Pacific Gas and Electric Company®

Emerging Markets & Technology Demand Response Projects 2018 Q2 to 2018 Q3 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 Q2 to Q3 2018

A. Res ADR/CBP Request for Information (RFI)

1. Overview

On January 17, 2017, PG&E filed its 2018-2022 Demand Response Application (A.17-01-012). In this Application, CPUC approved PG&E to expand the Capacity Bidding Program (CBP) to residential customers.

The goal of the RFI is to help uncover and assess best practices, and available commercial solutions to implement an enrollment solution for PG&E's Residential CBP, and an enrollment, dispatch, and rebate solution for PG&E's Residential ADR automated demand response (ADR) Program.

2. Collaboration

In the Motion of the Settling Parties for Adoption of Settlement on Specified Issues in PG&E Application 17-01-012, PG&E committed to conduct a RFI to identify best practices for a streamlined, digital residential CBP customer authorization and enrollment process, that also considers whether and how ADR enrollments and CBP enrollments can be coordinated in PG&E's systems.

3. Results/Status

In January 2018, PG&E released the RFI and received seven responses in February 2018. Most responses provided information on the vendor's solution for the following three objectives:

- Objective 1 – Digital Enrollment in PG&E's Residential CBP
- Objective 2 – Digital Enrollment, Dispatch, and Rebate Processing for PG&E's Residential ADR Program
- Objective 3 – Coordination between the CBP and the ADR Program for Residential Customers

4. Next Steps

After reviewing the seven responses, PG&E decided not to move forward with any proposals. However, PG&E will continue to explore other opportunities to improve the residential CBP and ADR enrollment process.

III. Projects Initiated in Q2 to Q3 2018

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 second quarter, a 3rd party consultant that supports this assessment led several working sessions at PG&E to discuss the Customer Data Access Committee (CDAC)-developed "Solution 1[1]" requirements with PG&E Subject Matter Experts (SME). The consultant helped inform PG&E stakeholders and technologists on the feasibility and merits/demerits of the solution, and facilitated a discussion with the CDAC to better understand key assumptions.

4. Next Steps

The study is expected to be completed in Q4 2018. A public version of the final report will be posted to the ETCC website when it becomes available.

B. Watter Saver Pilot

1. Overview

As part of PG&E's Assembly Bill 2868 proposal, PG&E proposes 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 level for customers who have ERWH controller installed
- 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 21st, ATS published a draft report for Phase 1 Lab Test. The project team is in the process of reviewing the draft report and identifying additional requirements, if any, before moving to Phase 2.

4. Next Steps

PG&E plans to launch Phase 2 Field Testing in the fourth quarter of 2018. The design of the pilot will be based on the recommendation from the ATS Phase 1 report.

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 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.

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

Based on stakeholder feedback from the webinar and the in-person meeting, PG&E developed a list of criteria to prioritize ADR enabled end uses for inclusion in the ADR program. PG&E will collect supporting data on the criteria from a broader group of stakeholders, including device manufacturers that were not on the 18-22 DR Application service list. The data will then be provided to a 3rd party Measurement and Evaluation consultant to assess and prioritize ADR enabled end uses. The assessment will consider ADR incentives based on the quality and quantity of the supporting data. When data for specific ADR enabled devices is not sufficient, PG&E will leverage the DRET program to develop the load impact for such end use devices.

Starting in September 2018, PG&E began the process of contract negotiations with a Measure and Evaluation consultant to perform the following tasks:

- Develop a Framework for Selecting and Prioritizing ADR Technologies
- Develop an Intake Process, Request for Information, and Perform Data Collection for Proposed ADR Technologies
- Review and Assess Submitted Technologies
- Stakeholder Engagement and Reporting

PG&E will provide an update on the status of this ADR Collaborative Stakeholder Process in the next semi-annual DRET report.

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 study is expected to be completed in Q4 2018. 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.

C. 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 the end of August 2018, this integrated emerging technology assessment has enrolled 131 participants. Most of participants have received connected control equipment by enrolling in the Connected Home Product Bundle Field Study.

4. Next Steps

The Measurement and Evaluation consultant will ask pilot participants to fill out a survey in mid-October 2018 to identify their initial pilot enrollment experience. PG&E plans to start dispatching DR events once

the pilot enrolls 200 participants. The M&E consultant will use an engineering approach to develop estimates of the likely load reduction, and load reduction potential for each EMT. The estimates will be based on secondary research regarding the load of each EMT when on and then combined with the estimate of how many devices were controlled during an event.

D. 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 CAISO[1].

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 VIDSOM tool developed by Stanford is a platform for gaining insight

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

into utility customer behavior using their observed energy consumption data combined with traditional demographic and psychographic attributes.

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 kWs 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 Q4 2018. PG&E will post the final report in the ETCC website when a public version of the report becomes available.

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 in 2018 as of August 31st	$321,586
2018-2022 Budget Remaining	$6,908,414