

**Emerging Markets & Technology
Demand Response Projects
2018 Q4 to 2019 Q1 Semiannual Report**

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I. Summary

Pacific Gas and Electric Company (PG&E) submits this semiannual report as directed in *Decision Adopting Demand Response Activities and Budgets for 2012 through 2014*, D.12-04-045, Ordering Paragraph (OP) 59 and continued per D.14-05-025 and D.16-06-029 adopting Bridge Funding for 2015-16 and 2017 respectively. The Demand Response Emerging Technologies (DRET) Program was also approved in the *Decision Adopting Demand Response Activities and Budgets for 2018 through 2022*, D.17-12-003.

PG&E's DRET program continues to explore new technologies and applications that have the potential to enable or enhance demand response (DR) capabilities and can include hardware, software, design tools, strategies, and services. Examples of some of the types of enabling technologies that have been investigated are advanced energy management control systems (EMCS), direct load controls, and advanced heating, ventilation, and air conditioning (HVAC) controls.

PG&E's DR Portfolio Strategy centers on addressing both customer and grid needs today and in the future, taking into account Rule 24, and the enablement of DR integration into the ISO wholesale markets. In addition, PG&E acknowledges the rapid development of "smart" devices, storage, and other technologies that are seeing increasing customer adoption across sectors and have the potential to help customers better perform on DR programs.

PG&E, Southern California Edison Company (SCE) and San Diego Gas & Electric Company (SDG&E), collectively referred to as the Investor Owned Utilities (IOUs), share updates on individual projects, including project status and findings, at monthly DRET conference calls as well as via participation in the Emerging Technologies Coordinating Council (ETCC) quarterly meetings.

II. Projects Completed in Q4 2018 to Q1 2019

A. ***Secured Data Sharing to improve residential DR programs' enrollment process.***

1. Overview

The CPUC's Decision Adopting Demand Response Activities and Budgets for 2018 through 2022 approved PG&E's ability to expand its CBP and ADR Programs to residential customers. Since the CBP and ADR programs were originally designed for non-residential customers, the customer and 3rd party enrollment processes for both programs could be improved for the residential customers segment. For example, both programs require a customer to sign a hard copy or electronic application for program enrollment and to allow a third party to access the customer's data. Stakeholders have stated that this signature requirement may

discourage residential customers from enrolling in these programs. In order to streamline these application processes, PG&E is using the DRET program to identify ways to streamline the program enrollment and data access processes.

The objective of this assessment is to collect information in order to create a smooth and secure customer authentication, authorization, and enrollment framework for DR pilots and programs in the future. This project focuses on improving the residential customer experience with third party DR aggregators or DR program providers.

2. Collaboration

The DRET Program partners with PG&E's internal Share My Data team on this assessment.

3. Results/Status

In the third quarter of 2018, the 3rd party consultant that supports this assessment developed a draft report to document the findings of this study. PG&E is in the process of reviewing this study.

4. Next Steps

A public version of the final report will be posted to the ETCC website when it is finalized in the 2nd quarter of 2019.

B. *Expansion of the Deemed Auto-DR Express/Fast Track Solutions*

1. Overview

In the past few years, PG&E and SCE have offered a more streamlined ADR incentive option to SMB customers: PG&E's SMB offering is the Fast Track ADR Program and SCE's SMB offering is the Express ADR Program. Since there were limited SMB customers enrolled in the Fast Track and Express ADR Programs, the objective of this DRET assessment is to increase ADR market penetration of SMB customers. Methods investigated to increase market penetration include expanding SMB eligible measures, adding additional facility types, and increasing customer and vendor awareness of the program.

2. Collaboration

This study is a joint DRET assessment between PG&E, SCE and SDG&E.

3. Results/Status

Below are tasks that were completed as of August 3, 2018:

- Interview Past Participants: 16 responses totaling 583 SAs & 67 MWs in SCE territory
- Analyze Past Participants
- Identify Additional Measures and New Facility Types
- Collect utility Stakeholder Feedback
- Expand scope to identify deemed incentives and savings for several SMB ADR controls

Below are recommendations based on initial findings:

- Simplify the reservation process
 - FastTrack form based on PG&E FastTrack program
- Increase eligibility of FastTrack/Express
 - Facilities based on past participants and interviews with vendors
- Make Auto-DR easier for vendor sales staff to discuss during onsite meetings with customers
 - Offline form, incentives and kW listed, uniform across utilities

4. Next Steps

The consultant is in the process of drafting the report and a public version of the final report will be posted to the ETCC website when it becomes available in Q2 of 2019.

III. Projects Initiated in Q4 2018 to Q1 2019

A. GHG Grid signal indicator lab test

1. Overview

The purpose of this Demand Response Emerging Technology (DRET) Assessment is to confirm that smart devices can be automatically controlled by a continuous/high frequency dispatch Demand Response (DR) signal (based on a combination of near-real-time GHG data from power grid operators and a forecast of grid conditions over a 30-day planning horizon) in a lab environment. The DRET Assessment will respond to research questions regarding the latency of fast and frequent DR signal, the success of algorithms that convert signals to device control and the impacts on both the electric grid and the devices themselves when operated under the command of the signal and algorithms.

2. Collaboration

The DRET Program partners with PG&E's internal Applied Technology Solution laboratory (ATS), and a 3rd party vendor who responsible to send out GHG signal based on near real time data from CAISO.

3. Results/Status

In Q1 2019, ATS has completed testing with most of the appliances (EV, Smart Thermostat, refrigerator and water heater).

4. Next Steps

The consultant and ATS are in the process of drafting the report and a public version of the final report will be posted to the ETCC website when it becomes available in Q2 of 2019.

B. Integrated Energy Efficiency and Demand Response Programs: Breaking Down Silos

1. Overview

The rapid growth of distributed energy resources, which include energy efficiency (EE) and demand response (DR), is transforming the electric utility industry. ACEEE and other organizations have long acknowledged the possible synergies and co-benefits of technologies and measures that can reduce both energy use (kWh) and peak power demand (kW), including cost savings to the IOUs, enhanced bill savings for customers, and increased participation from more effective marketing. Market changes have exacerbated the need for flexible demand in specific times and locations, increasing utility motivation to deliver targeted savings to address reliability concerns.

This research will review experiences with integrated EE/DR programs. Key objectives will be to assess promising opportunities, identify barriers, and recommend supportive policies for greater integration of utility EE and DR programs that yield greater benefits to customers at lower costs than would separate programs.

2. Collaboration

This study is led by ACEEE, and the DRET team will partner with PG&E's internal Energy Efficiency group, and other utilities participating in this ACEEE study.

3. Results/Status

In Q1 2019, ACEEE provided a draft workplan for study participants to comments.

4. Next Steps

Below is the schedule planned for this study:

- Research: January - March
- Drafting report: first draft by end of April
- Internal review draft: mid-May
- External review draft: late June
- Copy editing – final production: August
- Report completed and ready for release: End of August

C. Bundling Energy Efficiency with Distributed Energy Resources

1. Overview

As increasing baselines squeeze efficiency programs, IDSM program administrators such as CA IOUs are looking for new opportunities to engage customers in energy efficiency by leveraging additional customer and grid benefits. Bundling building energy efficiency retrofits with building-sited distributed energy resources, energy storage systems, or electric vehicle infrastructure has the potential to expand energy efficiency and demand response program participation and effectiveness while encouraging adoption of other technologies that address a broader set of customer concerns and enhancing grid operations and stability.

This DRET study will explore projects that have bundled technologies and look at existing program offerings for efficiency retrofits, distributed energy resources, energy storage, and electric vehicle integration. Drawing on this research, the final report will offer recommendations for program designs that encourage bundling by incorporating successful project level strategies and policies that reduce barriers to future program implementation.

2. Collaboration

This study is led by ACEEE, and the DRET team will partner with PG&E's internal Energy Efficiency group, and other utilities participating in this ACEEE study.

3. Results/Status

In Q1 2019, ACEEE provided a one page questionnaire for study participants to comments. The objective of the questionnaire is to identify integrated EE and DER programs that are offered or in development by participating utilities.

4. Next Steps

ACEEE plans to release the final report in the fourth quarter of 2019.

IV. Projects continue since 2017/2018

A. *Automated Demand Response Collaborative Stakeholder Process*

1. Overview

In 2017, PG&E expanded its Automated Demand Response (ADR) Program to residential customers to satisfy the AB 793 requirement. The first eligible residential ADR end use device was Smart Thermostat, which was an Energy Management Technology that could qualify for EE and DR incentive based on AB 793 guidance. On January 17, 2017, PG&E filed its 2018-2022 Demand Response Application (A.17-01-012). In this Application PG&E proposed to continue to offer the ADR Program to residential customers. The 18-22 DR Application was approved December 14, 2017.

In order for the Residential ADR Program to provide ADR incentive to other residential ADR enabled end use devices (beyond Smart Thermostat), PG&E needs to develop average load impact and deemed incentive levels for these end-use devices. The incentive of \$50 on eligible Smart Thermostat was based on a DRET assessment on Smart Thermostats in 2016. This assessment developed the DR load impact for Smart thermostats, which was used to calculate the ADR incentive, based on the up to \$200/kW ADR incentive approved by CPUC.

2. Collaboration

In the Motion of the Settling Parties for Adoption of Settlement on Specified Issues in a PG&E Application 17-01-012, PG&E committed to start a collaborative stakeholder process for the development of the following two items:

- 1) Relevant criteria to determine the order in which the load impact study for the residential ADR-enabled end-use devices identified should be done, as an input to the calculation of their associated ADR incentive
- 2) The development of a list of residential ADR-enabled end-use devices to be considered for eligibility for an ADR incentive.

The collaborative stakeholder process was opened to all stakeholders in the 18-22 DR application service list. All three IOUs and Energy Division staff from CPUC attended the first in person meeting in 2018.

3. Results/Status

On February 5, 2018, PG&E hosted a webinar to kick off the collaborative stakeholder process. Approximately twenty people attended the webinar.

On March 15, 2018, PG&E hosted an in person meeting to continue the collaborative stakeholder process. Approximately twelve people attended the in-person meeting.

4. Next Steps

In the most recent CPUC Decision resolving the remaining issues from the applications for 2018-2022 Demand Response Portfolios 18-11-029 dated November 29, 2018, the Ordering Paragraph 8 stated that beginning in 2019, and on an annual basis, the Director of the Commission's Energy Division is authorized to work with Pacific Gas and Electric Company (PG&E), San Diego Gas and Electric Company, and Southern California Edison Company (the Utilities) and other stakeholders to identify a set of Auto Demand Response issues to resolve for that year.

The annual Auto Demand Response process adopted in decision 18-11-029 will replace PG&E's stakeholder process adopted in D.17-12-003. Development of a list of residential Auto Demand Response enabled end-use devices to be considered for eligibility for an Auto Demand Response incentive from PG&E only and b) development of criteria to determine the order for PG&E to evaluate load impacts attributable to the devices are added to the list of issues to be discussed in 2019. PG&E will provide update on this process in the report for OP8 instead of this bi-annual DRET report in the future.

B. Connected Home Product Bundle Field Study

1. Overview

PG&E believes that in-home technologies introduced to the market in the last several years create new opportunities for residential customers to better manage, and control, their energy use. New control devices, home automation systems, and individual end-use controls can now be integrated to make it possible for customers to better understand their energy use, and to efficiently receive, and respond to information from the utility, which might include pricing signals, DR event signals, or other information. However, at this point, some of the elements that represent a fully functional, in-home, energy-management-focused control system covering multiple end uses are relatively new to the market. This is particularly true in terms of the role that some of these devices can and will play as energy management information and control gateways.

Because of this, PG&E wishes to conduct a Connected Home Field Study (“the Field Study”) in order to explore the way that customers are currently interacting, and could interact, with new Energy Management Technologies (EMTs) for a variety of different energy management-related applications.

The goals of the Field Study are to explore the EE, DR and Share My Data opportunities and customer satisfaction aspects of connected home product bundles that include smart thermostats, lights, switches, and Smart Plug devices.

2. Collaboration

PG&E’s EE and DR Emerging Technology and Share My Data teams jointly design and implement this Emerging Technology assessment.

3. Results/Status

In April 2018, PG&E selected a vendor to implement this assessment.

As of March 2019, this integrated emerging technology assessment has enrolled 158 participants. All participants have received connected control equipment such as smart plugs and smart lights by enrolling in this study.

4. Next Steps

The Measurement and Evaluation consultant will ask pilot participants to fill out a consensus survey in the end of March to identify their willingness to receive DR event notification. PG&E plans to start dispatching DR events to participants who agree to receive the event

notifications in the 2nd quarter of 2019. The M&E consultant will use an engineering approach to develop estimates of the load reduction potential for smart plugs based on the results from the DR events.

C. Testing Statistical Sampling Methodologies and Alternative Baseline

1. Overview

The CAISO evaluates Proxy Demand Resource (PDR) and Reliability Demand Response Resource (RDRR) wholesale market performance using one of two North American Energy Standards Board (NAESB) measurement and verification standard baseline types (a.k.a. “Type-I” and “Type-II”), with Type-I being the default methodology. Under Type-I, a resource’s performance is based on aggregated interval Revenue Quality Meter Data (RQMD) for all customer locations comprising that resource. However, Type-II is available for resources that do not have interval RQMD available for all locations, which would meet the CAISO’s required timelines. Using Type-II, performance evaluation uses statistical sampling to estimate the performance of the entire resource based on interval RQMD for a subset of the locations in that resource. In order to use the Type-II methodology, a proposal specific to the resource, which demonstrates 10% error at a 90% confidence interval must be submitted to and approved by the CAISO¹.

The purpose of this project was to develop and analyze a Type-II methodology so that all residential customers may be able to participate in CAISO’s wholesale markets. Phase 1 of the project utilized the residential customers participating in PG&E’s Supply-side Pilot (SSP) to develop a proposal for CAISO’s consideration.

Phase 2 of this project will allow PG&E to further validate the CAISO approved statistical sampling methodology. The DRET team is planning to work with the Stanford Linear Acceleration Center (SLAC) to test the existing methodology and DR baselines using the Visualization and Insight System for Demand Operations and Management (VISDOM) tool. The VISDOM tool developed by Stanford is a platform for gaining insight into utility customer behavior using their observed energy consumption data combined with traditional demographic and psychographic attributes.

¹ For more details on the proposal requirements, see:<http://www.caiso.com/Documents/RevisedDraftFinalProposal-EnergyStorageDistributedEnergyResources.pdf>

2. Collaboration

In Phase 1, PG&E worked in partnership with Olivine, the SSP program implementer and Scheduling Coordinator (SC). This study was conducted in concert with the SSP. In Phase 2, PG&E will work with SLAC.

3. Results/Status

In 2016, CAISO approved a sampling plan that was developed for a participant in PG&E's Supply Side Pilot. The approval of the sampling plan was significant, as it was the first Type II baseline proposal to go through a previously unspecified process.

After the sampling methodology was established and approved, the team planned to assess the accuracy of the plan by comparing the projected performance against actual available meter data. The sampling methodology was developed for a participant in the SSP who ultimately proved unable to enroll a sufficient number of kW's to be able to participate in the pilot and therefore the remainder of the assessment could not be pursued.

Meanwhile, PG&E's Measurement and Evaluation team conducted an assessment on the CAISO approved statistical sampling methodology by applying it to the Smart AC program's population and comparing it to the existing methodology, which requires a bigger population than the CAISO approved statistical sampling. Preliminary results indicate that PG&E's approach is more accurate compared to the CAISO approved methodology due to the large population RQMD customers already participating in the Smart AC Program. PG&E may explore comparing the two methodologies using a control group with only the RQMD population in 2017.

4. Next Steps

In 2018, PG&E started the Phase 2 study with SLAC. The objective of Phase 2 work includes the following:

- Identify methodologies that quantify load accurately for each customer and as a variety of aggregations for supply-side.
- Explore the impact of clustering on the accuracy and bias of the baseline models compared to the existing baseline methodologies for Residential and SMB customers.

- Research machine learning and other methods for load forecasting and calculating Residential and SMB resource availability.

The Phase 2 study is scheduled to be completed by Q2 2019. PG&E will post the final report in the ETCC website when a public version of the report becomes available.

D. *Water Saver Pilot*

1. Overview

As part of PG&E's Assembly Bill 2868 proposal, PG&E proposed a behind-the-meter (BTM) thermal storage program with a goal to reduce peak load by up to 5 megawatts (MW) by 2025 using smart electric water heaters and/or smart control devices. This proposal will incentivize customers to replace existing propane-based and Electric Resistance Water Heaters (ERWH) with hybrid Heat Pump Water Heaters (HPWH) in single family homes, multi-family homes, and small businesses, as well as provide a pay-for-performance incentive to operate electric water heaters during off-peak hours (late evening, early morning and afternoon).

The purpose of the DRET assessment is to test program implementation approaches that can be used for an actual program if the AB 2868 proposal is approved or in the alternate if the EE or DR programs leverage water heating for Energy Efficiency (EE) and DR benefits in the future. The DRET assessment is separated into two Phases. Phase 1 is a lab test and Phase 2 is a field test, with the following objectives:

Phase 1 Lab Test focus on evaluating the two HPWH and two ERWH:

- User interfaces
- Customer platform functions and utility platform functions
- CTA 2045 control and capability
- OpenADR signal capability
- Manufacturers support and warranties

Phase 2 Field Test focus on evaluating:

- The customers' willingness to adopt connected HPWH
- Test multiple incentive levels for customers who adopted HPWH
- The EE benefit from HPWH and load shifting potential for TOU rate
- If there is any benefit to send daily OpenADR signal to manage TOU

- The effectiveness of different messaging on marketing materials

2. Collaboration

The DRET Program partners with PG&E’s internal Energy Efficiency group, its Applied Technology Solution laboratory (ATS), and the Pricing Product team on this assessment.

3. Results/Status

On September 2018, ATS published a draft report for Phase 1 Lab Test. The project team has recently deployed Phase 2 Field Test, and have installed three HPWH as of March 21st.

4. Next Steps

PG&E will continue to launch the HPWH and water heater controller for ERWH. The goal of Phase 2 Field test is to install 110 HPWH and 50 controllers for ERWH in the next 12 months. The DRET Program is also in the process of contracting a M&E consultant to evaluate the two mains goals of the study:

1. Estimate the peak demand impact and energy savings of the two thermal storage bundles offered to participants, and
2. Estimate the demand and energy savings potential directly related to thermal storage and load shifting via electric water heaters.

V. Budget

The following is a breakdown of the total expenditures for PG&E’s 2018-2022 DRET budget. These values are based on accruals made each month. Values do not reflect commitments for projects, including those described in this report, which have been scoped and contracted, but not yet executed.

Approved 2018-2022 Budget	\$7,230,000
Budget Spent as of February 28 th	\$731,332
2018-2022 Budget Remaining	\$6,498,668