Technical Reference Manual Multifamily 1.0

Prepared for

Idaho Power Company

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1. Overview and Purpose of Deemed Savings Method

This Technical Reference Manual (TRM) is a compilation of stipulated algorithms and values for various energy efficiency measures implemented by Idaho Power Company's Multifamily demand side management programs and serves the New Construction and Retrofit programs by providing up to date savings estimates for the energy efficiency measures offered by the programs. This manual is intended to facilitate the cost effectiveness screening, planning, tracking, and energy savings reporting for the New Construction and Retrofit Energy Efficiency incentive programs. While the algorithms and stipulated values contained in this TRM are derived using best practices, the stipulated values should be reviewed and revised according to relevant industry research and impact evaluation findings as necessary to ensure that they remain accurate for the New Construction and Retrofit programs. The following sections describe many of the processes and cross-cutting assumptions used to derive the measure level savings estimates found in Section 2.

1.1. Purpose

This manual is intended to facilitate the cost effectiveness screening, planning, tracking, and energy savings reporting for the New Construction and Retrofit energy efficiency incentive programs. This document is intended to be a living document in which the stipulated values are revised according to relevant industry research and impact evaluation findings.

1.2. Methodology and Framework

The algorithms and stipulated values contained in this TRM are derived using current industry standard engineering best practices. Current relevant research, recent impact evaluations, and Technical Reference Manuals developed for other states and/or regions are referenced where appropriate. All energy savings algorithms in this TRM are designed to be applied using the simple engineering formulas defined for each measure in conjunction with the included stipulated values.

Each measure is presented first with a summary of the technology and typical expected (per unit) energy savings, expected useful life, and incremental cost estimates. The ‘typical’ per unit values leverage basic assumptions regarding the geographic distribution of program participants (e.g. weather zone) as well as participant demographics (for example distribution of building types, efficiency of current building stock, etc.). Each measure is accompanied by a spreadsheet calculator containing live formulas and all weights used to derive the typical per-unit estimates. It is expected that as better information is made available regarding program participants, or as program designs are adjusted these numbers will be updated accordingly.

Following the measure summary information, each measure section provides a description of its scope and the spectrum of eligible projects/equipment to which the algorithms and values apply. When applicable, a discussion of code compliance topics (for new construction projects) is included.

1.3. Weather Data Used for *Weather Sensitive* Measures

The service territory for Idaho Power Company covers much of southern Idaho and stretches into eastern Oregon. This is illustrated in Figure 1-1.In order to normalize expected annual energy savings and peak demand reductions for annual variations in weather patterns, all stipulated values for weather sensitive measures were derived using the industry standard Typical Meteorological Year (TMY3) weather data. While there are many weather stations in Idaho for which TMY3 data is available, it was determined that averaging the TMY3 weather across stations in three ASHRAE weather zones (zones 5, 6, and Oregon) provided sufficient resolution without adding too many separate variations for stipulated values reported in the TRM.

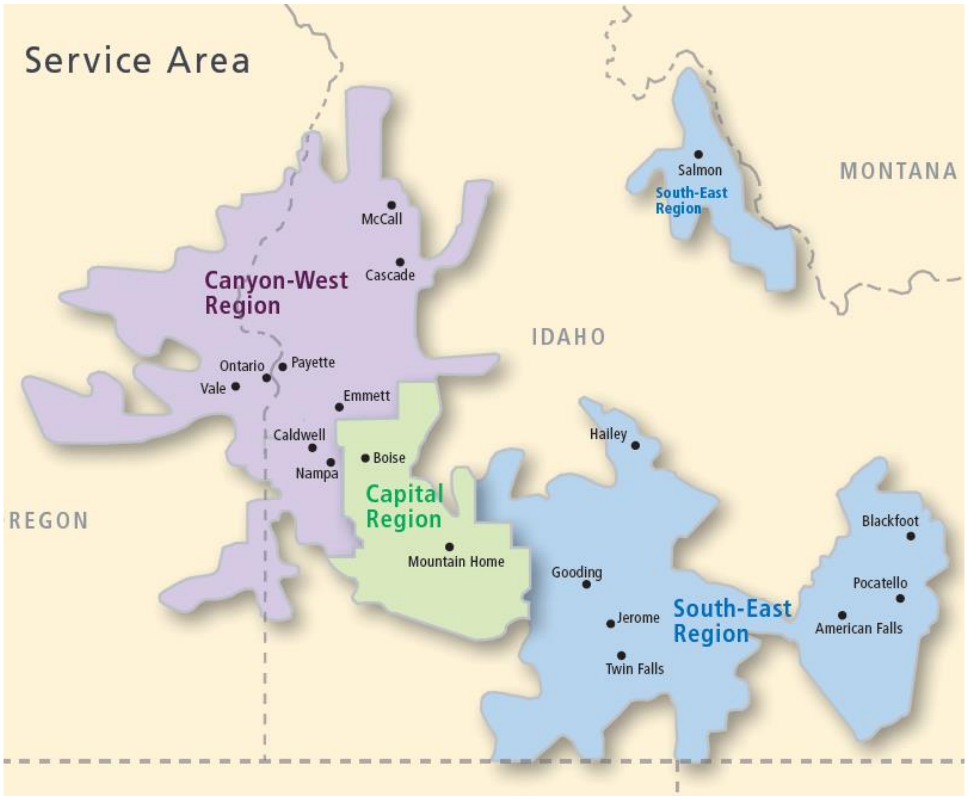

Figure 1-1 Map of Idaho Power Company Service Territory[1]

All stipulated values for weather sensitive measures (e.g. Equivalent Full Load Cooling Hours) are based on ‘typical’ weather data and provided separately for each of these two weather zones. A map of the ASHRAE weather zones is provided in Figure 1-2. When separate savings estimates are provided for different weather zones, the project location should be used to determine which of the values are applicable. The ‘typical’ energy savings values reported at the beginning of each measure’s section assumes a weighted average between the three weather zones using weights of 77.5%, 17.5%, and 5% for Zones 5, 6, and Oregon respectively.

[1] Map represents service territory at the time of this publication.

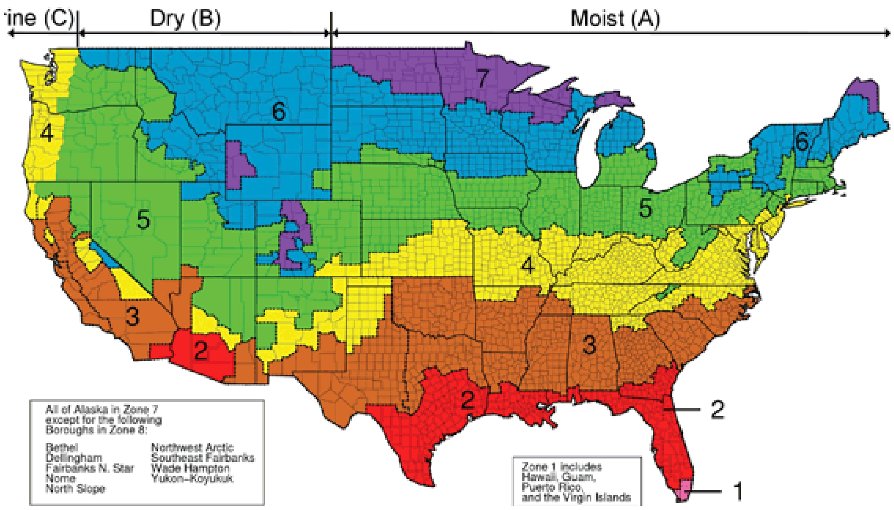

Figure 1-2 Map Illustrating ASHRAE Weather Zones[2]

While reviewing the weather data it was noted that while both weather zones are 'heating dominated' Weather Zone 6 is on average cooler that Weather Zone 5. Therefore, energy conservation measures targeting heating efficiency tend to perform much better in Zone 6. However; measures which result in a heating penalty tend to perform better in Zone 5. Monthly average dry bulb temperatures are compared for both weather zones in Figure 1-3.

[2] Note how Idaho is bisected by Zones 5 and 6

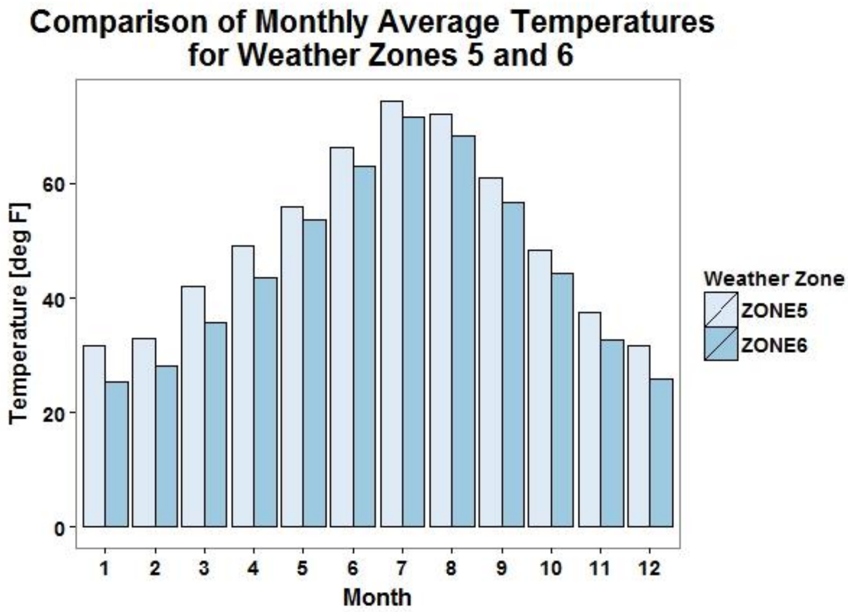

Figure 1-3 Comparison of Monthly Average Temperatures

1.4. Peak Demand Savings and Peak Demand Window Definition

Where applicable peak demand savings estimates are derived using Idaho Power Company's peak period definition of: *weekdays from 12:00 PM to 8:00 PM, June 1 through August 31*. Hourly savings estimates are averaged over the aforementioned time period to report peak savings.

Coincidence Factors for Lighting

Coincidence factors are defined as the percentage of the demand savings which occur during Idaho Power Company's peak period (defined above). When hourly data are available these are calculated by averaging the hourly demand savings over the peak period definition. This is exemplified in Figure 1-4 which illustrates a hypothetical hourly savings profile. The highlighted region bounds the peak period definition and the CF is calculated by taking the average demand reduction during that period divided by the max demand reduction

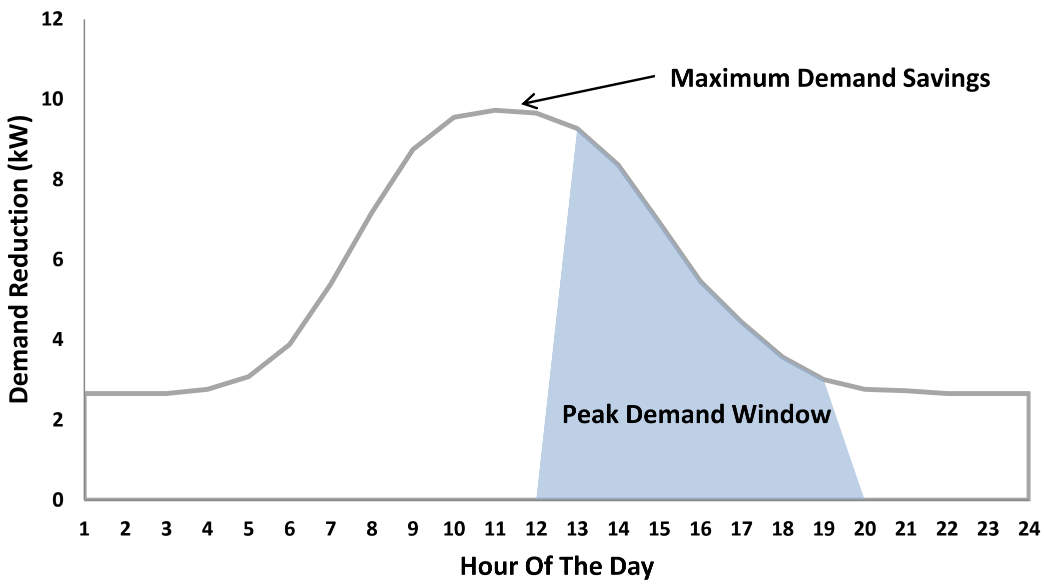

Figure 1-4 Hypothetical Hourly Savings Profile Used to Illustrate Calculation of Coincidence Factor

Thus in the example above let's suppose that the maximum Demand savings are 10 kW and the average kW reduction in the shaded area is 6 kW. The coincidence factor is calculated as follows:

$$Coincidence\ Factor = \frac{Average\ Reduction}{Max\ Reduction} = \frac{6\ kW}{10\ kW} = .6$$

1.5. Building Type by Measure

This TRM estimates the facility energy savings for each measure using deemed values where applicable. Because of how various measure savings are sourced and calculated, all building types are not present for all measures. When applying for measure savings, the building type that most closely resembles the stated facility should be used and should be consistent for all measures being implemented at the same facility. Table 1-1 helps combine the building types listed for HVAC and Lighting measures. This table can be used to select a single building type from either list and lookup the appropriate building type label in the other measure.

Table 1-1 Building Type and Location

Building Type[3]	**Idaho**[4]		**Oregon**	
	HVAC Cooling EFLH	HVAC Heating EFLH	HVAC Cooling EFLH	HVAC Heating EFLH
Low Rise[5]	469	679	287	929
High Rise	896	338	764	516

[3] Typical savings values are calculated using an average of the low and high rise building types. For more precise estimates, use the savings algorithms and provided deemed numbers.

[4] Idaho combined hours are weighted 80/20 for zone 5, and 6 respectively.

[5] Low rise is defined as any building with less than 5 stories above ground.

2. Multifamily Deemed Savings Measures

This chapter contains the protocols and stipulated values for multifamily measures covered by this TRM. Spreadsheets were developed for each measure and contain any calculations used to derive stipulated values (or deemed savings estimates). Each measure is presented first with a summary of the technology and typical expected (per unit) energy savings, expected useful life, and incremental cost estimates. The 'typical' per unit values leverage basic assumptions regarding the geographic distribution of program participants (e.g. weather zone) as well as participant demographics (for example distribution of building types, efficiency of current building stock, etc.) and are intended for use in cost effectiveness screening – not as deemed savings estimates (given their generality). Where applicable, deemed savings estimates are provided for various scenario in tables at the end of each measure's section. Most deemed saving values are rounded and may cause the combined totaled value to not match the values above, (e.g. heating and cooling numbers combined total not matching the stated total).

Each measure is accompanied by a spreadsheet calculator containing live formulas and all weights used to derive the typical per-unit estimates. It is expected that as better information is made available regarding program participants, or as program designs are adjusted these numbers will be updated accordingly. Following the measure summary information, each measure section provides a description of its scope and the spectrum of eligible projects/equipment to which the algorithms and values apply. When applicable, a discussion of code compliance topics (for new construction projects) is included. It should also be noted that while savings estimates are provided for a multitude of measures (both for retrofit and new construction) a custom engineering analysis should be preferred for significantly large projects when possible.

2.1. Ductless Heat Pumps

The following algorithms and assumptions are applicable to ductless heat pump units installed in multifamily spaces. This measure applies to projects which represent either equipment retrofit or new construction (including major renovations). Table 2-1 through Table 2-4 summarize the 'typical' expected (per ton) unit energy impacts for this measure broken out by the baseline assumption. Typical values are based on algorithms and stipulated values described below and data from past program participants.[6] Note that the values listed in the tables below are averaged across each of the system efficiency and tonnage categories offered by the program.

Table 2-1 Typical Savings Estimates for New Construction Ductless Heat Pumps Idaho

	Ductless Mini-Spit HP base	Ductless Mini-Spit Gas base	Ductless Mini-Spit ER base
Deemed Savings Unit	Tons	Tons	Tons
Average Unit Energy Savings (Cooling)	94 kWh	94 kWh	94 kWh
Average Unit Energy Savings (Heating)	82 kWh	0 kWh	685 kWh
Average Unit Energy Savings (Combined)	176 kWh	94 kWh	779 kWh
Average Unit Peak Demand Savings (Cooling)	173 W	173 W	173 W
Expected Useful Life	15 Years	15 Years	15 Years
Average Material & Labor Cost	NA	NA	NA
Average Incremental Cost	$786	$858	$858
Stacking Effect End-Use	HVAC		

Table 2-2 Typical Savings Estimates for Retrofit Ductless Heat Pumps Idaho

	Ductless Mini-Spit HP base	Ductless Mini-Spit Gas base	Ductless Mini-Spit ER base
Deemed Savings Unit	Tons	Tons	Tons
Average Unit Energy Savings (Cooling)	128 kWh	128 kWh	128 kWh
Average Unit Energy Savings (Heating)	125 kWh	0 kWh	685 kWh
Average Unit Energy Savings (Combined)	252 kWh	128 kWh	812 kWh
Average Unit Peak Demand Savings (Cooling)	234 W	234 W	234 W
Expected Useful Life	15 Years	15 Years	15 Years
Average Material & Labor Cost	$1766	$1766	$1766
Average Incremental Cost	NA	NA	NA
Stacking Effect End-Use	HVAC		

[6] See spreadsheet "1-TypicalCalcs_DuctlessHP_MF_v1.xlsx" for assumptions and calculations used to estimate the typical unit energy savings and incremental costs.

Table 2-3 and Table 2-4 show deemed savings for the Oregon territory.

Table 2-3 Typical Savings Estimates for New Construction Ductless Heat Pumps Oregon

	Ductless Mini-Spit HP base	**Ductless Mini-Spit Gas base**	**Ductless Mini-Spit ER base**
Deemed Savings Unit	Tons	Tons	Tons
Average Unit Energy Savings (Cooling)	72 kWh	72 kWh	72 kWh
Average Unit Energy Savings (Heating)	117 kWh	0 kWh	973 kWh
Average Unit Energy Savings (Combined)	189 kWh	72 kWh	1,045 kWh
Average Unit Peak Demand Savings (Cooling)	173 W	173 W	173 W
Expected Useful Life	15 Years	15 Years	15 Years
Average Material & Labor Cost	NA	NA	NA
Average Incremental Cost	$786	$858	$858
Stacking Effect End-Use		HVAC	

Table 2-4 Typical Savings Estimates for Retrofit Ductless Heat Pumps Oregon

	Ductless Mini-Spit HP base	**Ductless Mini-Spit Gas base**	**Ductless Mini-Spit ER base**
Deemed Savings Unit	Tons	Tons	Tons
Average Unit Energy Savings (Cooling)	98 kWh	98 kWh	98 kWh
Average Unit Energy Savings (Heating)	177 kWh	0 kWh	973 kWh
Average Unit Energy Savings (Combined)	275 kWh	98 kWh	1,071 kWh
Average Unit Peak Demand Savings (Cooling)	234 W	234 W	234 W
Expected Useful Life	15 Years	15 Years	15 Years
Average Material & Labor Cost	$1766	$1766	$1766
Average Incremental Cost	NA	NA	NA
Stacking Effect End-Use		HVAC	

2.1.1. Definition of Eligible Equipment

All ductless heat pump systems under 5 tons cooling capacity are eligible provided the installed equipment meets or exceeds ENERGYSTAR ductless heat pump requirements. Note that projects replacing pre-existing A/C only units with heat-pump units are eligible under this measure. In such project the heating component must use a *new construction baseline* whereas the cooling component can use either (retrofit or new construction) baselines as deemed appropriate. Eligibility is determined by calculating the EER, SEER, and/or HSPF as appropriate for the installed unit.

2.1.2. Definition of Baseline Equipment

Baseline equipment for this measure is determined by the nature of the project. There are two possible scenarios: retrofit (early replacement) or New construction.

Retrofit (Early Replacement)

If the project is retrofitting pre-existing equipment in working condition, then the baseline efficiency is defined by the pre-existing equipment. If the equipment being replaced is not in working order, then this is considered “replace on burn-out” and the baseline becomes new construction.

New Construction (Includes Major Remodel & Replace on Burn-Out)

For New Construction, the baseline efficiency is defined as the minimum allowable EER by the prevailing building energy code or standard according to which the project was permitted. Current applicable standards are defined by ASHRAE 90.1-2019. Recently Idaho adopted IECC 2018 as the energy efficiency standard for new construction.

2.1.3. Algorithms

The following energy and demand savings algorithms are applicable for this measure:

$$\Delta kWh = \Delta kWh_{Cool} + \Delta kWh_{Heat}$$

$$= Cap * (1/SEER_{base,\ cool} - 1/SEER_{Installed,\ cool}) / 1000 * EFLH_{Cool} * DF +$$
$$Cap * (1/HSPF_{base,\ Heat} - 1/HSPF_{Installed,\ Heat}) / 1000 * EFLH_{Heat} * DF$$

$$\Delta kW_{peak} = Cap * (1/EER_{base,\ cool} - 1/EER_{Installed,\ cool}) / 1000 * CF$$

2.1.4. Definitions

ΔkWh Expected energy savings between baseline and installed equipment.

ΔkW_{peak} Expected peak demand savings.

EFLH Equivalent full load cooling/heating hours of Idaho specific EFLH are by weather zone and building in Table 2-5.

CF Peak coincidence factor. Represents the % of the connected load reduction which occurs during Idaho Power’s peak period. Table 2-6

EER Energy Efficiency Ratio for *base* and *installed* systems in *cooling* and *heating* modes. This is defined as the ratio of the cooling capacity of the air conditioner in British Thermal Units per hour, to the total electrical input in watts. Since ASHRAE does not provide EER requirements for air-cooled air conditioners < 65,000 Btu/h, assume the following conversion:

$$EER \approx -0.02 * SEER^2 + 1.12 * SEER$$

SEER — Seasonal Energy efficiency ratio of the air conditioning unit. This is defined as the ratio of the Annual cooling provided by the air conditioner (in BTU/hr), to the total electrical input (in Watts). Note that the IEER is an appropriate equivalent. If the SEER or IEER are unknown or unavailable use the following formula to estimate from the EER: [7]

$$SEER = .0507 * EER^2 + .5773 * EER + .4919$$

HSPF — Heating Season Performance Factor. This is identical to the SEER (described above) as applied to Heat Pumps in heating mode. If only the heat pump COP is available, then use the following:

$$HSPF = .5651 * COP^2 + .464 * COP + .4873$$

Cap — Nominal cooling capaity in kBTU/Hr (1 ton = 12,000BTU/Hr)

DF — Discount factor for reduced savings pertaining to high efficiency HVAC units based on actual energy saving studies. (Default 0.55)

2.1.5. Sources

- ENERGYSTAR Ductless Heat Pump Requirements and list of qualified products
- New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs – Residential, Multi-Family, and Commercial/Industrial Measures, Version 9
- California DEER Effective Useful Life worksheets: EUL_Summary_10-1-08. California DEER Incremental Cost worksheets: Revised DEER Measure Cost Summary (05_30_2008) Revised (06_02_2008).xls
- IECC 2018

2.1.6. Stipulated Values

The following tables stipulate allowable values for each of the variables in the energy and demand savings algorithms for this measure.

[7] Note that this formula is an approximation and should only be applied to EER values up to 15 EER.

Table 2-5 Stipulated Equivalent Full Load Hours (EFLH) by Building Type[8]

	Zone 5		Zone 6		Oregon	
Building Type	EFLH Cooling	EFLH Heating	EFLH Cooling	EFLH Heating	EFLH Cooling	EFLH Heating
Low Rise	488	622	394	903	287	929
High Rise	910	298	842	498	764	516

Table 2-6 HVAC Coincidence Factors by Building Type

Building Type	Coincidence Factor
Low Rise	0.69
High Rise	0.69

[8] Idaho specific heating and cooling equivalent full load hours were calculated by weather normalizing data from the New York State TRM for multifamily EFLH values.

2.2. Air Source HVAC units

The following algorithms and assumptions are applicable to air source heat pump and air conditioning units installed in multifamily spaces. This measure applies to projects which represent either equipment retrofit or new construction (including major renovations). Air source air conditioning units can only claim savings for cooling savings.

Table 2-7 through Table 2-14 summarize the 'typical' expected (per ton) unit energy impacts for this measure broken out by the baseline assumption. Typical values are based on algorithms and stipulated values described below and data from past program participants.[9] Note that Table 2-7 reports the incremental savings and costs associated with going from CEE Tier 1 to CEE Tier 2 and are therefore additive with the appropriate baseline value based on the product.

Typical Savings are split into two regions, Idaho and Oregon. Table 2-7 through Table 2-10 refer to Idaho and Table 2-11 through Table 2-14 refer to Oregon.

Table 2-7 Typical Savings Estimates for New Construction CEE Tier 1, Idaho

	HVAC Unit w/ HP Baseline	HVAC Unit w/ Gas Baseline	HVAC Unit w/ Elec Res Baseline
Deemed Savings Unit	Tons	Tons	Tons
Average Unit Energy Savings (Cooling)	0 kWh	0 kWh	0 kWh
Average Unit Energy Savings (Heating)	0 kWh	0 kWh	602 kWh
Average Unit Energy Savings (Combined)	0 kWh	0 kWh	602 kWh
Average Unit Peak Demand Savings (Cooling)	0 W	0 W	0 W
Expected Useful Life	15 Years	15 Years	15 Years
Average Material & Labor Cost	NA	NA	NA
Average Incremental Cost	$0	$72	$72
Stacking Effect End-Use		HVAC	

[9] See spreadsheet "2-TypicalCalcs_AirSourceHP_MF_v1.xlsx" for assumptions and calculations used to estimate the typical unit energy savings and incremental costs.

Table 2-8 Typical Savings Estimates for New Construction CEE Tier 2, Idaho

	HVAC Unit w/ HP Baseline	HVAC Unit w/ Gas Baseline	HVAC Unit w/ Elec Res Baseline
Deemed Savings Unit	Tons	Tons	Tons
Average Unit Energy Savings (Cooling)	19 kWh	19 kWh	19 kWh
Average Unit Energy Savings (Heating)	8 kWh	0 kWh	611 kWh
Average Unit Energy Savings (Combined)	27 kWh	19 kWh	630 kWh
Average Unit Peak Demand Savings (Cooling)	35 W	35 W	35 W
Expected Useful Life	15 Years	15 Years	15 Years
Average Material & Labor Cost	NA	NA	NA
Average Incremental Cost	$124	$124	$124
Stacking Effect End-Use		HVAC	

Table 2-9 Typical Savings Estimates for Retrofit CEE Tier 1, Idaho

	HVAC Unit w/ HP Baseline	HVAC Unit w/ Gas Baseline	HVAC Unit w/ Elec Res Baseline
Deemed Savings Unit	Tons	Tons	Tons
Average Unit Energy Savings (Cooling)	33 kWh	33 kWh	33 kWh
Average Unit Energy Savings (Heating)	42 kWh	0 kWh	602 kWh
Average Unit Energy Savings (Combined)	76 kWh	33 kWh	636 kWh
Average Unit Peak Demand Savings (Cooling)	0 W	61 W	61 W
Expected Useful Life	15 Years	15 Years	15 Years
Average Material & Labor Cost	$980	$980	$980
Average Incremental Cost	NA	NA	NA
Stacking Effect End-Use		HVAC	

Table 2-10 Typical Savings Estimates for Retrofit CEE Tier 2, Idaho

	HVAC Unit w/ HP Baseline	HVAC Unit w/ Gas Baseline	HVAC Unit w/ Elec Res Baseline
Deemed Savings Unit	Tons	Tons	Tons
Average Unit Energy Savings (Cooling)	52 kWh	52 kWh	52 kWh
Average Unit Energy Savings (Heating)	51 kWh	0 kWh	611 kWh
Average Unit Energy Savings (Combined)	103 kWh	52 kWh	663 kWh
Average Unit Peak Demand Savings (Cooling)	96 W	96 W	96 W
Expected Useful Life	15 Years	15 Years	15 Years
Average Material & Labor Cost	$1032	$1032	$1032
Average Incremental Cost	NA	NA	NA
Stacking Effect End-Use		HVAC	

Table 2-11 Typical Savings Estimates for New Construction CEE Tier 1, Oregon

	HVAC Unit w/ HP Baseline	HVAC Unit w/ Gas Baseline	HVAC Unit w/ Elec Res Baseline
Deemed Savings Unit	Tons	Tons	Tons
Average Unit Energy Savings (Cooling)	0 kWh	0 kWh	0 kWh
Average Unit Energy Savings (Heating)	0 kWh	0 kWh	856 kWh
Average Unit Energy Savings (Combined)	0 kWh	0 kWh	856 kWh
Average Unit Peak Demand Savings (Cooling)	0 W	0 W	0 W
Expected Useful Life	15 Years	15 Years	15 Years
Average Material & Labor Cost	NA	NA	NA
Average Incremental Cost	$0	$72	$72
Stacking Effect End-Use		HVAC	

Table 2-12 Typical Savings Estimates for New Construction CEE Tier 2, Oregon

	HVAC Unit w/ HP Baseline	HVAC Unit w/ Gas Baseline	HVAC Unit w/ Elec Res Baseline
Deemed Savings Unit	Tons	Tons	Tons
Average Unit Energy Savings (Cooling)	14 kWh	14 kWh	14 kWh
Average Unit Energy Savings (Heating)	12 kWh	0 kWh	868 kWh
Average Unit Energy Savings (Combined)	26 kWh	14 kWh	883 kWh
Average Unit Peak Demand Savings (Cooling)	35 W	35 W	35 W
Expected Useful Life	15 Years	15 Years	15 Years
Average Material & Labor Cost	NA	NA	NA
Average Incremental Cost	$124	$124	$124
Stacking Effect End-Use		HVAC	

Table 2-13 Typical Savings Estimates for Retrofit CEE Tier 1, Oregon

	HVAC Unit w/ HP Baseline	HVAC Unit w/ Gas Baseline	HVAC Unit w/ Elec Res Baseline
Deemed Savings Unit	Tons	Tons	Tons
Average Unit Energy Savings (Cooling)	26 kWh	26 kWh	26 kWh
Average Unit Energy Savings (Heating)	60 kWh	0 kWh	856 kWh
Average Unit Energy Savings (Combined)	86 kWh	26 kWh	882 kWh
Average Unit Peak Demand Savings (Cooling)	0 W	61 W	61 W
Expected Useful Life	15 Years	15 Years	15 Years
Average Material & Labor Cost	$980	$980	$980
Average Incremental Cost	NA	NA	NA
Stacking Effect End-Use		HVAC	

Table 2-14 Typical Savings Estimates for Retrofit CEE Tier 2, Oregon

	HVAC Unit w/ HP Baseline	HVAC Unit w/ Gas Baseline	HVAC Unit w/ Elec Res Baseline
Deemed Savings Unit	Tons	Tons	Tons
Average Unit Energy Savings (Cooling)	40 kWh	40 kWh	40 kWh
Average Unit Energy Savings (Heating)	72 kWh	0 kWh	868 kWh
Average Unit Energy Savings (Combined)	112 kWh	40 kWh	908 kWh
Average Unit Peak Demand Savings (Cooling)	96 W	96 W	96 W
Expected Useful Life	15 Years	15 Years	15 Years
Average Material & Labor Cost	$1032	$1032	$1032
Average Incremental Cost	NA	NA	NA
Stacking Effect End-Use		HVAC	

2.2.1. Definition of Eligible Equipment

All air source systems under 5 tons cooling capacity are eligible provided the installed equipment meets or exceeds 2019 Consortium for Energy Efficiency (CEE) Tier 1 or Tier 2 efficiencies. Note that projects replacing pre-existing A/C only units with heat-pump units are eligible under this measure. In such project the heating component must use a *new construction baseline* whereas the cooling component can use either (retrofit or new construction) baselines as deemed appropriate. Eligibility is determined by calculating the EER, SEER, and/or HSPF as appropriate for the installed unit.

2.2.2. Definition of Baseline Equipment

Baseline equipment for this measure is determined by the nature of the project. There are two possible scenarios: retrofit (early replacement) or New construction.

Retrofit (Early Replacement)

If the project is retrofitting pre-existing equipment in working condition, then the baseline efficiency is defined by the pre-existing equipment. If the equipment being replaced is not in working order, then this is considered “replace on burn-out” and the baseline becomes new construction.

New Construction (Includes Major Remodel & Replace on Burn-Out)

For New Construction, the baseline efficiency is defined as the minimum allowable EER by the prevailing building energy code or standard according to which the project was permitted. Current applicable standards are defined by ASHRAE 90.1-2019. Recently Idaho adopted IECC 2018 as the energy efficiency standard for new construction.

2.2.3. Algorithms

The following energy and demand savings algorithms are applicable for this measure:

$$\Delta kWh = \Delta kWh_{Cool} + \Delta kWh_{Heat}$$

$$= Cap * (1/SEER_{base, cool} - 1/SEER_{Installed, cool}) / 1000 * EFLH_{Cool} * DF +$$
$$Cap * (1/HSPF_{base, Heat} - 1/HSPF_{Installed, Heat}) / 1000 * EFLH_{Heat} * DF$$

$$\Delta kW_{peak} = Cap * (1/EER_{base, cool} - 1/EER_{Installed, cool}) / 1000 * CF$$

2.2.4. Definitions

ΔkWh Expected energy savings between baseline and installed equipment.

ΔkW_{peak} Expected peak demand savings.

EFLH Equivalent full load cooling/heating hours of Idaho specific EFLH are by weather zone and building in Table 2-15.

CF Peak coincidence factor. Represents the % of the connected load reduction which occurs during Idaho Power's peak period. Table 2-16

EER Energy Efficiency Ratio for *base* and *installed* systems in *cooling* and *heating* modes. This is defined as the ratio of the cooling capacity of the air conditioner in British Thermal Units per hour, to the total electrical input in watts. Since ASHRAE does not provide EER requirements for air-cooled air conditioners < 65,000 Btu/h, assume the following conversion:

$$EER \approx -0.02 * SEER^2 + 1.12 * SEER$$

SEER Seasonal Energy efficiency ratio of the air conditioning unit. This is defined as the ratio of the Annual cooling provided by the air conditioner (in BTU/hr), to the total electrical input (in Watts). Note that the IEER is an appropriate equivalent. If the SEER or IEER are unknown or unavailable use the following formula to estimate from the EER: [10]

$$SEER = .0507 * EER^2 + .5773 * EER + .4919$$

HSPF Heating Season Performance Factor. This is identical to the SEER (described above) as applied to Heat Pumps in heating mode. If only the heat pump COP is available, then use the following:

$$HSPF = .5651 * COP^2 + .464 * COP + .4873$$

Cap Nominal cooling capaity in kBTU/Hr (1 ton = 12,000BTU/Hr)

[10] Note that this formula is an approximation and should only be applied to EER values up to 15 EER.

DF Discount factor for reduced savings pertaining to high efficiency HVAC units based on actual energy saving studies. (Default 0.55)

2.2.5. Sources

- ENERGYSTAR Heat Pump Requirements and list of qualified products
- New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs – Residential, Multi-Family, and Commercial/Industrial Measures, Version 9
- California DEER Effective Useful Life worksheets: EUL_Summary_10-1-08. California DEER Incremental Cost worksheets: Revised DEER Measure Cost Summary (05_30_2008) Revised (06_02_2008).xls
- IECC 2018
- Consortium for Energy Efficiency, High Efficiency Commercial Air Conditioning and Heat Pumps Initiative 2019

2.2.6. Stipulated Values

The following tables stipulate allowable values for each of the variables in the energy and demand savings algorithms for this measure.

Table 2-15 Stipulated Equivalent Full Load Hours (EFLH) by Building Type[11]

	Zone 5		Zone 6		Oregon	
Building Type	EFLH Cooling	EFLH Heating	EFLH Cooling	EFLH Heating	EFLH Cooling	EFLH Heating
Low Rise	488	622	394	903	287	929
High Rise	910	298	842	498	764	516

Table 2-16 HVAC Coincidence Factors by Building Type

Building Type	Coincidence Factor
Low Rise	0.69
High Rise	0.69

[11] Idaho specific heating and cooling equivalent full load hours were calculated by weather normalizing data from the New York State TRM for multifamily EFLH values.

2.3. PTAC and PTHP

The following algorithms and assumptions are applicable to energy efficient PTAC and PTHP units installed in multifamily units. This measure applies to projects which represent either equipment retrofit or new construction (including major renovations).

Table 2-17 through Table 2-22 summarizes the 'typical' expected (per ton) unit energy impacts for this measure.[12] Typical values are based on algorithms and stipulated values described below and data from past program participants. Savings are shown as a unit that is 10% better than the stated baseline and 20% better than code. Note: the 20% better than code column should be added to the 10% better than code for eligible units.

Typical Savings are split into two regions, Idaho and Oregon. Table 2-17 through Table 2-19 refer to Idaho and Table 2-20 through Table 2-22 refer to Oregon.

Table 2-17 Typical Savings Estimates for New Construction High Efficiency, PTHP with Different Baseline Units, Idaho

	PTHP +10% w/ HP Baseline	PTHP +10% w/ Gas Baseline	PTHP +10% w/ Elec Res Baseline	PTHP +20% w/ +10% Baseline
Deemed Savings Unit	Tons	Tons	Tons	Tons
Average Unit Energy Savings (Cooling)	39 kWh	39 kWh	39 kWh	32 kWh
Average Unit Energy Savings (Heating)	48 kWh	0 kWh	612 kWh	34 kWh
Average Unit Energy Savings (Combined)	87 kWh	39 kWh	651 kWh	66 kWh
Average Unit Peak Demand Savings (Cooling)	71 W	71 W	71 W	60 W
Expected Useful Life	15 Years	15 Years	15 Years	15 Years
Average Material & Labor Cost	NA	Na	NA	NA
Average Incremental Cost	$224	$384	$384	$224
Stacking Effect End-Use	HVAC			

[12] See spreadsheet "3-TypicalCalcs_Packaged_MF_v1.xlsx" for assumptions and calculations used to estimate the typical unit energy savings and incremental costs.

Table 2-18 Typical Savings Estimates for Retrofit High Efficiency, PTHP with Different Baseline Units, Idaho

	PTHP +10% w/ HP Baseline	PTHP +10% w/ Gas Baseline	PTHP +10% w/ Elec Res Baseline	PTHP +20% w/ +10% Baseline
Deemed Savings Unit	Tons	Tons	Tons	Tons
Average Unit Energy Savings (Cooling)	86 kWh	86 kWh	86 kWh	32 kWh
Average Unit Energy Savings (Heating)	95 kWh	0 kWh	722 kWh	34 kWh
Average Unit Energy Savings (Combined)	181 kWh	86 kWh	808 kWh	66 kWh
Average Unit Peak Demand Savings (Cooling)	159 W	159 W	159 W	60 W
Expected Useful Life	15 Years	15 Years	15 Years	15 Years
Average Material & Labor Cost	$1783	$1783	$1783	$2006
Average Incremental Cost	NA	NA	NA	NA
Stacking Effect End-Use	HVAC			

Table 2-19 Typical Savings Estimates for High Efficiency, PTAC, Idaho

	New Construction PTAC +10%	Retrofit PTAC +10%	PTAC +20% w/ +10% baseline[13]
Deemed Savings Unit	Tons	Tons	Tons
Average Unit Energy Savings (Cooling)	39 kWh	86 kWh	32 kWh
Average Unit Energy Savings (Heating)	0 kWh	0 kWh	0 kWh
Average Unit Energy Savings (Combined)	39 kWh	86 kWh	32 kWh
Average Unit Peak Demand Savings (Cooling)	71 W	159 W	60 W
Expected Useful Life	15 Years	15 Years	15 Years
Average Material & Labor Cost	NA	$1599	$1800
Average Incremental Cost	$201	NA	$201
Stacking Effect End-Use	HVAC		

[13] This column can be used to add to New Construction or Retrofit.

Table 2-20 Typical Savings Estimates for New Construction High Efficiency, PTHP with Different Baseline Units, Oregon

	PTHP +10% w/ HP Baseline	PTHP +10% w/ Gas Baseline	PTHP +10% w/ Elec Res Baseline	PTHP +20% w/ +10% Baseline
Deemed Savings Unit	Tons	Tons	Tons	Tons
Average Unit Energy Savings (Cooling)	30 kWh	30 kWh	30 kWh	25 kWh
Average Unit Energy Savings (Heating)	68 kWh	0 kWh	870 kWh	48 kWh
Average Unit Energy Savings (Combined)	98 kWh	30 kWh	900 kWh	73 kWh
Average Unit Peak Demand Savings (Cooling)	71 W	71 W	71 W	60 W
Expected Useful Life	15 Years	15 Years	15 Years	15 Years
Average Material & Labor Cost	NA	Na	NA	NA
Average Incremental Cost	$224	$384	$384	$224
Stacking Effect End-Use	HVAC			

Table 2-21 Typical Savings Estimates for Retrofit High Efficiency, PTHP with Different Baseline Units, Oregon

	PTHP +10% w/ HP Baseline	PTHP +10% w/ Gas Baseline	PTHP +10% w/ Elec Res Baseline	PTHP +20% w/ +10% Baseline
Deemed Savings Unit	Tons	Tons	Tons	Tons
Average Unit Energy Savings (Cooling)	67 kWh	67 kWh	67 kWh	25 kWh
Average Unit Energy Savings (Heating)	134 kWh	0 kWh	1,025 kWh	48 kWh
Average Unit Energy Savings (Combined)	201 kWh	67 kWh	1,092 kWh	73 kWh
Average Unit Peak Demand Savings (Cooling)	159 W	159 W	159 W	60 W
Expected Useful Life	15 Years	15 Years	15 Years	15 Years
Average Material & Labor Cost	$1783	$1783	$1783	$2006
Average Incremental Cost	NA	NA	NA	NA
Stacking Effect End-Use	HVAC			

Table 2-22 Typical Savings Estimates for High Efficiency, PTAC, Oregon

	New Construction PTAC +10%	Retrofit PTAC +10%	PTAC +20% w/ +10% baseline[14]
Deemed Savings Unit	Tons	Tons	Tons
Average Unit Energy Savings (Cooling)	30 kWh	67 kWh	25 kWh
Average Unit Energy Savings (Heating)	0 kWh	0 kWh	0 kWh
Average Unit Energy Savings (Combined)	30 kWh	67 kWh	25 kWh
Average Unit Peak Demand Savings (Cooling)	71 W	159 W	60 W
Expected Useful Life	15 Years	15 Years	15 Years
Average Material & Labor Cost	NA	$1599	$1800
Average Incremental Cost	$201	NA	$201
Stacking Effect End-Use	HVAC		

2.3.1. Definition of Eligible Equipment

All commercial PTHP and PTAC units under 5 tons are eligible provided the installed equipment exceeds IECC 2018 minimum standard equipment efficiency by at least 10%.

2.3.2. Definition of Baseline Equipment

Baseline equipment for this measure is determined by the nature of the project. There are two possible scenarios: retrofit (early replacement) or new construction.

Retrofit (Early Replacement)

If the project is retrofitting pre-existing equipment in working condition, then the baseline efficiency is defined by the pre-existing equipment. If the equipment being replaced is not in working order, then this is considered “replace on burn-out” and the baseline becomes new construction. Note that units replacing window/wall mounted air-conditioners, room air-conditioners, and/or evaporative cooling are not eligible for early replacement and are considered “New Construction.”

New Construction (Includes Major Remodel & Replace on Burn-Out)

For New Construction, the baseline efficiency is defined as the minimum allowable SEER and EER by the prevailing building energy code or standard according to which the project was permitted. Recently Idaho adopted IECC 2018 as the energy efficiency standard for new construction.

2.3.3. Algorithms

The following energy and demand savings algorithms are applicable for this measure:

[14] This column can be used to add to New Construction or Retrofit.

$$\Delta kWh = \Delta kWh_{Cool} + \Delta kWh_{Heat}$$

$$= Cap * (1/SEER_{base,\ cool} - 1/SEER_{Installed,\ cool}) / 1000 * EFLH_{Cool} * DF +$$
$$Cap * (1/HSPF_{base,\ Heat} - 1/HSPF_{Installed,\ Heat}) / 1000 * EFLH_{Heat} * DF$$

$$\Delta kW_{peak} = Cap * (1/EER_{base,\ cool} - 1/EER_{Installed,\ cool}) / 1000 * CF$$

2.3.4. Definitions

ΔkWh Expected energy savings between baseline and installed equipment.

ΔkW_{peak} Expected peak demand savings.

EFLH Equivalent full load cooling/heating hours of Idaho specific EFLH are by weather zone and building in Table 2-23.

CF Peak coincidence factor. Represents the % of the connected load reduction which occurs during Idaho Power's peak period. Table 2-24

EER Energy Efficiency Ratio for *base* and *installed* systems. This is defined as the ratio of the cooling capacity of the air conditioner in British Thermal Units per hour, to the total electrical input in watts. Since ASHRAE does not provide EER requirements for air-cooled air conditioners < 65,000 Btu/h, assume the following conversion:

$$EER \approx -0.02 * SEER^2 + 1.12 * SEER$$

SEER Seasonal Energy efficiency ratio of the air conditioning unit. This is defined as the ratio of the Annual cooling provided by the air conditioner (in BTU/hr), to the total electrical input (in Watts). Note that the IEER is an appropriate equivalent. If the SEER or IEER are unknown or unavailable use the following formula to estimate from the EER: [15]

$$SEER = .0507 * EER^2 + .5773 * EER + .4919$$

HSPF Heating Season Performance Factor. This is identical to the SEER (described above) as applied to Heat Pumps in heating mode. If only the heat pump COP is available, then use the following:

$$HSPF = .5651 * COP^2 + .464 * COP + .4873$$

Cap Nominal cooling capaity in kBTU/Hr (1 ton = 12,000BTU/Hr)

DF Discount factor for reduced savings pertaining to high efficiency HVAC units based on actual energy saving studies. (Default 0.55)

[15] Note that this formula is an approximation and should only be applied to EER values up to 15 EER.

2.3.5. Sources

- New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs – Residential, Multi-Family, and Commercial/Industrial Measures, Version 9
- ASHRAE, Standard 90.1-2019.
- California DEER Effective Useful Life worksheets: EUL_Summary_10-1-08. California DEER Incremental Cost worksheets: Revised DEER Measure Cost Summary (05_30_2008) Revised (06_02_2008).xls
- IECC 2018

2.3.6. Stipulated Values

The following tables stipulate allowable values for each of the variables in the energy and demand savings algorithms for this measure.

Table 2-23 Stipulated Equivalent Full Load Cooling and Heating Hours (EFLH) by Building Type[16]

	Zone 5		Zone 6		Oregon	
Building Type	EFLH Cooling	EFLH Heating	EFLH Cooling	EFLH Heating	EFLH Cooling	EFLH Heating
Low Rise	488	622	394	903	287	929
High Rise	910	298	842	498	764	516

Table 2-24 HVAC Coincidence Factors by Building Type

Building Type	Coincidence Factor
Low Rise	0.69
High Rise	0.69

[16] Idaho specific heating and cooling equivalent full load hours were calculated by weather normalizing data from the New York State TRM for multifamily EFLH values.

2.4. Ventilating Bathroom Exhaust Fan

Ventilating bath exhaust fans in multifamily buildings are installed to exhaust either hot and humid air caused by a resident taking a shower in the space, or foul smelling air. A bathroom exhaust fan can be installed in two different systems. The first system is in a residential bathroom which is manually controlled to turn on when the space is in use. This will exhaust air as needed based on the occupant. The second system is designed to function as part of the building's HVAC system and operate continuously.

Table 2-25 through Table 2-28 summarizes the 'typical' expected energy impacts for this measure. Typical values are based on the algorithms and stipulated values described below[17].

Table 2-25 Typical Saving Estimate for New Construction Manual Exhaust Fan

	ESME Fan without Light	ESME Fan with Light
Deemed Savings Unit	Unit	Unit
Average Unit Energy Savings	126 kWh	169 kWh
Average Unit Peak Demand Savings	0.13 kW	0.18 kW
Expected Useful Life	19 years	19 years
Average Material & Labor Cost	NA	NA
Average Incremental Cost	$17	$95
Stacking Effect End-Use	NA	

Table 2-26 Typical Saving Estimate for Retrofit Manual Exhaust Fan

	ESME Fan without Light	ESME Fan with Light
Deemed Savings Unit	Unit	Unit
Average Unit Energy Savings	139 kWh	188 kWh
Average Unit Peak Demand Savings	0.15 kW	0.20 kW
Expected Useful Life	19 years	19 years
Average Material & Labor Cost	$82	$177
Average Incremental Cost	NA	NA
Stacking Effect End-Use	NA	

[17] See spreadsheet "4-TypicalCalcs_Bath Fan_MF_v1.xlsx" for assumptions and calculations used to estimate the typical unit energy savings and incremental costs.

Table 2-27 Typical Saving Estimate for New Construction Continuous Exhaust Fan

	Single Speed	2-speed <90	2-speed >90
Deemed Savings Unit	Unit	Unit	Unit
Average Unit Energy Savings	113 kWh	120 kWh	120 kWh
Average Unit Peak Demand Savings	0.01 kW	0.01 kW	0.01 kW
Expected Useful Life	19 years	19 years	19 years
Average Material & Labor Cost	NA	NA	NA
Average Incremental Cost	$46	$58	$56
Stacking Effect End-Use		NA	

Table 2-28 Typical Saving Estimate for Retrofit Continuous Exhaust Fan

	Single Speed	2-speed <90	2-speed >90
Deemed Savings Unit	Unit	Unit	Unit
Average Unit Energy Savings	128 kWh	137 kWh	137 kWh
Average Unit Peak Demand Savings	0.01 kW	0.02 kW	0.02 kW
Expected Useful Life	19 years	19 years	19 years
Average Material & Labor Cost	$86	$205	$168
Average Incremental Cost	NA	NA	NA
Stacking Effect End-Use		NA	

2.4.1. Definition of Eligible Equipment

Eligible equipment are bath fans that meet or exceed ENERGY STAR minimum energy requirements. For continuously operated exhaust fans, eligible equipment is broken up based on the number and cfm of the unit.

For manually operated exhaust fans, eligible equipment must meet ENERGY STAR's Most Efficient (ESME) certified requirements. Eligible equipment is broken up based on if the exhaust fan has a light and heater included.

2.4.2. Definition of Baseline Equipment

There are two possible project baseline scenarios – retrofit and new construction.

Retrofit (Early Replacement)

The baseline equipment for retrofit are standard exhaust fans that do not meet ENERGY STAR's requirements.

New Construction (Includes Major Remodel & Replace on Burn-Out)

The baseline equipment for new construction are standard exhaust fans that do not meet ENERGY STAR's requirements.

2.4.3. Algorithms

The following energy and demand savings algorithms are applicable for this measure:

Manual Exhaust Fans:

$$kWh_{savings} = kWh_{base} - kWh_{measure}$$

$$kWh_i = (W_{fan} \times Hrs_{fan} + W_{heat} \times Hrs_{heat}) \times \left(\frac{365}{1{,}000}\right)$$

Continuous Exhaust Fans:

$$kWh_{savings} = kWh_{base} - kWh_{measure}$$

$$kWh_i = (Eff_{HS} \times CFM_{HS} \times Hrs_{HS} + Eff_{LS} \times CFM_{LS} \times Hrs_{LS}) \times \left(\frac{365}{1{,}000}\right)$$

2.4.4. Definitions

$kWh_{savings}$	Expected annual energy savings between baseline and installed equipment.
kWh_i	Expected daily energy consumption of bathroom exhaust fan
W	Operating wattage of the system component
Hrs	Daily estimated operating hours
HS/LS	Fan operating condition, High Speed or Low Speed
Eff	Fan operating efficiency, cfm/W
CFM	Operating airflow, cfm

2.4.5. Sources

- Energy Trust of Oregon Measure Approval Document for Multifamily Bath Fans
- Energy Trust of Oregon Measure Approval Document for Ventilating Bath Exhaust Fans in New Multifamily Buildings

2.4.6. Stipulated Values

Table 2-29 Continuous Exhaust Fan Deemed Variables

	High Speed Efficacy (CFM/W)	High Speed CFM	High Speed Daily Operating Hours	Low Speed Efficacy (CFM/W)	Low Speed CFM	Low Speed Daily Operating Hours
Baseline Single Speed	2.8	50	24	0.0	0	0.0
Baseline 2-speed <90	2.8	80	2.6	2.8	50	21.4
Baseline 2-speed >90	3.5	110	2.6	2.8	50	21.4
Measure Single Speed	10.0	50	24.0	10.0	0	0.0
Measure 2-speed <90	10.0	80	2.6	10.0	50	21.4
Measure 2-speed >90	10.0	110	2.6	10.0	50	21.4

Table 2-30 Continuous Exhaust Fan Deemed Variables

	Fan Wattage (W)	Light/heater Wattage (W)	Daily Fan Hours of Use (hrs)	Daily light/heater hours of use (hrs)
Baseline ESME Fan without Light	140.5	0.0	2.6	0.0
Baseline ESME Fan with Light	51.9	312.0	2.6	1.2
Measure ESME Fan without Light	8.2	0.0	2.6	0.0
Measure ESME Fan with Light	12.5	11.5	2.6	1.2

2.5. Spa Covers

A typical spa will use up to 2,500 kWh per year to maintain the desired temperature. This is caused by heat loss through all sides of the spa. A typical above ground spa will come with a standard cover to help insulate the water from the outside conditions. This measure consists of using a high insulation spa cover to reduce the amount of heat loss.

Table 2-31 and Table 2-32 summarizes the 'typical' expected energy impacts for this measure. Typical values are based on the algorithms and stipulated values described below[18].

Table 2-31 Typical Saving Estimate for Efficient Spa Covers, Idaho

	New Construction Cover	Retrofit Cover
Deemed Savings Unit	Unit	Unit
Average Unit Energy Savings	196 kWh	196 kWh
Average Unit Peak Demand Savings	0.02 kW	0.02 kW
Expected Useful Life	7 years	7 years
Average Material & Labor Cost	NA	$100
Average Incremental Cost	$100	NA
Stacking Effect End-Use	NA	

Table 2-32 Typical Saving Estimate for Efficient Spa Covers, Oregon

	New Construction Cover	Retrofit Cover
Deemed Savings Unit	Unit	Unit
Average Unit Energy Savings	216 kWh	216 kWh
Average Unit Peak Demand Savings	0.02 kW	0.02 kW
Expected Useful Life	7 years	7 years
Average Material & Labor Cost	NA	$100
Average Incremental Cost	$100	NA
Stacking Effect End-Use	NA	

2.5.1. Definition of Eligible Equipment

Eligible spa covers must have a minimum R-value of 12 and be continuous with no hinges. Spa cover measure only applies to electrically heated spa units. Spa covers must have an area greater than 25 square feet and less than 77 square feet.

2.5.2. Definition of Baseline Equipment

There are two possible project baseline scenarios – retrofit and new construction.

[18] See spreadsheet "5-TypicalCalcs_SpaCover_MF_v1.xlsx" for assumptions and calculations used to estimate the typical unit energy savings and incremental costs.

Retrofit (Early Replacement)

The baseline equipment for retrofit covers are a standard spa cover with an average insulation value between 8 and 15.

New Construction (Includes Major Remodel & Replace on Burn-Out)

The baseline equipment for new construction are a standard spa cover with an average insulation value between 8 and 15.

2.5.3. Algorithms

The following energy and demand savings algorithms are applicable for this measure:

$$kWh_{savings} = kWh_{base} - kWh_{measure}$$

$$kWh_i = \frac{U \times A \times \Delta T}{3{,}412}$$

2.5.4. Definitions

$kWh_{savings}$	Expected annual energy savings between baseline and installed equipment.
kWh_i	Expected annual energy consumption of the spa
U	Cover insulation U-value
A	Cover insulation area, square feet
ΔT	Annual summation of temperature difference between the spa and outside air temperature
3,412	Conversion factor

2.5.5. Sources

- Energy Trust of Oregon Measure Approval Document for Efficient Spa Covers

2.5.6. Stipulated Values

Table 2-33 Standard Spa Cover Deemed Variables

Baseline Cover Insulation (U-value)	Measure Cover Insulation (U-value)	Cover Area (sf)
0.096	0.067	51

Table 2-34 Annual Summation of Hour Temperature Difference by Weather Zone

Zone 5	Zone 6	Oregon
436,642	480,956	489,216

2.6. Pool Covers

A typical heated pool will lose energy through Convection, Evaporation, Radiation and Conduction. A majority of the heat loss is caused by evaporation, so adding a pool cover that stops water evaporation will help save energy when the pool is not in use. This measure consists of installing a solid pool cover to prevent evaporation when the heated pool is not occupied.

Table 2-35 and Table 2-37 summarizes the 'typical' expected energy impacts for this measure. Typical values are based on the algorithms and stipulated values described below[19].

Table 2-35 Typical Saving Estimate for Outdoor Pool Covers, Idaho

	Electric Resistance Heater	Heat Pump Heater
Deemed Savings Unit	Square Foot	Square Foot
Average Unit Energy Savings	104 kWh	21 kWh
Average Unit Peak Demand Savings	0.00 kW	0.00 kW
Expected Useful Life	10 years	10 years
Average Material & Labor Cost	$4.99	$4.99
Average Incremental Cost	$4.99	$4.99
Stacking Effect End-Use	NA	

Table 2-36 Typical Saving Estimate for Outdoor Pool Covers, Oregon

	Electric Resistance Heater	Heat Pump Heater
Deemed Savings Unit	Square Foot	Square Foot
Average Unit Energy Savings	77 kWh	15 kWh
Average Unit Peak Demand Savings	0.00 kW	0.00 kW
Expected Useful Life	10 years	10 years
Average Material & Labor Cost	$4.99	$4.99
Average Incremental Cost	$4.99	$4.99
Stacking Effect End-Use	NA	

[19] See spreadsheet "6-TypicalCalcs_PoolCover_MF_v1.xlsx" for assumptions and calculations used to estimate the typical unit energy savings and incremental costs.

Table 2-37 Typical Saving Estimate for Indoor Pool Covers

	Electric Resistance Heater	Heat Pump Heater
Deemed Savings Unit	Square Foot	Square Foot
Average Unit Energy Savings	39 kWh	8 kWh
Average Unit Peak Demand Savings	0.00 kW	0.00 kW
Expected Useful Life	10 years	10 years
Average Material & Labor Cost	$4.99	$4.99
Average Incremental Cost	$4.99	$4.99
Stacking Effect End-Use	NA	

2.6.1. Definition of Eligible Equipment

Eligible pool covers must be installed on a heated pool without a cover and must be installed during time periods when the pool is not open. Pool covers must be a solid track, bubble or foam cover. Oher pool covers such as liquid evaporation suppressants, solar disks, and mesh covers do not qualify.

2.6.2. Definition of Baseline Equipment

There are two possible project baseline scenarios – retrofit and new construction.

Retrofit (Early Replacement)

The baseline equipment for retrofit is an uncovered pool.

New Construction (Includes Major Remodel & Replace on Burn-Out)

The baseline equipment for new construction is an uncovered pool.

2.6.3. Algorithms

The following energy and demand savings algorithms are applicable for this measure:

$$kWh_{savings} = kWh_{per\ area} \times A$$

2.6.4. Definitions

$kWh_{savings}$	Expected annual energy savings
$kWh_{per\ area}$	Deemed savings per pool location and heating type
A	Cover area, square feet

2.6.5. Sources

- Energy Trust of Oregon Measure Approval Document for Pool Covers

2.6.6. Stipulated Values

Table 2-38 Deemed Savings for Outdoor Pool Covers by Zone and Heater Type

	Electric Resistance	Heat Pump
Zone 5	107.3	21.5
Zone 6	93.0	18.7
Oregon	76.8	15.4
Indoor	38.8	7.8

2.7. Efficient Windows

The following algorithm and assumptions are applicable to efficient windows in multifamily spaces which provide a lower U-value than existing windows or prevailing codes and standards. Savings will be realized through reductions in the buildings cooling and heating loads. Note that window films and windows with too low an SHGC value can for many buildings increase the heating loads (unless the building has a significant internal load as is the case for example in hospitals and/or data centers). In a heating dominated climate such as Idaho the increase in heating loads can negate any reduction in the cooling loads. Energy impacts for this measure are largely due to the improved U-Value and care should be taken when selecting windows to ensure that the SHGC values are appropriate for the building and climate. This measure only applies to low-rise multifamily buildings.

Table 2-39 through Table 2-42 summarize the 'typical' expected (per window ft^2) energy impacts for this measure. Typical values are based on the algorithms and stipulated values described below. [20]

Typical Savings are split into two regions, Idaho and Oregon. Table 2-39 and Table 2-40 refer to Idaho, and Table 2-41 and Table 2-42 refer to Oregon.

Table 2-39 Typical Savings Estimates for Efficient Windows with Electric Resistance Heating, Idaho

	Tier 1 Savings	**Tier 2 Savings**	**Tier 3 Savings**
Deemed Savings Unit	Square Foot	Square Foot	Square Foot
Average Unit Energy Savings	2.46 kWh	5.17 kWh	8.89 kWh
Average Unit Peak Demand Savings	0 kW	0 kW	0 kW
Expected Useful Life	45 years	45 years	45 years
Average Material & Labor Cost	$0.71	$1.5	$2.57
Average Incremental Cost	$0.71	$1.5	$2.57
Stacking Effect End-Use		HVAC	

[20] See spreadsheet "7-TypicalCalcs_Window_v1.xlsx" for additional assumptions and calculations, EUL, and incremental cost.

Table 2-40 Typical Savings Estimates for Efficient Windows with Heat Pump Heating, Idaho

	Tier 1 Savings	Tier 2 Savings	Tier 3 Savings
Deemed Savings Unit	Square Foot	Square Foot	Square Foot
Average Unit Energy Savings	0.15 kWh	0.29 kWh	0.51 kWh
Average Unit Peak Demand Savings	0 kW	0 kW	0 kW
Expected Useful Life	45 years	45 years	45 years
Average Material & Labor Cost	$0.71	$1.5	$2.57
Average Incremental Cost	$0.71	$1.5	$2.57
Stacking Effect End-Use		HVAC	

Table 2-41 Typical Savings Estimates for Efficient Windows with Electric Resistance Heating, Oregon

	Tier 1 Savings	Tier 2 Savings	Tier 3 Savings
Deemed Savings Unit	Square Foot	Square Foot	Square Foot
Average Unit Energy Savings	3.06 kWh	6.44 kWh	11.08 kWh
Average Unit Peak Demand Savings	0 kW	0 kW	0 kW
Expected Useful Life	45 years	45 years	45 years
Average Material & Labor Cost	$0.71	$1.5	$2.57
Average Incremental Cost	$0.71	$1.5	$2.57
Stacking Effect End-Use		HVAC	

Table 2-42 Typical Savings Estimates for Efficient Windows with Heat Pump Heating, Oregon

	Tier 1 Savings	Tier 2 Savings	Tier 3 Savings
Deemed Savings Unit	Square Foot	Square Foot	Square Foot
Average Unit Energy Savings	0.18 kWh	0.37 kWh	0.63 kWh
Average Unit Peak Demand Savings	0 kW	0 kW	0 kW
Expected Useful Life	45 years	45 years	45 years
Average Material & Labor Cost	$0.71	$1.5	$2.57
Average Incremental Cost	$0.71	$1.5	$2.57
Stacking Effect End-Use		HVAC	

2.7.1. Definition of Eligible Equipment

To be considered eligible equipment windows must be independently tested and certified according to the standards established by the National Fenestration Rating Council (NFRC). While the NFRC does provide such testing and certification - any NFRC-licensed independent certification and inspection agency can provide certification. One example of such a body is the American Architectural Manufacturers Association (AAMA). In addition, eligible windows must meet or exceed the following performance ratings:

Tier 1:	SHGC = any and U-factor <=0.3
Tier 2:	SHGC = any and U-factor <= 0.27
Tier 3:	SHGC = any and U-factor <= 0.24

Window films and shades are not eligible under this measure as they reduce the SHGC without providing an appreciable improvement in the U-Value and in many circumstances their addition would result in an increased heating load which negates or exceeds the reduction in cooling loads.

Retrofit equipment replacement must include replacing the glass and window frame together.

2.7.2. Definition of Baseline Equipment

Baseline equipment for this measure is determined by the nature of the project. There are two possible scenarios: retrofit (early replacement) or new construction.

Retrofit (Early Replacement)

If the project is retrofitting pre-existing equipment, then the baseline efficiency is defined by the pre-existing windows.

New Construction (Includes Major Remodel & Replace on Burn-Out)

For new construction, the baseline efficiency is defined as the minimum allowable window performance in the prevailing building energy code or standard to which the project was permitted. Recently Idaho adopted IECC 2018 and ASHRAE 90.1 2019 as the energy efficiency standard for new construction.

2.7.3. Algorithms

The following energy and demand savings algorithms are applicable for this measure:

$$kWh_{savings} = kWh_{per\ area} \times A$$

2.7.4. Definitions

$kWh_{savings}$	Expected annual energy savings
$kWh_{per\ area}$	Deemed savings per square foot
A	Cover area, square feet

2.7.5. Sources

- Energy Trust of Oregon Measure Approval Document for Residential Windows

2.7.6. Stipulated Values

The following tables stipulate allowable values for each of the variables in the energy and demand savings algorithms for this measure.

Table 2-43 Window Tier Efficiency Requirements

	U-Value	SHGC
Tier 1	0.3 - 0.28	Any
Tier 2	0.27 – 0.25	Any
Tier 3	<=0.24	Any

Table 2-44 Deemed Savings per Sq. Ft.

Tier	Heating Type	kWh/sf
1	Elec Res	1.84
	HP	0.11
2	Elec Res	3.87
	HP	0.22
3	Elec Res	6.66
	HP	0.38

2.8. Ceiling Insulation

The following algorithms and assumptions are applicable to ceiling insulation installed in multifamily spaces which are more efficient than existing insulation or prevailing codes and standards.

Ceiling insulation is rated by its R-value. An R-value indicates its resistance to heat flow (where a higher the R-value indicates a greater insulating effectiveness). The R-value depends on the type of insulation including its material, thickness, and density. When calculating the R-value of a multilayered installation, add the R-values of the individual layers.

Table 2-45 and Table 2-52 summarizes the 'typical' expected (per insulation ft^2 square foot) energy impacts for this measure.[21]

Typical Savings are split into two regions, Idaho and Oregon. For Retrofit, Table 2-45 and Table 2-46 refer to Idaho, and Table 2-47 and Table 2-48 refer to Oregon. For New Construction, Table 2-49 and Table 2-50 refer to Idaho, and Table 2-51 and Table 2-52 refer to Oregon.

Table 2-45 Typical Savings Estimates for Retrofit Heat Pump Heated Spaces, Idaho

	Adding Rigid Insulation	Upgrading to R-38	Upgrading to R-49
Deemed Savings Unit	Square Foot	Square Foot	Square Foot
Average Unit Energy Savings	0.10 kWh	0.15 kWh	0.18 kWh
Average Unit Peak Demand Savings	0.002 W	0.003 W	0.004 W
Expected Useful Life	25 years	25 years	25 years
Average Material & Labor Cost	$0.81	$1.57	$1.87
Average Incremental Cost	NA	NA	NA
Stacking Effect End-Use		HVAC	

Table 2-46 Typical Savings Estimates for Retrofit Electric Resistance Heated Spaces, Idaho

	Adding Rigid Insulation	Upgrading to R-38	Upgrading to R-49
Deemed Savings Unit	Square Foot	Square Foot	Square Foot
Average Unit Energy Savings	0.21 kWh	0.31 kWh	0.38 kWh
Average Unit Peak Demand Savings	0.002 W	0.003 W	0.004 W
Expected Useful Life	25 years	25 years	25 years
Average Material & Labor Cost	$0.81	$1.57	$1.87
Average Incremental Cost	NA	NA	NA
Stacking Effect End-Use		HVAC	

[21] See spreadsheet "8-TypicalCalcs_CeilingInsulation_v1.xlsx" for assumptions and calculations used to estimate the typical unit energy savings and incremental costs for cooling savings.

Table 2-47 Typical Savings Estimates for Retrofit Heat Pump Heated Spaces, Oregon

	Adding Rigid Insulation	Upgrading to R-38	Upgrading to R-49
Deemed Savings Unit	Square Foot	Square Foot	Square Foot
Average Unit Energy Savings	0.13 kWh	0.18 kWh	0.23 kWh
Average Unit Peak Demand Savings	0.001 W	0.002 W	0.003 W
Expected Useful Life	25 years	25 years	25 years
Average Material & Labor Cost	$0.81	$1.57	$1.87
Average Incremental Cost	NA	NA	NA
Stacking Effect End-Use		HVAC	

Table 2-48 Typical Savings Estimates for Retrofit Electric Resistance Heated Spaces, Oregon

	Adding Rigid Insulation	Upgrading to R-38	Upgrading to R-49
Deemed Savings Unit	Square Foot	Square Foot	Square Foot
Average Unit Energy Savings	0.27 kWh	0.39 kWh	0.47 kWh
Average Unit Peak Demand Savings	0.001 W	0.002 W	0.003 W
Expected Useful Life	25 years	25 years	25 years
Average Material & Labor Cost	$0.81	$1.57	$1.87
Average Incremental Cost	NA	NA	NA
Stacking Effect End-Use		HVAC	

Table 2-49 Typical Savings Estimates for New Construction Heat Pump Heated Spaces, Idaho

	Adding Rigid Insulation	Upgrading to R-38	Upgrading to R-49
Deemed Savings Unit	Square Foot	Square Foot	Square Foot
Average Unit Energy Savings	0.06 kWh	0.08 kWh	0.11 kWh
Average Unit Peak Demand Savings	0.001 W	0.002 W	0.002 W
Expected Useful Life	25 years	25 years	25 years
Average Material & Labor Cost	NA	NA	NA
Average Incremental Cost	$0.81	$0.35	$0.65
Stacking Effect End-Use		HVAC	

Table 2-50 Typical Savings Estimates for New Construction Electric Resistance Heated Spaces, Idaho

	Adding Rigid Insulation	Upgrading to R-38	Upgrading to R-49
Deemed Savings Unit	Square Foot	Square Foot	Square Foot
Average Unit Energy Savings	0.13 kWh	0.16 kWh	0.23 kWh
Average Unit Peak Demand Savings	0.001 W	0.002 W	0.002 W
Expected Useful Life	25 years	25 years	25 years
Average Material & Labor Cost	NA	NA	NA
Average Incremental Cost	$0.81	$0.35	$0.65
Stacking Effect End-Use		HVAC	

Table 2-51 Typical Savings Estimates for New Construction Heat Pump Heated Spaces, Oregon

	Adding Rigid Insulation	Upgrading to R-38	Upgrading to R-49
Deemed Savings Unit	Square Foot	Square Foot	Square Foot
Average Unit Energy Savings	0.08 kWh	0.10 kWh	0.14 kWh
Average Unit Peak Demand Savings	0.001 W	0.001 W	0.002 W
Expected Useful Life	25 years	25 years	25 years
Average Material & Labor Cost	NA	NA	NA
Average Incremental Cost	$0.81	$0.35	$0.65
Stacking Effect End-Use		HVAC	

Table 2-52 Typical Savings Estimates for New Construction Electric Resistance Heated Spaces, Oregon

	Adding Rigid Insulation	Upgrading to R-38	Upgrading to R-49
Deemed Savings Unit	Square Foot	Square Foot	Square Foot
Average Unit Energy Savings	0.17 kWh	0.20 kWh	0.29 kWh
Average Unit Peak Demand Savings	0.001 W	0.001 W	0.002 W
Expected Useful Life	25 years	25 years	25 years
Average Material & Labor Cost	NA	NA	NA
Average Incremental Cost	$0.81	$0.35	$0.65
Stacking Effect End-Use		HVAC	

2.8.1. Definition of Eligible Equipment

Eligible roof/ceiling area is limited to buildings or potions of buildings with central mechanical air conditioning or PTAC systems. Qualifying ceiling insulation can be rigid foam, fiberglass bat, or blown-in fiberglass or cellulose a long as material is eligible, assuming it meets or exceeds the required R-value. The insulation must upgrade from R19 or less. Added rigid insulation must provide continuous insulation with an R-value of 10 minimum. Additional insulation measures include installing R-38 and R-49.

2.8.2. Definition of Baseline Equipment

Baseline equipment for this measure is determined by the nature of the project. There are two possible scenarios: retrofit (early replacement) or new construction.

Retrofit (Early Replacement)

If the project is retrofitting pre-existing insulation, then the baseline efficiency is defined by the pre-existing insulation.

New Construction (New Construction, Replace on Burnout)

New Construction must meet building code and will only be eligible for added insulation above building code. The baseline ceiling insulation for new construction is estimated at R-25 continuous insulation.

2.8.3. Algorithms

The following energy and demand savings algorithms are applicable for this measure:

$$\Delta kWh = \Delta kWh_{cool} + \Delta kWh_{heat}$$

$$\Delta kWh_{cool} = A * (CDD * 24)/(SEER * 3412) * (1/R_{base} - 1/R_{meas})$$

$$\Delta kWh_{heat} = A * (HDD * 24)/(HSPF * 3412) * (1/R_{base} - 1/R_{meas})$$

$$\Delta kW_{peak} = \Delta kWh_{cool} / EFLH_{cool} * CF$$

2.8.4. Definitions

A	Area of the insulation that was installed in square feet
HDD	Heating degree days, refer to Table 2-54 for typical heating degree days for different buildings. When possible, actual base temperatures should be used to calculate the HDD
CDD	Cooling degree days refer to Table 2-54 for typical cooling degree days for different buildings. When possible, actual base temperatures should be used to calculate the CDD.
R_{base}	The R-value of the insulation and support structure before the additional insulation is installed
R_{meas}	The total measure R-value of all insulation after the additional insulation is installed

EFLH	Annual equivalent full load cooling hours for the air conditioning unit. Values for various building types are stipulated in Table 2-54. When available, actual system hours of use should be used.
SEER	Seasonal Energy efficiency ratio of the air conditioning unit. This is defined as the ratio of the Annual cooling provided by the air conditioner (in BTU/hr), to the total electrical input (in Watts). Note that the IEER is an appropriate equivalent. If the SEER or IEER are unknown or unavailable use the following formula to estimate from the EER: $SEER^{22} = .0507 * EER^2 + .5773 * EER + .4919$
HSPF	Heating Season Performance Factor. This is identical to the SEER (described above) as applied to Heat Pumps in heating mode. If only the heat pump COP is available, then use the following: $HSPF = .5651 * COP^2 + .464 * COP + .4873$
CF	Peak coincidence factor. Represents the % of the connected load reduction which occurs during Idaho Power's peak period.

2.8.5. Sources

- ASHRAE, Standard 90.1-2019.
- New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs – Residential, Multi-Family, and Commercial/Industrial Measures, Version 9
- California DEER Effective Useful Life worksheets: EUL_Summary_10-1-08.xls
- IECC 2018
- 2019 California Residential Appliance Saturation Study (RASS)

2.8.6. Stipulated Values

The following tables stipulate allowable values for each of the variables in the energy and demand savings algorithms for this measure.

Table 2-53 Standard System Variables

CF	SEER	HSPF,hp	HSPF,elec
0.69	12.6	7.2	3.41

[22] Note that this formula is an approximation and should only be applied to EER values up to 15 EER.

Table 2-54 Weather Zone Dependent Variables

	EFLH,c	EFLH,h	CDD	HDD
Zone 5	699	460	240	5,297
Zone 6	618	701	165	6,954
Oregon	526	722	107	7,094
Idaho Weighted Average	683	508	225	5,628

2.9. Floor Insulation

The following algorithms and assumptions are applicable to floor insulation installed in multifamily spaces which are more efficient than existing insulation or prevailing codes and standards.

Floor insulation is rated by its R-value. An R-value indicates its resistance to heat flow (where a higher the R-value indicates a greater insulating effectiveness). The R-value depends on the type of insulation including its material, thickness, and density. When calculating the R-value of a multilayered installation, add the R-values of the individual layers.

Table 2-55 and Table 2-62 summarizes the 'typical' expected (per insulation ft^2 square foot) energy impacts for this measure.[23]

Typical Savings are split into two regions, Idaho and Oregon. For Retrofit, Table 2-55 and Table 2-56 refer to Idaho, and Table 2-57 and Table 2-58 refer to Oregon. For New Construction, Table 2-59 and Table 2-60 refer to Idaho, and Table 2-61 and Table 2-62 refer to Oregon.

Table 2-55 Typical Savings Estimates for Retrofit Heat Pump Heated Spaces, Idaho

	Adding Rigid Insulation	Upgrading to R-13	Upgrading to R-19
Deemed Savings Unit	Square Foot	Square Foot	Square Foot
Average Unit Energy Savings	0.75 kWh	0.69 kWh	0.83 kWh
Average Unit Peak Demand Savings	0.017 W	0.016 W	0.019 W
Expected Useful Life	25 years	25 years	25 years
Average Material & Labor Cost	$0.81	$0.89	$1.04
Average Incremental Cost	NA	NA	NA
Stacking Effect End-Use		HVAC	

Table 2-56 Typical Savings Estimates for Retrofit Electric Resistance Heated Spaces, Idaho

	Adding Rigid Insulation	Upgrading to R-13	Upgrading to R-19
Deemed Savings Unit	Square Foot	Square Foot	Square Foot
Average Unit Energy Savings	1.56 kWh	1.44 kWh	1.73 kWh
Average Unit Peak Demand Savings	0.017 W	0.016 W	0.019 W
Expected Useful Life	25 years	25 years	25 years
Average Material & Labor Cost	$0.81	$0.89	$1.04
Average Incremental Cost	NA	NA	NA
Stacking Effect End-Use		HVAC	

[23] See spreadsheet "9-TypicalCalcs_FloorInsulation_v1.xlsx" for assumptions and calculations used to estimate the typical unit energy savings and incremental costs for cooling savings.

Table 2-57 Typical Savings Estimates for Retrofit Heat Pump Heated Spaces, Oregon

	Adding Rigid Insulation	Upgrading to R-13	Upgrading to R-19
Deemed Savings Unit	Square Foot	Square Foot	Square Foot
Average Unit Energy Savings	0.93 kWh	0.86 kWh	1.03 kWh
Average Unit Peak Demand Savings	0.010 W	0.010 W	0.012 W
Expected Useful Life	25 years	25 years	25 years
Average Material & Labor Cost	$0.81	$0.89	$1.04
Average Incremental Cost	NA	NA	NA
Stacking Effect End-Use		HVAC	

Table 2-58 Typical Savings Estimates for Retrofit Electric Resistance Heated Spaces, Oregon

	Adding Rigid Insulation	Upgrading to R-13	Upgrading to R-19
Deemed Savings Unit	Square Foot	Square Foot	Square Foot
Average Unit Energy Savings	1.96 kWh	1.81 kWh	2.17 kWh
Average Unit Peak Demand Savings	0.010 W	0.010 W	0.012 W
Expected Useful Life	25 years	25 years	25 years
Average Material & Labor Cost	$0.81	$0.89	$1.04
Average Incremental Cost	NA	NA	NA
Stacking Effect End-Use		HVAC	

Table 2-59 Typical Savings Estimates for New Construction Heat Pump Heated Spaces, Idaho

	Adding Rigid Insulation	Upgrading to R-19
Deemed Savings Unit	Square Foot	Square Foot
Average Unit Energy Savings	0.19 kWh	0.14 kWh
Average Unit Peak Demand Savings	0.004 W	0.003 W
Expected Useful Life	25 years	25 years
Average Material & Labor Cost	NA	NA
Average Incremental Cost	$0.81	$0.15
Stacking Effect End-Use	HVAC	

Table 2-60 Typical Savings Estimates for New Construction Electric Resistance Heated Spaces, Idaho

	Adding Rigid Insulation	**Upgrading to R-19**
Deemed Savings Unit	Square Foot	Square Foot
Average Unit Energy Savings	0.39 kWh	0.29 kWh
Average Unit Peak Demand Savings	0.004 W	0.003 W
Expected Useful Life	25 years	25 years
Average Material & Labor Cost	NA	NA
Average Incremental Cost	$0.81	$0.15
Stacking Effect End-Use	HVAC	

Table 2-61 Typical Savings Estimates for New Construction Heat Pump Heated Spaces, Oregon

	Adding Rigid Insulation	**Upgrading to R-19**
Deemed Savings Unit	Square Foot	Square Foot
Average Unit Energy Savings	0.23 kWh	0.17 kWh
Average Unit Peak Demand Savings	0.003 W	0.002 W
Expected Useful Life	25 years	25 years
Average Material & Labor Cost	NA	NA
Average Incremental Cost	$0.81	$0.15
Stacking Effect End-Use	HVAC	

Table 2-62 Typical Savings Estimates for New Construction Electric Resistance Heated Spaces, Oregon

	Adding Rigid Insulation	**Upgrading to R-19**
Deemed Savings Unit	Square Foot	Square Foot
Average Unit Energy Savings	0.49 kWh	0.36 kWh
Average Unit Peak Demand Savings	0.003 W	0.002 W
Expected Useful Life	25 years	25 years
Average Material & Labor Cost	NA	NA
Average Incremental Cost	$0.81	$0.15
Stacking Effect End-Use	HVAC	

2.9.1. Definition of Eligible Equipment

Eligible floor area is limited to buildings or potions of buildings with central mechanical air conditioning or PTAC systems. Qualifying Floor insulation can be rigid foam, fiberglass bat, or blown-in fiberglass or cellulose a long as material is eligible, assuming it meets or exceeds the required R-value. The insulation must upgrade from R5 or less. Added rigid insulation must provide continuous insulation with an R-value of 10 minimum. Additional insulation measures include installing R-13 and R-19.

2.9.2. Definition of Baseline Equipment

Baseline equipment for this measure is determined by the nature of the project. There are two possible scenarios: retrofit (early replacement) or new construction.

Retrofit (Early Replacement)

If the project is retrofitting pre-existing insulation, then the baseline efficiency is defined by the pre-existing insulation.

New Construction (New Construction, Replace on Burnout)

New Construction must meet building code and will only be eligible for added insulation above building code. The baseline insulation should be determined for each building based on the location and building type. The baseline flooring insulation for new construction is estimated at R-13 continuous insulation.

2.9.3. Algorithms

The following energy and demand savings algorithms are applicable for this measure:

$$\Delta kWh = \Delta kWh_{cool} + \Delta kWh_{heat}$$

$$\Delta kWh_{cool} = A * (CDD * 24)/(SEER * 3412) * (1/R_{base} - 1/R_{meas})$$

$$\Delta kWh_{heat} = A * (HDD * 24)/(HSPF * 3412) * (1/R_{base} - 1/R_{meas})$$

$$\Delta kW_{peak} = \Delta kWh_{cool} / EFLH_{cool} * CF$$

2.9.4. Definitions

A	Area of the insulation that was installed in square feet
HDD	Heating degree days, refer to Table 2-64 for typical heating degree days for different buildings. When possible, actual base temperatures should be used to calculate the HDD

CDD	Cooling degree days refer to Table 2-64 for typical cooling degree days for different buildings. When possible, actual base temperatures should be used to calculate the CDD.
R_{base}	The R-value of the insulation and support structure before the additional insulation is installed
R_{meas}	The total measure R-value of all insulation after the additional insulation is installed
EFLH	Annual equivalent full load cooling hours for the air conditioning unit. Values for various building types are stipulated in Table 2-64. When available, actual system hours of use should be used.
SEER	Seasonal Energy efficiency ratio of the air conditioning unit. This is defined as the ratio of the Annual cooling provided by the air conditioner (in BTU/hr), to the total electrical input (in Watts). Note that the IEER is an appropriate equivalent. If the SEER or IEER are unknown or unavailable use the following formula to estimate from the EER: SEER[24] $= .0507 * EER^2 + .5773 * EER + .4919$
HSPF	Heating Season Performance Factor. This is identical to the SEER (described above) as applied to Heat Pumps in heating mode. If only the heat pump COP is available, then use the following: $HSPF = .5651 * COP^2 + .464 * COP + .4873$
CF	Peak coincidence factor. Represents the % of the connected load reduction which occurs during Idaho Power's peak period.

2.9.5. Sources

- ASHRAE, Standard 90.1-2019.
- New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs – Residential, Multi-Family, and Commercial/Industrial Measures, Version 9
- California DEER Effective Useful Life worksheets: EUL_Summary_10-1-08.xls
- IECC 2018
- 2019 California Residential Appliance Saturation Study (RASS)

2.9.6. Stipulated Values

The following tables stipulate allowable values for each of the variables in the energy and demand savings algorithms for this measure.

Table 2-63 Standard System Variables

CF	SEER	HSPF,hp	HSPF,elec
0.69	12.6	7.2	3.41

[24] Note that this formula is an approximation and should only be applied to EER values up to 15 EER.

Table 2-64 Weather Zone Dependent Variables

	EFLH,c	EFLH,h	CDD	HDD
Zone 5	699	460	240	5,297
Zone 6	618	701	165	6,954
Oregon	526	722	107	7,094
Idaho Weighted Average	683	508	225	5,628

2.10. Reflective Roof

This section covers installation of "cool roof" roofing materials in multifamily buildings. Energy and demand saving are realized through reductions in the building cooling loads. The approach utilizes DOE-2.2 simulations on a series of commercial DEER prototypical building models.

Table 2-65 and Table 2-66 summarize the 'typical' expected (per ft^2) e*nergy impacts for this measure.* Typical values are based on the algorithms and stipulated values described below. Low Slope assumes a slope of less then 2:12 and Steep slope assumes a slope greater then 2:12

Table 2-65 Summary Deemed Savings Estimates for Reflective Roof, Idaho

	Low Slope	**Steep Slope**
Deemed Savings Unit	Square Foot	Square Foot
Average Unit Energy Savings	0.093 kWh	0.017 kWh
Average Unit Peak Demand Savings	0.07 W	0.01 W
Expected Useful Life[25]	15 years	15 years
Average Material & Labor Cost[26]	$2.15	$2.15
Average Incremental Cost[27]	$0.05	$0.05
Stacking Effect End-Use	HVAC	

Table 2-66 Summary Deemed Savings Estimates for Reflective Roof, Oregon

	Low Slope	**Steep Slope**
Deemed Savings Unit	Square Foot	Square Foot
Average Unit Energy Savings	0.087 kWh	0.016 kWh
Average Unit Peak Demand Savings	0.07 W	0.01 W
Expected Useful Life	15 years	15 years
Average Material & Labor Cost	$2.15	$2.15
Average Incremental Cost	$0.05	$0.05
Stacking Effect End-Use	HVAC	

2.10.1. Definition of Eligible Equipment

Eligible equipment includes all reflective roofing materials when applied to the roof above a space with central mechanical air conditioning or PTAC systems. The roof treatment must be Energy Star rated or tested through a Cool Roof Rating Council (CRRC) accredited laboratory. For low-

[25] From 2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05, "Effective/Remaining Useful Life Values", California Public Utilities Commission, December 16, 2008

[26] Labor costs from 2005 Database for Energy-Efficiency Resources (DEER), Version 2005.2.01, "Technology and Measure Cost Data", California Public Utilities Commission, October 26, 2005

[27] Material costs from common roof types found in EPA's Reducing Urban Heat Islands: Compendium of Strategies: http://www.epa.gov/heatisld/resources/pdf/CoolRoofsCompendium.pdf

slope (2:12 or less) roofs, the roof products must have a solar reflectivity of at least 0.70 and thermal emittance of 0.75. For steep slope (greater than 2:12) roofs, minimum solar reflectance is 0.25. Note that facilities with pre-existing cool roofs are not eligible for this measure.

2.10.2. Definition of Baseline Equipment

There are two possible project baseline scenarios – retrofit and new construction.

Retrofit (Early Replacement)

The baseline equipment for retrofit projects is the pre-existing (non-cool roof) roofing material.

New Construction (Includes Major Remodel & Replace on Burn-Out)

The baseline equipment for new construction projects is a standard code compliant roofing (non-cool roof) materials.

2.10.3. Algorithms

The following energy and demand savings algorithms are applicable for this measure:

$$\Delta kWh = \Delta kWh/Unit * A$$

$$\Delta kW = \Delta kW/Unit * A$$

2.10.4. Definitions

∆kWh	Expected energy savings between baseline and installed equipment.
∆kW	Expected demand reduction between baseline and installed equipment.
∆kWh/Unit	Per unit energy savings as stipulated in Table 2-68 according to climate zone.
∆kW/Unit	Per unit demand reduction as stipulated in Table 2-68 according to climate zone.
A	Area of cool roofing material installed [ft^2]

2.10.5. Sources

- ASHRAE, Standard 90.1-2019.
- California DEER Prototypical Simulation models, eQUEST-DEER 3-5.[28]

[28] Prototypical building energy simulation models were used to obtain U-Factor and SHGC values for each building type.

- ASHRAE. 2006. Weather data for building design standards. ANSI/ASHRAE Standard 169-2006.
- 2004-2005 Database for Energy Efficiency Resources (DEER) Update Study. December 2005
- 2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05, “Effective/Remaining Useful Life Values”, California Public Utilities Commission, December 16, 2008
- 2005 Database for Energy-Efficiency Resources (DEER), Version 2005.2.01, “Technology and Measure Cost Data”, California Public Utilities Commission, October 26, 2005

2.10.6. Stipulated Values

The following tables stipulate allowable values for each of the variables in the energy and demand savings algorithms for this measure.

Table 2-67 Weather Zone Dependent Variables

	EFLH,c	**EFLH,h**	**CDD**	**HDD**
Zone 5	699	460	240	5,297
Zone 6	618	701	165	6,954
Oregon	526	722	107	7,094
Weighted Average	676	515	220	5,677

Table 2-68 Deemed Savings by Weather Zone

	Low Slope		**Steep Slope**	
	kWh/sf	W/sf	kWh/sf	W/sf
Zone 5	0.093	0.072	0.017	0.013
Zone 6	0.090	0.071	0.016	0.013
Oregon	0.087	0.070	0.016	0.013

3. Appendix A: Document Revision History

Table 3-1 Document Revision History

Date	Modified Version	Revised Version	Description of Changes
09/20/2022	-	1.0	Initial Adoption of TRM.