### Gas Water Heater

###### Description

This measure characterizes:

1. Time of sale or new construction:

The purchase and installation of a new efficient gas-fired water heater, in place of a Federal Standard unit in a residential setting. Savings are provided for power-vented, condensing storage, and whole-house tankless units meeting specific EF criteria.

1. Early replacement:

The early removal of an existing functioning natural gas water heater from service, prior to its natural end of life, and replacement with a new high efficiency unit. Savings are calculated between existing unit and efficient unit consumption during the remaining life of the existing unit, and between new baseline unit and efficient unit consumption for the remainder of the measure life.

This measure was developed to be applicable to the following program types:  TOS, NC, EREP.

If applied to other program types, the measure savings should be verified.

###### Definition of Efficient Equipment

To qualify for this measure the efficient equipment must be a water heater rated with the following minimum efficiency ratings:

|  |  |
| --- | --- |
| **Water Heater Type** | **Minimum Energy Factor** |
| Gas Storage | 0.67 |
| Condensing gas storage | 0.80 |
| Tankless whole-house unit | 0.82 |

###### Definition of Baseline Equipment

Time of Sale or New Construction: The baseline condition is assumed to be a standard gas storage water heater of the same capacity as the efficient unit, rated at the federal minimum. For 20 to 55 gallon tanks the Federal Standard is calculated as 0.675 – (0.0015 \* storage size in gallons) and for tanks 55 - 100 gallon 0.8012 – (0.00078 \* storage size in gallons)[[1]](#footnote-1). For a 40-gallon storage water heater this would be 0.615 EF.

Early replacement: The baseline for this measure is the efficiency of the existing equipment for the assumed remaining useful life of the unit and a new baseline unit for the remainder of the measure life.

###### Deemed Lifetime of Efficient Equipment

The expected measure life is assumed to be 13 years.[[2]](#footnote-2)

For early replacement: Remaining life of existing equipment is assumed to be 4 years[[3]](#footnote-3).

###### Deemed Measure Cost

Time of Sale or New Construction:

The incremental capital cost for this measure is dependent on the type of water heater as listed below[[4]](#footnote-4).

Early Replacement: The full installed cost is provided in the table below. The assumed deferred cost (after 4 years) of replacing existing equipment with a new baseline unit is assumed to be $614[[5]](#footnote-5). This cost should be discounted to present value using the utility’s discount rate.

|  |  |  |
| --- | --- | --- |
| **Water heater Type** | **Incremental Cost** | **Full Install Cost** |
| Gas Storage | $400 | $1014 |
| Condensing gas storage | $685 | $1299 |
| Tankless whole-house unit | $605 | $1219 |

###### Loadshape

N/A

###### Coincidence Factor

N/A

Algorithm

###### Calculation of Savings

###### Electric Energy Savings

N/A

###### Summer Coincident Peak Demand Savings

N/A

###### Natural Gas Energy Savings

Time of Sale or New Construction:

ΔTherms = (1/ EFbase - 1/EFefficient) \* (GPD \* Household \* 365.25 \* γWater \* (TOUT – Tin) \* 1.0 )/100,000

Early replacement[[6]](#footnote-6):

ΔTherms for remaining life of existing unit (1st 4 years):

= (1/ EFExisting - 1/EFefficient) \* (GPD \* Household \* 365.25 \* γWater \* (TOUT – Tin) \* 1.0 )/100,000

ΔTherms for remaining measure life (next 9 years):

= (1/ EFbase - 1/EFefficient) \* (GPD \* Household \* 365.25 \* γWater \* (TOUT – Tin) \* 1.0 )/100,000

Where:

EF\_Baseline = Energy Factor rating for baseline equipment

For <=55 gallons: 0.675 – (0.0015 \* tank\_size)

For > 55 gallons: 0.8012 – (0.00078 \* tank size)

= If tank size unknown assume 40 gallons and EF\_Baseline of 0.615

EF\_Efficient = Energy Factor Rating for efficient equipment

= Actual. If Tankless whole-house multiply rated efficiency by 0.91[[7]](#footnote-7). If unknown assume values in look up in table below

|  |  |
| --- | --- |
| **Water Heater Type** | **EF\_Efficient** |
| Condensing Gas Storage | 0.80 |
| Gas Storage | 0.67 |
| Tankless whole-house | 0.82 \* 0.91 = 0.75 |

EF\_Existing = Energy Factor rating for existing equipment

= Use actual EF rating where it is possible to measure or reasonably estimate.

= if unknown assume 0.52 [[8]](#footnote-8)

GPD = Gallons Per Day of hot water use per person

= 45.5 gallons hot water per day per household/2.59 people per household[[9]](#footnote-9)

= 17.6

Household = Average number of people per household

|  |  |
| --- | --- |
| **Household Unit Type** | **Household** |
| Single-Family - Deemed | 2.56[[10]](#footnote-10) |
| Multi-Family - Deemed | 2.1[[11]](#footnote-11) |
| Custom | Actual Occupancy or Number of Bedrooms[[12]](#footnote-12) |

365.25 = Days per year, on average

γWater  = Specific Weight of water

= 8.33 pounds per gallon

Tout = Tank temperature

= 125°F

Tin = Incoming water temperature from well or municipal system

= 54°F[[13]](#footnote-13)

1.0 = Heat Capacity of water (1 Btu/lb\*°F)

For example, a 40 gallon condensing gas storage water heater, with an energy factor of 0.80 in a single family house:

ΔTherms = (1/0.615 - 1/0.8) \* (17.6 \* 2.56 \* 365.25\* 8.33 \* (125 – 54) \* 1) / 100,000

= 36.6 therms

###### Water Impact Descriptions and Calculation

N/A

###### Deemed O&M Cost Adjustment Calculation

N/A

###### Measure Code: RS-HWE-GWHT-V05-160601

1. Minimum Federal Standard as of 4/1/2015;

   http://www.gpo.gov/fdsys/pkg/CFR-2012-title10-vol3/pdf/CFR-2012-title10-vol3-sec430-32.pdf [↑](#footnote-ref-1)
2. DOE, 2010 Residential Heating Products Final Rule Technical Support Document, Table 8.2.14 http://www1.eere.energy.gov/buildings/appliance\_standards/residential/pdfs/htgp\_finalrule\_ch8.pdf Note: This source is used to support this category in aggregate. For all water heaters, life expectancy will depend on local variables such as water chemistry and homeowner maintenance. Some categories, including condensing storage and tankless water heaters do not yet have sufficient field data to support separate values. Preliminary data show lifetimes may exceed 20 years, though this has yet to be sufficiently demonstrated. [↑](#footnote-ref-2)
3. Assumed to be one third of effective useful life [↑](#footnote-ref-3)
4. Source for cost info; DOE, 2010 Residential Heating Products Final Rule Technical Support Document, Table 8.2.14 (http://www1.eere.energy.gov/buildings/appliance\_standards/residential/pdfs/htgp\_finalrule\_ch8.pdf) [↑](#footnote-ref-4)
5. The deemed install cost of a Gas Storage heater is based upon DCEO Efficient Living Program Data for a sample size of 157 gas water heaters. [↑](#footnote-ref-5)
6. The two equations are provided to show how savings are determined during the initial phase of the measure (existing to efficient) and the remaining phase (new baseline to efficient). In practice, the screening tools used may either require a First Year savings (using the first equation) and then a “number of years to adjustment” and “savings adjustment” input which would be the (new base to efficient savings)/(existing to efficient savings). [↑](#footnote-ref-6)
7. The disconnect between rated energy factor and in-situ energy consumption is markedly different for tankless units due to significantly higher contributions to overall household hot water usage from short draws. In tankless units the large burner and unit heat exchanger must fire and heat up for each draw. The additional energy losses incurred when the mass of the unit cools to the surrounding space in-between shorter draws was found to be 9% in a study prepared for Lawrence Berkeley National Laboratory by Davis Energy Group, 2006. “Field and Laboratory Testing of Tankless Gas Water Heater Performance” Due to the similarity (storage) between the other categories and the baseline, this derating factor is applied only to the tankless category. [↑](#footnote-ref-7)
8. Based on DCEO Efficient Living Program Data for a sample size of 157 gas water heaters. [↑](#footnote-ref-8)
9. Deoreo, B., and P. Mayer. Residential End Uses of Water Study Update. Forthcoming. ©2015 Water Research Foundation. Reprinted With Permission. [↑](#footnote-ref-9)
10. ComEd Energy Efficiency/ Demand Response Plan: Plan Year 2 (6/1/2009-5/31/2010) Evaluation Report: All Electric Single Family Home Energy Performance Tune-Up Program citing 2006-2008 American Community Survey data from the US Census Bureau for Illinois cited on p. 17 of the PY2 Evaluation report. 2.75 \* 93% evaluation adjustment [↑](#footnote-ref-10)
11. Navigant, ComEd PY3 Multi-Family Home Energy Savings Program Evaluation Report Final, May 16, 2012. [↑](#footnote-ref-11)
12. Bedrooms are suitable proxies for household occupancy, and may be preferable to actual occupancy due to turnover rates in residency and non-adult population impacts. [↑](#footnote-ref-12)
13. US DOE Building America Program. Building America Analysis Spreadsheet. For Chicago, IL [http://www1.eere.energy.gov/buildings/building\_america/analysis\_spreadsheets.html](http://www.bpi.org/files/pdf/DistributionEfficiencyTable-BlueSheet.pdf) [↑](#footnote-ref-13)