### Gas High Efficiency Furnace

**Description**

High efficiency furnace features may include improved heat exchangers and modulating multi-stage burners.

This measure characterizes:

1. Time of sale:
   1. The installation of a new high efficiency, gas-fired condensing furnace in a residential location. This could relate to the replacement of an existing unit at the end of its useful life, or the installation of a new system in a new home.
2. Early Replacement:

Early Replacement determination will be based on meeting the following conditions:

* + - The existing unit is operational when replaced, or
    - The existing unit requires minor repairs (<$528 per ton)[[1]](#footnote-2).
    - All other conditions will be considered Time of Sale.

The Baseline AFUE of the existing unit replaced:

* + - If the AFUE of the existing unit is known and <=75%, the Baseline AFUE is the actual AFUE value of the unit replaced. If the AFUE is >75%, the Baseline AFUE = 80%.
    - If the operational status, repair cost or AFUE of the existing unit is unknown, use time of sale assumptions.

A weighted average early replacement rate is provided for use when the actual baseline early replacement rate is unknown[[2]](#footnote-3).

Deemed Early Replacement Rates For Furnaces

| **Replacement Scenario for the Furnace** | **Deemed Early Replacement Rate** |
| --- | --- |
| Early Replacement Rate for Furnace-only participants | 7% |
| Early Replacement Rate for a furnace when the furnace is the Primary unit in a Combined System Replacement (CSR) project | 14% |
| Early Replacement Rate for a furnace when the furnace is the Secondary unit in a CSR project | 46% |

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 installed equipment must be a residential sized (input energy less than 225,000 Btu/hr) natural gas fired furnace with an Annual Fuel Utilization Efficiency (AFUE) rating exceeding the program requirements.

**Definition of Baseline Equipment**

Time of Sale: Although the current Federal Standard for gas furnaces is an AFUE rating of 78%, based upon review of available product in the AHRI database, the baseline efficiency for this characterization is assumed to be 80%. The baseline will be adjusted when the Federal Standard is updated.

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. As discussed above we estimate that the new baseline unit that could be purchased in the year the existing unit would have needed replacing is 90%.

**Deemed Lifetime of Efficient Equipment**

The expected measure life is assumed to be 20 years[[3]](#footnote-4).

For early replacement: Remaining life of existing equipment is assumed to be 6 years[[4]](#footnote-5).

**Deemed Measure Cost**

Time of sale: The incremental installed cost (retail equipment cost plus installation cost) for this measure depends on efficiency as listed below[[5]](#footnote-6):

| **AFUE** | **Installed Cost** | **Incremental Installed Cost** |
| --- | --- | --- |
| 80% | $2011 | n/a |
| 90% | $2641 | $630 |
| 91% | $2727 | $716 |
| 92% | $2813 | $802 |
| 93% | $3025 | $1014 |
| 94% | $3237 | $1226 |
| 95% | $3449 | $1438 |
| 96% | $3661 | $1650 |

Early Replacement: The full installed cost is provided in the table above. The assumed deferred cost (after 6 years) of replacing existing equipment with a new baseline unit is assumed to be $2641. This cost should be discounted to present value using the utility’s discount rate.

**Loadshape**

N/A

**Coincidence Factor**

N/A

**Algorithm**

**Calculation of Savings**

**Electric Energy Savings**

Electrical energy savings from the more fan-efficient (typically using brushless permanent magnet (BPM) blower motor) should also be claimed, please refer to “Furnace Blower Motor” characterization for details.

**Summer Coincident Peak Demand Savings**

If the blower motor is also used for cooling, coincident peak demand savings should also be claimed, please refer to “Furnace Blower Motor” characterization for savings details.

**Natural Gas Savings**

Time of Sale:

ΔTherms = Gas\_Furnace\_Heating\_Load \* HF \* (1/AFUE(base) - 1/AFUE(eff))

Early replacement[[6]](#footnote-7):

ΔTherms for remaining life of existing unit (1st 6 years):

= Gas\_Furnace\_Heating\_Load \* HF \* (1/AFUE(exist) - 1/AFUE(eff)))

ΔTherms for remaining measure life (next 14 years):

= Gas\_Furnace\_Heating\_Load \* HF \* (1/AFUE(base) - 1/AFUE(eff)))

Where:

Gas\_Furnace\_Heating\_Load

= Estimate of annual household heating load[[7]](#footnote-8) for gas furnace heated single-family homes. If location is unknown, assume the average below[[8]](#footnote-9).

= Actual if informed by site-specific load calculations, ACCA Manual J or equivalent[[9]](#footnote-10).

| **Climate Zone**  **(City based upon)** | **Gas\_Furnace\_Heating\_Load (therms)** |
| --- | --- |
| 1 (Rockford) | 873 |
| 2 (Chicago) | 834 |
| 3 (Springfield) | 714 |
| 4 (Belleville) | 551 |
| 5 (Marion) | 561 |
| Average | 793 |

HF = Household factor, to adjust heating consumption for non-single-family households.

|  |  |
| --- | --- |
| **Household Type** | **HF** |
| Single-Family | 100% |
| Multi-Family | 65%[[10]](#footnote-11) |
| Actual | Custom[[11]](#footnote-12) |

AFUE(exist) = Existing Furnace Annual Fuel Utilization Efficiency Rating

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

If unknown, assume 64.4 AFUE% **[[12]](#footnote-13)**.

AFUE(base) = Baseline Furnace Annual Fuel Utilization Efficiency Rating

= Dependent on program type as listed below[[13]](#footnote-14):

|  |  |
| --- | --- |
| **Program Year** | **AFUE(base)** |
| Time of Sale | 80% |
| Early Replacement | 90% |

AFUE(eff) = Efficent Furnace Annual Fuel Utilization Efficiency Rating

= Actual. If unknown, assume 95%[[14]](#footnote-15)

Time of Sale:

For example, a 95% AFUE furnace near Rockford and purchased in the year 2014

ΔTherms = 873 \* (1/0.8 - 1/0.95)

=172 therms

Early Replacement:

For example, an existing functioning furnace with unknown efficiency is replaced with an 95% furnace purchased and installed in Rockford in 2014.

ΔTherms for remaining life of existing unit (1st 6 years):

= 873 \* (1/0.644 – 1/0.95)

= 437 therms

ΔTherms for remaining measure life (next 14 years):

= 873 \* (1/0.9 - 1/0.95)

=51.1 therms

**Water Impact Descriptions and Calculation**

N/A

**Deemed O&M Cost Adjustment Calculation**

N/A

**Measure Code: RS-HVC-GHEF-V05-160601**

1. The Technical Advisory Committee agreed that if the cost of repair is less than 20% of the new baseline replacement cost it can be considered early replacement. [↑](#footnote-ref-2)
2. Based upon research from “Home Energy Efficiency Rebate Program GPY2 Evaluation Report” which outlines early replacement rates for both primary and secondary central air cooling (CAC) and residential funaces. The unit (furnace or CAC unit) that initially caused the customer to contact a trade ally is defined as the “primary unit”. The furnace or CAC unit that was also replaced but did not initially prompt the customer to contact a trade ally is defined as the “secondary unit”. This evaluation used different criteria for early replacement due to the availability of data after the fact; cost of any repairs < $550 and age of unit < 20 years. Report presented to Nicor Gas Company February 27, 2014, available at http://www.ilsag.info/evaluation-documents.html. [↑](#footnote-ref-3)
3. Table 8.3.3 The Technical support documents for federal residential appliance standards: <http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/fb_fr_tsd/chapter_8.pdf> [↑](#footnote-ref-4)
4. Assumed to be one third of effective useful life [↑](#footnote-ref-5)
5. Based on data from Table E.1.1 of Appendix E of the Appliance Standards Technical Support Documents including equipment cost and installation labor.(<http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/fb_fr_tsd/appendix_e.pdf>). Where efficiency ratings are not provided, the values are interpolated from those that are. Note that ECM furnace fan cost (refer to other measure in TRM) has been deducted from the 93%-96% AFUE values to avoid double counting. [↑](#footnote-ref-6)
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-7)
7. Heating load is used to describe the household heating need, which is equal to (gas consumption \* AFUE ) [↑](#footnote-ref-8)
8. Values are based on household heating consumption values and inferred average AFUE results from Table 2-1, *Energy Efficiency / Demand Response Nicor Gas Plan Year 1 (6/1/2011-5/31/2012) Research Report: Furnace Metering Study* (August 1, 2013) (prepared by Navigant Consulting, Inc.) and adjusting to a statewide average using relative HDD values to adjust for the evaluation results focus on northern region. Values for individual cities are then calculated by comparing average HDD to the individual city’s HDD. [↑](#footnote-ref-9)
9. The Air Conditioning Contractors of America Manual J, Residential Load Calculation 8th Edition produces equipment sizing loads for Single Family, Multi-single, and Condominiums using input characteristics of the home. A best practice for equipment selection and installation of Heating and Air Conditioning, load calculations are commonly completed by contractors during the selection process and may be readily available for program data purposes. [↑](#footnote-ref-10)
10. Multifamily household heating consumption relative to single-family households is affected by overall household square footage and exposure to the exterior. This 65% reduction factor is applied to MF homes with electric resistance, based on professional judgment that average household size, and heat loads of MF households are smaller than single-family homes [↑](#footnote-ref-11)
11. Program-specific household factors may be utilized on the basis of sufficiently validated program evaluations. [↑](#footnote-ref-12)
12. Average nameplate efficiencies of all Early Replacement qualifying equipment in Ameren PY3-PY4. [↑](#footnote-ref-13)
13. Though the Federal Minimum AFUE is 78%, there were only 50 models listed in the AHRI database at that level. At AFUE 79% the total rises to 308. There are 3,548 active furnace models listed with AFUE ratings between 78 and 80. [↑](#footnote-ref-14)
14. Minimum ENERGY STAR efficiency after 2.1.2012. [↑](#footnote-ref-15)