Pacific Gas and Electric Company®

Emerging Markets & Technology Demand Response Projects 2019 Q2- 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 and Q3 2019

A. GHG Grid signal indicator lab test

1. Overview

The purpose of this DRET Assessment is to confirm that smart devices can be automatically controlled by a continuous/high frequency dispatch 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 future 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

This study shows that is it possible both to communicate with and control smart devices in real-time to achieve emissions reductions through load reduction and load shifting in a lab environment. As the electric grid incorporates more renewable generators, the variability of grid emissions should continue to rise, increasing the potential of load shifting to reduce emissions. WattTime has demonstrated their ability to robustly communicate with their supported endpoint devices. WattTime has also demonstrated the effectiveness of their algorithm and load reduction and shifting through devices for reducing the carbon emissions associated with energy use. The degree to which WattTime can reduce carbon is largely dependent on the variability of the carbon intensity of the grid, which have seasonal and daily trends, and the device type.

4. Next Steps

The DRET program posted the report in the ETCC website in September 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 DR, is transforming the electric utility industry. American Council for an Energy-Efficient Economy (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

KEY TAKEAWAYS

- Despite multiple benefits for customers and grid operators, the number of utility integrated energy efficiency/demand response (EE/DR) programs is small.
- Rapid technological advances and utility industry transformation are creating new opportunities for integrated EE/DR programs.
- Residential smart thermostat programs are prevalent among current EE/DR offerings. They provide DR capabilities along with home energy management.
- Organizational changes and supportive regulation will be needed to overcome barriers to integrated programs.
- The benefits of integrated programs include fully capturing the resources' value streams, more efficient administration, and a streamlined customer experience.
- Administrators should pursue these programs when the net benefits outweigh the costs of integration.

4. Next Steps

The DRET program posted the report in the ETCC website in September 2019.

III. Projects Initiated in Q2 and Q3 2019

A. Research project on the approach to calculate ADR control incentives

1. Overview

As a result of the 2019 ADR Program Annual Issue Process, the IOUs agreed to engage in an approximately one-year research project to identify the new deemed approach and values for ADR control incentives, which would be third party conducted and facilitated. PG&E will lead this research project on behalf of all three IOUs. In no particular order, possible options that will be researched for a new incentive structure could include, but are not limited to:

1. Technology-based control costs – Possible technology-based methodologies include the actual, or a percentage of the actual, market costs of the technologies, with a factor associated with the application to a business type, size, and/or location of the customer, etc.

2. Average load reduction expected from the control – Identifies the range of potential load impacts of a technology, calculates the average, and assigns a deemed incentive value.

3. Predictability/Reliability of the automated technology-assisted response to DR events – One of the benefits of ADR technology is that it has the potential to increase a customer's DR load impact predictability and reliability. Different technologies are more reliable and provide more predictable DR load impact. This approach could develop a methodology that could be applied to a variety of technologies and assign deemed incentive values based on how reliably the DR load can be predicted.

4. Other – IOU ADR teams recognize there could be other incentive constructs and approaches that should be considered and will work with the selected third-party consultant to ensure these are included.

2. Collaboration

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

3. Results/Status

In late September 2019, PG&E started to develop the research project design/scopes and will continue this development in the 4th quarter.

4. Next Steps

PG&E will not include this research project in this report if it is determined that the research project will be funded by the ADR Program.

IV. Ongoing DRET Projects

A. 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.

Starting April 2019, the study dispatch DR events by turning off customers' smart plug for few hours.

4. Next Steps

The Measurement and Evaluation consultant will ask pilot participants to fill out a final survey in the end of September to capture customers' experiences on this study. The survey result will be included in the final report.

B. 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.

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

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 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 estimated to be completed by Q4 2019. PG&E will post the final report in the ETCC website when a public version of the report becomes available.

C. Watter 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 could be used for an actual program when the AB 2868 proposal was approved in 2019 for PG&E to launch the program in 2020. The DRET assessment was separated into two Phases. Phase 1 was a lab test and Phase 2 was 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 its Pricing Product team on this assessment.

3. Results/Status

In September 2018, ATS published a draft report for the Phase 1 Lab Test. The project team has recently deployed Phase 2 Field Test, and has installed eleven HPWH, one water heater controller as of September 24, 2019.

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 has contracted with 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 technologies (HPWH and ERWH controller) offered to participants, and

2. Estimate the daily load shifting potential of the two thermal storage technologies (HPWH and ERWH controller) offered to participants.

D. Bundling Energy Efficiency with Distributed Energy Resources

1. Overview

IDSM program administrators such as CA IOUs and other 3rd parties 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 comment. 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.

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 August 31st	$911,632
2018-2022 Budget Remaining	$6,318,368