**Work Paper WPSDGEREWH0023**

**Revision 0**

**San Diego Gas & Electric**

**Energy Efficiency Engineering**

**Storage Tank Water Heaters**

### Core Measure Summary Table

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| General Measure Information | | | | | | | | PT | | 1st Baseline Period | | | | 2nd Baseline Period | | | | TOU |
| Measure Name | Measure RunID | Solution Code | CZ | Building Type | Load Shape | EUL | Unit Definition | Program Type (NEW, ROB, RET) | Applicable Code | Gross Unit Annual Electricity Savings (kWh/unit) | User Entered kW Savings per unit (kW/unit) | Gas Savings (Therms) | 1st Baseline Useful Life | kWh Saving per unit (kWh/unit) | kW Savings per unit (kW/unit) | Gas Savings (Therms) | 2nd Baseline Useful Life | % TOU |
| Electric HE W/H 30 Gal EF=0.95 | RE-WtrHt-SmlStrg-Elec-lte12kW-30G-0p95EF | N/A | 06 | Residential Mobile Home - Double-Wide | 19-RES-AllResidential-WAT\_HEAT | 13.0 | Installation | ROB | Yes | 98.70 | 0.01 | 0.00 | 13.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Electric HE W/H 30 Gal EF=0.95 | RE-WtrHt-SmlStrg-Elec-lte12kW-30G-0p95EF | N/A | 07 | Residential Mobile Home - Double-Wide | 19-RES-AllResidential-WAT\_HEAT | 13.0 | Installation | ROB | Yes | 97.00 | 0.01 | 0.00 | 13.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Electric HE W/H 30 Gal EF=0.95 | RE-WtrHt-SmlStrg-Elec-lte12kW-30G-0p95EF | N/A | 08 | Residential Mobile Home - Double-Wide | 19-RES-AllResidential-WAT\_HEAT | 13.0 | Installation | ROB | Yes | 96.90 | 0.01 | 0.00 | 13.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Electric HE W/H 30 Gal EF=0.95 | RE-WtrHt-SmlStrg-Elec-lte12kW-30G-0p95EF | N/A | 10 | Residential Mobile Home - Double-Wide | 19-RES-AllResidential-WAT\_HEAT | 13.0 | Installation | ROB | Yes | 97.10 | 0.01 | 0.00 | 13.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Electric HE W/H 30 Gal EF=0.95 | RE-WtrHt-SmlStrg-Elec-lte12kW-30G-0p95EF | N/A | 14 | Residential Mobile Home - Double-Wide | 19-RES-AllResidential-WAT\_HEAT | 13.0 | Installation | ROB | Yes | 100.00 | 0.01 | 0.00 | 13.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Electric HE W/H 30 Gal EF=0.95 | RE-WtrHt-SmlStrg-Elec-lte12kW-30G-0p95EF | N/A | 15 | Residential Mobile Home - Double-Wide | 19-RES-AllResidential-WAT\_HEAT | 13.0 | Installation | ROB | Yes | 85.20 | 0.00 | 0.00 | 13.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Note: **For the complete list of Measures, refer to the attached calculation spreadsheet**

### Costing and NTG Summary Table

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| General Measure Information | | | | PT | | NTG | | | IR | 1st Baseline Period | 2nd Baseline Period | IMC | DIM |
| Measure Name | Solution Code | CZ | Unit Definition | Program Type (NEW, ROB, RET) | Applicable Code | NTG Non-Res. | NTG Res. | NTG Multi Family | Installation Rate | Gross Measure Cost per unit | Gross Measure Cost per unit | Incremental Measure Cost per unit | Delivery & Incentive Method |
| Electric HE W/H 30 Gal EF=0.95 | N/A | 6 | Installation | ROB | Yes |  | 0.55 | 0.55 | 1.00 | $149.94 | $0.00 | $149.94 | Financial Support / Down-Stream Incentive - Deemed |
| Electric HE W/H 30 Gal EF=0.95 | N/A | 7 | Installation | ROB | Yes |  | 0.55 | 0.55 | 1.00 | $172.35 | $0.00 | $172.35 | Financial Support / Down-Stream Incentive - Deemed |
| Electric HE W/H 30 Gal EF=0.95 | N/A | 8 | Installation | ROB | Yes |  | 0.55 | 0.55 | 1.00 | $161.32 | $0.00 | $161.32 | Financial Support / Down-Stream Incentive - Deemed |
| Electric HE W/H 30 Gal EF=0.95 | N/A | 10 | Installation | ROB | Yes |  | 0.55 | 0.55 | 1.00 | $155.80 | $0.00 | $155.80 | Financial Support / Down-Stream Incentive - Deemed |
| Electric HE W/H 30 Gal EF=0.95 | N/A | 14 | Installation | ROB | Yes |  | 0.55 | 0.55 | 1.00 | $151.50 | $0.00 | $151.50 | Financial Support / Down-Stream Incentive - Deemed |
| Electric HE W/H 30 Gal EF=0.95 | N/A | 15 | Installation | ROB | Yes |  | 0.55 | 0.55 | 1.00 | $161.32 | $0.00 | $161.32 | Financial Support / Down-Stream Incentive - Deemed |

Note: **For the complete list of Measures, refer to the attached calculation spreadsheet**

# Document Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| Revision # | MM/DD/YY | Author/Affiliation | Summary of Changes |
| 0 | 03/20/2014 | Kyle Dunn (MWE2) | Original Workpaper for release |

# Section 1. General Measure & Baseline Data

## 1.1 Measure & Delivery Description

The measure creates the opportunity for energy savings by installing high efficiency natural gas or electric storage water heaters in residential households. This workpaper covers the energy savings through installations of electric storage water heaters of 30 gallons, 40 gallons, 50 gallons, and 60 gallons, as well as, installations natural gas storage water heaters with storage capacities of 30 gallons, 40 gallons, 50 gallons, 60 gallons, and 75 gallons.

### 1.1a Measure Description

Conventional electric-resistance and natural gas water heaters usually consist of a glass-lined steel tank with foam insulation. Located at the base end of the tank is an electric or natural gas burner. Cold water enters the base of the tank and is heated by the burner. The water then rises to the top portion of the tank. This is where the hot water is drawn for consumption.

Energy efficient units have greater amounts of insulation and electric units have two heating elements located at the base and top end of the tank, while natural gas units have higher efficiency burners. Cold water enters the base of the tank and is heated by the lower electrical heating element, or natural gas burner. The water then rises to the top portion of the tank. This is where the hot water is drawn for consumption. For electric units during periods of high demand, the electrical heating element located at the top end of the tank can be turned on to provide additional water heating [1].

Table 1 Measure Names

|  |
| --- |
| Measure name |
| Electric HE W/H 30 Gal EF=0.95 |
| Electric HE W/H 40 Gal EF=0.94 |
| Electric HE W/H 50 Gal EF=0.93 |
| Electric HE W/H 60 Gal EF=0.91 |
| Natural Gas W/H 30 Gal EF (0.62-0.64) |
| Natural Gas W/H 30 Gal EF (0.65-0.69) |
| Natural Gas W/H 30 Gal EF (0.70+) |
| Natural Gas W/H 40Gal EF (0.62-0.66) |
| Natural Gas W/H 40Gal EF (0.67-0.69) |
| Natural Gas W/H 40 Gal EF (0.70+) |
| Natural Gas W/H 50 Gal EF (0.62-0.66) |
| Natural Gas W/H 50 Gal EF (0.67-0.69) |
| Natural Gas W/H 50 Gal EF (0.70+) |
| Natural Gas W/H 60 Gal EF (0.62-0.65) |
| Natural Gas W/H 60 Gal EF (0.66-0.69) |
| Natural Gas W/H 60 Gal EF (0.70+) |
| Natural Gas W/H 75 Gal EF (0.62-0.65) |
| Natural Gas W/H 75 Gal EF (0.66-0.69) |
| Natural Gas W/H 75 Gal EF (0.70+) |

### 1.1b Delivery and Incentive Mechanism

The Delivery Mechanism for this measure is Financial Support Downstream Deemed, and includes a Program Type of replace on burnout (ROB).

### 1.1c Measure Requirements

***Terms and Conditions***

* Efficient electric storage water heaters must have an Energy Factor (EF) of 0.93 or greater. Look for the EF rating on the water heater specification sheet or on the packaging box; it does not always appear on the water heater label itself. This rebate is limited to electric storage water heaters that are 30 gallons or greater. If qualifying product is replacing an existing unit, the existing unit must be electric. [2]
* Efficient natural gas storage water heaters must have an Energy Factor (EF) of 0.67 or greater to qualify for the $100 rebate. Look for the EF rating on the water heater specification sheet or on the packaging box; it does not always appear on the water heater label itself. This rebate is limited to natural gas storage water heaters that are 30 gallons or greater. If qualifying product is replacing an existing unit, the existing unit must be natural gas. [2]

***Market Applicability***

This measure is applicable to single-family, multi-family, and double-wide mobile home residential building types. The most significant barrier to water heater retrofit is the existing nature of water heater replacement. Two-thirds of consumers replace their water heaters due to the sudden failure of their existing water heater. When a water heater suddenly fails, most consumers purchase replacements that are the cheapest and most readily available model that are also easy to install. These prevailing attitudes do not encourage consumers to make the extra effort to find more advanced, energy-efficient technologies that are now available on the market [1]

## 1.2 DEER Differences Analysis

***Storage Water Heaters – Electric and Natural Gas***

The DEER 2011 [3] database includes all measure types described in this workpaper, including energy savings, equipment unit costs, and equipment incremental costs. The DEER 2011 data also includes equipment useful life (EUL), and net to gross ration which are applicable to all measures in this paper. The DEER equipment and installation costs for storage water heaters were not utilized for this workpaper, as a targeted measure cost analysis was performed and utilized in the creation of this workpaper.

Table 2 DEER Difference Summary

|  |  |
| --- | --- |
| DEER Difference Summary Table | |
| Modified DEER Methodology | Yes |
| Scaled DEER Measure | No |
| DEER Building Prototypes Used | Yes |
| Deviation from DEER | Baseline and Measure material costs |
| DEER Version | DEER 2011, D11 v4.00 |
| DEER Run ID and Measure Name (Sample) | 2005-D03-937 |

## 1.3 Code Analysis

Table 3 Code Summary

|  |  |  |
| --- | --- | --- |
| Code | Applicable Code Reference | Effective Dates |
| DOE Regulations | N/A | January 20, 2004 |
| Title 20 (2010) | N/A | N/A |

### *Department of Energy:* Current federal regulations require that all small gas storage water heaters (<75 kBtu/h) meet the minimum energy factor requirements calculated as 0.67- (0.0019 x Rated Storage Volume in gallons), and small electric storage water heaters meet the minimum requirements calculated as (0.97 – (0.00132 x Rated Storage Volume in gallons).

***Title 20:*** Same as DOE regulations

## 1.4 Measure Effective Useful Life

The Effective Useful Life (EUL) of Electric Storage water heaters, EUL ID: WtrHt-SmlStrg-Elec-Res, is 13 years. The EUL of Natural Gas Storage water heaters, EUL ID: WtrHt-SmlStrg-Gas-Res, is 10 years. This was taken from a DEER publication “EUL\_Summary\_10-1-08”[4]. DEER08 documentation provides EUL and RUL information to be used for the 13-14 program cycle on [www.deeresources.com](http://www.deeresources.com). The DEER documentation “Summary of EUL-RUL Analysis for the April 2008 Update to DEER” provides the RUL value as a flat 1/3 of the EUL value. Table 4 below identifies the value/methodology used for the measures in this work paper.

Table 4 DEER08 EUL Value/Methodology

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Market | Enduse | Measure | EUL (Years) | RUL (Years) |
| Residential | WaterHtg\_eq | WtrHt-SmlStrg-Elec-Res | 13 | 4.3 |
| Residential | WaterHtg\_eq | WtrHt-SmlStrg-Gas-Res | 10 | 3.3 |

## 1.5 Net-to-Gross Ratios for Different Program Strategies

The net-to-gross ratios (NTGR) were obtained from the “DEER2011\_NTGR\_2012-05-16.xls”[5] on the DEER website. The relevant NTGR for these measures are shown in Table 5 below.

Table 5 Net-to-Gross Ratio

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| NTGR\_ID\* | Description\* | Sector\* | BldgType\* | ProgDelivID | NTG\* |
| RES-DEFAULT>2 | Electric Storage Water Heaters | Res | Any | Downstream Prescriptive Rebate | 0.55 |
| RES-DEFAULT>2 | Natural Gas Storage Water Heaters >=0.65 EF | Res | Any | Downstream Prescriptive Rebate | 0.55 |
| Res-sAll-mDHWgt62 | Natural Gas Storage Water Heaters >.62, <0.65 EF | Res | Any | Downstream Prescriptive Rebate | 0.28 |

\*Denotes that the column is taken from the DEER NTG Table.

The installation rate (IR) is identified in the calculation attachment. This value is obtained from a spreadsheet created by the DEER team titled ““GrossSavingsAdjustments.xlsx”[6], and includes GSIA ID DEF-GSIA.

## Spillage rate will also be applied to measures however the values will not be tracked in the workpapers. The spillage rate will be tracked in an external table to be supplied to the Energy Division.

## 1.6 Time-of-Use Adjustment Factor

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

# Section 2. Energy Savings & Demand Reduction Calculations

Energy Savings for the measures included in this workpaper are taken directly from the DEER 2011 READi Tool or were created using the READi Tool. These results have not been modified and are included on the embedded calculation spreadsheet. For DMo building types, READi did not include savings values for SDG&E territory for climate zones 6 and 15. For these instances, the energy savings values were taken from SCE territory for electric measures and for SCG for natural gas measures.

# Section 3. Load Shapes

The difference between the base case load shape and the measure load shape would be the most appropriate load shape; however, only end-use profiles are available. Therefore, the closest load shape chosen for this measure is 19-RES-AllResidential-WAT\_HEAT load shape for the electric measures.

# Section 4. Base Case & Measure Costs

## 4.1 Base Case Cost

A targeted measure cost summary was conducted for purposes of creating this workpaper. The results of the vendor study performed are summarized in Table 6 below, with the full cost study attached. Labor costs were not analyzed and the attached calculation spreadsheet applies DEER climate zone multipliers.

Table 6 Base Equipment Cost

|  |  |
| --- | --- |
| Measure Name | Base  Equipment Cost |
| Electric HE W/H 30 Gal EF=0.95 | $372.73 |
| Electric HE W/H 40 Gal EF=0.94 | $296.24 |
| Electric HE W/H 50 Gal EF=0.93 | $411.58 |
| Electric HE W/H 60 Gal EF=0.91 | $745.30 |
| Natural Gas W/H 30 Gal EF (0.62-0.64) | $476.62 |
| Natural Gas W/H 30 Gal EF (0.65-0.69) | $476.62 |
| Natural Gas W/H 30 Gal EF (0.70+) | $476.62 |
| Natural Gas W/H 40Gal EF (0.62-0.66) | $466.79 |
| Natural Gas W/H 40Gal EF (0.67-0.69) | $466.79 |
| Natural Gas W/H 40 Gal EF (0.70+) | $466.79 |
| Natural Gas W/H 50 Gal EF (0.62-0.66) | $518.49 |
| Natural Gas W/H 50 Gal EF (0.67-0.69) | $518.49 |
| Natural Gas W/H 50 Gal EF (0.70+) | $518.49 |
| Natural Gas W/H 60 Gal EF (0.62-0.65) | $785.98 |
| Natural Gas W/H 60 Gal EF (0.66-0.69) | $785.98 |
| Natural Gas W/H 60 Gal EF (0.70+) | $785.98 |
| Natural Gas W/H 75 Gal EF (0.62-0.65) | $864.74 |
| Natural Gas W/H 75 Gal EF (0.66-0.69) | $864.74 |
| Natural Gas W/H 75 Gal EF (0.70+) | $864.74 |

## 4.2 Gross Measure Cost

The gross measure cost was determined from the detailed vendor study. The results of which are summarized in Table 7 below, with full results included on the attached file.

Table 7 Measure Equipment Cost

|  |  |
| --- | --- |
| Measure Name | Measure  Equipment Cost |
| Electric HE W/H 30 Gal EF=0.95 | $545.08 |
| Electric HE W/H 40 Gal EF=0.94 | $1,102.71 |
| Electric HE W/H 50 Gal EF=0.93 | $696.63 |
| Electric HE W/H 60 Gal EF=0.91 | $851.98 |
| Natural Gas W/H 30 Gal EF (0.62-0.64) | $530.98 |
| Natural Gas W/H 30 Gal EF (0.65-0.69) | $530.98 |
| Natural Gas W/H 30 Gal EF (0.70+) | $530.98 |
| Natural Gas W/H 40Gal EF (0.62-0.66) | $765.15 |
| Natural Gas W/H 40Gal EF (0.67-0.69) | $765.15 |
| Natural Gas W/H 40 Gal EF (0.70+) | $765.15 |
| Natural Gas W/H 50 Gal EF (0.62-0.66) | $784.81 |
| Natural Gas W/H 50 Gal EF (0.67-0.69) | $784.81 |
| Natural Gas W/H 50 Gal EF (0.70+) | $784.81 |
| Natural Gas W/H 60 Gal EF (0.62-0.65) | $1,287.48 |
| Natural Gas W/H 60 Gal EF (0.66-0.69) | $1,287.48 |
| Natural Gas W/H 60 Gal EF (0.70+) | $1,287.48 |
| Natural Gas W/H 75 Gal EF (0.62-0.65) | $1,255.72 |
| Natural Gas W/H 75 Gal EF (0.66-0.69) | $1,255.72 |
| Natural Gas W/H 75 Gal EF (0.70+) | $1,255.72 |

## 

## 4.3 Incremental Measure Cost

The incremental measure costs for each measure are summarized below in Table 8.

Table 8 Incremental Measure Cost

|  |  |
| --- | --- |
| Measure Name | Measure  Equipment Cost |
| Electric HE W/H 30 Gal EF=0.95 | $172.35 |
| Electric HE W/H 40 Gal EF=0.94 | $806.48 |
| Electric HE W/H 50 Gal EF=0.93 | $285.06 |
| Electric HE W/H 60 Gal EF=0.91 | $106.68 |
| Natural Gas W/H 30 Gal EF (0.62-0.64) | $54.37 |
| Natural Gas W/H 30 Gal EF (0.65-0.69) | $54.37 |
| Natural Gas W/H 30 Gal EF (0.70+) | $54.37 |
| Natural Gas W/H 40Gal EF (0.62-0.66) | $298.36 |
| Natural Gas W/H 40Gal EF (0.67-0.69) | $298.36 |
| Natural Gas W/H 40 Gal EF (0.70+) | $298.36 |
| Natural Gas W/H 50 Gal EF (0.62-0.66) | $266.32 |
| Natural Gas W/H 50 Gal EF (0.67-0.69) | $266.32 |
| Natural Gas W/H 50 Gal EF (0.70+) | $266.32 |
| Natural Gas W/H 60 Gal EF (0.62-0.65) | $501.49 |
| Natural Gas W/H 60 Gal EF (0.66-0.69) | $501.49 |
| Natural Gas W/H 60 Gal EF (0.70+) | $501.49 |
| Natural Gas W/H 75 Gal EF (0.62-0.65) | $390.98 |
| Natural Gas W/H 75 Gal EF (0.66-0.69) | $390.98 |
| Natural Gas W/H 75 Gal EF (0.70+) | $390.98 |

# Attachments

 

# References

[1] *U.S. Environmental Protection Agency and US Department of Energy. ENERGY STAR® Residential Water Heaters: Draft Criteria Analysis. October 2007.* [*http://www.energystar.gov/*](http://www.energystar.gov/)

[2]2013-2014 SDGE Home Energy Efficiency Rebate Application, available from: <https://www.sdge.com/sites/default/files/documents/1640036986/home-rebates-application.pdf?nid=151>

[3] *DEER2011, from deeresources.com*

[4] *EUL\_Summary\_10-1-08.xls, available from deeresources.com*

[5] *DEER2011\_NTGR\_2012-05-16.xls available from deeresources.com*

[6] *GrossSavingsAdjustments.xlsx available from deeresources.com*