

## DEEMED SAVINGS TECHNICAL ASSUMPTIONS

### Product: Heating Efficiency

Prescriptive rebates will be offered for Hot Water Boilers (Condensing and non-condensing), Commercial Water Heaters and various heating system improvements.

#### Algorithms:

BTUH_upgraded	= Input BTUH for the upgraded boiler or water heater to generate the same output as existing boiler or water heater that is being retrofitted = $BTUH_{existing} \times EFFb/EFFh$
BTUH_base	= Input BTUH for the baseline boiler or water heater to generate the same output as the new high efficient boiler or water heater = $BTUH_{new} \times EFFh/EFFb$
New Boiler Savings (Dth)	= $(BTUH_{base} - BTUH_{new}) \times Hrs / 1,000,000$
Furnace Savings (Gross Dth)	= $Alt \times ((BTUH_{new} \times EFFh/EFFb) - BTUH_{new}) \times Hrs / 1,000,000$
Boiler Tune Up savings (Gross Dth)	= $((BTUH \times EFFh/EFFb) - BTUH) \times Hrs / 1,000,000$
Outdoor Air Reset savings (Gross Dth)	= $(BTUH - (BTUH \times EFFb/EFFh)) \times Hrs / 1,000,000$
Stack Dampers savings (Gross Dth)	= $(BTUH - (BTUH \times EFFb/EFFh)) \times Hrs / 1,000,000$
Modulating Burner Controls savings (Gross Dth)	= $(BTUH - (BTUH \times EFFb/EFFh)) \times Hrs / 1,000,000$
O2 Trim Control savings (Gross Dth)	= $(BTUH - (BTUH \times EFFb/EFFh)) \times Hrs / 1,000,000$
Steam Traps savings (Gross Dth)	= $Leak\_Rate \times Leak\_Hours \times BTU\_per\_Pound / EFFb/1,000,000$
	= $((BTUH_{base} - BTUH_{new}) \times Hrs / 1,000,000) + ((SL_{base} - SL_{new}) \times SL\_Hrs / 1,000,000) = ((Quantity * Input\_btuh) / (Quantity * Input\_btuh + Other\_Water\_Heater\_btuh) * (8.33 * Gallons\_per\_1000\_ft2\_per\_day * Days\_per\_Year * SqFt\_Served / 1000 * (T\_setpoint - T\_supply) + Quantity * Standby\_Loss\_Base) / Baseline\_Efficiency - ((Quantity * Input\_btuh) / (Quantity * Input\_btuh + Other\_Water\_Heater\_btuh) * (8.33 * Gallons\_per\_1000\_ft2\_per\_day * Days\_per\_Year * Building\_Square\_Feet / 1000 * (T\_Stepoint - T\_Supply) + Quantity * Standby\_Loss\_New)) / Efficiency) / 100$
New Water Heater Savings (Dth)	
Pipe Insulation Savings (Dth)	= $LF \times Hrs \times (BTU\_per\_foot\_U - BTU\_per\_foot\_I) \times Existing / EFFb$
DeltaT	= $(T_{fluid} - T_{ambient})$
BTU_per_Foot	= $[Coef0 + (Coef1 \times \Delta T) + (Coef2 \times \Delta T^2) + (Coef3 \times \Delta T^3)] / EFFb$ The U or I designation after the name indicates Uninsulated or Insulated.
Custom Boiler savings (Dth)	Gas energy savings and any associated savings or increase in electrical energy will be calculated based on the project specific details. Each project will undergo an engineering review in accordance with standard engineering practices. The review will be in accordance with the calculation methodologies detailed in the prescriptive products where applicable.

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**Variables:**

BTUH_new	= Rated boiler or water heater Input BTUH nameplate data for the new boiler or water heater.
BTUH_existing	= Rated boiler or water heater Input BTUH nameplate data for the existing boiler or water heater that is being replaced or retrofitted with OA Reset dampers, Modulating Burner Controls, Tabulators or O2 Trim Controls.
Hrs	= 659 hrs/yr for space heating only boilers = 2,190 hrs/yr for domestic hot water only boilers = 1,443 hrs/yr for space heating & domestic hot water boilers Pipe insulation hours are given in Table 2. = 1,092 hrs/yr for commercial water heaters = 950 hrs/yr for commercial furnaces
SL_Hrs	= Standby loss hours for commercial water heaters = 8,760 hrs/yr
EFFb	= Efficiency of Baseline equipment. Refer Table 1 below
EFFh	= Efficiency for higher efficiency equipment. Refer Table 1 below.
SL_base	= Standby Losses for baseline storage water heater = <del>1,200-BTUH</del> -(Reference 4)-13.21 BTUH per gallon of storage (Ref 2)
SL_new	= Standby Losses for efficient water heater = <del>1,200-BTUH</del> 8.90 BTUH per gallon of storage (ref 2) for storage models and 0 BTUH for tankless models (Reference 4)
Leak_Hours	
Leak_Rate	=Leakage rate, pounds of steam per hour. High Pressure = 11, Low Pressure = 5 (Reference 5)
BTU_Per_Pound	<u>Low Pressure Applications:</u> = 1164 BTU per pound for lost to atmosphere, 964 BTU per pound lost to condensate. Assume 50/50 mix = 1064 BTU per pound. (Reference 5) <u>High Pressure Applications:</u> = 1181 BTU per pound for lost to atmosphere, 981 BTU per pound lost to condensate. Assume 50/50 mix = 1081 BTU per pound. (Reference 5)
LF	= Linear feet of insulation installed, provided by the customer.
Coef	= Heat loss polynomial equation coefficient. The number represents the power to which DeltaT is raised. Values for insulation/pipe combinations allowed in the product are listed in Table 7. Coefficients will be selected based on the pipe diameter, R (or k) value and insulation thickness provided by the customer.
k	= Thermal conductivity, btu-in/hr-ft <sup>2</sup> -F
R-Value	= Thermal Resistance, (1/k)*thickness(inches)
T <sub>fluid</sub>	= Average temperature of the fluid in the pipe receiving insulation in degrees F, provided by the customer.
T <sub>ambient</sub>	= Average temperature of the space surrounding the pipe. We will ask the customer if the pipe is in a conditioned space or outside. We will use 70 degrees for conditioned spaces and 51 degrees for outside domestic hot water (full year average) and 44 degrees for outside space heating (average excluding June-September) which are the average TMY3 temperatures for Colorado.

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Existing	= Pipe insulation savings multiplier to determine credit if existing deteriorated insulation is being replaced. We will use 1 if no existing insulation is present and 0.25 if existing insulation is being replaced.
1,000,000	= Conversion from BTU to Dth
Measure Life	= Length of time the boiler equipment will be operational = See table 8.
Incremental Cost	= Refer to Tables 3 to 6
NTG	Net-to-gross = 86% for all measures. Reference Tetra Tech Program Evaluation Report
ALT	Altitude Adjustment factor = 0.8 The output of the furnace is derated to 80% of sea level output
density	Density of water = 8.33 lbs/gal
C_p	Specific heat of water = 1 Btu / lb - F
Other_Water_Heater btuh	Capacity of other water heaters installed in the building, provided by the customer
Volume_Daily_SqFt_Usage	Average daily hot water consumption, use values from Table 9 [gallons / 1,000 ft2 / day].
Days_Year	Applicable days per year of building operation, if unknown use values from Table 9.
SqFt_Served	Number of Square feet served by water heater in thousands of square feet, site specific.
T_setpoint	Water heater setpoint = 140 deg F (1).
T_supply	Supply temperature of water heater = 58 deg F (1).
Eff_Rating_Standard	Efficiency Rating of standard replacement water heater, Thermal Efficiency = 80%
Eff_Rating_High	Efficiency Rating of high efficiency replacement water heater, Thermal Efficiency, provided by customer
Incremental Cost	Cost of the higher efficiency option over the baseline option for the end-use customer. (Table 11,12)
O&M Cost	Operating and Maintenance Cost is for tankless units only; annual cost = \$100 trip charge + \$300 per unit for a coil flush
Baseline new construction water heater	= a 100 gallon non-condensing storage water heater
Gallons_per_1000_ft2_per_day	Volume of hot water per SF of building as determined from Table 9.

### Needed from Customer/Vendor/Administrator for Calculations:

#### For boilers:

Boiler size rated at sea level (BTUH)

New boiler type (Non-Condensing or Condensing)

Boiler Use (Space heating and/or water heating)

#### Additional Information for Plan B boilers:

Efficiency of boiler being replaced

Current State of Colorado Inspection certificate indicating the age and active status of the boiler

#### For steam traps:

High or low pressure

Incremental cost

#### For all but boilers, steam traps, and pipe insulation:

Boiler size (BTUH)

Implemented measure

Incremental cost

#### For Insulation:

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Linear feet of insulation added  
Nominal diameter of pipe  
Thickness of insulation  
Insulation R-Value or thermal conductivity (k)  
Average fluid temperature  
Pipe location (conditioned space or not)  
Pipe use (Space heating and/or water heating)  
Was existing insulation replaced

### **For Water Heaters:**

Water heater type (Non-condensing or Condensing)  
Water heater storage capacity (Gallons) i.e. 0 if tankless  
Water Heater size rated at sea level (BTUH)  
Incremental cost

Building type

Square footage served by water heater

BTUH input capacity of existing water heaters

Thermal efficiency rating

### **For Furnaces:**

New furnace size (BTUH)  
New furnace efficiency

### **References:**

1. Arkansas Deemed Savings Quick Start Program Draft Report Commercial Measures Final Report, Nexant.
2. AHRI Directory of Certified Product Performance; average of Standby Loss in BTUH

## DEEMED SAVINGS TECHNICAL ASSUMPTIONS

### Assumptions:

- Each boiler is replaced with the same size on a 1 for 1 basis.
- Only boilers used for space and/or domestic water heating can receive prescriptive rebates; other boilers must go through Custom Efficiency.
- Climate zone assumed to be Denver for all boilers and water heaters
- Thermal Efficiency as defined in ASHRAE 90.1-2007 indicates the total efficiency of the boiler equal to 100% fuel energy minus all losses.
- The full load efficiency of condensing boiler is assumed to be 92%. For savings calculations, part load efficiency of 94% was used.
- The full load efficiency of the baseline Plan B boiler is assumed to be 78%. For savings calculations, the actual nameplate efficiency provided by the customer will be
- Standby losses are from the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) database based on a 100 gallon tank.
- Standby losses are equal for the baseline and efficient storage type water heaters and cancel out.
- Each furnace is replaced with the same size on a 1 for 1 basis.
- Prescriptive rebates are only given for furnaces put into service, rebates are not given for backup furnaces.
- Service life of typical furnace is 20 years (per FEMP), 15 years used in the calculations. Reference 10
- Furnaces must have a minimum efficiency of 92% AFUE for a rebate, and 94% AFUE or higher efficiency will receive a larger rebate.
- The baseline efficiency for the furnace is based on 2006 IECC, minimum of 78%.
- Efficiency of all furnaces is Annual Fuel Utilization Efficiency ("AFUE")
- For 175,000 Btu/h hot water boilers: 100% of capacity used for space heating. For 500,000-4,000,000 Btu/h boilers: 50% of capacity used for space heating, 50% of capacity used for hot water.

\*Condensing boiler efficiencies at part loads were taken from Tetra Tech's final report "Comprehensive Process and Impact Evaluation of the Business Heating Efficiency Program - Colorado" to Xcel Energy dated December 14, 2011

- Prescriptive rebates are only given for boilers put into service, rebates are not given for backup boilers. Even though we do not rebate backup boilers, our assumed hours have been conservatively reduced to 65% of the predicted hours to account for boiler redundancy.
- Steam boiler has condensate return.
- Assumed savings for boiler tune-up = 2% for non condensing boiler. This is an average value of the two years, 4% initial to no savings at the end of the two years. Life of product is 2 years. DOE states up to 5%.
- Assumed savings for outdoor air reset on non condensing boilers = 3%. Life of product is 20 years. The Natural Gas consortium states up to 5% savings
- Assumed savings for installing Stack dampers on non condensing boilers = 1%. Life of product is 12 years. Canada energy council, up to 4%
- Assumed savings for modulating burner controls on non condensing boilers = 3%. Life of product is 20 years. The Natural Gas consortium states up to 4% savings
- Assumed savings for O2 trim controls on non condensing boilers = 2%. Life of product is 20 years. The Natural Gas consortium states of 2 to 4% savings
- For boilers: Though the BTU input and output are affected by altitude, the efficiency stays the same, so the elevation effect is not considered.

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<b>Table 1: Heating Equipment Efficiencies</b>		
	<b>Baseline Efficiency (EFFb)</b>	<b>Efficient Efficiency (EFFh)</b>
New Boilers (Non-Condensing)	80.00%	85.00%
New Boilers (Condensing)	80.00%	94.00%
Replacement Boilers (Condensing)	78.00%	94.00%
Boiler Tune Up	78.00%	80.00%
Outdoor Air Reset	80.00%	83.00%
Stack Dampers	80.00%	81.00%
Modulating Burner Controls	80.00%	83.00%
O2 Trim Control	80.00%	82.00%
Steam Traps	80.00%	N/A
Commercial Furnaces	78.00%	<b>From Customer</b>
Water Heaters	80.00%	96.00%
Pipe Insulation	80.00%	N/A

<b>Table 2: Hours for Pipe Insulation</b>			
<b>Use of Pipe</b>	<b>Location</b>	<b>Pipe Insulation Hours</b>	<b>Explanation</b>
Domestic Hot Water	Inside	5,584	Hours when outside temp is above building balance point. Heat loss from pipe is wasted
Domestic Hot Water	Outside	8,760	Domestic hot water available year round, outside temp is always less than 120 F.
Space Heating	Inside	2,622	Hours when boiler is running but outdoor temp is above building balance point
Space Heating	Outside	6,000	Hours that boiler is running

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Boiler Nameplate Capacity	Non-condensing		Condensing	Incremental	Incremental	Incremental
	Baseline	High Efficient - Non Condensing	High Efficient - Condensing	Baseline to High Efficient - Non Condensing	Baseline to High Efficient - Condensing	Plan B Replacement High Efficient - Condensing
175,000 Btuh	\$3,000	\$3,500	\$4,600	\$500	\$1,600	\$6,613
500,000 Btuh	\$5,000	\$9,000	\$11,200	\$4,000	\$6,200	\$16,951
1,000,000 Btuh	\$7,300	\$11,700	\$15,000	\$4,400	\$7,700	\$26,502
2,000,000 Btuh	\$12,000	\$17,000	\$26,500	\$5,000	\$14,500	\$49,504
4,000,000 Btuh	\$24,000	\$34,000	\$53,000	\$10,000	\$29,000	\$99,008
6,000,000 Btuh	\$36,000	\$51,000	\$79,500	\$15,000	\$43,500	\$148,512
8,000,000 Btuh	\$48,000	\$68,000	\$106,000	\$20,000	\$58,000	\$198,016

Water Heater Nameplate Capacity	Baseline	High Efficient	Incremental
Commercial Water Heater - Condensing; 125 MBTUH	\$3,105	\$4,006	\$901
Commercial Water Heater - Condensing; 160 MBTUH	\$3,512	\$4,530	\$1,018
Commercial Water Heater - Condensing; 199 MBTUH	\$3,450	\$4,450	\$1,000
Commercial Water Heater - Condensing; 300 MBTUH	\$5,959	\$7,687	\$1,728
Commercial Tankless Water Heater - Condensing; 150 MBTUH	\$4,284	\$5,526	\$1,242
Commercial Tankless Water Heater - Condensing; 199.9 MBTUH	\$3,450	\$4,450	\$1,000

Boiler Tune Up	Actual costs will be provided by customer
Outdoor Air Reset	Actual costs will be provided by customer
Stack Dampers > 750 Mbtuh	Actual costs will be provided by customer
Stack Dampers > 750 Mbtuh	Actual costs will be provided by customer
Modulating Burner Controls < 750 Mbtuh	Actual costs will be provided by customer
Modulating Burner Controls > 750 Mbtuh	Actual costs will be provided by customer
O2 Trim Control	Actual costs will be provided by customer
Steam Traps	Actual costs will be provided by customer
Pipe Insulation	Actual costs will be provided by customer

Btu Input	Incremental Cost
60,000	\$804.95
70,000	\$782.26
80,000	\$775.83
90,000	\$785.68
100,000	\$811.80
115,000	\$893.02
120,000	\$912.86
125,000	\$948.29
140,000	\$1,079.00

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Table 7: Pipe Insulation polynomial equation coefficients and incremental cost

Pipe Nominal Diameter (inches)	Insulation Thickness (Inches)	Polynomial Coefficients, Uninsulated				Polynomial Coefficients, Insulated			
		Coef0	Coef1	Coef2	Coef3	Coef0	Coef1	Coef2	Coef3
0.50	1.0	-3.0374E+00	4.5690E-01	8.6645E-04	4.0333E-07	-1.4187E-01	9.4515E-02	9.5675E-05	2.0500E-07
0.50	1.5	-3.0374E+00	4.5690E-01	8.6645E-04	4.0333E-07	-9.3332E-02	7.8916E-02	7.4175E-05	1.7167E-07
0.75	1.0	-3.6084E+00	5.5068E-01	1.0738E-03	4.9833E-07	-1.8348E-01	1.1210E-01	1.1840E-04	2.4000E-07
0.75	1.5	-3.6084E+00	5.5068E-01	1.0738E-03	4.9833E-07	-1.1155E-01	9.0618E-02	8.7550E-05	1.9667E-07
1.00	1.0	-4.4355E+00	6.6986E-01	1.3218E-03	6.3167E-07	-1.9200E-01	1.1754E-01	1.2070E-04	2.5333E-07
1.00	1.5	-4.4355E+00	6.6986E-01	1.3218E-03	6.3167E-07	-1.1202E-01	9.8294E-02	9.6075E-05	2.1167E-07
1.25	1.0	-5.7434E+00	8.3004E-01	1.5980E-03	8.8500E-07	-2.9272E-01	1.4849E-01	1.5975E-04	3.1667E-07
1.25	1.5	-5.7434E+00	8.3004E-01	1.5980E-03	8.8500E-07	-1.3118E-01	1.0982E-01	1.0618E-04	2.3833E-07
1.50	1.0	-6.3813E+00	9.3332E-01	1.8326E-03	9.9000E-07	-2.7700E-01	1.5147E-01	1.5938E-04	3.2500E-07
1.50	1.5	-6.3813E+00	9.3332E-01	1.8326E-03	9.9000E-07	-1.6005E-01	1.2339E-01	1.2200E-04	2.6667E-07
2.00	1.0	-7.7082E+00	1.1384E+00	2.2752E-03	1.2350E-06	-3.3948E-01	1.7646E-01	1.8525E-04	3.8333E-07
2.00	1.5	-7.7082E+00	1.1384E+00	2.2752E-03	1.2350E-06	-2.0389E-01	1.4083E-01	1.3790E-04	3.0667E-07
2.50	1.5	-9.3690E+00	1.3590E+00	2.6993E-03	1.5500E-06	-1.7869E-01	1.4528E-01	1.4075E-04	3.1667E-07
2.50	2.0	-9.3690E+00	1.3590E+00	2.6993E-03	1.5500E-06	-1.3498E-01	1.2739E-01	1.1985E-04	2.7667E-07
3.00	1.5	-1.1275E+01	1.6288E+00	3.2514E-03	1.9067E-06	-2.6414E-01	1.8400E-01	1.8783E-04	3.9500E-07
3.00	2.0	-1.1275E+01	1.6288E+00	3.2514E-03	1.9067E-06	-1.7765E-01	1.5601E-01	1.5245E-04	3.3667E-07
4.00	1.5	-1.4044E+01	2.0490E+00	4.1818E-03	2.3833E-06	-3.3314E-01	2.2060E-01	2.2868E-04	4.7167E-07
4.00	2.0	-1.4044E+01	2.0490E+00	4.1818E-03	2.3833E-06	-2.3785E-01	1.8565E-01	1.8200E-04	4.0000E-07
5.00	1.5	-1.6652E+01	2.4856E+00	5.2152E-03	2.8167E-06	-4.5046E-01	2.6745E-01	2.7580E-04	5.8000E-07
5.00	2.0	-1.6652E+01	2.4856E+00	5.2152E-03	2.8167E-06	-2.9805E-01	2.2138E-01	2.1908E-04	4.7833E-07
6.00	1.5	-2.0439E+01	2.9514E+00	6.0177E-03	3.6500E-06	-6.1558E-01	3.1278E-01	3.1310E-04	6.9333E-07
6.00	2.0	-2.0439E+01	2.9514E+00	6.0177E-03	3.6500E-06	-3.4456E-01	2.4953E-01	2.4818E-04	5.3833E-07
8.00	1.5	-2.6767E+01	3.8025E+00	7.6705E-03	4.9667E-06	-6.9016E-01	3.7481E-01	3.9035E-04	8.1000E-07
8.00	2.0	-2.6767E+01	3.8025E+00	7.6705E-03	4.9667E-06	-1.4066E+00	3.3454E-01	9.9850E-05	1.1100E-06
10.00	1.5	-3.1882E+01	4.6589E+00	9.7102E-03	5.8167E-06	-8.7637E-01	4.4116E-01	4.4313E-04	9.7500E-07
10.00	2.0	-3.1882E+01	4.6589E+00	9.7102E-03	5.8167E-06	-5.2419E-01	3.5989E-01	3.6058E-04	7.7833E-07
12.00	2.0	-3.8751E+01	5.5187E+00	1.1240E-02	7.3333E-06	-1.0195E+00	5.1188E-01	5.2188E-04	1.1250E-06
12.00	2.0	-3.8751E+01	5.5187E+00	1.1240E-02	7.3333E-06	-5.6113E-01	4.1443E-01	4.3003E-04	8.8167E-07

**Note:**  
 The updated coefficients were developed using the NAIMA 3E Plus 4.0 Software.  
 The following assumptions were used:  
 Base metal - Steel  
 Insulation - 650F min.Fiber Pipe and Tank, Type II, C1393-00a  
 Jacket Material – 0.13 Stainless Steel, new, cleaned  
 Ambient Temperature -45F  
 Wind Speed - 0mph  
 Max Surface Temp - 140F  
 System Application - Pipe Horizontal  
 System Units - ASTM C585



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<b>Table 8: Measure Lives</b>		
<b>Measure</b>	<b>Product Life (yrs)</b>	<b>Source of Information</b>
<b>Hot Water Boilers (Non-condensing)</b>		
Hot Water Boiler - Non-condensing 175 MBTUH	20	Federal Energy Management Program
Hot Water Boiler - Non-condensing 500 MBTUH	20	Federal Energy Management Program
Hot Water Boiler - Non-condensing 1MMBTUH	20	Federal Energy Management Program
Hot Water Boiler - Non-condensing 2 MMBTUH	20	Federal Energy Management Program
Hot Water Boiler - Non-condensing 4 MMBTUH	20	Federal Energy Management Program
Hot Water Boiler - Non-condensing 6 MMBTUH	20	Federal Energy Management Program
Hot Water Boiler - Non-condensing 8, MMBTUH	20	Federal Energy Management Program
<b>Hot Water Boilers (Condensing)</b>		
Hot Water Boiler - Condensing 175 MBTUH	20	Federal Energy Management Program
Hot Water Boiler - Condensing 500 MBTUH	20	Federal Energy Management Program
Hot Water Boiler - Condensing 1 MMBTUH	20	Federal Energy Management Program
Hot Water Boiler - Condensing 2 MMBTUH	20	Federal Energy Management Program
Hot Water Boiler - Condensing 4 MMBTUH	20	Federal Energy Management Program
Hot Water Boiler - Condensing 6 MMBTUH	20	Federal Energy Management Program
Hot Water Boiler - Condensing 8 MMBTUH	20	Federal Energy Management Program
<b>Commercial Furnaces</b>	15	Federal Energy Management Program
<b>Commercial Water Heaters</b>		
Commercial Hot Water Heater - Condensing; 125 MBTUH	15	Federal Energy Management Program
Commercial Hot Water Heater - Condensing; 160 MBTUH	15	Federal Energy Management Program
Commercial Hot Water Heater - Condensing; 199 MBTUH	15	Federal Energy Management Program
Commercial Hot Water Heater - Condensing; 300 MBTUH	15	Federal Energy Management Program
Commercial Tankless Hot Water Heater - Non-condensing; 150 MBTUH	15	Federal Energy Management Program
Commercial Tankless Hot Water Heater - Non-condensing; 199 MBTUH	15	Federal Energy Management Program
Commercial Tankless Hot Water Heater - Non-condensing; 399 MBTUH	15	Federal Energy Management Program
Commercial Tankless Hot Water Heater - Non-condensing; 500 MBTUH	15	Federal Energy Management Program
<b>Steam Traps</b>		
Gas Boiler - Steam Traps - Low Pressure - average of 10 and 15 PSI	5	Internet
Gas Boiler - Steam Traps - High Pressure - average of 50 PSI and 65 PSI		
Boiler Tune Ups	2	Federal Energy Management Program
<b>Pipe Insulation</b>		
Insulation - Hot Water System	15	Federal Energy Management Program
Insulation - Steam System	15	Federal Energy Management Program

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**Table 9: Annual Hot Water Use Data (Ref 3)**

<b>Building Type</b>	<b>Applicable Days/Year</b>	<b>Gallons / 1,000 ft<sup>2</sup> / day</b>
Small Office	250	2.3
Large Office	250	2.3
Fast Food Restaurant	365	549.2
Sit-Down Restaurant	365	816.0
Retail	365	2.0
Grocery	365	2.2
Warehouse	250	1.0
Elementary School	200	5.7
Jr. High/High School/College	200	17.1
Health	365	342.0
Motel	365	100.0
Hotel	365	30.8
Other Commercial	250	0.7
Industrial	Site Specific	Site Specific

**Table 10: Baseline Equipment Sizing compared to New Construction Tankless**

<b>Customer Segment</b>	<b>Sizing multiplier for equivalent Storage System with 100 gallons of storage</b>
Fast Food Restaurant	48%
Sit-Down Restaurant	54%
Elementary School	52%
Junior High School	88%
Motel	98%
Apartment Building	51%
Fitness Center	65%
Other	65%

## DEEMED SAVINGS TECHNICAL ASSUMPTIONS

**Table 11: Incremental Cost per Nameplate Input BTUH for Storage Water Heater per 100 gallons of storage**

<b>Customer Segment</b>	<b>\$/BTUH</b>
Fast Food Restaurant	0.0326
Sit-Down Restaurant	0.0056
Elementary School	0.0056
Junior High School	0.0085
Motel	0.0056
Apartment Building	0.0340
Fitness Center	0.0085
Other	0.0144

**Table 12: Incremental Cost per Nameplate Input BTUH for Tankless Water Heater**

<b>Customer Segment</b>	<b>\$/BTUH</b>
Fast Food Restaurant	0.0105
Sit-Down Restaurant	0.0044
Elementary School	0.0044
Junior High School	-0.0049
Motel	-0.0080
Apartment Building	0.0105
Fitness Center	0.0037
Other	0.0029

**References:**

3. Minnesota DER Deemed Values