DEEMED SAVINGS TECHNICAL ASSUMPTIONS

Product: Residential Air Conditioning

Description:

Prescriptive incentives will be offered for new cooling equipment. Plan A is defined as central air conditioning (CAC) or air-source heat pump (ASHP) systems installed in new homes, existing homes without CAC or ASHP systems or homes with CAC or ASHP systems that are inoperable or unrepairable. Ground Source Heat Pumps will be rebated with a Quality Install (appropriate for GSHP) in new homes or when replacing electric resistance heating equipment in existing homes. For new Mini-Split Heat Pumps (MSHP) it is assumed that the MSHP is being installed in either new construction or to supplement an existing heating and cooling system. The MSHP rebate is intended to incent customers to install a high efficiency MSHP rather than the code level baseline unit. CAC installations that have associated gas furnaces realize QI gas savings which will be claimed under the air conditioning product.

Program References:

Measures "Heating System QI"	Refer to Program "Residential Heating - CO" to find variables for (Customer Therms, Gross kW Saved at Customer, Gross kWh Saved at Customer, Customer PCkW, etc.) for Heating System QI measures.

Algorithms:

High Efficiency Air Conditioning - Equipment:

Gross kW Saved at Customer / Unit F_MC_Res_Cool_EQ_kW__c	IF (Program_Measure__r.eo3__Component__r.Name = "13.0+ SEER" , 0 , I_MC_Qty_Prop_Equip__c * (((I_MC_Equipment_Tons__c / 12000) / (1 - P_MC_Sizing_Loss__c) * 12 / (P_MC_EER_Standard__c)) - ((I_MC_Equipment_Tons__c / 12000) / (1 - P_MC_Sizing_Loss__c) * 12 / (F_MC_Res_Cool_EER_Value__c))))
Gross PCkW Saved at Customer / Unit F_MC_Res_Cool_EQ_PCkW__c	IF (Program_Measure__r.eo3__Component__r.Name = "13.0+ SEER" , 0 , I_MC_Qty_Prop_Equip__c * Project_Measure__r.eo3__Equipment_Model__r.Coincidence_Factor__c * (((I_MC_Equipment_Tons__c / 12000) / (1 - P_MC_Sizing_Loss__c) * 12 / (P_MC_EER_Standard__c)) - ((I_MC_Equipment_Tons__c / 12000) / (1 - P_MC_Sizing_Loss__c) * 12 / (F_MC_Res_Cool_EER_Value__c))))
Gross kWh Saved at Customer / Unit F_MC_Res_Cool_EQ_kWh__c	IF (Program_Measure__r.eo3__Component__r.Name = "13.0+ SEER" , 0 , I_MC_Qty_Prop_Equip__c * (((I_MC_Equipment_Tons__c / 12000) / (1 - P_MC_Loss_No_QI__c) * P_MC_EFLH__c * 12 / P_MC_SEER_Standard__c) - ((I_MC_Equipment_Tons__c / 12000) / (1 - P_MC_Loss_No_QI__c) * P_MC_EFLH__c * 12 / I_MC_SEER_Eff__c)))
Incremental Cost / Unit F_MC_Res_Cool_EQ_Inc_Cost__c	IF (AND (State__c = "CO" , TEXT (I_MC_Replacement_Picklist__c) = "Yes") , Project_Measure__r.eo3__Equipment_Model__r.Increm_Cost_per_12000_BTUh__c, Project_Measure__r.eo3__Equipment_Model__r.Incremental_Cost_per_Ton__c) * I_MC_Equipment_Tons__c / 12000 * I_MC_Qty_Prop_Equip__c
Sub-Formula F_MC_Res_Cool_EER_Value__c	IF (AND ((I_MC_EER_Eff__c = 0 , ISPICKVAL (Measure__r.eo3__Component_Type__c , "Res Cooling AC/ASHP v2")) , Project_Measure__r.eo3__Equipment_Model__r.iCoef0__c * (I_MC_SEER_Eff__c ^ 2) + Project_Measure__r.eo3__Equipment_Model__r.iCoef1__c * I_MC_SEER_Eff__c , I_MC_EER_Eff__c)

High Efficiency Air Conditioning - Quality Install:

Gross kW Saved at Customer / Unit	I_MC_Qty_Prop_Equip__c * (((I_MC_Equipment_Tons__c / 12000) / (1- P_MC_Sizing_Loss__c) * 12 / (F_MC_Res_Cool_EER_Value__c)) - ((I_MC_Equipment_Tons__c / 12000) * (1- P_MC_Sizing_Loss_QI__c) * 12 / (F_MC_Res_Cool_EER_Value__c)))
Gross PCkW Saved at Customer / Unit	I_MC_Qty_Prop_Equip__c * Project_Measure__r.eo3__Equipment_Model__r.Coincidence_Factor__c * (((I_MC_Equipment_Tons__c / 12000) /(1 - P_MC_Sizing_Loss__c) * 12 / (F_MC_Res_Cool_EER_Value__c)) - ((I_MC_Equipment_Tons__c / 12000) * (1 - P_MC_Sizing_Loss_QI__c) * 12 / (F_MC_Res_Cool_EER_Value__c)))
Gross kWh Saved at Customer / Unit - *STANDARD EQUIPMENT BASELINE*	I_MC_Qty_Prop_Equip__c * ((((I_MC_Equipment_Tons__c / 12000) / (1- P_MC_Loss_No_QI__c) * P_MC_EFLH__c * 12 / P_MC_SEER_Standard__c) - ((I_MC_Equipment_Tons__c / 12000) / (1 - P_MC_Uncorr_Loss__c) * P_MC_EFLH__c * 12 / P_MC_SEER_Standard__c)))

High Efficiency Air Conditioning - Quality Install (Continued):

Gross kWh Saved at Customer / Unit - *EFFICIENT EQUIPMENT BASELINE*	I_MC_Qty_Prop_Equip__c * (((I_MC_Equipment_Tons__c / 12000) / (1- P_MC_Loss_No_QI__c) * P_MC_EFLH__c * 12 / I_MC_SEER_Eff__c) - ((I_MC_Equipment_Tons__c / 12000) / (1 - P_MC_Uncorr_Loss__c) * P_MC_EFLH__c * 12 / I_MC_SEER_Eff__c)))
Incremental Cost / Unit	IF (TEXT (I_MC_Home_Type__c) = "new" , I_MC_Qty_Prop_Equip__c * P_MC_QI_Incremental_Cost__c , MAX (75 , I_MC_Qty_Prop_Equip__c * (P_MC_QI_Incremental_Cost__c - (IF (TEXT (Project_Measure__r.eo3__Equipment_Model__r.eo3__Equipment_Type__c) = "Res Cooling GSHP - CO v2" , I_MC_Size_Heat__c , I_MC_Equipment_Tons__c) / 12000 * Project_Measure__r.eo3__Equipment_Model__r.Baseline_Cost__c * P_MC_Sizing_Loss_QI__c))))
Dtherm Savings Heat_QI_Existing_Home (Customer Dth)	= Dth_Heat_No_QI_Existing_Home_Eff - Dth_Heat_QI_Existing_Home_Eff
Dth_Heat_No_QI_Existing_Home_Eff	= I_MC_Size_Heat__c * (1 - Oversize Factor) * (1 - Altitude_Adj_Factor) * EFLH_Heat * 1 / (F_MC_Furnace_Eff__c * (1 - Loss_No_QI_Exist)) / 1,000,000
Dth_Heat_QI_Existing_Home_Eff	= I_MC_Size_Heat__c * (1 - Oversize Factor) * (1 - Altitude_Adj_Factor) * EFLH_Heat * 1 / (F_MC_Furnace_Eff__c * (1 - Uncorr_Loss_Existing)) / 1,000,000

Ground Source Heat Pump - Equipment:

Gross kW Saved at Customer / Unit	MAX(I_MC_Qty_Prop_Equip__c * (((MIN (I_MC_Size_Heat__c / 12000 * P_MC_GSHP_Cooling_Ratio__c , I_MC_Equipment_Tons__c / 12000)) / (1 - P_MC_Sizing_Loss__c) * 12 / (P_MC_EER_Standard_HP__c)) - ((MIN (I_MC_Size_Heat__c / 12000 * P_MC_GSHP_Cooling_Ratio__c , I_MC_Equipment_Tons__c / 12000)) / (1 - P_MC_Sizing_Loss__c) * 12 / (I_MC_EER_Eff__c))) + I_MC_Qty_Prop_Equip__c * (((MIN (I_MC_Size_Heat__c / 12000 * P_MC_GSHP_Cooling_Ratio__c , I_MC_Equipment_Tons__c / 12000)) /(1 - P_MC_Sizing_Loss__c) * 12 / (I_MC_EER_Eff__c)) - ((MIN (I_MC_Size_Heat__c / 12000 * P_MC_GSHP_Cooling_Ratio__c , I_MC_Equipment_Tons__c / 12000)) * (1 - P_MC_Sizing_Loss_QI__c) * 12 / (I_MC_EER_Eff__c))) , (I_MC_Size_Heat__c * (1 + P_MC_Sizing_Loss__c) / P_MC_Standard_COP__c / 3412) - (I_MC_Size_Heat__c / I_MC_GSHP_COP__c / 3412))
Gross PCkW Saved at Customer / Unit	(I_MC_Qty_Prop_Equip__c * (((MIN (I_MC_Size_Heat__c / 12000 * P_MC_GSHP_Cooling_Ratio__c , I_MC_Equipment_Tons__c / 12000)) /(1 - P_MC_Sizing_Loss__c) * 12 / (P_MC_EER_Standard_HP__c)) - ((MIN (I_MC_Size_Heat__c / 12000 * P_MC_GSHP_Cooling_Ratio__c , I_MC_Equipment_Tons__c / 12000)) /(1 - P_MC_Sizing_Loss__c) * 12 / (I_MC_EER_Eff__c))) + I_MC_Qty_Prop_Equip__c * (((MIN (I_MC_Size_Heat__c / 12000 * P_MC_GSHP_Cooling_Ratio__c , I_MC_Equipment_Tons__c / 12000)) /(1 - P_MC_Sizing_Loss__c) * 12 / (I_MC_EER_Eff__c)) - ((MIN (I_MC_Size_Heat__c / 12000 * P_MC_GSHP_Cooling_Ratio__c , I_MC_Equipment_Tons__c / 12000)) * (1 - P_MC_Sizing_Loss_QI__c) * 12 / (I_MC_EER_Eff__c))) * Project_Measure__r.eo3__Equipment_Model__r.Coincidence_Factor__c
Gross kWh Saved at Customer / Unit - *COOLING*	((MIN (I_MC_Size_Heat__c / 12000 * P_MC_GSHP_Cooling_Ratio__c , I_MC_Equipment_Tons__c / 12000)) * P_MC_EFLH__c * 12 / (P_MC_SEER_Standard_HP__c * (1 - P_MC_Loss_No_QI__c))) - ((MIN (I_MC_Size_Heat__c / 12000 * P_MC_GSHP_Cooling_Ratio__c , I_MC_Equipment_Tons__c / 12000)) * P_MC_EFLH__c * 12 / (F_MC_GSHP_SEER__c * (1 - P_MC_Loss_No_QI__c)))
Gross kWh Saved at Customer / Unit - *HEATING (NEW HOME)*	(P_MC_BTU_Heat__c / 3412 * 3.412 / (Project_Measure__r.eo3__Equipment_Model__r.HSPF_Baseline__c * (1 - P_MC_Loss_No_QI__c))) - (P_MC_BTU_Heat__c * (1 + P_MC_Sizing_Loss__c) / P_MC_Standard_COP__c / 3412)
Gross kWh Saved at Customer / Unit - *HEATING (EXISTING HOME)*	(P_MC_BTU_Heat__c / 3412 / (P_MC_Standard_COP__c * (1 - P_MC_Loss_No_QI__c))) - (P_MC_BTU_Heat__c * (1 + P_MC_Sizing_Loss__c) / P_MC_Standard_COP__c / 3412)
Incremental Cost / Unit - *COOLING*	I_MC_Size_Heat__c / 12000 * Project_Measure__r.eo3__Equipment_Model__r.Incremental_Cost_per_Ton__c * Project_Measure__r.eo3__Equipment_Model__r.ARR_Electric_Cooling__c
Incremental Cost / Unit - *HEATING*	I_MC_Size_Heat__c / 12000 * Project_Measure__r.eo3__Equipment_Model__r.Incremental_Cost_per_Ton__c * Project_Measure__r.eo3__Equipment_Model__r.ARR_Electric_Heating__c
Sub-Formula F_MC_GSHP_SEER__c	I_MC_EER_Eff__c

Ground Source Heat Pump - Quality Install:

Gross kW Saved at Customer / Unit	N/A
Gross PCkW Saved at Customer / Unit	N/A
Gross kWh Saved at Customer / Unit - *COOLING*	((MIN (I_MC_Size_Heat__c / 12000 * P_MC_GSHP_Cooling_Ratio__c , I_MC_Equipment_Tons__c / 12000)) * P_MC_EFLH__c * 12 / (F_MC_GSHP_SEER__c * (1 - P_MC_Loss_No_QI__c))) - ((MIN (I_MC_Size_Heat__c / 12000 * P_MC_GSHP_Cooling_Ratio__c , I_MC_Equipment_Tons__c / 12000)) * P_MC_EFLH__c * 12 / (F_MC_GSHP_SEER__c * (1 - P_MC_Uncorr_Loss__c)))
Gross kWh Saved at Customer / Unit - *HEATING (NEW HOME)*	(P_MC_BTU_Heat__c * (1 + P_MC_Sizing_Loss__c) / P_MC_Standard_COP__c / 3412) - ((P_MC_BTU_Heat__c / I_MC_GSHP_COP__c * (1 - P_MC_Uncorr_Loss__c)) / 341 2)
Gross kWh Saved at Customer / Unit - *HEATING (EXISTING HOME)*	(P_MC_BTU_Heat__c * (1 + P_MC_Sizing_Loss__c) / P_MC_Standard_COP__c / 3412) - (P_MC_BTU_Heat__c / (I_MC_GSHP_COP__c * (1 - P_MC_Uncorr_Loss__c)) / 3412)
Incremental Cost / Unit	IF (TEXT (I_MC_Home_Type__c) = "new", I_MC_Qty_Prop_Equip__c * P_MC_QI_Incremental_Cost__c , MAX (75 , I_MC_Qty_Prop_Equip__c * (P_MC_QI_Incremental_Cost__c - (IF (TEXT (Project_Measure__r.eo3__Equipment_Model__r.eo3__Equipment_Type__c) = "Res Cooling GSHP - CO v2" , I_MC_Size_Heat__c , I_MC_Equipment_Tons__c) / 12000 * Project_Measure__r.eo3__Equipment_Model__r.Baseline_Cost__c * P_MC_Sizing_Loss_QI__c))))

Western Cooling Control Device:

Gross kW Saved at Customer / Unit	I_MC_Qty_Prop_Equip__c * Project_Measure__r.eo3__Equipment_Model__r.eo3__kW_Savings__c
Gross PCkW Saved at Customer / Unit	I_MC_Qty_Prop_Equip__c * Project_Measure__r.eo3__Equipment_Model__r.eo3__kW_Savings__c * Project_Measure__r.eo3__Equipment_Model__r.Coincidence_Factor__c
Gross kWh Saved at Customer / Unit	I_MC_Qty_Prop_Equip__c * Project_Measure__r.eo3__Equipment_Model__r.eo3__kWh_Savings__c
Incremental Cost / Unit	I_MC_Qty_Prop_Equip__c * Project_Measure__r.eo3__Equipment_Model__r.Cost__c

Minisplit Heat Pump:

Gross kW Saved at Customer / Unit	I_MC_Equipment_Tons__c / 12000 * (12 / F_MC_MSHP_EER_Std__c - 12 / F_MC_Res_Cool_EER_Value__c)
Gross PCkW Saved at Customer / Unit	I_MC_Equipment_Tons__c / 12000 * (12 / F_MC_MSHP_EER_Std__c - 12 / F_MC_Res_Cool_EER_Value__c) * Project_Measure__r.eo3__Equipment_Model__r.Coincidence_Factor__c
Gross kWh Saved at Customer / Unit - *COOLING*	(I_MC_Equipment_Tons__c / 12000 * P_MC_MSHP_EFLHC__c * (12 / P_MC_SEER_Standard_HP__c - 12 / I_MC_SEER_Eff__c)) / (1 - P_MC_Loss_No_QI__c)
Gross kWh Saved at Customer / Unit - *HEATING*	((I_MC_Size_Heat__c / 1000 * P_MC_MSHP_EFLHH__c * (1 / Project_Measure__r.eo3__Equipment_Model__r.HSPF_Baseline__c - 1 / I_MC_HSPF_Eff__c)) / (1 - P_MC_Loss_No_QI__c))
Incremental Cost / Unit	IF (AND (State__c = "CO" , TEXT (I_MC_Replacement_Picklist__c) = "Yes") , Project_Measure__r.eo3__Equipment_Model__r.Increm_Cost_per_12000_BTUh__c , Project_Measure__r.eo3__Equipment_Model__r.Incremental_Cost_per_Ton__c) * I_MC_Equipment_Tons__c / 12000 * I_MC_Qty_Prop_Equip__c
Sub-Formula F_MC_MSHP_EER_Std__c	((Project_Measure__r.eo3__Equipment_Model__r.iCoef0__c * ((P_MC_SEER_Standard_HP__c / (I_MC_Equipment_Tons__c / 12000)) ^3) + Project_Measure__r.eo3__Equipment_Model__r.iCoef1__c * ((P_MC_SEER_Standard_HP__c / (I_MC_Equipment_Tons__c / 12000)) ^2) + Project_Measure__r.eo3__Equipment_Model__r.iCoef2__c * (P_MC_SEER_Standard_HP__c / (I_MC_Equipment_Tons__c / 12000)) + Project_Measure__r.eo3__Equipment_Model__r.iCoef3__c) * (I_MC_Equipment_Tons__c / 12000))
Sub-Formula F_MC_Res_Cool_EER_Value__c	IF (AND (I_MC_EER_Eff__c = 0 , ISPICKVAL (Measure__r.eo3__Component_Type__c , "Res Cooling AC/ASHP v2")) , Project_Measure__r.eo3__Equipment_Model__r.iCoef0__c * (I_MC_SEER_Eff__c ^ 2) + Project_Measure__r.eo3__Equipment_Model__r.iCoef1__c * I_MC_SEER_Eff__c , I_MC_EER_Eff__c)

DEEMED SAVINGS TECHNICAL ASSUMPTIONS

Variables:

Numeric Constant	3,412	Conversion between BTU/h and kilowatts
Numeric Constant	12,000	Conversion between BTU/h and tons
State__c		Applicable DSM Jurisdiction (CO, MN, NM). Variable is used for formula management only and is based on customer premise location
Program_Measure__r.eo3__Component__r.Name		Administrative data categorization flag - Triggers changes in formula manipulation between programs.
Measure__r.eo3__Component_Type__c		Administrative data categorization flag - Triggers changes in formula manipulation between programs.
Project_Measure__r.eo3__Equipment_Model__r.Incremental_Cost_per_Ton__c	Tables 1a, 1d	Deemed Plan A & MSHP Incremental Capital Cost per Ton, Based On Unit Efficiency (New Construction) - where applicable
Project_Measure__r.eo3__Equipment_Model__r.Increm_Cost_per_12000_BTUh__c	Table 1b	Deemed Plan B Incremental Capital Cost per Ton, Based On Unit Efficiency (Retrofit)
Project_Measure__r.eo3__Equipment_Model__r.Coincidence_Factor__c	Table 3	Coincidence Factor, the probability that peak demand savings will coincide with peak utility system demand.
Project_Measure__r.eo3__Equipment_Model__r.Baseline_Cost__c	Table 2	Deemed baseline installation cost.
Project_Measure__r.eo3__Equipment_Model__r.Cost__c	WCCD Incremental cost	Deemed Equipment Specific incremental cost ($) Refer to data or tables below where appropriate.
Project_Measure__r.eo3__Equipment_Model__r.iCoef0__c	Table 7	Conversion Coefficient
Project_Measure__r.eo3__Equipment_Model__r.iCoef1__c	Table 7	Conversion Coefficient
Project_Measure__r.eo3__Equipment_Model__r.iCoef2__c	Table 7	Conversion Coefficient
Project_Measure__r.eo3__Equipment_Model__r.iCoef3__c	Table 7	Conversion Coefficient
Project_Measure__r.eo3__Equipment_Model__r.HSPF_Baseline__c	8.20	GSHP & MSHP Deemed Baseline Heating Seasonal Performance Factor (HSPF)
Project_Measure__r.eo3__Equipment_Model__r.ARR_Electric_Cooling__c	0.19	GSHP 'Deemed Elec Heat/Cool Ratio - Cooling
Project_Measure__r.eo3__Equipment_Model__r.ARR_Electric_Heating__c	0.81	GSHP 'Deemed Elec Heat/Cool Ratio - Heating
Project_Measure__r.eo3__Equipment_Model__r.eo3__Equipment_Type__c		Administrative data categorization flag - Triggers changes in formula manipulation between programs.
Project_Measure__r.eo3__Equipment_Model__r.eo3__kW_Savings__c	Table 8	Deemed Equipment Specific demand savings (kW)
Project_Measure__r.eo3__Equipment_Model__r.eo3__kWh_Savings__c	Table 8	Deemed Equipment Specific energy savings (kWh)
Project_Measure__r.eo3__Equipment_Model__r.eo3__Alt_Adj_Factor__c	20.8%	Deemed Altitude adjustment factor for derating sea level nameplate equipment for use in Denver (4% / 1000 Feet above sea level)
Project_Measure__r.eo3__Equipment_Model__r.eo3__Oversize_Factor__c	20%	Deemed Oversize Safety Factor for heating equipment.
Project_Measure__r.eo3__Equipment_Model__r.eo3__EFLH_Heat__c	1,159	Deemed Furnace Equivalent Full Load Heating Hours from Res Heating Systems rebate
I_MC_Qty_Prop_Equip__c	Vendor input	Quantify of HEAC Equipment associated with measure, provided by the customer.
I_MC_Equipment_Tons__c	Vendor input	AHRI Total (Sensible + Latent) Cooling Capacity of HEAC Equipment (in BTU/h), provided by the customer.
I_MC_EER_Eff__c	Vendor input	AHRI EER of HEAC Equipment, provided by the customer.
I_MC_SEER_Eff__c	Vendor input	AHRI SEER of HEAC Equipment, provided by the customer.
I_MC_Size_Heat__c	Vendor input	AHRI Heating Capacity of ~~HEAC~~ GSHP or Furnace Equipment, provided by the customer (BTU/h).
I_MC_Furnace_Type__c	Vendor input	Contractor to determine if the new AC equipment is associated with a furnace that has a **Condensing** or **Non-Condensing** burner / heat exchanger.
F_MC_Furnace_Eff__c	Vendor input	Contractor to provide the associated furnace efficiency if known. If the furnace efficiency is unknown, the Furnace Type (**Condensing** or **Non-Condensing)** will determine the deemed furnace efficiency to be used in the calculations. Condensing furnaces = 95% efficiency and for Non-Condensing = 80% effiiciency.
I_MC_GSHP_COP__c	Vendor input	AHRI COP of GSHP HEAC Equipment, provided by the customer.
I_MC_HSPF_Eff__c	Vendor input	AHRI Heating Seasonal Performance Factor, provided by the customer.
~~I_MC_Replacement_Picklist__c~~	~~Yes, No~~	~~Identfies if measure represents a replacement of existing equipment (Plan A or B), provided by the customer.~~
I_MC_Home_Type__c	Vendor input	Identfies if measure represents installation at a new or existing home, provided by the customer.
P_MC_EER_Standard__c	Table 3	Energy Efficiency Ratio (EER) of standard equipment, based upon the minimum Federal acceptable efficiency.
P_MC_EER_Standard_HP__c	Table 3	Energy Efficiency Ratio (EER) of standard equipment, based upon the minimum Federal acceptable efficiency. (Heat Pump)
P_MC_SEER_Standard__c	Table 3	Seasonal Energy Efficiency Ratio (SEER) of std. equipment, based upon the minimum Federal acceptable efficiency.
P_MC_SEER_Standard_HP__c	Table 3	Seasonal Energy Efficiency Ratio (SEER) of std. equipment, based upon the minimum Federal acceptable efficiency. (Heat Pump)
P_MC_Standard_COP__c	Table 3	Deemed coefficient of performance (COP) of baseline heating system
P_MC_EFLH__c	Table 4	The Equivalent Full Load Hours (EFLH) of residential cooling. Values are determined through modeling.
P_MC_BTU_Heat__c	Table 4	The annual heating load in Btu. Value is determined through modeling.
P_MC_Loss_No_QI__c	Table 5	Efficiency of average unit lost due to improper installation of HEAC Equipment
P_MC_QI_Incremental_Cost__c	Table 1c	Deemed incremental cost for 'quality install' installtion effort.
P_MC_GSHP_Cooling_Ratio__c	Table 6	Ratio applied on the Rated Heating Capacity of GSHP to determine cooling load.
P_MC_Sizing_Loss__c	Table 6	Specific losses from non-QI installtion effectes that impact peak load operation
P_MC_Sizing_Loss_QI__c	Table 6	Reduction in necessary equipment size due to application of quality install.
P_MC_Uncorr_Loss__c	Table 6	Deemed value for uncorrectable duct leakage losses
P_MC_MSHP_EFLHC__c	416	Deemed Equivalent Full Load Cooling Hours (ELFHC)
P_MC_MSHP_EFLHH__c	1,013	Deemed Equivalent Full Load Heating Hours (ELFHH). Consistent with the residential heating program for an existing home that is the average of a weatherized and non-weatherized home
NTG	67.6%	Net-to-gross for AC units which is calculated from High Efficiency AC Program Evaluation conducted in 2012.

NTG	100.0%	Net-to-gross for GSHP units
Measure Life - Matched Split-System Air Conditioner (Plan A)	18	Reference 16
Measure Life - Matched Split-System Air -Source Heat Pump	18	Reference 16
Measure Life - Ground Source Heat Pump	20	Reference 3
Measure Life - Mini-Split Heat Pump	18	Reference 9
Measure Life - WCCD	7.5	Matches associated AC System Lifetime (Plan A/B)
Measure Life - Quality Installation (Plan A)	18	Reference 16
WCCD Incremental cost	$100.00	Market Data

Table 1a. Incremental Capital Costs - New Construction (Plan A) - Reference 6
Project_Measure__r.eo3__Equipment_Model__r.Incremental_Cost_per_Ton__c

SEER	AC Base Cost per Ton	AC Incremental Cost per Ton	ASHP Base Cost per Ton	ASHP Incremental Cost per Ton	GSHP Base Cost per Ton	GSHP Incremental Cost per Ton
13 SEER	$ 422.85	N/A	N/A	N/A	$ 422.85	N/A
14/14.5 SEER	$ 514.98	$ 92.13	$ 777.64	N/A	N/A	N/A
15 SEER	$ 607.10	$ 184.25	$ 960.40	$ 182.76	N/A	N/A
16 SEER	$ 699.23	$ 276.38	$ 1,143.16	$ 365.52	N/A	N/A
17/18+ SEER	$ 791.36	$ 368.51	$ 1,325.93	$ 548.29	N/A	N/A
All Efficiencies	N/A	N/A	N/A	N/A	$ 1,006.85	$ 584.00

Table 1c. Incremental Capital Costs - Quality Install (Reference 6)

P_MC_QI_Incremental_Cost__c	
Measures	**New Home**	**Existing Home***
Quality Installation	$ 103.56	$ 286.58

Table 1d. Incremental Capital Costs - Mini-Split Heat Pump (Reference 8)

Mini-Split Heat Pump	Current Year Purchase Price	Incremental cost per ton Cooling
Mini-Split Heat Pump (15-20 SEER, 11+ EER, 9-12 HSPF)	$ 3,322.19	$ 401.99
Mini-Split Heat Pump (21-26 SEER, 11+ EER, 9-12 HSPF)	$ 3,535.64	$ 555.94

Incremental costs for unit sizes not listed will be interpolated/extrapolated from listed values
Incremental costs for GSHP to High Efficient GSHP will use the incremental cost table for standard A/C Units. This is due to a GSHP to HE GSHP the loop cost are the same so that cost is

Table 3. Coincidence Factor, EER Baseline

Project_Measure__r.eo3__Equipment_Model__r.Coincidence_Factor__c
P_MC_EER_Standard__c
P_MC_EER_Standard_HP__c
P_MC_SEER_Standard__c
P_MC_Standard_COP__c

Equipment Type	Home Type	Replace / Plan	Deemed Equipment Coincidence Factor	Deemed QI Coincidence Factor	EER Baseline	SEER Baseline	Heating COP	Notes
AC	New	No / A	90%	100%	11.18	13.00	N/A	Reference 14
AC	Existing	No / A	90%	100%	11.18	13.00	N/A	Reference 14
ASHP	New	No / A	90%	100%	11.76	14.00	N/A	Reference 14
ASHP	Existing	No / A	90%	100%	11.76	14.00	N/A	Reference 14
GSHP	New	N/A	90%	100%	11.18	13.00	2.4	Reference 14
GSHP	Existing	N/A	90%	100%	11.18	13.00	1.0	Reference 14
MSHP (Cooling Only)	N/A	N/A	90%		8.28	14.00	N/A	Reference 14
WCCD	N/A	N/A	90%		N/A	N/A	N/A	N/A

Table 4. Modeled AC/ASHP/GSHP EFLH and Total Annual Heating Load:

P_MC_EFLH__c						
P_MC_BTU_Heat__c						
Home Type	EFLH	BTU Heat	Modeled Area	Modeled Tons	Modeled SEER	Notes
New	610	37,400,000	2,460	2	13	Reference 4
Existing	549	74,900,000	2,206	3.0	13	Reference 4

Table 5. Loss NO QI Derivation (References 5 & 12)

P_MC_Loss_No_QI__c		Reference 11	Reference 13	Reference 5	Reference 12	
Equipment Type	Home Type	Equipment Sizing	Refrigeration Charge	Improper Airflow	Duct Leakage	Total
AC	New	0.0%	7.0%	2.0%	0.0%	9.00%
AC	Existing	2.5%	7.0%	2.0%	21.6%	33.10%
ASHP	New	0.0%	7.0%	2.0%	0.0%	9.00%
ASHP	Existing	2.5%	7.0%	2.0%	21.6%	33.10%
GSHP	New	0.0%	0.0%	2.0%	0.0%	2.00%
GSHP	Existing	2.5%	0.0%	2.0%	21.6%	26.10%
MSHP	New	0.0%	0.0%	0.0%	0.0%	0.00%
MSHP	Existing	0.0%	0.0%	0.0%	0.0%	0.00%

Table 6. HEAC Equipment Characteristics

P_MC_Sizing_Loss__c				
P_MC_Sizing_Loss_QI__c				
P_MC_Uncorr_Loss__c				
P_MC_GSHP_Cooling_Ratio__c	Reference 11	Reference 13	Reference 12	Deemed
Home Type - HEAC	Sizing Loss	Sizing Loss QI	Uncorrected Loss	GSHP Cooling Ratio
New - General	0%	0%	0%	0.806451613
Existing - General	2.5%	10.0%	12.7%	0.638297872
New or Existing - MSHP	0.0%	0.0%	N/A	N/A

Table 7. Conversion Coefficients

Equpiment type	Coef0	Coef1	Coef2	Coef3	Notes
MSHP - SEER to EER	-0.0002600	0.0101270	0.5263880	-0.0233300	Xcel Derivation
AC/ASHP/GSHP - EER to SEER	-0.020	1.120	N/A	N/A	Reference 1

Table 8. Deemed Demand and Energy Savings (per unit)

Equpiment type	kW_Savings	kWh_Savings	Notes
Western Cooling Control Device	0.130	73.0	Based on Internal Analysis

Assumptions:

Baseline equipment meets applicable minimum Federal standards for efficiency

Baseline equipment installation (for QI) has 33.1% efficiency losses

Baseline equipment installation in Existing Homes has 26.75% efficiency losses

High efficiency equipment exceeds minimum Federal standards for efficiency

Installed equipment does not operate at optimum efficiency until a Quality Installation is completed.

To qualify for a rebate, each piece of equipment must meet the minimum EER and SEER requirements. The customer should provide both the EER and SEER values for the particular piece of equipment. If the customer is unable to provide both values, the value(s) not provided will be calculated using the equations shown above. If a value is not provided by the customer, the calculated value still must meet the minimum requirement.

10-year Average Inflation Rate = 2.57% (InflationData.com)

CO Weighted Average Cost of Capital = 7.88%

Average Cost of Central AC Repair=$750 (EEBC)

GSHP New Home REMRATE Modeling = Larger , more tightly built, better insulated new home was modeled with GSHP COP of 3.3

GSHP Existing Home REMRATE modeling = Smaller, less tightly built, poorly insulated existing home was modeled with GSHP of 3.3.

GSHP Installed Loop Cost/Ton = $2004 per loop per Ton

GSHP Baseline Equipment Cost combines AC unit and electric resistance heating

GSHP appropriate Quality Install savings included in modeling

No Heating kW saving are claimed for GSHP or MSHP during winter, only summer cooling kW savings are claimed.

Assumed $50 each for contractor to complete right sizing calculations and air flow work on AC and HP units.

DEEMED SAVINGS TECHNICAL ASSUMPTIONS

References:

1. For equation to convert SEER to EER "Building America, Research Benchmark Definitions, 2010", see p. 10. http://www.nrel.gov/docs/fy10osti/47246.pdf

2. ASHRAE, 2007, Applications Handbook, Ch. 37, table 4, Comparison of Service Life Estimates

3. For estimated life of GSHP see http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12640 (indoor components up to 25 years; ground loop =50 years)

4.Building loads were estimated using Building Energy Optimization (BEOpt) software version 2.5.0.0. The model was run Jan 2016. See "Model Data New" and "Model Data Existing" tabs for assumptions.

5. For losses with air flow see Neme, Proctor, Nadel, ACEEE, 1999. Energy Savings Potential From Addressing Residential Air Conditioner and Heat Pump Installation Problems. http://aceee.org/research-report/a992

6. Costs obtained from "2010-2012 WO017 Ex Ante Measure Cost Study Final Report", by Itron, May 2014. These are used in the DEER 2016 database.

7. DOE Appliance Standards Website, Residential Central Air Conditioners and Heat Pumps. https://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75

8. Incremental costs for MSHPs were determined from the NEEP Incremental Cost Study Phase 2 Report

9. MSHP equipment life is from Measure Life Report Residential and Commercial/Industrial Lighting and HVAC Measures; http://library.cee1.org/content/measure-life-report-residential-and-commercialindustrial-lighting-and-hvac-measures

10.For assumptions on GSHP efficiencies see "ENERGY STAR Geothermal Heat Pumps Key Product Criteria"; www.energystar.gov

11 For losses with equipment sizing see ENERGY STAR Quality Installation. https://www.energystar.gov/index.cfm?c=hvac_install.hvac_install_index

12.For assumptions on duct leak losses see "NREL 2011 Measure Guideline Sealing and Insulating Ducts in Existing Homes". http://www.nrel.gov/docs/fy12osti/53494.pdf

13.For assumptions on losses related to overcharge or undercharge on refrigerant see "Sensitivity Analysis of Installation Faults on Heat Pump Performance", by P. Domanski, et. al., Sept 2014. http://www.acca.org/HigherLogic/System/DownloadDocumentFile.ashx?DocumentFileKey=f02c1f61-4d1d-4a24-971d-cc9ea3e626b2&forceDialog=0

14. For Efficiency assumptions associated with baseline AC/ASHP/MSHP systems, refer to: 2015 International Energy Conservation Code

15. For Residential A/C System Lifetime, Refer to DOE Technical Support Document: Energy Efficiency Prrogram for Consumer Products: CHAPTER 8. LIFE-CYCLE COST AND PAYBACK PERIOD ANALYSIS

16. Measure Life Report Residential and Commercial/Industrial Lighting and HVAC Measures, GDS, June 2007. http://library.cee1.org/sites/default/files/library/8842/CEE_Eval_MeasureLifeStudyLights&HVACGDS_1Jun2007.pdf

Changes

Added Table 3. This didn't introduce new data, but broke the data out of a text paragraph

Clarifies that the Baseline EER for ASHP is 11.76. This was stated indirectly from the deemed SEER, but not clear from the EER values.

Added Dtherm Savings associated with current QI requirements. Formulas, variables, and deemed values as noted.