DEEMED SAVINGS TECHNICAL ASSUMPTIONS

Program: Low Income SF Weatherization - CO

Description:

Residential income-qualified natural gas and electricity customers have energy efficiency measures performed at no cost.

Program References:

Measures "Refrigerator Replacements"	Refer to Program "Refrigerator Recyling - CO" to find formulas for (Customer Dth, Customer kW, Customer kWh, Customer PCkW, etc.) for all "Refrigerator Replacements" measures.
Measures "Heating Efficiency" and "EC Motor Furncace Fan"	Refer to Program "Residential Heating - CO" to find formulas for (Customer Dth, Customer kW, Customer kWh, Customer PCkW, etc.) for all "Heating Efficiency" measures.
Measures for "Water Heating Efficiency"	Refer to Program "Water Heating - CO" to find formulas for (Customer Dth, Customer kW, Customer kWh, Customer PCkW, etc.) for all "Water Heating Efficiency" measures.
Measures "Attic Insulation", "Wall Insulation", and "Air Sealing"	Refer to Program "Insulation Rebates - CO" to find formulas for (Customer kW, Customer kWh, Customer PCkW, etc.) for all "Attic Insulation", "Wall Insulation", and "Air Sealing" measures.
Measures "LEDs"	Refer to Program "Home Lighting and Recycling - CO" to find formulas for (Customer kW, Customer kWh, Customer PCkW, etc.) for the "LED" measures.
Mearsures "Provide Efficient Showerhead"	Refer to Program "Energy Efficient Showerhead - CO" to find formulas for Customer Dth, Customer kWh, customer kW, customer PCkW, etc. for the "Efficient Showerhead" measures.
Measures "Provide Efficient Kitchen Faucet Aerator"	Refer to Program "Energy Efficient Showerhead - CO" to find formulas for Customer Dth, Customer kWh, customer kW, customer PCkW, etc. for the "Efficient Kitchen Faucet Aerator" measure.
Measures "Provide Efficient Bath Faucet Aerator"	Refer to Program "Energy Efficient Showerhead - CO" to find formulas for Customer Dth, Customer kWh, customer kW, customer PCkW, etc. for the "Efficient Bath Faucet Aerator" measure.
Measures "Install New Thermostat"	Refer to Program "Home Energy Squad - CO" to find formulas for Customer Dth, Customer kWh, customer kW, customer PCkW, etc. for the "Install New Thermostat" measure.
Measures "Water Heater Blanket"	Refer to Program "Home Energy Squad - CO" to find formulas for Customer Dth, Customer kWh, Customer kW, Customer PCkW, etc. for the measure "Water Heater Blanket".
Measures "Heating Efficiency" and "EC Motor Furnace Fan"	Refer to Program "Residential Heating - CO" to find values for Heating Hours, Coincidence Factors, Measure Life, EC Motor Baseline Watts and EC Motor Efficient Watts and EC Motor Operating Hours.
Measures "Attic Insulation", "Wall Insulation", "Crawl Space Wall", and "Air Sealing"	Refer to Program "Insulation Rebates - CO" to find reference table for Measure Life, Deemed and Customer Inputs, Heating and Cooling Degree Days, Climate Zone data, Heating and Cooling Hour Data values, Measure Life.

DEEMED SAVINGS TECHNICAL ASSUMPTIONS

Measures "Storm Windows"	Refer to Program "Residential Heating - CO" to find values for Heating Hours, Measure Life. For use in the Storm Windows Customer kW calculation.
Measure "Provide Efficient Showerhead"	Refer to Program "Energy Efficient Showerhead - CO" to find reference table for "Gas Split Factor", "Measure Life", "Hours", "Coincidence Factor", etc values.
Measures "Provide Efficient Kitchen Faucet Aerator"	Refer to Program "Energy Efficient Showerhead - CO" to find reference table for "Gas Split Factor", "Measure Life", "Hours", "Coincidence Factor", etc values.
Measures "Provide Efficient Bath Faucet Aerator"	Refer to Program "Energy Efficient Showerhead - CO" to find reference table for "Gas Split Factor", "Measure Life", "Hours", "Coincidence Factor", etc values.
Measures "Water Heating Efficiency"	Refer to Program "Water Heating - CO" to find references for baseline water heater efficiency, tank sizes, Measure Life, incremental costs.
Measures "Install New Thermostat"	Refer to Program "Home Energy Squad - CO" to find references and deemed savings values, Measure Life for the "Install New Thermostat" measure.
Measures "Water Heater Blanket"	Refer to Program "Home Energy Squad - CO" to find references for deemed savings values, tank sizes, Measure Life, incremental costs.
Measure "Provide Efficient Showerhead"	Refer to Program "Energy Efficient Showerhead - CO" to find reference table for Operation and Maintenance cost savings value due to water savings.
Measures "Provide Efficient Kitchen Faucet Aerator"	Refer to Program "Energy Efficient Showerhead - CO" to find reference table for Operation and Maintenance cost savings value due to water savings.
Measures "Provide Efficient Bath Faucet Aerator"	Refer to Program "Energy Efficient Showerhead - CO" to find reference table for "Operation and Maintenance cost savings", value due to water savings.

Algorithms:

Crawl Space Wall Insulation:

Customer Dth	= (1 / R_Crawl_Space_Wall_Base - 1 / R_Crawl_Space_Wall_Proposed) * Wall_Area * HDD_Insulation * 24 / 1,000,000 / Heating_Eff_Gas
Customer kWh	= (1 / R_Crawl_Space_Wall_Base - 1 / R_Crawl_Space_Wall_Proposed) * Wall_Area * HDD_Insulation * 24 / 3,412 / Heating_Eff_Elec
Customer kW	= Customer kWh / (Heating_Hours)
Customer PCkW	= Customer_kW * CF

Tune-up:

Boiler Tune Up savings (Gross Dth)	= Input Capacity x Alt x ((EFFh / EFFb) - 1) x EFLH
Furnace Tune Up savings (Gross Dth)	= Input Capacity x Alt x ((EFFh / EFFb) - 1) x EFLH

DEEMED SAVINGS TECHNICAL ASSUMPTIONS

Boilers:

Customer Therms F_Res_Heat_Therm__c	(((Size * Proposed_Efficiency)/Baseline_Efficiency) - Size) * (1- Oversize_Factor) * (Furnace_Hours / 100000)* Qty_Prop_Equip

Storm Window Equations:

Storm Windows Customer kW	= Customer kWh / Heating_Hours

Refrigerator Replacement Equations:

Customer kW	= Customer kWh / (Operating_Hours)

Variables:

R_Crawl_Space_Wall_Base	4.41	R-Value for baseline wall insulation, calculated assuming no cavity insulation
R_Crawl_Space_Wall_Proposed	20.34	R-Value for proposed crawl space wall insulation, calculated assuming R-19 cavity insulation
CF	0%	Insulation Coincidence Factor in electrically heated homes.
Crawlspace Insulation Measure Life	20.00	Measure Life for crawl space insulation. Reference 3
Tuneup Measure:	**Value**	
Input Capacity	Customer Input	Size of the unit in BTUh
Alt	0.792	Altitude correction factor for Denver
EFFh	80%	Efficiency of the unit after the tune-up
EFFb	75%	Efficiency of the unit before tune-up
EFLH	Table 4	Full load heating hours of the unit
Boilers:	**Value**	
I_Qty_Prop_Equip__c	Customer Input	
I_Size__c	Customer Input	Rated new furnace or boiler Input BTUH nameplate data provided by customer on rebate form.
Baseline_Efficiency__c	80%	Efficiency of baseline code minimum boiler (Reference 10)
Proposed_Efficiency__c	Customer Input	Efficiency for higher efficiency boiler will be provided by the customer on the rebate form.
Furnace_Hours	1,054	Equivalent Full Load Heating Hours assumed for installed high efficiency boiler equipment
Storm Window Variables:	**Value**	
Customer kWh Savings	Table 3	Storm window savings in electrically heated homes.
Customer Dth savings	Table 2	Storm window savings in gas heated homes.
CF	0%	Storm window Coincidence Factor in electrically heated homes.
Storm Window Installation	$1,225.00	Incremental Cost for Storm window installation. (Reference 5)
Storm Window Measure Life	20.00	Life of the installed Storm Windows. (Reference 3)
Furnace_Size_Mobile_Home	57.9	MBTUH of new fuel fired heating equipment for Mobile homes (Reference 1)
Furnace_Size_Site_Built	65.9	MBTUH of new fuel fired heating equipment for Site Built homes (Reference 1)

DEEMED SAVINGS TECHNICAL ASSUMPTIONS

Refrigerator Recycling Variables:	**Value**	
Customer kWh Refrigerator **Replacement**	204	Refrigerator replacement energy savings kWh
Refrigerator Hours	5,592	Operating Hours for the refrigerator
CF	64%	Coincidence Factor for Refrigerator measures
Refrigerator Replacement Measure Life	18	Measure Life for Refrigerator Replacement measure based on program data
LED Variables:	**Value**	
kW_Bulb_New	Customer Input	Efficient Lamp Wattage provided by Vendor.
kW_Bulb_Existing	Customer Input	Baseline Lamp Wattage collected by Vendor during installation
Lamp Rated Life	25,000	Rated hours for lamp installed. Provided by vendor
New Programmable T-Stat:	**Value**	
Heating_Delta_T	3.37	Deemed one-week weighted average temperature difference between normal operation and heating setback temperature in degrees F.

DEEMED SAVINGS TECHNICAL ASSUMPTIONS

Inputs:

Inputs as required by referenced programs		
Wattage of CFLs Installed	Customer Input	
Quantity of CFLs Installed by wattage	Customer Input	
Quantity of Refrigerators Replaced	Customer Input	
R-Value of existing Attic Insulation	Customer Input	R-value of existing insulation without adjustments for structure or air films.
R-Value of as-built Attic Insulation	Customer Input	Overall R-value of insulation at completion of work; existing plus new insulation.
Attic Insulation Square Feet Installed	Customer Input	
Wall Insulation Square Feet Installed	Customer Input	
Crawl Space Insulation Square Feet Installed	Customer Input	
EFFn of new heating equipment	Customer Input	
EFn of new domestic water heating equipment	Customer Input	
Blower Door Test-in CFM50	Customer Input	
Blower Door Test-out CFM50	Customer Input	
Conditioned Square Footage	Customer Input	
Climate Zone (Front Range, Western Slope, or Mountains)	Customer Input	
Quantity of Storm Windows Installed	Customer Input	
Quantity of Showerhead or Aeroator Installed	Customer Input	
New Thermostat Installed	Customer Input	Assume that only one T-stat will be provided per home.
Wattage of LED A-Style Lamps Installed	Customer Input	
Quantity of LED A-Style Lamps Installed by wattage	Customer Input	
Wattage of LED BR-Style Lamps Installed	Customer Input	
Quantity of LED BR-Style Lamps Installed by wattage	Customer Input	
WH_Tank_Size	Customer Input	Tank Size of customer's Water Heater

Assumptions:

Work performed in coordination with the Governors Energy Office

Tables:

Table 1: Home Characteristics (Reference 1)

Category	Characteristic	Evaluation Result	Units	Home Type
Envelope and Mechanical Systems	Home Type	Mobile and Site Built		Specified
	Location	Multiple Regions		Both
	Conditioned Floor Area	961	SF	Mobile
		1451	SF	Site Built
	Number of Bedrooms	Two		Mobile
		Three		Site Built
	Foundation Type	Open Crawlspace		Mobile
		Enclosed Crawlspace		Site Built
	Foundation Wall Type	Mobile Home Skirt		Mobile
		R-11 Draped Insulation		Site Built
	Home Complexity	Four Corners		Both
	Nominal Ceiling Height	7.6	FT	Mobile
		8.2	FT	Site Built
	Ceiling Type Baseline	REM/Rate Default		Mobile
		R-11 + Grade III		Site Built
	Above Grade Wall Type Baseline	REM/Rate Default		Mobile
		Empty Cavity Insulation		Site Built
		R-4.37 Grade III		
	Foundation Floor Type	R-9.3		Mobile
		Uninsulated		Site Built
	Door Type	R-1.7		Both
	Infiltration Rate	0.8 ACH		Both
	Window Properties	U Value 0.86		Mobile
		SHGC 0.72		
		U Value 0.75		Site Built
		SHGC 0.67		
		108.25 sqft		Mobile
		144.15 sqft		Site Built
Refrigerators	Adjusted Volume	Value	CU FT	Both
	Survival Rate	Value		Both
	Degradation	Value		Both

Table 2: Gas Energy Savings (Dtherms) by Region (Reference 1)*

Measure	Denver	Dillon	Eagle	Grand Junction	Leadville	Alamosa
Storm Window Installation	16.3	29.0	23.1	14.8	33.7	28.6

*SB = Site Built, MH = Mobile Home. All others are not expected to be affected by home type.

Table 3: Electric Energy Savings by Measure (Reference 1)*, **

Measure	Denver	Dillon	Eagle	Grand Junction	Leadville	Alamosa
Storm Window Installation	3,794	6,771	5,384	3,454	7,873	6676.1

*SB = Site Built, MH = Mobile Home. All others are not expected to be affected by home type.

** envelope measures contribute electric savings when an electric heating source is utilized. Assumed efficiency is 98%.

Table 4: Effective Full Load Hours for Space Heating

Heating	Denver	Grand Junction	Alamosa
EFLH for New Home	1073	1041	1353
EFLH for Existing Weatherized Home	1011	969	918
EFLH for Existing Non -Weatherized Home	1230	1248	1120

References:

1) 2011 Program Evaluation by Cadmus Group
2) Xcel Energy Water Heater Rebate Program
3) California Measurement Advisory Committee (CALMAC) Protocols, Appendix F (www.calmac.org/events/APX_F.pdf).
4) CO Governor's Energy Office Guidance
5) RS Means RR 2007
6) NEAT/Frontier
7) Energy Outreach Colorado equipment costs
8) These numbers are based on "CO Insulaton Rebate" analysis and references provided in that program.
9) California Energy Commission's Database for Energy Efficient Resources (DEER) http://www.deeresources.com/
10) US Department of Energy; Residential Furnaces and Boilers; http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/72
11) 2015 ASHRAE Handbook - HVAC Applications; Comparison of Service Life Estimates; Page 37.3, Table 4
12) Colorado House Bill - 2019 1231

Changes from 2017 / 2018 Plan

Changed lifetime for storm windows to 20 years
Removed CFL measure
Created tier 1 and tier 2 measures for certain technologies
Updated values for furnace size based on reference 1
Added Boilers, Boiler tuneup, and furnace tuneup measures
Removed incremental cost information from the deemed sheet