Work Paper WPSCGREWH120919A

**Revision 5**

**Tankless Water Heaters for Single Family and Multifamily Applications**

# At-a-Glance Summary

|  |  |
| --- | --- |
| **Measure Codes** | TBD |
| **Measure Description** | Tankless (or instantaneous) water heater with an input of less than 175kBtuh. Tier 1 ≥ 0.81 UEF and Tier 2 ≥ 0.87 UEF |
| **Base Case Description** | Replaces a small 40-gallon storage tank water heater with an input of less than 75 kBtuh. |
| **Units** | Each |
| **Energy Savings**  **(see Attachment A)** | Annual therm savings for Tier 1, 0.52 baseline:  SFm – 36.6  MFm – 27.2  DMo – 37.2  Annual therm savings for Tier 1, 0.58 baseline  SFm – 41.2  MFm – 31.3  DMo – 42.2  Annual therm savings for Tier 1, 0.64 baseline  SFm – 37.8  MFm – 28.3  DMo – 38.4  Annual therm savings for Tier 2, 0.52 baseline  SFm – 49.3  MFm – 37.7  DMo – 47.9  Annual therm savings for Tier 2, 0.58 baseline  SFm – 55.4  MFm – 43.0  DMo – 54.1  Annual therm savings for Tier 2, 0.64 baseline  SFm – 51.6  MFm – 39.8  DMo – 50.0 |
| **Full Measure Cost ($/unit)** | Tier 1 – $2381  Tier 2 – $2896 |
| **Incremental Measure Cost ($/unit)** | Tier 1, 0.52 baseline – $1302  Tier 1, 0.58 baseline – $1220  Tier 1, 0.64 baseline – $1131  Tier 2, 0.52 baseline – $1817  Tier 2, 0.58 baseline – $1735  Tier 2, 0.64 baseline – $1646 |
| **Effective Useful Life** | EUL ID: WtrHt-Instant-Res (20 years) |
| **Measure Installation Type** | Normal Replacement (NR), New Construction (NC) |
| **Net-to-Gross Ratio** | 0.55 (DEER NTGR ID: Res-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** |
| 0 | 10/09/12 | Stu Knoke (ICF) | * Original release |
| 1 | 05/20/14 | Julianna Colwell (SCG) | * Revision due to Title 24 |
| 2 | 08/08/14 | Miguel Urrea (SCG) | * Update with regards to DEER 2015 and Federal Code Standard * Update Workpaper Template * Updated Cost Information * Incorporated SF Tankless WP WPSCGREWH140122a * Added Tier 1 measure * Added Measure ID * Revised Terms and Conditions to exclude tankless water heater attached to storage tank. |
| 3 | 08/08/16 | Miguel Urrea (SCG) | * Updates per Water Heater Disposition (Attachment A) * Adjust cost to include installation (Labor and Material) * Changed energy impacts to report directly from DEER * Added air quality emission requirements |
| 4 | 10/12/18 | Rebecca Jenkins (SCG) | * Update from EF to UEF values in accordance with DEER-WaterHeater-Calculator-v3.1.1 * Update to State Wide workpaper format |
| 5 | 2/13/2019 | Rebecca Jenkins (SCG) | * Update DEER calculator reference from DEER-WaterHeater-Calculator-v3.1.1\_rev11July2018.xlsm to DEER-WaterHeater-Calculator-v3.2\_rev25Sep2018.xlsm * Measure IDs and measure descriptions updated throughout workpaper to reference DEER calculator. * MAT and delivery type updated per E-4952 |

# Section 1. General Measure & Baseline Data

## Measure Description & Background

**Note: These measures are directly adopted from currently in use DEER measures.**

These measures apply to energy efficient instantaneous water heaters used in the residential (SFm, MFm, DMo) sector. Relative to standard models, energy efficient units typically have features such as larger heat exchanging surfaces, additional and/or more effective insulation. These features allow for a more effective use of energy, thus providing a more effective water heating unit which results in energy savings.

The measures in this workpaper are the following:

1. Small Tankless Water Heater ≤ 175 kBtuh, Tier 1
   1. UEF = 0.81 Low Draw (RG-WtrHt-SmlInst-Gas-Ite175kBtuh-It2G-LW-0p81UEF-40g)
   2. UEF = 0.81 Medium Draw (RG-WtrHt-SmlInst-Gas-Ite175kBtuh-It2G-MD-0p81UEF-40g)
   3. UEF = 0.81 High Draw (RG-WtrHt-SmlInst-Gas-Ite175kBtuh-It2G-HI-0p81UEF-40g)
2. Small Tankless Water Heater ≤ 175 kBtuh, Tier 2
   1. UEF = 0.87 Low Draw (RG-WtrHt-SmlInst-Gas-Ite175kBtuh-It2G-LW-0p87UEF-40g)
   2. UEF = 0.87 Medium Draw (RG-WtrHt-SmlInst-Gas-Ite175kBtuh-It2G-MD-0p87UEF-40g)
   3. UEF = 0.87 High Draw (RG-WtrHt-SmlInst-Gas-Ite175kBtuh-It2G-HI-0p87UEF-40g)

**Base, Standard, and Measure Cases**

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | Small (≤175 MBtu/hr) tankless water heater   1. Small Tankless Water Heater ≤ 175 kBtuh, Tier 1, UEF=0.81 Low Draw 2. Small Tankless Water Heater ≤ 175 kBtuh, Tier 1, UEF=0.81 Medium Draw 3. Small Tankless Water Heater ≤ 175 kBtuh, Tier 1, UEF=0.81 High Draw 4. Small Tankless Water Heater ≤ 175 kBtuh, Tier 2, UEF=0.87 Low Draw 5. Small Tankless Water Heater ≤ 175 kBtuh, Tier 2, UEF=0.87 Medium Draw 6. Small Tankless Water Heater ≤ 175 kBtuh, Tier 2, UEF=0.87 High Draw |
| Existing Condition | N/A |
| Code/Standard | Small (≤75 MBtu/hr) 40 gallon storage water heater   1. Storage Water Heater 40 Gal ≤75 kBtuh, UEF=0.52 2. Storage Water Heater 40 Gal ≤75 kBtuh, UEF=0.58 3. Storage Water Heater 40 Gal ≤75 kBtuh, UEF=0.64 4. Storage Water Heater 40 Gal ≤75 kBtuh, UEF=0.52 5. Storage Water Heater 40 Gal ≤75 kBtuh, UEF=0.58 6. Storage Water Heater 40 Gal ≤75 kBtuh, UEF=0.64 |
| Industry Standard Practice | N/A |

**Note: In the table above, measure number 1 aligns with code/standard number 1. This repeats for all measures.**

Measures and Codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Codes** | | | | **Measure Name** |
| SCG | SDG&E | SCE | PG&E |
| TBD |  |  |  | RG-WtrHt-SmlInst-Gas-Ite175kBtuh-It2G-LW-0p81UEF-40g |
| TBD |  |  |  | RG-WtrHt-SmlInst-Gas-Ite175kBtuh-It2G-MD-0p81UEF-40g |
| TBD |  |  |  | RG-WtrHt-SmlInst-Gas-Ite175kBtuh-It2G-HI-0p81UEF-40g |
| TBD |  |  |  | RG-WtrHt-SmlInst-Gas-Ite175kBtuh-It2G-LW-0p87UEF-40g |
| TBD |  |  |  | RG-WtrHt-SmlInst-Gas-Ite175kBtuh-It2G-MD-0p87UEF-40g |
| TBD |  |  |  | RG-WtrHt-SmlInst-Gas-Ite175kBtuh-It2G-HI-0p87UEF-40g |

Eligibility Requirements

* Test methods for measuring water heater efficiencies are referenced in the California Titles 20 and 24 standards.1,2
* Meet minimum qualifying uniform energy factor (UEF) for small or medium (<200 MBtu/hr) tankless water heaters replacing storage water heaters:
  + 0.81 UEF for Tier 1 (non-condensing)
  + 0.87 UEF for Tier 2 (condensing)
* Meet minimum emission requirements per air district.
* Tier 2 hot water heaters are condensing and often require flue modifications to handle the condensate.

Implementation Requirements

* The rebate applies to one natural gas tankless water heater replacing one natural gas storage water heater on burnout or to new installations in existing buildings.
* This measure is applicable only to single family and multifamily residential domestic (or “service”) hot water applications with a water heater in (single family only), or attached to, each dwelling unit or in adjacent units (multifamily only).
* This measure is limited to single family residences with a water heater and multifamily residences with a water heater in each dwelling unit or with a water heater serving adjacent unit.
* This measure applies to replacing a storage water heater with a tankless water heater.
* This Workpaper does not cover water heaters or hot water boilers used for commercial domestic hot water, space conditioning, industrial (process) end-use, pool, or spa applications.

Documentation Requirements

* The manufacturer’s name and equipment model number must be provided.
* If necessary, customer must provide proof of unit efficiency (e.g., manufacturer’s equipment specification sheet).

Terms & Conditions

* Only tankless water heaters as defined by the California Energy Commission qualify. They must:
  + Be used primarily for domestic hot water
  + Be installed at the point of use
  + Provide hot water only when there is a hot water draw from the end use
  + Not be connected to an external storage tank.
  + Have an input rating of at least 4,000 Btu per hour per gallon of stored water.
  + Never be used to supply hot water to a circulation loop

## 1.2 Technical Description

Measure Description

* Relative to a storage water heater, a tankless unit has a larger burner that rapidly heats water to the desired temperature. The rapid heating ability removes the need for a storage tank. Tankless water heaters are also known as instantaneous water heaters.
* A tankless unit can provide hot water on a continuous basis. Tankless units have a higher energy efficiency rating than storage units due to no longer having standby losses from the storage tanks.
* The California Titles 20 and 24 standards define an instantaneous water heater to mean “a water heater that has an input rating of at least 4,000 Btu per hour per gallon of stored water”. Tankless water heaters generally have rated inputs less than 200 MBtu/hr.
* Tankless water heaters are most useful in point-of-use applications, i.e., at the faucet and with no circulation loop. They are inefficient in applications with a circulation loop due to the temperature loss in the circulation system; this causes the tankless water heater to run without water demand. They are problematic in central systems with circulation loops which have long pipe runs from the water heater to the faucet.
* The 2005 Instantaneous Water Heater Workpaper includes a more detailed technology description in its Appendix A.5

## 1.3 Installation Types and Delivery Mechanisms

Installation Type

* This measure is applied as NR. This is defined as when existing equipment fails, or maintenance requires replacement.

Delivery Method

* Financial support in the form of rebate. See the Incentive Method section for details.

Incentive Method

* The preferred incentive method is a downstream prescriptive rebate offered to the gas customer purchasing the new tankless water heater.
* However, a midstream point-of-sale prescriptive rebate or an upstream manufacturer prescriptive rebate strategy may also be implemented.
* Below are the DEER approved delivery methods and delivery method descriptions. Each IOU may select its own preferred delivery method in their ex ante database submission.

**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 (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.

**Incentive Method Descriptions**

|  |  |
| --- | --- |
| **Incentive 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. |

**Delivery Method Descriptions**

|  |  |
| --- | --- |
| **Delivery Method** | **Description** |
| UpDeemed | Upstream deemed |
| DnDeemed | Downstream deemed |

## 1.4 Measure Parameters

### 1.4.1 DEER Data

The UEF values used are provided by the DEER-WaterHeater-Calculator-v3.2\_rev25Sep2018 (Attachment E). This calculator determines consumption of individual water heaters.

DEER has adopted the following measures into READI per IOU request and are used as is:

Tankless Water Heater ≤175 MBtu/hr (Small / Medium), Tier 1 (≥0.81 UEF)

RG-WtrHt-SmlInst-Gas-Ite175kBtuh-It2G-LW-0p81UEF-40g

RG-WtrHt-SmlInst-Gas-Ite175kBtuh-It2G- MD -0p81UEF-40g

RG-WtrHt-SmlInst-Gas-Ite175kBtuh-It2G-HI-0p81UEF-40g

Tankless Water Heater ≤175 MBtu/hr (Small / Medium), Tier 2 (≥0.87 UEF)

RG-WtrHt-SmlInst-Gas-Ite175kBtuh-It2G-LW-0p87UEF-40g

RG-WtrHt-SmlInst-Gas-Ite175kBtuh-It2G-MD-0p87UEF-40g

RG-WtrHt-SmlInst-Gas-Ite175kBtuh-It2G-HI-0p87UEF-40g

DEER Difference Summary

|  |  |
| --- | --- |
| **DEER Item** | **Used for Workpaper?** |
| Modified DEER methodology | No |
| Scaled DEER measure | No |
| DEER Base Case | Yes |
| DEER Measure Case | Yes |
| DEER Building Types | Yes |
| DEER Operating Hours | Yes |
| DEER eQUEST Prototypes | Yes |
| DEER Version | DEER-WaterHeater-Calculator-v 3.2\_rev25Sep2018 |
| Reason for Deviation from DEER | N/A |
| DEER Measure IDs Used | See above (Section 1.4.1) |

**Net-to-Gross Ratio**

The 2014 DEER documents recommend a net-to-gross ratio (NTGR) of 0.55 for all other EEMs with no evaluated NTGR; existing EEM in programs with same delivery mechanism for more than 2 years listed as Res-Default>2.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **NTGR ID** | **Description** | **Sector** | **BldgType** | **Measure Delivery** | **NTGR** |
| Res-Default>2 | All other EEM with no evaluated NTGR; existing EEM with same delivery mechanism for more than 2 years | Res | Any | Any | 0.55 |

**Spillage Rate**

N/A

**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. 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-Res | Residential Instantaneous Water Heater | Res | SHW | 20 | 6.67 |

### 1.4.2 Codes and Standards Analysis

Code/Standard Description

* The minimum baseline efficiencies are consistent with the Code of Federal Regulations standards.
* The minimum qualifying measure efficiency for Tier 2 exceeds the California Titles 2 and 24 and the Code of Federal Regulations standards. Since it is considered standard practice to purchase storage water heaters for residential applications we are offering a Tier 1 measure of a tankless water heater listed at the Code of Federal Regulations standards of uniform energy factor 0.81 for low to high draw patterns3

Code Summary

|  |  |  |
| --- | --- | --- |
| **Code** | **Reference** | **Effective Dates** |
| Title 24 (2016)2 | Section 110.3 | 01/01/2017 |
| Title 20 (2018)1 | Section 1605.3(f) | 05/01/2018 |
| Code of Federal Regulations4 | 10 CFR 430.32(d) | 05/01/2018 |
| South Coast AQMD | Rule 1121, Rule 1146.2 | See Rule |
| Bay Area AQMD | Regulation 9, Rule 6 | See Rule |
| San Joaquin Valley APCD | Rule 4902 | See Rule |
| Sacramento Metropolitan AQMD | Rule 414 | See Rule |
| Yolo-Solano AQMD | Regulation II, Rule 2.37 | See Rule |
| Ventura County Air Pollution Control District | Rule 74.11, Rule 74.11.1 | See Rule |

Code Summary- NOx Requirements for AQMDs

|  |  |  |  |
| --- | --- | --- | --- |
| **Category** | **Rated heat input capacity** | **Rule** | **Emission Limit** |
| Small Water Heater | <75,000 Btu/hr | YSAQMD-2.37, SJVUAPCD-4902, SCAQMD-1121, BAAQMD-Reg 9-Rule 6, SMAQMD-414, SBCAPCD-352, VCAPCD-74.11 | 10ng/J or 15 ppm NOx @3% O2 dry |
| Instantaneous Water Heater | Unspecified | SJVUAPCD-4902, BAAQMD-Reg 9-Rule 6, VCAPCD-74.11.1, SMAQMD-414, SCAQMD-1146.2\*, YSAQMD-2.37\* | 14ng/J or 20 ppm NOx @3% O2 dry |

\*SCAQMD does not set emission requirements for instantaneous water heaters, but any instantaneous water heaters within Type 1 water heaters (75,001 Btu/h – 400,000 Btu/h) rated input capacity must meet this requirement. YSAQMD and VCAPCD requirements are based on small and large water heaters ( < 75,000 and 75,001 – 400,000 btu/h). Any instantaneous water heater within this rated input capacity must meet this requirement.

California Title 20 Gas Appliance Standards and Code of Federal Regulations

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Gas Water Heater** | **Input Rating (Btu/hr)** | **Rated Storage Volume - V (gal)** | **Draw Pattern** | **Minimum Uniform Energy Factor (UEF) or EF (Energy Factor) – Effective May 1, 2018** |
| Instantaneous – federally regulated4 (effective May 1, 2018) | > 50, 000 | < 2 | Very Small | 0.80 UEF |
| Low | 0.81 UEF |
| Medium | 0.81 UEF |
| High | 0.81 UEF |
| Instantaneous – not federally regulated1 | ≤ 50,000 | any | unspecified | 0.62 – (.0019 \* V) EF |
| Instantaneous – not federally regulated1 | ≤ 200,000 | ≥ 2 | unspecified | 0.62 – (.0019 \* V) EF |

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

DEER measure directly adopted.

## 1.6 Data Quality and Future Data Needs

DEER measure directly adopted.

# Section 2. Calculation Methodology

The energy savings for the measures presented in this workpaper are estimated using the DEER tool: “DEER-WaterHeater-Calculator-v 3.2\_rev25Sep2018”. The summary of pulled energy savings data is attached. Energy factor(EF) values have been converted to uniform energy factor(UEF) values. The DEER calculator was used to estimate energy consumption for both the baseline and measure. The difference was taken as the measure savings.

Following consumption, the conversion from EF to UEF is be covered for both instantaneous and storage type water heaters. This workpaper requires the conversion for both instantaneous and storage type as they are measure and baseline, respectively.

## 2.1 Annual Consumption

The DEER tool utilizes hourly output from the DOE building prototypes for hot water loads and ambient conditions to estimate hourly gas consumption.3 The baseline EF values in DEER have been converted to UEF for consistency with the new DOE efficiency requirements. The following will show the calculation process for determining consumption with UEF, followed by the conversion from EF to UEF.

The annual consumption for a storage or tankless water heater is estimated with the expression below.

For each hour:

Where,

## 2.2 EF to UEF Conversion

This workpaper will use the adopted DOE[[1]](#endnote-2) process to convert EF values to UEF. It is important to note that while EF values were based on a single draw pattern, the UEF value is based on four different draw patterns. This workpaper requires there to be two conversion methods covered: for instantaneous (measure) and storage (baseline) water heaters.

The following is the DOE process to convert a gas-fired instantaneous water heater from EF to UEF.

First, the draw pattern for a given instantaneous water heater must be determined. The UEF has four potential draw patterns. One out of those four, will provide the correct conversion from EF to UEF. The EUF draw pattern is determined by the new maximum gallons per minute (New Max GPM) per the DOE test procedure. The following defines the conversion to the new GPM.

Where,

Using the New Max GPM, the appropriate draw pattern can be selected in the table below.

|  |  |  |
| --- | --- | --- |
| **New Max GPM greater than or equal to:** | **and New Max GPM rating less than:** | **Draw Pattern** |
| 0 gallons/minute …………………………………… | 1.7 gallons/minute ………………………… | Very Small |
| 1.7 gallons/minute ………………………………… | 2.8 gallons/minute ………………………… | Low |
| 2.8 gallons/minute ………………………………… | 4 gallons/minute …………………………… | Medium |
| 4 gallons/minute …………………………………… | No upper limit ………………………………… | High |

The draw pattern can then be used to select the coefficient (A) necessary for the conversion to UEF.

|  |  |
| --- | --- |
| **Draw Pattern** | **A** |
| Very Small ……………… | 0.026915 |
| Low ………………………… | 0.010917 |
| Medium ………………… | 0.008362 |
| High ……………………… | 0.005534 |

Where,

UEF for an instantaneous water heater can then be found using the following formula.

The following is the DOE process to convert a gas-fired storage water heater from EF value to UEF.

First, the draw pattern for a given storage water heater must be determined. The UEF has four potential draw patterns. One out of those four, will provide the correct conversion from EF to UEF. The EUF draw pattern is determined by the new first hour rating (FHR) per the DOE test procedure. The following defines the conversion to the new FHR.

Where,

Using the FHR, the appropriate draw pattern can be selected in the table below.

|  |  |  |
| --- | --- | --- |
| **New FHR greater than or equal to:** | **And New FHR rating less than:** | **Draw Pattern** |
| 0 gallons ……………………………………… | 18 gallons ……………………………… | Very Small |
| 18 gallons …………………………………… | 51 gallons ……………………………… | Low |
| 51 gallons …………………………………… | 75 gallons ……………………………… | Medium |
| 75 gallons …………………………………… | No upper limit ……………………… | High |

The draw pattern can then be used to select the constant coefficients in the below table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Draw Pattern** | **a** | **b** | **c** | **d** |
| Very small……………… | 0.250266 | 57.5 | 0.039864 | 67.5 |
| Low………………………… | 0.065860 | 57.5 | 0.039864 | 67.5 |
| Medium………………… | 0.045503 | 57.5 | 0.039864 | 67.5 |
| High……………………… | 0.029794 | 57.5 | 0.039864 | 67.5 |

Along with the water heater specifications listed below, the constant coefficients are used to determine the UEFWHAM.

Where,

The UEF for a storage water heater can then be determined with the following formula.

# Section 3. Load Shapes

The DEER-WaterHeater-Calculator-v3.2\_rev25Sep2018 provides the domestic hot water load schedule and profile.

# Section 4. Costs

There are two sources utilized for cost data. One source for the measure and one for the baseline. Multiple sourcing was necessary due to the most current cost data, used for the storage tank baseline, did not provide relevant data for the tankless measures.

## 4.1 Base Case Cost

The WO017 Ex Ante Measure Cost Study Final Report was used to create a regression for the baseline costs (see Attachment B). The EF values, from the study, were converted to UEF values using the DOE conversion. These UEF values, paired with cost data, were then plotted and expanded using a constrained linear regression. The CEC database was used as a reference to verify the average specs of the storage water heaters relative to the efficiency. Along this regression line, the costs values for the desired UEF values for storage water heaters are found. These costs included purchase and installation (labor and material) costs.

## 4.2 Measure Case Cost

The DOE data (see Attachment C), as used in version 3 of this workpaper, holds the most relevant cost data for tankless water heaters. While the DOE data is older than the WO017 data, it is shown to be more accurate for current costs. This relevancy is confirmed by direct comparison to SCG invoices (see Attachment D) showing cost information for tankless water heaters and the associated installation costs. The DOE sourced data provided purchase and installation (labor and material) costs for both tier 1 and tier 2 measures.

## 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 |
| NC |

MEC = Measure Equipment Cost; MLC = Measure Labor Cost

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

**Full and Incremental Costs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Description** | **Installation Type** | **Incremental Measure Cost** | **Full Measure Cost** | |
| **1st Baseline** | **2nd Baseline** |
| Tier 1, 0.52 baseline | NR | $2381 - $1079 = $1302 | $1302 | N/A |
| NC |
| Tier 1, 0.58 baseline | NR | $2381 - $1161 = $1220 | $1220 | N/A |
| NC |
| Tier 1, 0.64 baseline | NR | $2381 - $1250 = $1131 | $1131 | N/A |
| NC |
| Tier 2, 0.52 baseline | NR | $2896 - $1079 = $1817 | $1817 | N/A |
| NC |
| Tier 2, 0.58 baseline | NR | $2896 - $1161 = $1735 | $1735 | N/A |
| NC |
| Tier 2, 0.64 baseline | NR | $2896 - $1250 = $1646 | $1646 | N/A |
| NC |

# Attachments

Attachment A - Tankless WH Savings by Measure

Attachment B - Cost Regression

Attachment C - Cost Data WPSSCGREW120919A\_Rev2

Attachment D - Invoice Summary

Attachment E - DEER-WaterHeater-Calculator-v3.2\_rev25Sep2018.xlsm

# References

1 (Title 20. Public Utilities and Energy - Division 2. State Energy Resources Conservation and Development Commission, May 2018), <http://www.energy.ca.gov/2018publications/CEC-140-2018-002/CEC-140-2018-002.pdf>

2 (Title 24, Part 6, 2016), <http://www.energy.ca.gov/2015publications/CEC-400-2015-037/CEC-400-2015-037-CMF.pdf>

3 (Department of Energy 10 CFR Parts 429, 430, 431), <https://energy.gov/sites/prod/files/2016/08/f33/Water%20Heaters%20Test%20Procedure%20SNOPR.pdf>

4 (Electronic Code of Federal Regulations, August 3, 2018), <https://www.ecfr.gov/cgi-bin/text-idx?SID=f200b678dedcc426210634c1af737e01&mc=true&node=se10.3.430_132&rgn=div8>

5 (B-REP-05-599-17A - Instantaneous (Tankless) Water Heaters, 2005)

1. [↑](#endnote-ref-2)