CALIFORNIA ENERGY COMMISSION

Energy Research and Development Division

**FINAL PROJECT REPORT**

# Reinventing Residential Demand Response

Appendices F-J

**Gavin Newsom, Governor**

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# APPENDIX F:
# Telemetry Interface Requirements & System Architecture Diagram for Demonstration of a Telemetry Solution for Mass Markets

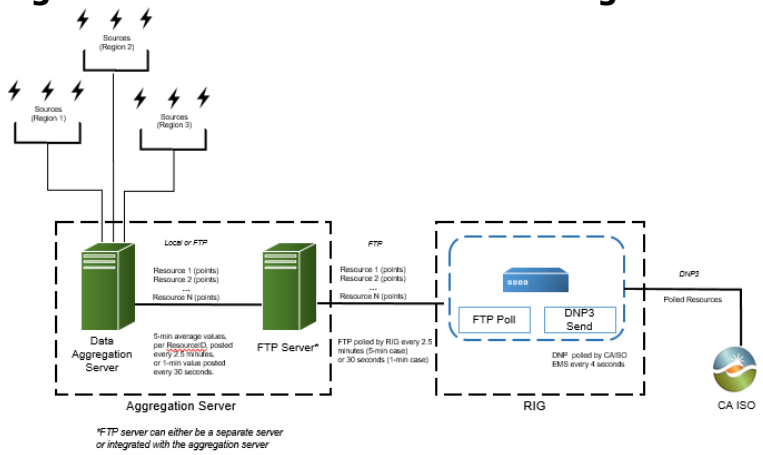
## Summary

This appendix identifies the proposed approach to interfacing the data aggregation server to the EPRI-provided RIG interface to the CAISO. The proposed approach is a short-term solution identified in order to get a system up and running quickly. EPRI is open to suggestions for alternative approaches. In the longer-term, additional modifications to this approach may be identified.

## Proposed approach

Figure F-1 illustrates a method to interface an aggregation server with a Remote Intelligent Gateway (RIG).

**Figure F-1: Architectural Diagram Illustrating a Method to Interface an Aggregation Server with a Remote Intelligent Gateway**




Source: EPRI

The proposed approach is for the required resource-level data to be provided via a text file and transmitted via FTP from the data aggregation server. This approach is based on two observations:

- A very small number of data points are required.
- The RIG can handle either a simple FTP file, whereas a much more complicated protocol (e.g. DNP3) would require greater effort than the current demonstration project requires.

The FTP site can either be hosted on the aggregation server, or on another server in the overall system.

## Security

It is assumed that the aggregation server and the RIG solution will be co-located in a secure facility using a dedicated internet connection for the FTP transmission. The FTP site will require the normal name and password security, but a secured facility is important as currently the file contents will be transmitted in plain text.[1]

## File Data Contents

The data that must be transmitted is identified in the CAISO Business Practice Manual (BPM) version 10.0 (Section 7.1 table, and additional info in Section 14).[2] The required data is identified for "Proxy Demand Resources (PDR)". The relevant information is extracted here. This is for information only. Please refer to the BPM for full details.

1. Unit Gross MW (see note 10)

   Definition: This quantity is defined as the resource's real power output, before subtracting the auxiliary real power load or step-up transformer real power losses.

   Each PDR shall be required to provide real-time load values. The load is the total real time load or the power consumed by the resource; it can be a directly measured or calculated. Load data can be provided directly from a field device, such as a revenue meter, or indirectly by interfacing to a PDR Energy Management System (EMS). It can also be derived by statistical sampling of a resource's underlying load. This data point is used to help establish a baseline and calculate the load reduction of a resource when the resource is dispatched. A method for calculating load is not valid unless approved by the CAISO.

2. Pseudo Gen MW

   PDR will be required to provide a pseudo generation point. The pseudo generation point calculates the real load, bias load, and the PDR UCON points. The pseudo generation point calculation can be performed within a control system, EMS, or RIG.

   The pseudo generation point allows the CAISO to model the PDR resources like a participating generator.

3. Bias Load MW

   Bias load is a calculated value that stores the initial real load of a resource when the PDR unit connectivity status (UCON) is initially set to ON (HIGH). The bias load is used to establish a resource's baseline load.

---

[1] A future possibility is for the file to be transmitted via a REST-based web service interface in order to provide additional flexibility and security options. However, the current proposed implementation just requires a file on an FTP server.

[2] California Independent System Operator. 2018. *Business Practice Manual Direct Telemetry.* CAISO Business Practice Manual Change Management. https://bpmcm.caiso.com/Pages/BPMDetails.aspx?BPM=Direct%20Telemetry.

4. PDR Resource Connect

   The PDR UCON in ON status is an indication that the PDR has been dispatched. CAISO dispatches for non-regulation resources are normally performed through the Automated Dispatch System (ADS). The PDR UCON can be manually set by an operator based off of an ADS signal. It can also be tied to an application programming interface (API) which automatically sends the ADS dispatch to the RIG to perform the calculation for the PDR UCON.

   If there are different resources with same point of connection then can have one PDR UCON.

5. PDR Unit Ready to Start and Start Status

   The PDR Ready to Start and Start statuses are required only if a PDR is participating in the Spinning or Non-Spinning Reserve market. The Ready to Start status should be set to ON (HIGH) if the resource has been awarded Spinning or Non-Spinning Reserve by the market and is available for dispatches. The Start status should be set to ON (HIGH) when the PDR UCON is ON (HIGH). Both status points can be linked to the PDR UCON status.

## Notes:

There may be more than one ResourceID provided by the aggregation server to the RIG. For example, if the original sources are in more than one Sub_LAP location, there will be a separate aggregation for each location, in a separate ResourceID for each Sub_LAP.

Currently, no data quality information is transferred through the FTP interface.

(note 10: Resolution @ .001 Gross MW = POD)

## File Transfer Information

It is proposed that the file that is transferred to the RIG be a simple text file, where each line consists of the variable name, an equal sign, and a value. It will look something like this:

RESOURCEID= 12345

DATE=YYMMDDHHMMSS

GROSSMW = 12.345

PSEUDOMW = 12.345

BIASLOADMW=12.345

AGGREGATEDGROSSMW=12.345

PDRCONNECT=1

AGGREGATEDUNITCONNECT=1

---

RESOURCEID= 12346

…

Although the interface supports floating point values, note that the interface to CAISO is using integers.

The filename will be of the form "RIGInterface.txt."

The FTP file will be read by the RIG at the frequency discussed below. The RIG does not delete the file, so the only means of detecting that the file has been updated is via the time embedded in the file.

## File Transfer Timing

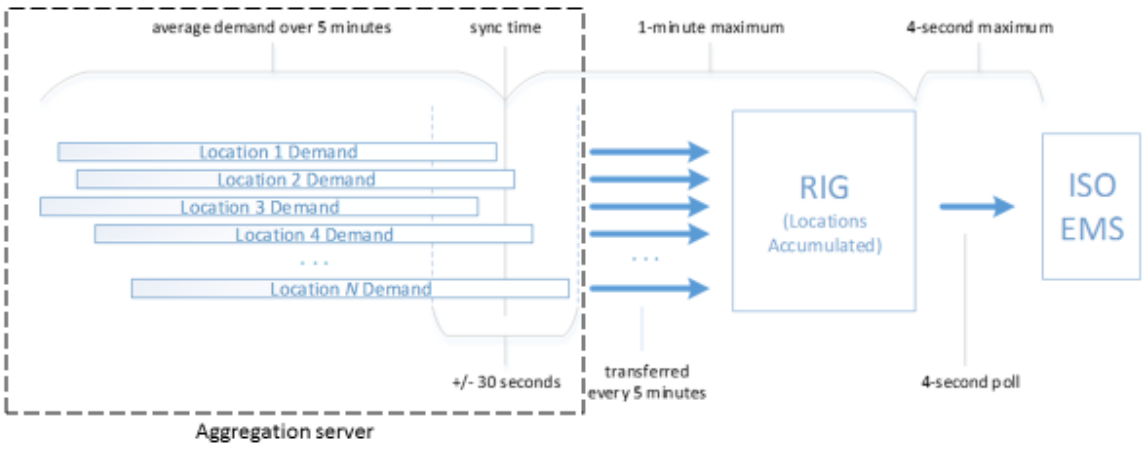
The timing of FTP file transfer is provided below. The timing was chosen to satisfy existing CAISO requirements found in the BPM in section 6.2.

1. The Aggregation Server stores 5-minute average values summed over all of the sources comprising a Resource, for RT case (or stores 1-minute average values for non-spin case). The end-time of each time window for which the averages are computed must be within +/- 30 seconds of the sync time (e.g., timestamp of the value stored).
2. The Aggregation Server updates the file on the FTP server every 2.5 minutes for RT case (or every 30 seconds for non-spin case).
3. The RIG polls for the FTP file every 2.5 minutes for RT case (or every 30 seconds for non-spin case), and reads the values into its memory.
4. The RIG transmits the most current data to CAISO every 4 seconds in response to the CAISO polls.

In the future it may be possible for the RIG to communicate to the aggregation server, for example to pass control signals from the CAISO EMS back to the aggregation server or to communicate status information. This feature is not implemented at this time, but in the future could consist of the RIG creating an FTP file for the aggregation server to read.

For reference, Figure F-2 illustrates timing requirements of the CAISO for the 5-minute case (RT energy). See the CAISO BPM on Direct Telemetry for further elaboration.

**Figure F-2: Direct Telemetry Requirement**




Source: California Independent System Operator. 2018. *Business Practice Manual Direct Telemetry.* CAISO Business Practice Manual Change Management. https://bpmcm.caiso.com/Pages/BPMDetails.aspx?BPM=Direct%20Telemetry.

## Error Handling

There are a number of possible errors that can occur during the FTP transfer:

- RIG fails to connect to the FTP server
- RIG fails to find the FTP file, or otherwise fails to open the FTP file (e.g. the file is open in another process)
- FTP file is incorrectly formatted, or other error occurs while reading
- FTP file is successfully read, but the date is more than 5 minutes old

In any of these cases, an error will be logged and the COMM_LOST indicator indicates that there is a communication failure in the path between the device where the data originates and the reporting device. This flag indicates that the value reported for the object may be stale or in bad quality. If set, the data value reported shall be the last value available from the originating device before communications were lost.

# APPENDIX G:
# Customer-Specific Data Collection

OhmConnect implemented several strategies to distribute "smart" devices to grant users in the effort to automate the usage of electronics and thermostats within households during an #OhmHour event. Initially, the purchase of these devices did not have high success rates as users did not want to pay upfront for technology whose value had yet to be proven. This memo will discuss both successful and failed strategies to distribute devices, results of a primary sourced survey to understand buyer behavior, how device data is collected and interpreted as well as how the information will be used to integrate with the RIG.

## Summary

This appendix highlights the data collected for customers via connected devices as stipulated in SubTask 4.4.1 of the CEC Grant 15-083. It discusses the communication logistics between smart devices and utility smart meters, consumption statistics and overall readiness for data aggregation of input to the RIG.

There were two pathways that could be taken to achieve the deliverable for this task. Method 1, distribute, monitor and collect data from Zigbee protocol enabled devices or Method 2, distribute, monitor and collect data from other devices. We disseminated both types of devices to users through our store and rebate programs. Due to low purchasing levels of devices with Zigbee technology (see Table G-1), it has been determined the most effective pathway to analyze communications between smart devices and utility smart meters, quantify consumption statistics and overall readiness for data aggregation of input into the RIG is to focus on Method 2, non-Zigbee enabled devices. This determination was based on four factors:

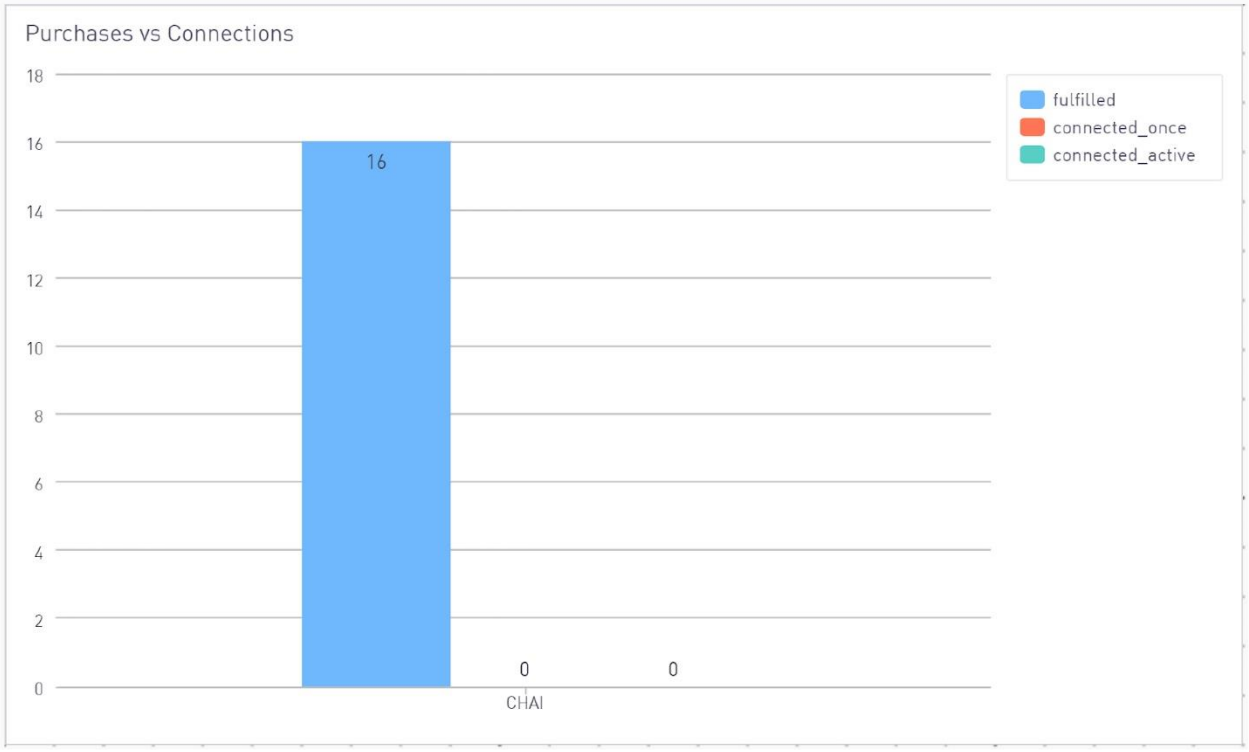
- A customer survey that highlighted the lack of interest in Zigbee devices
- Poor uptake rate on Zigbee devices compared to non-Zigbee devices (Figures G-1 and G-2)
- The general trend away from Zigbee devices
- Engineering challenges to incorporate Zigbee devices with the smart meters

**Table G-1: Purchased Devices vs. Connected Devices**

| | Spend | Purchased Devices | Connected Devices | Connected/ Purchased |
|---|---|---|---|---|
| Method 1: Zigbee Protocol Devices | $5,009.00 | 16 | 0 | 0 |
| Method 2: All Other Devices | $103,464.88 | 3,772 | 2,341 | 62% |

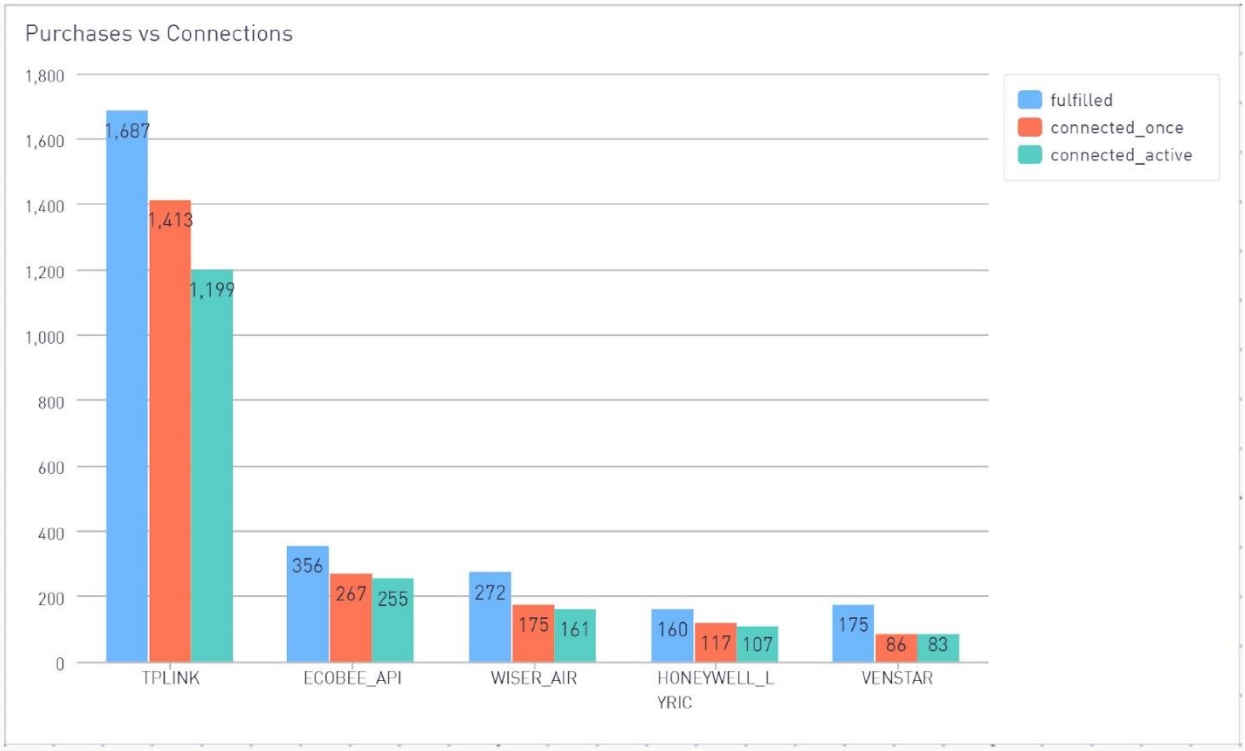
Source: OhmConnect

**Figure G-1: Method 1 – Zigbee Device Uptake**




Source: OhmConnect

**Figure G-2: Method 2 – All Other Devices Uptake**




Source: OhmConnect

The highest uptake in devices occurred with TP Links, the smart plugs. While we initially allocated only a portion of the budget for TP Links, the high uptake rate justified a budget move from the less consumer friendly thermostats to these newer smart plugs. We deployed 1600 TP Link devices and nearly 1000 thermostats. Going forward, we expect that the majority of our deployment will be with TP Links.

This appendix also discusses the data collection for Method 2 and the reliability of each device. Overall, we see a failure rate of device communication on the order of 3.4%, driven by high failure rates with TP Links and Honeywell. Excluding TP Link and Honeywell, the failure rate is 0.7%.

## Zigbee Device Investigation

The initial requirements of customer-specific data collection specified the coordination with device manufacturers and participating customers to enable real-time communication (via Zigbee) between customers' devices and utility smart meters. Zigbee is a wireless, low-power, flexible solution for building home area networks (HANs). While there is no dominant HAN standard, Zigbee is a significant participant. Silver Springs utility electric meters incorporate Zigbee to broadcast electricty prices and meter data. Some other devices, like Wiser and Ecobee, also support the Zigbee protocol. However, not all of these devices support Zigbee and as the protocol itself is not stable. Zigbee suffers from several limitations including low bandwidth, interference sensitivity, interoperability problems and limited acceptance.

To provide an example of the limited acceptance of Zigbee, consider that the popular Nest thermostat does not support Zigbee at all and while Ecobee thermostats used to have Zigbee support, their latest models do not. This suggests that Zigbee is not becoming a standard and may be falling by the wayside.

In addition, not all smart meters have Zigbee support. And for those that do, not all utilities allow it to be turned on or connected to devices. For utilities that do offer Zigbee connections, the number of devices they support is very small. For instance, PG&E has only certified 6 different Zigbee devices for use with their meters. While Zigbee initially showed a lot of promise to be the unifying HAN that would allow devices to be easily connected to smart meters, the reality is that this has never materialized and the support for it is waning.

Nevertheless, in an effort to promote telemetry solutions as mandated by the grant, OhmConnect offers Zigbee enabled technology to users such as Chai Energy and Energate devices. These devices are offered through our store for purchase and have been included in our Thermostat Rebate Program. This program offered customers a rebate of 50% at the time of purchase and another 50% once the user has installed and connected the device to their OhmConnect account, a 100% rebate or free device.

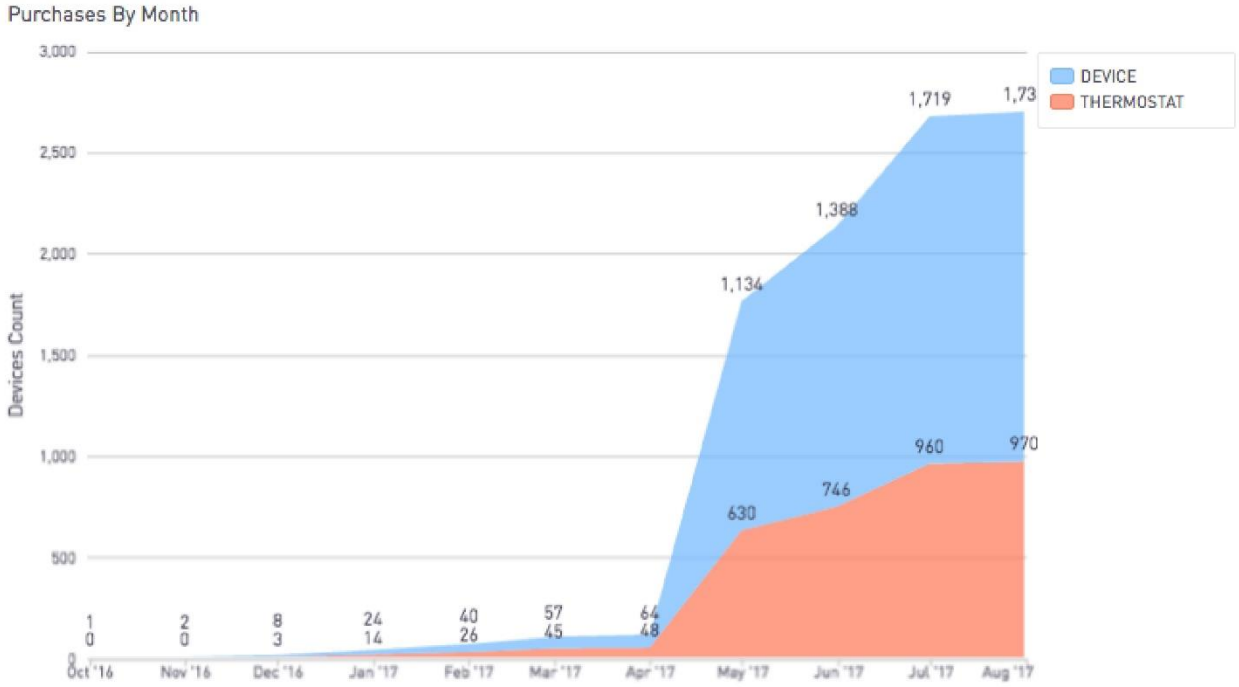
The purchase of these devices has been extremely low. There have been a total of 16 Chai and 0 Energate devices sold compared to other devices without Zigbee technology, such as TP Links with 2,763, sold see Table 1. Users tend to purchase, connect and continuously use devices that are easy to install and take little time to configure.

## Smart Device Uptake

OhmConnect struggled with smart device uptake over the first few months of the project. Even though we offered a 100% rebate upon device connection, our marketing was poor. The fact that our users had to purchase the device at full price up-front before they received the unit resulted in a low response from users. From June 2016 to April 2017, the promotion strategy was a user would purchase a device for 100% cost, then once they have connected their device to their OhmConnect account, allowing for OhmConnect to control the devices during #OhmHours, the user would receive a full rebate for their purchase. After evaluation of the initial promotion, an alternative strategy was implemented. In May 2017, OhmConnect rolled out a second experiment to increase device uptake, which was termed "50/50" rebate. The overall economics were very similar, with higher exposure to risk of non-connection. For the 50/50 rebate, the initial purchase of the device was 50% off the retail price and then once the device was connected, the user would receive a rebate, an additional 50%, for their purchase. The success of the May 2017 50/50 rebate is shown in Figure G-3 below, which shows a sharp uptick in device sold in May through July 2017.

Some other notable points is that the CEC free device rebate had some additional marketing materials, including the inclusion of the California Energy Commission name and logo, text messages to provide notifications of the free devices for all users, and an expiration date of one week (though we let users purchase devices up to three months after they initially saw the code, reaching a total of 2700 devices sold with the majority happening in the first few months of the promotion.

**Figure G-3: Smart Device Sales by Month**

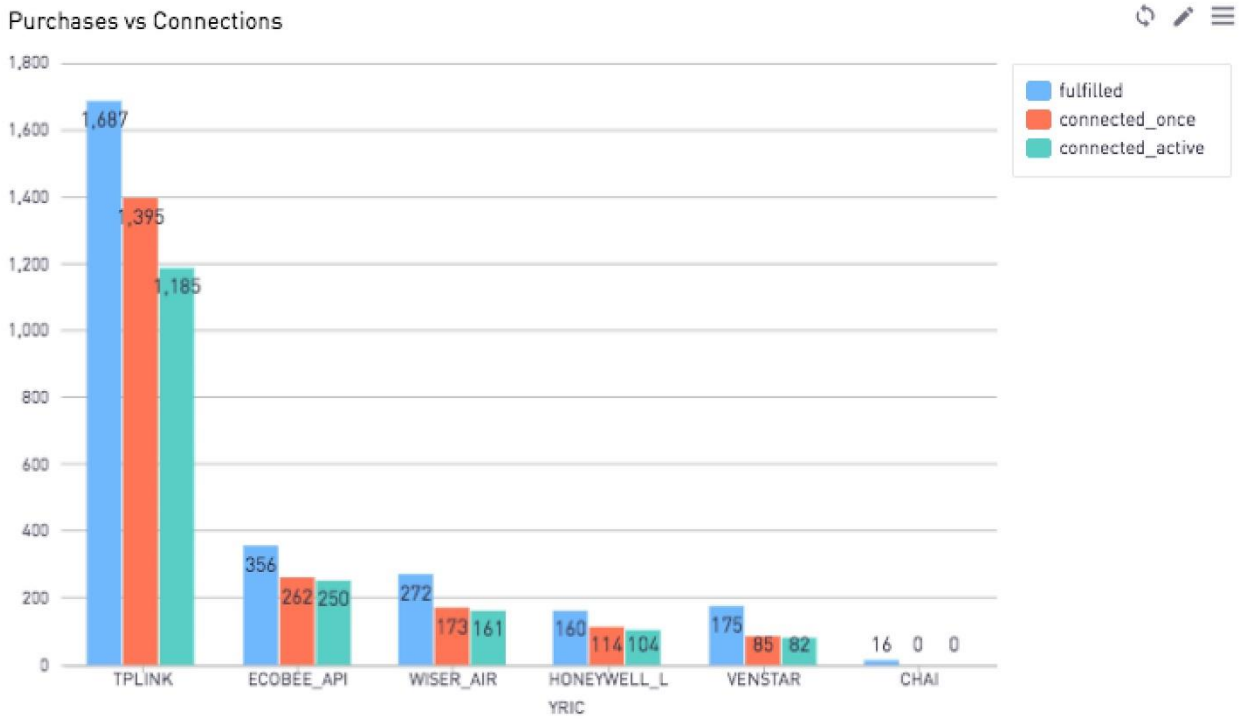



Source: OhmConnect

Figure G-4 outlines the number of devices purchased from the OhmConnect store, the connection of the devices to the users OhmConnect account and the devices that remain in use, actively participating in #OhmHours.

During the second promotion, users have overwhelming chosen plug and play devices such as TP Links as their preferred device. The ease of use involved with simply plugging a major appliance into an outlet that will automate energy use is very attractive to users because there is no configuration or complexity involved. There have been over 1600 TP Links purchased and nearly 1200 are actively connected or 70%. The next preferred smart thermostat is ecobee with over 356 devices sold and 250 currently active (also 70%). The balance of the devices purchased combined is approximately 623 units, 347 active or 55%. Note that while connection rates were fairly high for ecobee, TP-Links and Honeywells, they suffered for Venstar and Schneider Electric's Wiser-Air. We suspect that those low rates were suffering due to the difficulty of installation.

**Figure G-4: Devices Sold, Connected, and Remaining Active**

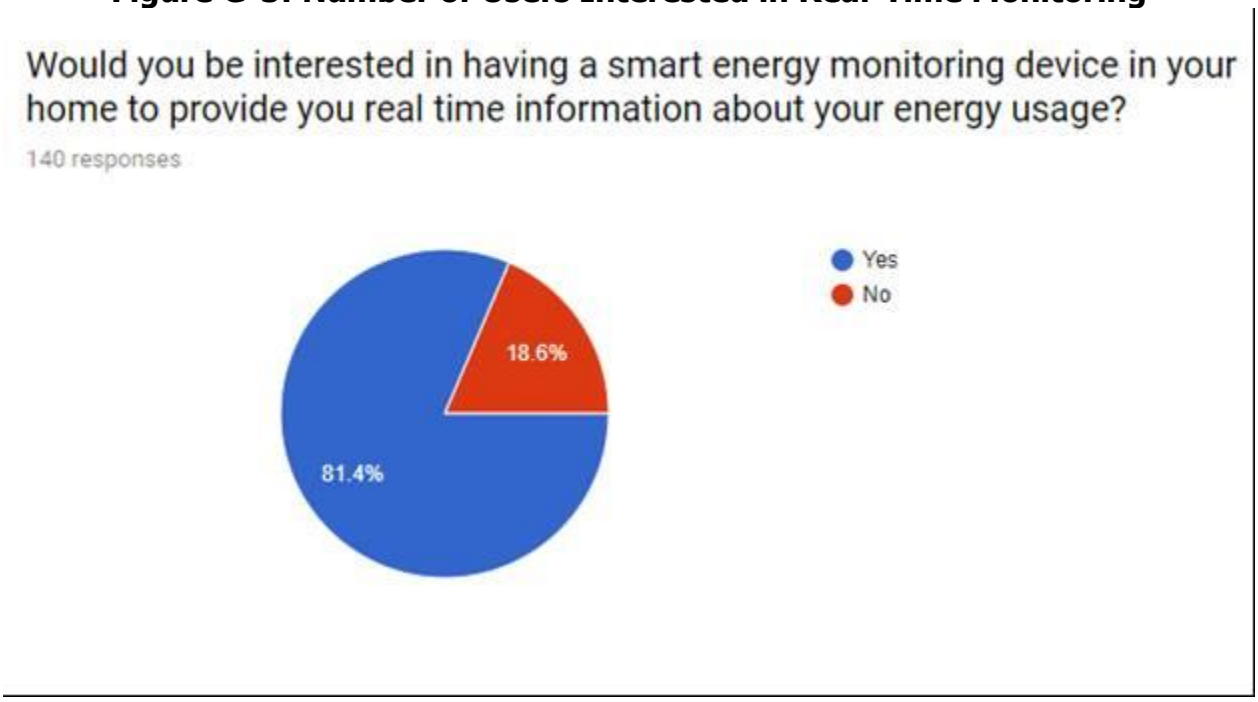



Source: OhmConnect

## Smart Device Survey

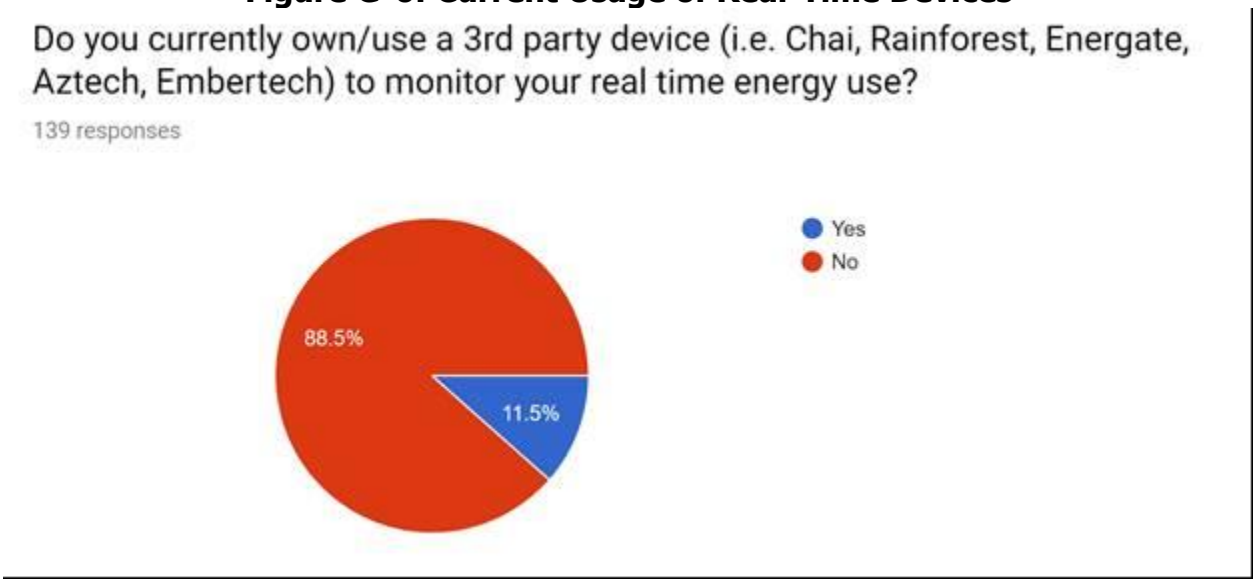
In an effort to understand user behavior and desire to utilize devices containing protocols like Zigbee, OhmConnect conducted a survey to gauge overall interest and likelihood of purchasing this type of device as well as non-Zigbee devices. Figure G-5 shows, 81% of users stated they would be interested in having their homes' energy usage monitored in real time, the main feature in a Zigbee enabled device; however, less than 12% currently own a device that enables real time tracking according to Figure G-6.

**Figure G-5: Number of Users Interested in Real-Time Monitoring**




Source: OhmConnect

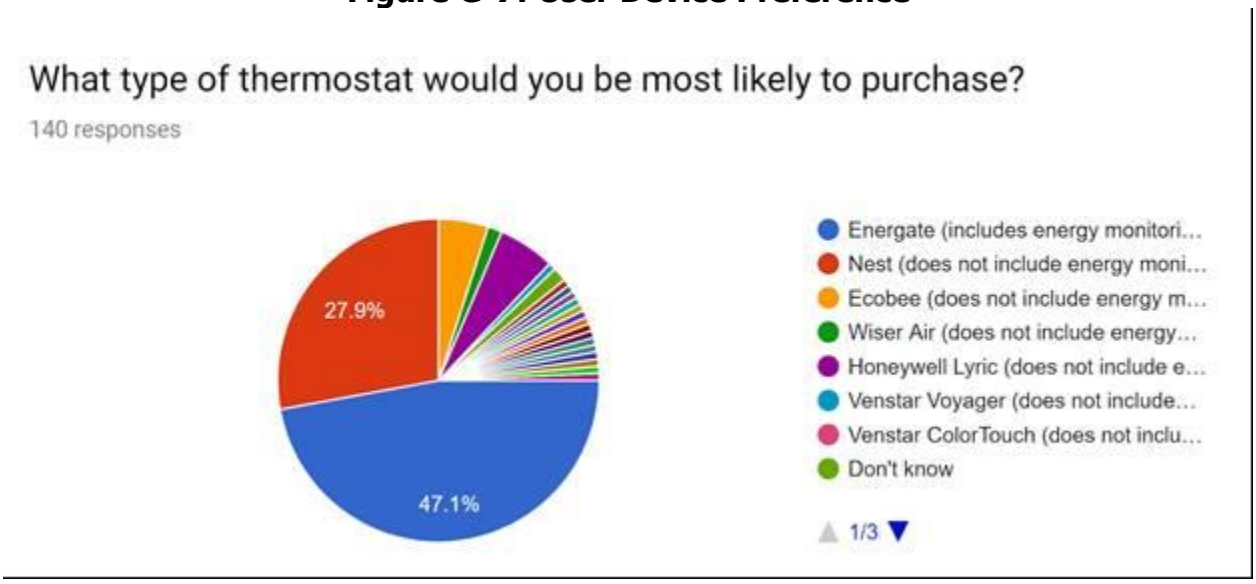
**Figure G-6: Current Usage of Real-Time Devices**




Source: OhmConnect

When users were asked about the type of device they would prefer to purchase, 47% stated Energate is the device of choice. This device contains the Zigbee protocol enabling real time data to be transferred to their utility meter. The remaining 53% of users selected a variety of other devices that do not have energy monitoring capabilities, see Figure G-7. This is very interesting because this conflicts with actual buyer behavior shown in Figure G-4. The theory here is users may desire the real time monitoring features, but purchases are driven by cost, ease of installation and usability factors.

**Figure G-7: User Device Preference**



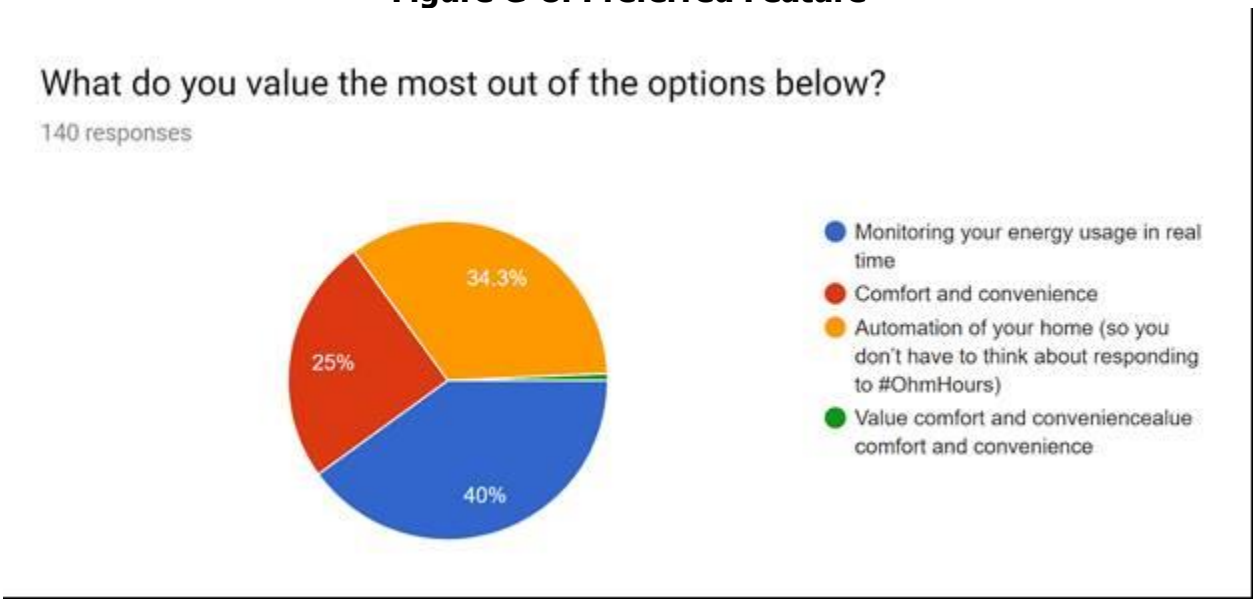

Source: OhmConnect

Zigbee-enabled products have not only had a low uptake in sales (16 Chai devices sold, 0 Energate devices sold), but the customer feedback from Chai devices have been less than favorable. While users believe real-time data is a desirable feature, concerns have been expressed regarding the overall product, specifically the complexity of installation, data integrity and readability.

To further understand the motivation of buyer behavior OhmConnect asked users what feature is valued the most from a smart device. According to Figure G-8, a consistent trend of stating real time energy monitoring is preferred as well as automation of the home to control devices without being present is most desired. Users also state thermostats are preferred over standalone devices, see Figure G-9. This is contradictory to user purchasing behavior outlined in Graph 4 depicting TP Links, a standalone device, is the overwhelming smart device of choice.

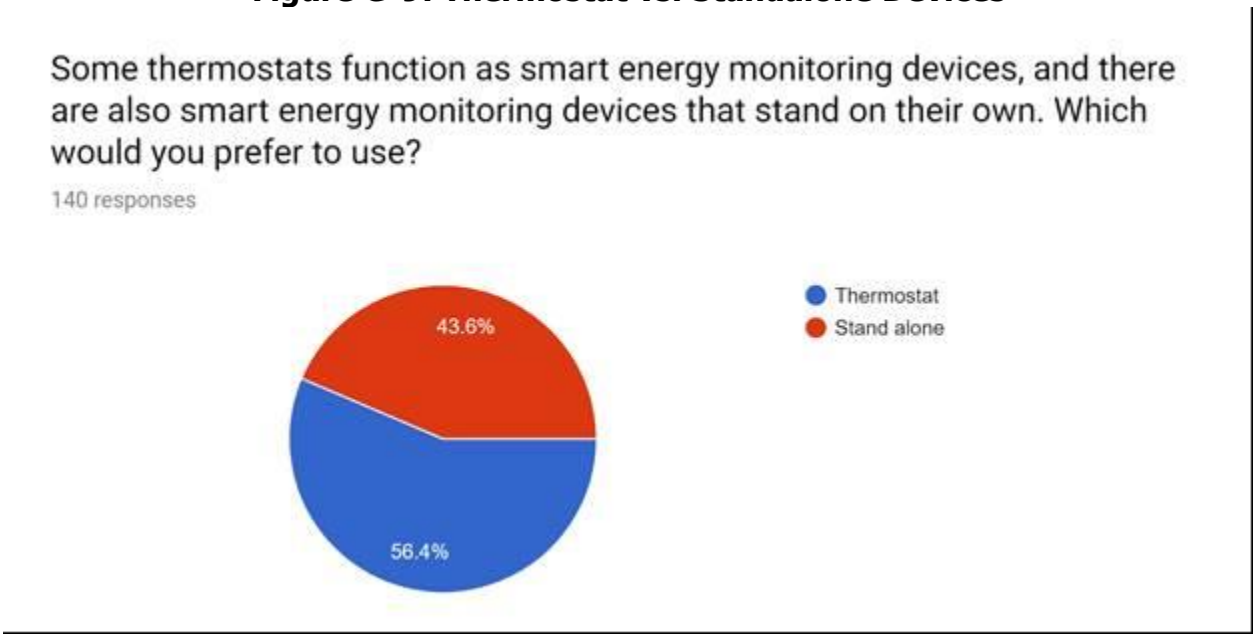
While 40% state the ability to have real time energy usage is desirable, almost as many users, 34% are ultimately interested in automation of their homes regardless of the type of device, see Figure G-8. The comfort and convenience of having an automated device is also important to users. Per Figure G-8, one user noted value, comfort and convenience were all equally important.

**Figure G-8: Preferred Feature**




Source: OhmConnect

**Figure G-9: Thermostat vs. Standalone Devices**

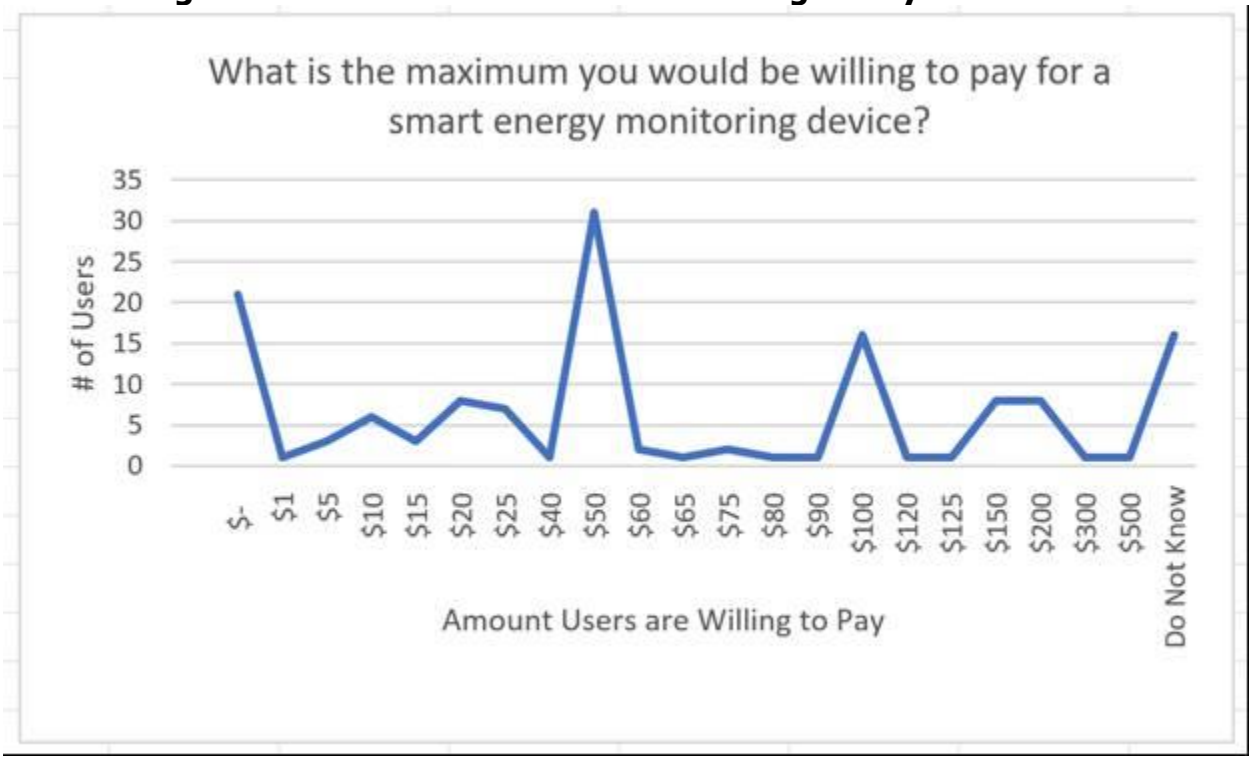



Source: OhmConnect

Given the survey results that indicate users want real time monitoring devices, but actively purchase other devices, we began to investigate if the cost of devices led to unexpected buyer behavior. Questions were posed to users regarding how much they would be willing to pay for a smart device, if users would prefer to use OhmConnect points to pay for a device, if they are willing to pay with OhmConnect points then how many points would users be willing to pay (see Figure G-10).

Most users, while very interested in automation technology, would prefer to pay $0 for this type of device or would choose a cost-effective device under $30. This observation supports the purchase levels of TP Links vs. other devices as indicated in Figure G-4.

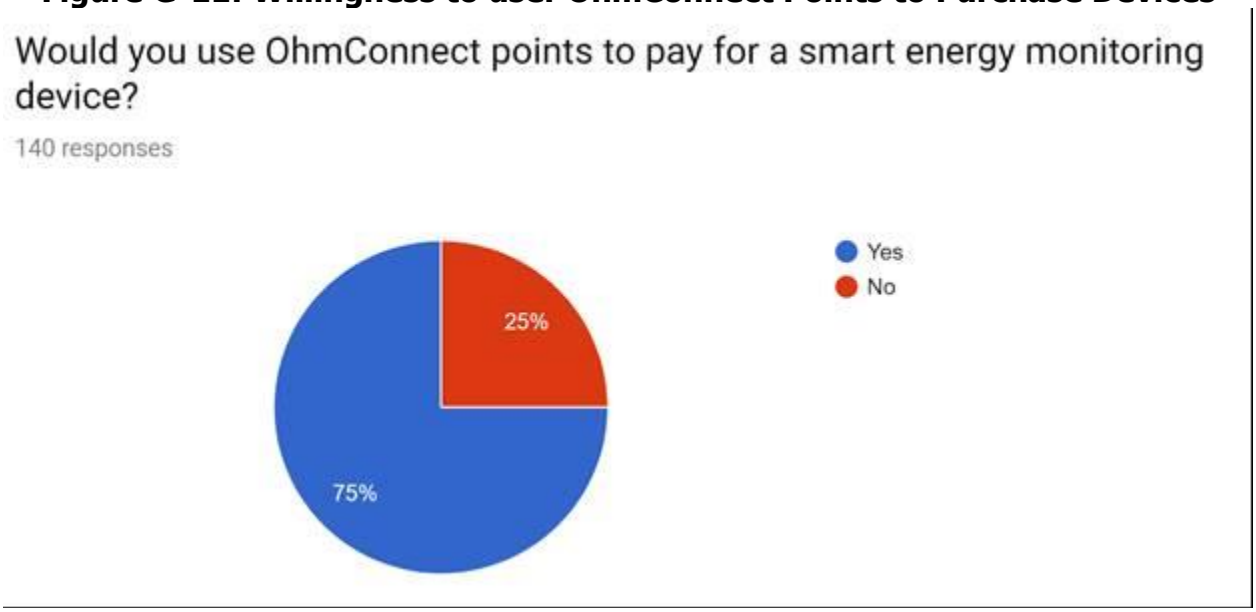
**Figure G-10: How Much Users Are Willing to Pay for Devices**




Source: OhmConnect

To offset the price factor of purchasing a device, users were asked if they were willing to buy a device using their OhmConnect points they have earned through #OhmHours and other incentives. An overwhelming majority of users, 75% stated they are willing to pay for a device using their OhmConnect points (Figure G-11).

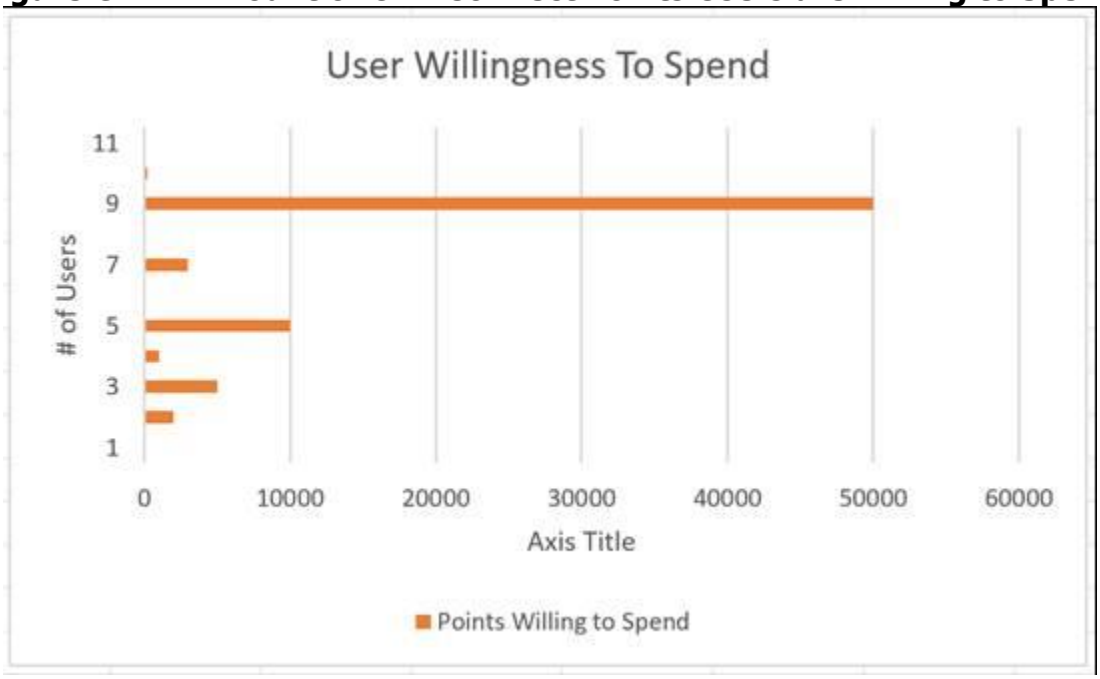
**Figure G-11: Willingness to user OhmConnect Points to Purchase Devices**




Source: OhmConnect

Even with paying for devices using points, most users do not want to pay more than 10000 points or $100 as shown in Figure G-12.

**Figure G-12: Amount of OhmConnect Points Users are Willing to Spend**




Source: OhmConnect

As shown through survey results and purchase history, the idea of real time energy monitoring devices is greatly desired by users; however, this feature is ultimately not chosen when purchasing products. As a result, OhmConnect has focused on obtaining data consumption information from user preferred devices. These devices do not provide the real time data. Instead, the data gathered comes from the state of devices (i.e., off/on/auto/etc). Specifics regarding this type of data is documented in the Data Consumption section of this memo.

## Data Consumption

OhmConnect verifies the status of devices every 15 minutes. Depending on the device, status updates include the state of the device (on, off, temperature setting, if the thermostat is set to heat, cool, fan, auto, etc). The reliability of the communication to these devices must be high in order to be able to turn on and off the user's thermostat during an #OhmHour. A constant connection with the device to obtain information and remote interactivity is imperative for successful participation in an energy saving event. If there is a connection issue to the device, after repeated attempts, the user is sent a device reconnect email. A large number of device reconnect emails indicates there is an issue with staying connected to that type of device or the device has a low communication reliability rate. Most of the time, the reliability for devices are extremely high. However, some devices have had a number of connection reliability issues. Through constant monitoring, OhmConnect has been able to identify trends and proactively work directly with manufacturers to create a more robust API, resulting in higher reliability and lower reconnection emails sent to users.

Devices are monitored and data is collected through OhmConnect's scraping process. OhmConnect checks the status of devices. Per Figure G-13 below, the blue bar indicates devices with successful scrapes (the ability to obtain all required data to successfully communicate with and control devices remotely). The red bar shows failed scrapes or events

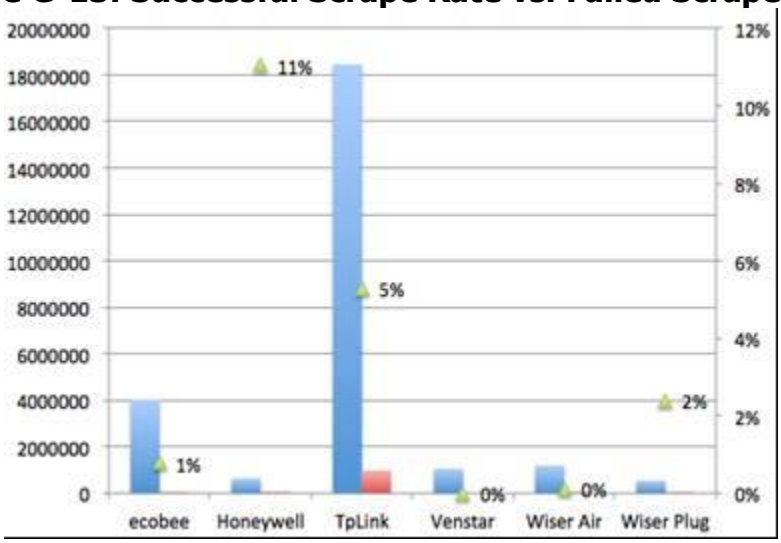
when devices were not able to be communicated with. The guide to evaluate scrapes are as follows:

0-1% - Excellent

2-3% - Fair

> 3% - Needs Improvement

**Figure G-13: Successful Scrape Rate vs. Failed Scrape Rate**



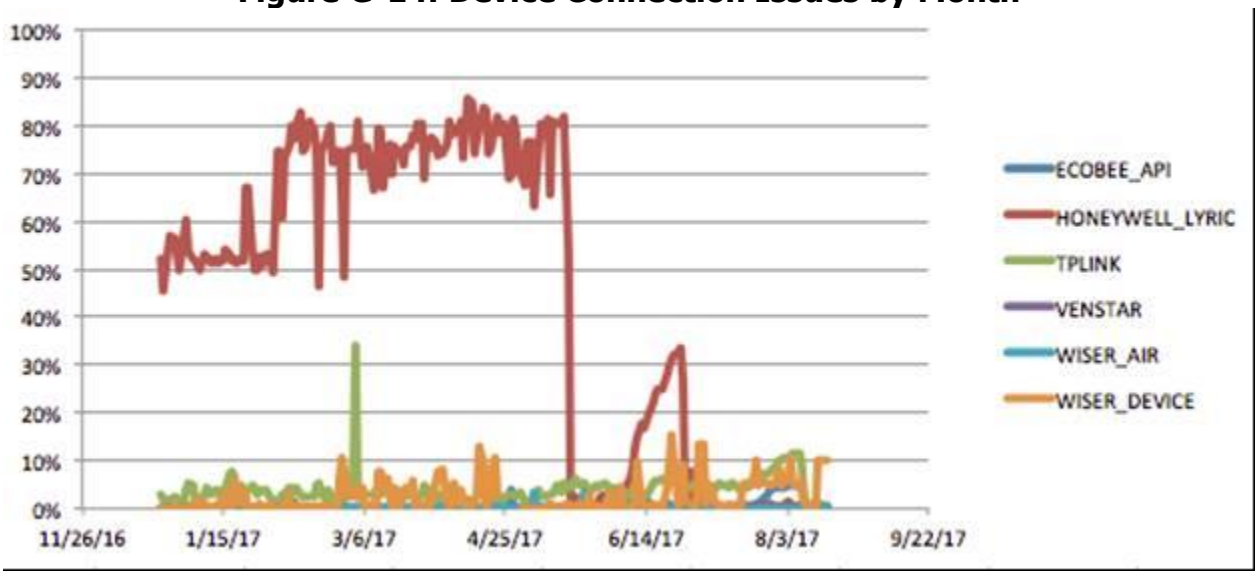

Source: OhmConnect

Given the guidelines above, there are three devices that require improvements to maximize customer-specific data. Over the lifetime of the grant, Honeywell devices have had an 11% failed scrape rate. We have had several users stating their Lyric was not getting turned on after the #OhmHour is over or not being turned off during the #OhmHour. After extensive testing of API calls, we discovered the "AutoChangeoverActive" setting of the device was incorrectly set to true causing consistent failures. This issue has now been resolved.

TP Link also had a failed scrape rate of 5%. The issue occurred because the code OhmConnect executed was often in conflict with the scheduled events in the embedded API software for TP Link. We were able to work with TP Link to get access to their "on/off API" code. OhmConnect is in the process of integrating with the TP Link API and enabling OAuth 2.0 technology to resolve issues allowing us to enable and disable the device as needed per #OhmHour.

The last device that needs improvement is the Venstar at 5%. There are a few connection issues with this device that have caused communication to be impaired. One issue discovered was users that have had their thermostats in "AWAY" mode while they are on vacation, come back from vacation, to find their device turned it back "ON" at the end of an #OhmHour causing inflated energy usage. Another issue is various error messages that occur when attempting to control the device from the OhmConnect Connect Page. These errors prevent the device from being turned back on after an #OhmHour. The issues are being actively investigated to determine the best path to a solution.

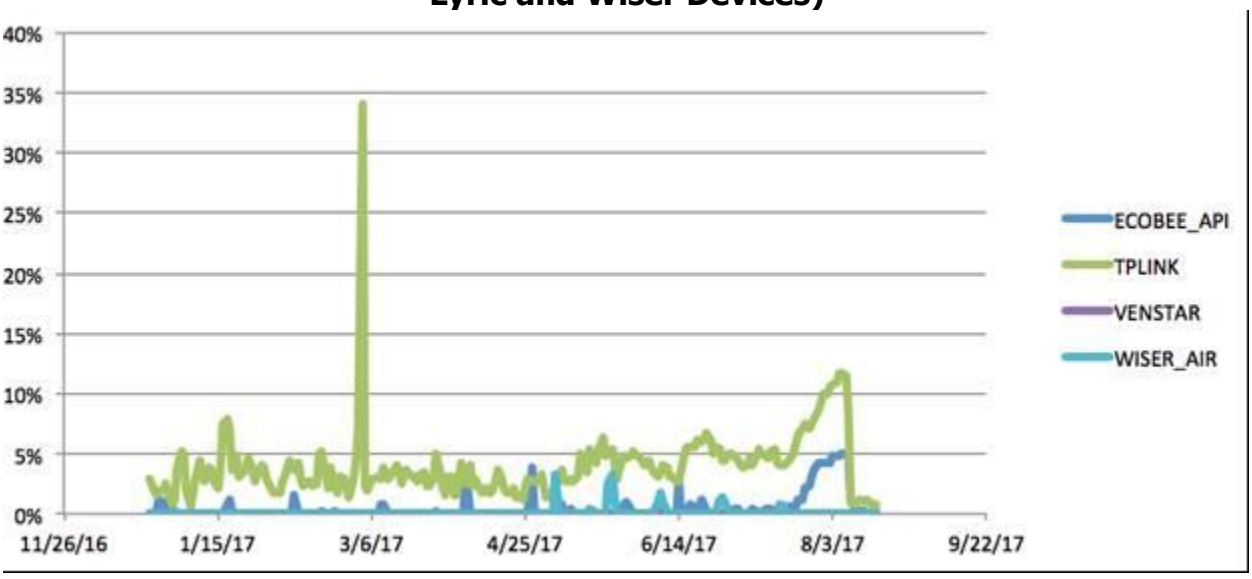
**Figure G-14: Device Connection Issues by Month**




Source: OhmConnect

Figure G-14 depicts the time period when there were issues with the Honeywell Lyric. The first spike was due to data integrity issues caused by the OhmConnect code failing to turn on devices after an #OhmHour as discussed above. In June, the first issue was resolved, but a subsequent issue appeared when Honeywell updated their API causing limitations.

**Figure G-15: Subset of Device Connection Issues by Month (excluding Honeywell Lyric and Wiser Devices)**

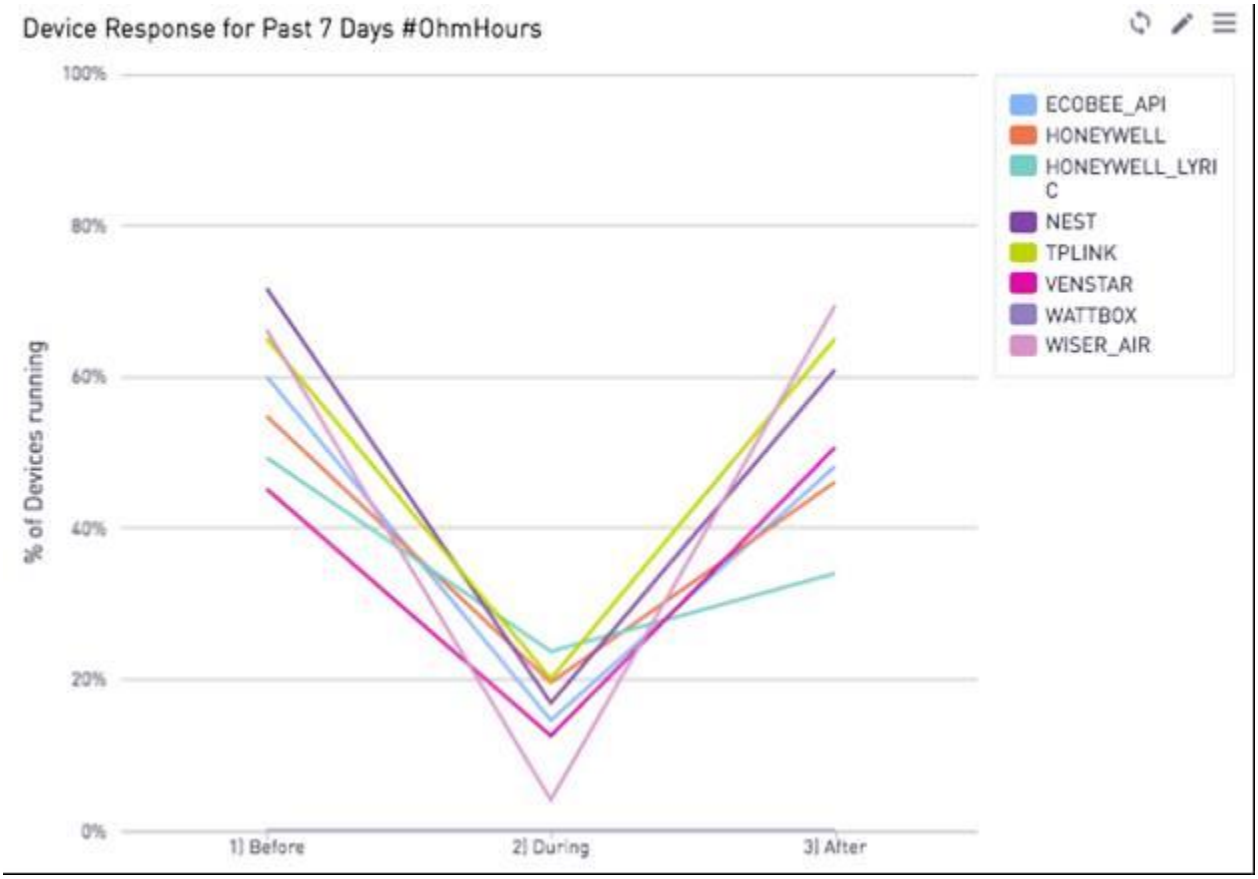



Source: OhmConnect

Figure G-15 is a subset of Figure G-14 that does not include Honeywell Lyric or the Wiser Devices. This diagram shows TP Link API failures began increasing in April 2017, and continued to increase through August 2017. The cause of this increase was due to higher number of devices that needed to be connected with on a daily basis. As we increased overall users with TP Links, we put increasing load on the TP Link servers, which created additional problems unforeseen at low levels of penetration. After discussions with TP Link on how to resolve these issues, OhmConnect successfully negotiated a contract with TPLink to integrate with their API and is in the process of enabling OAuth 2.0 to address connectivity issues.

Another possible reliability indicator is the percentage of devices in the "Off" state before an #OhmHour. Users have connected their device to their OhmConnect account and for various reason have turned the device off, not actively participating in #OhmHours. As the percentage rate of devices that are turned off increases, this could be an indicator there are communication reliability issues associated with the device. This is just a theory as there are many reasons devices can be left in the off state. For example, some California users have heating, but not air conditioning. This would cause a device to be off during the summer months.

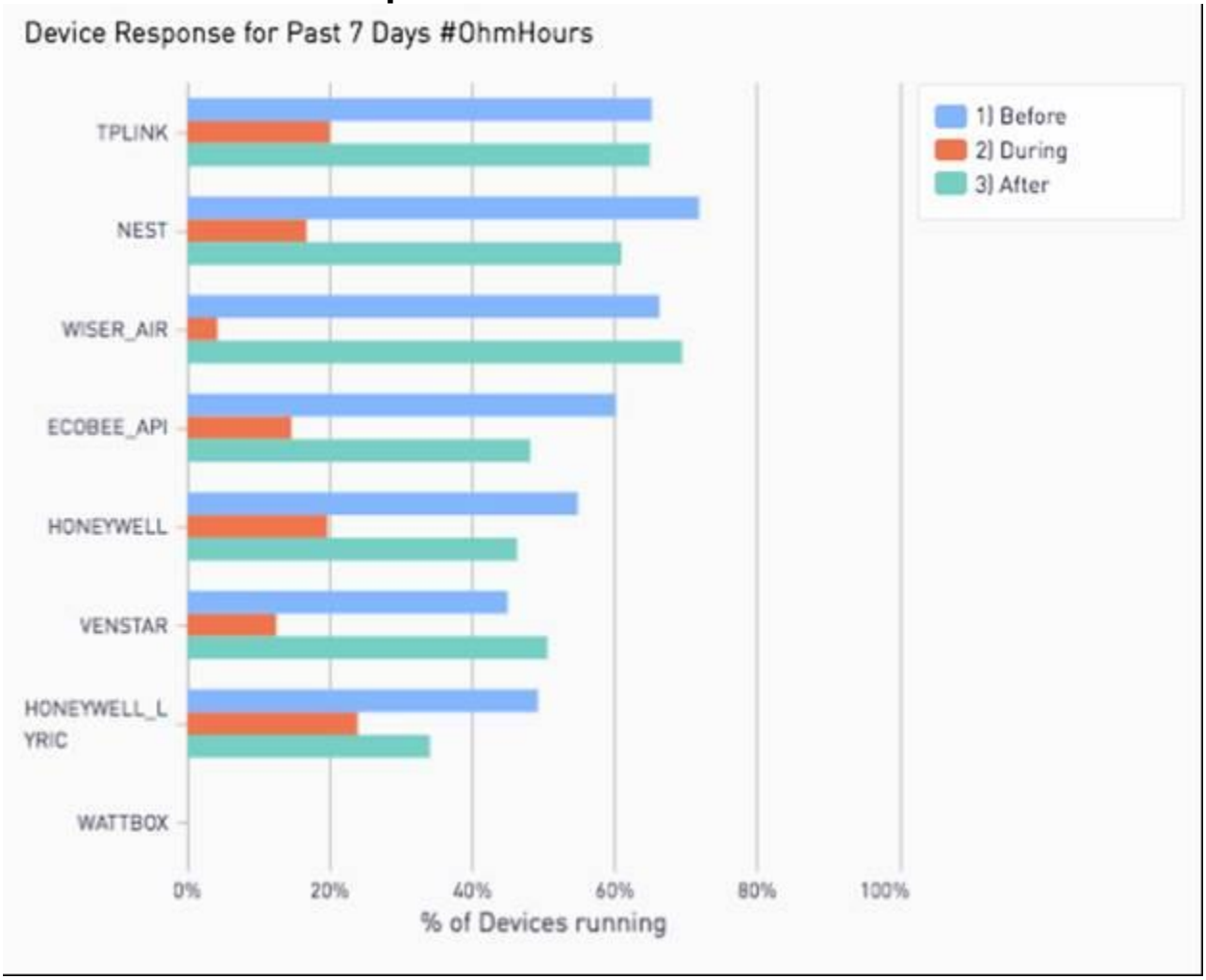
**Figure G-16: Percent of Devices that are Turned Off Before, During, and After an #OhmHour**




Source: OhmConnect

Figure G-16 demonstrates the "On" state of all devices before, during and after an #OhmHour. Not all devices are turned on before or after an event. As shown above, TP links are the device most often in the on state before and after an #OhmHour. The dip in graph indicates either OhmConnect has failed to turn off the device or the user turned it back on during an #OhmHour.

**Figure G-17: Same data as Figure G-4, Shown in Bar Chart to Highlight Discrepancies for Each Individual Device**




Source: OhmConnect

Figure G-17 is another visual showing how the Honeywell device has the greatest challenge in turning to an off state during an #OhmHour. It has also experienced issues turning the device back on after the completion of an event. Other devices such as TP Link also experience similar issues. As stated previously, we have implemented solutions to successfully resolve Honeywell issues. The TP Link solution has been determined and is currently pending implementation.

# APPENDIX H:
# Telemetry Solution Implementation

This appendix provides a December 12, 2017 EPRI presentation on Telemetry Solution Implementation.

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

# Telemetry Solution Implementation

**Angela Chuang**
Senior Technical Leader

**Alekyha Vaddiraj**
Engineer/Scientist II

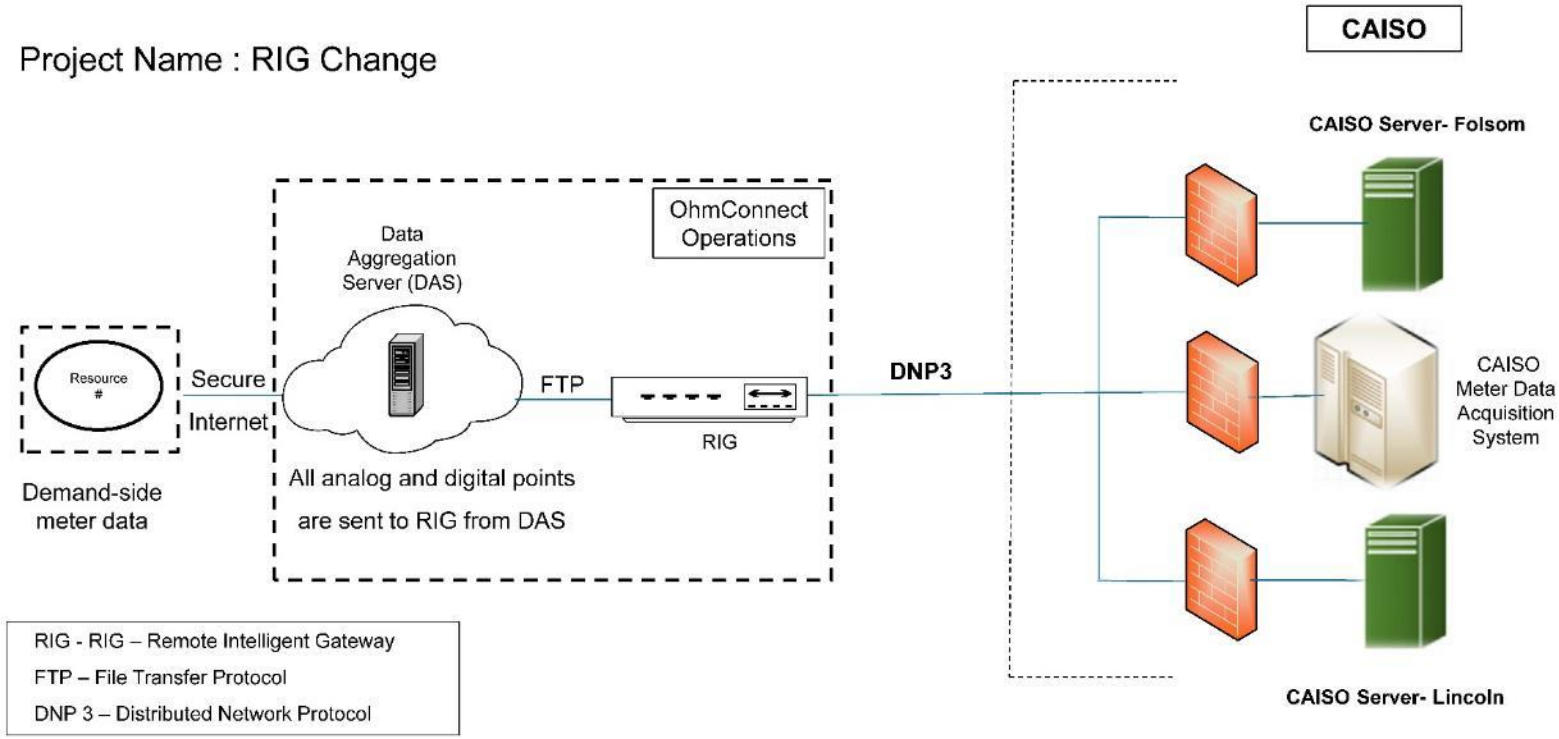
**Andrew Han**
Sr. Software Developer

**Hoan Cai, SEL**

**December 12, 2017**

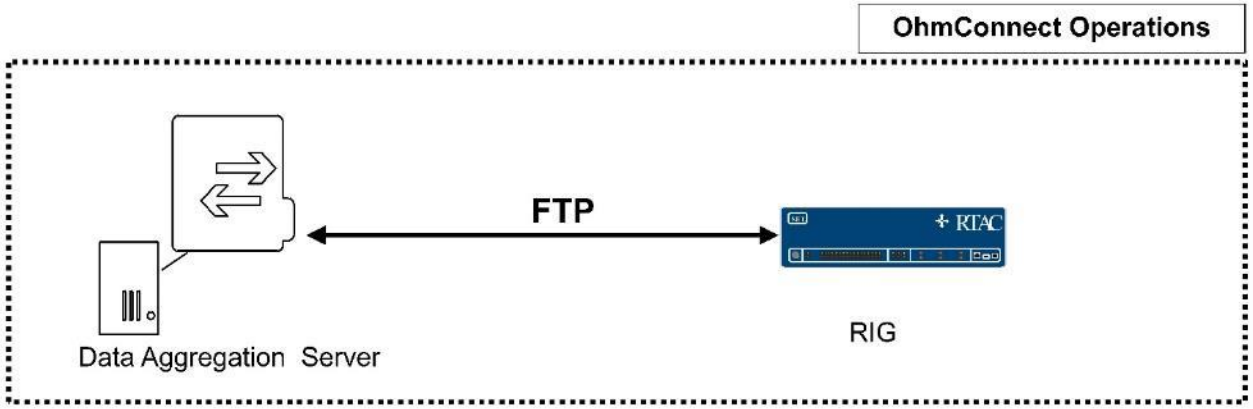
# Communication Block Diagram

Project Name : RIG Change




RIG - RIG – Remote Intelligent Gateway
FTP – File Transfer Protocol
DNP 3 – Distributed Network Protocol

# RIG – DATA Exchange Implementation




RIG – Remote Intelligent Gateway

FTP – File Transfer Protocol

# RIG – DATA Exchange Details

- RIG receives data from Data Aggregation Server via text file over FTP
- Parameter entries consist of a variable name, equal sign, and a value
- The filename is of the form "RIGInterface.txt"

RIG setup

RIGInterface - Notepad

File Edit Format View Help

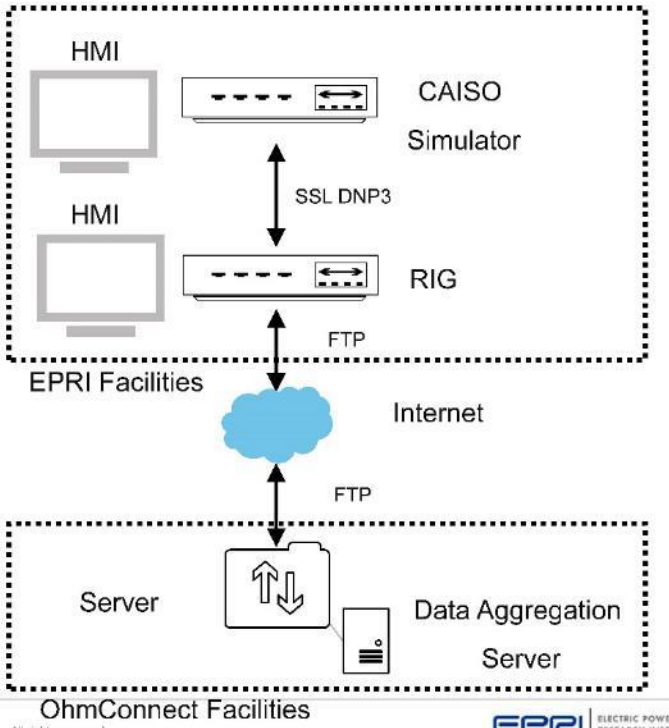
```
RESOURCEID=12347DATE=DT#2017-09-12-18:20:00GROSSMW=593.03PSEUDOMW=0BIASLOADMW=593.03AGGREGATEDGROSSMW=0PDRCONNECT=0AGGREGATEDUNITCONNECT=0
-----
RESOURCEID=12346DATE=DT#2017-09-12-18:20:00GROSSMW=71.18PSEUDOMW=0BIASLOADMW=71.18AGGREGATEDGROSSMW=0PDRCONNECT=0AGGREGATEDUNITCONNECT=0
-----
RESOURCEID=12345DATE=DT#2017-09-12-18:20:00GROSSMW=302.24PSEUDOMW=0BIASLOADMW=302.24AGGREGATEDGROSSMW=0PDRCONNECT=0AGGREGATEDUNITCONNECT=0
-----
```

File to RIG

# Initial Demonstration (Phase 1)

**Verify communications and equipment operation from OhmConnect to EPRI facilities:**

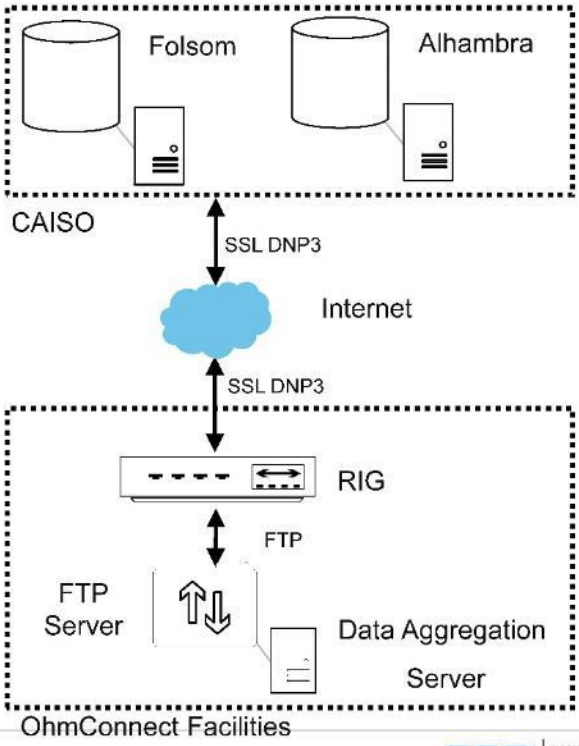
- Power up
- Local communication connections at EPRI
- Telecom communication checks between OhmConnect, FTP server and RIG
- I/O points check on RIG Human Machine Interface (HMI) demonstrating received data and setpoint controls
  - Analog
  - Digital
  - Calculated
- I/O points check on CAISO Simulator HMI demonstrating received data and setpoint controls to the RIG
  - Analog
  - Digital
  - Calculated
- Demo different scenarios of communications success and loss of connectivity between DAS, RIG, and CAISO simulator



# PDR RIG Deployment (Phase 2)

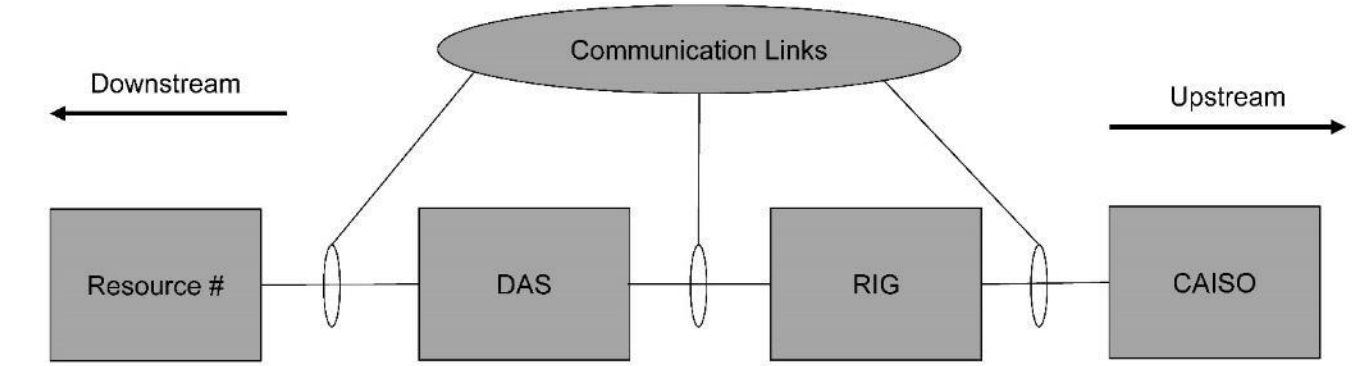
**Verify communications and equipment operation from OhmConnect to CAISO facilities:**

- Power up
- Local communication checks at OhmConnect
- Data Aggregation Server communication checks
- I/O points check on RIG
  - Analog
  - Digital
  - Calculated
- Signed certificate Installation for RIG at OhmConnect
- Verify Secure Communications and visibility to CAISO Simulator
- I/O points check to CAISO Servers
  - Analog
  - Digital
  - Calculated
- Document results of tests



# Communications Links

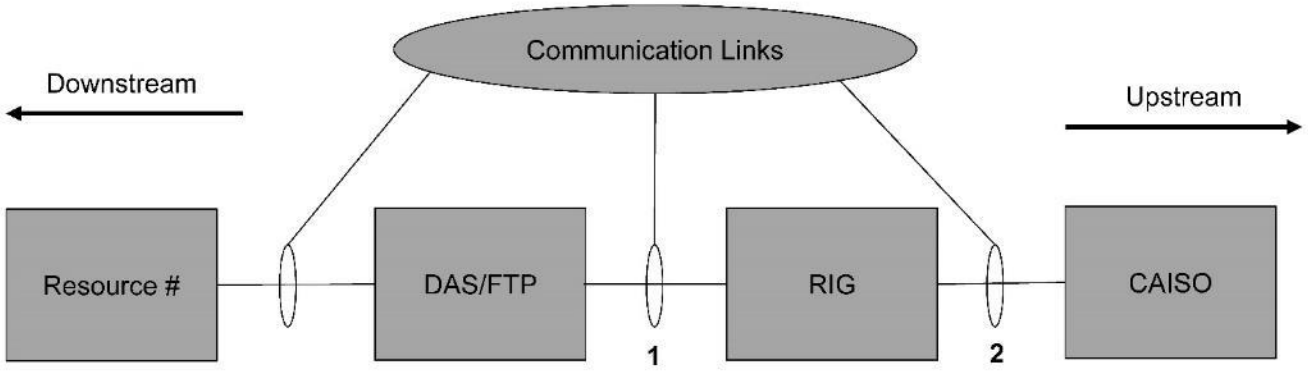
## *Potential Loss of Connectivity or Malfunction Points*




CAISO – California Independent System Operator
RIG – Remote Intelligent Gateway
DAS- Data Aggregation Server

# Demo Scenarios

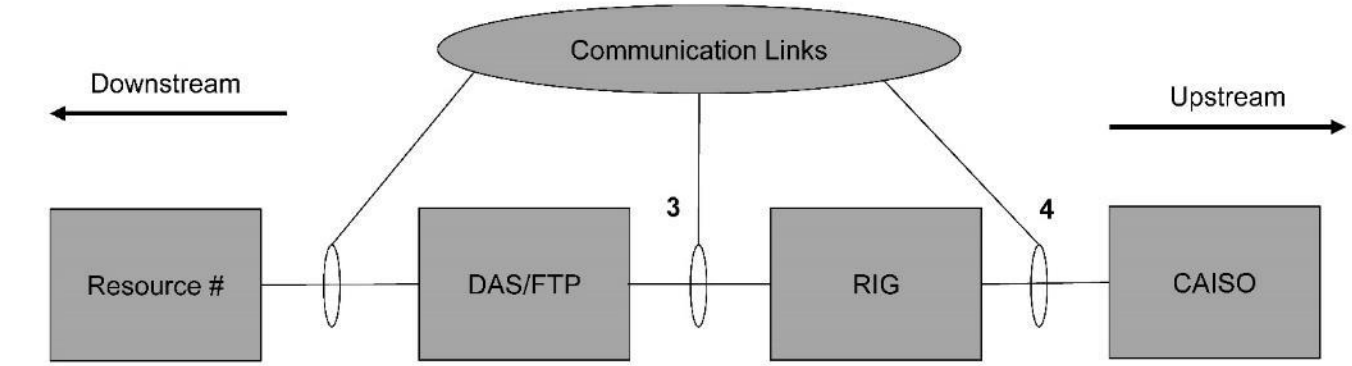
## *Communications between DAS, RIG, and CAISO*




CAISO – California Independent System Operator
RIG – Remote Intelligent Gateway
DAS- Data Aggregation Server

# Demo Scenarios

## *Potential Loss of Connectivity or Malfunction Points*




CAISO – California Independent System Operator
RIG – Remote Intelligent Gateway
DAS- Data Aggregation Server

# Telemetry Performance and Timing Threshold Requirements

## Requirements:

- 1 or 5 minute latency between Data Aggregation Server and RIG
- CAISO polls the RIG every 4 seconds for new data
- Time of data within +/-30 second accuracy
- DNP3 status points quality from data aggregation server notifies RIG and CAISO when data is stale
- Data Aggregation Server communication failure alarms notifies RIG and CAISO when originating source data is stale or invalid
- FTP communication alarm from the RIG notifies CAISO when data is stale or invalid

# Telemetry Demonstration

## Phase 2 demonstration

- Data Aggregation Server is providing real-time values to a text file within a +/- 30 second window
- The timestamp in each text file is comparable to the time stamp in the RIG once it is parsed, and falls within the 1 or 5 minute requirement
- The RIG to CAISO data update interval is within the 4 second requirement. The time stamp from the data in the RIG can be verified with the CAISO Simulator timestamp and also by CAISO during Phase 2 testing.
- Communication failures will alert the RIG and CAISO of invalid data
- ADS (Automated Dispatch System) Dispatch Signal from CAISO will call for the PDR resource to connect to the grid, with a calculated point called pseudo generation, which allows the CAISO to model the participating generator – Not part of Phase 2 if there is no generation

# Questions?

# Together…Shaping the Future of Electricity

# APPENDIX I:
# Low-Cost Telemetry Analysis

This appendix provides a presentation by OhmConnect on low-cost telemetry analysis.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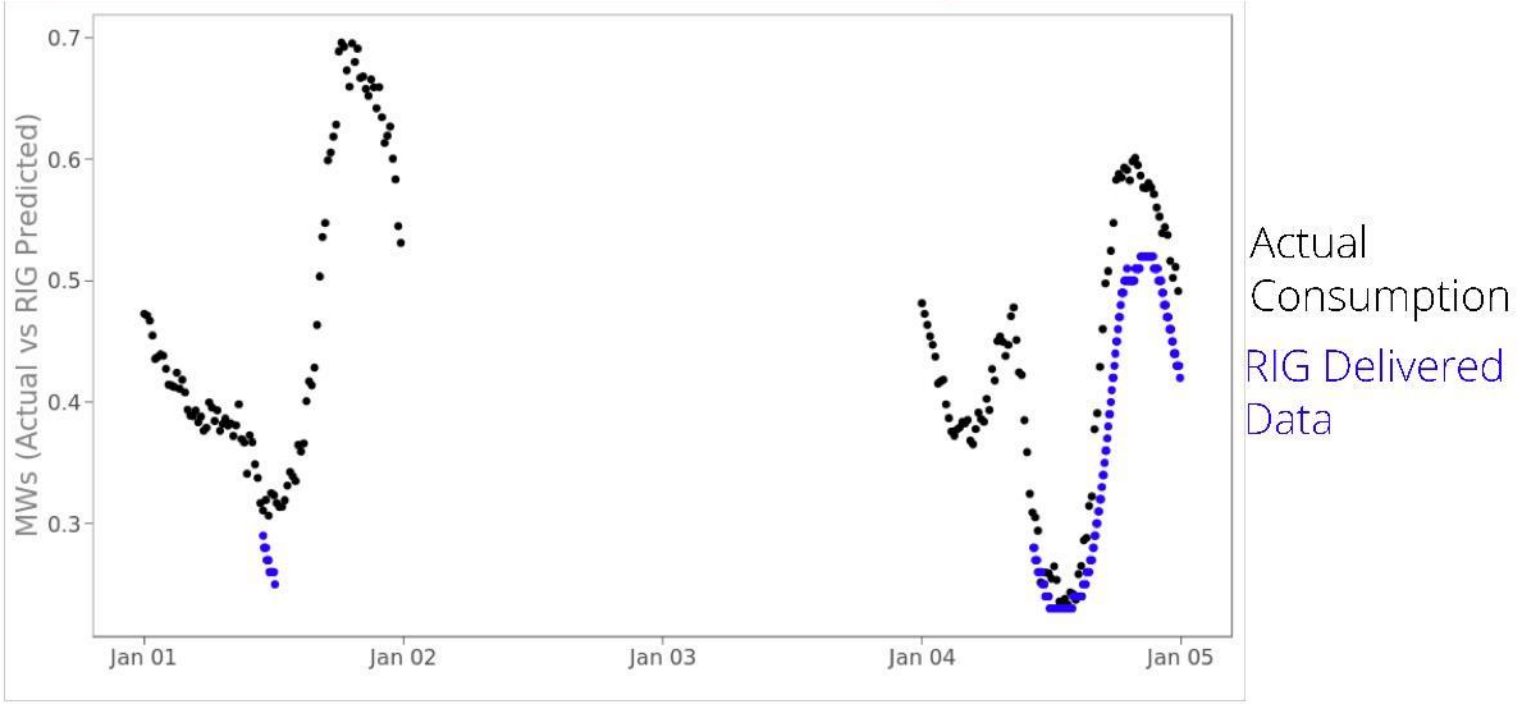
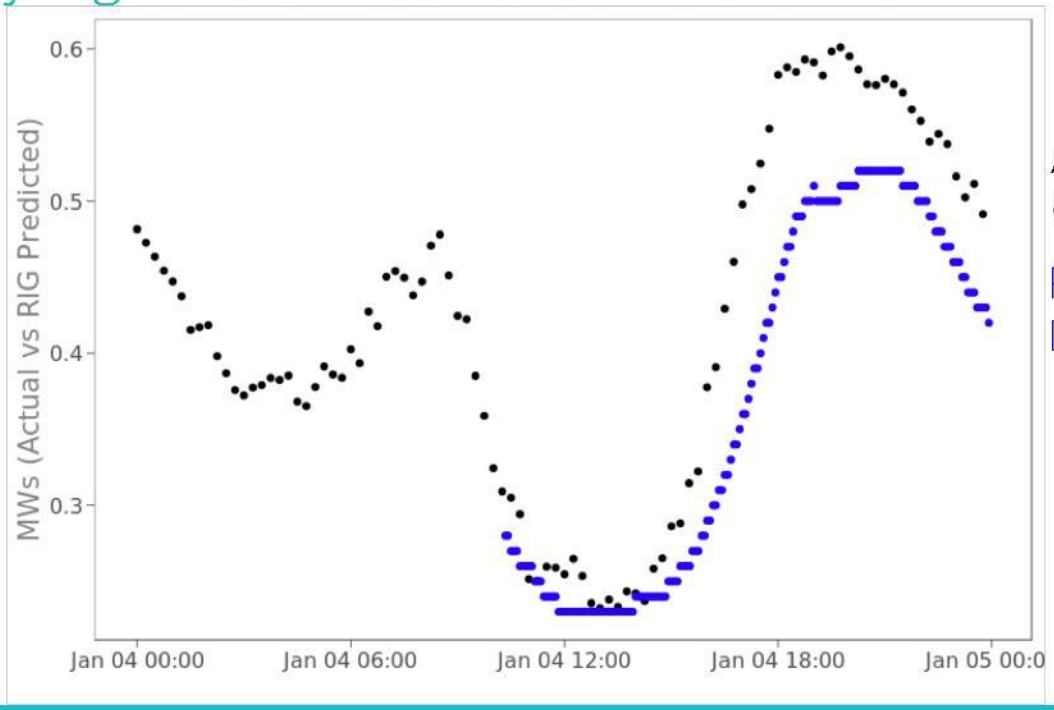
# Executive Summary

- The purpose of this analysis was to compare the estimated RIG data against the actual consumption
  - 725 users were aggregated for both the RIG data and actual consumption data
  - 178 entries were analyzed across the dataset, representing 61 interval comparisons
  - Comparison is only fair for January 4th date, which included the correct user list
- Overall, the total number of data points were insufficient to draw strong conclusions off of. However, the data points available showed a high degree of accuracy between the estimated RIG data and the actual consumption
- The general shape of the curves aligned closely for counterfactuals
  - R2 = 0.949

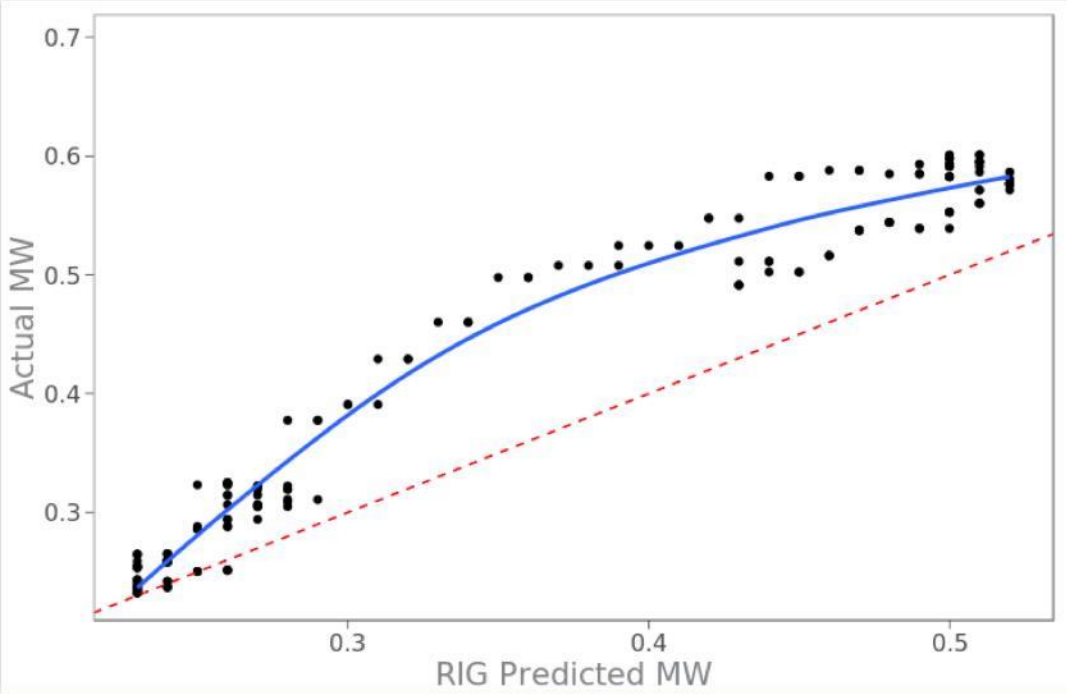
# Comparison to actual shows similar shapes but a factor off



# For 1/4/2019, the shape looks similar, with actual coming in slightly higher than estimated via the RIG



# The data lines up pretty closely with an $R^2$ of 0.949* and slope of 1.19

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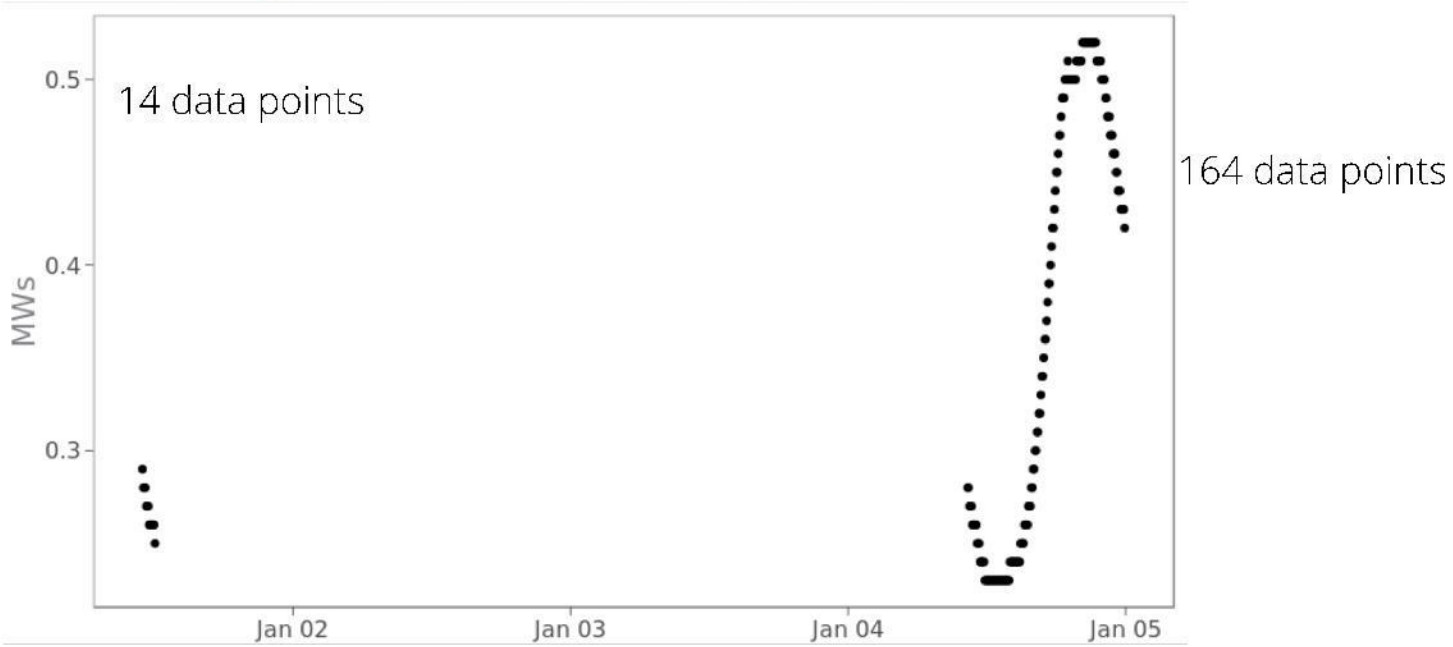
* The R² is used based on a linear model (the line shown in the graphs is a loess prediction function)

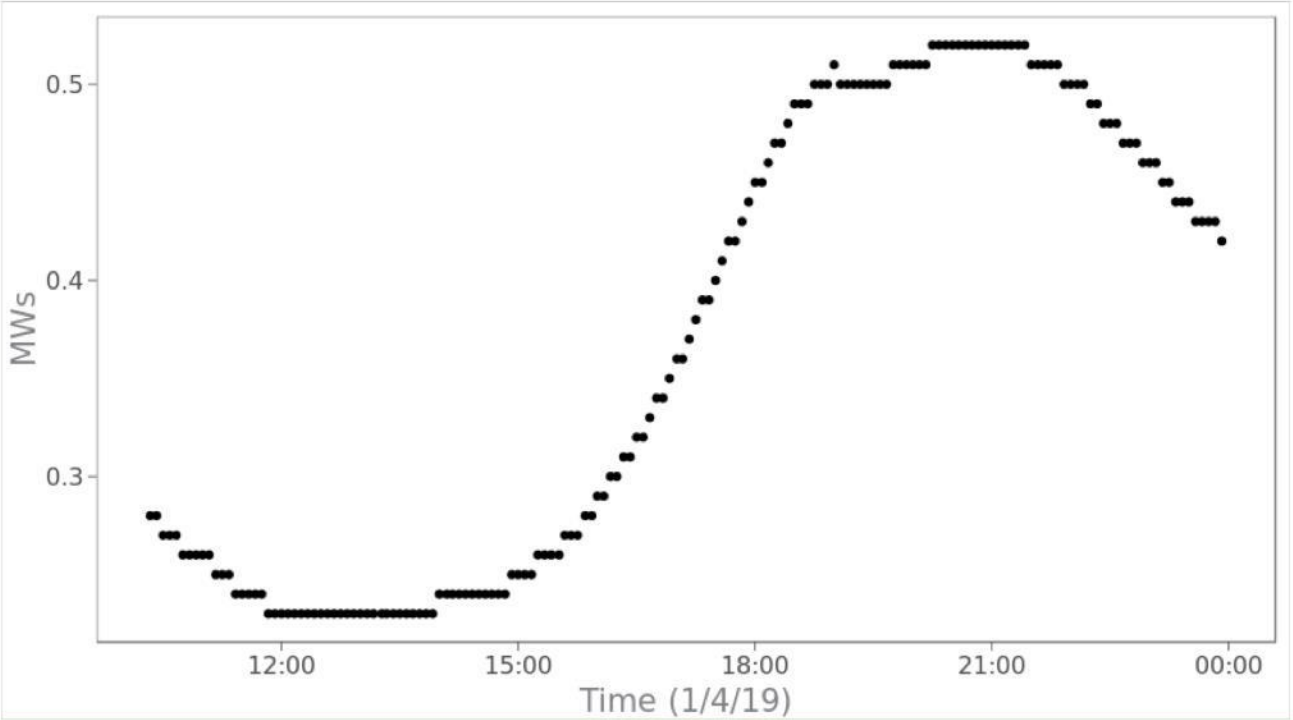
# Raw data represented showed a few data points on 1/1 and a large number of data points on 1/4

Backup



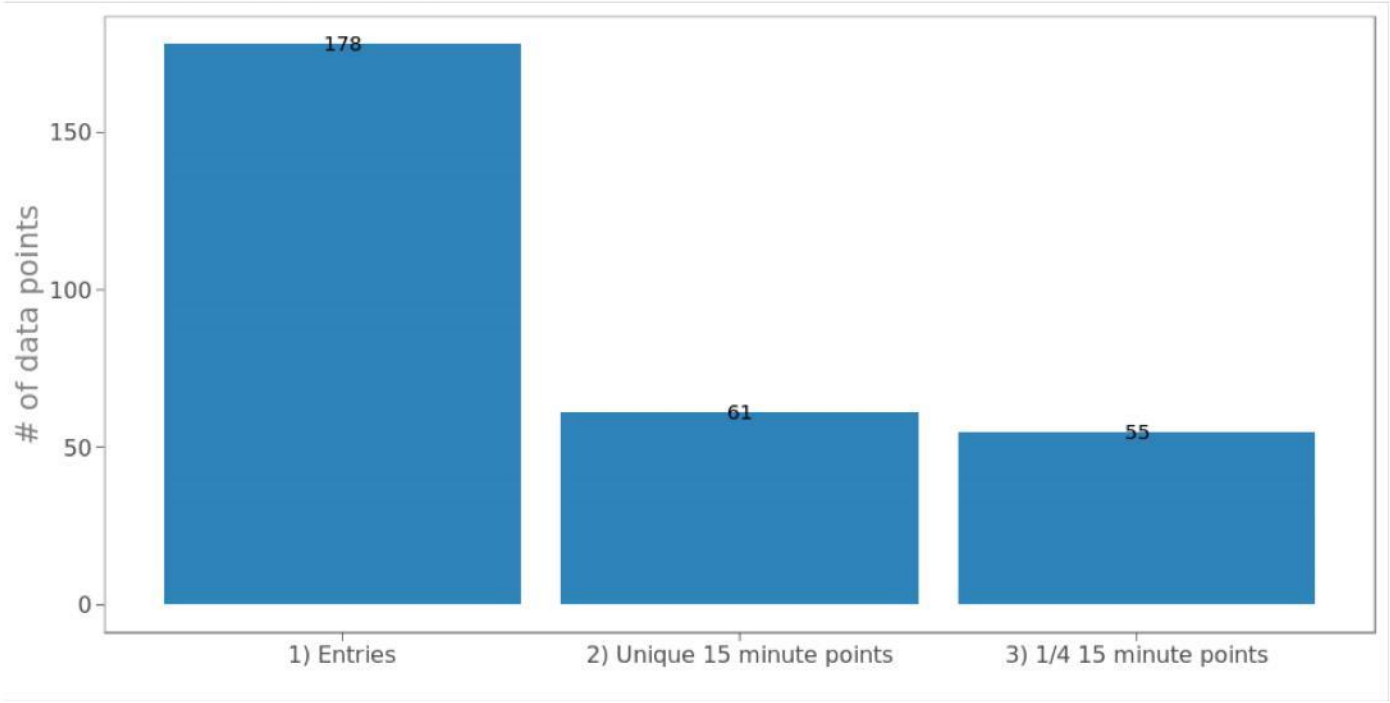
# Drill down on 1/4/19 to 1/5/19 dates

Backup



# RIG data available

Backup



# APPENDIX J:
# State of the Demand Response Market – Policy Recommendations Deep Dive

California has made great strides in recent years to empower third parties to provide residential Demand Response to the State's power grid. Five years ago, third-party residential Demand Response Providers (DRPs, or aggregators)[3] did not have a clear pathway to provide energy reductions into any existing energy market. However, the following years saw an increase in participation as new regulations and policies helped overcome four major blockers to enabling DRPs' entry into the energy market:

1. Proxy Demand Resources (PDRs) were incorporated into the California Independent System Operator (CAISO) energy market, along with major improvements to the Demand Response System (DRS) and Demand Response Registration System (DRRS) to enable the registration of residential DR resources;
2. Consumer data became accessible by third parties via Electric Rule 24/32;[4]
3. Pilots, including the Demand Response Auction Mechanism (DRAM), enabled a wide variety of technologies capable of providing Demand Response to be incorporated into the CAISO energy market to satisfy Resource Adequacy requirements; and,
4. All-source solicitations allowed the procurement of technology-agnostic resources to provide energy products, such as the San Diego Gas & Electric (SDG&E) and Southern California Edison (SCE) Local Capacity Resource solicitations.

Nevertheless, while policy and regulations have helped overcome certain barriers to residential Demand Response (DR) and interest in market participation by perspective third parties has been growing at a rapid pace, additional barriers remain that prevent full integration of residential DR into the California grid. The current sustained growth is a step towards incorporating residential DR as a large and permanent piece of California's ambitious climate goals, but if policymakers are uncertain about the opportunities that energy-sharing resources such as DR provide, then that uncertainty will stymie innovation.[5]

The purpose of this *Policy Recommendations to Overcome Regulatory Barriers to Demand Response Report* (Report) is to provide solutions to the regulatory barriers to entry for

[3] An aggregator or DR Provider per the CPUC website is defined as "a commercial entity that provides demand response services such as assisting retail customers with strategies or technology to reduce their electric consumption and then providing the electric load reductions as a 'bid' in wholesale energy markets." See "DR Provider Registration Information," available at http://www.cpuc.ca.gov/general.aspx?id=8314.

[4] Pacific Gas and Electric (PG&E) and Southern California Edison (SCE) both allow the sharing of data to authorized third parties via each of their separate Electric Rule 24. San Diego Gas & Electric allows the sharing of data to authorized third parties via their Electric Rule 32.

[5] As companies drive down the price to of delivering the same energy products, the private sector will invest in technologies that will deliver on those energy products. However, if the energy products are uncertain to be available in the following year due to regulatory changes, the private sector will hesitate to invest in these technologies.

residential Demand Response Providers in California, which were previously identified in the *Summary Report on Current Regulatory Barriers to Entry* (Summary Report). The Summary Report highlighted barriers for residential aggregators that impeded their ability to provide DR services to the CAISO. In addition, the Summary Report detailed each barrier's total impact on the customer.[6] Specifically, the Summary Report described four key barriers, rank-ordered below, that challenge residential DRP participation:

1. Market Certainty
2. Accessing Data
3. Competitive Asymmetries
4. Expansion of Customers' Retail Energy Options

This Report will briefly summarize each barrier and the impact it has on DRP participation. The Report will then consider solutions to address each barrier, drawing on both ongoing discussions or potential future decisions.

# Market Certainty

## Summary

Although the market for third-party residential DR has both opened and expanded in the last five years, the paradigm under which DR is procured in California persistently retains a relatively higher level of market uncertainty. This uncertainty is attributed to a variety of factors, ranging from confidence in sustained long-term procurement to inconsistent procurement methodologies. These uncertainties present potential barriers to residential DR Providers contemplating entry to the California market who may consider the current levels of risk of entering the market as unreasonably high.

Presently, the Demand Response Auction Mechanism pilot is the single avenue through which third-party residential DR Providers can have their product procured and then subsequently bid their load reductions into the CAISO wholesale market. The DRAM was designed and approved under the direction of the California Public Utilities Commission (CPUC), which consequently gives the CPUC the unique authority to address the market certainty concerns detailed above as they relate to this primary procurement mechanism. However, as a CPUC construct, the DRAM is currently only conducted by the Investor-Owned Utilities (IOUs); not all energy providers in California have obligations to procure residential DR.

An initial DRAM auction was conducted in 2015 for delivery of the DR resources in 2016, and a second auction was similarly conducted in 2016 for delivery in 2017. A subsequent Commission decision, Decision (D.) 16-06-029, approved a third auction to be held in 2017 for delivery in 2018 and, optionally, 2019. Notably, the third auction retained essentially the same dollar per year level as the preceding auction ($27 million over two years versus $13.5 million

[6] The Summary Report primarily focused on barriers to wholesale market entry – i.e. via the California Independent System Operator. The area serviced by the CAISO is largely covered by the three main Investor-Owned Utilities in California – Pacific Gas and Electric Company, Southern California Edison Company, and San Diego Gas & Electric Company. Thus, the Summary Report excluded analysis of third-party residential DR participation with municipal utilities, as they are not direct participants in the CAISO.

over one year)[7] instead of increasing the available funding to continue to grow the market. Although the CPUC initially rejected two Petitions for Modification that would have either increased the procurement for 2018 and 2019 or accelerated the launch of the permanent DRAM to 2019,[8] ultimately the CPUC approved an additional auction for delivery in 2019.[9,10]

However, the fate of the DRAM for 2020 and beyond has not yet been finalized by the CPUC. As was reiterated in D.16-09-056, the Commission will conduct an independent analysis of the first two auctions. The CPUC will then vote on whether to approve the analysis and recommendation of its Energy Division and, in following, whether to authorize a permanent DRAM procurement mechanism. This unknown future of a permanent DRAM has introduced an element of uncertainty for all market participants. The uncertainty coincides with the phasing out of other IOU legacy programs, such as the Aggregator Managed Portfolio.[11] If a permanent DRAM is not approved, this could result in DR resources that are stranded from the market, functionally leaving residential DR providers without a means to sell significant levels of residential DR to the IOUs.

The results of the DRAM pilot have highlighted inconsistencies with the actual procurement of the DR product, which has in turn exacerbated concerns over market certainty. In 2016, the CPUC found that two of the IOUs did not procure all the DR the DRAM pilot budget would allow for, and the IOUs were consequently instructed to select additional bids.[12] In addition, the actual bid selection criteria for the DRAM bids contain several proprietary valuation elements known only to the IOUs and the independent group that oversees bid selection.[13]

The opacity of the procurement methodology has carried into other solicitations, such as the SCE and SDG&E Integrated Distributed Energy Resources (IDER) Request for Offers (RFOs). Each of these solicitations evaluates all proposals under proprietary "least-cost, best-fit"

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[7] See September 29, 2016 Decision (D.) 16-09-056, at p. 33.

[8] See April 27, 2017 D.17-04-045, OP 1 and 2, at p. 18.

[9] Within the same Decision rejecting the Petitions, the CPUC also stated that "[t]he Commission should consider whether to allow for a second auction to occur in 2018," whereby such an auction would allow for additional procurement singularly for the 2019 delivery year. After receiving stakeholder input on a potential auction for delivery in 2019, the Commission released two Proposed Decisions – one alternate that approved additional procurement in 2019, and one that did not. As the Proposed Decision supporting additional procurement states, "while there have been some opportunities for demand response providers to bid on procurement contracts, growth opportunities for third-party demand response providers have been limited." Following consideration of these two Proposed Decisions, the Commission voted to adopt the Alternate Proposed Decision that supported additional procurement.

[10] See October 26, 2017 D.17-10-017, OP 7, at p. 89.

[11] See June 9, 2016 Decision (D.) 16-06-029, at pp. 5-16.

[12] See September 29, 2016 Resolution E-4802, Ordering Paragraph (OP) 2, at p. 17 and Resolution E-4803, OP 2, at p. 16.

[13] See April 6, 2017 "2018 DRAM RFO Frequently Asked Questions," available at https://pge.com/pge_global/common/pdfs/save-energy-money/energy-management-programs/demand-response-programs/2018-demand-response/2018-demand-response-auction-mechanism/2018-DRAM-FAQs.pdf

methodology,[14] causing prospective bidders (including DRPs) to struggle with understanding how their product will be valued. In addition, certain solicitations require overly prescriptive operating requirements that *de facto* preclude DR from participating.[15]

In sum, the existing design of the DRAM pilot, the lack of residential DR procurement beyond 2019, and the ongoing uncertainty regarding the valuation methodology for DR resources may preclude the market for DR from growing. This preclusion may occur even if the available DR is cost-competitive as compared to existing IOU programs or other. Subsequently, if the market does not show an ability to grow, even a low-cost third party will effectively be prevented from entering the California market. Moreover, businesses will remain hesitant to enter any markets, especially one where the procurement rules are uncertain or unenforced, because they are less likely to trust that their product is being fairly compared to the other products in the market.

Furthermore, Lawrence Berkeley National Lab (LBNL) recently issued a report describing the evolution of conventional DR into advanced DR over the next several years.[16] The advanced DR products include "Shape," "Shift," and "Shimmy;" currently, however, no market-based opportunities exist to provide these advanced DR products. The LBNL report's top recommendation to achieve the transition from "conventional to advanced DR" include "continued work on how integrated energy efficiency (EE), behind-the-meter storage and DR can lead to value across a range of categories-integrated demand-side management" and "continued work to integrate value streams at the system scale, on the distribution system, and at the site level-distributed resource planning."[17] The CPUC summarily in D.17-10-017 established a Load Shift Working Group to in part further examine how to determine a capacity value for some or all of these advanced DR products (with a final report due in early 2019).[18] To fully evolve DR to a set of products that best meet the needs of the grid, the CPUC should strive to use this final report from the Working Group to identify paths forward that will incentivize companies to provide these Advanced DR products, leaning on existing market structures (such as the DRAM) that most optimally procure these products.

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[14] See "2017 INTEGRATED DISTRIBUTED ENERGY RESOURCES INCENTIVE PILOT REQUEST FOR OFFERS - Participant Instructions Version 2," at p. 16, available at https://sceider.accionpower.com/_sceider_1701/home.asp and "SDG&E'S 2018 INTEGRATED DISTRIBUTED ENERGY RESOURCE (IDER) INCENTIVE PILOT RFO," at p. 18, available at https://www.sdge.com/sites/default/files/documents/1928537776/IDER_RFO_Protocols.pdf?nid=23216.

[15] For example, the SDG&E IDER solicitation required that projects "be able to provide the required capacity either by providing the capacity every day or by responding to a day-ahead dispatch instruction" and that the minimum requirements "apply for each hour and each year from June 1 – October 31" (pp. 10 and 34). In addition, the SDG&E solicitation noted that "traditional distribution project would provide…99.976% availability" (pp. 34 and 35), implicitly stating that the resource needed to be capable of providing energy *as if it were a distribution line*. Thus, while technically demand response was able to participate in the RFO, there would be no realistic way for a non-storage device to operate in exactly the same way as a distribution line.

[16] See Lawrence Berkeley National Lab (LBNL) "Final Report on Phase 2 Results: 2025 California Demand Response Potential Study," available at http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442452698.

[17] Ibid, pp 1-11 and 1-12.

[18] See October 26, 2017 D.17-10-017, OP 12, at p. 91.

## Solutions

We recommend the following solutions to address the barrier of market certainty:

1. The CPUC should approve a permanent DRAM (contingent on positive results from the DRAM Evaluation);
2. The CPUC should ensure that all procurements under its jurisdiction are conducted fairly and transparently, while prioritizing clean, emissions-free resources; and,
3. The CPUC should utilize market-based approaches to procure advanced Demand Response energy products.

We expand further on these recommendations below.

### Approval of Permanent DRAM

To address market certainty beyond 2019, the CPUC should approve a permanent DRAM. Decision 17-10-017 emphasizes that "as a policy matter the [CPUC] adopted the demand response auction mechanism as the primary tool to fulfill its goals of expanding the role of demand response and third-party providers."[19] In the absence of DRAM, the alternative for DRPs is to participate in utility programs or other all-resource solicitations. However, the Decision finds that the present procurement paradigm without DRAM would present barriers to third-party participation, noting that "although some utility programs remain available to non-utility providers, even with other solicitation opportunities pointed out by the parties, business opportunities in 2019 for third-party demand response providers are limited without a 2018 auction."[20] Furthermore, the CPUC was persuaded by CAISO comments that "providing continuous annual funding for utility programs with no solicitation for competitively procured demand response in 2018 may harm third parties' ability to compete on a level playing field and cause the nascent competitive market to wither."[21] In summary, the absence of a permanent DRAM will not improve market certainty; rather, the likely outcome is that many DR providers will be frozen out of California.

#### *Ensuring Fair and Transparent Procurements*

In addition, continued CPUC direction that cleaner resources are to be prioritized when considering capacity needs is essential to ensuring the market for DR is provided the full opportunity to grow. For example, when SCE proposed signing additional contracts with Once-Through Cooling fossil-fueled power plants,[22] the CPUC initially rejected this proposal, in part because the signing of these contracts might diminish the opportunity for cleaner resources.[23] Such direction from the CPUC must persist in California as long as Load-Serving Entities (LSEs) are responsible for procuring capacity. The other alternative is for California to transform towards an entirely market-based approach for procuring all capacity. This approach would

[19] See October 26, 2017 D.17-10-017, at p. 38.

[20] Ibid, at p. 39.

[21] Ibid, at p. 40.

[22] See October 10, 2016 Advice Letter (AL) 3488-E, at p. 2.

[23] See August 10, 2017 California Public Utilities Commission Voting Meeting, available at http://www.adminmonitor.com/ca/cpuc/voting_meeting/201707132/.

allow regulators, such as the CPUC, to provide more clarity on co-benefits or incentives for cleaner resources across all capacity procurement as opposed to providing one-off solutions outside of a centralized approach.

### Procuring Advanced DR Products

Finally, to evolve from conventional DR to advanced DR, existing market-based approaches such as the DRAM auction should include the flexibility to incorporate additional energy products, like those required for "Shift," "Shimmy," and "Shed." The CPUC (via the Load Shift Working Group) and the CAISO (via the Energy Storage and Distributed Energy Resources initiative, or ESDER) should help to inform this evolution such that the nascent marketplaces for these products are designed in a robust manner where little to no additional administrative costs are needed to enable these additional products to be procured via the market. In addition, these energy products should be tested early on via programs or pilots that would pay resources for providing measured and verified energy products.

## Accessing Data

### Summary

To operate and offer their full suite of services, third-party DR Providers must obtain access to each of their customer's energy data. In California, the IOU generally serves as the custodian of the customer's energy data. Therefore, data sharing between a customer and a DRP necessitates an additional agreement with the IOU; the IOU has the ultimate responsibility to deliver the customer's data to the DRP. This existing three-party data-sharing process has introduced several challenges, including lengthy enrollment forms, inconsistent data delivery, and incomplete data sets. Furthermore, these challenges are frequently exacerbated due to a lack of accountability for breaks in the process.

Up until 2018, customers in California authorized data sharing primarily via the IOU's six-page, twenty-nine-field Customer Information Service Request-Demand Response Provider (CISR-DR Provider, or CISR) form. SCE customers could additionally authorize data sharing using the Green Button – Third Party Connection (Green Button Connect) from their online account with SCE via a 19-step process.[24] Once the authorization to share data with the DR Provider was approved, the customer's Load Serving Entity (e.g., PG&E, SCE, or SDG&E) would begin to provide the data that the customer requested be shared with the DRP.

This lengthy data authorization process (either through the CISR or the Green Button Connect process) discouraged customers from completing their enrollment with a DR Provider. In addition, the process introduced delays in data delivery (discussed below) that further inhibited both the customer's and the DR Provider's participation in DR. The CPUC determined that a streamlining of the authentication and authorization of data sharing between customers

[24] The data shared between the IOU and DR Provider, necessary for both DR Provider business practices and actual integration with the wholesale market, has terms and conditions specified via Electric Rule No.24 (PG&E and SCE) and Electric Rule No.32 (SDG&E) (collectively, Rule 24/32). See PG&E "Electric Rule No.24," available at https://www.pge.com/tariffs/tm2/pdf/ELEC_RULES_24.pdf, SCE "Rule 24," available at https://www.sce.com/NR/sc3/tm2/pdf/Rule_24.pdf, and SDG&E "Rule 32," available at http://regarchive.sdge.com/tm2/pdf/ELEC_ELEC-RULES_ERULE32.pdf.

and DRPs, via a standardized OAuth Click-Through[25] solution, would improve the enrollment process. This Click-TFhrough solution was envisioned by the CPUC in Decision 16-06-008 to "streamline and simplify the direct participation enrollment process, including adding more automation, mitigating enrollment fatigue, and resolving any remaining electronic signature issues."[26]

However, the IOU proposal for a click-through solution was only recently approved by the CPUC following vigorous stakeholder discussion that spanned over a year. When approving the click-through proposal, the CPUC established a timeline for the IOUs to adhere to, which would launch Phase 1 of the click-through solution by February of 2018 and have the full click-through solution completed by November of 2018.[27] The goal of the CPUC is for the click-through solution to increase enrollments beginning with the 2018 DRAM, and so any further delays jeopardizes growth in the market for both 2018 and 2019.[28] Despite this direction, the rollout of the click-through solution has already experienced delays. For example, on February 9, 2018, SCE requested that the CPUC approve an extension of time for SCE to complete the first phase of their click-through implementation.[29] The CPUC approved this request, but sternly warned against any further delays, citing "the potential negative impact on customer enrollments in third-party programs and the possible negative impact on deliveries in the demand response auction mechanism program."

Although the click-through solution will improve the enrollment process of customers with a DRP, the ongoing reliance on the LSE to provide the data may continue to yield data quality issues, such as containing various inconsistencies for data formatting and data delivery.[30] In addition, data that is essential to properly integrate the customer into CAISO's wholesale market is occasionally not provided by the IOU, such as non-static factors and interval data at 5-minute granularity. In some of the worst cases, the LSEs simply fail to deliver data. Since the launch of the first DRAM, DRPs like OhmConnect have dedicated resources to specifically handle the task of facilitating data delivery from the LSE to the DRP. Although the process continues to improve, the process is not yet reliable on a day-by-day basis. Currently, the only existing recourse for enrollment or data delivery issues is to file a formal complaint with the

[25] OAuth is a standard authentication and authorization framework similar to what users see when accessing a site that includes a login using a secondary company (e.g. "Login with Facebook"). This framework allows a user to share information across multiple companies by simply approving that information sharing through a login to the original company that stores that data. In the example above, Facebook is the data custodian; in the example listed in this paper, the utilities are the data custodians.

[26] See June 9, 2016 D. 16-06-008, OP 9, at p. 35.

[27] See August 25, 2017 Resolution E-4868, at p. 74.

[28] See August 25, 2017 Resolution E-4868, at pp. 59 and 72.

[29] See February 22, 2018 letter to PG&E and SCE entitled "PG&E and SCE Requests for Extension of Time to Comply with Resolution E-4868, Ordering Paragraph 26."

[30] See PG&E Advice Letter 4992-E, SCE Advice Letter 3541-E, and SDG&E Advice Letter 3030-E, filed on January 3, 2017, for examples of the data elements that the IOUs currently provide, and the format in which these data elements are delivered.

CPUC. However, this is a lengthy process that is far more overreaching and time-consuming than the technical fix would require.

## Solutions

We recommend the following solutions to address the barrier of accessing data:

1. The IOUs should be held accountable for meeting appropriate deadlines for rolling out their click-through solution, streamlining the authorization and authentication process for data sharing, providing data at a quality that meets industry standards, and responding quickly to the third parties authorized to receive data; and
2. The California Energy Commission or the CPUC should empower a third-party watchdog, such as Mission:data, that can centralize data issues across third parties and provide a platform to communicate between third parties and utilities.

We expand further on these recommendations below.

### Ensuring Data Access Accountability

First, it is imperative that the IOUs are held accountable to the deadline by the CPUC to complete their click-through solution – delays in 2018 could negatively impact DRP participation in auctions for 2018, 2019, and beyond.

The CPUC has addressed barriers caused by insufficient data sets through approving the expansion of the Rule 24/32 data set via Resolution E-4868 (Rule 24/32 establishes the rules enabling DRP and their customers' participation in the CAISO energy markets).[31] The goal of the CPUC, by expanding the data set, is to provide data needed for: "(1) direct participation integration into the wholesale market; (2) essential Demand Response Provider business practices; and (3) a successful customer experience."[32] In addition, the [CPUC] has continuously acknowledged that "the direct participation enrollment process is an evolving one that can and should be improved."[33] Therefore, the CPUC should continue to be willing to expand the data set as the needs of the DRPs and the needs of the DR market evolves, and it should ensure that future changes to Rule 24/32 reflect these needs. For example, to address the necessary five-minute interval meter data, the CPUC should ensure that the IOUs will undertake meter reprogramming for every customer that registers to participate in a Demand Response program. The meter reprogramming will improve the interval meter granularity to at least 15 minutes, and it will facilitate DRP participation in additional CAISO energy products (such as real-time or ancillary services).

The CPUC also has regulatory oversight regarding the quality of data sent from the IOUs to the DRPs following customer authorization. As noted in the Summary Report, each IOU has a separate process for data delivery, a separate standard for data formatting, and unique technical solutions to any errors in the data or data-sharing process. These inconsistencies require third-party DRPs to build out three individual integrations for each IOU if they wish to serve customers throughout all of California. Furthermore, when issues do arise, the resolution

[31] See August 25, 2017 Resolution E-4868, at pp. 37-48.

[32] See August 25, 2017 Resolution E-4868, at p. 47.

[33] See June 16, 2016 D.16-06-008, at p. 25 and Finding of Fact (FOF) 27.

process defaults to the DRP and the IOU resolving the issues. However, this can lead to delays of varying lengths, with the only form of official escalation being the time-consuming and formal CPUC Complaint process.

**Resolving and Centralizing Data Issues**

To facilitate DRP participation, data issues must be resolved promptly. Prompt resolution can be facilitated either through direct CPUC involvement or a third-party watchdog that can assist with tracking data issues via complaints that have come either through the customer or the third party. Direct CPUC involvement would require frequent check-ins with participating DRPs or ongoing mediation when addressing individual issues between parties. In addition, the CPUC can establish Working Groups or Committees to address more holistic issues; for example, the CPUC has formed a Customer Data Access Committee to assist the IOUs in rolling out their click-through solution and resolving outstanding questions or issues.[34] Alternatively (or concurrently), either the CPUC or a third-party watchdog could develop a system whereby any party can direct their customers to file informal complaints that are then appropriately forwarded by the watchdog. This process would improve accountability by incorporating an independent entity that could facilitate and log complaints and flag when recurring problems occur. Utilities and DRPs can jointly track key metrics such as uptime, breaks, response times to inquiries, and gaps in the data delivery process flow to more expediently determine when breaks in the system have occurred.

We recommend that the CPUC empowers a third-party watchdog, such as Mission:data, that can centralize these issues and provide a platform to communicate across all third parties and utilities. Established DRPs have already spent significant time working with utilities to build in company-specific processes to deal with the volume of data that DRPs manage. It will be inefficient for utilities to continue to build one-off solutions instead of creating more centralized, longer-term solutions for all third parties.

Alternatively, California could undergo a shift whereby the utilities are no longer the custodians of customer data and instead the data is housed in a central repository. The central repository could share the data with any third party so long as the party has proper authentication and authorization from the customer. Texas utilizes such a system: for all customers serviced by a Retail Electric Provider, their data is stored in a central repository known as Smart Meter Texas (SMT).[35] Any customer with data stored by SMT can create an account with SMT and authorize data sharing with a third party of their choosing.

However, although this system does not require a participating third party to involve the customer's utility in order to access their data, the actual implementation of SMT has introduced cumbersome and unnecessary features. For example, Green Button Connect My Data functionality, which would allow third parties to access customer data using API calls, has yet to be implemented.[36] In addition, the technical support for SMT has faced challenges, with

[34] See August 25, 2017 Resolution E-4868, OP 27, at pp. 104-105

[35] See "Frequently Asked Questions," available at https://www.smartmetertexas.com/CAP/public/home/home_faq.html.

[36] See "5 Things You Should Know About Smart Meter Texas," available at http://www.missiondata.org/news/2017/9/22/5-things-you-dont-know-about-smart-meter-texas.

59% of all help tickets related to accessing or using the website.[37] Therefore, while a central repository may improve the issues associated with the existing third-party data-sharing experience in California, the actual implementation should be carefully monitored by all parties who will use the system and the regulators who approved the system. Most importantly, the foremost priority in constructing this system would be to minimize the amount of time it takes a customer to authorize data sharing. Such a system could be authorized either by the CPUC or the California legislature.

# Competitive Asymmetries between Utility and Third-Party Demand Response Providers

## Summary

CPUC rules generally prohibit customers from dual participation in both a third-party DR program and an IOU DR program. For this reason, third-party and IOU DR programs effectively compete against each other for customers' participation. Asymmetries give the IOUs unfair advantages over third parties in the form of lower marketing costs to potential customers and greater incentive payments to participating customers. For example, the IOUs have ready access to interval meter data, rate schedules, and billing histories for all customers. This enables the IOUs to undertake highly-targeted marketing campaigns for their own DR programs. In contrast, third-party DR providers presently cannot access this type of information about a customer until after the customer provides an explicit data authorization and the DRP undertakes some form of sunk costs to recruit that customer to their program.

In addition, customers who install technology to curtail energy use within their homes may be eligible to receive incentive payments from their IOU (e.g. in the form of bill credits) if they participate in a qualifying DR program.[38] However, many customers participating in third-party DR programs are still practically unable to receive these technology incentives, despite a recent CPUC decision that found that "[p]roviding technology incentives to both third-party customers and utility customers enrolled in supply side programs/activities not subject to cost-effectiveness analysis provides improved customer choice."[39]

The competitive asymmetries discussed above increase the costs to third-party providers of recruiting customers to their DR programs. Customers, for their part, may be less likely to participate in third-party DR programs than in IOU DR programs (or no DR program at all) because of these competitive asymmetries. Furthermore, high-potential customers may be unaware of the DR programs offered by third parties due to the difficulty in marketing to these customers selectively.

[37] Ibid.

[38] SCE, for example, offers a $75-$125 one-time bill credit to customers who "enroll a qualified smart thermostat in [its] Save Power Days program." See "Rebates & Incentives: Efficiency Has Its Perks," available at https://www.sce.com/wps/portal/home/residential/rebates-savings/rebates.

[39] See December 14, 2017 D.17-12-003, Finding of Fact (FOF) 87, at p. 173.

## Solutions

We recommend the following solution to address the barrier of competitive asymmetries:

1. The IOUs should be compelled to provide a level-competitive playing field by enabling third parties to access information used by IOU programs (thereby opening technology incentives to any participant in a DR program), using marketing dollars to socialize all programs (including third parties – not just IOU programs), and allowing third parties to reference the utilities that they are working with.

We expand further on this recommendation below.

### Addressing Competitive Asymmetries

Both the issue of marketing to customers and eligibility of incentive payments were taken up in the CPUC proceeding Application (A.) 17-01-012 et al, which sought approval of the IOU DR programs from 2018 to 2022. While PG&E proposed a Settlement that would extend incentives for certain devices to all customers participating in a DR program, the other two IOUs did not.[40] Furthermore, none of the three IOUs addressed the issue of co-marketing all available DR programs, both offered by third parties and the IOUs themselves. In part as a response to these concerns, the Commission issued D.17-12-003, which ordered the IOUs to provide technology incentives to participants of any supply-side demand response program (regardless of DRP)[41] and to begin a marketing push to inform customers of all demand response options.[42]

However, the implementation of this direction from the CPUC has been neither expedient nor smooth. Presently, only PG&E has built out the system enhancements that allow customers on an eligible DR program to receive the thermostat incentive. Furthermore, the CPUC suspended the three IOU Advice Letters that detailed their marketing plan for the DR program options following the Protests of two parties.[43] We recommend the CPUC continue to direct the IOUs in ways that promote a level playing field between the IOUs and other third parties.

# Expansion of Customers' Retail Energy Options

## Summary

The ability of third-party DR providers to bid their customers' load reductions directly into the CAISO's wholesale market is governed by CPUC Electric Rule 24 (PG&E and SCE) or Electric Rule 32 (SDG&E).[44] Rule 24/32 has two key provisions: (1) the IOU must provide to a

[40] See June 26, 2017 "MOTION OF THE SETTLING PARTIES FOR ADOPTION OF SETTLEMENT ON SPECIFIED ISSUES IN PACIFIC GAS AND ELECTRIC APPLICATION 17-01-012" Attachment, at p. 10.

[41] See December 14, 2017 D.17-12-003, OP 28, at p. 193.

[42] Ibid, OP 46, at pp. 197-198.

[43] See March 13, 2018 "Suspension Notice for AL 3746-E," "Suspension Notice for AL 5233-E," and "Suspension Notice for AL 3189-E," available via email.

[44] Information on Rule 24/32 can be accessed at https://www.pge.com/tariffs/tm2/pdf/ELEC_RULES_24.pdf (PG&E), https://www.sce.com/NR/sc3/tm2/PDF/14-942.pdf (SCE), and http://regarchive.sdge.com/tm2/pdf/ELEC_ELEC-SF_144-0821.pdf (SDG&E).

customer's designated third-party DR provider all data (including interval meter data) necessary for the customer to participate in DR at the CAISO; and (2) the IOU may not deny a customer's request to participate in a third-party provider's CAISO DR program without good cause (e.g. the customer must first disenroll from a conflicting IOU DR program). The second provision is not sufficient to guarantee unbundled customers (e.g. customers of CCAs) the ability to participate in third-party providers' CAISO DR programs. A CCA may deny a customer's request to participate in a third-party provider's CAISO DR program because the CPUC is not the Local Regulatory Authority (LRA) for CCAs and Rule 24/32 consequently does not directly apply to CCAs.

In addition, only customers of LSEs that participate in the CAISO energy markets are fully able to participate in DR. This barrier exists for a variety of reasons, chiefly that: (1) customers of non-LSEs do not have smart meters installed; and (2) these non-LSEs do not purchase DR in a centralized market the way that the IOUs do via the DRAM. Presently, millions of customers (e.g. those that are served by a municipal utility) are precluded from providing DR to California.

## Solutions

We recommend the following solutions to address the barrier of expansion of retail provider options:

1. Legislation should prevent any preclusion of unbundled customers from services such as third-party demand response;
2. The CAISO should relax the requirement that a resource must contain all users from a single LSE; and,
3. Electric providers that do not participate in the CAISO energy markets should install smart meters, set up a mechanism to allow customers to share their usage data, and procure DR services.

We expand further on this recommendation below.

### Avoiding Preclusion of Participation in DR

A lack of clarity persists regarding jurisdictional oversight specific to DR services within CCA territory. Presently, a customer's preferred DRP is tied to their electric provider (either an IOU, a CCA, or by Direct Access (DA)). Therefore, the simplest way to mitigate any potential conflicts is to bifurcate the DR provider role from the electric provider role whereby a customer can choose their electric provider independent of their DR provider. This would enable CCA customers to participate in the third-party DR programs of their choice. To create such a system, regulatory clarity must come from either the California Legislature or the CPUC. The CPUC has, at present, limited regulatory oversight with respect to CCAs. However, one area the CPUC could establish authority is through the cost causation of IOU programs.

Currently, every customer of a CCA must share in the costs of the IOU's DR programs until their CCA creates a "similar" program.[45] The CPUC could determine that, as a condition of similarity, customers who were eligible to participate in a program with their existing third-party DRP continue to be able to participate in that program. Alternatively, the Legislature could introduce a bill that creates such a separation between the customer's DR provider and

[45] See December 9, 2014 D.14-12-024, OP 8, at p. 87.

electric provider. For example, the bill could forbid CCAs or DA companies from withholding their customers from other DR programs.

### Relaxing Technical Barriers to Participation

The CAISO can address the technical barriers that prevent CCA customers from fully participating in DR programs by adjusting the requirements for a resource that is bid into the CAISO. Currently, every PDR must be comprised entirely of customers from the same LSE (i.e. the same electric provider). This results in DRPs having to create additional resources just to satisfy this requirement – and if that resource does not meet a minimum threshold size, the customers end up stranded from the CAISO market. This topic is currently under consideration in the CAISO Energy Storage and Distribution Energy Services (ESDER) Phase 3 initiative,[46] and has faced minimal stakeholder opposition. We encourage the CAISO to approve the necessary changes that will enable DRPs to register customers in a resource regardless of their LSE.

### Facilitating Customer Participation

Finally, more jurisdictions (namely those where electric customers are served by municipal utilities) should follow the same steps the California IOUs have by: (1) installing smart meters; (2) building out a click-through process; and (3) procuring DR in a transparent and market-driven process. Otherwise, California customers that are not served by an IOU or a CCA will continue to be unable to participate in DR. We suggest that these entities consider the barriers presented in this document as they undergo the steps necessary to create their own market for DR, to avoid precluding third parties.

## Conclusion

This *Policy Recommendations to Overcome Regulatory Barriers to Demand Response Report* summarizes the regulatory barriers to entry for residential Demand Response Providers in California and provides solutions to address the barriers. Addressing these barriers can further the growth of the market for residential DR and assist California with meeting the State's energy and environmental goals. The majority of the recommendations involve action taken by the CPUC, the legislature, or the CAISO. A summary of top recommendations is outlined below:

1. The CPUC should approve a permanent DRAM (contingent on positive results from the DRAM Evaluation);
2. The CPUC should ensure that all procurements under its jurisdiction are conducted fairly and transparently, while prioritizing clean, emissions-free resources;
3. The CPUC should utilize market-based approaches to procure advanced Demand Response energy products;
4. The IOUs should be held accountable for meeting appropriate deadlines for rolling out their click-through solution, streamlining the authorization and authentication process for data sharing, providing data quality that meets the standards claimed in their applications, and responding quickly to the third parties requesting data;

[46] See February 15, 2018 "Energy Storage and Distributed Energy Resources Phase 3 Straw Proposal," available at https://www.caiso.com/Documents/StrawProposal-EnergyStorageandDistributedEnergyResourcesPhase3.pdf.

5. The CEC or the CPUC should empower a third-party watchdog, such as Mission:data, that can centralize data issues across third parties and provide a platform to communicate across third parties and utilities;
6. The IOUs should be compelled to provide a level-competitive playing field by enabling third parties to access information used by IOU programs (thereby opening technology incentives to any participant in a DR program), using marketing dollars to socialize all programs (including third parties not just IOU programs), and allowing third parties to reference the utilities that they are working with;
7. Legislation should prevent any preclusion of unbundled customers from services such as third-party demand response;
8. The CAISO should relax the requirement that a resource must contain all users from a single LSE; and,
9. Electric providers that do not participate in the CAISO energy markets should install smart meters, set up a mechanism to allow customers to share their usage data, and procure DR services.

It is imperative that these barriers are addressed promptly as additional delays will only compound the difficulties that third party DRPs face when attempting to enter the California market for DR.