**Work Paper PGECODHW122**

**Instantaneous Gas Hot Water Heater**

**Revision # 0**

**Pacific Gas & Electric Company**

**Customer Energy Solutions**

**Instantaneous Gas Hot Water Heater**

**Measure Codes DWHC1, DWHC2**

# At-a-Glance Summary

|  |  |  |
| --- | --- | --- |
| **Applicable Measure Codes:** | **DWHC1** | **DWHC2** |
| **Measure Description:** | NG-WtrHt-MedInst-Gas-76to200kBtuh-0p90Et  This measure is for installing instantaneous domestic water heaters instead of traditional storage-type water heaters. Instantaneous water heaters do not have traditional storage tanks, with their associated standby heat losses. | NG-WtrHt-LrgInst-Gas-gt200kBtuh-0p90Et  This measure is for installing instantaneous domestic water heaters instead of traditional storage-type water heaters. Instantaneous water heaters do not have traditional storage tanks, with their associated standby heat losses. | |
| **Energy Impact Common Units:** | Therms per kBtuh input (instantaneous water heater input rating) | | |
| **Base Case Description:** | DEER 2014  The base case is a storage-type water heater of appropriate (average tank size) input rating and average tank size. | | |
| **Base Case Energy Consumption:** | Source: DEER2014 | | |
| **Measure Energy Consumption:** | Source: DEER2014 | | |
| **Energy Savings**  **(Base Case – Measure):** | 2.60 Therms per kBtuh | 2.43 Therms per kBtuh | |
| **Costs Common Units:** | $ per kBtuh input | | |
| **Base Case Equipment Cost ($/unit):** | DEER  $5.21 | DEER  $6.48 | |
| **Measure Equipment Cost ($/unit):** | DEER  $9.11 | DEER  $9.67 | |
| **Gross Measure Cost ($/unit)** |  |  | |
| **Measure Incremental Cost ($/unit):** | Source: DEER2014  $3.90 | DEER2014  $3.19 | |
| **Effective Useful Life (years):** | 20 | | |
| **Measure Application Type:** | ROB | | |
| **Net-to-Gross Ratios:** | Source: DEER 2014  Default All >2 yr 0.60 | | |
| **Important Comments:** |  | | |

# Work Paper Approvals

The following Manager(s) approved this workpaper through the PG&E Electronic Data Routing System under Routing Requisition # \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |
| --- |
|  |
| **Grant Brohard**  Manager, Technical Product Support |
| **Carolyn Weiner**  Manager, Appliance Products |

# Document Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Revision #** | **Revision Date** | **Section-by-Section Description of Revisions** | **Author (Company)** |
| **Revision 0** | **12/16/2013** | **Commercial Tankless Water Heater** | **Charlene Spoor CLCi** |
| **Revision 1** | **5/19/2014** | **New Template for 7/1/14 filing** | **Charlene Spoor (CLCi)** |

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# Section 1. General Measure & Baseline Data

## 1.1 Product Measure Description & Background

***Catalog Description – High Efficiency Tankless water heaters > 90% Thermal Efficiency***

Available to commercial end-use customers only (NAICS codes 111, 112, 42, 44, 45,48-49, 51-56, 61-62, 71-72, 81 & 92). Water heaters must meet efficiency requirements based on size, as shown. Only instantaneous water heaters (as defined by the California Energy Commission Title 20 & 24 standards) used for non-process hot water applications qualify. The manufacturer name and equipment model number must be provided. Customers must provide proof of the tankless nature of the water heater (e.g., manufacturer equipment specification sheets). Multi Family installations do not apply, please see PGECODHW123R0, or PGECODHW114R4 for qualifying multi family values .

Input Rating Required Efficiency

<=200 kBtu/h Thermal Efficiency > 90%

> 200 kBtu/h Thermal Efficiency> 90%

All required efficiencies exceed Title 20 & 24 standards, as prescribed above.

Product Code Rebate/Unit Measure

DWHC1 Instantaneous Water Heater > 75 kBtu/h, <=200 kBtu/h.......... $3.00/kBtu/h

DWHC2 Instantaneous Water Heater >200 kBtu/h…………………….. $3.00/kBtu/h

**Program Restrictions and Guidelines**

This work paper documents the rationale for the savings methodologies and assumptions for High Efficiency Domestic Instantaneous or Tankless Water Heaters installed in a commercial application, as listed in the Boilers and Water Heating Rebate Catalog. The Boilers and Water Heating Catalog is part of Pacific Gas and Electric Company’s Customer Energy Efficiency Program. PG&E offers incentives to non-residential customers for installing qualifying, high-efficiency equipment.

**Terms and Conditions:**

Customer must have gas/electricity distributed by PG&E to the installation address. The customer must meet all the terms and conditions as described on the rebate application form or in the upstream Trade Pro qualifications.

DWHC1, DWHC2: The rebate is **upstream** provided to the **distributor** at the time of **sale** upon receipt of application and invoice.  This **is not** a direct install program.

***Market Applicability:***

This rebate is available to all commercial customers across all climate zones, building types, and building vintages in the PG&E service territory.

***1.2 Product Technical Description***

The California Energy Commission (CEC) Title 20 definition of a tankless/instantaneous water heater is as follows:

“Instantaneous water heater” means a water heater that has an input rating of at least 4,000 Btu per hour, per gallon of stored water.

## 

## 1.3 Measure Application Type

This measure is for replacing a traditional storage-type domestic water heater with instantaneous water heater(s) as Replace on Burnout (ROB) as identified in Table 1 below. Instantaneous water heaters heat water directly, without the use of a storage tank. Therefore, they avoid the standby heat losses associated with storage water heaters[[1]](#endnote-1). Due to reduced standby losses, instantaneous water heaters are able to achieve higher efficiency ratings than traditional tank-type water heaters.

Instantaneous water heaters generally have higher input ratings (Btu/hr) than storage-type water heaters for the same application, to meet peak demands

Table 1 Measure Application Type[[2]](#endnote-2)

*Identifies the measure application type in the Measure Implementation table in DEER2014*

|  |  |  |
| --- | --- | --- |
| **Code** | **Description** | **Comment** |
| ER | Early retirement | *measure applied while existing equipment still viable, or retrofit of existing equipment* |
| ROB | Replace on Burnout | *measure applied when existing equipment fails or maintenance requires replacement* |
| NC | New Construction | *measure applied during construction design phase as an alternative to a code-compliant standard design* |

## 1.4 Product Base Case and Measure Case Data

## 1.4.1 DEER Base Case and Measure Case Information

DEER 2014 READI tool includes high efficiency tankless water heater > 90% Thermal Efficiency (TE) savings, all values are taken directly from DEER 2014. (demand, electric, gas energy savings(interactive or not), equipment unit costs, equipment incremental costs, equipment useful life, Net to Gross or Initial Service Rate for PG&E Measure Codes DWHC1 and DWHC2-

**Table 2 DEER Use and Technology Table**



**Therms Savings Assumption (ΔTh) DEER Version and Impact IDs**

DEER 2014 was used to establish the baseline energy usages and peak demands to which the measure savings apply. The customer average base case energy usages and peak demands were obtained from DEER 2014 under the measure ID: NG-WtrHt-MedInst-Gas-76to200kBtuh-0p90Et, and NG-WtrHt-LrgInst-Gas-gt200kBtuh-0p90Et. The measure impacts were downloaded directly from DEER 2014 using specific building type, building vintage, climate zone values, there are no interactive effects.

**Hours of Operation**:

The hours of operation were downloaded from DEER directly; they match the intended measures for climate zones and building types and vintages. 8760

**Base Case Costs and Measure Case Costs:**

The Base Case / Measure Case / Incremental] Costs were downloaded from DEER directly; they match the intended measures for climate zones and building types and vintages.

**Net-to-Gross Assumption:**

Table 3 below summarizes all applicable DEER based Net-to-Gross ratios for programs that may be used by this measure. The NTG is based on the program type described in Section 1.1.

Table 3 DEER Net-to-Gross Ratios

|  |  |
| --- | --- |
|  |  |
| Program Approach | NTG |
| ALL-Default >= 2Yrs | 0.60 |

**Effective Useful Life (EUL): 20 years**

The Effective Useful Life estimates were downloaded directly from DEER; they match the intended measures for climate zones and building types and vintages. DEER14 Index 613.

**In-service rate/first year installation rate**: 1

The in service rates were downloaded from DEER directly; they match the intended measures for climate zones and building types and vintages. The ISR is based on the DEER measure and delivery described in Section 1.1.

## 1.4.2 Codes & Standards Requirements Base Case and Measure Information

***Title 20:*** These measures fall under the California Code of Regulations, Title 20 Public Utilities and Energy, Article 4 Appliance Efficiency Regulations 1.

**Table 4 Title 20 Codes and Standards 2013 (Effective 7/1/14)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title 20 Std. Description** | **Base or Measure Case** | **Value** | **Units** | **Code Source or Reference** |
| Small Gas Inst <200kBtuh | Base  Measure | (0.67-(0.0019\*V)  90% TE | Energy Factor  TE | *T20 2013 (effective 7/1/14)* |
| Large Gas Inst  >200kBtuh | Base  Measure | *80% TE*  *90% TE* | Thermal Efficiency | *T20 2013 (Effective 7/1/14)* |

***Title 24:*** These measures do not fall under Title 24 standards.

***Federal Standards:*** These measures include federally regulated commercial and industrial equipment under 42 U.S.C. Sections 6302 (a)(5), 6316(a), and 6316(b)(1), which are enforced by the U.S. Department of Energy. The federal standards are the same as the Claifornia Title 20 Standards listed above.

## 1.4.3 EM&V, Market Potential, and Other Studies – Base Case and Measure Case Information

There are no M&V or other studies that apply to these measures. Information on the base and measure case is found in the other sub-sections of 1.4.

## 1.4.4 Assumptions and Calculations from other sources—Base and Measure Cases

DEER 2014 values were used for this measure. There are no further data or calculations provided for the support of the measures in this workpaper.

***1.4.5 Time-of-Use Adjustment Factor***

We are required by CPUC decision 06-06-063 dated June 29, 2006 to apply time-of-use (TOU) adjustment factors on residential A/C and commercial A/C (packaged and split-system direct-expansion cooling) measures only. Since this is not an A/C measure, the TOU adjustment factor is 0.

***1.5 Summary of Inputs for Savings Calculations***

The following table provides references to sections that document the inputs for calculation:

**Table 5 Savings Calculations Summary Table**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Input Variable** | **Variations** | **Base Case 1 Average Value** | **Base Case 2 Average Value** | **Measure Case Average Value DWHC1** | **Measure Case Average Value DWHC2** | **Reference Section** |
| **Electric Savings** | N/A | N/A | N/A | N/A | N/A | N/A |
| **Gas Savings per kBtuh** | CZ, BT, BV, IE | N/A | N/A | 2.58 | 2.42 | Section 2.3 |
| **Hours of operation per Yr** | None | 8760 | 8760 | 8760 | 8760 | Section 1.4.1 |
| **Full Cost per kBtu** | ER, ROB, NC | 5.21 | 6.48 | 9.11 | 9.67 | Section 4 |
| **Incremental Cost per kBtu** | ER, ROB, NC | N/A | N/A | 3.90 | 3.19 | Section 4 |
| **EUL /RUL** | ER, ROB, NC | 10 | 10 | 20 | 20 | Section 1.4.1 |
| **NTG** | One | 0.23 | N/A | 0.7 | 0.7 | Section 1.4.1 Table 3 |
| **ISR** | Yes | 1 | 1 | 1 | 1 | Section 1.4.1 |
| **TOU Factor** | A/C projects only | N/A | N/A | N/A | N/A | Section 1.4.5 |

# Section 2. Calculation Methods

Table 6 Baseline by Measure Application Type

|  |  |  |  |
| --- | --- | --- | --- |
| ****Measure Application Type**** | ****Measure Life Basis**** | ****First Baseline Period: Energy Savings Baseline**** | ****Second Baseline Period: Energy Savings Baseline**** |
| ***ROB* (replace-on-burnout)** | **EUL** | Code Baseline | N/A |

Notes:

* For ROB measures, First Baseline is the baseline for the full EUL. There is no second baseline.

## 2.1 Electric Energy Savings Estimation Methodologies

* There were no electric energy savings associated with this (these) measure(s).

## 2.2. Demand Reduction Estimation Methodologies

* There is no anticipated demand reduction associated with this measure

## 2.3. Gas Energy Savings Estimation Methodologies

* This measure is not an Early Retirement measure.
* All savings values are downloaded directly from the DEER 2014 READI database.

**Annual Gas Savings:**

EUL Energy Savings [therms/unit] = Annual Code/Industry std. Base Gas Usage – Annual Energy Efficient Gas Usage

# *Section 3. Load Shapes*

Load Shapes are not applicable to gas measures at this time.

## 3.1 Base Case Load Shapes N/A to Gas measures

## 3.2 Measure Load Shapes N/A to Gas measures

# 

# Section 4. Base Case & Measure Costs

**Table 7 Base Case and Measure Costs**

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Application Type** | **Measure Life Basis** | **First Baseline Period Gross Measure Cost (RUL)** | **Second Baseline Period Gross Measure Cost (EUL – RUL)** |
|  |  |  |  |
| ***ROB(replace on burnout)*** | EUL | Calculated as Incremental Measure Cost | N/A |
|  |  |  |  |

To develop average costs, DEER data was collected for base case storage-type water heaters and measure case instantaneous water heaters.

Comparing costs for the base and measure cases is somewhat difficult. Installation costs are different for base case and measure case units. Instantaneous-type water heaters, with their larger burner capacity, require larger natural gas supply piping and larger exhausts. Also, in many applications, more than one instantaneous water heater will be used in place of each storage-type heater. Both issues can add significantly to retrofit costs. For this work paper, installation costs for new larger gas piping only were estimated. These costs were calculated using average instantaneous water heater size for each measure, typical length of new pipe required (based on engineering judgment), Natural Gas Pipe Sizing tables[[3]](#endnote-3) and RS Means 2010 Mechanical Cost Data for schedule 40 steel Gas Service Piping[[4]](#endnote-4). See the following table.

**Table 8 - Gas Pipe Installation Costs**

**Measure**

**Base**

**Equipment**

**Cost**

Measure

Equipment

Cost

Incremental

Equipment

Cost

Incremental

Installation

Cost

**Total**

**Incremental**

**Cost**

**Measure**

**Cost**

**DWHC1, Instantaneous Water Heaters**

**Medium, >75 to <= 200 MBtuh**

**5.21**

**$**

7.03

$

1.81

$

2.09

$

**3.90**

**$**

**9.11**

**$**

**DWHC2, Instantaneous Water Heaters**

**Large, > 200 MBtuh**

**6.48**

**$**

9.23

$

2.75

$

0.44

$

**3.20**

**$**

**9.67**

**$**

## 4.1 Base Case(s) Costs

The base case and measure case equipment costs were calculated using DEER2014 cost data, and a PG&E survey of available water heaters in the marketplace. The following Measure Application Types are appropriate to these measures.

**Table 9 Base Case Costs**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ***Measure Code*** | **Measure Application Type** | **Baseline** | **Equipment Cost** | **Labor / Installation Cost** | **Maintenance / Other Cost** | **Total Base Case Cost** |
| DWHC1 | ROB | Code | $5.21 | N/A | N/A | $5.21 |
| DWHC2 | ROB | Code | $6.48 | N/A | N/A | $6.48 |

*All costs are noted as $ per measure unit (kBtuh input)*

## 4.2 Measure Case Costs

The following Measure Application Types are appropriate to these. The Measure Case Costs are:

**Table 10 Measure Case Costs**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ***Measure Code*** | **Measure Application Type** | **Baseline** | **Equipment Cost** | **Labor / Installation Cost** | **Maintenance / Other Cost** | **Total Measure Case Cost** |
| DWHC1 | ROB | Code | $7.03 | $2.09 | N/A | $9.11 |
| *DWHC2* | ROB | Code | $9.23 | $0.44 | N/A | $9.67 |

*All costs are noted as $ per measure unit (kBtuh input)*

## 4.3 Incremental & Full Measure Costs

**Table 11 Incremental and Full Measure Cost**

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Application Type** | **Gross Measure Cost**  **(RUL Period/First Baseline)** | **Gross Measure Cost**  **(EUL-RUL Period/ Second Baseline)** | **Incremental Measure Cost** |
| ROB | Measure Equipment Cost  – Base Case Equipment Cost | N/A | Measure Equipment Cost  – Base Case Equipment Cost |
| NC | Measure Equipment Cost  – Base Case Equipment Cost | N/A | Measure Equipment Cost  – Base Case Equipment Cost |

# *4.3.1 Gross Measure Cost*

Gross Measure Cost is the cost to install an energy efficient measure per the CPUC calculators. This definition implies a different meaning depending on the Measure Application type.

This Measure Application Types are: **NC** or **ROB**, so the Gross Measure Cost (GMC) is represented by the equation below (choose):

GMC = (Measure Equipment Cost + Measure Labor Cost) –

(Base Case Equipment Cost + Base Case Labor Cost)

\*Note: We assume that, unless stated otherwise, the measure case labor and base case labor are assumed to be the same value reducing the equation to the following:

GMC = Measure Equipment Cost – Base Case Equipment *Cost*

*GMC = $ per (unit) - $ per (unit) = $ per unit*

\*Note: Various complicated price fluctuations are not addressed in these equations, such as future costs due to inflation in labor, future costs due to deflation in material cost, and other variables that cannot be accurately described at this time.

# *4.3.2 Incremental Measure Costs*

Incremental Measure Cost is the premium cost to install an energy efficient measure over a standard efficiency measure or code baseline measure. While IMC has a straightforward definition depending on the Measure Application type, the equation does vary.

This Measure Application Types are: **ROB or** **NC** so the Incremental Measure Cost (IMC) is represented by the appropriate equation below:

IMC = (Measure Equipment Cost + Measure Labor Cost) –

(Base Case Equipment Cost + Base Case Labor Cost)

\*Note: Unless stated otherwise the measure case and base case labor costs are typically the same, reducing the equation to the following:

IMC = Measure Equipment Cost – Base Case Equipment Cost

*IMC = $ per (unit) -- $ per (unit) = $ per (unit)*

**Table 12 Summary Table for Section 4**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Measure ID** | **Measure Application Types** | **Base Case Total Cost** | **Measure Case Total Cost[[5]](#endnote-5)** | **Gross Measure Case Cost** | **Incremental Measure Cost** |
| **DWHC1** | ROB | **$5.21** | **$7.03** | **$9.11** | **$3.90** |
| **DWHC2** | ROB | **$6.48** | **$9.23** | **$9.67** | **$3.19** |
|  |  |  |  |  |  |

# 

# References

1. Demand (Tankless or Instantaneous) Water Heaters. US Department of Energy. Web. Updated2/9/2011. <http://www.energysavers.gov/your\_home/water\_heating/index.cfm/mytopic=12820> [↑](#endnote-ref-1)
2. The DEER Measure Cost Data Users Guide found on [www.deeresources.com](http://www.deeresources.com) under *DEER2014 Database Format* hyperlink, DEER2011 for 13-14, spreadsheet *SPTdata\_format-V0.97.xls.* [↑](#endnote-ref-2)
3. *Natural Gas – Pipe Sizing.* The Engineering ToolBox. Web. Accessed 5/29/12.

   <http://www.engineeringtoolbox.com/natural-gas-pipe-sizing-d\_826.html> [↑](#endnote-ref-3)
4. RS.Means 2010 Mechanical Cost Data, G3060-110 Gas Service Piping, p.575, including material, installation and 25% O&P, Schedule 40 steel pipe. [↑](#endnote-ref-4)
5. *DEER2014\_NTGR\_2012-05-16.xls* from DEER Database for Energy-Efficient Resources; Version 2011 4.01 found at :<http://www.deeresources.com/index.php?option=com_content&view=article&id=68&Itemid=60>

   Under: DEER2014 Update Documentation linked at: [DEER2014 Update Net-To-Gross table](http://www.deeresources.com/DEER2011/download/DEER2011_NTGR_2012-05-16.xls)

   DEER Database for Energy-Efficient Resources; Version 2014 V 1.0.5 found at :<http://www.deeresources.com/index.php?option=com_content&view=article&id=68&Itemid=60>

   READI Tool Version 1.0.5; Measures D14 v1.00 –NG-WtrHt-LrgInst-Gas-gt200kBtuh-0p90Et, NG-WtrHt-MedInst-Gas-76to200kBtuh-0p90Et

    [↑](#endnote-ref-5)