Portland General Electric
121 SW Salmon Street · Portland, Ore. 97204

August 25, 2020

Public Utility Commission of Oregon
Attn: Filing Center
201 High Street S.E., Suite 100
P.O. Box 1088
Salem, OR 97308-1088

RE: Advice No. 20-23 Updates to Schedule 13 Residential Testbed Pilot

Portland General Electric Company (PGE) submits this filing pursuant to Oregon Revised Statutes 757.205 and 757.210, and Oregon Administrative Rule 860-022-0025, for filing proposed tariff sheets associated with Tariff P.U.C. No. 18, with a requested effective date of **October 7, 2020**:

Twenty Seventh Revision of Sheet No. 1-1
Second Revision of Sheet No. 13-1
Second Revision of Sheet No. 13-2
Original Sheet No. 13-3
Original Sheet No. 13-4

PGE filed updates to Schedule 13, Residential Testbed Pilot on May 29, 2020. After discussions with Staff, it was agreed to continue joint efforts to draft language that would be supported by both parties, therefore, PGE withdrew Advice No. 20-12 on July 13, 2020.

PGE has revised the language in Schedule 13 to accommodate small-scale direct load control demonstrations to evolve the program beyond the behavioral demand response of Peak Time Rebates (PTR) to direct load control (DLC) activities as proposed in PGE Testbed application in Docket UM 1976 and approved in Order 19-425. This request includes simple tariff language changes.

PGE worked with Commission Staff to develop proposal, reporting and evaluation requirements for the direct load control demonstration activity. A detailed description for each of the demonstration activities is attached as Attachments B and C. Staff and PGE collaborated to determine the necessary and right amount of information for these descriptions.

PGE is proposing to undertake two demonstrations within the Testbed. The first is a coordinated research and demonstration effort with the Energy Trust of Oregon regarding the co-benefits of EE and DR available from ductless heat pumps. This work is being conducted pursuant to Commission Order 19-301.

Additionally, to fulfill the proposed activity of the PGE Smart Grid Testbed, PGE is pursuing a demonstration of demand response capability of single-family heat pump water heaters. This work is also informed by work conducted by the Energy Trust of Oregon and is a continuation of our Testbed proposal to further our coordination efforts with the Energy Trust.

Any future demonstrations that PGE may wish to implement through this tariff will be subject to approval of a revised Schedule 13 and accompanying, detailed write-ups.

- Attachment A - Redline courtesy of Schedule 13 changes
- Attachment B - Project Activity: Ductless Minisplit Controls
- Attachment C - Project Activity: Single-Family Water Heater Communications R&D

To satisfy the requirements of OAR 860-022-0025, PGE responds as follows:

The changes do not increase, decrease, otherwise change existing rates, or impact revenues.

Please direct questions to Santiago Beltran Laborde at (503) 464-7902. Please direct all formal correspondence and requests to the following email address pge.opuc.filings@pgn.com

Sincerely,

\s\ *Robert Macfarlane*

Robert Macfarlane
Manager, Pricing and Tariffs

Enclosures

PORTLAND GENERAL ELECTRIC COMPANY
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RATE SCHEDULES

SCHEDULE 13
RESIDENTIAL TESTBED PILOT (C)

PURPOSE

The Testbed Pilot is a first-of-its-kind research project meant to advance PGE's collective understanding and development of demand response to gain insight into how PGE could provide a demand-side resource in lieu of traditional supply-side resources. Eligible customers are those in the geographical area defined by the SGTB boundary located on PGE's webpage regarding the "Smart Grid Testbed". (C)

The Testbed Pilot will achieve these goals through marketing and communications activities, an opt-out demand response program, and optional activities that seek to demonstrate ways that PGE may work with customers to perform flexible load services.

All eligible Testbed participants will be enrolled in an opt-out peak time rebate (PTR) in which customers may receive a rebate when they respond to PGE's notification of peak time events. Additional Optional Activities offered to Testbed participants presently include, water heater direct load control for flexible grid services and ductless heat pump controls for demand response. Additional offerings will require modification of this schedule. (C)

DEFINITIONS

Direct Load Control (DLC) - A remotely controllable technology that allows the utility to modify appliance energy usage for the purposes of demand response and other flexible load services. (N)

Direct Load Control Event – A period in which the Company will provide direct load control.

Event Notification – The Company may issue a notification of a PTR or DLC event to participating Customers. Participating Customers must choose at least one method for receipt of notification. Notification methods may include email, text, auto-dialer phone call, on thermostat display screen, or via mobile app notification. Notification may also be available on the Company's website. Prior event notification is not required for all optional activities. (N)

Holiday – The following are holidays for purposes of the program: New Year's Day (January 1), Memorial Day (last Monday in May), Independence Day (July 4), Labor Day (first Monday in September), Thanksgiving Day (fourth Thursday in November), and Christmas Day (December 25). If a holiday falls on a Saturday, the preceding Friday will be designated the holiday. If a holiday falls on a Sunday, the following Monday will be designated the holiday. (T)

Optional Activities – Flexible load services demonstrations, research projects, or other activities governed under this tariff. (N) (N)

Peak Time Rebate (PTR) Program – customers choosing the PTR program are eligible to receive a rebate by reducing Energy use during Company-called events, relative to each Customer's baseline Energy use, as determined by the Company. (M)

SCHEDULE 13 (Continued) (T)

DEFINITIONS (Continued) (T)

Water Heater Direct Load Control Demonstration – Optional activity whereby customers with qualifying water heaters may opt to allow PGE to perform direct load control on the water heater. Customers will receive the credits outlined below for reduced water heater energy use during a DLC event. PGE may also provide enrollment incentives up to $50 per customer at the company's sole discretion. Qualifying water heaters are those that PGE is able to direct load control through onboard WiFi or a native CTA 2045 port. (N)

Ductless Heat Pump Control Demonstration – Optional activity whereby customers with a ductless heat pump are eligible to receive a smart thermostat control at no cost, as well as the credits outlined below for reduced DHP energy use during a DLC event. PGE may also provide enrollment incentives up to $50 per customer at the company's sole discretion. (N)

AVAILABLE (M)

To Residential Customers within the PGE testbed geographic region, as defined on PGE's webpage regarding the "Smart Grid Testbed". (C) (C)

APPLICABLE

Eligible Residential (Schedule 7) Customers are automatically enrolled in the PTR portion of the Pilot, as described in the Enrollment section of this tariff. Customers within the geographic boundary of the Testbed may elect to participate in any Optional Activities for which they may have a qualified appliance or are otherwise qualified. Customers will remain on Schedule 7 and will be eligible for the incentive described in this schedule. Eligible Customers must have a Network Meter. See the Special Conditions section for additional eligibility criteria. (C) (C)

CHARGES AND CREDITS

Customers participating in this Pilot will continue to pay all fees and charges in Schedule 7.

Participants in PTR and/or an Optional Activity will receive the following credit for reducing Energy Usage during a PTR or DLC Event: (C)

Credit 100.00 ¢ per kWh

To receive the Credit, the PTR Participant must reduce the home's overall energy use relative to the Customer's baseline energy use during a PTR event. The Optional Activity Participant's appliance must respond to the DLC event and reduce load during the DLC event to receive the credit.

Credits may be calculated based on actual savings or estimated based on engineering estimates. (C)

Events will not be called on Holidays or weekends. (M)

SCHEDULE 13 (Continued)

PEAK TIME REBATE (PTR) EVENT (M)

The PTR program has two event seasons: summer (the successive calendar months of June through September) and winter (successive calendar months of November through February). PGE will not call PTR events on weekends or Holidays. The Company will call PTR events only in event seasons. Prior to each season, the Company will remind the enrolled Customers that they are on the program, that they may participate in PTR events, and ways to be successful.

The Company initiates PTR events with an event notification to participating Customers the day prior to the PTR event. Participating Customers must choose at least one method for receipt of notification: email, text, or another available option. The Company will not call PTR events for more than two consecutive days. Reasons for calling events may include but are not limited to: Energy load forecasted to be in the top 1% of annual load hours, forecasted temperature above 90 or below 32, expected high generation heat rates and market power prices, and/or forecasted low or transitioning wind generation.

DIRECT LOAD CONTROL EVENT (N)

Direct Load Control Events occur in 5 minute increments during an event period between one hour to five hours. The Company may call multiple events per day but will not exceed five cumulative hours for the day. During Direct Load Control Events the Customer may allow the Company to control their enrolled appliance for the duration of the event. The Customer has the option not to participate in each event by opting out. The Company may initiate Direct Load Control Events with Event notification prior to the event, but Event notification is not required. (N)

PTR ENROLLMENT (T)

Eligible Customers within the PGE testbed geographic region will be automatically enrolled in PTR. (C) Customers will be notified of the program, their enrollment and option to unenroll, by mail or email. (C) In the program notification, PGE will also advise Customers how to be successful on the Pilot. The Customers will be enrolled prior to the term of the Pilot; eligible customers starting new service in the Testbed will be enrolled shortly after the start of service. (C) Unless this Pilot is otherwise terminated, participating Customers will be enrolled for the entire pilot term. (C) (M)

OPTIONAL ACTIVITIES ENROLLMENT (N)

Eligible Customers–those within the Testbed geographic region and with a qualified appliance or who are otherwise qualified have the option to enroll in additional demonstration or research projects. PGE will attempt to identify customers with qualified appliances or who are otherwise qualified to make them aware of the program. Customers may unenroll from the program at any time. (N)

SCHEDULE 13 (Concluded)

SPECIAL CONDITIONS **(M)**

1. The Customer may unenroll from PTR at the next regularly scheduled meter reading. If a Customer unenrolls from PTR, the Customer is not eligible to re-enroll during the pilot period. **(T)** **(T)**

2. Customers already enrolled in a demand response offering are not eligible to participate in PTR. This includes, Schedule 3, Schedule 4, Schedule 5, Schedule 6, Time of Use under Schedule 7, Schedule 215, Schedule 216, Schedule 217, and the DLC option of this tariff. In addition, Solar Payment Option or Schedule 203 Net Metering Service are not eligible for this Pilot. **(T)** **(T)** **(C)**

3. Incentives may be provided in an on-bill credit on the Customer's next monthly billing statement or by check at the next billing statement after the event season ends. **(T)**

4. The Company is not responsible for any direct, consequential, incidental, punitive, exemplary, or indirect damages to the participating Customer or third parties that result from performing direct load control on a participating appliance. **(N)**

5. The Company shall have the right to select the schedule and the percentage of the Customer's appliance(s) to cycle at any one time, up to 100%, at its sole discretion. **(N)**

6. Customers with interconnected energy storage are only eligible for PTR if the energy storage system is controlled by the Company and not the Customer. **(T)**

7. The Company will defer and seek recovery of all pilot costs not otherwise included in customer prices. **(T)**

TERM

This Pilot concludes June 30, 2022. **(M)**

PGE Advice No. 20-23
Attachment A
Redline of Schedule 13

Portland General Electric Company | **Second Revision of Sheet No. 13-1**
P.U.C. Oregon No. E-18 | **Canceling First Revision of Sheet No. 13-1**

SCHEDULE 13
~~OPT-OUT~~ RESIDENTIAL ~~DEMAND RESPONSE~~ TESTBED PILOT

PURPOSE

~~The Demand Response Testbed Pilot seeks to establish high program participation of demand response by eligible Residential Customers through~~The Testbed Pilot is a first-of-its-kind research project meant to advance PGE's collective understanding and development of demand response to gain insight into how PGE could provide a demand-side resource in lieu of traditional supply-side resources. Eligible customers are those in the geographical area defined by the SGTB boundary located on PGE's webpage regarding the "Smart Grid Testbed".

The Testbed Pilot will achieve these goals through marketing and communications activities, an opt-out demand response program, and optional activities that seek to demonstrate ways that PGE may work with customers to perform flexible load services.

All eligible Testbed participants will be enrolled in an opt-out peak time rebate (PTR) in which customers may receive a rebate when they respond to PGE's notification of peak time events. ~~Eligible customers are those who live in the geographical areas served by three specific substations. The Pilot will test approaches to move PTR opt-out customers to opt-in direct load control program offerings that are offered through other tariff Schedules. The Pilot is offered through June 30, 2022.~~Additional Optional Activities offered to Testbed participants presently include, water heater direct load control for flexible grid services and ductless heat pump controls for demand response. Additional offerings will require modification of this schedule.

DEFINITIONS

Direct Load Control (DLC) - A remotely controllable technology that allows the utility to modify appliance energy usage for the purposes of demand response and other flexible load services.

Direct Load Control Event – A period in which the Company will provide direct load control.

Event Notification – The Company may issue a notification of a PTR or DLC event to participating Customers. Participating Customers must choose at least one method for receipt of notification. Notification methods may include email, text, auto-dialer phone call, on thermostat display screen, or via mobile app notification. Notification may also be available on the Company's website. Prior event notification is not required for all optional activities.

Holiday – ~~the~~The following are holidays for purposes of the program: New Year's Day (January 1), Memorial Day (last Monday in May), Independence Day (July 4), Labor Day (first Monday in September), Thanksgiving Day (fourth Thursday in November), and Christmas Day (December 25). ~~–~~If a holiday falls on a Saturday, the preceding Friday will be designated the holiday.~~–~~ If a holiday falls on a Sunday, the following Monday will be designated the holiday.

Optional Activities – Flexible load services demonstrations, research projects, or other activities governed under this tariff.

Peak Time Rebate (PTR) Program – customers choosing the PTR program are eligible to receive a rebate by reducing Energy use during Company-called events, relative to each Customer's baseline Energy use, as determined by the Company.

SCHEDULE 13 (Continued)

DEFINITIONS (Continued)

Water Heater Direct Load Control Demonstration – Optional activity whereby customers with qualifying water heaters may opt to allow PGE to perform direct load control on the water heater. Customers will receive the credits outlined below for reduced water heater energy use during a DLC event. PGE may also provide enrollment incentives up to $50 per customer at the company's sole discretion. Qualifying water heaters are those that PGE is able to direct load control through onboard WiFi or a native CTA 2045 port.

Ductless Heat Pump Control Demonstration – Optional activity whereby customers with a ductless heat pump are eligible to receive a smart thermostat control at no cost, as well as the credits outlined below for reduced DHP energy use during a DLC event. PGE may also provide enrollment incentives up to $50 per customer at the company's sole discretion.

AVAILABLE

To Residential Customers ~~served by the following PGE substations: Delaware (Portland), Island (Milwaukie), and Roseway (Hillsboro).~~within the PGE testbed geographic region, as defined on PGE's webpage regarding the "Smart Grid Testbed".

APPLICABLE

Eligible Residential (Schedule 7) Customers are automatically enrolled in ~~this~~the PTR portion of the Pilot, as described in the Enrollment section of this tariff. Customers within the geographic boundary of the Testbed may elect to participate in any Optional Activities for which they may have a qualified appliance or are otherwise qualified. Customers will remain on Schedule 7 and will be eligible for the incentive described in this schedule. ~~-~~Eligible Customers must have a Network Meter. ~~-~~See the Special Conditions section for additional eligibility criteria.

CHARGES AND CREDITS

Customers participating in this Pilot will continue to pay all fees and charges in Schedule 7. ~~Energy Charges may also include the~~

Participants in PTR and/or an Optional Activity will receive the following ~~PTR~~ credit for reducing Energy Usage during a PTR or DLC Event:

~~PTR Credit 100.00 ¢ per kWh~~

Credit 100.00 ¢ per kWh

To receive the ~~PTR~~ Credit, the ~~Customer~~PTR Participant must reduce ~~Energy~~the home's overall energy use relative to the Customer's baseline energy use during a PTR event. ~~Such~~The Optional Activity Participant's appliance must respond to the DLC event ~~will be a two- to five-consecutive-hour window between the hours of 7:00 AM to 11:00 AM or 4:00 PM~~and reduce load during the DLC event to ~~9:00 PM.~~ receive the credit.

Credits may be calculated based on actual savings or estimated based on engineering estimates.

Events will not be called on Holidays or weekends.

SCHEDULE 13 (Continued)

PEAK TIME REBATE (PTR) EVENT

The PTR program has two event seasons: summer (the successive calendar months of June through September) and winter (successive calendar months of November through February). PGE will not call PTR events on weekends or Holidays. The Company will call PTR events only in event seasons. Prior to each season, the Company will remind the enrolled Customers that they are on the program, that they may participate in PTR events, and ways to be successful.

The Company initiates PTR events with an event notification to participating Customers the day prior to the PTR event. Participating Customers must choose at least one method for receipt of notification: email, text, or another available option. The Company will not call PTR events for more than two consecutive days. Reasons for calling events may include but are not limited to: Energy load forecasted to be in the top 1% of annual load hours, forecasted temperature above 90 or below 32, expected high generation heat rates and market power prices, and/or forecasted low or transitioning wind generation.

DIRECT LOAD CONTROL EVENT

Direct Load Control Events occur in 5 minute increments during an event period between one hour to five hours. The Company may call multiple events per day but will not exceed five cumulative hours for the day. During Direct Load Control Events the Customer may allow the Company to control their enrolled appliance for the duration of the event. The Customer has the option not to participate in each event by opting out. The Company may initiate Direct Load Control Events with Event notification prior to the event, but Event notification is not required.

PTR ENROLLMENT

Eligible Customers ~~– those served by the Delaware, Island and Roseway Substations –~~ within the PGE testbed geographic region will be automatically enrolled~~.~~ in PTR. Customers will be notified of the program, their enrollment and option to unenroll, by mail or email. ~~–~~In the program notification, PGE will also advise Customers how to be successful on the Pilot. ~~-~~The Customers will be enrolled prior to the term of the Pilot~~. Service under this schedule~~; eligible customers starting new service in the Testbed will ~~commence April 1, 2019 or~~be enrolled shortly ~~thereafter.~~ after the start of service. Unless this Pilot is otherwise terminated, participating Customers will be enrolled for the entire pilot term.

OPTIONAL ACTIVITIES ENROLLMENT

Eligible Customers–those within the Testbed geographic region and with a qualified appliance or who are otherwise qualified have the option to enroll in additional demonstration or research projects. PGE will attempt to identify customers with qualified appliances or who are otherwise qualified to make them aware of the program. Customers may unenroll from the program at any time.

Portland General Electric Company
P.U.C. Oregon No. E-18 **Original Sheet No. 13-4**

SCHEDULE 13 (Concluded)

SPECIAL CONDITIONS

1. The Customer may unenroll from ~~the Pilot~~PTR at the next regularly scheduled meter reading. If a Customer unenrolls from ~~the Pilot~~PTR, the Customer is not eligible to re-enroll during the pilot period.

2. Customers already enrolled in a demand response offering are not eligible to participate in PTR. This includes, Schedule 3, Schedule 4, Schedule 5, Schedule 6, Time of Use under Schedule 7, Schedule 215, Schedule 216, Schedule 217~~.~~, and the DLC option of this tariff. In addition, Solar Payment Option or Schedule 203 Net Metering Service are not eligible for this Pilot.

3. ~~The PTR incentive~~Incentives may be provided in an on-bill credit on the Customer's next monthly billing statement or by check at the next billing statement after the event season ends.

4. The Company is not responsible for any direct, consequential, incidental, punitive, exemplary, or indirect damages to the participating Customer or third parties that result from performing direct load control on a participating appliance.

5. The Company shall have the right to select the schedule and the percentage of the Customer's appliance(s) to cycle at any one time, up to 100%, at its sole discretion.

~~4.~~6. Customers with interconnected energy storage are only eligible for ~~this schedule~~ PTR if the energy storage system is controlled by the Company and not the Customer.

~~5.~~7. ~~5.~~ The Company will defer and seek recovery of all pilot costs not otherwise included in customer prices.

TERM

This Pilot concludes June 30, 2022.

PGE Advice No. 20-23
Attachment B
Project Activity: Ductless Minisplit Controls

Testbed Demonstration Project Activity

Subject: Ductless Minisplit Controls **Date:** 8/25/2020

Summary of Project Dashboard

Number of Customers Involved	Technology Being Tested	Funding Source	Funding Amount	Time Period	Contractor and/or partner
50 EE/DR and 100 DR only residential customers	DR savings potential of mini-split controls	Testbed Budget	$100k	Late Q3 2020 through Q3 2021	Energy Trust; Flair

- **Description of Demonstration Project (Statement of the Research Question)**
  The goal of the demonstration is to identify the combined value of energy efficiency (EE) and demand response (DR) for ductless heat pump (DHP) technology. PGE and the Energy Trust will collaborate to identify customers with DHPs and provide them Flair Puck thermostats at no cost in exchange for participating in the demonstration and allowing PGE and Energy Trust to evaluate the performance. For participating customers within PGE's Testbed the smart controls will additionally be used for demand response load shifting, with customers being compensated $1 per kWh shifted[1], in accordance with the proposed revisions to PGE Schedule 13.

  Energy Trust has been directed by the OPUC to explore a collaboration with PGE on the combined DR/EE value of connected DHP and DHP controls as part of a cost effectiveness exception request.[2] Energy Trust's goal is to assess whether add on controls can increase EE performance of DHPs and their backup heating, while at the same time delivering DR/flex load benefit to PGE. DHP controls are on PGE's existing product roadmap and this research provides an opportunity to explore the measure while sharing the costs of that activity with Energy Trust. The project also demonstrates increased collaboration with Energy Trust, which is a Testbed Key Performance Indicator (KPI).

[1] This compensation amount is no greater or less than that offered through the current Schedule 13 Opt-out PTR participation. This allows us to test the concept of "PTR with Tech" as an offer. PTR with tech is a successful an approach used by Baltimore Gas and Electric who program design informed PGE's own PTR program design.
[2] Commission Order 19-301

- **Participation and type of participant targeted (Provide reasoning for the number)**

  The Energy Trust energy efficiency study seeks to include 800 customers- 400 in a treatment group that will receive DHP controls, and 400 in a control group that will not receive a smart thermostat until the end of the study, spread across PGE's and PacifiCorp's service territories. PGE's smaller DR portion of the study is targeting ~150 customers within the Smart Grid Testbed (50 overlapping with the Energy Trust's EE treatment group and an additional 100 testing DR capabilities alone). Due to the limited number of Energy Trust eligible[3] DHP in the Testbed for the treatment group (50), PGE is supplementing the population with non-incentive eligible systems (DHP without an electric heating backup) to increase the sample size and get a better understanding of customer acceptance, equipment performance, and DR potential.

- **Optional Activities or Alternatives Considered**
  1. Continue with business as usual for DHP as an EE measure.
  2. Use a separate channel to retrofit existing units with controls and test the DR value of DHP.
  3. Lab test the DR value of several DHP models and control. However, this is likely to cost similarly and require additional in-field testing to verify.
  4. No investigate the DR value of DHP and assume the value to too low to craft and offer a separate DR solution.

- **How the Demonstration Project fulfills Testbed Proposal Work**
  The Testbed proposal included work on connect DHP and PTAC units as an emerging technology which could be co-deployed with the Energy Trust and NEEA. The Testbed proposal at page 74 Appendix B, Section B.3 describes possible work on DHP.

- **How the Demonstration Project informs Pilot and Program Development (Including potential scale)**

  Efficient heating and cooling is the primary value of DHP technology. However, as a stand-alone energy efficiency measure DHPs are not presently cost effective. Through Order 19-301 the Commission directed Energy Trust to work with PGE to explore the combined EE/DR value of a DHP strategy. The demonstration project will provide insights into how smart controls impact the underlying EE value of DHP technology, as well as its value as a flexible load resource. Through this demonstration, PGE will work directly with the Energy Trust to lay the foundation for future collaborative activity. Further, the demonstration project will inform the PGE team whether a DHP measure as a co-deployed EE/DR approach is viable and should be considered as part of a strategic resource development plan to meet the 2019 DR goals identified in PGE's 2019 IRP. The demonstration project will potentially save ratepayer dollars by spending a small sum of money in a defined system geography over a short, discrete timeline to determine the viability of DHP as a grid services resource. The value identified by the activity will inform cost effectiveness screening and planning assumptions thereby savings customers additional evaluation activity during any subsequent pilot phase.

[3] DHPs eligible for the treatment group must have electric back-up heating, while the PGE supplemental devices for standalone DR may be backed up by other fuel sources or have no backup.

Should the demonstration prove that Flair Pucks (and other similar DHP controls) have the potential to effectively perform grid services such as load shifting and/or load shedding, PGE would evaluate the potential to create a scalable and cost-effective Program. The load shifting potential of DHPs in the climate zones served by PGE is uncertain, however studies of ductless heat pumps have shown an average hourly power draw of ~1kW in heating mode with outdoor air temperatures of 20 degrees F and ~0.5kW in cooling mode with outdoor air temperatures of 95 degrees F.[4] Assuming a 2% penetration rate of DHPs across ~500,000 single family homes in PGE's service territory and a conservative, dual season average peak demand savings potential of 0.5kW per unit, the DR Total technical potential could be as much as 5MW. This research will provide additional data on the DR value of DHP control technology and help to hone these estimates.

- **Funding Source and Total Costs (Including: O&M expenses and revenues, broken down by FERC account, capital costs, number of FTE employees, and number of contractors.)**

  Total costs for the PGE portion of this work is estimated at $100,000 and would come out of the existing program budget. All staff are existing resources.

Budget Item	Amount	Notes
Hardware	$18,000	$120 per unit, free shipping
Software & Controls	$32,000	This demonstration project is sharing the costs of the DRMS platform with the other Test Bed demonstrations and the Battery Storage Pilot. Flair must be integrated into the DRMS platform, a one-time cost.
Customer Incentives	$15,000	Estimated at $50 per year per device. A key learning of the study will be the actual DR potential, which in a pay for performance structure directly impacts the incentive spend.
Recruitment & Outreach	$15,000	Creation of collateral and enrollment procedures to secure participants
Evaluation & Energy Trust Collaboration	$20,000	Support for project activities being conducted by the Energy Trust that are incremental to their EE research.
Total	*$100,000*	

- **Timeline of activity, Milestones, Risks, and Mitigation Plan**

Scoping (Q4-2019 – Q3-2020):

PGE has been collaborating with the Energy Trust on the project scope since October of 2019. During this time, we have reviewed DHP control technology, conducted demos with control OEMs, evaluated DR capabilities, reviewed customer DHP adoption data and aligned on the research design. We are currently working with Energy Trust on a MOU for this project.

Milestone – execute MOU with Energy Trust of Oregon on DHP Demonstration Project

[4] Long-Term Monitoring of Mini-Split Ductless Heat Pumps in the Northeast - https://www.nrel.gov/docs/fy15osti/63079.pdf

Contracting (Q2-2019 – Q3-2020):

PGE has been working with the controls vendor, Flair, on device pricing, DERMS integration costs, and cloud access fees. We are seeking to finalize this agreement in August 2020 in preparation for the project launch in late Q3 2020.

Milestone – Execute contract with Flair (Controls OEM vendor) and Virtual Peaker (DERMS vendor)

Risk and Mitigation Strategy:

1. Cannot reach agreement on acceptable pricing with controls OEM
    a. Mitigation Strategy – Leverage marketing value of partnership and future work stemming from DERMS integration
2. DERMS provider cannot complete integration in time for winter DR season
    a. Mitigation Strategy – Early engagement with vendor and inclusion of project on integration roadmap

Procurement (Q3-2020):

Device procurement will be handled via Energy Trust and Flair, with customers being shipped the unit as they are enrolled in the research. PGE will compensate Flair for the units that are part of the DR-only group, Energy Trust will pay for the EE.

Customer recruitment/communications (Q3-2020):

Recruitment will be handled through an enrollment survey administered by CLEAResult on behalf of Energy Trust and PGE. The survey will determine customer eligibility and be used to assign customer into the treatment and control groups. Surveys will go out to customers that received a DHP incentive from Energy Trust. All SGTB customers will be assigned to the treatment group. For the DR-only customers (those who did not receive an incentive), PGE is using a mix of other sources (e.g. public permit data and residential load disaggregation results) to identify and recruit participants.

Milestone – Complete enrollment of DR-EE and DR-only customers in the SGTB at levels sufficient to get an indicative measure of DR value and customer acceptance

Risk and Mitigation Strategy:

1. Customers do not participate in the offer
    a. Mitigation Strategy – Increase customer incentives, including adding an upfront incentive to entice enrollment
2. Customers drop out of program during or between season
    a. Mitigation Strategy – Continually engage customers in the research and finds, provide regular updates on energy savings and incentive earned. Created regular check-in's between seasons and before season to keep them engaged and prepared for events.

Project launch and management (Q3-2020 – Q4-2021):

Once this project is approved by the OPUC, PGE will launch and, in coordination with Energy Trust, begin enrolling customers. Our goal is to have the controls installed and operational in customer homes before the 2020 heating season and to remain in place through the 2021 cooling season and the first part of the 2021 heating season. Following the end of Phase I field work, PGE will suspend DR calls on the devices and leave them in customers' homes for their continued use. The integration with our DERMS will remain and these customers may be re-enrolled in a future offering, either as part of a Phase II activity and/or a future full-scale pilot or program.

Milestone – Call at least two events per season in both the 2020 winter season and 2021 summer season.

Risk and Mitigation Strategy:

1. Weather is not conducive to DR event calls
    a. Call events on milder weather days than planned in order to maintain adequate sample of customer response and equipment performance.

Analysis/evaluation (Q1-2022):

Following the close of the project, PGE will transfer AMI, event and customer data to an evaluator to analyze the DR value of DHP controls, customer acceptance of the technology, and other relevant project activities/outcomes.

- **Impacts of the Activity to Phase 1 Primary Work**

The activity is in-line with the Testbed proposal and requirements of Commission Order 19-301. The activity is limited to ~150 participants among 20,000 residential customers within the Testbed. This activity will not statistically or materially affect either the primary customer value proposition work, customer engagement and education work, or the customer migration work of the Testbed Phase 1. It will provide some foundational insights into not only general coordination with the Energy Trust but also some foundational lessons regarding the co-development and co-deployed demonstration project within the Testbed.

- **Lessons to be learned (Learning Objectives)**

The primary goals of this project are to: 1) determine if connected controls can improve the cost effectiveness of DHPs and to 2) better understand the DR potential of DHP controls.

In addition to the goals listed above, the project will also inform future program design, by providing insights into:

- The optimal setback cycle for DHPs to maximize both efficiency savings and demand response load shifting,
- Equipment features that deliver efficiency and DR benefits,
- User satisfaction and acceptance of devices (including ease of installation),
- How smart controls would best be deployed as a program offering if they are successful

- **Benefit to Customers and Ratepayers**

  Savings ratepayer dollars to accelerate lessons learned:

  1. The demonstration project will potentially save ratepayer dollars by spending a small sum of money, in a discrete system geography, over a short discrete timeline to determine the viability of DHP as a flexible load resource.

  Inform planning values to accelerate the pilot phase and inform cost effectiveness

  1. The value identified by the activity will inform cost effectiveness screening and planning assumptions thereby savings customers additional evaluation activity during any subsequent pilot phase.
  2. Informed and refined accuracy of the planning value to assure a shorted pilot cycle.
  3. The lessoned learned from the demonstration work will accelerate pilot development answering a series of questions which need not be initiated through the pilot cycle.

  Identify how to formalize co-deployment and coordinated measure development

  1. Informed by the co-development and deployment activity PGE and ETO will better understand each entity's pinch points, processes, requirements and pace of activity. This will help inform collective efforts between the two entities from a small-scale demonstration and investment and inform subsequent larger co-development and co-deployment activity.

- **Evaluation Strategy (Including a Final Report)**

The testbed team will separately evaluate and report to the Commission at the close of the activity the DR value and lessons learned. PGE will issue an RFP for third party evaluation if such evaluation costs do not exceed $15k or 10% of the total activity budget. PGE will report the outcome of the RFP to the Commission Staff is a qualified third-party evaluation can-not be conducted at the price aforementioned. In this case PGE will work with Commission Staff to define how an in-house evaluation can be conducted. PGE will report the Commission when the project is initiated and will report to the DRRC (quarterly) the status of the demonstration project.

Quarterly updates will be given through the regular DRRC meetings.

PGE Advice No. 20-23
Attachment C
Project Activity: Single-Family Water Heater Communications R&D

Testbed Demonstration Project Activity

Subject: Single-Family Water Heater Communications R&D **Date:** 8/25/2020

Summary of Project Dashboard

Number of Customers Involved	Technology Being Tested	Funding Source	Funding Amount	Time Period	Contractor and/or partner
Up to 130 residential customers	Communications protocols for water heaters. CTA 2045 over LTE and mesh radio frequency, as well as customer-hosted wifi	Testbed Budget + PGE internal research & development funds	$144k from Testbed, $120k from PGE internal research & development	Late Q3 2020 through Q3 2021	Rheem, AO Smith, Virtual Peaker, Apricity, Landis + Gyr

- **Description of Demonstration Project (Statement of the Research Question)**

PGE seeks to perform demand response on water heaters in single-family homes. The demonstration will employ three different communications protocols to understand differences in the uptime, latency, customer experience, and load shifting potential of the three methods. The tested methods will be customer-hosted wifi, cellular LTE, and two-way radio frequency mesh network. The latter two will employ CTA 2045 protocols.

PGE will dispatch the water heaters for grid services and utilize the proposed schedule 13 revisions to compensate customers for their participation, at $1 per kWh of realized capacity. The objective is to uncover the costs, benefits, hurdles, and opportunities of the various options of communicating with distributed water heaters, then use those learnings to develop a cost-effective and scalable single-family water heater program. As there are significant start-up costs associated with conducting this pilot, PGE is utilizing $120,000 in internal research & development funds in addition to the Test Bed funds.

Participation and type of participant targeted (Provide reasoning for the number)

Protocol	WiFi	Cellular LTE	Mesh Network
CTA 2045?	No	Yes	Yes
Communications host	Customer-hosted	Verizon, PGE paid for	Landis + Gyr 2-way radio network
Water Heater	Rheem EcoNet HPWH	CTA 2045 compatible AO Smith HPWH models	Rheem or AO Smith CTA 2045 compatible HPWH or electric resistance
New or Existing Device?	Existing	Existing	New installations in University of Portland owned student housing
Target # of installations	~50	~50	~30

PGE will seek to recruit customers with compatible water heaters already installed for the WiFi and LTE portions and will perform direct outreach to encourage these customers to enroll in the demonstration. PGE will seek out customers with the specific make & model of water heater required based on Energy Trust rebate information and other publicly available information. Identified customers will be sent information and invited to participate in the study. Those on the WiFi track will simply be able to click the link to connect their water heater to the aggregation platform (Virtual Peaker), while customers wishing to enroll a water heater on the cellular LTE path must receive and install a CTA 2045 universal communications module (UCM).

To control water heaters with the two-way radio frequency mesh network (or simply, "mesh") PGE must install the network in a localized area. Due to the need for a close concentration of compatible water heaters that is unlikely to be found organically in the testbed, PGE is collaborating with University of Portland to replace aging water heaters in up to 30 university owned single-family homes with CTA 2045 compatible water heaters that will participate in the study. The water heater installer will attach the UCMs.

With an estimated load shifting potential of 0.09 kW in the summer and 0.17 kW in the winter for heat pump water heaters, PGE estimates an annual capacity of 22.4 kW per HPWH using the same dispatch methodology of the multifamily water heater pilot. This amounts to a total of 2.9 MW for the targeted 130 enrolled water heaters. All enrolled water heaters will be dispatched according to Schedule 13, and customers will be paid $1 per kWh of energy shifted. At 3-4 hours per DR event, each customer with an enrolled water heater has the potential to earn approximately $70 annually.

- **Optional Activities or Alternatives Considered**

A demand response program for single-family water heaters is on PGE's roadmap, but there are many unanswered questions on the best way to implement a scalable and cost-effective program that this demonstration seeks to explore. Without this project, PGE could answer these question by:

1. Field test the relative value and stability of various water heater communications technologies in an existing pilot structure, such as the multifamily water heater program
2. Stand up a dedicated single-family pilot that includes a communications testing element.

3. Stand up a single-family water heater pilot using one of the three options without any field-testing data.

- **How the Demonstration Project fulfills Testbed Proposal Work**

The Testbed proposal included work on single family water heater controls, which would be co-deployed with the Energy Trust (leveraging their existing EE measure) and NEEA (currently working on CTA-2045 technology).

- **How the Demonstration Project informs Pilot and Program Development (Including potential scale)**

The results of this demonstration will be very impactful on the future pilot and program development of a single-family water heater demand response customer offering. Even within the development phase of conducting research, soliciting RFPs, and establishing the technical requirements PGE has collected invaluable technical and economic learnings about what is involved with CTA 2045 integration. This will help PGE understand the scale of the cost involved for future efforts involving CTA 2045 technology (e.g. EVSE, DHP, pool pumps, etc.), and make sure that cost-effectiveness figures are realistic.

When the actual research is conducted PGE will learn the load shifting potential of heat pump water heaters in our market to inform incentives and program design. The multifamily water heater pilot is currently only controlling electric resistance water heaters, which have a much higher load shifting potential due to their inherent lower efficiency. A key element of the study will be to evaluate the individual and aggregated load shifting differences between devices controlled with different communications methods. This will help PGE evaluate whether the additional costs of a more connected communications methodology result in elevated demand response savings.

Funding Source and Total Costs (Including: O&M expenses and revenues, broken down by FERC account, capital costs, number of FTE employees, and number of contractors.)

This demonstration is being co-funded by PGE R&D ($120,000) and the Test Bed existing program budget ($150,000). All staff are existing resources.

Budget Item	Amount	Notes
UCM Engineering	$80,000	Development work to engineer UCMs able to communicate CTA 2045 commands via cellular LTE and 2-way radio frequency
UCM Hardware Manufacturing	$15,000	Custom small-batch manufacturing of 80 UCMs – 50 cellular LTE and 30 2-way RF
Dispatch Fees	$8,000	• Cellular & RF annual fees= $1,590 • Rheem has waived cloud fees for WiFi • DERMS annual fees = $1,560 Amount reflects two years of annual fees.
Two-way radio frequency infrastructure	$83,000	Landis + Gyr will erect radio transmitters on streetlights in the area of the UP installations. Costs include hardware and licensing.
Customer Incentives	$19,000	Estimated at $70 per year per device. A key learning of the study will be the actual DR

		potential, which in a pay for performance structure directly impacts the incentive spend.
Recruitment & Outreach	$5,000	Creation of collateral and enrollment procedures to secure participants
University of Portland water heater installation	$60,000	Installation of 30 demand response enabled water heaters in homes owned by UP
Total	*$270,000*	

The CTA 2045 modules must be custom manufactured, with custom engineering development. This is an expense that the R&D project is funding. PGE does not expect to continue to incur upfront costs with a future program at scale. The upfront cost of the radio frequency mesh network would also be a one time cost, and this technology would likely be a capital investment that PGE would leverage for other applications within the ADMS effort.

- **Timeline of activity (Including: Milestones and evaluation)**

Scoping (Q4-2019 – Q3-2020):

The Testbed program team was awarded PGE research & development funds in Q4 2019 for the 2020 calendar year to research communications protocols for single-family demand response. A cross-functional team was compiled and began researching the technical necessities of implementing the three-tiered research plan.

Milestone – All costs and technical requirements are identified and PGE is knowledgeable enough to move forward with the implementation.

Contracting (Q2-2020 – Q3-2020):

PGE has been gathering bids for the manufacturing of the UCMs and the installation of the radio frequency mesh network. This will also include a new integration with PGE's DERMS platform to dispatch the CTA 2045 devices (the WiFi integration was existing). PGE is awaiting approval of Schedule 13 prior to executing any contracts.

Milestone – Execute contracts with Apricity (UCM manufacturer), Landis + Gyr (mesh network vendor), Virtual Peaker (DERMS vendor), and University of Portland.

Risk and Mitigation Strategy:

1. Cannot reach agreement on acceptable pricing with vendors
    a. Mitigation Strategy – Leverage marketing value of partnership and potential for scalable future programs. Reduction in scope is possible if some elements cannot be agreed upon.
    b. Decision Point – Costs are currently well understood with competitive bids received. PGE is still negotiating some costs (specifically Landis + Gyr's licensing and software costs) to achieve the most competitive price, and has the option to drop the mesh network portion of the study if an agreement cannot be attained.

2. DERMS provider cannot complete integration in time for winter DR season

    a. Mitigation Strategy – Early engagement with vendor and inclusion of project on integration roadmap

    b. Decision Point – Apricity and Virtual Peaker have already begun conversations on an integration strategy, and PGE expects them to be prepared for dispatch by the time the devices are manufactured. PGE has the option to perform customer outreach and delivery of the communication modules, and dispatch when the integration is complete.

Procurement (Q3-2020):

There is a 12 week lead time for manufacturing of the UCMs, as well as time required to install the mesh network. PGE hopes to execute contracts with all parties involved in the demonstration immediately upon Schedule 13 approval.

Risk and Mitigation Strategy:

1. Schedule overruns

    a. Mitigation Strategy – The water heater dispatch is not dependent on seasonality in the same way that that space heating DR programs are, and if the manufacturing of the UCMs or the creation of the mesh network are delayed PGE can proceed with the wifi portion of the project, then launch the CTA 2045 portion when ready.

Customer recruitment/communications (Q3-2020):

PGE will be able to reach out to customers on the WiFi track almost immediately upon Schedule 13 approval. The Company has identified potentially eligible customers through Energy Trust EPS and RETC data and will provide an invitation to enroll their Rheem EcoNet water heater into the Virtual Peaker platform to begin earning on-bill rewards.

For the mesh network portion, PGE must coordinate the installation of the water heaters in the University of Portland owned homes, the erection of the network, and provide the pre-provisioned UCMs for the installer to attach to the water heaters. Subsequent tenants will be automatically enrolled in direct load control, with the option to opt out.

For the cellular LTE portion, PGE will identify customers with compatible water heaters in the same manner as the WiFI track and will reach out to invite them to participate. Eligible customers must be sent a pre-provisioned UCM that they will need to install on their water heater to participate and earn rewards.

Milestone – Complete enrollment of DR-EE and DR-only customers in the SGTB at levels sufficient to get an indicative measure of DR value and customer acceptance

Risk and Mitigation Strategy:

1. Customers do not participate in the offer

    a. Mitigation Strategy – Increase customer incentives, including adding an upfront incentive to entice enrollment. Also, PGE may engage the contractor that installed the water heater under the original Energy Trust incentive to help engage customers and get the LTE UCMs installed

b. Decision Point – PGE will recruit customers for six months, and if it cannot find adequate participants will suspend recruiting and continue to dispatch the devices that have been installed

2. Customers drop out of program

a. Mitigation Strategy – Continually engage customers in the research and finds, provide regular updates on energy savings and incentive earned. There will be no traditional "seasons" for water heater DR so it will be important to make sure customers are not experiencing discomfort from their participation and that they are engaged with the program and recognize the value of their savings.

b. Decision Point – Consider opening recruitment back up to replace attrition of more than 20% of participants.

Project management (Q3-2020 – Q4-2021):

Once this project is approved by the OPUC, PGE will proceed with manufacturing of the UCMs and installation of the mesh network to enable the testing of the water heaters. The water heaters will be enrolled in the DRMS platform as soon as they are able to be, with WiFi coming first, then LTE and mesh network once the UCMs are manufactured and the mesh network is erected, by end of 2020. The water heaters will be operated in accordance with the multifamily water heater dispatch methodology through the end of 2021. For reference, the multifamily water heater program calls approximately 60 4-hour events in the summer, and 100 3-hour events in the winter.

Milestone – Call demand response events regularly through the year, evaluate performance of water heaters and communication protocols.

Analysis/evaluation (Q1-2022):

Following the close of the project, PGE will transfer AMI, event and customer data to an evaluator to analyze the DR value of heat pump water heaters, uptime, latency and performance of communications protocols, customer acceptance of the technology, and other relevant project activities/outcomes.

- **Impacts of the Activity to Phase 1 Primary Work**

The activity is in-line with the Testbed proposal and requirements of Commission Order 19-301. The activity is limited to ~130 participants among 20,000 residential customers within the Testbed. This activity will not statistically or materially affect either the primary customer value proposition work, customer engagement and education work, or the customer migration work of the Testbed Phase 1. It will provide some foundational insights into not only general coordination with the Energy Trust but also some foundational lessons regarding the co-development and co-deployed demonstration project within the Testbed.

- **Lessons to be learned (Learning Objectives)**

The primary goals of this project are to: 1) compare and contrast the costs and benefits of single-family water heater communications protocols, and 2) better understand the DR potential of heat pump water heaters.

In addition to the goals listed above, the project will also inform future program design, by providing insights into:

- The technical requirements, costs, and benefits of CTA 2045 as a DR communications method
- The technical requirements, costs, and benefits of mesh networks for communications with end use appliances
- User satisfaction and acceptance of various methods of water heater demand response controls (including ease of installation),
- Customer acceptance with a pay for performance incentive structure for water heaters

- **Benefit to Customers and Ratepayers**

  Saves ratepayer dollars to accelerate lessons learned:

  1. Prior to embarking on the development of this R&D project PGE did not have a complete understanding of the technical requirements involved with CTA 2045, so by the planning and solicitation of completive bids ratepayers will benefit before the first customer is even enrolled.
  2. Executing this research in a smaller geography with a limited number of customers will enable PGE to quickly and for a relatively low cost determine the best way to create a scalable, cost-effective program and be appropriately informed to respond to future CTA 2045 code standards.
  3. PGE will be able to appropriately value the capacity potential of heat pump water heaters to ensure that incentives and overhead costs are appropriate in relation to the potential benefits.

  Inform planning values to accelerate the pilot phase and inform cost effectiveness

  1. The value identified by the activity will inform cost effectiveness screening and planning assumptions thereby savings customers additional evaluation activity during any subsequent pilot phase.
  2. Informed and refined accuracy of the planning value to assure a shorted pilot cycle.
  3. The lessoned learned from the demonstration work will accelerate pilot development answering a series of questions which need not be initiated through the pilot cycle.

- **Evaluation Strategy (Including a Final Report)**

The testbed team will evaluate and report to the Commission at the close of the activity the results of the R&D study, including the DR value realized from the heat pump water heaters, performance of the communication methods, and lessons learned. PGE will perform qualitative evaluation as well, to understand the customer satisfaction with delivery and comfort during DR events, installer experience for the University of Portland portion, and program team for opportunities for improvement in the delivery of the project.

PGE will issue an RFP for third party evaluation if such evaluation costs do not exceed $15k or 10% of the total activity budget. PGE will report the outcome of the RFP to the Commission Staff is a qualified third-party evaluation can-not be conducted at the price aforementioned. In this case PGE will work with Commission Staff to define how an in-house evaluation can be conducted. PGE will report the

Commission when the project is initiated and will report to the DRRC (quarterly) the status of the demonstration project.

Quarterly updates will be given through the regular DRRC meetings.