## 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:

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

### 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 (Reference 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. |
### Table 1: Incremental cost

| 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:**
- Efficiency of new unit (Furnace 92%, 94%, 96% 95% - Boiler 85%)
- Furnace or Boiler Nameplate Capacity of new unit at sea level (BTUH, Input)
- Was ECM furnace fan motor provided

**Verified during M&V:**
- Yes
- 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
- Therm annually: 835

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

References:
   (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
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)
10. Data obtained from EC motors program