DEEMED SAVINGS TECHNICAL ASSUMPTIONS

Program: Home Energy Squad - CO

Description:

Residential electric and natural gas customers can have energy efficiency measures directly installed while paying for certain material and/or contractor costs.

Program References:

~~CFL Lighting Measures~~	~~Refer to Product "CO Home Lighting & Recycling" formulas for (Gross kW, Gross Annual kWh, Gross Coincident kW, etc.) for the "Replace incandescent lamps with CFLs" measure, except kW_Savings_per_Bulb will be determined by subtracting the wattage of the direct-installed bulb from the actual bulb removed.~~
~~CFL Lighting Measures~~	~~Refer to Product "CO Home Lighting & Recycling" reference table for "CFL" values.~~
LED Lighting Measures	Refer to Product "CO Home Lighting & Recycling" formulas for (Gross kW, Gross Annual kWh, Gross Coincident kW, etc.) for the "Replace incandescent lamps with LEDs" measure, except kW_Savings_per_Bulb will be determined by subtracting the wattage of the direct-installed bulb from the actual bulb removed.
LED Lighting Measures	Refer to Product "CO Home Lighting & Recycling" reference table for "LED" values (Hours and Coincidence Factor)
Measure "Direct Install - Low-Flow Showerhead"	Refer to Product "CO Energy Efficient Showerhead" formulas for (Gross kW, Gross Annual kWh, Gross Coincident kW, etc.) for the "Provide Efficient Showerhead" measure.
Measure "Direct Install - Low-Flow Showerhead"	Refer to Product "CO Energy Efficient Showerhead" reference table for "Low-Flow Showerhead" values.
Measure "Direct Install - Kitchen Aerator"	Refer to Product "CO Energy Efficient Showerhead" formulas for (Gross kW, Gross Annual kWh, Gross Coincident kW, etc.) for the "Provide Kitchen Faucet Aerator" measure.
Measure "Direct Install - Kitchen Aerator"	Refer to Product "CO Energy Efficient Showerhead" reference table for "Kitchen Aerator" values.
Measure "Direct Install - Bath Aerator"	Refer to Product "CO Energy Efficient Showerhead" formulas for (Gross kW, Gross Annual kWh, Gross Coincident kW, etc.) for the "Provide Bath Faucet Aerator" measure.
Measure "Direct Install - Bath Aerator"	Refer to Product "CO Energy Efficient Showerhead" reference table for "Bath Aerator" values.
Measure "Weatherstrip Door"	Refer to Product "CO Insulation" formulas for (Gross kW, Gross Annual kWh, Gross Coincident kW, etc.) for the "Air Sealing" measure.
Measure "Weatherstrip Door"	Refer to Product "CO Insulation" reference table for ""Air Sealing" values with the following exceptions: CFM50_Baseline and CFM50_Proposed are calculated below in the equations section.
Measure "Smart Thermostat"	Refer to Product "CO Smart Thermostat & Optimization" formulas for (Gross kW, Gross Annual kWh, Gross Coincident kW, etc.) for the "Smart Thermostat" measure.
Measure "Smart Thermostat"	Refer to Product "CO Smart Thermostat & Optimization" reference table for "Smart Thermostat" values. Equipment Incremental costs shown in forecast are estimates only. Actual costs will be utilized.

DEEMED SAVINGS TECHNICAL ASSUMPTIONS

Equations:

TV & Electronics Controller Electrical Energy Savings (Gross Annual kWh)	= (Measured_Watts_WO - Measured_Watts_WITH) / 1000 x Controller_Hours
TV & Electronics Controller Electrical Demand Savings (Gross kW)	= (Measured_Watts_WO - Measured_Watts_WITH) / 1000
Programmable Thermostat Electrical Energy Savings (Gross Annual kWh)	= Cooling_Delta_T x kWh_Savings_per_Degree
Programmable Thermostat Electric Demand Savings (Gross kW)	= Cooling_Delta_T x kW_Savings_per_Degree
Programmable Thermostat Electric Peak Coincident Demand Savings (PC kW)	= Cooling_Delta_T x kW_Savings_per_Degree x Coincidence_Factor
Programmable Thermostat Gas Savings (Gross Dth/Yr)	= Heating_Delta_T x Dth_Savings_per_Degree
Water Heater Blanket Electrical Energy Savings (Gross Annual kWh)	= (WH_Tank_Size / 45) x (HLF before - HLF with blanket) x 8760 / HE_Elec / 3412
Water Heater Blanket Electrical Demand Savings (Gross kW)	= (WH_Tank_Size / 45) x (HLF before - HLF with blanket) x 8760 / HE_Elec / 3412 / Hr_WH_Operation
Water Heater Blanket Gas Savings (Gross Dth/Yr)	= (WH_Tank_Size / 45) x (HLF before - HLF with blanket) x 8760 / HE_Gas / 1,000,000
Water Heater Temperature Setback Gas Savings (Gross Dth/Yr)	= (WH_S_Baseline - WH_S_Proposed) / 10
CFM50_Baseline	= (Air_Gap_Base X Gap_Length)/LAF, CFM at 50 pascals similar to blower door tests results. For use in "Air Sealing" equations.
CFM50_Proposed	= (Air_Gap_Eff X Gap_Length)/LAF, CFM at 50 pascals similar to blower door test results. For use in "Air Sealing" equations.

DEEMED SAVINGS TECHNICAL ASSUMPTIONS

Variable ID	Value	Description
Measured_Watts_WO	Vendor Input	Measured demand for appliances that will be connected to controller before controller is installed
Measured_Watts_WITH	Vendor Input	Measured demand for controller with appliances connected when controller is in off state
Controller_Hours	Vendor Input	Hours of operation for the controller determined for each customer based on interview results.
HE_Elec	1.00	Heat generation efficiency for electric water heater based on steady-state water heater efficiency.
HE_Gas	0.80	Heat generation efficiency for gas water heater based on steady-state water heater efficiency.
Hr_WH_Operation	8760	Annual water heater "on" time
HLF_Before	237	Heat loss in BTU/hr based on a 45 gallon average of water heater sizes with 2" of polyurethane insulation at 135 F degrees.
HLF_with_blanket	138	Heat loss in BTU/hr based on a 45 gallon average of water heater sizes with 2" of polyurethane insulation at 135 F degrees plus an additional 2.5" fiberglass blanket.
WH_Tank_Size	Vendor Input	Tank Size of customer's Water Heater
WH_S_Baseline	26.18	Baseline gas water heater shell losses, Therms/year
WH_S_Proposed	22.44	Proposed gas water heater shell losses, with -10 F adjustment of setpoint, Therms/year
Cooling_Delta_T	Vendor Input	One-week weighted average temperature difference between normal operation and cooling setback temperature in degrees F, based on information provided by the customer during the interview.
kW_Savings_per_Degree	0.106	kW per degree F of setback (Reference 1, 2)
kWh_Savings_per_Degree	88.61	kWh per degree F of setback (Reference 1, 2)
kW_Savings_per_Degree_2	0.053	kW per degree F of setback for second thermostat = half of savings for first thermostat (Reference 1, 2)
kWh_Savings_per_Degree_2	44.30	kWh per degree F of setback for second thermostat = half of savings for first thermostat (Reference 1, 2)
Heating_Delta_T	Vendor Input	One-week weighted average temperature difference between normal operation and heating setback temperature in degrees F, based on information provided by the customer during the interview.
Dth_Savings_per_Degree	1.754	Dth per degree F of setback (Reference 1, 2)
Dth_Savings_per_Degree_2	0.877	Dth per degree F of setback for second thermostat = half of savings for first thermostat (Reference 1, 2)
Air_Gap_Base	0.56	Effective Air Leakage Area per foot of door gap for door without weatherstripping. (Reference 5)
Air_Gap_Eff	0.15	Effective Air Leakage Area per foot of door gap for door with weatherstripping. (Reference 5)
Gap_Length	Vendor Input	Length of weatherstripping installed. Provided by contractor.
Air_Density	See Table 2	Density of air, Lbm / ft^3. Values for different climate zones provided in Table 2.
LAF	See Table 2	Leakage Area Factor calculated from formula below for use in calculating CFM50 from a gap area in the building envelope. Values for different climate zones provided in table 2. "= 0.186 X SQRT (Air_Density / (2 X Ref_Pressure)) / Discharge_Coefficient
Ref_Pressure	0.20	Reference pressure, inches WC, equivalent to 50 Pa
Discharge_Coefficient	1.00	Discharge coefficient for opening, dimensionless
Coincidence Factor	See Table 1	Coindicence Factor for lighting, programmable thermostat, door weatherstrip, and water heater blanket.
Measure Life	See Table 1	Measure life for lighting, programmable thermostat, door weatherstrip, and water heater blanket.
Incremental Cost	See Table 1	Incremental cost for lighting, second programmable thermostat, second door weatherstrip.
NTG	100%	Net-to-gross factor. Assumed to be 100% for a new program.
Lamp Lifetime	25000	Lifetime of lamps installed through the program. Spec sheets provided by vendor
Baseline Lamp Wattage	Vendor Input	Wattage of the lamp types being removed. Recorded by vendor during visit.
Proposed Lamp Wattage	Vendor Input	Wattage of the lamp types being installed provided by vendor after installation.

DEEMED SAVINGS TECHNICAL ASSUMPTIONS

Table 1: Measure Life, Coincidence Factor, and Hours (Reference 3)

Type of measure:	Measure life:	Incremental Cost:	Coincidence Factor:	Hours of Operation	
Programmable thermostat (Cooling)	10	$ 30	76%		Reference 6
Programmable thermostat (Heating)	10	$ 30	0%		
Weatherstripping (electrically heated and cooled homes)	10	$ 10	19%		Reference 10
Weatherstripping (electrically cooled and gas heated homes)	10	$ 10	90%		Reference 2
Water heater blanket elec HW	7.5	na	100%	8760	
Water heater temperature setback	8	$ 0			
TV & Electronics Controller	5	$ 20	80%		

Table 2: Leakage Area Factor (Reference 4)

	Front Range	Western Slope	Mountain
Air Density	0.0619	0.0629	0.0565
Leakage Area Factor	0.0730	0.0736	0.0698

References:

1. Energy Information Administration's (EIA) 2009 Residential Energy Consumption Survey (RECS)
2. Bin analysis using RECS data for thermostat operation and typical CO home cooling and heating conditions.
3. Consumer Electronics Characteristics http://standby.lbl.gov/summary-table.html
4. 2013 ASHRAE Fundamentals, Chapter 16
5. Door leakage from Colorado Energy Office website: http://www.coloradoenergy.org/procorner/stuff/window_air_leakage.htm
6. Lifetime of 5 years for door weatherstripping and 10 years for programmable T-Stats from "Measure Life Report Residential and Commercial/Industrial Lighting and HVAC Measures", June 2007 by GDS Associates.
7. Lifetime of 5 years for TV controller/timer based on DEER database from READI v2.3.0 for Res-Plug-AdvPwrStrip Ex Ante 2015
8. These numbers are based on "CO Home Lighting & Recycling" analysis and references provided in that program.
9. Based on spec sheet of lamps used in direct install of program
10. Colorado House Bill 2019 1231

Changes from 2017 / 2018 Plan

Revised weatherstripping savings calculations so they are consistent with changes in air sealing calculations.
Updated savings methodology for water heater blankets and setback of gas water heater temperature setpoint.
Removed CFL lamps from the program
Added LED lamps to the program