Program: Low Income SF Weatherization

Description:

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

Program References:

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 "CFLs"	Refer to Program "Home Lighting and Recycling - CO" to find formulas for (Customer kW, Customer kWh, Customer PCkW, etc.) for the "CFL" measure.
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 "Heating Efficiency" and "EC Motor Furncace Fan"	Refer to Program "Residential Heating - CO" to find values for Heating Hours, Coincidence Factors, EC Motor Baseline Watts and EC Motor Efficient Watts and EC Motor Operating Hours.
Measures "CFLs"	Refer to Program "Home Lighting and Recycling - CO" to find values for kW_Bulb_Existing, kW_Bulb_New, CF, and Average CFL Hours per lamp.
Measures "LEDs"	Refer to Program "Home Lighting and Recycling - CO" to find values for kW_Bulb_Existing, kW_Bulb_New, CF, Measure Life, and Average LED Hours per lamp.
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.
Measures "Storm Windows"	Refer to Program "Residential Heating - CO" to find values for Heating Hours. 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 efficinecy, tank sizes, 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

Storm Window Equations:

Storm Windows Customer kW	= Customer kWh / Heating_Hours Heating Hours from the Heating Efficiency CO Program

Refrigerator Recycling Equations:

Customer kW	= Customer kWh / (Operating_Hours)

Variables:	**Value**	
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 (Reference 5)	Measure Life for crawl space insulation
Storm Window Variables:	**Value**	
Customer kWh Savings	See Table 3	Storm window savings in electrically heated homes.
Customer Dth savings	See Table 2	Storm window savings in gas heated homes.
CF	0%	Storm window Coincidence Factor in electrically heated homes.
Storm Window Installation	$1225 (Reference 8)	Incremental Cost for Storm window installation.
Storm Window Measure Life	20 (Reference 5)	Life of the installed Storm Windows.
Refrigerator Recycling Variables:	**Value**	
Customer kWh Refrigerator Recycling	584	Refrigerator replacement energy savings kWh
Refrigerator Hours	7,361	Operating Hours for the refrigerator
CF	100%	Coincidence Factor for Refrigerator measures
Refrigerator Replacement Measure Life	7.30 (Reference 3)	Measure Life for Refrigerator Replacement measure
Incremental Cost	See Table 4	The incremental costs for equipment only in low income program.
CFL Variables:	**Value**	
kW_Bulb_New	Customer Input	Efficient Lamp Wattage provided by Vendor.
LED Variables:	**Value**	
kW_Bulb_New	Customer Input	Efficient Lamp Wattage provided by Vendor.

Inputs:

Inputs as required by referenced programs		
~~Quantity of CFLs Installed~~	~~Customer Input~~	
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	

DEEMED SAVINGS TECHNICAL ASSUMPTIONS

Wall Insulation Square Feet Installed	Customer Input	
Crawl Space Insulation Square Feet Installed	Customer Input	
BTUH size of new fuel fired heating equipment	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	
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	

Assumptions:

Work performed in coordination with the Governors Energy Office

Tables:

Table 1: Home Characteristics (Reference 1)

Category	Characteristic	Evaluation Result	Home Type
Envelope and Mechanical Systems	Home Type	Mobile and Site Built	Specified
	Location	Multiple Regions	Both
	Conditioned Floor Area	961 Square Feet	Mobile
		1,452 Square Feet	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 Feet Mobile	Mobile
		8.2 Feet Site Built	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	21.58 Cubic Feet	Both
	Survival Rate	Dependent on age	Both
	Degradation	1.25%	Both
CFLs	Coincidence Factor	8%	Both

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

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

*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
Storm Window Installation	3,794	6,771	5,384	3,454	7,873

*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: Incremental Equipment Cost by Measure (Reference 11)

Measure	Incremental Cost
Refrigerator Replacement (2014 standard)	$ 630.00
CFL per lamp	$ 1.75
LED A-style per lamp	$ 5.00
LED BR-style per lamp	$ 8.00
Storm Windows	$ 1,225.00
High Efficiency Furnace	$ 550.00
67% EF Storage Water Heater	$ 300.00
Efficient Showerhead	$ 5.00
Efficient Kitchen Faucet Aerator	$ 3.00
Efficient Bath Faucet Aerator	$ 3.00
EC Motor Furnace Fan	$ 200.00
Attic insulation to code minimum	$ 715.00
Air Sealing & Weather-stripping (25% reduction)	$ 200.00
Wall Insulation from R-0 to R11	$ 670.00
crawl space wall insulation R-0 to R-19	$ 175.00

References:

1) 2011 Program Evaluation by Cadmus Group
2) US Lighting Market Characterization Study performed for the Department of Energy in 2002
3) Environmental Protection Agency Energy Star Program - www.energystar.gov
4) Xcel Energy Water Heater Rebate Program
5) California Measurement Advisory Committee (CALMAC) Protocols, Appendix F (www.calmac.org/events/APX_F.pdf).
6) Energy Conservation Standards for Residential Furnaces and Boilers, Efficiency Standards for Consumer Products
7) CO Governor's Energy Office Guidance
8) RS Means RR 2007
9) Database for Energy Efficient Resources (DEER)
10) NEAT/Frontier
11) Energy Outreach Colorado equipment costs

Changes from Recent Filing

Insualtion and air sealing measures calculated based on formulas developed in stand alone residential insulation program.
updated CFL light baseline with current EISA baseline standards.
Added Energy Efficient Showerhead, Kitchen Aerator, and Bath Aerator measures
Updated Heating Efficiency measures to be based on the calculations and baseline assumptions from the standalone Heating Efficiency Program.
Updated Water Heating measures to be based on the calculations and baseline assumptions from the standalone Water Heating Program.