Work Paper WPSCGREWH180207A

**Revision 01**

**SoCalGas**

**Residential Small Storage Water Heaters**

# At-a-Glance Summary

|  |  |
| --- | --- |
| **Measure Codes** | TBD |
| **Measure Description** | Residential efficient small storage water heaters. |
| **Base Case Description** | Low efficiency small storage water heaters. |
| **Units** | Each |
| **Energy Savings** | CZ9 SFM: Stor\_UEF-Gas-030gal-MD-0.64UEF: 20.60 Therms |
| **Full Measure Cost ($/unit)** | CZ9 SFM: Stor\_UEF-Gas-030gal-MD-0.64UEF: $1,079.16  Refer to Excel Calculation Attachment |
| **Incremental Measure Cost ($/unit)** | CZ9 SFM: Stor\_UEF-Gas-030gal-MD-0.64UEF: $46.98  Refer to Excel Calculation Attachment |
| **Effective Useful Life** | EUL ID:WtrHt-Res-Gas(11 years) |
| **Measure Installation Type** | New Construction (NC)  Normal Replacement (NR) |
| **Net-to-Gross Ratio** | 0.55 (DEER NTGR ID: Res-Default>2) |
| **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 | 08/31/18 | Carlos Pineda (SCG) | * Original Release: Workpaper for DEER 2017 Residential Small Storage Water Heaters. |
| 1 | 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 |

Table of Contents

[At-a-Glance Summary 2](#_Toc523230092)

[Revision History 3](#_Toc523230093)

[Section 1. General Measure & Baseline Data 6](#_Toc523230094)

[1.1 Measure Description & Background 6](#_Toc523230095)

[1.2 Technical Description 8](#_Toc523230096)

[1.3 Installation Types and Delivery Mechanisms 8](#_Toc523230097)

[1.4 Measure Parameters 9](#_Toc523230098)

[1.4.1 DEER Data 9](#_Toc523230099)

[1.4.2 Codes and Standards Analysis 10](#_Toc523230100)

[1.5 EM&V, Market Potential, and Other Studies – Base Case and Measure Case Information 13](#_Toc523230101)

[1.6 Data Quality and Future Data Needs 13](#_Toc523230102)

[Section 2. Calculation Methodology 13](#_Toc523230103)

[Section 3. Load Shapes 15](#_Toc523230104)

[Section 4. Costs 15](#_Toc523230105)

[4.1 Base Case Cost 15](#_Toc523230106)

[4.2 Measure Case Cost 15](#_Toc523230107)

[4.3 Full and Incremental Measure Cost 16](#_Toc523230108)

[Attachments 17](#_Toc523230109)

[References 18](#_Toc523230110)

List of Tables

[Table I: Base, Standard, and Measure Cases 6](#_Toc523229186)

[Table II: Measures and Codes 7](#_Toc523229187)

[Table III: Installation Type Descriptions 8](#_Toc523229188)

[Table IV: Incentive Method Descriptions 8](#_Toc523229189)

[Table V: Delivery Method Descriptions 8](#_Toc523229190)

[Table VI: DEER Difference Summary 9](#_Toc523229191)

[Table VII: NTGR ID 9](#_Toc523229192)

[Table VIII: GSIA ID 10](#_Toc523229193)

[Table IX: EUL ID 10](#_Toc523229194)

[Table X: Code Summary 10](#_Toc523229195)

[Table XI: Building Types and Load Shapes 15](#_Toc523229196)

[Table XII: Full and Incremental Measure Cost Equations 16](#_Toc523229197)

List of Tables

[Figure I: Title 20, Residential Small Storage Water Heater Requirements 11](#_Toc523229200)

[Figure II: 10 CFR UEF Requirements 12](#_Toc523229201)

# Section 1. General Measure & Baseline Data

## 1.1 Measure Description & Background

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

These measures apply to energy efficient storage 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. 30 Gallon Small Storage Water Heater ≤ 75 kBtuh
   1. UEF = 0.64 Medium Draw (RG-WtrHt-SmlStrg-Gas-Ite75kBtuh-30G-MD-0p64UEF)
2. 40 Gallon Small Storage Water Heater, ≤ 75 kBtuh
   1. UEF = 0.64 Medium Draw (RG-WtrHt-SmlStrg-Gas-Ite75kBtuh-40G-MD-0p64UEF)
   2. UEF = 0.68 High Draw (RG-WtrHt-SmlStrg-Gas-Ite75kBtuh-40G-HD-0p68UEF)
3. 50 Gallon Small Storage Water Heater, ≤ 75 kBtuh
   1. UEF = 0.64 Medium Draw (RG-WtrHt-SmlStrg-Gas-Ite75kBtuh-50G-MD-0p64UEF)
   2. UEF = 0.68 High Draw (RG-WtrHt-SmlStrg-Gas-Ite75kBtuh-50G-HD-0p68UEF)

Table I: Base, Standard, and Measure Cases

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | Superior efficiency due to improved heat exchange surfaces and insulation.   1. Efficient water heater: 30 gallon gas water heater (UEF=0.64), medium draw 2. Efficient water heater: 40 gallon gas water heater (UEF=0.64), medium draw 3. Efficient water heater: 40 gallon gas water heater (UEF=0.68), high draw 4. Efficient water heater: 50 gallon gas water heater (UEF=0.64), medium draw 5. Efficient water heater: 50 gallon gas water heater (UEF=0.68), high draw |
| Existing Condition | N/A |
| Code/ Standard | Less efficient units due to smaller heat exchangers and less effective insulation.   1. 40 gallon standard gas water heater (UEF=0.60) 2. 40 gallon standard gas water heater (UEF=0.58) 3. 40 gallon standard gas water heater (UEF=0.64) 4. 50 gallon standard gas water heater (UEF=0.56) 5. 50 gallon standard gas water heater (UEF=0.63) |
| Industry Standard Practice | N/A |

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

Table II: Measures and Codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Codes** | | | | **Measure Name** |
| SCG | SDG&E | SCE | PG&E |
|  |  |  |  | RG-WtrHt-SmlStrg-Gas-Ite75kBtuh-30G-MD-0p64UEF-Msr001 |
|  |  |  |  | RG-WtrHt-SmlStrg-Gas-Ite75kBtuh-40G-MD-0p64UEF-Msr002 |
|  |  |  |  | RG-WtrHt-SmlStrg-Gas-Ite75kBtuh-40G-HD-0p68UEF-Msr003 |
|  |  |  |  | RG-WtrHt-SmlStrg-Gas-Ite75kBtuh-50G-MD-0p64UEF-Msr004 |
|  |  |  |  | RG-WtrHt-SmlStrg-Gas-Ite75kBtuh-50G-HD-0p68UEF-Msr005 |

* **Eligibility requirements**:

1. Units Efficiency shall have been evaluated by the test methods referenced in the California Title 20 and Title 24 standards.
2. Minimum qualifying uniform energy factor (UEF) for small (≤75 MBtu/hr) storage water heaters replacing storage water heaters.
   1. 30, 40, 50 gallon: 0.64 UEF, 0.68 for medium and high draw patterns respectively.
3. Minimum emmissions requirement as defined per applicable air district.

* **Implementation and installation requirements**:

1. The rebate applies to gas-for-gas equipment replacements on burnout or to new installations.
2. This Workpaper does not cover water heaters used for space conditioning, process end-use applications, pools, or spas.
3. These measures are applicable to any building type in the residential building sector.
4. These measures replace a storage water heater by another storage water heater.

* **Other program restrictions and guidelines:**

1. The manufacturer’s name and equipment model number must be provided.
2. If necessary, customer must provide proof of unit efficiency (e.g., manufacturer’s equipment specification sheet).
3. Only storage water heaters as defined by the California Energy Commission qualify, and they must:
   1. Be used primarily for domestic hot water
   2. “Storage water heater” means a water heater that heats and stores water within the appliance at a thermostatically-controlled temperature for delivery on demand, and that has an input less than 4,000 Btu per hour per gallon of stored water.
   3. Never be used for process end-use.

## 1.2 Technical Description

High efficient storage water heaters are characterized by having superior insulating material and very effective heat transfer surfaces. These features reduce the water heaters envelope losses and the energy required to mainatain the water at the desired set point temperature. In effect these reductions affect the work required by the water heater and provide an opportunity for energy savings.

## 1.3 Installation Types and Delivery Mechanisms

This workpaper measures will be offered through the following installation types.

Table III: 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 |

The following delievery mechanism will be used to offer these measures.

Table IV: Incentive 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. |

The following incentive methods will be used to offer these measures.

Table V: Delivery Method Descriptions

|  |  |
| --- | --- |
| **Incentive Method** | **Description** |
| Any | All Delivery Strategies |

## 1.4 Measure Parameters

### 1.4.1 DEER Data

This measures are DEER measures.

Table VI: 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 2018, READI v2.4.8 |
| Reason for Deviation from DEER | NA |
| DEER Measure IDs Used | 1. RG-WtrHt-SmlStrg-Gas-Ite75kBtuh-30G-MD-0p64UEF-Msr001 2. RG-WtrHt-SmlStrg-Gas-Ite75kBtuh-40G-MD-0p64UEF-Msr002 3. RG-WtrHt-SmlStrg-Gas-Ite75kBtuh-40G-HD-0p68UEF-Msr003 4. RG-WtrHt-SmlStrg-Gas-Ite75kBtuh-50G-MD-0p64UEF-Msr004 5. RG-WtrHt-SmlStrg-Gas-Ite75kBtuh-50G-HD-0p68UEF-Msr005 |

**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.

Table VII: NTGR ID

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **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**

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.

Table VIII: GSIA ID

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **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 one-third 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.

Table IX: EUL ID

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **EUL ID** | **Description** | **Sector** | **UseCategory** | **EUL (Years)** | **RUL (Years)** |
| WtrHt-Res-Gas | Residential Gas Water Heater | Res | SHW | 11 | 3.67 |

### 1.4.2 Codes and Standards Analysis

California Title 20 presents water heater efficiency requirements with energy factor (EF) ratings, this factor has been changed by the code of federal regulations to uniform energy factor (UEF). This workpaper presents the code, savings and measure requirements in UEF values.

Table X: Code Summary

|  |  |  |
| --- | --- | --- |
| **Code** | **Reference** | **Effective Dates** |
| Title 24 (2016) | Section 110.3 | January 1, 2016 |
| Title 20 (2018) | Section 1605.1(f)(2) | October 29, 2003 |
| Code of Federal Regulations (CFR) | 10 CFR 430.32(d) | December 29, 2016 |
| 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 |

Figure I, displays energy factor requirements, however, figure II shows the current CFR uniform energy factor requirements.

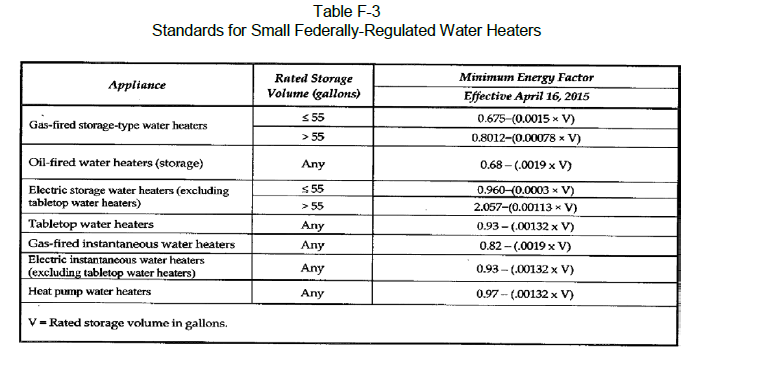


Figure I: Title 20, Residential Small Storage Water Heater Requirements



Figure II: 10 CFR UEF Requirements

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

These measures are adopted directly from DEER.

## 1.6 Data Quality and Future Data Needs

These measures are adopted directly from DEER.

# Section 2. Calculation Methodology

The energy savings for the measures presented in this workpaper are estimated through the use of the tool “DEER-WaterHeater-Calculator-v3.2\_rev25Sep2018”, [***Attachment B***](#_Attachments_1).[[1]](#footnote-1) This calculator was used to estimate energy consumption for both baseline and measure, the difference was taken as the measure savings. The DEER tool utilizes hourly output from the DOE2 building prototypes for hot water loads and ambient conditions to estimate hourly gas consumption. The following will show the calculation process.

The annual consumption is estimated with the expression below.

For each hour:

Where,

**Sample Calculation:**

The consumption for one hour of the year per the water heating schedule used in the “DEER-WaterHeater-Calculator-v3.2\_rev25Sep2018” will be calculated. Considering hour 8th which heats 0.6 gallons of water in climate zone 9 for a single-family dwelling.

The above result is for one hour of the year, the process will be performed for all annual hours and summed to yield the annual water heater load.

The savings will be computed as the difference between the measure annual sum and the baseline annual sum.

The ideal load shape for net benefits estimates would represent the difference between the base case and measure case. The closest load shapes that are applicable to the measures in this work paper are listed in the table below.

# Section 3. Load Shapes

Table XI: Building Types and Load Shapes

|  |  |  |
| --- | --- | --- |
| **Building Type** | **Load Shape** | **E3 Alternate Building Type** |
| RES | Residential | DEER:Res:ClothesDishWasher |

# Section 4. Costs

This workpaper will present each measure with respective uniform energy factor (UEF), the CPUC energy division had formerly issued a cost study “ Ex Ante Measure Cost Study Results Matrix, Volume I: Hedonic Model Estimates” presents material and labor cost for water heaters units rated with energy factor (EF). To acquire cost in UEF rating, the EF values were converted to UEF and a regression ([***Attachment A***](#_Attachments)) was made. The labor cost is not expected to change between measure and baseline as the process of installation shall be the same.

## 4.1 Base Case Cost

The base case cost for each unit in this workpaper is presented below.

**Material:**

1. 40 gallon standard gas water heater (UEF=0.60) = $728.08
2. 40 gallon standard gas water heater (UEF=0.58) = $772.74
3. 40 gallon standard gas water heater (UEF=0.64) = $951.21
4. 50 gallon standard gas water heater (UEF=0.56) = $646.88
5. 50 gallon standard gas water heater (UEF=0.63) = $885.66

**Labor:**

1. 40 gallon standard gas water heater (UEF=0.60) = $304.10
2. 40 gallon standard gas water heater (UEF=0.58) = $328.73
3. 40 gallon standard gas water heater (UEF=0.64) = $328.73
4. 50 gallon standard gas water heater (UEF=0.56) = $353.36
5. 50 gallon standard gas water heater (UEF=0.63) = $353.36

## 4.2 Measure Case Cost

The measure case cost for each unit in this workpaper is presented below.

**Material:**

1. Efficient water heater: 30 gallon gas water heater (UEF=0.64), medium draw = $775.06
2. Efficient water heater: 40 gallon gas water heater (UEF=0.64), medium draw = $951.21
3. Efficient water heater: 40 gallon gas water heater (UEF=0.68), high draw = $1,070.19
4. Efficient water heater: 50 gallon gas water heater (UEF=0.64), medium draw = $919.17
5. Efficient water heater: 50 gallon gas water heater (UEF=0.68), high draw =$1,056.21

**Labor:**

1. Efficient water heater: 30 gallon gas water heater (UEF=0.64), medium draw = $304.10
2. Efficient water heater: 40 gallon gas water heater (UEF=0.64), medium draw = $328.73
3. Efficient water heater: 40 gallon gas water heater (UEF=0.68), high draw = $328.73
4. Efficient water heater: 50 gallon gas water heater (UEF=0.64), medium draw = $353.36
5. Efficient water heater: 50 gallon gas water heater (UEF=0.68), high draw = $353.36

## 4.3 Full and Incremental Measure Cost

Table XII: Full and Incremental Measure Cost Equations

|  |  |  |  |
| --- | --- | --- | --- |
| **Installation Type** | **Incremental Measure Cost** | **Full Measure Cost** | |
| **1st Baseline** | **2nd Baseline** |
| NR | (MEC + MLC) – (BEC + BLC)   1. RG-WtrHt- SmlStrg-Gas-Ite75kBtuh-30G-MD-0p64UEF-Msr001   ($775.06 +$304.10) – ($728.08+304.10) = $46.98   1. RG-WtrHt- SmlStrg-Gas-Ite75kBtuh-40G-MD-0p64UEF-Msr002   ($951.21+$328.73) – ($772.74+$328.73) = $178.47   1. RG-WtrHt-SmlStrg-Gas-Ite75kBtuh-40G-HD-0p68UEF-Msr003   ($1,070.19+$328.73) – ($951.21+$328.73) = $118.98   1. RG-WtrHt-SmlStrg-Gas-Ite75kBtuh-50G-MD-0p64UEF-Msr004   ($919.17 + $353.36) – ($646.88+$353.36) = $272.29   1. RG-WtrHt-SmlStrg-Gas-Ite75kBtuh-50G-HD-0p68UEF-Msr005   ($1,056.21 + $353.36) – ($885.66+$353.36) = $170.55 | (MEC + MLC) – (BEC + BLC)   * + - 1. RG- WtrHt- SmlStrg-Gas-Ite75kBtuh-30G-MD-0p64UEF-Msr001   ($775.06 +$304.10) –($728.08+304.10) = $46.98   * + - 1. RG- WtrHt- SmlStrg-Gas-Ite75kBtuh-40G-MD-0p64UEF-Msr002   ($951.21+$328.73) – ($772.74+$328.73) = $178.47     * + - 1. RG- WtrHt-SmlStrg-Gas-Ite75kBtuh-40G-HD-0p68UEF-Msr003   ($1,070.19+$328.73) – ($951.21+$328.73) = $118.98   * + - 1. RG- WtrHt-SmlStrg-Gas-Ite75kBtuh-50G-MD-0p64UEF-Msr004   ($919.17 + $353.36) – ($646.88+$353.36) = $272.29   * + - 1. RG- WtrHt-SmlStrg-Gas-Ite75kBtuh-50G-HD-0p68UEF-Msr005   ($1,056.21 + $353.36) – ($885.66+$353.36) = $170.55 | N/A |
| NC |

MEC = Measure Equipment Cost; MLC = Measure Labor Cost

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

# Attachments

Attachement A: Cost Regression

Attachment B: DEER-WaterHeater-Calculator-v3.2\_rev25Sep2018

1. http://www.deeresources.com/index.php/23-deer-versions [↑](#footnote-ref-1)