

PUBLIC UTILITIES COMMISSION

505 VAN NESS AVENUE



January 19, 2021

**Advice Letter 5731-E, 5731-E-A**

Erik Jacobson  
Director, Regulatory Relations  
Pacific Gas and Electric Company  
77 Beale Street, Mail Code B10C  
P.O. Box 770000  
San Francisco, CA 94177

**SUBJECT: Summary of AB 2868 Behind-the-Meter (BTM) Thermal Storage Program in Compliance with Decision 19-06-032.\**

Dear Mr. Jacobson:

Advice Letter 5731-E, 5731-E-A is effective as of January 14, 2021, per resolution E-5073 Ordering Paragraphs.

Sincerely,

A handwritten signature in cursive script that reads "Edward Randolph".

Edward Randolph  
Deputy Executive Director for Energy and Climate Policy/  
Director, Energy Division



**Erik Jacobson**  
Director  
Regulatory Relations

Pacific Gas and Electric Company  
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San Francisco, CA 94177

Fax: 415-973-3582

December 31, 2019

**Advice 5731-E**

(Pacific Gas and Electric Company – U 39 E)

Public Utilities Commission of the State of California

**Subject: Summary of AB 2868 Behind-the-Meter (BTM) Thermal Storage Program in Compliance with Decision 19-06-032**

**Purpose**

Pursuant to Ordering Paragraph (OP) 4 of Decision (D.) 19-06-032, Pacific Gas and Electric Company (PG&E) hereby submits this Tier 3 advice letter seeking final approval of its proposed behind-the-meter thermal storage program.

**Background**

Assembly Bill (AB) 2868 directs the three Investor Owned Utilities (IOUs) to file applications for programs and investments to accelerate widespread deployment of distributed energy storage systems to achieve ratepayer benefits, reduce dependence on petroleum, meet air quality standards, and reduce emissions of greenhouse gases.

To meet these goals, PG&E filed an application (A.18-03-001) on March 1, 2018, which includes a request to spend up to approximately \$6.4 million for a 2-5 MW behind-the-meter thermal storage program (Program) during the period from 2019 through 2025. The Program will use smart electric water heaters and/or smart control devices that are incentivized to replace existing propane-based and electric resistance water heaters with hybrid heat pump water heaters in single-family homes, multi-family homes, and small businesses. This program will also provide incentives for digital communication controls and a pay-for-performance incentive to operate electric water heaters during off-peak hours (late evening, early morning and afternoon) and complement Time-of-Use (TOU) tariffs.

PG&E proposes the Program will target the following sets of customers:

- Customers with electric resistance water heaters in low-income communities where a smart heat pump water heater and pay for performance incentive could reduce customer energy bills;
- Customers across the service territory with electric resistance water heaters where a smart water heater controller and pay for performance incentive could reduce customer energy bills and shift load to off-peak periods;
- Customers in low-income communities with propane water heaters, where a smart heat pump water heater and pay for performance incentive could reduce site GHG emissions and overall energy costs; and
- Customers in low-income communities with propane water heaters in the San Joaquin Valley, via PG&E's proposed electrification pilots in response to the California Public Utilities Commission's (CPUC or Commission) Order Instituting Rulemaking (OIR) 15-03- 010.

During party comments on PG&E's A.18-03-001 proposal, the Natural Resources Defense Council (NRDC) supported the Program, noting its alignment with the intent of AB 2868 and benefit of deploying a technology in the California market that could both reduce greenhouse gas emissions and integrate renewable energy into the electric grid at lower cost by providing a flexible and affordable thermal storage resource. NRDC highlighted that when smart water heaters reduce system peaks, enable renewable electricity integration, and help maintain grid stability, benefits are shared by all customers in the form of reduced electric bills.

On June 27, 2019, the Commission adopted D.19-06-032, which, among other issues, authorized PG&E to move forward with the Program subject to submitting a Tier 3 advice letter by September 30, 2019 that includes additional program details, prior to PG&E launching the Program. PG&E requested and received an extension of time from the Commission's Executive Director pursuant to Commission Rule 16.6 to comply with OP 4 of D.19-06-032. The Commission set a new deadline of December 31, 2019 for PG&E to submit its Tier 3 advice letter.

On August 30, 2019, PG&E released a comprehensive Request for Proposals (RFP) that resulted in the selection of a Third-Party Program Implementer that will have the capacity to run a robust and effective program.

In its decision implementing the AB 2868 Energy Storage Program and Investment Framework, the Commission authorized PG&E to move forward with its proposed BTM thermal storage program but required PG&E to inform the Commission about the following in its advice letter:

- The specific actions PG&E will take to prioritize public sector and low-income customers<sup>1</sup>
- A clear explanation on what customer outreach PG&E will conduct to ensure its customers understand how their rates will change and what the bill impact would have been based on historical usage
- How PG&E is deploying energy management systems, or another mechanism, that provides controls that ensure that the projects will reduce dependence on petroleum, meet air quality standards, and reduce greenhouse gas emissions<sup>2</sup>
- A quantitative estimate for the reduction in energy demand, which in some cases involved fuel switching away from propane, from this program

In order to address these topics, key components of the final program design are outlined in the next section below, detailing the comprehensive approach that will be taken to achieve the goals and objectives expected by the Commission, including an emphasis on public sector and low-income customers.<sup>3</sup>

### **Summary**

The widespread deployment of distributed thermal energy storage systems will be an innovative opportunity in achieving ratepayer benefits, reducing dependence on fossil fuels, meeting air quality standards, and reducing emissions of greenhouse gases in California in the years to come.

PG&E is planning to launch the new BTM thermal storage program – the “WatterSaver” program – upon approval by the Commission in early 2020, after having conducted a successful RFP for a program implementation team. Subject to finalizing a contract with PG&E, the implementation team consists of three key partners that will work together to achieve the Program’s goal of 2-5 MWs of peak-load reduction: the Association for Energy Affordability (AEA), Energy Solutions (ES), and Virtual Peaker (VP) – together known as the “WatterSaver team.” Importantly, the WatterSaver team will focus its efforts to achieve the majority of the peak load reduction goal in low-income, multifamily, and single-family residential homes located in disadvantaged communities (DACs) throughout PG&E’s service territory.

PG&E selected this combined team to leverage their experience working in and delivering energy programs and projects to low-income customers located in DACs, which will allow

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<sup>1</sup> While the Commission has stated that “PG&E has sufficiently demonstrated that its behind the meter thermal storage program is prioritizing public sector and low-income customers (D.19-06-032, page 67),” additional detail is included in this section.

<sup>2</sup> Similarly, the Commission noted that PG&E’s proposal to utilize time-of-use rates and controls as different ways of managing the storage systems is appropriate for the BTM thermal storage program (D.19-06-032, page 72) – additional detail is included in this section.

<sup>3</sup> PG&E previously noted that its BTM program will coordinate with the team administering the San Joaquin Valley pilot and scaled program, as proposed in R.15-03-010, to ensure customers who are fuel-switching will also have the opportunity to enroll in this thermal storage program.

them to ramp up the WatterSaver program in a shorter timeframe, including coordination with other energy efficiency and San Joaquin Valley pilot teams to tap into the existing pipeline of projects that have already received or are in the process of receiving heat pump water heaters (HPWHs).

Related experience that will benefit the WatterSaver program includes the following:

- The Association for Energy Affordability has been designing and implementing energy efficiency and renewable energy programs since 1993 and is currently implementing a number of programs in California that have focused on heat pump water heating, including providing candidate projects for the Sacramento Municipal Utility District (SMUD) and VP's PowerMinder Pilot. Additionally, AEA has been deeply involved in current research and demonstration projects for the California Energy Commission (CEC), including the use of HPWHs for load-shifting applications.
- Energy Solutions brings a depth of experience designing and implementing mid-stream contractor and distributor-driven programs, which will support the scaled deployment of HPWHs into the market and will serve as a continuous pipeline of new projects to increase participation in the WatterSaver program.
- The Virtual Peaker team and its state-of-the-art demand management platform will manage the enrolled water heaters and provide for an easy and efficient onboarding process through multiple channels – upstream, midstream, or downstream – to effectively meet the goals of the Program. VP currently runs a number of water-heater programs for utilities throughout the United States, including SMUD, Green Mountain Power, and Tennessee Valley Authority.

The WatterSaver team anticipates achieving approximately 2.5 MW of peak-demand reduction by enrolling approximately 9,400 customers during the five-year implementation period.<sup>4</sup> Additionally, the WatterSaver team anticipates that the program will achieve load shifting of up to 6.76 MWh per day from the 4-9pm period to off peak times of the day. Details on these assumptions are available in Attachment A, Proposed Measurement and Verification Framework.

Furthermore, while the details below represent an agreed-to program design and action items that will be taken to implement the Program, PG&E will be executing the signed contract in early 2020, once all internal processing and contract compliance measures are completed.

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<sup>4</sup> This enrollment figure was reached by forecasting the technical potential for peak demand reduction of the average program customer and aggregating to the program total of approximately 2.5 MW. Preliminary information at the time of PG&E's A.18-03-001 indicated approximately 0.5-0.8 kW per unit reduction in demand. Ongoing learnings from PG&E's Request for Information (RFI) and industry outreach have refined the expected per unit peak-load reduction (~0.28 kW) to the levels submitted in this advice letter, resulting in approximately 9,400 customer enrollments.

## **Marketing, Education & Outreach**

Effective outreach will be critical for the Program to meet its stated goals. PG&E will continuously monitor, work with, and refine outreach strategies with the WatterSaver team to ensure that goals are being met. Near-term actions include the following:

- 1. Leveraging Existing Programs:** In order to facilitate a rapid launch, the WatterSaver team will take the following actions:
  - a. Reconnect with the 50+ heat pump water heating projects AEA has completed or is currently working on under the Low Income Weatherization Program for Multifamily (LIWP) administered by Community Services and Development (CSD) as well as other programs that AEA administers. AEA will work with its existing pipeline of public sector and low-income customers who have already installed HPWHs or were unable to retrofit an ERWH with a HPWH. Currently, it is estimated that 750 units of existing LIWP projects have HPWHs, which could enroll in WatterSaver in Year 1.
  - b. Utilize the BayREN's Bay Area Multifamily Building Enhancements Program (BAMBE) and MCE's Low Income Families and Tenants Program (LIFT), both of which are implemented by AEA and also offer HPWHs as an eligible measure.
  - c. Connect with existing connections in targeted areas, including current relationships that AEA has with affordable multifamily housing developers that complete comprehensive upgrades via Low Income Housing Tax Credits as administered by TCAC and CLDAC (which will support a continuous pipeline of publicly funded low-income housing opportunities).
  - d. Coordinate with PG&E's Energy Savings Assistance Program (ESA), San Joaquin Valley Electrification Pilots (SVJ pilots), existing HPWH rebate program, and the existing Energy Upgrade California program.
  - e. Conduct webinars for the California affordable multifamily network and provide a presence at relevant affordable housing conferences.
  - f. Work with trusted community-based organizations to provide enrollment information to low-income customers in regions with a high opportunity for a HPWH retrofit (such as areas without natural gas access) or where an existing ERWH may exist and be unable to be upgraded.
  - g. Leverage new and existing CCA working relationships to develop a coordinated strategy for deployment of our mutual thermal storage programs.
  
- 2. Mid-stream Program Pipeline:** Contingent upon the implementation of new heat pump water heater midstream program, the WatterSaver team will coordinate with the midstream program to enroll newly sold and installed HPWH equipment into the WatterSaver program.

- 3. External Program Coordination Based Enrollment:** The WatterSaver team will work to identify additional areas that would be a part of a targeted marketing and outreach campaign, in addition to the coordination methods mentioned above. The campaigns may include:
- a. Enrolling CARE customer likely to have a propane WH or ERWH
  - b. Enrolling small commercial and residential customers in Disadvantaged Communities (DACs) which are likely to have propane WHs or ERWHs.

In these campaigns, ERWH customers will be encouraged to pursue the upgrade to a HPWH through available funding channels (PG&E ESA, PG&E EE, Midstream, LIWP, and others). If the ERWH is unable to be upgraded with a HPWH, then ERWH load shifting controls will be installed with the customer's permission. Propane WH customers will be encouraged to pursue the upgrade of a HPWH through available funding channels.

The WatterSaver team will also coordinate with existing home performance contractors and plumbing contractors to identify any existing or newly installed HPWHs installed outside of the programs listed above to solicit customers for WatterSaver participation.

- 4. Rate Change and Bill Impact:** Customers who are not yet on a TOU rate will need to enroll in an approved TOU rate to be eligible for the WatterSaver Program. The WatterSaver team will provide prospective customers with PG&E approved estimates of the bill impact from moving to a TOU rate and will identify the customers who would benefit with utility bill savings by enrolling in a TOU rate and the WatterSaver Program. As part of this engagement, PG&E will provide the last year of historical interval usage data for a customer and the customer's previous rate schedule, which AEA will use to develop a tool that analyzes the bill impact of the new TOU rate schedule and the bill impact of a WatterSaver shifting water heater load to off peak time periods. Additionally, in coordination with PG&E, the WatterSaver team will provide customer educational materials on how to optimize their TOU rate through other behavioral changes, in addition to having a controlled smart water heater.
- 5. Marketing & Education Materials:** Collateral will be developed to support the three marketing pathways. This will start with establishing WatterSaver program branding standards. Then the WatterSaver team will develop customer profiles and/or customer journey maps. This will be unique for each pathway and will ensure the marketing efforts are targeting the customer at their different decision points. An additional foundational marketing effort is to develop pre-approved messages at the beginning of each year. Once the messages are approved, they can be used in a variety of collateral and through different mediums throughout the year.

Marketing and education materials that will be developed may vary year-to-year and by marketing pathway to ensure effective targeting of customers that evolves with lessons learned.

In addition to education on TOU rates, potential collateral could include the following items:

- a. Program informational landing webpage to complement the online enrollment and to provide a digital location for program information
- b. One-page overview of the program, including key features, benefits, and ways to enroll
- c. PowerPoint presentations to use at community meetings
- d. Email templates and/or a direct mailer/postcard for active marketing campaigns

To ensure effective marketing, the WatterSaver team will conduct ongoing marketing performance monitoring and reporting to inform PG&E about what pathways and collateral are most effective.

### **Energy Management System**

The WatterSaver program will communicate with smart devices multiple times per minute, receiving real-time data back on key variables including mode, tank temperature, and setpoint. This data is continuously fed through the WatterSaver program's cloud-based real-time control system, making control decisions based on frameworks determined by PG&E.

In order to achieve the stated goals approved by the Commission, the WatterSaver program will employ Time-of-Use (Time-of-day) based learning, where the water heater takes into account a rate structure (like TOU) and heats the water at the lowest-cost time period while ensuring that the customer doesn't receive a cold-water event.

Additional control strategies available for use in the program may include:

- **Event-based load shifting**, where water is preheated during a desired time and the water heater remains off during the event window
- **Fixed scheduling**, where a set charge/discharge schedule for a group of water heaters is set and can be updated by the utility, as needed
- **Energy Arbitrage-based dispatch** uses the locational marginal price (LMP) from a local ISO (such as CAISO) to "charge" the water heater when the price of energy is low and "discharge" when the price is high

## Measurement and Verification

PG&E and the WatterSaver team have developed a Measurement and Verification (M&V) plan for calculating program benefits. The methodology for this calculation is available in Attachment A, Proposed Measure and Verification Framework. Below is a table quantifying the benefits of the program.

	<b>Controlled Units</b>	kW/ unit	kWh/ unit	MW total	MWh/ day total	kg CO2e/ day/ unit <sup>5</sup>	Total kg CO2e/ Day	Estimated Bill Savings/ Unit/yr <sup>6</sup>	Estimated Bill Savings/ year
Residential HPWH	6400	0.28	0.67	1.79	4.29	0.27	1,759	\$30	\$192,000
Residential ERWH	1112	0.51	1.88	0.57	2.09	0.78	869	\$120	\$133,440
Commercial HPWH	67.2	1.40	3.35	0.09	0.23	0.82	55	\$150	\$10,080
Commercial ERWH	28	1.53	5.64	0.04	0.16	3.91	109	\$360	\$10,080
			<b>TOTAL</b>	<b>2.50</b>	<b>6.76</b>		<b>2,793</b>		<b>\$345,600</b>

## Program Incentives

The Program will include customer pay-for-performance incentives with the following features:

### Residential participants

- An initial one-time enrollment incentive per controlled water heater in the form of a prepaid gift card (or other payment method)
- A fixed performance incentive per month that will be added to a participant gift card for each month they continue to participate in the program and allow 3rd party control of their water heaters (as verified by WatterSaver program software confirming the customer participated in the energy storage event, the water heater control was online, and responded positively to communications)
- Utility bill reduction benefits that naturally come from shifting usage away from peak hours while on a TOU rate

### Small commercial participants<sup>7</sup>

- Direct incentive checks every 6 months based on their participation in the program, payable to the account holder on the PG&E account, unless otherwise authorized by the participant.
- Utility bill reduction benefits that will accrue from shifting usage away from peak hours while on a TOU rate

<sup>5</sup> 2022 CPUC Assumed Generation Mix 2019 ACC

<sup>6</sup> Per Ecotope Heat Pump Heater Electric Load Shifting: A Modeling Study (June 8, 2018)

<sup>7</sup> Including central multifamily water heating systems

## **Data & Reporting**

The WatterSaver team will provide statistical outputs and will summarize and provide, monthly, quarterly, annual, and/or final reports on the overall project, upon request from PG&E.

Reports will detail the number and types of smart water heaters connected (including make, model, size and all other relevant participant information), thermal storage capacity, the savings (kW peak, kW average, and kWh shifted) achieved in that period, narrative descriptions of challenges experienced during implementation and solutions deployed to overcome them, contractors trained, observations about load shifting strategies that were more or less effective than others, and any other data or information PG&E requests.

All data sources will be used to provide a complete and accurate account of program activity and achievements, including the following list of Key Performance Indicators (KPIs) that the WatterSaver team plans to use. These will be continually monitored to ensure efficient and effective program performance, and to guide iterative changes and improvements to the program as needed.

1. Enrolled Thermal Energy Storage Peak Demand Capacity (MW)
2. Enrolled Thermal Energy Storage Energy Capacity (MWh)
3. Targeted Customer Segment Enrollments (#/Segment)
4. Program Cost-Effectiveness (Program \$/Gross kW shifted; Program \$/Gross kWh shifted)
5. Controlled Residential and Commercial HPWHs (CTA-2045, WiFi),
  - o Subtotal Control, API costs, and Mixing Valve Costs per Gross kW and per Gross kWh
6. Controlled Residential and Commercial ERWHs
  - o Subtotal Control +API costs, and Mixing Valve Costs per Gross kW and per Gross kWh
7. Customer TOU cost savings (Gross and average per customer)
8. GHG Reduction (average per customer and gross)
9. Air quality improvement
10. Petroleum reliance reduction (removal of propane water heaters)
11. Customer Satisfaction

## **Protests**

Anyone wishing to protest this submittal may do so by letter sent via U.S. mail, facsimile or E-mail, no later than January 21, 2020, which is 21 days<sup>8</sup> after the date of this submittal. Protests must be submitted to:

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<sup>8</sup> The 20-day protest period concludes on a holiday. PG&E is hereby moving this date to the following business day.

CPUC Energy Division  
ED Tariff Unit  
505 Van Ness Avenue, 4<sup>th</sup> Floor  
San Francisco, California 94102

Facsimile: (415) 703-2200  
E-mail: EDTariffUnit@cpuc.ca.gov

Copies of protests also should be mailed to the attention of the Director, Energy Division, Room 4004, at the address shown above.

The protest shall also be sent to PG&E either via E-mail or U.S. mail (and by facsimile, if possible) at the address shown below on the same date it is mailed or delivered to the Commission:

Erik Jacobson  
Director, Regulatory Relations  
c/o Megan Lawson  
Pacific Gas and Electric Company  
77 Beale Street, Mail Code B13U  
P.O. Box 770000  
San Francisco, California 94177

Facsimile: (415) 973-3582  
E-mail: PGETariffs@pge.com

Any person (including individuals, groups, or organizations) may protest or respond to an advice letter (General Order 96-B, Section 7.4). The protest shall contain the following information: specification of the advice letter protested; grounds for the protest; supporting factual information or legal argument; name, telephone number, postal address, and (where appropriate) e-mail address of the protestant; and statement that the protest was sent to the utility no later than the day on which the protest was submitted to the reviewing Industry Division (General Order 96-B, Section 3.11).

### **Effective Date**

PG&E requests that this Tier 3 advice letter become effective upon Commission approval.

### **Notice**

In accordance with General Order 96-B, Section IV, a copy of this advice letter is being sent electronically and via U.S. mail to parties shown on the attached list and the parties on the service list for A.18-03-001. Address changes to the General Order 96-B service list should be directed to PG&E at email address PGETariffs@pge.com. For changes to any other service list, please contact the Commission's Process Office at (415) 703-2021

or at [Process\\_Office@cpuc.ca.gov](mailto:Process_Office@cpuc.ca.gov). Send all electronic approvals to [PGETariffs@pge.com](mailto:PGETariffs@pge.com). Advice letter submittals can also be accessed electronically at: <http://www.pge.com/tariffs/>.

\_\_\_\_\_  
/S/

Erik Jacobson  
Director, Regulatory Relations

#### Attachments

cc: Gabe Petlin, Energy Division  
Kanya Dorland, Energy Division  
Service List A.18-03-001



# ADVICE LETTER SUMMARY

## ENERGY UTILITY



MUST BE COMPLETED BY UTILITY (Attach additional pages as needed)

Company name/CPUC Utility No.: Pacific Gas and Electric Company (ID U39E)

Utility type:

- ELC       GAS       WATER  
 PLC       HEAT

Contact Person: Kimberly Loo

Phone #: (415)973-4587

E-mail: PGETariffs@pge.com

E-mail Disposition Notice to: KELM@pge.com

EXPLANATION OF UTILITY TYPE

ELC = Electric      GAS = Gas      WATER = Water  
 PLC = Pipeline      HEAT = Heat

(Date Submitted / Received Stamp by CPUC)

Advice Letter (AL) #: 5731-E

Tier Designation: 3

Subject of AL: Summary of AB 2868 Behind-the-Meter (BTM) Thermal Storage Program in Compliance with Decision 19-06-032

Keywords (choose from CPUC listing): Compliance

AL Type:  Monthly  Quarterly  Annual  One-Time  Other:

If AL submitted in compliance with a Commission order, indicate relevant Decision/Resolution #: D.19-06-032

Does AL replace a withdrawn or rejected AL? If so, identify the prior AL: No

Summarize differences between the AL and the prior withdrawn or rejected AL:

Confidential treatment requested?  Yes  No

If yes, specification of confidential information:

Confidential information will be made available to appropriate parties who execute a nondisclosure agreement. Name and contact information to request nondisclosure agreement/ access to confidential information:

Resolution required?  Yes  No

Requested effective date:

No. of tariff sheets: 0

Estimated system annual revenue effect (%): N/A

Estimated system average rate effect (%): N/A

When rates are affected by AL, include attachment in AL showing average rate effects on customer classes (residential, small commercial, large C/I, agricultural, lighting).

Tariff schedules affected: N/A

Service affected and changes proposed<sup>1</sup>: N/A

Pending advice letters that revise the same tariff sheets: N/A

<sup>1</sup>Discuss in AL if more space is needed.

**Protests and all other correspondence regarding this AL are due no later than 20 days after the date of this submittal, unless otherwise authorized by the Commission, and shall be sent to:**

CPUC, Energy Division  
Attention: Tariff Unit  
505 Van Ness Avenue  
San Francisco, CA 94102  
Email: [EDTariffUnit@cpuc.ca.gov](mailto:EDTariffUnit@cpuc.ca.gov)

Name: Erik Jacobson, c/o Megan Lawson  
Title: Director, Regulatory Relations  
Utility Name: Pacific Gas and Electric Company  
Address: 77 Beale Street, Mail Code B13U  
City: San Francisco, CA 94177  
State: California Zip: 94177  
Telephone (xxx) xxx-xxxx: (415)973-2093  
Facsimile (xxx) xxx-xxxx: (415)973-3582  
Email: [PGETariffs@pge.com](mailto:PGETariffs@pge.com)

Name:  
Title:  
Utility Name:  
Address:  
City:  
State: District of Columbia Zip:  
Telephone (xxx) xxx-xxxx:  
Facsimile (xxx) xxx-xxxx:  
Email:

Advice 5731-E  
December 31, 2019

## **Attachment A**

### **Proposed Measurement and Verification Framework**

## Attachment A – Proposed Measurement and Verification Framework

### Methodology for calculating peak kW and load shift kWh savings

Calculating the value of the savings of the WatterSaver program present unique M&V requirements when compared to a typical demand response program. Event-based demand response relies heavily on the existence of non-event days to provide an accurate baseline. For example, if demand response events occur several days a month, then the other non-event days are able to represent typical behavior by a population, had those events not occurred. Customers that enroll in the WatterSaver program will have a daily and on-going load shift, which will make it difficult to establish a baseline using traditional methods.

The WatterSaver team is proposing a number of unique approaches to address this issue:

1. Utilization of programs and research outside of the WatterSaver program (such as EPIC) to provide aggregate baseline of non-shifted HPWH in other programs
2. Utilization of simulation data to establish a baseline of non-shifted water heaters
3. Use of sampling, with subsets of water heaters within the program remaining unshifted and providing a consistent baseline
4. Creation of “rolling” control group, whereby un-shifted water heaters are selected and placed in and out of control groups for short periods.

The WatterSaver team will work closely with those at PG&E to determine the optimal course(s) of action to accurately establish a baseline.

Once that baseline is established, the WatterSaver team will utilize the average of each of the demand reductions within the desired peak (5 hour) window to calculate kW savings. kWh load shift/thermal storage savings (energy) will be calculated as the sum of the kW saved during the control period. An example of that calculation is shown below.

	Hour	Heat Pump (kW per hour)			Electric Resistance (kW per hour)		
		UnControlled	Controlled	Demand Change	UnControlled	Controlled	Demand Change
4p-5p	16	0.08	0.01	0.07	0.32	0.04	0.28
5p-6p	17	0.14	0.05	0.09	0.4	0.14	0.26
6p-7p	18	0.09	0	0.09	0.48	0	0.48
7p-8p	19	0.19	0.05	0.14	0.47	0.12	0.35
8p-9p	20	0.3	0.02	0.28	0.55	0.04	0.51
	<b>Average (kW)</b>	<b>0.16</b>	<b>0.025</b>	<b>0.135</b>	<b>0.444</b>	<b>0.068</b>	<b>0.376</b>

4pm-9pm TOU Peak Period	Peak Technical Capacity (kW)	0.3	0.02	0.28	0.55	0.04	0.51
	Total (kWh)	0.8	0.13	0.67	2.22	0.34	1.88
	Load Shift (%)			84%			85%

### Methodology for calculating reduced petroleum reliance

In order to calculate petroleum reliance reduction from the removal of a propane water heater, the WatterSaver team will use publicly available industry information, manufacturer data, CEC RASS studies, and CEC simulation engines to calculate the “typical” propane consumption from a propane water heater during a given period. These may be divided into subgroups based on size (50 vs. 80 gallon), type (tankless vs. tanked), efficiency rating (etc.), based on the available data and practical/program requirements.

#### An indicative example (for illustration purposes only):

A typical 50-gallon propane water heater utilizes about 1.5 gallons (137,000 btu) of propane per day, consuming 250 propane gallons per year.

1 gallon of propane = 0.67 gallons of oil equivalent  
 1 barrel of oil = 42 gallons

Thus, one replaced water heater saves

$$(250 \text{ gallons} \times 0.67) / 42 = 4 \text{ barrels of oil equivalent per year}$$

This calculation will then be multiplied by the number of devices in the population / segment to get total program petroleum savings.

### Methodology for calculating improved air quality by removing on-site combustion of propane WHs

Similar to the calculation above, the WatterSaver team will calculate the per unit (e.g. per gallon) emissions for on-site propane combustion using publicly available data for emissions factors from combustion of propane. That data will then be applied to the propane consumed from the replaced water heater. Using the example of 250 gallons of propane from the calculation above, we can see the on-site CO<sub>2</sub>, Methane and Nitrous Oxide emissions saved from replacing a single water heater.

GHG	Units	Per Gallon <sup>1</sup>	250 Gallons
Carbon dioxide	kg CO2	5.72	1430
Methane	g CH4	0.27	67.5
Nitrous oxide	g N2O	0.05	12.5

Depending on data availability, other air quality measures (e.g. sulfur dioxide, particulates) may be added to the table above.

### Methodology for calculating GHG reductions

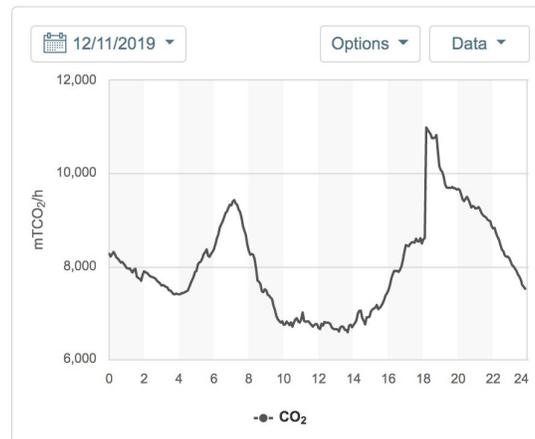
Total greenhouse gas savings from the WaterSaver program will be calculated in two parts:

1. GHG savings achieved from the installation of a new water heater (e.g. going from propane to heat pump)
2. GHG savings achieved from load shift

Part 1 will be calculated using the energy consumption pattern of a population of heat pump water heaters (determined by our baseline calculation in part one). That consumption will then be assumed to have a GHG (CO<sub>2</sub>) “emissions factor” for each hour of the day based on an agreed upon source, such as the California ISO (shown below).

#### CO<sub>2</sub> trend

Emissions typically rise when traditional resources are needed, such as during periods of reduced production of solar and wind resources.



CO<sub>2</sub> emission factor per kw<sub>hour</sub> x x kw water heater power<sub>hour</sub> x = water heater CO<sub>2</sub><sub>hour</sub> x

<sup>1</sup> Source: EPA [https://www.epa.gov/sites/production/files/2015-07/documents/emission-factors\\_2014.pdf](https://www.epa.gov/sites/production/files/2015-07/documents/emission-factors_2014.pdf)

The sum of these hours over a given period less GHG emissions from the previously installed water heaters (such as the propane example shown above) results in the average savings of GHG for a given population.

Part 2 will be calculated using the delta between the CO2 emissions of the controlled vs. uncontrolled water heater groups. Since the calculated emissions factor varies by hour (as shown below) substantial reductions in CO2 intensity for water that is heated outside of the peak period are expected.

The level of detail and specificity around the CO2 emissions factor will be calculated by the WatterSaver team and approved by PG&E prior to implementation.

### Methodology for calculation of customer bill savings

Customer bill savings will be calculated using the delta between the cost of energy consumed if the water heater had not been controlled (baseline) vs. the controlled water heaters. Since customers in the WatterSaver program will be enrolled in time-of-use rate (with a basic structure shown below), the customer savings will result from the sum of the kWh shifted from the higher price peak to the lower price off-peak period.

#### Example TOU Rate Structure (Source: PG&E):

EVERY DAY (WEEKDAYS AND WEEKENDS)



As mentioned in previous sections of this document, the typical demand response baselining approach will be insufficient to provide proxy bill savings for the WatterSaver program. The WatterSaver team warns that calculating exact savings for an individual customer using individual data may prove impractical and require an “average” or “indicative” savings calculation. In concert with PG&E, the WatterSaver team will analyze outcomes and data from early program participants to accurately determine the most effective methodology.

**PG&E Gas and Electric  
Advice Submittal List  
General Order 96-B, Section IV**

AT&T	Downey & Brand	Pioneer Community Energy
Albion Power Company	East Bay Community Energy	Praxair
Alcantar & Kahl LLP	Ellison Schneider & Harris LLP	
	Energy Management Service	
Alta Power Group, LLC	Engineers and Scientists of California	Redwood Coast Energy Authority
Anderson & Poole	Evaluation + Strategy for Social Innovation	Regulatory & Cogeneration Service, Inc.
	GenOn Energy, Inc.	SCD Energy Solutions
Atlas ReFuel	Goodin, MacBride, Squeri, Schlotz & Ritchie	
BART	Green Charge Networks	SCE
	Green Power Institute	SDG&E and SoCalGas
Barkovich & Yap, Inc.	Hanna & Morton	
P.C. CalCom Solar	ICF	SPURR
California Cotton Ginners & Growers Assn	International Power Technology	San Francisco Water Power and Sewer
California Energy Commission	Intestate Gas Services, Inc.	Seattle City Light
California Public Utilities Commission	Kelly Group	Sempra Utilities
California State Association of Counties	Ken Bohn Consulting	Southern California Edison Company
Calpine	Keyes & Fox LLP	Southern California Gas Company
	Leviton Manufacturing Co., Inc. Linde	Spark Energy
Cameron-Daniel, P.C.	Los Angeles County Integrated Waste Management Task Force	Sun Light & Power
Casner, Steve	Los Angeles Dept of Water & Power	Sunshine Design
Cenergy Power	MRW & Associates	Tecogen, Inc.
Center for Biological Diversity	Manatt Phelps Phillips	TerraVerde Renewable Partners
	Marin Energy Authority	Tiger Natural Gas, Inc.
Chevron Pipeline and Power	McKenzie & Associates	
City of Palo Alto		TransCanada
	Modesto Irrigation District	Troutman Sanders LLP
City of San Jose	Morgan Stanley	Utility Cost Management
Clean Power Research	NLine Energy, Inc.	Utility Power Solutions
Coast Economic Consulting	NRG Solar	Utility Specialists
Commercial Energy		
County of Tehama - Department of Public Works	Office of Ratepayer Advocates	Verizon
Crossborder Energy	OnGrid Solar	Water and Energy Consulting Wellhead Electric Company
Crown Road Energy, LLC	Pacific Gas and Electric Company	Western Manufactured Housing Communities Association (WMA)
Davis Wright Tremaine LLP	Peninsula Clean Energy	Yep Energy
Day Carter Murphy		
Dept of General Services		
Don Pickett & Associates, Inc.		
Douglass & Liddell		