

**Emerging Markets & Technology
Demand Response Projects
2020 Q4 – 2021 Q1 Semiannual Report**

March 31st, 2021

Table of Contents

Contents

I.	Summary	4
II.	Projects Completed in Q4 2020 and Q1 2021	4
	A. WatterSaver Pilot	4
	1..... Overview.....	4
	2..... Collaboration.....	5
	3..... Results/Status.....	5
III.	Projects Initiated in Q4 2020 and Q1 2021.....	6
	A. BTM Battery for Load Management Study	6
	1..... Overview.....	6
	2..... Collaboration.....	6
	3..... Results/Status.....	7
	4..... Next Steps.....	7
	B. New DR Program/Rate designs for Ag customers	7
	1..... Overview.....	7
	2..... Collaboration.....	8
	3..... Results/Status.....	8
	4..... Next Steps.....	8
	C. TOU optimization study with smart technologies	8
	1..... Overview.....	8
	2..... Collaboration.....	8
	3..... Results/Status.....	8
	4..... Next Steps.....	8
IV.	Ongoing DRET Projects	9
	A. Evaluate 3rd party aggregator and vendor interest on residential digital rate.....	9
	1..... Overview.....	9
	2..... Collaboration.....	9
	3..... Results/Status.....	9
	4..... Next Steps.....	9
	B. Develop a residential ADR incentive for EV Charging Controls.....	10
	1..... Overview.....	10
	2..... Collaboration.....	10
	3..... Results/Status.....	10
	4..... Next Steps.....	11

C.	Using voice automation technology for load management.....	11
	1..... Overview.....	11
	2..... Collaboration.....	12
	3..... Results/Status.....	12
	4..... Next Steps.....	12
D.	Heat Pump Water Heater barriers and mid-stream solution study	13
	1..... Overview.....	13
	2..... Collaboration.....	13
	3..... Results/Status.....	14
	4..... Next Steps.....	14
V.	Budget.....	14

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 2020 and Q1 2021

A. *WaterSaver 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 is on evaluating two HPWH units and two ERWH units:

- 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 is 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
- Benefits to sending daily OpenADR signals to manage TOU and 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

Below are the high-level results for this study. For the full report, please go to the ETCC website.

Did the technology work?

Yes. The technology enabled electric water heaters to control water heater operations and recorded granular information about water heater energy use, temperature setting, operation modes. The process for dispatching and monitoring water heaters was fully automated, and allowed testing of multiple algorithms. The algorithms clearly reduced peak demand over all five hours in the 4-9 pm window while avoiding increases in total daily

energy use.¹ The effect of the impacts was consistently observable for nearly all devices.

What are the peak demand reductions resulting from the installation of smart water heater devices?

When operating under Algorithm A, the devices reduced peak demand by $62\% \pm 21\%$ (95% confidence), saving $0.15 \text{ kW} \pm 0.05$ (95% confidence) on average.

When operating under Algorithm B, the devices reduced peak demand by $68\% \pm 20\%$ (95% confidence), saving $0.17 \text{ kW} \pm 0.05$ on average.

III. Projects Initiated in Q4 2020 and Q1 2021

A. BTM Battery for Load Management Study

1. Overview

This study evaluates how BTM residential battery system can be used to provide value to the customers and the grid when the battery is optimizing under different dynamic rates (e.g. TOU and RTP²) and DR events. The study will focus on two groups of customers, customer with existing battery and customer purchasing new battery.

This study will collect data such as customer load performance and effectiveness of different algorithm during 2021 and 2022 to inform optimal program design for aggregators and customers with a BTM battery, which would help the DR team to file the 2023-2027 DR funding application in November 2021.

2. Collaboration

The DRET team will collaborate with the internal Distributed Generation (DG) team to implement this study. PG&E is planning to hire one consultant to manage the implementation and M&V for this DRET study.

¹ Phase 2 indicated that the reduction was mostly due to the efficiency of the heat pump, and that once the study factored in efficiency the amount of water heater load available the load shift was small. More data collected in the final report allowed us to make a similar conclusion.

² Day Ahead hourly RTP

3. Results/Status

The DRET team is still developing the scopes of this study in the first and second quarter of 2021, and PG&E will start the contracting process with the manufacturers and study implementer in the second quarter of 2021.

4. Next Steps

This assessment is scheduled to start on the third quarter of 2021 and will last twelve months. PG&E will provide updates on the bi-annual DRET report in the future.

B. New DR Program/Rate designs for Ag customers

1. Overview

PG&E received direct feedback from major aggregators of agricultural customers that these customers have significant load to drop and are interested in an agricultural specific DR program. Existing demand response programs are not an optimal fit for some customers in the agricultural industry given their unique load patterns and energy usage. By creating an agricultural specific demand response program or rate that helps customers overcome these obstacles and optimize their unique resources, more customers will have the opportunity to participate in demand response and PG&E will be able to meet its goals of maintaining, growing, and optimizing DR MWs.

The objective of this study to collect data on new DR Program/Rate designs for Ag customers during 2021 in order to create a draft DR program design for agricultural and irrigation customers to be filed by PG&E in November 2021 for the 2023-2027 DR funding application. Specifically, the study goal is to collect data that informs the below program design for Ag customers:

- Greater load reduction per SAID than agricultural participants in existing DR programs
- Increase number of agricultural participants
- Reliable load reduction – ability to deliver the amount of load reduction that is promised
- Higher customer and aggregator satisfaction than agricultural participants in existing DR programs
- Cost-effectiveness remains the same or better than other agricultural participants in existing DR programs

2. Collaboration

The DRET team will use a 3rd party vendor who are familiar with the Ag industries and market to implement this DRET study.

3. Results/Status

The DRET team developed scopes for this study in the fourth quarter of 2020, and PG&E contracted with the study implementer and M&E consultant in the first quarter of 2021.

4. Next Steps

This assessment is scheduled to start on the second quarter of 2021 and will last twelve months. PG&E will provide updates on the bi-annual DRET report in the future.

C. TOU optimization study with smart technologies

1. Overview

The objective of this study is to evaluate if residential smart technologies such as smart thermostat can optimize TOU customers HVAC energy use in order to shift customers energy usage from peak to non-peak and potentially result in customers' bill saving. In the study, the technology should provide a "set it and forget it" experience for the customers.

2. Collaboration

The DRET team will use a 3rd party vendor who are familiar with residential smart technologies and manufacturers and market to implement this DRET study.

3. Results/Status

The DRET team developed scopes for this study in the first quarter of 2021, and PG&E will contract with the study implementer and M&E consultant in the second quarter of 2021.

4. Next Steps

This assessment is scheduled to start on the second or third quarter of 2021 and will last until the end of 2021. PG&E will provide updates on the bi-annual DRET report in the future.

IV. Ongoing DRET Projects

A. Evaluate 3rd party aggregator and vendor interest on residential digital rate

1. Overview

The objective of this study is to evaluate 3rd party (example: IDSM aggregators and smart energy vendors/manufacturers) interest in receiving residential digital rate in order to help residential customers to be successful when enrolling in a dynamic rate such as TOU, EV and Smart Rate. Below are the proposed scoping topics for this study:

- Defining what is a digital rate
- Determine the format of the dynamic rate
- Scoping IT infrastructure design that can be scaled in the future
- Documenting 3rd parties' preferences on the channels and different type of rates
- Testing different channels that can provide digital rates to 3rd parties
- Testing the elasticity of different type of rates (dynamic, tier and non-tier, etc.)

2. Collaboration

PG&E's DR Emerging Technology and Share My Data teams jointly designed and will implement this Emerging Technology assessment. Internal stakeholders would include the Pricing Product and IT Team. A consultant was hired to lead the digital rate development.

3. Results/Status

CPUC Energy Division staffs has suggested to PG&E to put this DRET study on hold due other priority such as Reliability OIR.

4. Next Steps

PG&E delayed the deployment of this DRET study until the end of second quarter 2021.

B. Develop a residential ADR incentive for EV Charging Controls

1. Overview

In 2019, the ADR Program conducted a Collaborative Stakeholder Process to identify and vet emerging residential ADR technologies for potential inclusion in the program. This process found that EV charging control (such as onsite charging station, or manufacturers telematic) were an excellent fit for the ADR program, based on the rigorous criteria and stakeholder process employed in the study. However, surveys with the vendors and their respective control technologies indicate that they were not ready for full-scale rollouts at the time for various reasons.

In order to develop a residential ADR incentive for EV charging controls, this study will test EV charging controls in a field setting and measure the DR impact of such technologies. The study will:

- Identify relevant eligibility criteria for EV charging controls' participation in the field test, and more broadly, in PG&E DR programs.
- Identify EV charging controls and assess their DR impact in a field test.
- Characterize, to the extent possible, the average load management potential for identified residential EVs in PG&E territory:
 - Characterize load management groups of PG&E EV owners based on their EV's, TOU rates, and charging habits.
 - Document existing DR incentives available through PG&E programs (e.g., Smart Rate, Demand Response Auction Mechanism (DRAM) and Capacity Bidding Program (CBP)) to inform how the residential ADR program fits into the DR landscape and how ADR incentives for EV ADR controls should apply to these different DR programs.
- Assess potential ADR incentive designs and amounts for residential EV charging control technologies.

2. Collaboration

The DRET team will collaborate with the internal EV team to implement this study. PG&E hired the same consultant that leads the ADR Collaborative Stakeholder Process to manage this DRET study.

3. Results/Status

This assessment started on November 2020, and will last twelve months. During Q4 2020 to Q1 2021, this study completed the following tasks:

- Performed EV charging station vendors research and short list eligible vendors
- Recruit EV charging station vendors on the short list
- Finalized study test plan
- Developed customer survey for recruitment

4. Next Steps

The next steps are to finalize customer participation agreement and start recruit customers into the study. The recruitment is expected to take couple months. The consultant will start sending DR signals to study participants' EV charging stations in the 3rd quarter of 2021.

C. Using voice automation technology for load management

1. Overview

PG&E plans to default residential customers to TOU rate starting April 2021. Therefore, it is important to develop new tools and technologies to help customers to be successful in this new time varying rates, in addition to the existing tools we currently offer at PG&E website. The objective of this DRET study is to leverage residential voice assistants technology (such as Amazon Alexa, Google Home) to educate residential customers on energy usage and bill forecast, rates and Time-Of-Use automation/optimization, available of Internet-of-Things (IoT) and connectivity, configuration, and notification on utility information. This study has two phases:

Phase I – Customer Engagement through Voice Assistants: This phase has no dependence on smart home energy hub hardware installation, however, it does require customer having access to Amazon Alexa (and in the future Google Assistants, etc.) via speakers, display and/or mobile app. Information is collected and processed from PG&E's Share My Data (SMD) to 3rd party system. Customer would then interact with a 3rd party system (Energy Expert) through smart speakers, display and mobile devices. The Energy Expert will advise the customers to optimize energy use based on the customer's rate schedule.

Targeted customer – up to 50 friendlies (combination of PG&E employees and friends of PG&E employees)

Phase II – Real Time Usage & Optimization: This phase requires the installation and commissioning of a smart home energy hub that connects with the customer’s Smart Meter and IoT devices.

Targeted customer – up to 200 friendlies (combination of PG&E employees and friends of PG&E employees)

2. Collaboration

The DRET team will partner with the internal customer care Pricing Pilot and Marketing teams to develop frequently asked questions (FAQs) that relate to TOU and load management. PG&E hired a 3rd party to develop a voice automation skill (Energy Expert) for this study.

3. Results/Status

The DRET team is in the process of performing small scale User Acceptance Test on the Energy Expert skill. Below is list of sample questions that are support by the Energy Expert skill in Phase I:

- i. What’s my bill? (As of yesterday)
- ii. What’s my energy usage? (As of yesterday)
- iii. What is my current rate?
- iv. What other rates are available?
- v. Am I on the right rate?
- vi. What’s a good time for to run appliances?
- vii. When are prices the lowest? (For both Smart Rate and non-SR customers)

4. Next Steps

Once the small scale UAT is completed, we will move the study to Phase I, which require us to recruit up to 50 participants for a bigger scale UAT. We plan to add Smart Days notification to Energy Expert as a Phase I function. PG&E forecasts Phase II of this study will be launched in 3rd or 4th quarter of 2021.

D. Heat Pump Water Heater barriers and mid-stream solution study

1. Overview

As CA policy focuses on reducing GHG emissions, residential natural gas use is one of the sources of GHG emissions in the state that warrants attention. The majority of existing single family and low-rise multifamily buildings use natural gas for some or all of the following end uses: space heating, water heating, cooking, clothes drying, fireplace and pool heating. The State has allocated funding from several different sources for residential electrification efforts targeting space and water heating equipment. As the market is developing and initial programs have launched to support these efforts, several challenges have been identified that could significantly delay market transformation.

Converting existing gas water heaters to heat pump water heating equipment across the state will require a comprehensive effort across the entire industry, including education for homeowners and equipment manufacturers, enforcement personnel, distributors and installers. Initial efforts have identified several challenges that inhibit selection and installation of Heat Pump Water Heaters (HPWH), including, but not limited to:

- Insufficient panel capacity,
- location of existing equipment (e.g., most HPWH require 240V supply, no electricity (or only 120V) at equipment location)
- permitting (both electrical and plumbing),
- familiarity with technology – both for homeowners and contractors
- equipment not locally stocked.

As most water heater replacements are triggered by equipment failure with the majority resulting in emergency replacements, the objective of this DRET study is to identify potential solutions to these barriers, with a focus on leveraging mid-stream channels such as contractors, distributors, and retailers to increase adoption of this technology.

2. Collaboration

This study is a joint EE/DR Emerging Technology Study. PG&E is planning to hire a 3rd party to lead this research project.

3. Results/Status

The DRET team is in the process of developing the scope for this study and plans to select a 3rd party vendor to lead the study in the next couple months.

4. Next Steps

This assessment is scheduled to start in the 2nd quarter of 2021 and will last for twelve to eighteen months. PG&E will provide updates on the bi-annual DRET report in the future.

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 for, but not yet executed.

Approved 2018-2022 Budget	\$7,230,000
Budget Spent as of February 28 th , 2021	\$1,559,081
Budget Committed ³ as of February 28 th , 2021	\$5,670,919
2018-2022 Budget Remaining (estimated)	\$0

³ The committed budget includes other projects that are not in this report, such as potential joint projects with CEC CalFlexHub.