | 94.0% | 73.8% | 165.1% | 277.7% | 231.7% | 311.0% |
| Customer | 24/7 | 12/15/2009 | 170.1% | 104.4% | 126.3% | 156.3% | 85.2% | 107.4% | 72.5% |
| | | | **50.6%** | **29.5%** | **34.5%** | **38.8%** | **393.8%** | **385.3%** | **395.9%** |

**Table 25 Alternate Baseline Performance for Directly-enrolled Customer**

The following sections illustrate baseline performance for several specific events.

### 5.4.1 August 13, Aggregator 1, Adjusted PDR

During this event, the adjusted PDR baseline tracks well against actual usage. Note that Load did not return to pre-event levels until an hour after the end of the event due to a communications failure between the aggregator and its customers.

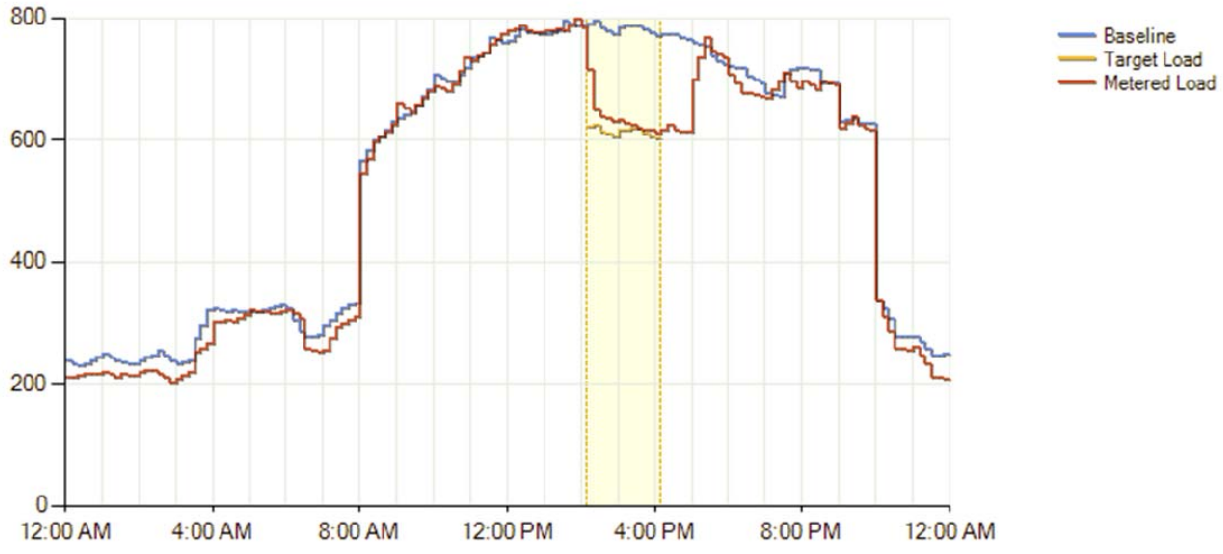


**Figure 28: Adjusted PDR Comparison for Aggregator 1, August 13th**

| | 14:20 | 14:30 | 14:40 | 14:50 | 15:00 | 15:10 | 15:20 | 15:30 | 15:40 | 15:50 | 16:00 | 16:10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Metered Load** | 717 | 649 | 639 | 635 | 631 | 634 | 629 | 624 | 620 | 618 | 617 | 611 |
| **Baseline** | 791 | 796 | 785 | 780 | 775 | 786 | 787 | 789 | 789 | 782 | 776 | 772 |
| **Nomination** | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 |
| **Target Load** | 621 | 626 | 615 | 610 | 605 | 616 | 617 | 619 | 619 | 612 | 606 | 602 |
| **Actual Reduction** | 74 | 147 | 146 | 145 | 144 | 152 | 158 | 165 | 169 | 164 | 159 | 161 |
| **Percent Reduction** | 44% | 86% | 86% | 85% | 85% | 89% | 93% | 97% | 99% | 97% | 94% | 95% |
| **Average Reduction** | | | | | | 87% | | | | | | |

**Table 26: Metered Performance for Aggregator 1, August 13th**

### 5.4.2 September 17, Aggregator 2, Various Baselines

This example compares the various baselines for Aggregator 2. The load on this particular day is significantly lower than in the previous days, making the unadjusted "average" baselines ineffective, as a measure of performance. For example, unadjusted performance with the CBP baseline would have been 232% instead of 80%. In fact, the difference between the CBP baseline and the Participant's actual load immediately prior to the event is 690 kW, which would have translated to a 159% performance factor, even without the participating resources actually curtailing their usage.

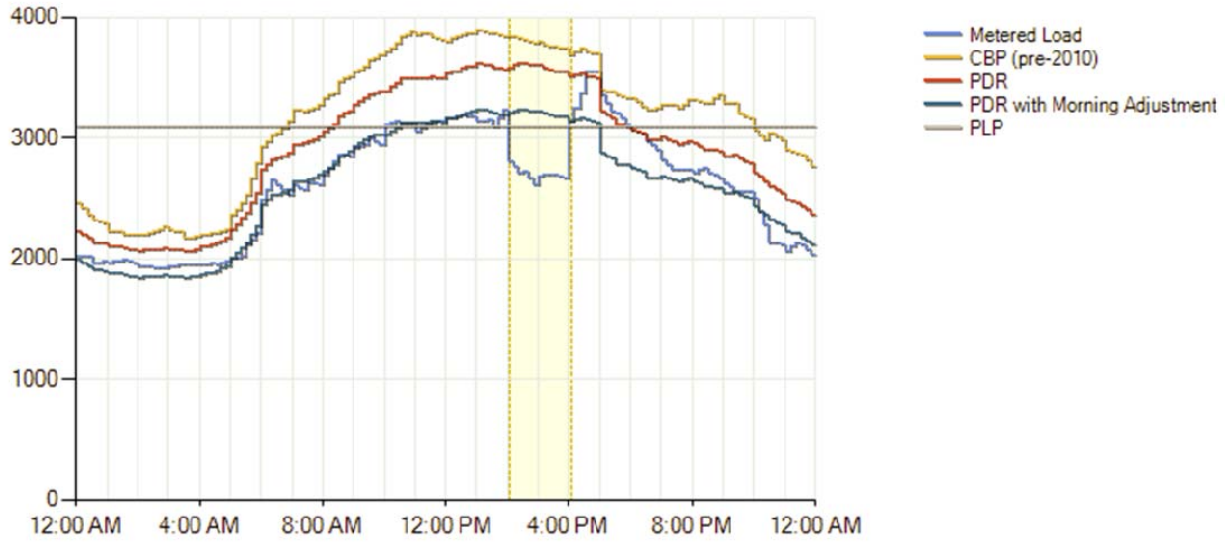


**Figure 29: Adjusted PDR Comparison for Aggregator 2, September 17th**

| | 14:10 | 14:20 | 14:30 | 14:40 | 14:50 | 15:00 | 15:10 | 15:20 | 15:30 | 15:40 | 15:50 | 16:00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metered Load | 2,816 | 2,763 | 2,709 | 2,727 | 2,673 | 2,620 | 2,691 | 2,696 | 2,702 | 2,696 | 2,684 | 2,671 |
| Baseline | 3,098 | 3,098 | 3,098 | 3,098 | 3,098 | 3,098 | 3,098 | 3,098 | 3,098 | 3,098 | 3,098 | 3,098 |
| Nomination | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 |
| Target Load | 2,648 | 2,648 | 2,648 | 2,648 | 2,648 | 2,648 | 2,648 | 2,648 | 2,648 | 2,648 | 2,648 | 2,648 |
| Actual Reduction | 281 | 335 | 389 | 371 | 424 | 478 | 407 | 402 | 396 | 402 | 414 | 427 |
| % Reduction | 63% | 74% | 86% | 82% | 94% | 106% | 90% | 89% | 88% | 89% | 92% | 95% |
| Average Reduction | | | | | | 87% | | | | | | |

**Table 27: Metered Performance for Aggregator 2, September 17th**

### 5.4.3 October 9, Aggregator 1, Various Baselines

This example compares the various baselines. It clearly shows discrepancies among the different baseline algorithms of as much as 50%. This appears to be caused by the fact that usage was significantly lower on this day than on the previous few days. The Adjusted PDR baseline works relatively well – as does the default baseline – due to the adjustment factor. Other baselines are significantly off.

Another interesting aspect of this event is that it occurs earlier in the day, at a time when load usually rises. The "averaged" baselines account for this, while the default PLP baseline does not, causing under-performance at the tail end of the event. Performance with the PDR with Morning Adjustment baseline would have been greater than 100%.

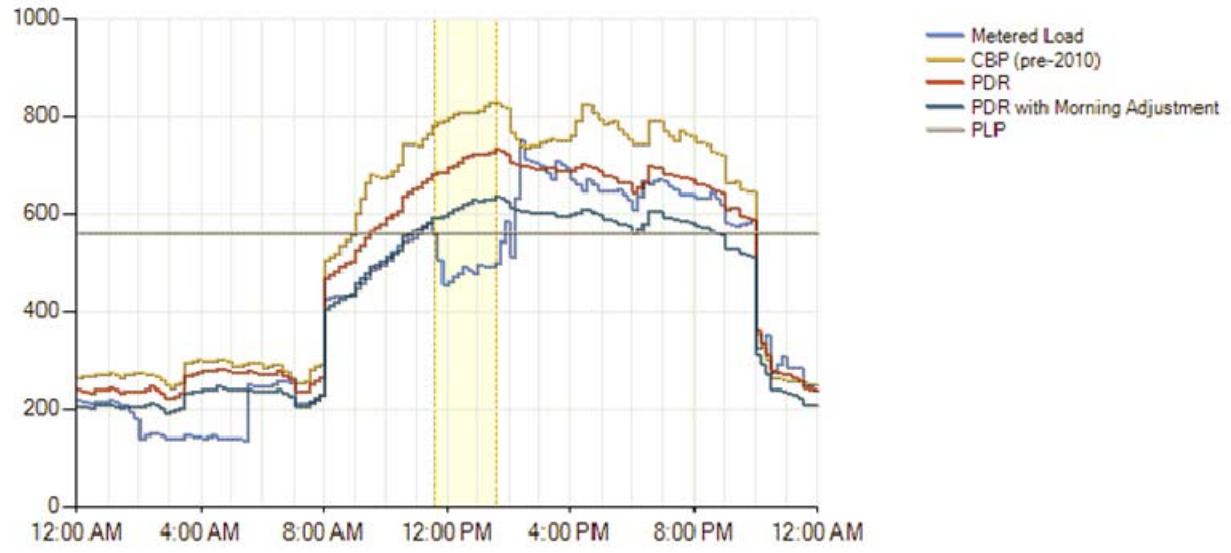


**Figure 30: Adjusted PDR Comparison for Aggregator 1, October 9th**

| | 11:40 | 11:50 | 12:00 | 12:10 | 12:20 | 12:30 | 12:40 | 12:50 | 13:00 | 13:10 | 13:20 | 13:30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Metered Load** | 561 | 507 | 453 | 462 | 471 | 480 | 494 | 486 | 477 | 494 | 493 | 492 |
| **Baseline** | 562 | 562 | 562 | 562 | 562 | 562 | 562 | 562 | 562 | 562 | 562 | 562 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Nomination** | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| **Target Load** | 462 | 462 | 462 | 462 | 462 | 462 | 462 | 462 | 462 | 462 | 462 | 462 |
| **Actual Reduction** | 1 | 55 | 109 | 100 | 91 | 82 | 68 | 76 | 84 | 68 | 69 | 70 |
| **Percent Reduction** | 1% | 55% | 109% | 100% | 91% | 82% | 68% | 76% | 84% | 68% | 69% | 70% |
| **Average Reduction** | 72% | | | | | | | | | | | |

**Table 28: Metered Performance for Aggregator 1, October 9th**

## 5.5 Alternate Products

The following sections cover what retail performance would have been for shorter events, and compares behavior between the first and second hours. The results are compared in the tables in section 5.5.3

### 5.5.1 1 Hour and 30-Minute Events

The rationale for performing this analysis is based on the expectation that Participants might be more willing to enroll in DR programs with lower participation requirements. Specifically, the recent change of relevant WECC standards reduces the CAISO duration requirement for Non-Spinning Capacity Reserves to 1 hour. This requirement formed the basis of the retail events duration.

The methodology for performing these comparisons takes the intervals related to the first portion of the event. That is, the 1 Hour events are based on the first half of metered intervals while the 30-minute events are based on the first quarter of intervals. Alternate methods of comparison were considered including using the ending interval of the actual event. While this other methodology might better model end of event ramp-down, it would require further computations to properly adjust the ending intervals to an earlier point in time.

Table 29 shows the comparison between Pilot performance and these alternate products for the three Participants with details in section 5.5.3. Note that events with performance below 50% are treated as outliers in this analysis and are therefore excluded.

| | Aggregator 1 | Aggregator 2 | Directly-enrolled Customer |
|---|---|---|---|
| **1 Hour** | -3% | 0% | -2% |
| **30 Minute** | -11% | -3% | -5% |

**Table 29: Relative Performance for Shorter Products**

Overall the difference between the Pilot events compared to the shorter products is not significant.

### 5.5.2 Does Behavior Differ in the Second Hour?

The methodology compares the performance of the first hour to the second using the Pilot baseline. These results are complementary to the alternate performance for the 1 hour events (i.e., the difference in performance of the one-hour event is inversely reflected in the second hour).

Table 30 shows the comparison between Pilot performance and these alternate products for the three Participants with details in section 5.5.3. Note that events with performance below 50% are treated as outliers in this analysis and are therefore excluded.

| | Aggregator 1 | Aggregator 2 | Directly-enrolled Customer |
|---|---|---|---|
| **2nd Hour** | 3% | 0% | 2% |

**Table 30: Relative Performance for Second Hour**

Overall the difference between the first and second hours of Pilot events is not significant.

### 5.5.3 Details

| | 13-Aug | 20-Aug | 27-Aug | 10-Sep | 17-Sep | 18-Sep | 24-Sep | 1-Oct | 9-Oct | 14-Oct |
|---|---|---|---|---|---|---|---|---|---|---|
| **Pilot** | 96% | 85% | 100% | 137% | 131% | 30% | 145% | 177% | 72% | 170% |
| **1 Hour** | 86% | 77% | 85% | 119% | 135% | 17% | 149% | 189% | 72% | 182% |
| **30 Minute** | 76% | 65% | 64% | 105% | 138% | 11% | 147% | 178% | 66% | 179% |
| **2nd Hour** | 105% | 94% | 117% | 155% | 126% | 43% | 141% | 167% | 71% | 159% |

**Table 31: Alternate Unadjusted Product Performance, Aggregator 1**

| | 13-Aug | 20-Aug | 27-Aug | 10-Sep | 17-Sep | 18-Sep | 24-Sep | 1-Oct | 9-Oct | 14-Oct | 16-Nov | 19-Nov | 24-Nov | 3-Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pilot** | 229% | 105% | 240% | 137% | 80% | 167% | 163% | 85% | 31% | 65% | 103% | 66% | 74% | 69% |
| **1 Hour** | 275% | 79% | 231% | 126% | 85% | 134% | 161% | 87% | 56% | 79% | 106% | 74% | 68% | 72% |
| **30 Minute** | 220% | 51% | 237% | 145% | 76% | 96% | 154% | 88% | 59% | 87% | 105% | 83% | 68% | 71% |
| **2nd Hour** | 184% | 136% | 231% | 147% | 76% | 204% | 165% | 83% | 7% | 50% | 101% | 59% | 80% | 66% |

**Table 32: Alternate Unadjusted Product Performance, Aggregator 2**

| | 23-Sep | 30-Sep | 15-Oct | 18-Nov | 2-Dec | 11-Dec | 15-Dec |
|---|---|---|---|---|---|---|---|
| **Pilot** | 192% | 251% | 1% | 41% | 112% | 34% | 170% |
| **1 Hour** | 184% | 250% | 1% | 113% | 110% | 31% | 169% |
| **30 Minute** | 169% | 249% | 1% | 145% | 107% | 25% | 165% |
| **2nd Hour** | 203% | 251% | 1% | -30% | 114% | 36% | 172% |

**Table 33: Alternate Unadjusted Product Performance, Direct Enrolled Customer**

# 6 Pilot Costs

## 6.1 Implementation

| 2009 | TOTAL | | |
|---|---|---|---|
| | Budget | Actual | Forecasted |
| Labor | 223,435 | 211,773 | 211,773 |
| Devices and Install | 68,000 | 62,000 | 88,410 |
| Systems and Technology | 2,538,565 | 612,000 | 1,078,410 |
| Incentive Payments | 215,000 | 69,311 | 209,599 |
| Other | 708,000 | 500,000 | 625,000 |
| Project Management | | *350,000* | |
| M&V/Final Report | | *150,000* | |
| | | | |
| | | | |
| | | | |
| Total | 3,753,000 | 1,455,084 | 2,213,192 |

## 6.2 Cost Analysis

The short duration of the first phase of the Pilot as well as the limited time between the end of the first phase and submitting this report make it difficult to do a complete or accurate cost-effectiveness evaluation. Further, certain aspects of the Pilot, such as the relatively high capacity payment used as an incentive to attract participants, need to be considered for modification before drawing accurate conclusions regarding cost effectiveness.

SDG&E will continue to analyze program costs with two key objectives in mind:

1) Which aspects can be modified to support cost effectiveness and scalability.

2) Which aspects contribute to the goal of integrating demand response into the wholesale market.

One of the key objectives of the Pilot was to determine the requirements in systems and processes that will be required for a full integration the required specifics of which were largely unknown at the Pilot's inception. Consistent with the very nature of a Pilot, SDG&E elected to use external parties to minimize the impact on the organization with the primary goal being the learning afforded SDG&E from the Pilot.

In addition to supporting the development and implementation of the Pilot, APX was able to provide infrastructure to support the Pilot. This enabled SDG&E to implement the Pilot quickly and focus on specific issues related to the aggregation of commercial and industrial customers. This also allowed SDG&E to avoid investing in unnecessary infrastructure and review the needs and requirements thoroughly before doing so. Similarly, given the small number of Participants many processes were developed and maintained manually throughout the Pilot period being refined prior to automation efforts.

As a result, the Pilot was able to be delivered at substantially less cost than had originally been anticipated and to provide insights into what would be needed to deal with a larger number of Participants.

Deviations:

- The budgeted incentives for the Pilot assumed a fully subscribed pilot of 3 MW from June through December 2009. However the Pilots delay in start and total megawatts enrolled (nominations did not exceed 1.9 MW) resulted in lower incentive payments than had initially been planned.
- Although there was only a small deviation in the Devices and Installation category due to the specific customers needs upon enrollment, a related item to note is that there was a heavy reliance on TI/TA funds with $207,200 being spent from that budget associated with participation in the PLP.
- The deviation in the Other category was most significantly due to two factors:
    - By using APX for both management and infrastructure already supporting necessary communications with the CAISO for telemetry a significant amount of costs originally anticipated were avoided for this Pilot period.
    - The budget had included an estimate for efforts required to incorporate Direct Access customers into the Pilot. During 2009 all end use customers with bundled.
- The most significant deviation is in the Systems and Technology section. This deviation is a direct result of the decision to use APX infrastructure and limit automation for the Pilot, focusing on the broader objectives around aggregation and postponing the development of much system integration until the requirements were more fully defined.

Ongoing costs for the Pilot as it currently stands are estimated to be approximately $750,000 per year. However the majority of these costs are not highly variable and enrollment in the Pilot, 'as is', could be expanded without more investment. The expansion however is limited by the manual effort involved in some of the data transfer processes and would the Pilot would be unable to take on more than 5-7 Participants (approx 5 MW).

# 7 Conclusions

The Pilot was successful in demonstrating that an aggregated resource composed of disparate small Commercial and Industrial customers can participate as a Non Spinning Reserve resource in the CAISO wholesale market. In particular, the aggregated resource was able to respond to CAISO dispatches within 10 minutes with a performance factor of 88%.

The lessons learned from the Pilot ranged from minor modifications to improve processes to significant learnings regarding future design and system integration requirements. The main technology infrastructure used, including communications, proved to be a solid decision with merit, enabling the Pilot and facilitating further integration efforts. It is envisioned that the Pilot technology would continue to be used and enhanced going forward. Some automation and integration activities originally envisioned for the Pilot have not yet been implemented. The processes were able to be developed and refined relatively manually given the small number of customers so that requirements could be more fully defined. Moving forward it would be SDG&E's expectation to implement those features.

A list of potential enhancements based on lessons learned follows. Each of these items is summarized in section 7.2.

- Replacement 24x7 Product
- Hourly Bidding
- PDR and RDRP
- 5-Minute Metering
- CAISO Network Model
- Market Bidding
- Establish Clear Telemetry Guidelines
- Standardized Telemetry Solutions
- Telemetry Modeling Pseudo-Generation
- Live Distribution Loss Factors
- Evaluate Baseline Efficacy
- Automate Retail Settlement
- Include Direct Access Customers
- Better Support for Dual Participation

Note that the load impact of the Pilot was de minimis and the PLP will be included in the Load Impact Study in the spring.

## 7.1 Feasibility of Retail PL Resources in the CAISO Markets

Performance in the CAISO market during the Pilot demonstrates that there are no technical reasons that an aggregated DR resource could not be considered on par with a combustion turbine.

However, there remain some questions about financial viability. Transitioning Participants from utility-based programs to market-based programs presents challenges given the expected reduction in

payments received by Participants. Current DR programs – as well as the Pilot – include incentives that are not expected to be achieved through wholesale markets. This disparity was illustrated during the Pilot, where the retail settlement outlays dwarfed the wholesale revenues earned by the PL resource in the CAISO Non Spinning Reserve market. While the addition of Capacity Payments for Non Spinning Reserves hold some promise of a reasonably predictable and sustainable revenue stream, a more substantial revenue source is necessary to make the PL resource financially viable in the wholesale market. The logical source would be the addition of the revenue that comes with a Resource Adequacy contract. This model would be more closely aligned with the development of a combustion turbine which is not economically viable solely based on potential revenues in the CAISO market, but has greater value due to its contribution to RA and so requires an RA contract to make it viable.

Until such time that DR capabilities qualify to be fully counted and compensated as Resource Adequacy resources will this economic gap between Utility programs and the wholesale market be closed.

## 7.2 Possible Next Steps

SDG&E is requesting to continue and expand the Pilot over the remaining budget cycle. The learning from the Pilot has been invaluable in identifying issues and possible solutions for further integration with the CAISO. Continuing the effort working with larger aggregations, additional Participants and Direct Access customers will increase the value significantly and provide a mechanism for standardization of telemetry solutions to improve cost-effectiveness and Pilot scalability. Additionally, the inclusion of PDR offers an opportunity to match customer segments and with appropriate products.

Possible next steps are divided into two sections. The first section describes substantive enhancements for a future Phase. The second section enumerates simple improvements over the first Phase, essentially those parts of the Pilot that could benefit from automation or could for which operational improvements can be made.

### 7.2.1 Potential Enhancements for Phase II

While there are a number of changes to be considered to improve processes and operations to be incorporated into a Phase II, the goal of the extension of the Pilot is to inform and support the transition of retail DR products for integration into the CAISO market.

The experiences and observations from the first year of Pilot operation inform improvements that could be implemented in future years. It is not feasible that all candidate improvements could be designed and implemented prior to the summer of 2010 and priorities need to be established. No rankings or priorities have yet been established. Key candidates for improvements in Phase II and beyond are enumerated in the following sections.

#### 7.2.1.1 Recruitment

The focused recruitment of customers is critical for future incarnations of the Pilot. By the very nature of the Pilot, recruitment for participation requires targeting at two levels to reach Aggregator Participants as well as end-use customers. Such recruitment efforts require significant coordination and would be assisted by outreach efforts that incorporate customer education, regardless of whether they might enroll through an aggregator or directly with SDG&E. Inclusion of Direct Access customers would also require additional coordination during the recruitment process. This effort requires a significant amount of lead time to be successful.

With the requirement for telemetry for PL and the need for automation throughout the process, there is a greater lead time required to recruit customers than for traditional DR programs. This is even more so when AutoDR is to be employed.

For the 2009 Pilot period there were no impacts due to meter installations or completion of the TI/TA process; however, this may be misleading because Participants were included based on their ability to qualify in time for the Pilot. Both Aggregators have identified that these processes have the potential to create delays making it imperative that plans for future Pilot activities be defined as early as possible.

The biggest objection raised during this Pilot period was concern about the unknown, essentially that some requirements were not yet finalized and that the term of the Pilot was in question. This former issue is now more easily addressed with many implementation issues associated with the Pilot now much clearer. However the need the have a fully approved Pilot with incentives, requirements and Pilot lifetime clearly identified remains for future recruitment efforts, to support return on investment analysis, associated with participation.

The participating customers expressed a high level of satisfaction with the Pilot, especially given the short implementation and operational period; however a number of items were identified to support an ongoing or increased level of customer satisfaction for the future and to support a larger effort. Specific improvements are noted in section 7.2.2. All of these items are also expected to contribute to providing customers with clarifications limiting the 'unknown' factor.

A focused recruitment effort to identify customer segments that can readily meet the requirements associated with participation in the Pilot (whether it be PDR or PL) on a larger basis would include increased customer segment analyses, increased training, additional customer education and outreach including marketing support materials. SDG&E would intend to continue to work through third-party Aggregators (or Demand Response Providers) and provide education and support materials to third-party Demand Response Providers as well as internal Account Management with a detailed marketing plan currently being developed. The more accurately the customer's capabilities are aligned with the needs of the Pilot the greater chance of success and the higher level of customer satisfaction anticipated.

#### 7.2.1.2 Replacement 24x7 Product

The 24x7 product was included in the Pilot to provide an opportunity for potential Participants that did not meet the criteria for the more typical 11-7 product and recognized that the CAISO procures reserves on all hours and all days. Certainly, the 11-7 product has particular value in that it provides capacity when the need is typically highest. While the 24x7 product better reflects the CAISO procurement practices, the nature of its broad stroke coverage has little bearing on the capabilities of potential customers since few if any have the same quantity of dispatchable demand available each hour of the day.

A replacement to the 24x7 product could narrow this gap between the CAISO procurement needs and the operational characteristics of potential participants. This might be enabled through a more flexible nomination profile or hourly bidding.

#### 7.2.1.3 Hourly Bidding

While per-hour nominations would be useful for a 24x7 product, providing an ability for PL customer bidding to be more dynamic for all products would provide an environment more representative of the

wholesale market. Incorporating this capability into the Pilot could significantly assist the transition, providing valuable insights into client capabilities as well as defining anticipated changes in scheduling behavior and systems changes required to support a full integration to MRTU.

The introduction of hourly bidding to the Pilot would necessitate automation of the bidding process to allow actual bids to be composed from the hourly nominations.

#### 7.2.1.4 PDR and RDRP

Participating Load was used as the wholesale product for the Pilots since the mechanism for bidding PL currently exists under MRTU. During the operational period of the Pilot an additional product, Proxy Demand Resource (PDR), has been designed and is anticipated to be implemented by the CAISO in May 2010. PDR will support bid variation across the month and the movement of customers in and out of resources and programs provided either by a utility or a third party Aggregator termed a Demand Response Provider (DRP). Additionally, a subsequent product RDRP is planned. The expectation is that the availability of these three products in the wholesale market will support the integration of utility retail DR programs.

The inclusion of PDR within Phase II of the Pilot could provide an opportunity to educate the marketplace as well as the utility and other key stakeholders and ensure that the plans and needs associated with the transition are fully understood prior to the filing for the 2012-2014 budget cycle.

#### 7.2.1.5 5-Minute Metering

Any change in the Pilot that results in per-hour nominations and the new CAISO limit on 1-hour events could result in a future Pilot phase that reduces the 2-hour retail events to 1-hour. Shorter events increases the worst-case impact introduced by 15-minute metering for the Pilot products. As a result, such a change would imply a transition to 5-minute metering to accurately reflect load drops for settlement purposes.

#### 7.2.1.6 CAISO Network Model

As noted in section 4.6.1, the advance notification requirement for submitting the data to model the specific location of demand that makes up a PL resource in the CAISO network model is challenging. That coupled with the relative infrequency of the promotion of those models into production in the market systems by the CAISO doesn't align well with a dynamic aggregation. While the CAISO adoption of default resource locations for the Proxy Demand Resources addresses this issue, there may circumstances where it is preferable to create a customized location.

A custom modeled aggregation has the benefit of being aligned with load reduction capability. In particular, there are grid locations in the SDG&E service territory that are extremely weather sensitive. Loads in Inland locations typically have higher AC requirements that provide a significant portion of load drop for a single customer that might not always be available at all locations. Specifically, if a retailer has both Coastal and Inland locations, providing the option to split the locations between two different aggregations that are location specific could facilitate broader participation.

In order to model SDG&E's service territory more accurately, more custom aggregations would need to be created.

#### 7.2.1.7 Market Bidding

During the Pilot, the prices bid into the market were chosen on the basis of best assuring that the Non Spinning Reserves capacity bids cleared the CAISO Day Ahead market and that the energy associated with that capacity would only be dispatched for a coordinated test or during a true system contingency. Outside of these parameters no effort was made to consider any other bidding strategy in the wholesale market. There exists the opportunity to structure bids in a manner that are coordinated with Utility procurement practices, interaction with other Utility DR programs and the relative value of the product in the wholesale market.

The use of the Pilot resource to be responsive to CAISO scarcity bidding needs also warrants consideration. The Scarcity Pricing assigns significant premiums to resources that respond to the CAISO needs and could provide an opportunity to better align the expectations of Pilot Participants with the frequency of use. While it is likely that the number of instances where the CAISO invokes scarcity pricing will be low, the premium paid could better inform a product offering and pricing structure that closes the gap between the Utility program and the wholesale market.

In order to utilitize market pricing, a more complex bidding strategy could be implemented in the future.

#### 7.2.1.8 Automation of Dispatch and Notification

Additional automation in the dispatch and notification process could come in the form of utilizing the CAISO Automated Dispatch System (ADS) Web service features to activate the SDG&E Pilot notification system. In Phase I, the APX operator monitored the ADS for dispatches of the Pilot resource and then activated the Pilot notification system that automatically sends curtailment notices to Participants. In a subsequent phase, connectivity between ADS and the notification system could be established to remove errors and reduce latency.

#### 7.2.1.9 Establish Clear Telemetry Guidelines

Overall, the CAISO telemetry requirements as currently established are predicated on large installations connected to the high voltage transmission grid. These requirements for Participating Load are not conducive for small Industrial and Commercial customer to adopt due to their high cost and technological complexity. SDG&E could propose coordinating with the CAISO to better clarify telemetry needs and to develop clear guidelines regarding telemetry measurement.

#### 7.2.1.10 Standardized Telemetry Solutions

While there are myriad issues regarding telemetry – if in fact the existing requirements persist in the next phase(s) of the Pilot – standardized solutions focused on low cost and ease of installation is imperative. In Phase I much of the available implementation timeframe was used to interpret CAISO telemetry requirements and adapt any existing end use installations to those requirements. With a better understanding of what works in a variety of customer configurations, SDG&E and its contractors are better equipped to design one or more solutions that can be adapted to customer configurations without the burden of trial and error experienced in Phase I.

#### 7.2.1.11 Telemetry Modeling Pseudo-Generation

The telemetered data being sent to the CAISO reflects the entirety of the load underlying the dispatchable demand. By changing the requirements to model pseudo-generation, that is looking only at the portion of demand that is “armed” for curtailment, the CAISO would be able to actually “see”

the resource. This would better allow demand response to be treated as generation and provide real-time feedback that could be incorporated into the CAISO real-time state estimator and used as an input into the dispatch algorithms. SDG&E could investigate techniques for providing this pseudo-generation instead of total load.

#### 7.2.1.12 Live Distribution Loss Factors

In the first phase of the Pilot, Distribution Loss Factors were fixed per voltage service level. While this simplified Pilot implementation, it would be more accurate to apply the SDG&E daily DLF values to the telemetry data. This will require some automation and process refinements for both the Pilot administrator as well as the Aggregators.

#### 7.2.1.13 Evaluate Baseline Efficacy

There continues to be issues and questions about the suitability of baselines for various event types. Continued analysis and review of the impacts baselines to continue to resolve differences between the wholesale and retail baseline methodologies could be incorporated into additional efforts.

#### 7.2.1.14 Automate Retail Settlement

Another area where automation enhancements could be made is to automate retail settlement calculations. While such automation would certainly allow for quicker financial settlement, it could also be used to provide more rapid post-event information and analysis to Participants.

#### 7.2.1.15 Include Direct Access Customers

Inclusion of Direct Access (DA) customers was contemplated in the design, development and implementation of Phase I of the Pilot; however few of these elements were tested since there were no DA Participants. As such, it cannot be entirely know if those elements would provide all the rights and protections that should be afforded a DA customer. To best assure protection of any DA customers data, a separate Scheduling Coordinator ID with separate resources was established with the CAISO.

It is not clear that an entirely separate Scheduling Coordinator and resources is necessary given that the CAISO is poised to roll out the Proxy Demand Resource (PDR) in May 2010. It may be possible that all of the protections necessary to separate confidential data between SDG&E and a DA Participant can be accomplished through the use of the PDR product. Within SDG&E, preliminary thought has been given to this possibility and will continue to be considered as the next phases of the Pilot are designed with the objective of ensuring that DA customers can participate.

#### 7.2.1.16 Better Support for Dual Participation

Participation in multiple demand response programs simultaneously provides the opportunity to earn revenues that make demand response solicitations to customers economic, but add administrative challenges. Multiple participation can only be allowed if the product being offered doesn't provide duplicate compensation for the same product in the same period.

In the case of the Pilot where demand response is being bid into the wholesale market as real-time contingency reserves, SDG&E does not see a reason that a customer could not be enrolled in a utility Day Ahead energy product as well. The value of the Day Ahead energy product is in its ability to manage day ahead procurement costs while the real-time product is designed to respond

instantaneously to a grid contingency. So long as the Participant can be known and removed from the quantity bid into the real-time capacity market, then there is no conflict between programs.

The Pilot could require the addition of certain features to better accommodate multiple participation. Among these items would be a registration process that allowed reconciliation between programs at enrollment and identify adjustments required prior to finalizing monthly compensation to the Participant, as well as a more fluid (automated) process to update the Scheduling Coordinator regarding resource availability prior to submitting bids to the CAISO wholesale market.

### 7.2.2 Additional Improvements

As expected with any Pilot, there were areas that presented challenges that can be improved upon with minimal effort and little, if any, program modifications or system development. In particular, and as noted throughout the report, the compressed implementation timeframe drove some of the challenges. Also there were instances where existing processes needed to be modified or new processes created that were accomplished in a "figure it out as you go/just in time delivery" mode.

Along with the implementation of items identified for the extension of the Pilot. Other improvements could be considered for implementation.

- Online Enrollment and Nomination integrated Settlement functionality
- Integration with other systems to address multiple participation
- Improved processes associated with metering and forecasting

# 8 Appendix I: Event Details

Unless otherwise noted, all numbers are in kilowatts (kW).

In this section there will be instances where there is limited wholesale settlement information because no event information was returned in the CAISO Settlement statement. There are two primary reasons for these discrepancies:

- The event was called outside of the CAISO market; or
- There were data propagation errors in the latest CAISO settlement statements available at the time this report was finalized.

The meaningful data component from the CAISO wholesale settlements is Ancillary Services No Pay which is indicative of whether or not the event met the CAISO standard of achieving curtailment within ten minutes of dispatch. Evaluation of this settlement component is particularly useful since it reflects any latency between CAISO dispatches and the ultimate response by the individual Participants. Energy settlement analysis at the CAISO level is generally not useful for comparison to the retail settlement since the majority of the CAISO dispatches were only for 10 minutes while the retail events lasted two hours. Further, the issues associated with the derivation of 5-minute meter data from 15-minute interval meters discussed elsewhere in this document are amplified when applied to this shorted 10 minute period (as opposed to a 120 minute period) rendering CAISO energy settlement analysis relatively meaningless. Meaningful CAISO energy analysis could only be accomplished with the application of telemetry data or a baseline other than the “meter before meter after” methodology which is only appropriate for measuring initial (10 minute) dispatch compliance.

## 8.1 August 13th (11-7)

The first event for the Pilot was dispatched by the CAISO on August 13th, 2009 at 14:00 for a reduction of 0.3 MW. This resulted in the notification of Participants to curtail their nominated capacity from 14:10 to 16:10. The following chart shows the metered performance for the two aggregators that participated in the event:

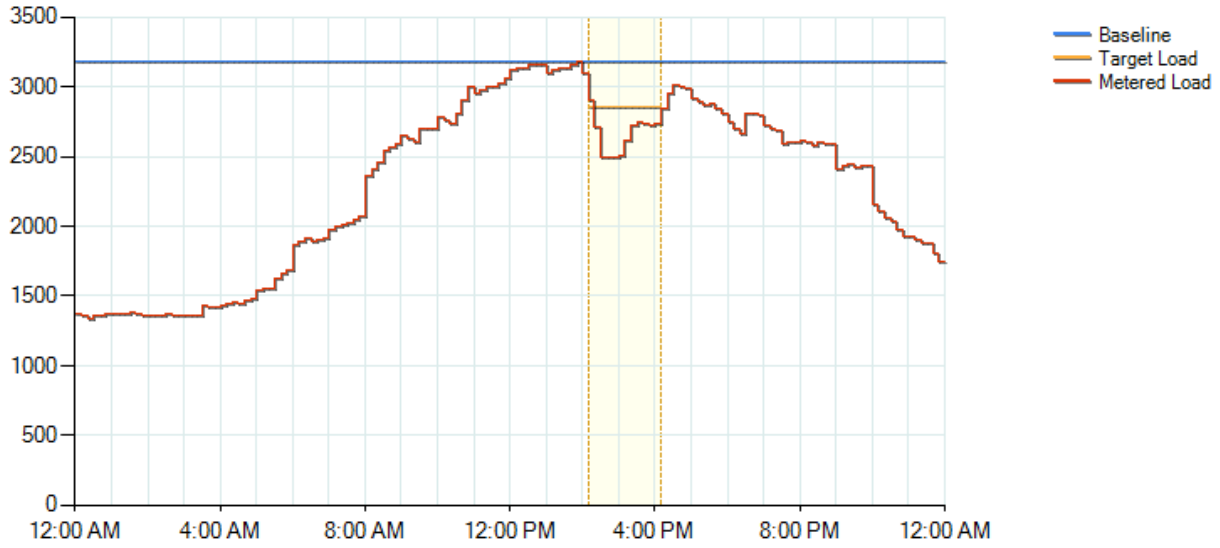


**Figure 31: Aggregate Metered Results, August 13th**

Although scheduled, this was the first event of the Pilot. Additional staff was on hand to ensure successful Participant notifications. Upon receiving a dispatch from the CAISO, a system issue occurred when attempting to notify Participants and the contingency notification process was triggered as a result. Participants were notified within the timeframe required per tariff and were able to perform within the 10 minute window required for the program. Below are summaries for the event.

| | Aggregator 1 | Aggregator 2 | Total |
|---|---|---|---|
| **Average Metered Load (kW)** | 635 | 2023 | 2658 |
| **Baseline (kW)** | 798 | 2379 | 3177 |
| **Nomination (kW)** | 170 | 155 | 325 |
| **Average Target Load (kW)** | 628 | 2224 | 2852 |
| **Average Reduction (kW)** | 163 | 355 | 518 |
| **Performance** | 96% | 229% | 159% |
| **Adjusted Performance** | 96% | 100% | 100% |

**Table 34: Retail Performance Summary, August 13th**

No specific wholesale settlement was associated with this test likely due to an error in the CAISO ADS system which propagated an exceptional dispatch for every interval from 10:45 through 14:35 for a total of 46 intervals instead or the two five minute intervals that were the basis for the test. As a result, no Non Spinning Reserve payments were rescinded, but it is not clear if this was a result of data issues that may have prevented the CIASO from performing No Pay calculations.

## 8.2 August 20th (11-7)

This scheduled event was dispatched by the CAISO on August 20th, 2009 at 13:55 for a reduction of 0.3 MW. This resulted in the notification of Participants to curtail their nominated capacity from 14:05 to 16:05. The following chart shows the metered performance for the two Aggregators that participated in the event:

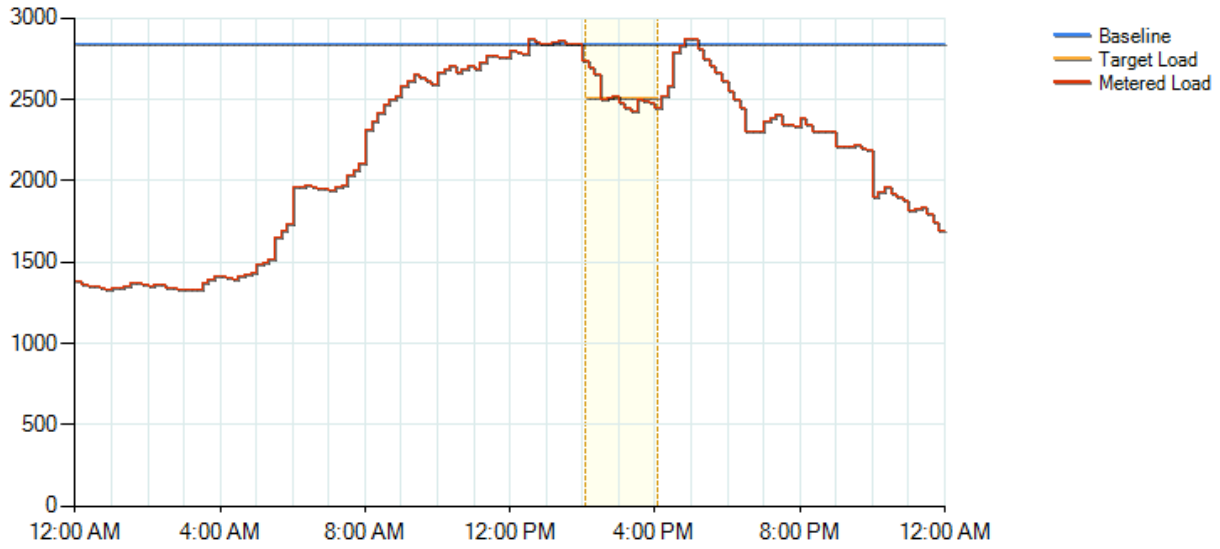


**Figure 32: Aggregate Metered Results, August 20th**

The Participants performed as expected during this event. Below are summaries for the event.

| | Aggregator 1 | Aggregator 2 | Total |
|---|---|---|---|
| **Average Metered Load (kW)** | 650 | 1882 | 2532 |
| **Baseline (kW)** | 794 | 2045 | 2839 |
| **Nomination (kW)** | 170 | 155 | 325 |
| **Average Target Load (kW)** | 624 | 1890 | 2514 |
| **Average Reduction (kW)** | 144 | 163 | 307 |
| **Performance** | 85% | 105% | 94% |
| **Adjusted Performance** | 85% | 100% | 94% |

**Table 35: Retail Performance Summary, August 20th**

CAISO Settlement Non Spinning Reserves No Pay for HE 15 was 0.3 MW the full amount of the day-ahead Bid/Award indicating that the load drop was not achieved within 10 minutes based on the CAISO calculation. Figure 32 clearly shows that there was a delay in achieving the expected load drop.

## 8.3 August 27th (11-7)

This scheduled event was dispatched by the CAISO on August 27th, 2009 at 13:55 for a reduction of 0.3 MW. This resulted in the notification of Participants to curtail their nominated capacity from 14:05 to

16:05. The following chart shows the metered performance for the two Aggregators that participated in the event:

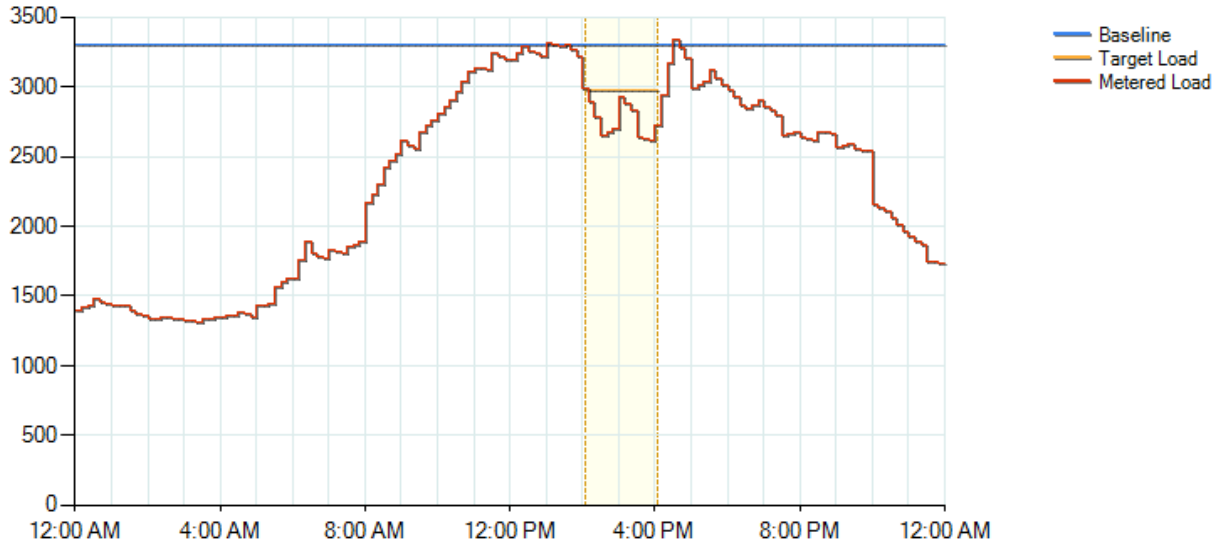


**Figure 33: Aggregate Metered Results, August 27th**

The Participants performed as expected during this event. Below are summaries for the event.

| | Aggregator 1 | Aggregator 2 | Total |
|---|---|---|---|
| **Average Metered Load (kW)** | 732 | 2031 | 2763 |
| **Baseline (kW)** | 902 | 2403 | 3305 |
| **Nomination (kW)** | 170 | 155 | 325 |
| **Average Target Load (kW)** | 732 | 2248 | 2980 |
| **Average Reduction (kW)** | 170 | 372 | 542 |
| **Performance** | 100% | 240% | 167% |
| **Adjusted Performance** | 100% | 100% | 100% |

**Table 36: Retail Performance Summary, August 27th**

CAISO Settlement Non Spinning Reserves No Pay quantity for HE 15 was 0.05 MW, one sixth the amount of the DA Bid/Award of 0.3 MW, resulting in a compliance factor of 83%.

## 8.4 September 10th (11-7)

This scheduled event was dispatched by the CAISO on September 10th, 2009 at 14:00 for a reduction of 0.6 MW. This resulted in the notification of Participants to curtail their nominated capacity from 14:10 to 16:10. The following chart shows the metered performance for the two Aggregators that participated in the event:

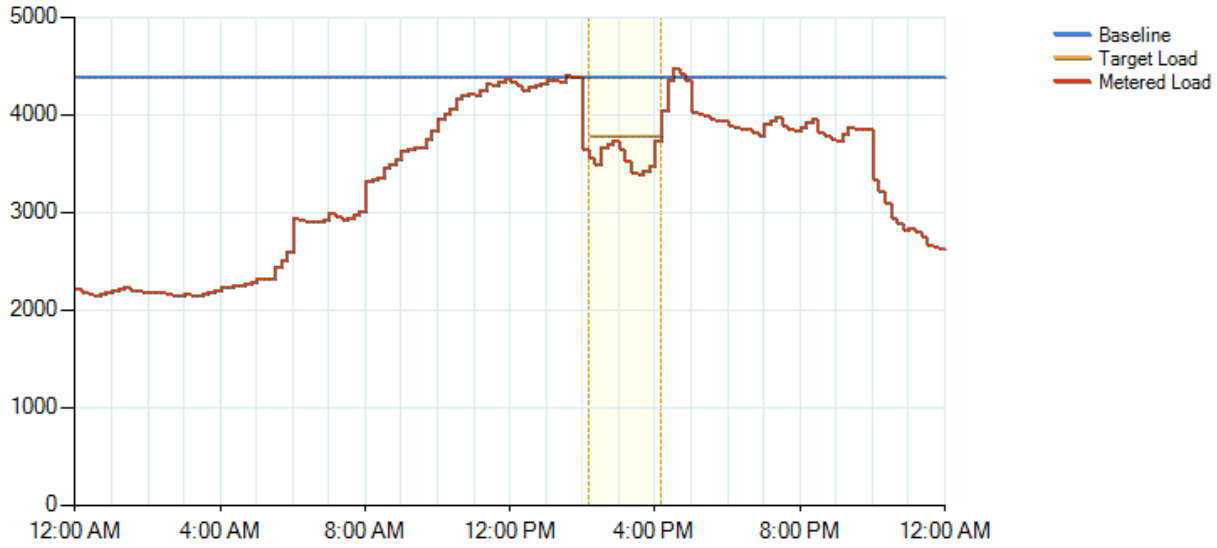


**Figure 34: Aggregate Metered Results, September 10th**

The Participants performed as expected during this event. Below are summaries for the event.

| | Aggregator 1 | Aggregator 2 | Total |
|---|---|---|---|
| **Average Metered Load (kW)** | 640 | 2927 | 3567 |
| **Baseline (kW)** | 846 | 3542 | 4388 |
| **Nomination (kW)** | 150 | 450 | 600 |
| **Average Target Load (kW)** | 696 | 3092 | 3788 |
| **Average Reduction (kW)** | 205 | 615 | 820 |
| **Performance** | 137% | 137% | 137% |
| **Adjusted Performance** | 100% | 100% | 100% |

**Table 37: Retail Performance Summary, September 10th**

CAISO Settlement Non Spinning Reserves No Pay quantity for HE 15 was 0.09 MW, approximately one sixth the amount of the DA Bid/Award of 0.6 MW, resulting in a compliance factor of 85%.

## 8.5 September 17th (11-7)

This scheduled event was dispatched by the CAISO on September 17th, 2009 at 13:55 for a reduction of 0.6 MW. This resulted in the notification of Participants to curtail their nominated capacity from 14:05 to 16:05. The following chart shows the metered performance for the two Aggregators that participated in the event:

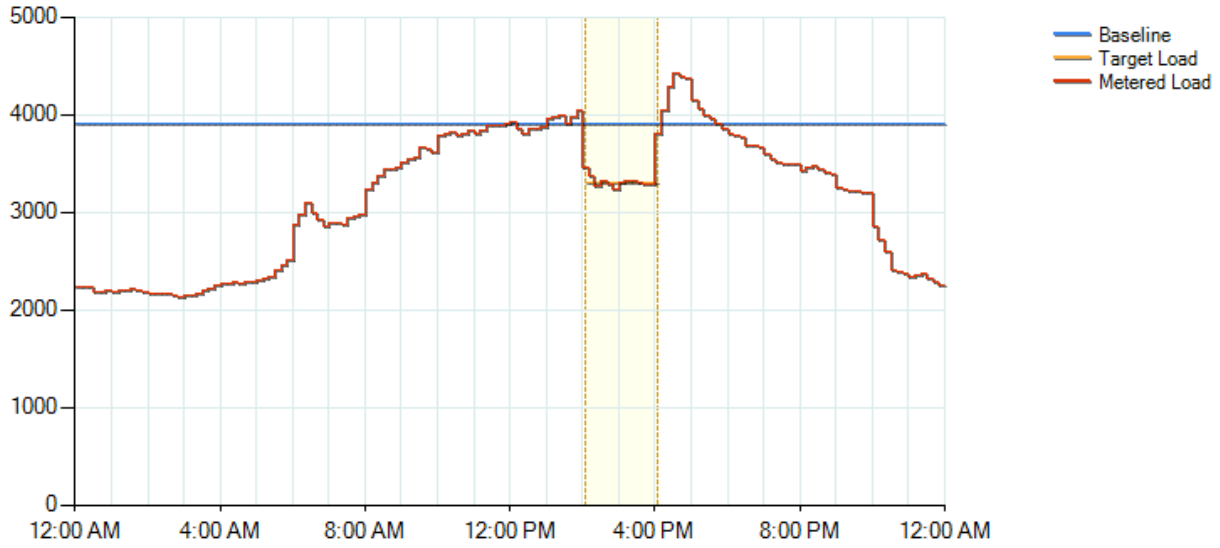


**Figure 35: Aggregate Metered Results, September 17th**

The Participants performed largely as expected during this event. The performance of Aggregator 2 was impacted due to an equipment timer set to count 2 hours from notification time before returning to normal operational level. Given that notifications are sent within the first five minutes of a CAISO dispatch, the equipment timer returned to normal during the last settlement interval, thus impacting the Aggregator's performance. The Aggregator subsequently configured the timer to start with the event start time, not the notification time. Below are summaries for the event.

| | Aggregator 1 | Aggregator 2 | Total |
|---|---|---|---|
| **Average Metered Load (kW)** | 617 | 2737 | 3354 |
| **Baseline (kW)** | 813 | 3098 | 3911 |
| **Nomination (kW)** | 150 | 450 | 600 |
| **Average Target Load (kW)** | 663 | 2648 | 3311 |
| **Average Reduction (kW)** | 196 | 360 | 556 |
| **Performance** | 131% | 80% | 93% |
| **Adjusted Performance** | 100% | 80% | 93% |

**Table 38: Retail Performance Summary, September 17th**

CAISO Settlement Non Spinning Reserves No Pay quantity was 0.05 MW, one twelfth the amount of the DA Bid/Award of 0.6 MW, resulting in a compliance factor of 92%.

## 8.6 September 18th (11-7)

This event was an unscheduled Contingency Dispatch from the CAISO on September 18th, 2009 at 15:55 for a reduction of 0.6 MW. The following chart shows the metered performance for the two Aggregators that participated in the event:

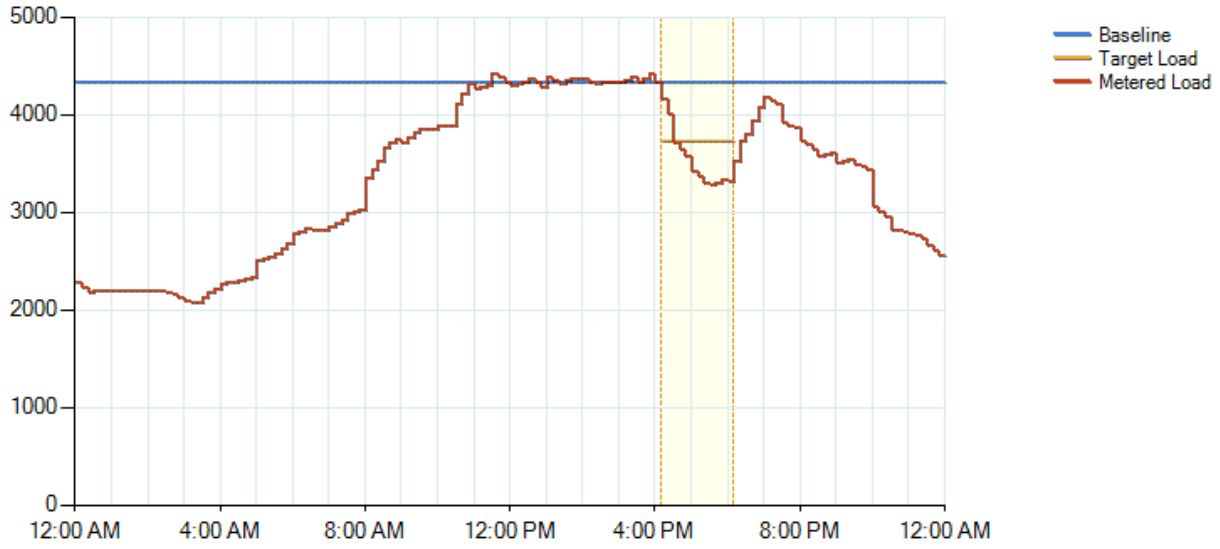


**Figure 36: Aggregate Metered Results, September 18th**

A notification system issue at APX prevented notifications from being sent in a timely fashion. Contingency notifications were sent at 16:06 with an event start time of 16:10. Consequently, so as to not penalize Participants, the beginning settlement interval was set at interval ending 16:20. Below are summaries for the event.

| | Aggregator 1 | Aggregator 2 | Total |
|---|---|---|---|
| **Average Metered Load (kW)** | 794 | 2746 | 3540 |
| **Baseline (kW)** | 836 | 3499 | 4335 |
| **Nomination (kW)** | 150 | 450 | 600 |
| **Average Target Load (kW)** | 686 | 3049 | 3735 |
| **Average Reduction (kW)** | 42 | 753 | 795 |
| **Performance** | 28% | 167% | 133% |
| **Adjusted Performance** | 28% | 100% | 100% |

**Table 39: Retail Performance Summary, September 18th**

CAISO Settlement Non Spinning Reserves No Pay quantity was 0.2 MW, one third the amount of the DA Bid/Award of 0.6 MW, resulting in a compliance factor of 67%. The late notification to Participants resulted in relatively poor performance in the wholesale settlement; however, retail settlement and payments to the Participants were not impacted.

## 8.7 September 23rd (24x7)

This scheduled event was a Retail test event counting towards Participant performance. APX Operations issued a notification to the Participant on September 23rd , 2009 at 23:35 for a reduction of 1.2 MW. The following chart shows the metered performance for the Direct Enrolled Customer that participated in the event:

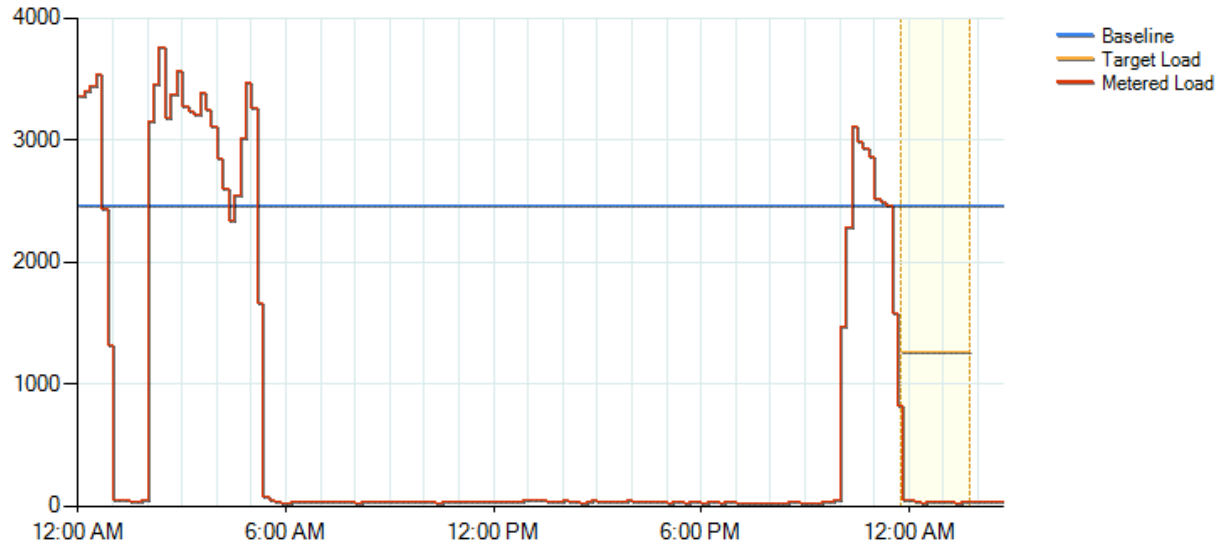


**Figure 37: Aggregate Metered Results, September 23rd.**

The Participants performed as expected during this event; however, Participant load remained low beyond the event end time. It was not understood by Operational staff at the Participant site that no additional instructions would be sent to return to normal operations. Participant operators contacted APX Operations after the end of the event and APX Operations confirmed that the site could resume normal operations as all PLP events have a default 2 hour duration and no event end notifications are provided. Below are summaries for the event.

| | Direct Enrolled Customer |
|---|---|
| **Average Metered Load (kW)** | 99 |
| **Baseline (kW)** | 2467 |
| **Nomination (kW)** | 1200 |
| **Average Target Load (kW)** | 1267 |
| **Average Reduction (kW)** | 2368 |
| **Performance** | 197% |
| **Adjusted Performance** | 100% |

**Table 40: Retail Performance Summary, September 23rd**

This event was called by the Pilot administrator independent of the CAISO and as such has no wholesale settlement associated with it.

## 8.8 September 24th (11-7)

This scheduled event was dispatched by the CAISO on September 24th, 2009 at 13:55 for a reduction of 1.8 MW. This resulted in the notification of Participants to curtail their nominated capacity from 14:05 to 16:05. The following chart shows the metered performance for the two Aggregators that participated in the event:

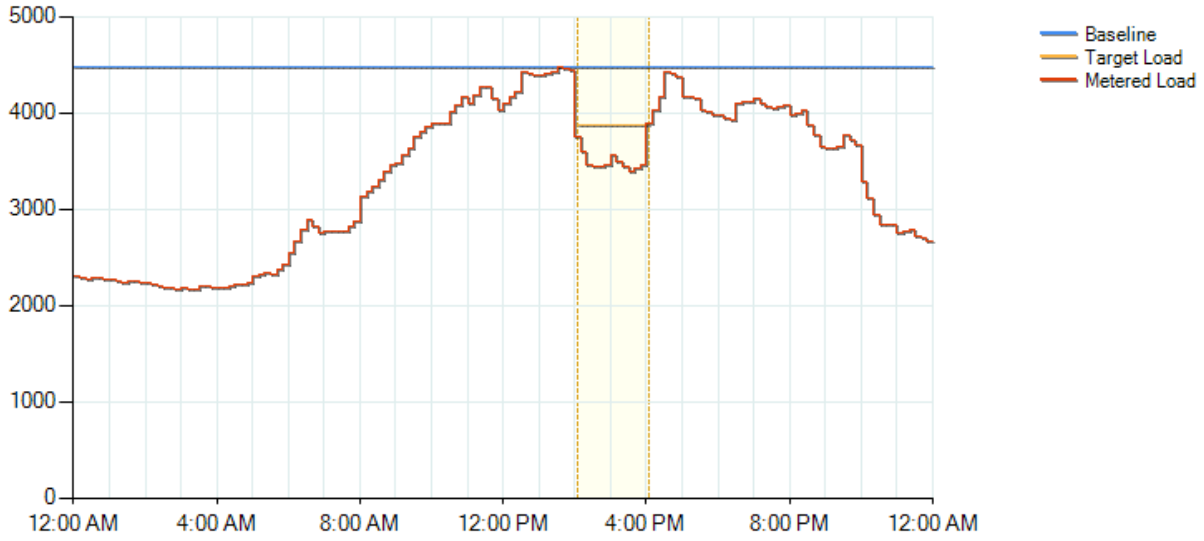


**Figure 38: Aggregate Metered Results, September 24th**

The Participants performed as expected during this event. Below are summaries for the event.

| | Aggregator 1 | Aggregator 2 | Total |
|---|---|---|---|
| **Average Metered Load (kW)** | 642 | 2883 | 3525 |
| **Baseline (kW)** | 860 | 3618 | 4478 |
| **Nomination (kW)** | 150 | 450 | 600 |
| **Average Target Load (kW)** | 710 | 3168 | 3878 |
| **Average Reduction (kW)** | 218 | 735 | 953 |
| **Performance** | 145% | 163% | 159% |
| **Adjusted Performance** | 100% | 100% | 100% |

**Table 41: Retail Performance Summary, September 24th**

While no Non Spinning Reserve payments were rescinded for the event indicating that the full amount of the DA Bid/Award of 1.8 MW was curtailed within 10 minutes, this doesn't appear to be correct. Both the 11 – 7 and 24x7 were bid into the wholesale market. This was a deliberate action with the purpose to acquire wholesale settlement data to evaluate the financial impact for the 24 x 7 enrolled customer not being truly available around the clock. Once it became evident that performance during the day would not be feasible, subsequent bids were adjusted to reflect that properly in the wholesale market. It is unknown why the CAISO did not process settlement data in a manner that would have resulted in a capacity payment rescission and the intended analysis could not be completed.

## 8.9 September 30th (24x7)

This scheduled event was dispatched by the CAISO on September 30th, 2009 at 04:55 for a reduction of 1.2 MW. This resulted in the notification of the Direct Enrolled Customer to curtail their nominated capacity from 05:05 to 07:05. The following chart shows the metered performance for the Direct Enrolled Customer that participated in the event:

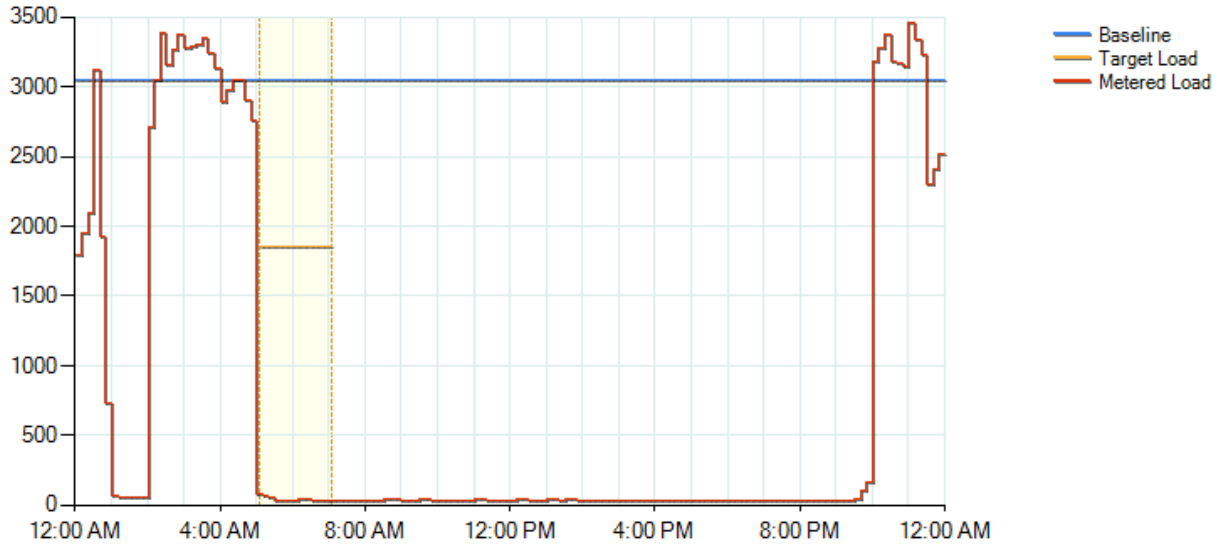


**Figure 39: Aggregate Metered Results, September 30th**

The Participants performed as expected during this event. Below are summaries for the event.

| | Direct Enrolled Customer |
|---|---|
| **Average Metered Load (kW)** | 45 |
| **Baseline (kW)** | 3053 |
| **Nomination (kW)** | 1200 |
| **Average Target Load (kW)** | 1853 |
| **Average Reduction (kW)** | 3008 |
| **Performance** | 251% |
| **Adjusted Performance** | 100% |

**Table 42: Retail Performance Summary, September 30th**

No Non Spinning Reserve payments were rescinded for the event indicating that the full amount of the hourly capacity of 1.2 MW was curtailed within 10 minutes resulting in a compliance factor of 100%.

## 8.10 October 1st (11-7)

This scheduled event was dispatched by the CAISO on October 1st, 2009 at 13:55 for a reduction of 0.8 MW. This resulted in the notification of Participants to curtail their nominated capacity from 14:05 to 16:05. The following chart shows the metered performance for the two Aggregators that participated in the event:

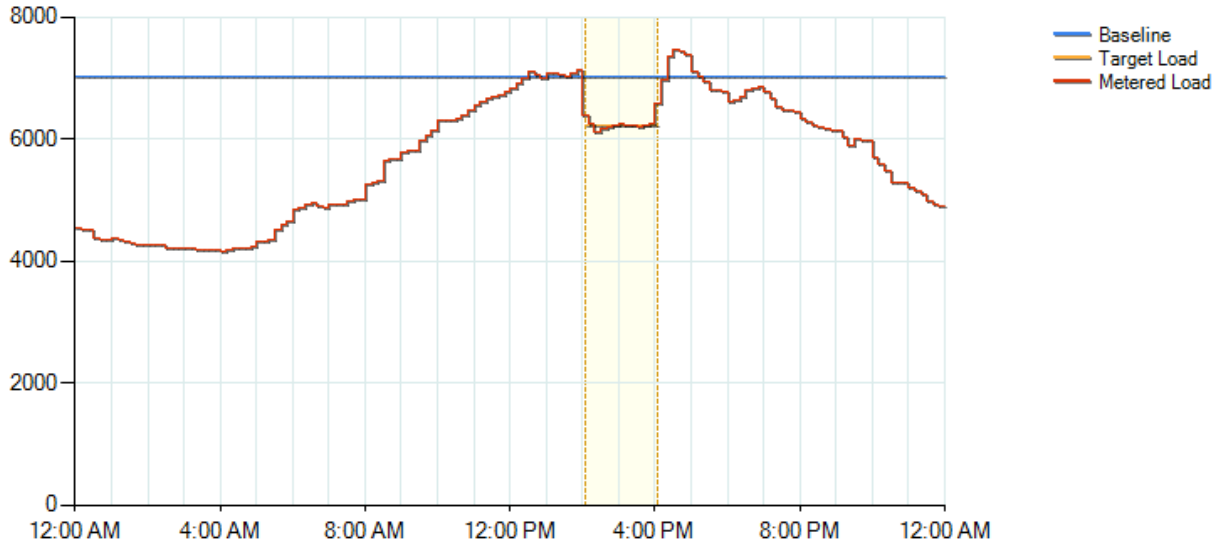


**Figure 40: Aggregate Metered Results, October 1st**

The Participants performed as expected during this event. Below are summaries for the event.

| | Aggregator 1 | Aggregator 2 | Total |
|---|---|---|---|
| **Average Metered Load (kW)** | 591 | 5663 | 6254 |
| **Baseline (kW)** | 768 | 6258 | 7026 |
| **Nomination (kW)** | 100 | 700 | 800 |
| **Average Target Load (kW)** | 668 | 5558 | 6226 |
| **Average Reduction (kW)** | 177 | 595 | 772 |
| **Performance** | 177% | 85% | 97% |
| **Adjusted Performance** | 100% | 85% | 97% |

**Table 43: Retail Performance Summary, October 1st**

No Non Spinning Reserve payments were rescinded for the event indicating that the full amount of the DA Bid/Award of 0.8 MW was curtailed within 10 minutes resulting in a compliance factor of 100%.

## 8.11 October 9th (11-7)

This scheduled event was dispatched by the CAISO on October 9th , 2009 at 11:25 for a reduction of 0.8 MW. This resulted in the notification of Participants to curtail their nominated capacity from 11:35 to 13:35. The following chart shows the metered performance for the two Aggregators that participated in the event:

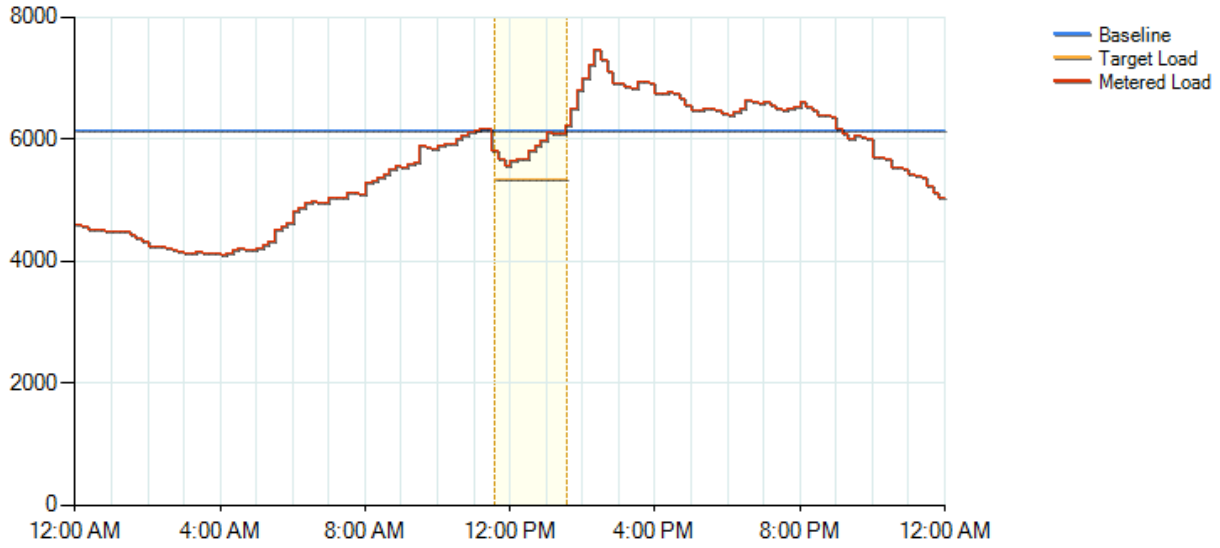


**Figure 41: Aggregate Metered Results, October 9th**

Participants did not perform as well as during previous events. Further research is needed to understand what operational factors may have caused lower performance for both Participants on this day. Below are summaries for the event.

| | Aggregator 1 | Aggregator 2 | Total |
|---|---|---|---|
| **Average Metered Load (kW)** | 490 | 5373 | 5863 |
| **Baseline (kW)** | 562 | 5588 | 6150 |
| **Nomination (kW)** | 100 | 700 | 800 |
| **Average Target Load (kW)** | 462 | 4888 | 5350 |
| **Average Reduction (kW)** | 72 | 216 | 288 |
| **Performance** | 72% | 31% | 36% |
| **Adjusted Performance** | 72% | 31% | 36% |

**Table 44: Retail Performance Summary, October 9th**

No Non Spinning Reserve payments were rescinded for the event indicating that the full amount of the DA Bid/Award of 0.8 MW was curtailed within 10 minutes resulting in a compliance factor of 100%. Good performance in the beginning of the event (see Figure 41) and the fact that the CAISO dispatch period was only 10 minutes create the circumstance where CAISO performance exceed the retail performance.

## 8.12 October 14th (11-7)

This scheduled event was dispatched by the CAISO on October 14th , 2009 at 12:35 for a reduction of 0.8 MW. This resulted in the notification of Participants to curtail their nominated capacity from 12:45 to 14:45. The following chart shows the metered performance for the two Aggregators that participated in the event:

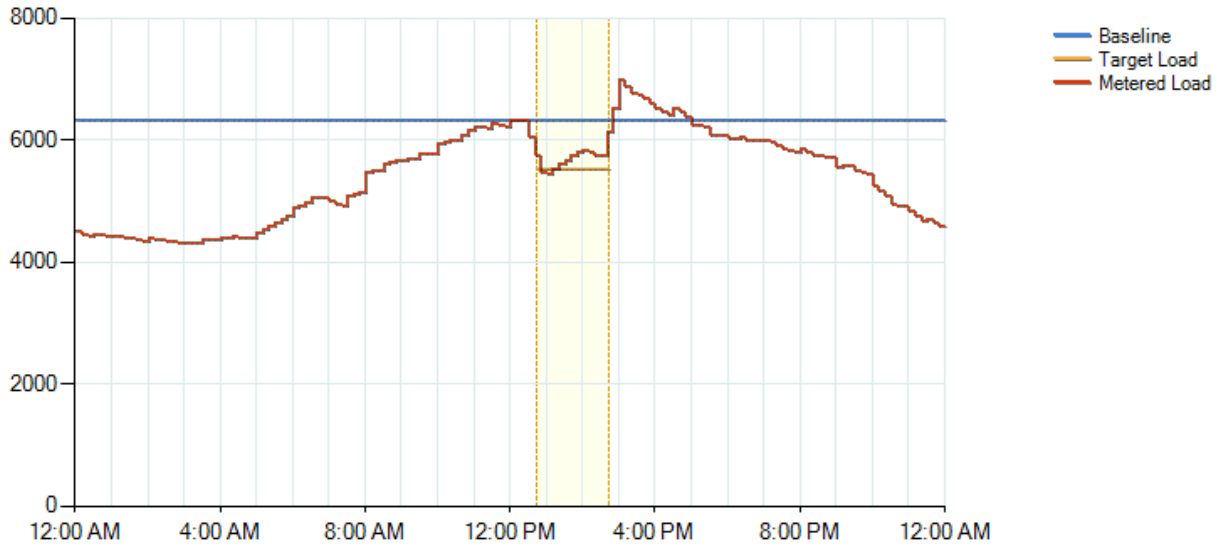


**Figure 42: Aggregate Metered Results, October 14th**

Aggregator 2 did not perform as well as during previous events. Further research is needed to understand what operational factors may have caused lower performance for Aggregator 2 on this day. Below are summaries for the event.

| | Aggregator 1 | Aggregator 2 | Total |
|---|---|---|---|
| **Average Metered Load (kW)** | 525 | 5197 | 5722 |
| **Baseline (kW)** | 695 | 5652 | 6347 |
| **Nomination (kW)** | 100 | 700 | 800 |
| **Average Target Load (kW)** | 595 | 4952 | 5547 |
| **Average Reduction (kW)** | 170 | 455 | 625 |
| **Performance** | 170% | 65% | 78% |
| **Adjusted Performance** | 100% | 65% | 78% |

**Table 45: Retail Performance Summary, October 14th**

CAISO Settlement Non Spinning Reserves No Pay quantity was 0.13 MW, approximately one sixth the amount of the DA Bid/Award of 0.8 MW, resulting in a compliance factor of 67%.

## 8.13 October 15th (24x7)

This scheduled event was dispatched by the CAISO on October 15th, 2009 at 04:55 for a reduction of 1.2 MW. This resulted in the notification of the Direct Enrolled Customer to curtail their nominated capacity from 05:05 to 07:05. The following chart shows the metered performance for the Direct Enrolled Customer that participated in the event:

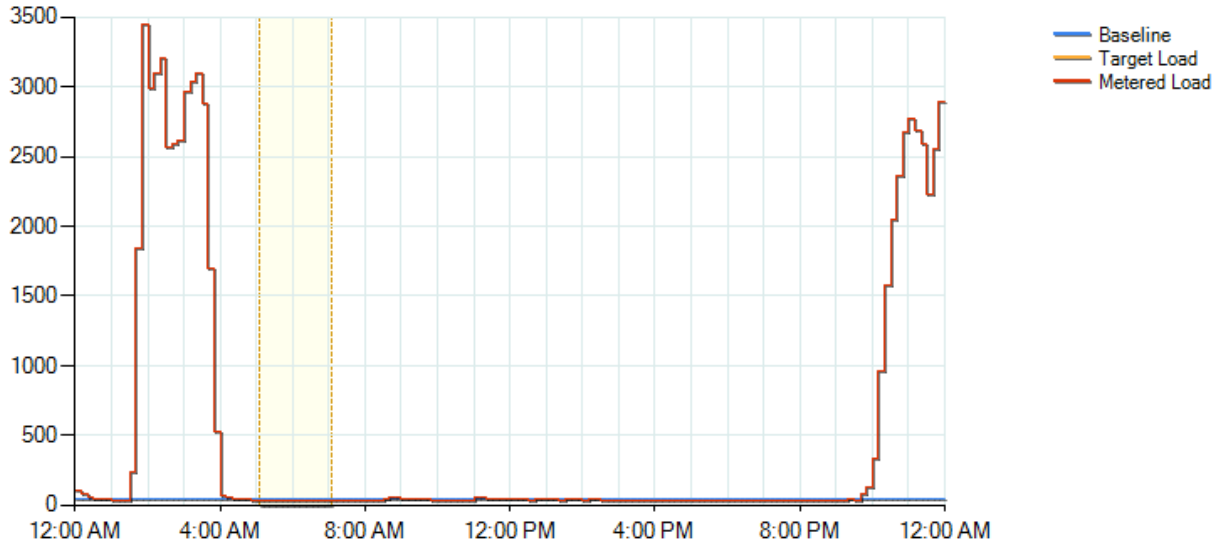


**Figure 43: Aggregate Metered Results, October 15th**

The Direct Enrolled Participant did not perform during this event as the site was shut down during event hours. Below are summaries for the event.

| | Direct Enrolled Customer |
|---|---|
| **Average Metered Load (kW)** | 38 |
| **Baseline (kW)** | 48 |
| **Nomination (kW)** | 1200 |
| **Average Target Load (kW)** | -1152 |
| **Average Reduction (kW)** | 10 |
| **Performance** | 1% |
| **Adjusted Performance** | 0% |

**Table 46: Retail Performance Summary, October 15th**

No Non Spinning Reserve capacity payments were rescinded for the event which is due to a data processing error by the CAISO evidenced by the fact that there was insufficient load available to meet the hourly bid quantity of 1.2 MW (see Figure 43). CAISO records indicate that the Capacity Award was not present in their system for the portion of the hour that the event was called leaving no capacity quantity in settlement data to process for payment rescission.

## 8.14 November 16th (11-7)

The PLP period was originally scheduled to last through 10/31. To study the results of such a pilot in a period outside of typical DR months, SDG&E extended their pilot period through 12/15/09. The CAISO possessed limited resources to support PLP test events beyond 10/31 however. Consequently, most of the events in November and December were Retail test events.

This scheduled event was dispatched on November 16th, 2009 at 15:00 for a reduction of 0.55 MW. This resulted in the notification of Participants to curtail their nominated capacity from 15:10 to 17:10. The following chart shows the metered performance for the aggregator that participated in the event:

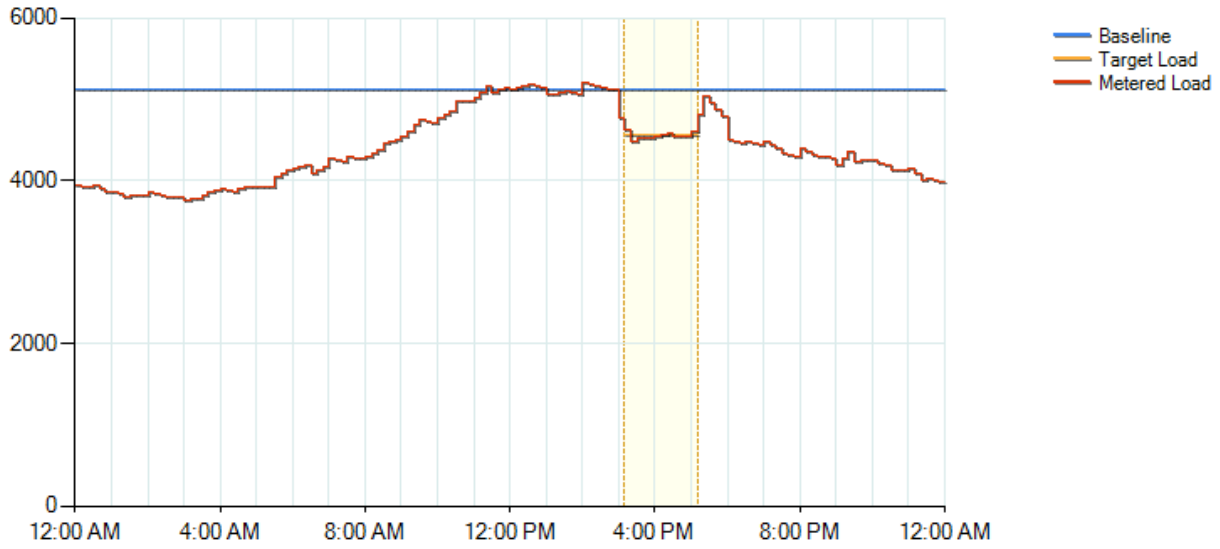


**Figure 44: Aggregate Metered Results, November 16th**

Only Aggregator 2 nominated capacity in the PLP for the month of November. Participant 2 performed as expected during this event. Below are summaries for the event.

| | Aggregator 1 | Aggregator 2 | Total |
|---|---|---|---|
| **Average Metered Load (kW)** | n/a | 4552 | 4552 |
| **Baseline (kW)** | n/a | 5120 | 5120 |
| **Nomination (kW)** | n/a | 550 | 550 |
| **Average Target Load (kW)** | n/a | 4570 | 4570 |
| **Average Reduction (kW)** | n/a | 569 | 569 |
| **Performance** | n/a | 103% | 103% |
| **Adjusted Performance** | n/a | 100% | 100% |

**Table 47: Retail Performance Summary, November 16th.**

This event was called by the Pilot administrator independent of the CAISO and as such has no wholesale settlement associated with it.

## 8.15 November 18th (24x7)

This Retail test event was dispatched on November 18th, 2009 at 01:00 for a reduction of 1.2 MW. This resulted in the notification of the Direct Enrolled Customer to curtail their nominated capacity from 01:10 to 03:10. The following chart shows the metered performance for the Direct Enrolled Customer that participated in the event:

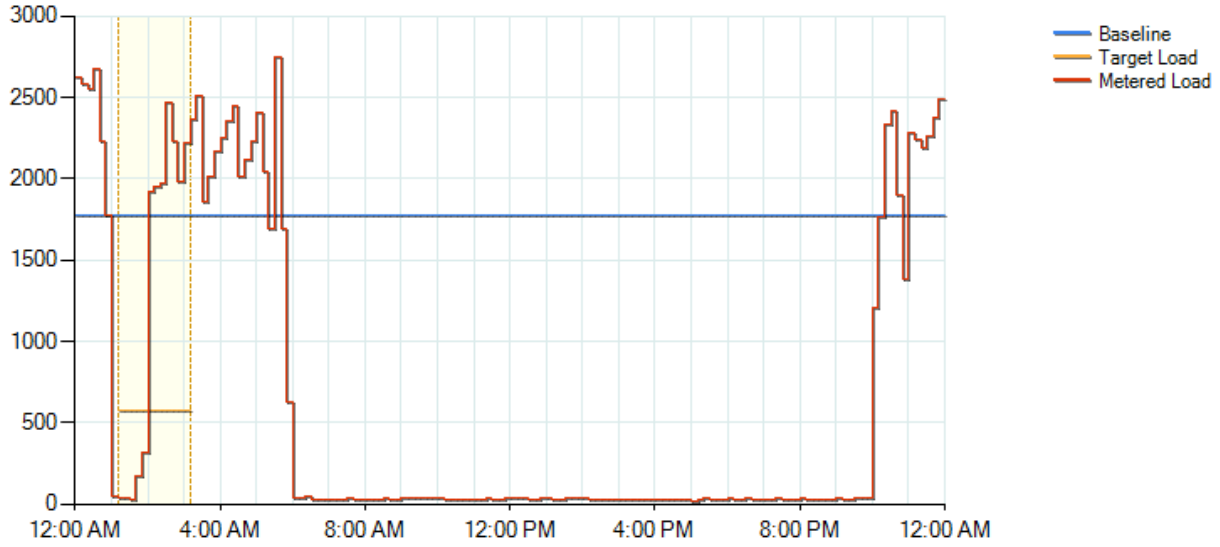


**Figure 45: Aggregate Metered Results, November 18th**

The Direct Enrolled Participant's performance was lower during this event due to staff leaving the site for their meal break. This meal break coincided with an event and as such, a baseline value along with a load drop was recorded for the first hour of the event. The site staff returned to normal operations approximately one hour later which resulted in lower performance for the second hour of the event. Below are summaries for the event.

| | Direct Enrolled Customer |
|---|---|
| **Average Metered Load (kW)** | 1279 |
| **Baseline (kW)** | 1776 |
| **Nomination (kW)** | 1200 |
| **Average Target Load (kW)** | 576 |
| **Average Reduction (kW)** | 497 |
| **Performance** | 41% |
| **Adjusted Performance** | 41% |

**Table 48: Retail Performance Summary, November 18th**

## 8.16 November 19th (11-7)

This Retail test event was dispatched on November 19th, 2009 at 12:06 for a reduction of 0.55 MW. When a notification is issued within a five minute interval, i.e. XX:X1 – XX:X4 or XX:X6 – XX:X9, the notification system defaults to the next five minute interval to calculate an event start time so as to not penalize Participants with reduced notification times. For this event, Participants we notified to curtail their nominated capacity from 12:20 to 14:20. The following chart shows the metered performance for the aggregator that participated in the event:

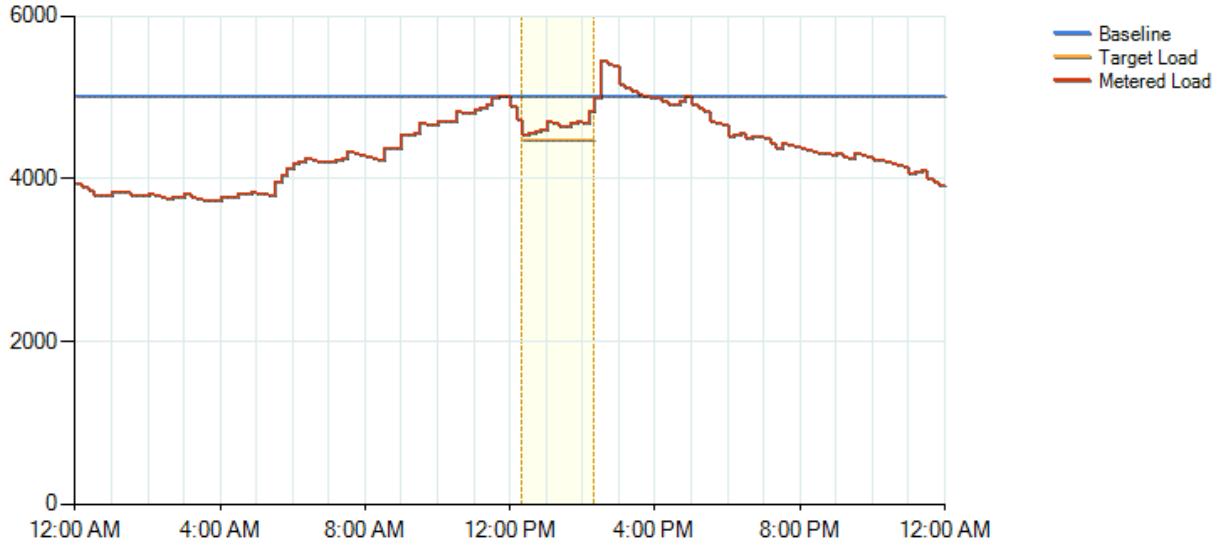


**Figure 46: Aggregate Metered Results, November 19th**

Only Aggregator 2 nominated capacity in the PLP for the month of November. Participant 2 performed as expected during this event. Below are summaries for the event.

| | Aggregator 1 | Aggregator 2 | Total |
|---|---|---|---|
| **Average Metered Load (kW)** | n/a | 4660 | 4660 |
| **Baseline (kW)** | n/a | 5025 | 5025 |
| **Nomination (kW)** | n/a | 550 | 550 |
| **Average Target Load (kW)** | n/a | 4475 | 4475 |
| **Average Reduction (kW)** | n/a | 365 | 365 |
| **Performance** | n/a | 66% | 66% |
| **Adjusted Performance** | n/a | 66% | 66% |

**Table 49: Retail Performance Summary, November 19th**

This event was called by the Pilot administrator independent of the CAISO and as such has no wholesale settlement associated with it.

Note: Due to an SDG&E scheduling system limitation (i.e., its inability to schedule in increments smaller than .1 MW), only 0.5 MW were bid for the 11-7 product hours in the month of November, in spite of total Participant nominations of 0.55 MW.

## 8.17 November 24th (11-7)

This Retail test event was dispatched on November 24th, 2009 at 15:00 for a reduction of 0.55 MW. The following chart shows the metered performance for the aggregator that participated in the event:

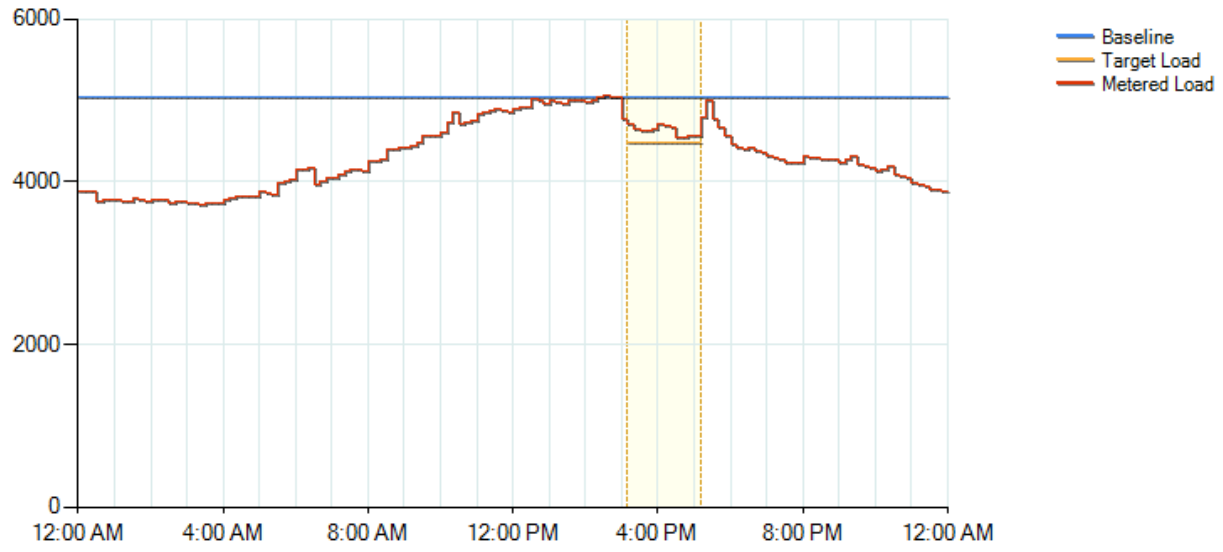


**Figure 47: Aggregate Metered Results, November 24th.**

Only Aggregator 2 nominated capacity in the PLP for the month of November. Participant 2 performed as expected during this event. Below are summaries for the event.

| | Aggregator 1 | Aggregator 2 | Total |
|---|---|---|---|
| **Average Metered Load (kW)** | n/a | 4630 | 4630 |
| **Baseline (kW)** | n/a | 5035 | 5035 |
| **Nomination (kW)** | n/a | 550 | 550 |
| **Average Target Load (kW)** | n/a | 4485 | 4485 |
| **Average Reduction (kW)** | n/a | 405 | 405 |
| **Performance** | n/a | 74% | 74% |
| **Adjusted Performance** | n/a | 74% | 74% |

**Table 50: Retail Performance Summary, November 24th.**

This event was called by the Pilot administrator independent of the CAISO and as such has no wholesale settlement associated with it.

Note: Due to an SDG&E scheduling system limitation (i.e., its inability to schedule in increments smaller than .1 MW), only 0.5 MW were bid for the 11-7 product hours in the month of November, in spite of total Participant nominations of 0.55 MW.

## 8.18 December 2nd (24x7)

This Retail test event dispatched on December 2nd, 2009 at 04:00 for a reduction of 1.2 MW. This resulted in the notification of the Direct Enrolled Customer to curtail their nominated capacity from 04:10 to 06:10. The following chart shows the metered performance for the Direct Enrolled Customer that participated in the event:

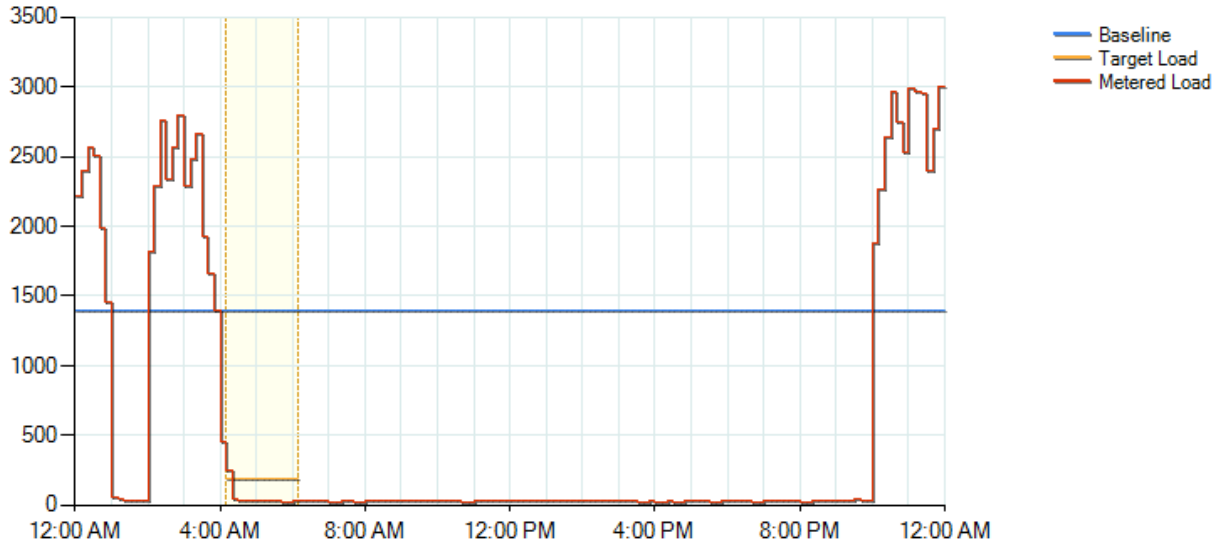


**Figure 48: Aggregate Metered Results, December 2nd**

The Direct Enrolled Participant performed as expected. Below are summaries for the event.

| | Direct Enrolled Customer |
|---|---|
| **Average Metered Load (kW)** | 49 |
| **Baseline (kW)** | 1392 |
| **Nomination (kW)** | 1200 |
| **Average Target Load (kW)** | 192 |
| **Average Reduction (kW)** | 1343 |
| **Performance** | 112% |
| **Adjusted Performance** | 100% |

**Table 51: Retail Performance Summary, December 2nd**

CAISO settlement data currently available shows that no Non Spinning Reserve capacity payment was rescinded, but the CAISO acknowledged an error in processing event for Initial Settlement statements. With the current information, the compliance factor cannot be accurately determined.

## 8.19 December 3rd (11-7)

This scheduled event was dispatched by the CAISO on December 3rd, 2009 at 14:55 for a reduction of 0.55 MW. The following chart shows the metered performance for the aggregator that participated in the event:

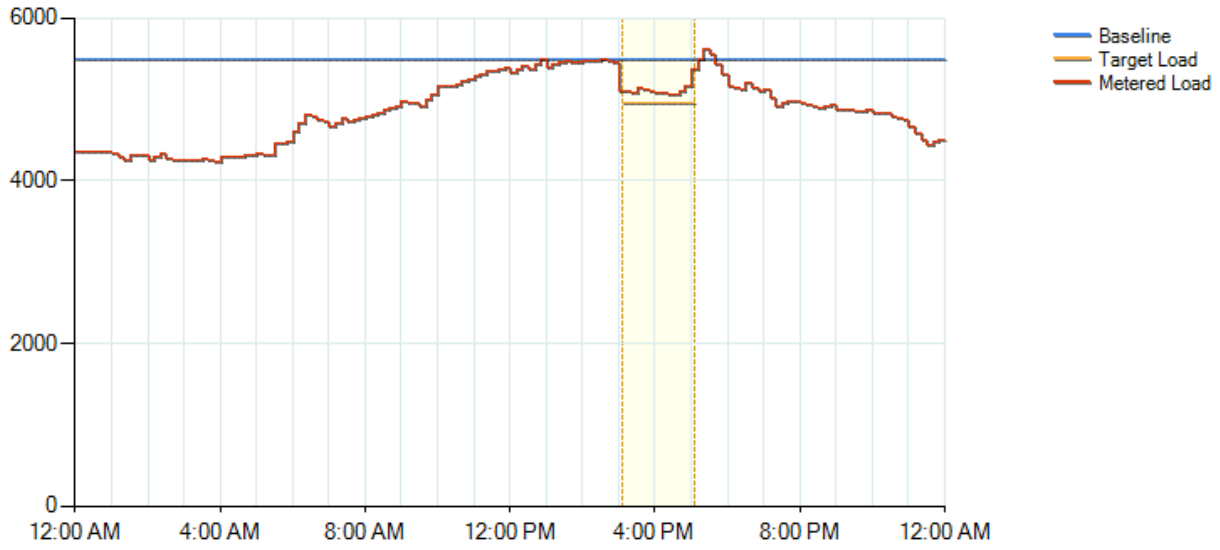


**Figure 49: Aggregate Metered Results, December 3rd.**

Only Aggregator 2 nominated capacity in the PLP for the month of December. Participant 2 performed as expected during this event. Below are summaries for the event.

| | Aggregator 1 | Aggregator 2 | Total |
|---|---|---|---|
| **Average Metered Load (kW)** | n/a | 5123 | 5123 |
| **Baseline (kW)** | n/a | 5500 | 5500 |
| **Nomination (kW)** | n/a | 550 | 550 |
| **Average Target Load (kW)** | n/a | 4950 | 4950 |
| **Average Reduction (kW)** | n/a | 377 | 377 |
| **Performance** | n/a | 69% | 69% |
| **Adjusted Performance** | n/a | 69% | 69% |

**Table 52: Retail Performance Summary, December 3rd.**

CAISO settlement data currently available shows that no Non Spinning Reserve capacity payment was rescinded, but the CAISO acknowledged an error in processing event for Initial Settlement statements. With the current information, the compliance factor cannot be accurately determined.

Note: Due to an SDG&E scheduling system limitation (i.e., its inability to schedule in increments smaller than .1 MW), only 0.5 MW were bid for the 11-7 product hours in the month of December, in spite of total Participant nominations of 0.55 MW.

## 8.20 December 7th (11-7)

This event was an unscheduled Contingency Dispatch from the CAISO on December 7th, 2009 at 18:25 for a reduction of 0.5 MW. Scheduled PLP events were set to have default duration of 2 hours; however, APX's notification system is configured to be able to notify 11am-7pm product Participants of events until 19:00 so this live contingency dispatched triggered an event from 18:35 to 19:00. The following chart shows the metered performance for the aggregator that participated in the event:

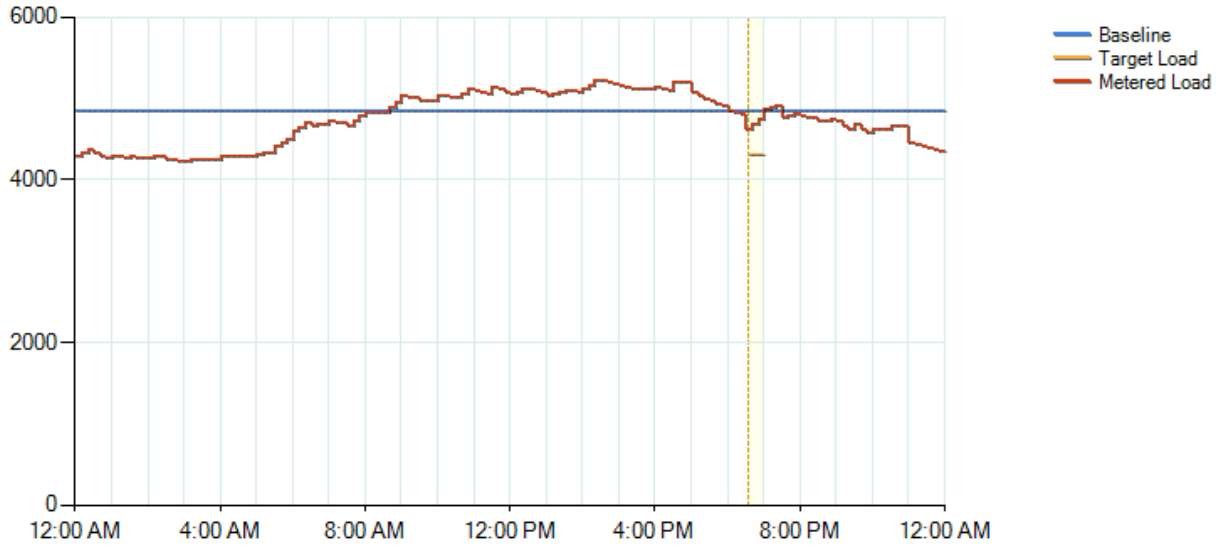


**Figure 50: Aggregate Metered Results, December 7th**

Only Aggregator 2 nominated capacity in the PLP for the month of December. Participant 2 performed as expected during this event. Below are summaries for the event.

| | Aggregator 1 | Aggregator 2 | Total |
|---|---|---|---|
| **Average Metered Load (kW)** | n/a | 4690 | 4690 |
| **Baseline (kW)** | n/a | 4858 | 4858 |
| **Nomination (kW)** | n/a | 550 | 550 |
| **Average Target Load (kW)** | n/a | 4308 | 4308 |
| **Average Reduction (kW)** | n/a | 169 | 169 |
| **Performance** | n/a | 31% | 31% |
| **Adjusted Performance** | n/a | 31% | 31% |

**Table 53: Retail Performance Summary, December 7th**

This event was called by the Pilot administrator independent of the CAISO and as such has no wholesale settlement associated with it.

Note: Due to an SDG&E scheduling system limitation (i.e., its inability to schedule in increments smaller than .1 MW), only 0.5 MW were bid for the 11-7 product hours in the month of December, in spite of total Participant nominations of 0.55 MW.

## 8.21 December 11th (24x7)

This Retail test event was dispatched on December 11th, 2009 at 02:00 for a reduction of 1.2 MW. This resulted in the notification of the Direct Enrolled Customer to curtail their nominated capacity from 02:10 to 04:10. The following chart shows the metered performance for the Direct Enrolled Customer that participated in the event:

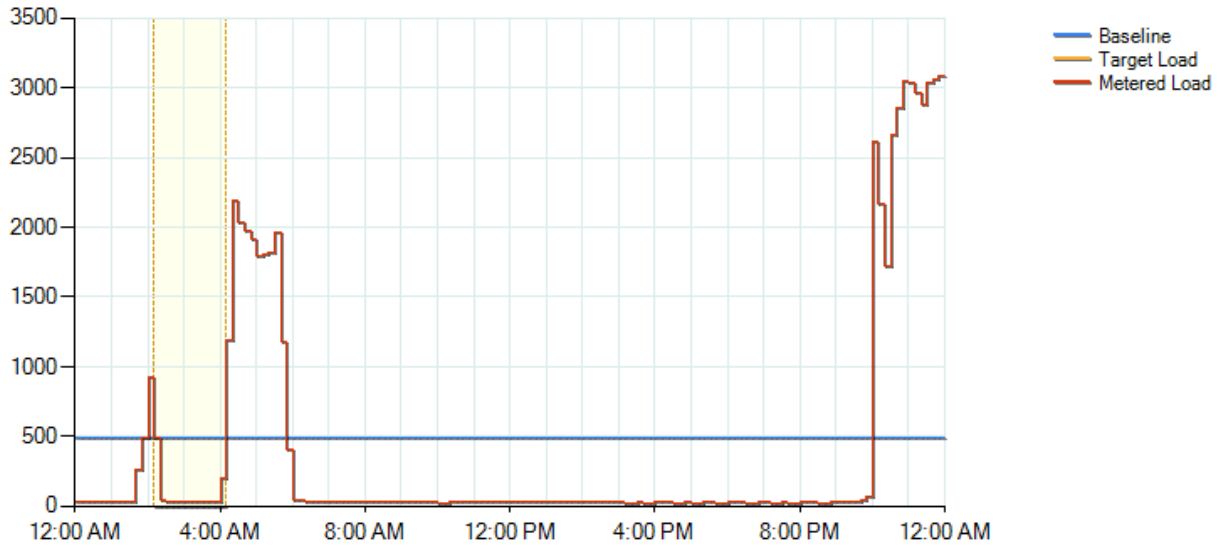


**Figure 51: Aggregate Metered Results, December 11th**

The Direct Enrolled Participant performed as expected, although a lower baseline drove down overall performance. Below are summaries for the event.

| | Direct Enrolled Customer |
|---|---|
| **Average Metered Load (kW)** | 86 |
| **Baseline (kW)** | 490 |
| **Nomination (kW)** | 1200 |
| **Average Target Load (kW)** | -710 |
| **Average Reduction (kW)** | 404 |
| **Performance** | 34% |
| **Adjusted Performance** | 34% |

**Table 54: Retail Performance Summary, December 11th**

This event was called by the Pilot administrator independent of the CAISO and as such has no wholesale settlement associated with it.

## 8.22 December 15th (24x7)

This Retail test event was dispatched on December 15th, 2009 at 02:30 for a reduction of 1.2 MW. This resulted in the notification of the Direct Enrolled Customer to curtail their nominated capacity from 02:40 to 04:40. The following chart shows the metered performance for the Direct Enrolled Customer that participated in the event:

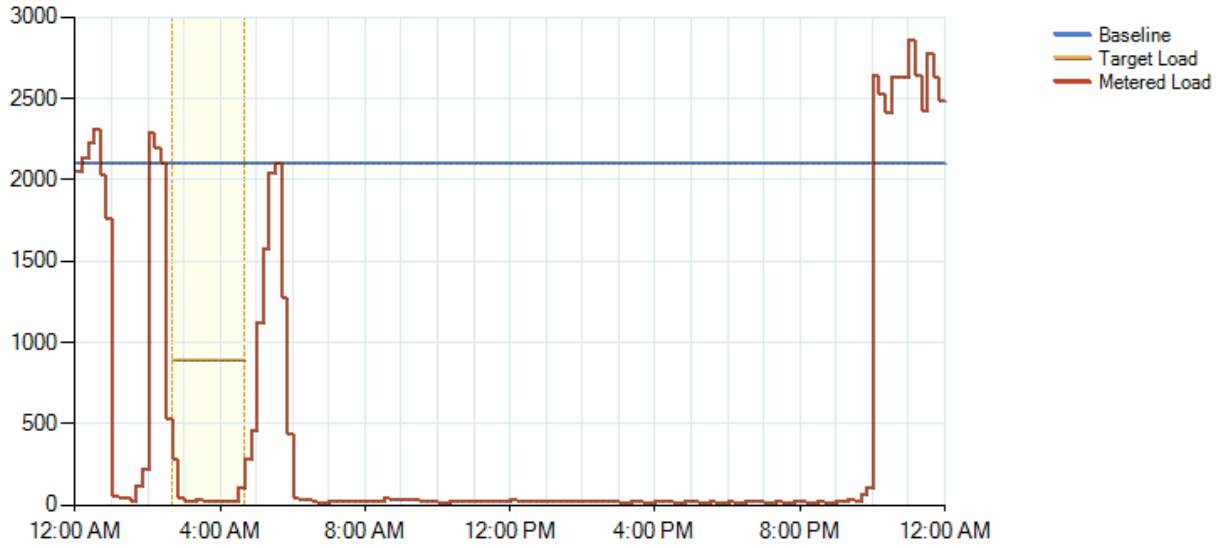


**Figure 52: Aggregate Metered Results, December 15th.**

The Direct Enrolled Participant performed as expected. Below are performance summaries for the event.

| | Direct Enrolled Customer |
|---|---|
| **Average Metered Load (kW)** | 61 |
| **Baseline (kW)** | 2102 |
| **Nomination (kW)** | 1200 |
| **Average Target Load (kW)** | 902 |
| **Average Reduction (kW)** | 2042 |
| **Performance** | 170% |
| **Adjusted Performance** | 100% |

**Table 55: Retail Performance Summary, December 15th.**

This event was called by the Pilot administrator independent of the CAISO and as such has no wholesale settlement associated with it.

# 9 Appendix II: Disaggregating 15-Minute Intervals

As is covered in section 4.5.1, 5-minute interval metering would have provided more accurate retail and wholesale settlements for the Pilot. The method used in the Pilot for converting 15-minute intervals into 5-minute intervals is to divide each 15-minute kWh value by three. This section covers three alternate ways of disaggregation:

- Roll-up telemetry kW reads into 5-minute intervals.
- Shape 5-minute intervals using Pilot telemetry
- Interpolate 5-minute intervals from the surrounding 15-minute intervals

The following sections go into the methodology and in detail results for and several Pilot events.

## 9.1 Telemetry Instead of Utility Meter Data

The first alternate approach is to use Pilot telemetry directly for settlement. This is an interesting idea to many as perhaps one way to cut costs. The rationale is that if telemetry devices are required for PL, then perhaps they can also provide settlement meter data. There are many reasons both institutional and practical that make this an unlikely proposition; however, it is an interesting enough idea that it gets coverage here.

The methodology used to compile these data was to take the 1-minute archived telemetry demand reads and use them to compile average kW over 5-minute intervals. There are a few downsides to this approach:

- Whether the telemetry is instantaneous demand or averaged demand, the aggregate of the archived telemetry reads is not necessarily indicative of the actual average demand.
- Latency introduced in the system from telemetry-read to archive skews the results in ways similar to those discussed in section 4.5.2.

If telemetry measurements were to be truly used for settlement, the collection of valid intervals would need to be correctly handled.

## 9.2 Telemetry-shaped Utility Meter data

Another approach is to continue to use utility meter data but to shape it with the telemetry. This has the advantage of maintaining the total 15-minute energy as recorded by the utility meter while recognizing that a straight "divided by three" algorithm does not recognize the ramp up and ramp-down effects at the boundaries of an event.

The methodology used was to take 5-minute intervals as calculated in section 9.1 and use them as ratios between the related 15-minute intervals. Then the 15-minute intervals are converted to 5-minute intervals using the same ratios.

## 9.3 Interpolated Utility Meter data

The final – and by far the simplest – approach is to use utility meter data alone and shape the 3 5-minute values for a 15-minute interval based on the surrounding 15-minute intervals. This has an advantage over the approach in section 9.2 as it eliminates clock-synchronization issues between the telemetry measurement device and the utility meter.

The methodology used for this calculation was to compute the slope for each 15-minute interval (i.e., the ratio between the preceding and subsequent interval). Then the 15-minute intervals are converted to 5-minute intervals using the same linear ratio.

## 9.4 Conclusions

Section 9.5 includes details of the different calculations. It is difficult to glean a strong conclusion from such a small sample; however, some general observations can be made:

- Using telemetry systems instead of utility metering is less a technical hurdle and more a policy hurdle on which the California utilities are in complete agreement. While this analysis used minutely telemetry data, more standard 5-minute average kW reads modeling utility metering would not make this policy hurdle go away. As such, telemetry metering is unlikely to be a viable solution in the foreseeable future.
- Using telemetry systems to shape utility metering is straightforward though challenging. Integrating such calculations alongside SQMD into real-world settlement and billing systems would be complex.
- While interpolating meter data may appear to be fair and reasonable, more analysis needs to be done to determine if such an algorithm truly works well, where it falls short, and if there are alternate approaches to the algorithm that more accurately reflect transitions.

Certainly the best option for products requiring 5-minute fidelity it is to eschew any kind of disaggregation and use 5-minute meters.

## 9.5 Details

### 9.5.1 Aggregator 1, August 20th

The following table provides details for these four alternate calculation scenarios.

| Interval (10 min) | 14:10 | 14:20 | 14:30 | 14:40 | 14:50 | 15:00 | 15:10 | 15:20 | 15:30 | 15:40 | 15:50 | 16:00 | 16:10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Nomination** | | | | | | | 170 | | | | | | |
| **SQMD / 3: Event Performance Factor** | | | | | | | **85%** | | | | | | |
| **Baseline** | | | | | | | 794 | | | | | | |
| **Target Load** | | | | | | | 624 | | | | | | |
| **Actual Load** | 757 | 699 | 640 | 638 | 638 | 638 | 637 | 638 | 639 | 634 | 630 | 627 | 632 |
| **Load Reduction** | 36 | 95 | 154 | 156 | 156 | 156 | 157 | 156 | 155 | 160 | 164 | 167 | 162 |
| **% Load reduction** | 21% | 56% | 91% | 92% | 92% | 92% | 92% | 92% | 91% | 94% | 96% | 98% | 95% |
| **Telemetry: Event Performance Factor** | | | | | | | **82%** | | | | | | |
| **Baseline** | | | | | | | 783 | | | | | | |
| **Target Load** | | | | | | | 613 | | | | | | |
| **Actual Load** | 767 | 704 | 629 | 627 | 626 | 635 | 630 | 630 | 627 | 624 | 620 | 617 | 626 |
| **Load Reduction** | 17 | 80 | 155 | 156 | 158 | 149 | 153 | 153 | 156 | 159 | 164 | 167 | 158 |
| **% Load reduction** | 10% | 47% | 91% | 92% | 93% | 87% | 90% | 90% | 92% | 94% | 96% | 98% | 93% |
| **Telemetry-Shaped SQMD: Performance Factor** | | | | | | | **88%** | | | | | | |
| **Baseline** | | | | | | | 794 | | | | | | |
| **Target Load** | | | | | | | 624 | | | | | | |
| **Actual Load** | 754 | 649 | 634 | 635 | 636 | 633 | 636 | 639 | 636 | 633 | 627 | 630 | 634 |
| **Load Reduction** | 40 | 145 | 160 | 159 | 158 | 161 | 158 | 155 | 158 | 161 | 167 | 164 | 160 |
| **% Load reduction** | 23% | 85% | 94% | 93% | 93% | 95% | 93% | 91% | 93% | 95% | 98% | 96% | 94% |
| **Interpolated SQMD: Performance Factor** | | | | | | | **87%** | | | | | | |
| **Baseline** | | | | | | | 794 | | | | | | |
| **Target Load** | | | | | | | 624 | | | | | | |
| **Actual Load** | 770 | 678 | 620 | 637 | 638 | 638 | 636 | 639 | 637 | 635 | 628 | 627 | 612 |
| **Load Reduction** | 24 | 116 | 174 | 157 | 156 | 156 | 158 | 155 | 157 | 159 | 166 | 167 | 182 |
| **% Load reduction** | 14% | 68% | 102% | 92% | 92% | 92% | 93% | 91% | 92% | 94% | 98% | 98% | 107% |

**Table 56: August 20th Alternate Performance for Aggregator 1**

| | Unadjusted Event Capacity Payment | Event Performance Factor | Tariff Adjusted Performance Factor | Event Adjusted Capacity Payment ($) |
|---|---|---|---|---|
| Actual Meters | $1,139.00 | 84.87% | 84.87% | $966.61 |
| Telemetry Data | $1,139.00 | 82.40% | 82.40% | $938.52 |
| Telemetry-shaped | $1,139.00 | 87.97% | 87.97% | $1,002.01 |
| Interpolated | $1,139.00 | 87.11% | 87.11% | $992.22 |

**Table 57: August 20th Alternate Capacity Payment Variations for Aggregator 1**

### 9.5.2 Aggregator 2, September 17th

The following table provides details for these four alternate calculation scenarios.

| Interval (10 min) | 14:10 | 14:20 | 14:30 | 14:40 | 14:50 | 15:00 | 15:10 | 15:20 | 15:30 | 15:40 | 15:50 | 16:00 | 16:10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Nomination** | | | | | | | 450 | | | | | | |
| **SQMD / 3: Event Performance Factor** | | | | | | | **80%** | | | | | | |
| **Baseline** | | | | | | | 3098 | | | | | | |
| **Target Load** | | | | | | | 2648 | | | | | | |
| **Actual Load** | 2816 | 2763 | 2709 | 2727 | 2673 | 2620 | 2691 | 2696 | 2702 | 2696 | 2684 | 2671 | 3138 |
| **Load Reduction** | 281 | 335 | 389 | 371 | 424 | 478 | 407 | 402 | 396 | 402 | 414 | 427 | -40 |
| **% Load reduction** | 63% | 74% | 86% | 82% | 94% | 106% | 90% | 89% | 88% | 89% | 92% | 95% | -9% |
| **Telemetry: Event Performance Factor** | | | | | | | **80%** | | | | | | |
| **Baseline** | | | | | | | 3051 | | | | | | |
| **Target Load** | | | | | | | 2601 | | | | | | |
| **Actual Load** | 2802 | 2690 | 2651 | 2718 | 2630 | 2598 | 2617 | 2683 | 2667 | 2677 | 2634 | 2634 | 2989 |
| **Load Reduction** | 249 | 362 | 400 | 333 | 421 | 453 | 434 | 368 | 384 | 374 | 417 | 417 | 62 |
| **% Load reduction** | 55% | 80% | 89% | 74% | 94% | 101% | 96% | 82% | 85% | 83% | 93% | 93% | 14% |
| **Telemetry-Shaped SQMD: Performance Factor** | | | | | | | **83%** | | | | | | |
| **Baseline** | | | | | | | 3098 | | | | | | |
| **Target Load** | | | | | | | 2648 | | | | | | |
| **Actual Load** | 2774 | 2722 | 2673 | 2754 | 2607 | 2610 | 2693 | 2699 | 2705 | 2681 | 2657 | 2712 | 3120 |
| **Load Reduction** | 324 | 376 | 425 | 344 | 491 | 488 | 405 | 399 | 393 | 416 | 441 | 386 | -22 |
| **% Load reduction** | 72% | 83% | 94% | 76% | 109% | 108% | 90% | 89% | 87% | 93% | 98% | 86% | -5% |
| **Interpolated SQMD: Performance Factor** | | | | | | | **80%** | | | | | | |
| **Baseline** | | | | | | | 3098 | | | | | | |
| **Target Load** | | | | | | | 2648 | | | | | | |
| **Actual Load** | 2765 | 2741 | 2697 | 2748 | 2643 | 2626 | 2701 | 2699 | 2702 | 2699 | 2604 | 2818 | 3177 |
| **Load Reduction** | 333 | 357 | 401 | 350 | 455 | 472 | 397 | 399 | 396 | 398 | 494 | 280 | -79 |
| **% Load reduction** | 74% | 79% | 89% | 78% | 101% | 105% | 88% | 89% | 88% | 89% | 110% | 62% | -18% |

**Table 58: August 17th Alternate Event Performance for Aggregator 2**

| | Unadjusted Event Capacity Payment | Event Performance Factor | Tariff Adjusted Performance Factor | Event Adjusted Capacity Payment ($) |
|---|---|---|---|---|
| Actual Meters | $2,261.25 | 80.09% | 80.09% | $1,811.02 |
| Telemetry Data | $2,261.25 | 79.90% | 79.90% | $1,806.80 |
| Telemetry-shaped | $2,261.25 | 83.14% | 83.14% | $1,880.06 |
| Interpolated | $2,261.25 | 79.50% | 79.50% | $1,797.73 |

**Table 59: August 17th Alternate Capacity Payments for Aggregator 2**

### 9.5.3 Direct Enrolled Customer, September 30th

The following table provides details for these four alternate calculation scenarios.

| Interval (10 min) | 05:10 | 5:20 | 5:30 | 5:40 | 5:50 | 6:00 | 6:10 | 6:20 | 6:30 | 6:40 | 6:50 | 7:00 | 7:10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Nomination** | | | | | | | 1200 | | | | | | |
| **SQMD / 3: Event Performance Factor** | | | | | | | **251%** | | | | | | |
| **Baseline** | | | | | | | 3053 | | | | | | |
| **Target Load** | | | | | | | 1853 | | | | | | |
| **Actual Load** | 86 | 86 | 58 | 38 | 38 | 29 | 38 | 38 | 48 | 38 | 38 | 29 | 38 |
| **Load Reduction** | 2966 | 2966 | 2995 | 3014 | 3014 | 3024 | 3014 | 3014 | 3005 | 3014 | 3014 | 3024 | 3014 |
| **% Load reduction** | 247% | 247% | 250% | 251% | 251% | 252% | 251% | 251% | 250% | 251% | 251% | 252% | 251% |
| **Telemetry: Event Performance Factor** | | | | | | | **227%** | | | | | | |
| **Baseline** | | | | | | | 2783 | | | | | | |
| **Target Load** | | | | | | | 1583 | | | | | | |
| **Actual Load** | 99 | 85 | 62 | 45 | 35 | 43 | 40 | 52 | 49 | 60 | 44 | 51 | 41 |
| **Load Reduction** | 2684 | 2698 | 2721 | 2738 | 2748 | 2740 | 2743 | 2730 | 2734 | 2723 | 2739 | 2732 | 2742 |
| **% Load reduction** | 224% | 225% | 227% | 228% | 229% | 228% | 229% | 228% | 228% | 227% | 228% | 228% | 229% |
| **Telemetry-Shaped SQMD: Performance Factor** | | | | | | | **251%** | | | | | | |
| **Baseline** | | | | | | | 3053 | | | | | | |
| **Target Load** | | | | | | | 1853 | | | | | | |
| **Actual Load** | 88 | 70 | 47 | 52 | 30 | 26 | 33 | 51 | 48 | 47 | 25 | 25 | 25 |
| **Load Reduction** | 2965 | 2983 | 3006 | 3001 | 3023 | 3027 | 3020 | 3002 | 3005 | 3006 | 3028 | 3028 | 3028 |
| **% Load reduction** | 247% | 249% | 250% | 250% | 252% | 252% | 252% | 250% | 250% | 250% | 252% | 252% | 252% |
| **Interpolated SQMD: Performance Factor** | | | | | | | **251%** | | | | | | |
| **Baseline** | | | | | | | 3053 | | | | | | |
| **Target Load** | | | | | | | 1853 | | | | | | |
| **Actual Load** | 14 | 70 | 47 | 37 | 30 | 30 | 38 | 46 | 46 | 44 | 22 | 22 | 22 |
| **Load Reduction** | 3039 | 2983 | 3006 | 3016 | 3023 | 3023 | 3015 | 3007 | 3007 | 3009 | 3031 | 3031 | 3031 |
| **% Load reduction** | 253% | 249% | 250% | 251% | 252% | 252% | 251% | 251% | 251% | 251% | 253% | 253% | 253% |

**Table 60: September 30th Alternate Event Performance for the Direct Enrolled Customer**

| | Unadjusted Event Capacity Payment | Event Performance Factor | Tariff Adjusted Performance Factor | Event Adjusted Capacity Payment ($) |
|---|---|---|---|---|
| Actual Meters | $5,160.00 | 250.52% | 100.00% | $5,160.00 |
| Telemetry Data | $5,160.00 | 227.39% | 100.00% | $5,160.00 |
| Telemetry-shaped | $5,160.00 | 250.76% | 100.00% | $5,160.00 |
| Interpolated | $5,160.00 | 251.39% | 100.00% | $5,160.00 |

**Table 61: September 30th Alternate Capacity Payments for the Direct Enrolled Customer**