DEEMED SAVINGS TECHNICAL ASSUMPTIONS

Product: Heating System Rebates

Residential natural gas customers receive a cash rebate for purchasing high-efficiency heating equipment.
Residential electric customers can receive an additional cash rebate for purchasing an electronically commutated motor (ECM) furnace fan with their heating system.

Algorithms:

New Furnace & Boiler Savings (Dth)	= ((BTUH x EFFh/EFFb) - BTUH) x (1 - oversize factor) x Hrs / 1,000,000
Net Dth	= Gross Dth x NTG
ECM Furnace Fan Efficiency Electric Energy Savings (kWh)	= (ECM_baseline_kW - ECM_Proposed_kW) x ECM_Operating_Hours
ECM Furnace Fan Efficiency Electric Demand Savings (Customer kW)	= (ECM_baseline_kW - ECM_Proposed_kW)
Electrical Energy Savings (Gross Generator kWh)	= (Customer kWh) / (1-TLDF)
Electrical Demand Savings (Gross Generator kW)	= (Customer kW)*CF / (1-TLDF)
Electrical Energy Savings (Net Generator kWh)	= Gross Generator kWh x NTG x Install Rate
Electrical Demand Savings (Net Generator kW)	= Gross Generator kW x NTG x Install Rate

Variables:

NTG	Net-to-Gross Factor = We will use 77% for furnaces and boilers (Reference 6) and 94% for EC Motors (Reference 13).
BTUH	= Rated new furnace or boiler Input BTUH nameplate data provided by customer on rebate form.
EFFb	EFFb = 80% for furnaces before new DOE install standards and 90% after New DOE Install Standards; EFFb = 80% for boilers.
EFFh	= Efficiency for higher efficiency furnace will be provided by the customer on the rebate form.
Hrs	Equivalent Full Load Heating Hours for Furnace and Boiler equipment will be assumed as follows: ~~96% AFUE Furnace = 958 Hours~~ 95% AFUE Furnace = 958 Hours ~~94% AFUE Furnace = 958 Hours~~ ~~92% AFUE Furnace = 978 Hours~~ 85% AFUE Boiler = 698 Hours
Oversize factor	= Oversizing factor on new furnace or boiler Input BTUH nameplate. Colorado oversize factor is assumed to be zero
Measure life	Furnace Life = 18 years (Reference 5) Boiler Life = 20 years (Refernece 8)
Measure life	EC Motor = 18 years (Reference 5)
ECM_Operating Hours	Operating Hours of Furnace Fan without Central AC = 6,478 hours (Reference 9, 12) Operating Hours of Furnace Fan with Central AC = 8,760 hours (Reference 9, 12)
ECM_Baseline_kW	= 0.173 (Reference 9, 12)
ECM_Proposed_kW	= 0.066 (Reference 9, 12)
CF	EC Motor Coincidence Factor = 0% for heating only and 69% for Furnace with Central AC
Transmission Distribution Loss Factor (TDLF)	Transmission Distribution Loss Factor = 7.70%, the percentage loss of electricity as it flows from the power plant to the customer.

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Table 1: Incremental cost	Before DOE's Newest Install Standards become effective
~~New Energy Star Furnace => 92% AFUE, < 94% AFUE without ECM (Reference 1)~~	~~$775.75~~
~~New Energy Star Furnace => 94% AFUE, < 96% AFUE without ECM (Reference 1)~~	~~$834.15~~
New Energy Star Furnace => ~~96%~~ 95% AFUE (Reference 1)	~~$892.54~~ $519.95
New Furnace EC Motor (reference 10)	$464.33
New boilers => 85% AFUE (Reference 11)	$933.50

Provided by Customer:	**Verified during M&V:**
Efficiency of new unit (Furnace ~~92%, 94%, 96%~~ 95% - Boiler 85%)	Yes
Furnace or Boiler Nameplate Capacity of new unit at sea level (BTUH, Input)	Yes
Was ECM furnace fan motor provided	Yes

Changes From 2012:

Change Program Savings Calculation Method to match the Minnesota program.

~~Changed top furnace efficiency tier from 94% to 96% or better.~~ Combined all furnace tiers into one 95% efficiency tier.

Added electronically commutated motor (ECM) furnace fans as an electric efficiency measure.

Increased Federal Standard baseline efficiency for gas furnaces from 78 to 80 AFUE.

Building Characteristics for Prototype Home Used for Modeling:

Single Family
Two story (Reference 3)
3 bedroom 2 bathroom (Reference 3)
2000 square feet (Reference 3)
Basement foundation (Reference 3)
HVAC:
heating - gas furnace 78 AFUE (55.9 kBtu unit required) - 85% of homes have gas heating, and 78% of which are forced air furnaces (Reference 2)
cooling - 59% have Central Air Conditioning model required a 2.5 ton unit to meet the cooling load (Reference 2)
air handler is in the basement and supply ducts and return ducts are assumed to be in majority interior space
Windows:
61% of homes have double pane windows (Reference 2)
double pane low-E are standard (Reference 4)
Model assumes 15% of wall area glazing
applied a u-factor of 0.53 (average between clear glass double pane and low-E)

Insulation Levels:

Existing Ceiling Insulation: R-19 (Reference 4)
Existing Wall Insulation: R-11 (Reference 4)

Basement Assumptions

Assumed basement walls to have R-11 insulation
Basement is considered finished space but not conditioned
The air handler is located in the basement
Some homes will have smaller sections of the basement conditioned – maybe a bonus room etc, however this cannot be easily modeled in EnergyGauge

DEEMED SAVINGS TECHNICAL ASSUMPTIONS

Appliances (Reference 2)
85% have dishwashers
74% electric ranges
88% and 89% have clothes washer and dryer (electric)
85% water heating is gas - model used a 40 gallon storage tank
68% of homes have ceiling fans

Average Customer Energy Consumption: (Reference 2)
kWh annually: 9,000 roughly for a 2,000 square foot home
Therms annually: 835

Assumptions

For the Heating System Rebate product, the incremental costs are based on difference between efficient and basline unit installed cost exlcuding any cost for ductwork or equipment rental costs.
Furnace and Boiler equipment oversize factor is zero.

References:

1. California Energy Commission's Database for Energy Efficient Resources (DEER) http//www.energy.ca.gov/deer
(Does not include labor or equipment rental fees as this measure is considered a replace on burnout)
2. 2006 Residential Energy Use Colorado Service Area - Xcel: Bruce Neilson
3. American Housing Survey for Denver - US Census Bureau
4. Xcel Energy CO DSM Potential 2006 - prepared by Kema
5. Draft Technical Support Document: Energy Conservation Standards for Residential Furnaces and Boilers, Efficiency Standards for Consumer Products: Residential Central Air Conditioners And Heat Pumps, Prepared for US DOE, September 2006
6. Summit Blue 2006 Midwest Residential Market Assessment and DSM Potential Study.
7. Baseline costs from RS MEANS Repair and Remodeling Cost Data 2007
8. 2007 ASHRAE HVAC Applications Handbook Chapter 36, page 36.3, Table 4 (Boiler life time was reduced to 20 years from 24 years in the ASHRAE Handbook)
9. State of Wisconsin, Department of Administration, Division of Energy, ECM Furnace Impact Assessment Report, January 12, 2009
10. Data obtained from EC motors program
11. http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/fb_fr_tsd/appendix_e.pdf
12. Center for Energy and Environment Comments to Docket Number EERE-2010-BT-STD-0011-0022, July 27, 2010
13. National Energy Efficiency Best Practices Study - Residential Single-Family Comprehensive Weatherization Best Practices Report from December 2004.