Work Paper WPSCGNRWH120206B

**Revision 8**

**Southern California Gas Company**

**Tankless Water Heaters for Commercial Applications**

# At-a-Glance Summary

|  |  |
| --- | --- |
| **Measure Codes** | TBD |
| **Measure Description** | High Efficiency Tankless Water heaters for commercial applications.   * High Efficiency Large Gas Instantaneous Water Heater; Tier I – Et ≥ 80%, Tier II – Et ≥ 90% * High Efficiency Small Instantaneous water heater; Tier I – UEF ≥ .81, Tier II – UEF ≥ .87 |
| **Base Case Description** | Code/Standard rated storage water tank   * Large Gas Storage Water Heater, Et = 0.80, Stdby Loss = 0.56%/hr * Small storage Gas water heater: 40 gallon, EF = 0.62, RE = 0.76, Cap = 40kBTUh, UA = 6.43 BTU/hr-F, AuxBTUh: 350 |
| **Units** | Per Cap-kBtuh |
| **Energy Savings** | Refer to Excel Calculation Attachment; *Attachment A, Savings Calculations and Measure Summary* |
| **Full Measure Cost ($/unit)** | Refer to Excel Calculation Attachment; *Attachment D, Cost Calculations* |
| **Incremental Measure Cost ($/unit)** | Refer to Excel Calculation Attachment; *Attachment D, Cost Calculations* |
| **Effective Useful Life** | 20 Years: (DEER EUL ID: *WtrHt-Instant-Com*) |
| **Measure Installation Type** | Normal Replacement (NR), New Construction (NC) |
| **Net-to-Gross Ratio** | 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). |

# Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Rev** | **Date** | **Author** | **Summary of Changes** |
| B | Jan. 25, 2006 | Stu Knoke (EEA) | Original release |
| 3 | May 18, 2012 | Stu Knoke (ICF) | Updated cost and efficiency data from B-REP-05-599-17B |
| 4 | May 29, 2014 | Miguel Urrea (SCG) | * Update to DEER 2014 saving values * Update Workpaper Template * Updated Cost Information * Added Electric Savings |
| 5 | April 6, 2015 | Miguel Urrea (SCG) | * Updated small tankless measures for DEER 2015 code update * Changed NTG for condensing technology to Com-Default >2 yrs * Added application type New Construction * Changed Midstream rebates to preferred delivery method instead of downstream. * Added Industrial and Agriculture building type applications |
| 6 | July 26, 2016 | Miguel Urrea (SCG) | * Updates per Water Heater Disposition (Attachment F) * Removed NC for Small tankless Water Heater * Adjust cost to include installation (Labor and Material) * Changed energy impacts to report per IOU * Added air quality emission requirements |
| 7 | October 16, 2018 | Matthew Mendoza (SCG) | * Conversion of DEER EF Values to UEF Values for applicable technology * Update Measure Costs according to the US DOE Technical Support Document for Commercial Water Heating Equipment * Addition of all building types given within the DEER Database for all IOUs * Conversion of workpaper to current Statewide Template |
| 8 | February 13, 2019 | Matthew Mendoza (SCG) | * Update Measure Application Types and Delivery Types |

Measure Summary Table

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ***Measure ID*** | ***Measure Name*** | ***Average Savings (Therms/Yr)*** | ***Unit*** | ***Base Cost*** | ***Material Cost*** | ***Labor Cost*** | ***IMC*** |
| NG-WtrHt-LrgInst-Gas-gt200kBtuh-0p80Et | Tier I; Large Gas Instantaneous Water Heater, Et = 0.80 | 0.31 | Cap-kBtuh | $8.74 | $17.94 | $0.75 | $9.96 |
| NG-WtrHt-LrgInst-Gas-gt200kBtuh-0p90Et | Tier II; Large Gas Instantaneous Water Heater, Et = 0.90 | 2.29 | Cap-kBtuh | $8.74 | $22.01 | $0.75 | $14.02 |
| WPSCGNRWH120206B\_Rev06\_Msr001 | Tier I; Small Instantaneous Water Heater (UEF>=0.81), Savings per Cap-kbtuh | 2.33 | Cap-kBtuh | $5.85 | $5.57 | $6.39 | $ 6.11 |
| WPSCGNRWH120206B\_Rev06\_Msr002 | Tier II; Small Instantaneous Water Heater (UEF>=0.87), Savings per Cap-kBtuh | 4.87 | Cap-kBtuh | $5.85 | $8.44 | $4.82 | $7.42 |

**\*Average therm savings presented within this table are aggregate averages amongst climate zones for the COM building type**

**\*For the complete list of Measures, refer to the accompanying calculation spreadsheet found in Attachment A.**

# Section 1. General Measure & Baseline Data

## 1.1 Measure Description & Background

Tankless water heaters have become widely available in recent years for a variety of applications. Relative to a storage water heater, a tankless unit has a relatively large burner that rapidly heats water to the desired temperature. Due to the rapid “instantaneous” heating, a tankless water heater does not require a storage tank, although a small tank may be included. Due to the relatively larger burner size, these water heating devices can provide hot water on a continuous basis. They have relatively high energy efficiency levels because standby losses from storage tanks are essentially eliminated.

**Base, Standard, and Measure Cases**

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | High Efficiency Tankless/Instantaneous Water Heater |
| Existing Condition | *N/A* |
| Code/Standard | Gas Storage Water Heater as defined by Title 20 |
| Industry Standard Practice | N/A |

Measures and Codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Codes** | | | | **Measure Name** |
| SCG | SDG&E | SCE | PG&E |
| TBD |  |  |  | Large Instantaneous Gas Water Heater, Et ≥ 0.80 |
| TBD |  |  |  | Large Instantaneous Gas Water Heater, Et ≥ 0.90 |
| TBD |  |  |  | Small Instantaneous Gas Water Heater, UEF >= 0.81 |
| TBD |  |  |  | Small Instantaneous Gas Water Heater, UEF >= 0.87 |

* **Eligibility requirements**: All storage water heating units must exceed the UEF or thermal efficiency values described in the following table to participate in the EE program.
* **Implementation and installation requirements**: This workpaper has savings values for many commercial and industrial building types. Non-Residential building types that are not explicitly included within the measure table tab within attachment A shall use the COM Building type designation.

The measures defined within this workpaper are offered as a Normal Replacement (NR/NC) offering. Therefore, the baseline for each measure is to be defined by either Code or standard practice. In this case, all measures are evaluated against the code defined by Title 20, as elaborated on in section 1.4.2. The below table shows the measure and baseline descriptions.

**Measure Summary Table**

|  |  |  |
| --- | --- | --- |
| ***Measure Name*** | ***Measure Description*** | ***Base Case Description*** |
| Tier I; Large Gas Instantaneous Water Heater, Et = 0.80 | Large Gas Instantaneous Water Heater, Et ≥ 0.80 | Large Gas Storage Water Heater, Et = 0.80, Stdby Loss = 0.56%/hr |
| Tier II; Large Gas Instantaneous Water Heater, Et = 0.90 | Large Gas Instantaneous Water Heater, Et ≥ 0.90 | Large Gas Storage Water Heater, Et = 0.80, Stdby Loss = 0.56%/hr |
| Tier I; Small Instantaneous Water Heater (UEF>=0.81), Savings per Cap-kbtuh | Small Instantaneous Gas Water Heater, UEF >= 0.81 | Small storage Gas water heater: 40 gallon, EF = 0.62, RE = 0.76, Cap = 40kBTUh, UA = 6.43 BTU/hr-F, AuxBTUh: 350 |
| Tier II; Small Instantaneous Water Heater (UEF>=0.87), Savings per Cap-kBtuh | Small Instantaneous Gas Water Heater, UEF >= 0.87 | Small storage Gas water heater: 40 gallon, EF = 0.62, RE = 0.76, Cap = 40kBTUh, UA = 6.43 BTU/hr-F, AuxBTUh: 350 |

## 1.2 Technical Description

Tankless water heaters, which can also be referred to as instantaneous or continuous flow water heaters, are high power water heaters that instantly heats up water as it flows through the heat exchanger of the unit. In most cases, these types of water heaters heat water directly without the use of a storage tank. When a hot water tap is turned on, cold water travels through a pipe and into the unit. A gas burner heats the water and as a result, there is a constant supply of hot water at the point of use. Typically, a tankless water heater can provide hot water at a rate of 2-5 gallons per minute which is a limiting factor when assessing the technologies possible applications.[[1]](#endnote-1) Tankless water heaters are most useful in point-of-use applications, i.e., at the faucet and with no circulation loop. They are very inefficient in applications with a circulation loop due to the temperature loss in the circulation system which causes the tankless water heater to run without water demand. They are also problematic in central systems with circulation loops which have long pipe runs from the water heater to the faucet.

**Measure Description:**

The measures highlighted within this workpaper are both high efficiency small instantaneous water heaters and large instantaneous water heaters. For small instantaneous water heaters, the measure has two tiers. The first tier is for small instantaneous water heaters (≤ 200 kBtuh) that have a UEF rating greater than 0.81 to 0.86. The UEF range for the second tier for these water heaters will be ≥ 0.87. A UEF value of 0.87 corresponds to a condensing recovery efficiency of .90, which can be seen in Attachment A. For large instantaneous water heaters, this workpaper adopts energy impact values directly from DEER, without modification. This measure is also split into two tiers, the first at ≥ 80% Thermal Efficiency and the second at ≥ 90% Thermal Efficiency.

**Base Description:**

The measures in this workpaper are to have a measure application type of Normal Replacement (NR) and are evaluated against the current code or standard. The base case description for small instantaneous water heaters is considered to be a 40 gallon water heater with an Energy Factor (EF) rating of 0.62 and a Recovery Efficiency of 76%. This baseline is applied to both measure tiers. The base case for Large Gas Instantaneous water heaters are large 75 gallon storage water heaters with a thermal efficiency of 80%. Both base case descriptions derive from the DEER Database and the current Title 20 federal code.

## 1.3 Installation Types and Delivery Mechanisms

This measure will only be implemented using the Normal Replacement and New Construction measure application types. The savings and useful life will only be evaluated for the 1st baseline, no second baseline will be needed as described in the table below. This measure offering will be extended to customers of any commercial building type.

**Installation Type Descriptions**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Installation Type** | **Savings** | | **Life** | |
| 1st Baseline (BL) | 2nd BL | 1st BL | 2nd BL |
| Normal Replacement (NR) | Above Code or Standard | N/A | EUL | N/A |
| New Construction (NEW/NC) | Above Code or Standard | N/A | EUL | N/A |

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** |
| Financial Support | The program motivates customers, through financial incentives such as rebates or low interest loans, to implement energy efficient measures or projects. |
| 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). |

**Incentive Method Descriptions**

|  |  |
| --- | --- |
| **Incentive Method** | **Description** |
| Down-Stream Incentive (DnDeemed) | 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. |

## 1.4 Measure Parameters

### 1.4.1 DEER Data

DEER measures for all small instantaneous water heaters were provided by the approved DEER Database and given in a Per Unit savings basis. This workpaper uses some assumptions to convert savings into a per Cap-kBTUh savings basis.

DEER Difference Summary

|  |  |
| --- | --- |
| **DEER Item** | **Used for Workpaper?** |
| 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 2015, READI v2.4.7 |
| Reason for Deviation from DEER | DEER tankless water heating measures include ratings with Energy factor and Thermal Efficiency. Due to recent DOE ruling, the ratings in deer will be converted to UEF values. The savings for small instantaneous water heaters are also converted to Cap-kBtuh. |
| DEER Measure IDs Used | |  | | --- | | NG-WtrHt-LrgInst-Gas-gt200kBtuh-0p80Et | | NG-WtrHt-LrgInst-Gas-gt200kBtuh-0p90Et | | NG-WtrHt-SmlInst-Gas-150kBtuh-lt2G-0p82EF-40g | | NG-WtrHt-SmlInst-Gas-150kBtuh-lt2G-0p92EF-40g | |

**Net-to-Gross Ratio**

The NTG values were obtained using the DEER READI tool. The relevant NTG 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 |

**Spillage Rate**

Spillage rates are not tracked in work papers; they are tracked in an external document which will be supplied to the Commission Staff.

**Installation Rate**

The 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 EUL and RUL 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. For this NR measure, only the EUL will be utilized. 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)** |
| WtrHt-Instant-Com | Commercial Instantaneous Water Heater | Com | SHW | 20 | 6.7 |

### 1.4.2 Codes and Standards Analysis

The manufacturing of tankless water heaters is federally regulated and have established standards within the California Code of Regulations. Title 20. Section 1605.1(f) shows the current standards for water heaters. For large tankless water heaters, units having an input rating of 200 kBtuh or more, the following standards, shown in Table 1, will apply. These standards were rated with thermal efficiency (%) and in maximum standby loss (Btu/hr).

**Table 1: Title 20 Standards for Large Water Heaters**



For small tankless water heaters, units with an input rating of less than or equal to 200 kBtuh, Title 20 section 1605.1(f) shows the following, rated with Energy Factor (EF).

**Table 2: Title 20 Standards for Small Water Heaters**



As of December 29, 2016, the Department of Energy developed a final ruling within the federal register which has changed the way that all residential and some commercial water heating technology would be rated. All water heaters within the scope of the ruling will no longer be rated with the Energy Factor (EF), thermal efficiency, or standby loss but now be using the Uniform Energy Factor (UEF). The UEF is the DOE’s newly developed metric for communicating the energy efficiency of water heaters. UEF ratings are determined by assigning water heaters into one of four different categories of hot water usage and then evaluating their performance based on that usage[[2]](#endnote-2). These categories are based on draw pattern and differ by the labels *very small, low, medium,* and *high*. This allows water heaters to be compared more easily between different types (i.e. Storage and Tankless), so long as they are being compared within those same bins. The final ruling from the Federal Register dated on December 29, 2019 can be found in *Attachment B*. The attachment contains the following table that can be referenced when evaluating the UEF of units that coincide with the current code standards of Title 20 for water heaters.

**Table 3: Equations to Convert Current Title 20 Code to UEF**





The final ruling also contains tables that define what is meant by the draw patterns of very small, low, medium, and high.

Section 429.17 (B) Determine the applicable draw pattern as follows:

(1) For consumer gas-fired water heaters, consumer oil-fired water heaters, consumer electric water heaters, tabletop water heaters, grid enabled water heaters, residential-duty commercial gas water heaters, residential-duty commercial oil filed water heaters: Use the New FHR (First Hour Rating) to select the applicable draw pattern from the table in this paragraph:

**Table 4: Storage Water Heater Draw Patterns**



(2) For instantaneous gas-fired water heaters, instantaneous electric water heaters, and residential-duty commercial electric instantaneous water heaters: Use New Max GPM to select the applicable draw pattern from the table in this paragraph:

**Table 5: Instantaneous Water Heater Draw Patterns**



Code Summary

|  |  |  |
| --- | --- | --- |
| **Code** | **Reference** | **Effective Dates** |
| Title 20 (2017) | Section 1605.1(f) Water Heaters (1) Large Water Heaters | October 29, 2013 |
| Title 20 (2017) | Section 1605.1(f) Water Heaters (2) Small Water Heaters | April 16, 2015 |
| Federal Register | Vol. 81, No. 250; Department of Energy, Rules and Regulations [Docket No. EERE-2015-BT-TP-0007] | December 29, 2016 |

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

### 1.5.1 Department of Energy – Rules and Regulations (Federal Register)

Attachment B:

* The effective date of this rule was December 29, 2016, proposed by the Department of Energy.
* This ruling was intended to change the way that residential water heating equipment is rated.
* In this final rule, DOE establishes a mathematical conversion factor between the values determined using the Energy Factor (EF), Thermal Efficiency (TE), and Standby Losses (SL) test procedures and the values would be determined using the uniform efficiency descriptor test procedure. The DOE used the conversion factors to derive minimum energy conservation standards in terms of UEF, which can be found in section 1.4.2. The standards denominated in UEF are neither more nor less stringent than the EF-denominated standards for consumer water heaters and for commercial water-heating equipment based on the thermal efficiency and standby loss metrics.
* This ruling has caused a shift in manufacturing to UEF rated appliances as opposed to EF rated appliances. This new workpaper update will address this shift by converting both baseline and measure cases to be rated with UEF, Medium and High Draw.

### 1.5.2 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial Water Heating Equipment

Attachment C:

* This technical support document was utilized for cost data amongst all measures within this workpaper.
* This document was developed by Navigant Consulting on behalf of the department of energy and published on April 18, 2064.
* The cost estimates provided by this study is the sole source of cost estimation within this workpaper. The data provides information about labor and costs for several efficiency levels for both commercial storage and tankless water heaters.

## 1.6 Data Quality and Future Data Needs

The data provided and utilized for the means of this workpaper is considered sufficient. The savings values utilized within this workpaper are approved values through the DEER READI Tool. Future data needs may come if there becomes a need to re-evaluate the measure costs that were based on data from 2014 and earlier. Furthermore, available product databases published by the CEC and AHRI do not include sufficient quantities of UEF rated water heaters to develop typical code baseline and measure level performance criteria. Therefore, DEER measure and baseline definitions were not revised.[[3]](#endnote-3) The small instantaneous water heater as implemented in non-residential building types should also be re-evaluated within upcoming versions of the DEER water heating Calculator. According to DEER, the savings were last referenced from WaterHeater-Calculator-v1.1, while the current version is 3.2 and does not include calculations for small sized units. This workpaper is using the best available data captured within DEER.

# Section 2. Calculation Methodology

## 2.1 Conversion from Energy Factor to Uniform Energy Factor

Tankless water heaters follow a different calculation methodology to convert the Energy Factor to Uniform Energy Factor than storage water heaters. The UEF is largely dependent on the recovery efficiency (*nr)* and the max gallons per minute (GPM) rating of the unit. Due to the design of a tankless water heater, other factors, like standby losses, play a minimal role in their energy rating. The DOE Federal Register, as described in section 1.5.1, elaborates on a simple calculation from EF to UEF for these units.

(1)

The UEFmodel­ is first calculated based on the recovery efficiency of the unit (nr­). This recovery efficiency can either be a tested value but is typically manufacturer rated and can be found as a nameplate value on the unit. The value of *A* is a coefficient given within the DOE documentation. This variable is given for all 4 draw patterns for electric and gas units.

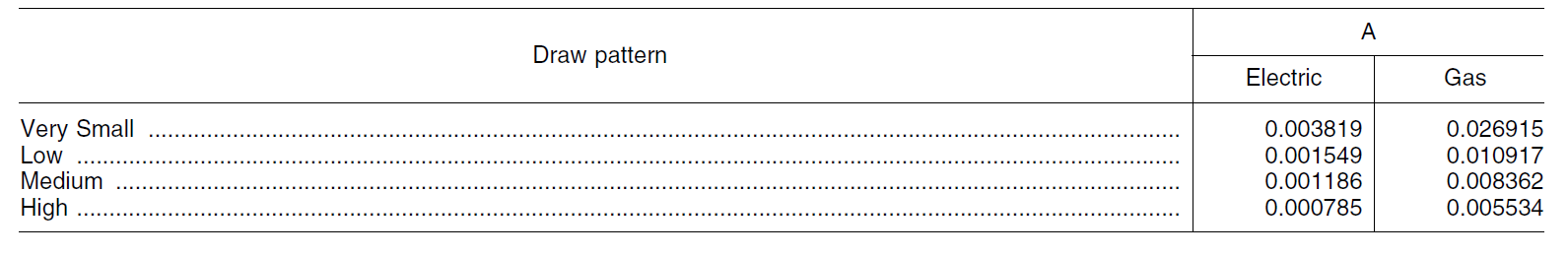


Figure 1: Coefficients for the Analytical UEF conversion Factor for Consumer Instantaneous Water Heaters

As seen above, each draw pattern is given a different coefficient that is unique to the draw pattern. This draw pattern correlates with the Max GPM of the unit. Due to the energy rating change, the measurement of Max GPM has changed and a conversion equation to go from a units original Max GPM to the unit’s “New Max GPM” was given with the DOE documentation.

(2)

The Max GPMp correlates with the manufacturer rated Max GPM rating. The new volumetric flow rating can then be used to determine the draw pattern of the unit using the given table in the Federal Register, which can be found on table 5 within section 1.4.2 of this workpaper.

The new UEF value for gas-fired instantaneous water heaters is calculated using the following equation.

(3)

The result from equation (1) is inserted into equation (3) to obtain the new UEF. Equation (2) is used to determine which draw pattern the unit belongs to.

**Sample Calculation:**

Using an example obtained from the CEC database for small tankless gas fired water heaters, which can be found within attachment *A*, a sample calculation is performed as follows.

Table 6: Example Unit Info

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Manufacturer** | **Model Number** | **Energy Source** | **Maximum GPM** | **Input BTUH** | **Recovery Efficiency** | **Energy Factor** |
| Rheem Sales Co.| Inc. | PH2-20RDVSLN | Natural Gas | 3 | 150000 | 84 | 0.82 |

Using equation (2);

This new max gpm will allow the determination of the proper coefficient used for UEF conversion. Using table 5, it is found that this unit is of the Medium Draw type. Using figure 1, the medium draw unit correlates with a coefficient of *A = 0.008362* for a gas fired unit. Using the Recovery Efficiency (nr) found in the unit info table, the UEFmodel­ is found.

Using equation (3), the final New UEF can be found.

## 2.2 UEF Estimation for Small Instantaneous Water Heater Measures

A plot of the UEF calculation for small instantaneous water heaters for all four draw patterns can be seen below.

Figure 2: Plot of UEF Ratings as recovery efficiency increases

Figure two above shows that the difference in UEF ratings are miniscule between the low, medium, and high draw patterns. The data used to create this plot can be found in *attachment A, tab “UEF Calcs*.” Due to this small difference, this workpaper utilizes one UEF value and one savings value for both medium and high draw patterns for nonresidential tankless water heaters.

## 2.3 Conversion from Per Unit Savings to Cap-kBTUh Savings

This workpaper adds additional measures that convert the per unit savings to savings per input capacity of the unit for all small category water heaters. This was done by using the average input rating per small sized instantaneous water heater provided in the READI Database. The corresponding input rate used in the calculator for each capacity is 150 kBtuh for Tier 1 and Tier 2 Small gas instantaneous water heaters. All therm savings per unit provided by the DEER Database were divided by the corresponding average input rating to find the savings per Cap-kBtuh input rating. These calculations can be found within *Attachment A, sheet “Msr001 & Msr002”.*

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

READI Data Used

|  |  |  |
| --- | --- | --- |
| **Measure Code** | **Measure Description** | **READI Data** |
| NG-WtrHt-LrgInst-Gas-gt200kBtuh-0p80Et | Large Gas Instantaneous Water Heater ≥ 20 kBtuh, Et = 0.80 | DEER 2014 |
| NG-WtrHt-LrgInst-Gas-gt200kBtuh-0p90Et | Large Gas Instantaneous Water Heater ≥ 200 kBtuh, Et = 0.90 | DEER 2014 |
| NG-WtrHt-SmlInst-Gas-150kBtuh-lt2G-0p82EF-40g | Small Instantaneous Gas Water Heater ≤ 200 kBtuh, UEF ≥ 0.81 | DEER 2015 |
| NG-WtrHt-SmlInst-Gas-150kBtuh-lt2G-0p92EF-40g | Small Instantaneous Gas Water Heater ≤ 200 kBtuh, UEF ≥ 0.87 | DEER 2015 |

# Section 3. Load Shapes

The ideal load shape for net benefits estimates would represent the difference between the base case and measure case. All measures within this workpaper are gas only measures that have a gas impact profile of “Annual.” Load shapes do not apply to this workpaper.

# Section 4. Costs

The cost estimations within this workpaper were derived from one source, as mentioned in section 1.4, the DOE Technical Support Document for Commercial Water Heating Equipment. The Navigant study was performed and submitted to the DOE in 2016. These details and calculations can be found in attachment D.

## 4.1 Base Case Cost

There are six measures, four of which are DEER Measures that are referenced within this workpaper. The base costs of each measure are provided below and are all derivative of the DOE Technical Support Document.

|  |  |  |
| --- | --- | --- |
| ***Measure ID*** | ***Base Cost*** | **Unit** |
| NG-WtrHt-LrgInst-Gas-gt200kBtuh-0p80Et | $ 8.74 | per Cap-kBtuh |
| NG-WtrHt-LrgInst-Gas-gt200kBtuh-0p90Et | $ 8.74 | per Cap-kBtuh |
| WPSCGNRWH120206B\_Rev08\_Msr001 | $ 5.85 | per Cap-kBtuh |
| WPSCGNRWH120206B\_Rev08\_Msr002 | $ 5.85 | per Cap-kBtuh |

## 4.2 Measure Case Cost

The measure costs and labor costs of each measure are provided below and are all derivative of the DOE Technical Support Document. The Measure Case Cost includes the labor cost, but labor cost is divided out and shown in the below table.

|  |  |  |  |
| --- | --- | --- | --- |
| ***Measure ID*** | ***Measure Case Cost*** | ***Labor Cost*** | **Unit** |
| NG-WtrHt-LrgInst-Gas-gt200kBtuh-0p80Et | $18.69 | $0.75 | per Cap-kBtuh |
| NG-WtrHt-LrgInst-Gas-gt200kBtuh-0p90Et | $22.75 | $0.75 | per Cap-kBtuh |
| WPSCGNRWH120206B\_Rev08\_Msr001 | $11.96 | $6.39 | per Cap-kBtuh |
| WPSCGNRWH120206B\_Rev08\_Msr002 | $14.55 | $4.82 | per Cap-kBtuh |

## 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** |
| NR | (MEC + MLC) – (BEC + BLC) | (MEC + MLC) – (BEC + BLC) | N/A |
| NEW/NC |

MEC = Measure Equipment Cost; MLC = Measure Labor Cost

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

For NR measures, the incremental cost and full measure costs are equal, as shown in the above equations. Therefore, the table below shows the full and incremental measure costs for each measure as calculated per input rating with data from the DOE TSD.

**Full & Incremental Costs**

|  |  |  |
| --- | --- | --- |
| ***Measure ID*** | ***Full & Incremental Measure Cost*** | ***Unit*** |
| NG-WtrHt-LrgInst-Gas-gt200kBtuh-0p80Et | $ 9.96 | per Cap-kBtuh |
| NG-WtrHt-LrgInst-Gas-gt200kBtuh-0p90Et | $ 14.02 | per Cap-kBtuh |
| WPSCGNRWH120206B\_Rev08\_Msr001 | $ 6.11 | per Cap-kBtuh |
| WPSCGNRWH120206B\_Rev08\_Msr002 | $ 8.70 | per Cap-kBtuh |

# Attachments

Attachment A: Savings Calculations and Measure Summary Table

Attachment B: Federal Register; Vol 81, No. 250; Department of Energy, Rules and Regulations (Docket No. EERE-2015-BT-TB-0007)

Attachment C: Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial Water Heating Equipment

Attachment D: Cost Calculation

# References

Department Of Energy. (n.d.). *Tankless or Demand-Type Water Heaters*. Retrieved from Energy.gov: https://energy.gov/energysaver/water-heating/tankless-or-demand-type-water-heaters

1. Energy, D. o. (n.d.). *Tankless or Demand-Type Water Heaters*. Retrieved from <https://energy.gov/energysaver/water-heating/tankless-or-demand-type-water-heaters>. [↑](#endnote-ref-1)
2. AO Smith. *What Does UEF Mean To You?* Retrieved from <https://www.hotwater.com/uef/>. [↑](#endnote-ref-2)
3. Draft Resolution E-4952, Retrieved Public Utilities Commission of the State of California, October 11, 2018, p. A-24. [↑](#endnote-ref-3)