DEEMED SAVINGS TECHNICAL ASSUMPTIONS

Product: Evaporative Cooling

Description:

Prescriptive rebates will be offered for the purchase and installation of evaporative coolers. Three tiers of rebates are offered based on the Evaporative Efficacy of the unit and the type of media. The rebates and analyses are based on a nominal 3 ton cooling load. Premium units are high efficiency evaporative coolers (see assumptions for details). Multi-Ducted Premium units are an integrated HVAC system rebate that compares the "whole house" conventional HVAC with an integrated heating and evaporative cooling system in new homes or existing homes with existing or new supply ducts. Credit will be calculated based on the number and type of units installed, the type of the existing unit and the location of the home

Program References:

Baseline Product Consumption	Refer to Program "Air Conditioning" to find all applicable formulas and assumptions for baseline product consumption for all evaporative cooling measures.

Algorithms:

GEN_kWh Customer kWh	Qty_Prop_Equip * kWh_Savings
GEN_PCkW Customer PCkW	GEN_kW * Coincidence_Factor
GEN_kW Customer kW	Qty_Prop_Equip * kW_Savings
Inc_Elec_O_M Electric O&M Savings	Incremental_OM_Savings_Electric * Qty_Prop_Equip

Variables:

Qty_Prop_Equip	Input	Quantity of equipment being replaced
13 SEER 3 Ton energy (Front Range)	1812	Energy use of 13 SEER 3 Ton AC unit (kWh)
13 SEER 3 Ton energy (Western Slope)	1907	Energy use of 13 SEER 3 Ton AC unit (kWh)
13 SEER 3 Ton energy (Alamosa/Mountain Area)	1283	Energy use of 13 SEER 3 Ton AC unit (kWh)
13 SEER 3 Ton demand	3.3	Demand (kW) of 13 SEER 3 Ton AC unit
kWh_Savings	Table 1	Energy savings for switching from a 3 ton AC unit to 3 ton evap cooling unit
kW_Savings	Table 1	Demand savings for switching from a 3 ton AC unit to 3 ton evap cooling unit
kWh Usage	Table 2	Motor HP x 0.746 x Load Factor / Motor Eff x OpHr
kW Usage	Table 2	Motor HP x 0.746 x Load Factor / Motor Eff
EFLH Front Range/Denver	549	Effective full load hours for the front range
EFLH Western Slope	578	Effective full load hours for the western slope
EFLH Alamosa/Mountain Area	389	Effective full load hours for Alamosa/Mountain Area

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MotorHP	Table 3	Motor Horsepower represents the motor size for an evaporative cooler which corresponds to the cooling output of a 3 ton AC unit. (Reference 4)
HP to kW	0.746	Standard conversion from HP to kW
Load Factor on High	80.00%	Load factor for motor - We will use 80% for standard systems and 80% on high and 10% on low for premium systems.
Load Factor on Low	10.00%	Load factor for motor - We will use 80% for standard systems and 80% on high and 10% on low for premium systems.
Motor Eff	81.67%	Efficiency of the evaporative cooler motor (Reference 2)
Coincidence_Factor	70%	Coincidence factor for the refrigerated air system, the probability that peak demand of the AC unit will coincide with peak utility system demand. (Program Evaluation 2010)
TDLF	6.38%	Transmission Distribution Loss Factor the percentage loss of electricity as it flows from the power plant to the customer, calculated using factors from Enhanced DSM Filing SRD-2
NTG	Table 4	Net-to-Gross Factor calculated based on Xcel Energy product experience.
Incremental Costs	Table 5	Incremental cost of efficient technology over baseline technology
Incremental_OM_Savings_Electric	Table 6	Operation and Maintenance savings related to water use
Measure Life	15	Life of evap cooling equipment

Table 1. Energy and Demand Savings for Evap Cooling

Description	Front Range	Western Slope	Alamosa/Mountain Area
Standard System Energy Savings	1603	1687	1759
Standard System Demand Savings	2.92	2.92	2.92
Premium System Energy Savings	1603	1687	1759
Premium System Demand Savings	2.92	2.92	2.92
Multi-Ducted Premium System Energy Savings	1403	1476	1617
Multi-Ducted Premium System Demand Savings	2.56	2.56	2.56

Table 2. Energy and Demand Usage for Evap Cooling

Description	Front Range	Western Slope	Alamosa/Mountain Area
Standard System Energy Usage	209	220	148
Standard System Demand	0.38	0.38	0.38
Premium System Energy Usage	209	220	148
Premium System Demand	0.38	0.38	0.38
Multi-Ducted Premium System Energy Usage	409	431	290
Multi-Ducted Premium System Demand	0.745	0.745	0.745

Table 3. Motor HP

System Type	HP
Standard System	0.52
Premium System	0.52
Multi-Ducted Premium System	1.02

Table 4. Net to Gross Factor

System Type	Replacement installation	New installation
Standard System	70%	70%
Premium System	70%	70%
Multi-Ducted Premium System	70%	90%

Table 5. Incremental Cost of Evaporative Coolers (Reference 5,6,7)

	Cost	Incremental Cost
13 SEER AC 3 T (Baseline System)	$ 3,811	N/A
Standard System Evaporative Cooling Unit	$ 867	$ (2,943)
Premium System Evaporative Cooling Unit	$ 2,778	$ (1,032)
Multi-Ducted Premium System Evap Cooling Unit	$ 4,021	$ 210

Table 6. Operation and Maintenance Savings (Reference 8)

Base System	New System	O&M Savings
13 SEER AC 3 T	Standard Evap Cooling	$ (19.80)
13 SEER AC 3 T	Premium Evap Cooling	$ (8.32)
Conventional 3 Ton HVAC; gas furn; elec cen AC	Gas furnace; Multi-Ducted Premium System	$ (8.32)

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Provided by Customer:	**Verified during M&V**
Type of unit installed (Standard System or Premium System) or installation type (Multi-Ducted Premium System).	Yes

Assumptions:

Baseline AC equipment is matched to the HEAC program. Please see the HEAC program for more information

The installed unit is assumed to have a 0.52 HP motor for Standard and Premuim Systems, and a 1.02 HP motor for Multi-Ducted Premium System (commonly available unit, confirmed through metering) .

Qualifying equipment must be new and be a permanently installed direct (Standard System or Premium System), indirect or two-stage evaporative cooling unit. Portable

Standard System: Qualifying evaporative cooling units must have a minimum Industry Standard Rated airflow of 2,500 CFM

Premium System: Qualifying evaporative cooling units must meet standard system requirements and additionally have a minimum Media Saturation Effectiveness of 85%. The units must be installed with a remote thermostat and a periodic purge water control.

Multi-Ducted Premium System: Integrated HVAC system rebate that compares the "whole house" conventional HVAC with an integrated heating and evaporative cooling system in new homes or existing homes with existing or new supply ducts (minimum of 3 ducts). Multi-Ducted Premium System evaporative cooling units must be indirect or indirect/direct combination units. Units utilizing only direct cooling units do not qualify for Multi-Ducted Premium System due to concerns with moisture loading.

Multi-Ducted Premium System incremental cost data from 2017 program invoices

Assumed that the EFLH for an evaporative cooling unit is equivalent to the EFLH for a standard AC unit

Assumed all sales from retail were self install unless otherwise noted

The technical assumptions for the Evaporative Cooling Rebate product were developed assuming that a standard 13 SEER central air conditioning system was replaced or displaced by either a standard evaporative cooling system or a premium unit with the same capacity. These units have a measure life of 15 years.

References:

1. ESPRE 2.1 engineering model: Simplified energy analysis methods for residential buildings
2. Average motor efficiency for 1 hp motor from NEMA, "Premium Efficiency Motor Selection and Application Guide"
3. Kinney, Larry. New Evaporative Cooling Systems: An Emerging Solution for Homes in Hot Dry Climates with Modest Cooling Loads. SWEEP 2007
4. Web site information - Grainger Evap Cooler - Essick Model N28W; Pheonix Mfg Corp; Model PD4231
5. http://www.google.com/products?q=home+depot+evaporative+cooler+cost&ie=UTF-8&oe=utf-8&rls=org.mozilla:en-US:official&client=firefox-
6. Xcel Program Data
7. SWEEP 2007 Report. O&M Savings based on manufacturers water use data and current Denver water rates (Denver Water Board).
8. ASHRAE Applications 2007 p.36.3 Used AC window unit as estimate for evaporative cooler.
9. https://www.denverwater.org/residential/billing-and-rates/2018-rates
10. https://www.denvergov.org/content/denvergov/en/wastewater-management/billing-and-rates/wastewater-rates.html

Updates:

1. Updated costs for equipment to 2017 values
2. Updated water cost to 2018 value
3. Removed old calculation for Type 3 using RS Means
4. Cleaned up Deemed sheet to fit with new format
5. Updated Baseline cost based on trade partner data
6. Added Alamosa/Mountain Area to the deemed sheet