

Exhibit A

Background Calculations for RREMP and CREMP submittal pages.

This page is for reference only. Values to be updated per Governing body when required. Click on individual cells to see formulas used.

This color cell is a calculated annual energy consumption used in REMP calculations.

This color cell is adjustable (by local Governing Body) to fit local jurisdiction choices for amount of offset and local cost of equipment installation.

PV Energy Cost Cales				Notes	
Energy cost used	\$3,500	\$/kW of array			Approximate average cost of PV installation in Summit County (2022), per sampling of local installers by HCC.
Time period used	1,500	kWh/yr per kW of array			NREL PVWatts estimated output (at optimum conditions for solar access, w/o derate for effects of snow)
Conversion of Btu/kWh	20	years (anticipated life of system)			Assumed system lifespan
GSHP COP minimum	3,412	3			kWh output of system over lifespan
ASHP COP minimum	1.8	30,000	kWh per kW for the life of system		Calculated installation cost per kWh output for life of the system
Energy cost used	\$0.117	\$/kWh			Installed onsite energy cost to offset external site energy
Time period used	20	years			Assumed system lifespan
Conversion of Btu/kWh	3,412	3			Standard conversion factors between Btu's and kWh
GSHP COP minimum	1.8	3			Minimum allowed GSHP COP
ASHP COP minimum	1.8	3			Minimum allowed ASHP COP

Residential Exterior Energy						Notes
	Energy Use	Units	Exterior Energy Offset Fee	% Offset	Adjusted	Units
Snowmelt	82,863	Btu's/yr	\$56.67	100%	\$56.67	\$/ft2
Pool	331,451	Btu's/yr	\$226.67	100%	\$226.67	\$/ft2
Spa	428,937	Btu's/yr	\$293.33	100%	\$293.33	\$/ft2
Heat tape	1.56	kWh/W/yr	\$3.65	0%	\$0.00	\$/W
Electric patio heaters	0.35	kWh/W/yr	\$0.82	0%	\$0.00	\$/W
Gas patio heaters	350	kBtu/kBtu/yr	\$0.24	0%	\$0.00	\$/Btu/h
Gas fireplaces	364	kBtu/kBtu/yr	\$0.25	0%	\$0.00	\$/Btu/h
Cooking appliances	80	kBtu/kBtu/yr	\$0.05	0%	\$0.00	\$/Btu/h

Commercial Exterior Energy						Notes
	Energy Use	Units	Exterior Energy Offset Fee	% Offset	Adjusted	Units
Snowmelt	146,239	Btu's/yr	\$100.00	100%	\$100.00	\$/ft2
Pool	414,314	Btu's/yr	\$283.33	100%	\$283.33	\$/ft2
Spa	428,937	Btu's/yr	\$293.33	100%	\$293.33	\$/ft2
Heat tape	1.56	kWh/W/yr	\$3.65	0%	\$0.00	\$/W
Electric patio heaters	1.01	kWh/W/yr	\$2.36	0%	\$0.24	\$/W
Gas patio heaters	1,008	kBtu/kBtu/yr	\$0.69	0%	\$0.00	\$/Btu/h
Gas fireplaces	2,016	kBtu/kBtu/yr	\$1.38	0%	\$0.00	\$/Btu/h
Cooking appliances	390	kBtu/kBtu/yr	\$0.27	0%	\$0.00	\$/Btu/h

Offset rates						Notes
		Equipment Credit Cost	% Credit	Adjusted	Units	
GSHP		\$7,500	25%	\$1,875.00	\$/10,000 Btu installed capacity	Average installed system upgrade cost of \$9,000 per ton of system capacity.
ASHP		\$2,500	25%	\$625.00	\$/10,000 Btu installed capacity	Average installed system upgrade cost of \$3,000 per ton of system capacity.
Residential SHW		\$112.25	100%	\$112.25	\$/ft2 of array	Average cost of SHW installation in Summit County (2021), per sampling of local installers.
Commercial SHW		\$112.25	100%	\$112.25	\$/ft2 of array	Average cost of SHW installation in Summit County (2021), per sampling of local installers.
PV		\$3,500	100%	\$3,500.00	\$/kW of array	Average cost of PV installation in Summit County (2021), per sampling of local installers.

Exterior Energy Use Exemptions						Notes
	Residential	Units	Commercial	Units		
Snowmelt	100	ft2	100	ft2	per egress pathway	
Pool	n/a		n/a			
Spa	64	ft2	64	ft2	per 10 private units	
Heat tape	FULL		FULL			
Electric patio heaters	FULL		n/a			
Gas patio heaters	n/a		n/a			
Gas fireplaces	n/a		n/a			
Outdoor cooking	n/a		n/a			

Exterior gas fired appliances (not including snowmelt, pool, and spa heat sources) are not exempt from the REMP program and are regulated according to the connected natural gas capacity budget (below).

Connected Natural Gas Capacity Budget						Notes
	Residential	Units	Commercial	Units		
Budget	200,000	Btu/hr	350,000	Btu/hr		
Offset within budget	10%	n/a	10%	n/a		
Offset in excess of budget	100%	n/a	100%	n/a		

Exterior Energy Use Annual Calculations:

Residential Snowmelt:			
Parameter	Value	units	Notes
Operational Load	125	Btu/h/af	Based on ASHRAE loads for Class 1: Residential & Light Commercial
Cleanup Load	45	Btu/h/af	Wirsbo design manual load for 22-25°F and 5MPH wind speed.
Run Time	560	hrs	Based on data collected by the Colorado Climate Center from 1980-1996.
Clean Up Time	260	hrs	Based on data collected by the Colorado Climate Center from 1980-1996.
Total Annual Load	82	kBtu/sf-yr	Energy consumed per year per square foot.

Commercial Snowmelt:			
Parameter	Value	units	Notes
Operational Load	175	Btu/h/af	Based on ASHRAE loads for Class 2: Heavy Commercial
Cleanup Load	45	Btu/h/af	Wirsbo design manual load for 22-25°F and 5MPH wind speed.
Idle Load	16	Btu/h/af	Median hourly idle load: calculation performed with Gypsum - Eagle County Airport weather data.
Run Time	560	hrs	Based on data collected by the Colorado Climate Center from 1980-1996.
Clean Up Time	260	hrs	Based on data collected by the Colorado Climate Center from 1980-1996.
Idle Time	2404	hrs	Number of hours the Gypsum - Eagle County Airport weather file is below a 35°F slab idle temperature set point less clean up and run time.
Total Annual Load	148	kBtu/sf-yr	Energy consumed per year per square foot.

Residential Pool:			
Parameter	Value	units	Notes
Day Use	4	hrs	Hours of use during day time. Calculations were performed with the DOE the Energy Smart Pools software using weather data from Dillon, CO.
Night Use	4	hrs	Hours of use during night time.
Pool Set Point	83	F	Pool temperature set point.
Cover Insulation	1.4	R-value	Thermal insulation value of bubble cover.
Wind Speed	5	mph	Assumed wind speed.
Total Annual Load	332	kBtu/sf-yr	Energy consumed per year per square foot.

Commercial Pool:			
Parameter	Value	units	Notes
Day Use	4	hrs	Hours of use during day time. Calculations were performed with the DOE the Energy Smart Pools software using weather data from Dillon, CO.
Seasonal Use	10	months	Months per year.
Pool Set Point	82	F	Pool temperature set point.
Pool Idle Set Point	68	F	Pool temperature set back.
Cover Insulation	0.1	R-value	Thermal insulation value of vinyl cover
Transmittance	75%	%	Visible transmittance of water.
Solar Exposure Factor	80%	%	Assumed solar exposure.
Pool Emissivity	0.9	n/a	Assumed emissivity of pool.
Wind Speed	5	mph	Assumed wind speed.
Total Annual Load	414	kBtu/sf-yr	Energy consumed per year per square foot.

Spas (residential and commercial)			
Parameter	Value	units	Notes
Day Use	10	hrs	Hours of use during day time. Calculations were performed with the DOE the Energy Smart Pools software using weather data from Dillon, CO.
Night Use	4	hrs	Hours of use during night time.
Pool Set Point	104	F	Spa temperature set point.
Cover Insulation	12	R-value	Thermal insulation value of spa cover
Wind Speed	5	mph	Assumed wind speed.
Total Annual Load	429	kBtu/sf-yr	Energy consumed per year per square foot.

Outdoor Gas Appliances:					
Parameter	Fireplaces		Patio Heaters		Notes
	Residential	Commercial	Residential	Commercial	
Type					
Number of heaters (input)	1	1	1	1	For example purposes only.
MBH (rated input)	20	250	20	20	kBtu/h For example purposes only.
MBH (total installed)	20	250	20	20	kBtu/h For example purposes only.
Hours per day	1	6	2	4	hrs/day Assumed hours per day, per committee meeting.
Weeks per year	42	48	25	36	weeks/yr Assumed weeks per year, per committee meeting.
Hours per year	364	2016	350	1008	hrs/yr Run hours per year.
Annual energy consumption	7280	504000	7000	20160	kBtu/yr Energy consumed per year.
Normalized annual energy consumption	364	2016	350	1008	kBtu/kBtu/yr Energy consumed per year per installed MBH.

Gas Cooking Appliances:

Type	Residential	Commercial	(units)	Notes
Normalized annual energy consumption	80	390	kBtu/kBtu/yr	Energy consumed per year per installed MBH. Similar to 'Outdoor Gas Appliance' Calculation w/ different run-time assumptions.

Electric Patio Heaters:				
Parameter	Electric Patio Heaters		units	Notes
Type	Residential	Commercial		
Number of heaters (input)	1	1		For example purposes only.
W (rated input)	6000	6000	Watts	For example purposes only.
W (total installed)	6000	6000	Watts	For example purposes only.
Day Use	2	4	hrs	Assumed hours per day, per committee meeting.
weeks/yr	25	36	weeks	Assumed weeks per year, per committee meeting.
hrs/yr	350	1008	hrs	Run hours per year.
Annual energy consumption	2100	6048	kWh/yr	Energy consumed per year.
Normalized annual energy consumption	0.35	1.01	kWh/yr/W	Energy consumed per year per installed Watt.

Heat tape:		Self Regulating Heat Tape Annual Energy Model (Pitkin County)	Notes
<u>Model Assumptions</u>			
Weather Data Location: Gypsum - Eagle County Airport Basis Product: Chomalex SRF-RG Output Temperature Adjustment (linear): Watt-Hour-m ² -b Max Output (Watt/LF): 8.0 W Max Output Temperature (Degrees F): 32.0 F Reduced Output (Watt/LF): 5.0 W Reduced Output Temperature (Degrees F): 40.0 F Adjustment Variable (m): - 3/8 Adjustment Variable (b): 20.0			These assumptions were used to run an hourly annual calculation in which, each Watt-Hour/foot of energy consumption was calculated and summed. Per discussions with manufacturer's regarding the operation of "self-regulating" heat tape, the tape is modeled as consuming full rated output when the outside air temperature was below 32°F, and if the outside air temperature is above 32°F the rate of energy consumption decreased linearly to the reduced output temperature listed by the manufacturer. Calculation accounts for seasonal and nightly shutdowns per required controls.
<u>Seasonal and Nightly Shut-Off</u>			
Control #1: Self Regulating Control #2: Manual System Shut-off (April-1 thru November-1) Control #3: Timer Switch Shut-off (1800-0600) Control #4: None			
Modeled Annual Energy Consumption per Linear Ft of Cable (kWh):	12.58	1.375	
	kWh/ft of cable/yr	kWh/yr/W	Energy consumed per year per installed Watt.

Available Gas Combustion Thermal Efficiencies:

- 92%
- 93%
- 94%
- 95%
- 96%
- 97%
- 98%
- 99%
- 100%