Work Paper PGECOHVC101

**Revision #4**

**Pacific Gas & Electric Company**

**Space Heating Boiler**

**For Work Paper Reviewer Use Only**

**List all major comments that occurred during the review. This table may only be removed during management review.**

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| --- | --- | --- | --- |
| **Major Comment** | **Reviewer Name** | **Date** | **Outcome/Resolution** |
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# At-a-Glance Summary

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| --- | --- | --- | --- |
| **Measure Codes** | HV015 – Medium Water Forced Draft Boiler for Space Heating | HV016 – Medium Water Condensing Boiler for Space Heating | HV018 – Large Water Forced Draft Boiler for Space Heating |
| **Measure Description** | Space heating forced draft water boiler thermal efficiency of ≥ 85.0% and input rating > 300 kBTUh and ≤ 2500 kBTUh | Space heating condensing water boiler thermal efficiency of ≥ 94.0% and input rating > 300 kBTUh and ≤ 2500 kBTUh | Space heating forced draft water boiler combustion efficiency of ≥ 85.0% and input rating > 2500 kBTUh |
| **Base Case Description** | Space heating water boiler with thermal efficiency of 80%.  Source: DEER2016 | Space heating water boiler with thermal efficiency of 80%.  Source: DEER2016 | Space heating water boiler with thermal efficiency of 80%.  Source: DEER2016 |
| **Units** | Per kBTUh of boiler rated input | Per kBTUh of boiler rated input | Per kBTUh of boiler rated input |
| **Energy Savings** | Source: DEER2016. READI v2.3.0  **kW: 0.00/kBTUh**  **kWh: 0.00/kBTUh**  **Therm: 0.446/kBTUh** | Source: DEER2016. READI v2.3.0  **kW: 0.00/kBTUh**  **kWh: -0.52/kBTUh**  **Therm: 1.05/kBTUh** | Source: DEER2016. READI v2.3.0  **kW: 0.00/kBTUh**  **kWh: 0.00/kBTUh**  **Therm: 0.27/kBTUh** |
| **Full Measure Cost ($/unit)** | Source: 2010-2012 WO017 Ex Ante Measure Cost Study Final Report  **$26.68/kBTUh** | Source: 2010-2012 WO017 Ex Ante Measure Cost Study Final Report  **$17.73/kBTUh** | Source: 2010-2012 WO017 Ex Ante Measure Cost Study Final Report  **$21.84/kBTUh** |
| **Incremental Measure Cost ($/unit)** | Source: 2010-2012 WO017 Ex Ante Measure Cost Study Final Report  **$14.08/kBTUh** | Source: 2010-2012 WO017 Ex Ante Measure Cost Study Final Report  **$5.13/kBTUh** | Source: 2010-2012 WO017 Ex Ante Measure Cost Study Final Report  **$6.57/kBTUh** |
| **Effective Useful Life** | **20 years** (DEER EUL ID: HVAC-Blr) | **20 years** (DEER EUL ID: HVAC-Blr) | **20 years** (DEER EUL ID: HVAC-Blr) |
| **Measure Installation Type** | Replace on Burnout (ROB) | Replace on Burnout (ROB) | Replace on Burnout (ROB) |
| **Net-to-Gross Ratio** | **0.6** (DEER NTGR ID: Com-Default>2yrs) | **0.6** (DEER NTGR ID: Com-Default>2yrs) | **0.6** (DEER NTGR ID: Com-Default>2yrs) |
| **Important Comments** | This work paper has a complementary Ex Ante Database data set that will be provided in a separate submission to the California Public Utilities Commission (CPUC). | This work paper has a complementary Ex Ante Database data set that will be provided in a separate submission to the California Public Utilities Commission (CPUC). | This work paper has a complementary Ex Ante Database data set that will be provided in a separate submission to the California Public Utilities Commission (CPUC). |

# At-a-Glance Summary Continued

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Codes** | HV019 – Large Water Condensing Boiler for Space Heating | HV023 – Medium Steam Forced Draft Boiler for Space Heating | HV025 – Large Steam Forced Draft Boiler for Space Heating |
| **Measure Description** | Space heating condensing water boiler thermal efficiency of ≥ 94.0% and input rating > 2500 kBTUh | Space heating forced draft steam boiler thermal efficiency of ≥ 85.0% and input rating > 300 kBTUh and ≤ 2500 kBTUh | Space heating forced draft steam boiler thermal efficiency of ≥ 80.0% and input rating > 2500 kBTUh |
| **Base Case Description** | Space heating water boiler with thermal efficiency of 80%.  Source: DEER2016 | Space heating water boiler with thermal efficiency of 79%.  Source: DEER2016 | Space heating water boiler with thermal efficiency of 79%.  Source: DEER2016 |
| **Units** | Per kBTUh of boiler rated input | Per kBTUh of boiler rated input | Per kBTUh of boiler rated input |
| **Energy Savings** | Source: DEER2016. READI v2.3.0  **kW: 0.00/kBTUh**  **kWh: -0.52/kBTUh**  **Therm: 1.05/kBTUh** | Source: DEER2016. READI v2.3.0  **kW: 0.00/kBTUh**  **kWh: 0.00/kBTUh**  **Therm: 0.27/kBTUh** | Source: DEER2016. READI v2.3.0  **kW: 0.00/kBTUh**  **kWh: 0.00/kBTUh**  **Therm: 0.09/kBTUh** |
| **Full Measure Cost ($/unit)** | Source: 2010-2012 WO017 Ex Ante Measure Cost Study Final Report  **$17.73/kBTUh** | Source: 2010-2012 WO017 Ex Ante Measure Cost Study Final Report  **$32.08/kBTUh** | Source: 2010-2012 WO017 Ex Ante Measure Cost Study Final Report  **$15.14/kBTUh** |
| **Incremental Measure Cost ($/unit)** | Source: 2010-2012 WO017 Ex Ante Measure Cost Study Final Report  **$5.13/kBTUh** | Source: 2010-2012 WO017 Ex Ante Measure Cost Study Final Report  **$28.60/kBTUh** | Source: 2010-2012 WO017 Ex Ante Measure Cost Study Final Report  **$5.01/kBTUh** |
| **Effective Useful Life** | **20 years** (DEER EUL ID: HVAC-Blr) | **20 years** (DEER EUL ID: HVAC-Blr) | **20 years** (DEER EUL ID: HVAC-Blr) |
| **Measure Installation Type** | Replace on Burnout (ROB) | Replace on Burnout (ROB) | Replace on Burnout (ROB) |
| **Net-to-Gross Ratio** | **0.6** (DEER NTGR ID: Com-Default>2yrs) | **0.6** (DEER NTGR ID: Com-Default>2yrs) | **0.6** (DEER NTGR ID: Com-Default>2yrs) |
| **Important Comments** | This work paper has a complementary Ex Ante Database data set that will be provided in a separate submission to the California Public Utilities Commission (CPUC). | This work paper has a complementary Ex Ante Database data set that will be provided in a separate submission to the California Public Utilities Commission (CPUC). | This work paper has a complementary Ex Ante Database data set that will be provided in a separate submission to the California Public Utilities Commission (CPUC). |

# Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Rev** | **Date** | **Author** | **Summary of Changes** |
| Revision 0 | 04/30/2008 | Daria Mashnik (KEMA Services, Inc.) | Original work paper:  Space Heating Boilers PGECOHVC101 R0 |
| Revision 1 | 03/23/2010 | Edwin Huestis (PG&E) and Charlie Middleton (PG&E) | Space Heating Boilers PGECOHVC101 R1 update including available 2008 DEER cost data, and update NTGR value to 0.70. |
| Revision 2 | 05/18/2012 | Justin Westmoreland (PG&E) | Space Heating Boilers PGECOHVC101 R2 update including available 2011 DEER data savings data, and update NTGR value to 0.58 |
|  | 08/28/2012 | Justin Westmoreland (PG&E) | Nomenclature Update & Non-DEER Building Type “OTR” Defined |
| Revision 3 | 03/21/2014 | Curtis Lee (kW Engineering)  Charlie Middleton (PG&E) | DEER 2014 Update; expanded measure list to align program offerings with DEER |
| Revision 4 | 12/29/2015 | Curtis Lee (kW Engineering) | DEER 2016 Update; collapsed measure list to align program offerings with DEER measures. Removed measures no longer offered by PG&E. Updated costs to align with WO017 |

# Commission Staff and Cal TF Comments

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Rev** | **Party** | **Submittal Date** | **Comment Date** | **Comments** | **WP Developer Response** |
| 0 | CS | 6/2/15 | 6/15/15 | * Comment 1 * Comment 2 | * Response 1 * Response 2 |
| 0 | Cal TF | 6/2/15 | 6/15/15 | * Comment 1 * Comment 2 | * Response 1 * Response 2 |
|  |  |  |  |  |  |

Cal TF website: <http://www.caltf.org/>

The Cal TF approved the version X of this workpaper found under the “Approved Measures” section of the website, <http://www.caltf.org/approved-measures/>

# Section 1. General Measure & Baseline Data

## 1.1 Measure Description & Background

**Base, Standard, and Measure Cases**

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | HV015 Medium Water Forced Draft Boiler for Space Heating |
| Existing Condition | N/A |
| Code/Standard | 80% Et, 2013 Title 24 |
| Industry Standard Practice | 80% Et, 2013 Title 24 |

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | HV016 Medium Water Condensing Boiler for Space Heating |
| Existing Condition | N/A |
| Code/Standard | 80% Et, 2013 Title 24 |
| Industry Standard Practice | 80% Et, 2013 Title 24 |

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | HV018 Large Water Forced Draft Boiler for Space Heating |
| Existing Condition | N/A |
| Code/Standard | 80% Et, 2013 Title 24 |
| Industry Standard Practice | 80% Et, 2013 Title 24 |

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | HV019 Large Water Condensing Boiler for Space Heating |
| Existing Condition | N/A |
| Code/Standard | 80% Et, 2013 Title 24 |
| Industry Standard Practice | 80% Et, 2013 Title 24 |

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | HV023 Medium Steam Forced Draft Boiler for Space Heating |
| Existing Condition | N/A |
| Code/Standard | 79% Et, 2013 Title 24 |
| Industry Standard Practice | 79% Et, 2013 Title 24 |

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | HV025 Large Steam Forced Draft Boiler for Space Heating |
| Existing Condition | N/A |
| Code/Standard | 79% Et, 2013 Title 24 |
| Industry Standard Practice | 79% Et, 2013 Title 24 |

Measures and Codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Codes** | | | | **Measure Name** |
| SCG | SDG&E | SCE | PG&E |
|  |  |  | HV015 | Hot water boiler (300-2500 kBTUh, 85.0% thermal efficiency, forced draft) |
|  |  |  | HV016 | Hot water boiler (300-2500 kBTUh, 94.0% thermal efficiency, condensing) |
|  |  |  | HV018 | Hot water boiler (> 2500 kBtuh, 83.0 Et, 85.0Ec, OA Reset from 140 to 165 F) |
|  |  |  | HV019 | Hot water boiler (> 2500 kBtuh, 94.0 Et, condensing, OA reset from 140 to 165 F) |
|  |  |  | HV023 | Steam boiler (300 - 2500 kBtuh, 82.0 Et, OA Reset from 140 to 165 F) |
|  |  |  | HV025 | Steam boiler (> 2500 kBtuh, 80.0 Et, OA Reset from 140 to 165 F) |

**Program Eligibility Requirements:**

Requirements from Boilers and Water Heating Catalog:

* Must be used for space heating to induce human comfort, as defined by the California Energy Commission (CEC) Title 20 and 24 standards.
* Must meet efficiency requirements based on input ratings and types shown in the Space Heating Boiler Table as listed in the PG&E rebate catalog.
* Must include a manufacturer’s specification sheet documenting the boiler type, input rating and efficiency rating with the incentive application.
* Installation address must have a commercial natural gas account with PG&E.

## 1.2 Technical Description

## Space heating boilers are pressure vessels that transfer heat to water for use primarily in space heating applications. Boilers heat water using a heat exchanger that works like an instantaneous water heater or by the addition of a separate tank with an internal heat exchanger that is connected to the boiler. Energy efficient units often feature high-efficiency and/or low NOx burners, and typically have features such as forced air burners, relatively large heat exchange surfaces, and/or utilize heat recovery from stack gases.

## High-efficiency gas-fired boilers, typically rated above 90% thermal efficiency, are commonly known as condensing boilers. Condensing boilers are equipped with larger heat exchangers that are able to recuperate additional thermal energy from the flue gas – compared to their non-condensing counterparts. Condensing boilers are able to condense moisture out of the flue gas, recovering the latent heat from the water vapor present. The removal of latent heat in the water vapor results in a lower flue gas temperature than traditional boilers.

## 1.3 Installation Types and Delivery Mechanisms

**Installation Type Descriptions**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Installation Type** | **Savings** | | **Life** | |
| 1st Baseline (BL) | 2nd BL | 1st BL | 2nd BL |
| Replace on Burnout (ROB) | Above Code or Standard | N/A | EUL | N/A |
| New Construction (NEW/NC) | Above Code or Standard | N/A | EUL | N/A |
| Retrofit or Early Replacement (RET/ER) | Above Customer Existing | Above Code or Standard | RUL | EUL-RUL |
| Retrofit First Baseline Only (REF) | Above Customer Existing | N/A | EUL | N/A |
| Retrofit Add-on (REA) | Above Customer Existing | N/A | EUL | N/A |

The measures in this work book are applicable to commercial and multifamily residential installations. The savings for all measures are calculated assuming that the installation is replace-on-burnout (ROB).

A delivery mechanism is a delivery method paired with an incentive method. Delivery mechanisms are used by programs to obtain program participation and energy savings.

**Delivery Method Descriptions**

|  |  |
| --- | --- |
| **Delivery Method** | **Description** |
| Appliance Turn-in and Recycling | The program motivates customers, through financial incentives, to recycle appliances that are functional but inefficient. This prevents the continued use of those appliances, by both the current owner and potential future owners. |
| Audit/Information/Testing Services | The program performs a free assessment of a customer’s facility and provides the customer with information and guidance on energy efficiency opportunities. |
| Commissioning and Retrocommissioning | The program modifies or repairs existing equipment to ensure that it works as intended. |
| Financial Support | The program motivates customers, through financial incentives such as rebates or low interest loans, to implement energy efficient measures or projects. |
| Innovative Design | The program funds new ideas that meet reasonable scientific scrutiny for potential energy savings. These innovative measures typically have small market penetration (less than 5%) or are targeted toward relatively unreached market segments. |
| New Construction | The program offers financial incentives and/or design assistance to customers involved with new building construction. This is intended is to motivate customer to exceed Title 24 building energy efficiency requirements (residential or nonresidential). |
| Partnership | The program implements projects through a partnership between the utility and an institutional, government, or community-based organization. |
| Performance Based | The program offers financial incentives that vary based on the energy efficiency performance of specific projects. |
| Up-Stream Programs | See Up-Stream Incentive and Up-Stream Buy Down in the Incentive Method table. |

The measures in this work paper are claimed though the Financial Support delivery method. Customers receive a monetary rebate based on equipment size and type after the equipment has been purchased and installed.

**Incentive Method Descriptions**

|  |  |
| --- | --- |
| **Incentive Method** | **Description** |
| Direct Install | The program implements energy efficiency measures for qualifying customers, at no cost to the customer. |
| Down-Stream Incentive | The customer installs qualifying energy efficient equipment and submits an incentive application to the utility program. Upon application approval, the utility program pays an incentive to the customer. Such an incentive may be deemed or customized. |
| Mid-Stream Incentive | The program gives a financial incentive to a midstream market actor, such as a retailer or contractor, to encourage the promotion of efficient measures. The incentive may or may not be passed on to the end-use customer. |
| Up-Stream Incentive | The program gives a financial incentive to an upstream market actor, such as a manufacturer or distributor, to encourage the manufacture, provision, or distribution of an efficient measure. The incentive may or may not be passed on to the end-use customer. |
| Up-Stream Buy Down | The program gives a financial incentive to an upstream market actor, such as a manufacturer or distributor, with specific requirements to pass down the incentive to the end use customer. Such an incentive buys-down the cost of an efficient measure for the end-use customer by at least the amount of the financial incentive. |
| Giveaway | The program provides customers with energy efficiency equipment or services for free. |
| Exchange/Replacement | The utility program holds events where customers can trade functional equipment for similar but more energy efficient equipment, free of charge. |
| On-bill Finance/Loan | The program offers financing for the cost an efficient measure as part of the utility bill. This can be an add-on option to an existing program or can serve as an organizing principle for its own program. |

The measures in this work paper are incentivized claimed through a Down-Stream and Direct Install Incentive. Customers are required to submit proof of purchase and that the purchased equipment meets or exceeds the required energy-efficiency specifications to receive a deemed rebate. The rebate amount varies based on installed equipment size and type.

## 1.4 Measure Parameters

### 1.4.1 DEER Data

The measures in this work paper were directly taken from the Database of Energy Efficient Resources (DEER) READI v.2.3.0.

DEER Difference Summary

|  |  |
| --- | --- |
| **DEER Item** | **Used for Work Paper?** |
| Modified DEER methodology | Yes |
| Scaled DEER measure | Yes |
| DEER Base Case | Yes |
| DEER Measure Case | Yes |
| DEER Building Types | Yes |
| DEER Operating Hours | Yes |
| DEER eQUEST Prototypes | Yes |
| DEER Version | DEER 2016, READI v2.3.0 |
| Reason for Deviation from DEER | N/A |
| DEER Measure IDs Used | NG-HVAC-Blr-HW-300to2500kBtuh-85p0Et-Drft, NG-HVAC-Blr-HW-300to2500kBtuh-94p0Et-CndStd, NG-HVAC-Blr-HW-gt2500kBtuh-83p0Et-Drft, NG-HVAC-Blr-HW-gt2500kBtuh-94p0Et-CndStd, NG-HVAC-Blr-Stm-300to2500kBtuh-82p0Et-Drft, NG-HVAC-Blr-Stm-gt2500kBtuh-80p0Et-Drft |

**Net-to-Gross Ratio**

The Net-to-Gross Ratio (NTGR) values were obtained using the DEER READI tool. The relevant NTGR values for the measures in this work paper are in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **NTGR ID** | **Description** | **Sector** | **BldgType** | **Measure Delivery** | **NTGR** |
| Com-Default>2yrs | All other EEMs with no evaluated NTGR; existing EEM in programs with same delivery mechanism for more than 2 years | Com | Any | Any | 0.6 |

**Installation Rate**

The Installation Rate (IR) values were obtained using the DEER READI tool. The relevant IR values for the measures in this work paper are in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **GSIA ID** | **Description** | **Sector** | **BldgType** | **ProgDelivID** | **GSIAValue** |
| Def-GSIA | Default GSIA values | Any | Any | Any | 1 |

**Effective and Remaining Useful Life**

The effective useful life and remaining useful life (EUL and RUL, respectively) values were obtained using the DEER READI tool. DEER defines the RUL as 1/3 of the EUL value. The RUL value is only applicable to the first baseline period for an RET measure with an applicable code baseline. The relevant EUL and RUL values for the measures in this work paper are in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **EUL ID** | **Description** | **Sector** | **UseCategory** | **EUL (Years)** | **RUL (Years)** |
| HVAC-Blr | High Efficiency Boiler | Com | HVAC | 20 | 6.7 |

### 1.4.2 Codes and Standards Analysis

It should be noted that the more stringent code be applied in all applicable situations. In this case, 2013 California Title 24 code supersedes the 2015 Title 20 code as the regulatory baseline for all measures.

**Title 20:** These measures do fall under Title 20 of the California Energy Regulations. Section 1605 of Title 20 states[[1]](#footnote-1):

*Central Gas Furnaces, Central Gas Boilers, Central Oil Furnaces, Central Oil Boilers and Electric Residential Boilers. The AFUE, thermal efficiency, and combustion efficiency, as applicable, of central gas furnaces, central gas boilers, central oil furnaces, and central oil boilers manufactured on or after the effective dates shownshall be not less than the applicable values shown in Tables E-3 and E-4. Electric hot water residential boilers manufactured on or after September 1, 2012 shall meet the design standard shown in Table E-3.*

The table below shows the 2015 California Title 20 Appliance Efficiency Regulations, Section 1605.1, Table E-4, Standards for Gas- and Oil-Fired Central Boilers and Electric Residential Boilers.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title 20 Std. Description** | **Base or Measure Case** | **Value** | **Units** | **Code Source or Reference** |
| Boiler, hot water, Gas Fired (>= 300 kBTUh, <=2,500 kBTUh) | Base | 80% | Thermal Efficiency | Table E-4 |
| Boiler, steam, Gas-Fired all except natural draft(>= 300 kBTUh, <=2,500 kBTUh) | Base | 79% | Thermal Efficiency | Table E-4 |

***Title 24:*** These measures fall under Title 24 of the California Energy Regulations. Title 24 states[[2]](#endnote-1):

*Any space-conditioning equipment listed in this section may be installed only if the manufacturer has certified to the Commission that the equipment complies with all the applicable requirements of this section.*

1. ***Efficiency.*** *Equipment shall meet the applicable efficiency requirements in TABLE 110.2-A through TABLE 110.2- K subject to the following:*
   1. *If more than one efficiency standard is listed for any equipment in TABLE 110.2-A through TABLE 110.2-K, the equipment shall meet all the applicable standards that are listed; and*
   2. *If more than one test method is listed in TABLE 110.2-A through TABLE 110.2-K, the equipment shall comply with the applicable efficiency standards when tested with each listed test method; and*
   3. *Where equipment can serve more than one function, such as both heating and cooling, or both space heating and water heating, it shall comply with all the efficiency standards applicable to each function; and*
   4. *Where a requirement is for equipment rated at its "maximum rated capacity" or "minimum rated capacity," the capacity shall be as provided for and allowed by the controls, during steady-state operation.*

The table below lists the 2013 California Title 24 Build Energy Efficiency Standards, Section 110.2, Table 110.2-K, Gas- and Oil-Fired Boilers, Minimum Efficiency requirements.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Title 24 Std. Description** | **Base or Measure Case** | **Value** | **Units** | **Code Source or Reference** |
| Boiler, hot water, Gas Fired (>= 300 kBTUh, <=2,500 kBTUh) | Base | 80% | Thermal Efficiency | Table 110.2-K |
| Boiler, hot water, Gas Fired (> 2,500 kBTUh) | Base | 82% | Combustion Efficiency | Table 110.2-K |
| Boiler, steam, Gas-Fired all except natural draft(>= 300 kBTUh, <=2,500 kBTUh) | Base | 79% | Thermal Efficiency | Table 110.2-K |
| Boiler, steam, Gas-Fired all, except natural draft(>2,500 kBTUh) | Base | 79% | Thermal Efficiency | Table 110.2-K |

***Federal Standards:*** These measures do not fall under Federal DOE or EPA Energy Regulations.

The applicable codes and standards for these measures do not dictate the associated hours of operation, measure or baseline costs, EUL, NTGR, or in-service rate for the equipment involved.

Code Summary

|  |  |  |
| --- | --- | --- |
| **Code** | **Reference** | **Effective Dates** |
| Title 24 (2013) | Section 110.2 Mandatory Requirements for Space Conditioning Equipment | July 1, 2014 |
| Title 20 (2015) | Section 1605.1(e) Gas and Oil Space Heaters and Electric Residential Boilers | July 1, 2014 |
| DOE | TBD | TBD |

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

There are no M&V or other studies which apply to these measures.

# Section 2. Calculation Methodology

The following table indicates which measures are taken directly from or created with the DEER READI tool.

READI Data Used

|  |  |  |
| --- | --- | --- |
| **Measure Code** | **Measure Name** | **READI Data** |
| HV015 | Hot water boiler (300-2500 kBTUh, 85.0% thermal efficiency, forced draft) | NG-HVAC-Blr-HW-300to2500kBtuh-85p0Et-Drft |
| HV016 | Hot water boiler (300-2500 kBTUh, 94.0% thermal efficiency, condensing) | NG-HVAC-Blr-HW-300to2500kBtuh-94p0Et-CndStd |
| HV018 | Hot water boiler (> 2500 kBtuh, 83.0 Et, 85.0Ec, OA Reset from 140 to 165 F) | NG-HVAC-Blr-HW-gt2500kBtuh-83p0Et-Drft |
| HV019 | Hot water boiler (> 2500 kBtuh, 94.0 Et, condensing, OA reset from 140 to 165 F) | NG-HVAC-Blr-HW-gt2500kBtuh-94p0Et-CndStd |
| HV023 | Steam boiler (300 - 2500 kBtuh, 82.0 Et, OA Reset from 140 to 165 F) | NG-HVAC-Blr-Stm-300to2500kBtuh-82p0Et-Drft |
| HV025 | Steam boiler (> 2500 kBtuh, 80.0 Et, OA Reset from 140 to 165 F) | NG-HVAC-Blr-Stm-gt2500kBtuh-80p0Et-Drft |

Demand reduction estimates must consider the DEER peak demand period, which is 2:00 PM to 5:00 PM during specific weekday periods and varies by climate zone:

|  |  |
| --- | --- |
| **Climate Zone** | **3-Weekday Period** |
| 1 | Sep 16 – Sep 18 |
| 2 | July 8 – July 10 |
| 3 | July 8 – July 10 |
| 4 | Sep 1 – Sep 3 |
| 5 | Sep 8 – Sep 10 |
| 6 | Sep 1 – Sep 3 |
| 7 | Sep 1 – Sep 3 |
| 8 | Sep 1 – Sep 3 |
| 9 | Sep 1 – Sep 3 |
| 10 | Sep 1 – Sep 3 |
| 11 | July 8 – July 10 |
| 12 | July 8 – July 10 |
| 13 | July 8 – July 10 |
| 14 | Aug 26 – Aug 28 |
| 15 | Aug 25 – Aug 27 |
| 16 | July 8 – July 10 |

Demand savings for these measures were taken directly from DEER under the COM building type and IOU climate zone. The savings value for this category is a weighted average across all climate zones. Therefore, the claimable demand savings is the same across all PG&E climate zones.

# Section 3. Load Shapes

Load shapes are not applicable to gas measures, because the price of gas is not dependent on time-of-use.

# Section 4. Costs

There are Base Case and Measure Case costs from the 2010-2012 WO017 Ex Ante Measure Cost Study Final Report[[3]](#endnote-2) that match exactly with catalog measures HV015, HV016, HV018, HV023 and HV025. Therefore, costs were taken directly from the study report. There are no DEER measure costs for HV019. Therefore, we have taken costs for this measure to be the same as HV016. All costs for these measures included material and labor costs and are reported on a per input kBTUh basis and shown in excel file. See 2010-2012 WO017 Ex Ante Measure Cost Study Final Report for further details.

It should be noted that there is an error in Table 3-20 in the 2010-2012 WO017 Ex Ante Measure Cost Study Final Report. Incremental measure costs per unit input capacity for hot water boilers larger than 2,500 MBH is listed at $14.08/MBH. However, the actual IMC/MBH is $6.57/MBH.

## 4.1 Base Case Cost

Base Case cost information was taken directly from Table 3-20: Incremental Equipment Price Estimates for Boilers in the 2010-2012 WO017 Ex Ante Measure Cost Study Final Report. See 2010-2012 WO017 Ex Ante Measure Cost Study Final Report for further details.

## 4.2 Measure Case Cost

Measure Case cost information was taken directly from Table 3-20: Incremental Equipment Price Estimates for Boilers in the 2010-2012 WO017 Ex Ante Measure Cost Study Final Report. See 2010-2012 WO017 Ex Ante Measure Cost Study Final Report for further details.

## 4.3 Full and Incremental Measure Cost

**Full and Incremental Measure Cost Equations**

|  |  |  |  |
| --- | --- | --- | --- |
| **Installation Type** | **Incremental Measure Cost** | **Full Measure Cost** | |
| **1st Baseline** | **2nd Baseline** |
| ROB | (MEC + MLC) – (BEC + BLC) | (MEC + MLC) – (BEC + BLC) | N/A |
| NEW/NC |
| RET/ER | (MEC + MLC) – (BEC + BLC) | MEC + MLC | (MEC + MLC) – (BEC + BLC) |
| REF | (MEC + MLC) – (BEC + BLC) | MEC + MLC | N/A |
| REA | MEC + MLC | MEC + MLC | N/A |

MEC = Measure Equipment Cost; MLC = Measure Labor Cost

BEC = Base Case Equipment Cost; BLC = Base Case Labor Cost

**Full and Incremental Costs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Code** | **Installation Type** | **Incremental Measure Cost** | **Full Measure Cost** | |
| **1st Baseline** | **2nd Baseline** |
| HV015 | ROB | $14.08 | $32.21 | N/A |
| HV016 | ROB | $5.13 | $23.40 | N/A |
| HV018 | ROB | $6.57 | $26.41 | N/A |
| HV019 | ROB | $5.13 | $23.40 | N/A |
| HV023 | ROB | $28.60 | $46.56 | N/A |
| HV025 | ROB | $5.01 | $20.22 | N/A |

Note: All costs are rated per kBTUh of input capacity

# Attachments

PGECOHVC101 R4-9-11-2015- v2.xlsx

# References

1. Dates are listed in Tables E-3 and E4 in Appendix 3 [↑](#footnote-ref-1)
2. 2013 Building Energy Efficiency Standards, Section 110.2 [↑](#endnote-ref-1)
3. 2010-2012 WO017 Ex Ante Measure Cost Study Final Report, May 27, 2014 [↑](#endnote-ref-2)