### Multifamily Central Domestic Hot Water Plants

**Description**

This measure covers multifamily central domestic hot water (DHW) plants with thermal efficiencies greater than or equal to 88%. This measure is applicable to any combination of boilers and storage tanks provided the thermal efficiency of the boilers is greater than 88%. Plants providing other than solely DHW are not applicable to this measure.

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

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

**Definition of Efficient Equipment**

To qualify the boiler(s) must have a Thermal Efficiency of 88% or greater and supply domestic hot water to multi-family buildings.

**Definition of Baseline Equipment**

For TOS the baseline boiler is assumed to have a Thermal Efficiency of 80%.[[1]](#footnote-1)

For Early Replacement the savings are calculated between existing unit and efficient unit consumption during the remaining life of the existing unit, and between new baseline unit as above and efficient unit consumption for the remainder of the measure life.

**Deemed Lifetime of Efficient Equipment**

The measure life for the domestic hot water boilers is 15 years.[[2]](#footnote-2)

**Deemed Measure Cost**

TOS: The actual install cost should be used for the efficient case, minus the baseline cost assumption provided below:

|  |  |
| --- | --- |
| **Capacity Range** | **Baseline Installed Cost per kBtuh[[3]](#footnote-3)** |
| <300kBtuh | $65 per kBTUh |
| 300 – 2500 kBtuh | $38 per kBTUh |
| >2500 kBtuh | $32 per kBTUh |

**Loadshape**

N/A

**Coincidence Factor**

N/A

**Algorithm**

**Calculation of Energy Savings**

**Electric Energy Savings**

There are no anticipated electrical savings from this measure.

**Summer Coincident Peak Demand Savings**

N/A

**Natural Gas Savings**

Time of Sale:

ΔTherms = Hot Water Savings + Standby Loss Savings

= [(MFHH \* #Units \* GPD \* Days/yr \* עWater \* (Tout – Tin) \* (1/Eff\_base – 1/Eff\_ee)) / 100,000] + [((SL \* Hours/yr \* (1/Eff\_base – 1/Eff\_ee)) / 100,000]

Early Replacment[[4]](#footnote-4):

ΔTherms for remaining life of existing unit (1st 5 years):

= [(MFHH \* #Units \* GPD \* Days/yr \* עWater \* (Tout – Tin) \* (1/Eff\_exist – 1/Eff\_ee)) / 100,000] + [((SL \* Hours/yr \* (1/Eff\_exist – 1/Eff\_ee)) / 100,000]

ΔTherms for remaining measure life (next 10 years):

= [(MFHH \* #Units \* GPD \* Days/yr \* עWater \* (Tout – Tin) \* (1/Eff\_base – 1/Eff\_ee)) / 100,000] + [((SL \* Hours/yr \* (1/Eff\_base – 1/Eff\_ee)) / 100,000]

Where:

MFHH = number of people in Multi-Family House Hold

= Actual. If unknown assume 2.1 persons/unit[[5]](#footnote-5)

#Units = Number of units served by hot water boiler

= Actual

GPD = Gallons of hot water used per person per day

= Actual. If unknown assume 17.6 gallons per person per day[[6]](#footnote-6)

Days/yr = 365.25

עWater = Specific Weight of Water

= 8.33 gal/lb

Tout = tank temperature of hot water

= 125°F or custom

Tin = Incoming water temperature from well or municiple system

= 54°F[[7]](#footnote-7)

Eff\_base = thermal efficiency of base unit

= 80%[[8]](#footnote-8)

Eff\_ee = thermal efficiency of efficient unit complying with this measure

= Actual. If unknown assume 88%

Eff\_exist = thermal efficiency of existing unit

= Actual. If unknown assume 73%[[9]](#footnote-9)

SL = Standby Loss[[10]](#footnote-10)

= (Input rating / 800) + (110 \* √Tank Volume)

Input rating = Name plate input capacity in Btuh

Tank Volume = Rated volume of the tank in gallons

Hours / yr = 8766 hours

100,000 = btu/therm

**EXAMPLES**

Time of Sale:

For example, an 88% 1000 gallon boiler with 150,000 Btuh input rating installed serving 50 units.

ΔTherms = Hot Water Savings + Standby Loss Savings

= [(MFHH \* #Units \* GPD \* Days/yr \* עWater \* (Tout – Tin) \* (1/Eff\_base – 1/Eff\_ee)) / 100,000] + [((SL \* Hours/yr \* (1/Eff\_base – 1/Eff\_ee)) / 100,000]

=[(2.1 \* 50 \* 17.6 \* 8.33 \* 365.25 \* 1.0 \* (125-54) \* (1/0.8 – 1/0.88)) / 100000] + [((150000/800 + (110 \* √1000)) \* 8766 \* (1/0.8 – 1/0.88)) / 100000]

= 454 + 37

= 490 therms

Early Replacement:

For example, an 88% 1000 gallon boiler with 150,000 Btuh input rating installed serving 50 units replaces a working unit with unknown efficiency.

ΔTherms for remaining life of existing unit (1st 5 years):

=[(2.1 \* 50 \* 17.6 \* 8.33 \* 365.25 \* 1.0 \* (125-54) \* (1/0.73 – 1/0.88)) / 100000] + [((150000/800 + (110 \* √1000)) \* 8766 \* (1/0.73 – 1/0.88)) / 100000]

= 932 + 75

= 1007 therms

ΔTherms for remaining measure life (next 10 years):

= 454 + 37 (as above)

= 490 therms

**Water Impact Descriptions and Calculation**

N/A

**Deemed O&M Cost Adjustment Calculation**

N/A

###### Measure code: CI-HW\_-MDHW-V02-160601

1. IECC 2012, Table C404.2, Minimum Performance of Water-Heating Equipment [↑](#footnote-ref-1)
2. Nicor Gas Energy Efficiency Plan 2011-2014. Revised Plan Filed Pursuant to Order Docket 10-0562, May 27, 2011. [↑](#footnote-ref-2)
3. Baseline install costs are based on data from the W017 Itron California Measure Cost Study, accessed via <http://www.energydataweb.com/cpuc/search.aspx>. The data is provided in a file named “MCS Results Matrix – Volume I”. [↑](#footnote-ref-3)
4. 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-4)
5. Navigant, ComEd PY3 Multi-Family Home Energy Savings Program Evaluation Report Final, May 16, 2012. [↑](#footnote-ref-5)
6. Deoreo, B., and P. Mayer. Residential End Uses of Water Study Update. Forthcoming. ©2015 Water Research Foundation. Reprinted With Permission. [↑](#footnote-ref-6)
7. 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.energystar.gov/ia/products/appliances/refrig/NAECA_calculation.xls) [↑](#footnote-ref-7)
8. IECC 2012, Table C404.2, Minimum Performance of Water-Heating Equipment [↑](#footnote-ref-8)
9. Based upon DCEO data provided 10/2014; average age adjusted efficiency of existing units replaced through the program. Efficiency age adjustment of 0.5% per year based upon NREL “Building America Performance Analysis Procedures for Existing Homes”. [↑](#footnote-ref-9)
10. Stand-by loss is provided in 2012 International Energy Conservation Code (IECC2012), Table C404.2, Minimum Performance of Water-Heating Equipment [↑](#footnote-ref-10)