Deemed Energy Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Summer Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Winter Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Additional Calculators and Tools

Not applicable.

Measure Life and Lifetime Savings

Based on the KEMA Residential Refrigerator Recycling Ninth Year Retention Study,[554] the Estimated Useful Life of Refrigerator Recycling is 8 years, representing the assumed remaining useful life of the retired unit.

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Number of refrigerators/freezers removed
- Year removed unit manufactured
- Total capacity (in cubic feet)
- Freezer configuration (top, bottom, side-by-side, upright, or chest)

[554] KEMA, Inc. "Residential Refrigerator Recycling Ninth Year Retention Study." Prepared for Southern California Edison Company. July 22, 2004.

References and Efficiency Standards

Petitions and Rulings

- Docket No. 42212. Petition of El Paso Electric Company to Approve Revisions to the Deemed Savings for the Appliance Recycling Market Transformation program. Public Utility Commission of Texas.

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

Document Revision History

Table 376. Refrigerator/Freezer Recycling—Revision History

TRM version	Date	Description of change
v2.1	1/30/2015	TRM v2.1 origin.
v3.0	4/10/2015	TRM v3.0 update. CF updated to align with new peak demand methodology.
v3.1	11/05/2015	TRM v3.1 update. No revision.
v3.1	3/28/2016	TRM v3.1 March revision. Updated summer and winter CFs.
v4.0	10/10/2016	TRM v4.0 update. No revision.
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. No revision.
v8.0	10/2020	TRM v8.0 update. Updated baseline energy consumption.
v9.0	10/2021	TRM v9.0 update. Correct deemed ranges for refrigerator volume.
v10.0	10/2022	TRM v10.0 update. No revision.
v11.0	10/2023	TRM v11.0 update. No revision.

2.5.8 ENERGY STAR® Air Purifiers Measure Overview

TRM Measure ID: R-AP-AP

Market Sector: Residential

Measure Category: Appliances

Applicable Building Types: Single-family, multifamily, manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Replace-on-burnout, new construction

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This document presents the accepted deemed savings awarded for the installation of an ENERGY STAR air purifier. Savings are awarded at a flat per-unit rate, both for energy and demand savings. This measure will apply to existing homes and new construction.

Eligibility Criteria

This measure applies to floor, tabletop, and wall-mounted air purifiers/room air cleaners.

Baseline Condition

The baseline condition is the current federal standard Tier 1 requirements, effective August 9, 2023 with compliance enforced as of December 31, 2023. The standard will increase to Tier 2 requirements on December 31, 2025.[555]

Table 377. Air Purifiers—Federal Standard

Smoke CADR	Tier 1 CADR/W	Tier 2 CADR/W
10–99	1.7	1.9
100–149	1.9	2.4
150+	2.0	2.9

[555] DOE minimum efficiency standard for residential air cleaners. https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=77. https://www.energy.gov/sites/default/files/2023-03/air-cleaners-ecs-dfr.pdf.

High-Efficiency Condition

The table below displays the ENERGY STAR Final Version 2.0 Requirements for eligible room air cleaners effective October 17, 2020, and revised May 2022.[556] Energy efficiency service providers are expected to comply with the latest ENERGY STAR requirements.

Table 378. Air Purifiers—ENERGY STAR Requirements

Smoke CADR	Minimum CADR/W
10–99	1.9
100–149	2.4
150+	2.9

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Energy Savings Algorithms

Energy savings for this measure were derived using the ENERGY STAR Appliance Savings Calculator and the revised ENERGY STAR specification in Table 348.[557] Default baseline standby power and clean air delivery rate (CADR) efficiency (CADR/W) values were taken from the ENERGY STAR calculator. ENERGY STAR standby power, CADR, and CADR/W are averages from the ENERGY STAR qualified product listing. Baseline CADR is assumed to be equivalent to ENERGY STAR CADR.

This measure will be updated to comply with the latest available ENERGY STAR specification and appliance calculator. It will also periodically be updated to comply with the latest updates to the ENERGY STAR qualified product listing.

$$Energy\ Savings\ [\Delta kWh] = (kWh_{baseline,\ OP} + kWh_{baseline,SB}) - (kWh_{ES,\ OP} + kWh_{ES,SB})$$

Equation 143

$$kWh_{baseline,OP} = \left(\frac{CADR_{baseline}}{\eta_{baseline}}\right)/1{,}000 \times hours \times days$$

Equation 144

$$kWh_{baseline,SB} = (8{,}760 - hours \times days) \times \frac{W_{baseline,SB}}{1{,}000}$$

Equation 145

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[556] ENERGY STAR Room Air Cleaners Final Version 2.0 Program Requirements. https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Version%202.0%20Room%20Air%20Cleaners%20Specification%20%28Rev.%20May%202022%29_0.pdf.

[557] ENERGY STAR Appliance Savings Calculator (updated October 2016).**Error! Hyperlink reference not valid.** The previously cited URL is no longer available, but a copy of the calculator can be provided upon request.

$$kWh_{ES,OP} = \left(\frac{CADR_{ES}}{\eta_{ES}}\right)/1{,}000 \times hours \times days$$

Equation 146

$$kWh_{ES,SB} = (8{,}760 - hours \times days) \times \frac{W_{ES,SB}}{1{,}000}$$

Equation 147

Where:

$kWh_{baseline,OP}$ =		*Baseline/conventional operating energy usage*
$kWh_{baseline,SB}$	=	*Baseline/conventional standby energy usage*
$kWh_{ES,OP}$	=	*ENERGY STAR average operating energy usage*
$kWh_{ES,SB}$	=	*ENERGY STAR average standby energy usage*
$CADR_{baseline}$	=	*Baseline unit clean air delivery rate (cu ft/min), assume equivalent to $CADR_{ES}$*
$CADR_{ES}$	=	*ENERGY STAR unit clean air delivery rate (cu ft/min) (see Table 380)*
$\eta_{baseline}$	=	*Baseline clean air delivery efficiency = 1.0 cfm/W*
η_{ES}	=	*ENERGY STAR air delivery efficiency (cfm/W) (see Table 380)*
hours	=	*Average hours of operation per day = 16*
days	=	*Average days of operation per year = 365*
$W_{baseline,SB}$	=	*Conventional model standby power = 1.0 W*
$W_{ES,SB}$	=	*ENERGY STAR model standby power = 0.6 W*
1,000	=	*Constant to convert from W to kW*
8,760	=	*Total hours per year*

Demand Savings Algorithms

$$Peak\ Demand\ Savings\ [\Delta kW] = \frac{\Delta kWh}{hours \times days} \times CF_{S/W}$$

Equation 148

Where:

$CF_{S/W}$	=	*Seasonal peak coincidence factor (see Table 379)*

Table 379. Air Purifiers—Coincidence Factors[558]

Season	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Summer	0.636	0.617	0.631	0.620	0.564
Winter	0.882	0.907	0.829	0.876	0.926

Deemed Energy Savings Tables

Table 380. Air Purifiers—Energy Savings (kWh)

Smoke CADR range (cu ft/min)	ENERGY STAR QPL Average Smoke CADR	ENERGY STAR QPL Average Smoke CADR/W	kWh savings
10–99	75	3.0	115
100–149	129	4.3	222
150–199	171	4.6	284
200–249	225	4.4	363
250–299	275	5.7	522
300+	375	5.5	699

Deemed Summer Demand Savings Tables

Table 381. Air Purifiers—Summer Peak Demand Savings (kW)

Smoke CADR range (cu ft/min)	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
10–99	0.012	0.012	0.012	0.012	0.011
100–149	0.024	0.023	0.024	0.024	0.021
150–199	0.031	0.030	0.031	0.030	0.027
200–249	0.040	0.038	0.039	0.039	0.035
250–299	0.057	0.055	0.056	0.055	0.051
300+	0.076	0.074	0.076	0.074	0.068

[558] See Volume 1, Section 4.

Deemed Winter Demand Savings Tables

Table 382. Air Purifiers—Winter Peak Demand Savings (kW)

Smoke CADR range (cu ft/min)	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
10–99	0.017	0.018	0.016	0.017	0.018
100–149	0.034	0.034	0.032	0.033	0.035
150–199	0.043	0.044	0.040	0.043	0.045
200–249	0.055	0.056	0.052	0.054	0.058
250–299	0.079	0.081	0.074	0.078	0.083
300+	0.106	0.109	0.099	0.105	0.111

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Additional Calculators and Tools

Not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is 9 years, as specified in the California Database of Energy Efficiency Resources (DEER) READI tool for EUL ID RES-AirCleaner.[559]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Unit quantity
- Manufacturer and model number
- ENERGY STAR certificate matching model number
- Smoke clean air delivery rate (CADR) in cu ft/min (cfm)
- Proof of purchase – including date of purchase and quantity
    - Alternative: photo of unit installed or another pre-approved method of installation verification.

[559] DEER READI (Remote Ex-Ante Database Interface). http://www.deeresources.com/index.php/readi.

References and Efficiency Standards

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

Document Revision History

Table 383. Air Purifiers—Revision History

TRM version	Date	Description of change
v7.0	10/2019	TRM v7.0 origin.
v8.0	10/2020	TRM v8.0 update. No revision.
v9.0	10/2021	TRM v9.0 update. Updated EUL reference.
v10.0	10/2022	TRM v10.0 update. Verified compliance with ENERGY STAR Final Version 2.0 Requirements. Updated dust CADR references to refer to smoke CADR. Updated deemed savings ranges and values.
v11.0	10/2023	TRM v11.0 update. Updated baseline to Tier 1 Federal Standard.

2.5.9 ENERGY STAR® Pool Pumps Measure Overview

TRM Measure ID: R-AP-PP

Market Sector: Residential

Measure Category: Appliances

Applicable Building Types: Single-family, multifamily, manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Retrofit

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure involves the replacement of a single-speed pool pump with an ENERGY STAR-certified variable-speed or multi-speed pool pump.

Eligibility Criteria

This measure applies to all residential applications of in-ground pools or above-ground pools. Pools that serve multiple tenants in a common area are not eligible for this measure. Ineligible pump products include waterfall, integral cartridge filter, integral sand filter, storable electric spa, and rigid electric spa.[560]

Multi-speed pool pumps are an alternative to variable speed pumps. The multi-speed pump uses an induction motor that functions as two motors in one, with full-speed and half-speed options. Multi-speed pumps may enable significant energy savings. However, if the half-speed motor is unable to complete the required water circulation task, the larger motor will operate exclusively. Having only two speed-choices limits the ability of the pump motor to fine-tune the flow rates required for maximum energy savings.[561] Therefore, multi-speed pumps must have a high-speed override capability to revert back to low speed after a period not to exceed 24 hours.

[560] These product types are excluded by the ENERGY STAR specification. https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Version%203.1%20Pool%20Pumps%20Final%20Specification_0.pdf.

[561] Hunt, A. and Easley, S., 2012, "Measure Guideline: Replacing Single-Speed Pool Pumps with Variable Speed Pumps for Energy Savings." Building America Retrofit Alliance (BARA), US DOE. May 2012. http://www.nrel.gov/docs/fy12osti/54242.pdf.

Baseline Condition

The baseline is assumed to be a new pool pump that is compliant with the current federal standard, effective July 19, 2021.[562] Weighted Energy Factor (WEF) requirements are based on rated hydraulic horsepower (hhp).

Table 384. Baseline Condition--Federal Standard Effective July 19, 2021

Pump Sub-Type	Size Class	WEF
Self-priming (inground) pool umps	Extra Small (hhp ≤ 0.13)	WEF = 5.55
	Small (hhp > 0.13 to < 0.711)	WEF = -1.30 x ln(hhp) + 2.90
	Standard (hhp ≥ 0.711)	WEF = -2.30 x ln(hhp) + 6.59
Non-self priming (above ground) pool pumps	Extra Small (hhp ≤ 0.13)	WEF = 4.60
	Standard Size (hhp > 0.13)	WEF = -0.85 x ln(hhp) + 2.87

High-Efficiency Condition

The high-efficiency condition is a 1 to 5 hp variable speed pump (VSP) or multi-speed pool pump that is compliant with the ENERGY STAR Final Version 3.1 Requirements for pool pumps effective July 19, 2021.[565] Energy efficiency service providers are expected to comply with the latest ENERGY STAR requirements.

Additional optional efficiency standards are available, aligning with recommendations from the Consortium for Energy Efficiency (CEE) residential swimming pool pump specification, effective October 21, 2020.[566] For all in-ground pumps, CEE Tier 1 matches the current federal standard, and CEE Tier 2 matches the current ENERGY STAR specification for in-ground standard size pumps. Additional savings are only specified for CEE tiers where there is an incremental efficiency improvement above the ENERGY STAR specification.

Compliance only needs to be verified against the CEE specification when claiming CEE savings that exceed the corresponding ENERGY STAR savings values. ENERGY STAR savings should be claimed for all pumps where CEE compliance is not verified and where there are no CEE savings specified.

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[562] Federal standard for dedicated-purpose pool pumps. https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=67.

[565] ENERGY STAR Pool Pumps Final Version 3.1 Program Requirements. https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Version%203.1%20Pool%20Pumps%20Final%20Specification_0.pdf.

[566] CEE Residential Swimming Pool Pump Specification. https://library.cee1.org/system/files/library/14404/CEE_ResSwimmingPoolPump_Specification_21Oct2020.pdf.

Table 385. ENERGY STAR Pool Pumps – Energy Efficiency Level

Pump Sub-Type	Size Class	ENERGY STAR	CEE Tier 1	CEE Tier 2
Self-priming (inground) pool pumps	Extra Small (hhp ≤ 0.13)	WEF ≥ 13.40	–	–
	Small (hhp > 0.13 to < 0.711)	WEF ≥ -2.45 x ln(hhp) + 8.40	WEF ≥ -1.30 x ln(hhp) + 4.95	WEF ≥ -2.83 x ln(hhp) + 8.84
	Standard (hhp ≥ 0.711)		WEF ≥ -2.30 x ln(hhp) + 6.59	WEF ≥ -2.45 x ln(hhp) + 8.40
Non-self priming (above ground) pool pumps	Extra Small (hhp ≤ 0.13)	WEF ≥ 4.92	–	–
	Standard Size (hhp > 0.13)	WEF ≥ -1.00 x ln(hhp) + 3.85	WEF ≥ -1.60 x ln(hhp) + 9.10	–

Energy and Demand Savings Methodology

Savings for this measure are based on methods and input assumptions from the ENERGY STAR Pool Pump Savings Calculator.

Savings Algorithms and Input Variables

Energy Savings Algorithms

Energy savings for this measure were derived using the ENERGY STAR Pool Pump Savings Calculator with Texas selected as the applicable location, so Texas-specific assumptions were used.[567]

$$Energy\ Savings\ [\Delta kWh] = kWh_{base} - kWh_{ES}$$

Equation 149

Where:

kWh_{base} = *Baseline pool pump energy (kWh)*

kWh_{ES} = *ENERGY STAR variable speed pool pump energy (kWh)*

Algorithms to calculate the above parameters are defined as:

$$kWh_{base} = \frac{PFR_{base} \times 60 \times hours \times days}{WEF_{base} \times 1{,}000}$$

Equation 150

$$kWh_{ES} = \frac{V \times TO \times days}{WEF_{ES} \times 1{,}000}$$

Equation 151

Where:

PFR_{base} = *Baseline pump flow rate [gal/min] (Table 386)*

$_{W}EF_{base}$ = *Baseline pump energy factor [gal/W x hr] (Table 386)*

WEF_{ES} = *ENERGY STAR pump energy factor [gal/W x hr] (Table 387)*

hours = *Pump daily operating hours (Table 386)*

days = *Operating days per year = 365 days (default)*

[567] The ENERGY STAR Pool Pump Savings Calculator, updated February 2013, can be found on the ENERGY STAR website at: https://www.energystar.gov/productfinder/product/certified-pool-pumps/results.

V	=	*Pool volume [gal] (Table 386)*
TO	=	*Turnovers per day, number of times the volume of the pool is run through the pump per day (Table 387)*
60	=	*Constant to convert between minutes and hours*
1,000	=	*Constant to convert from W to kW*

Table 386. Pool Pumps—Baseline Assumptions[568]

New pump HP	Reference HP	Reference HHP[569]	Hours[570]	PFR_{base} (gal/min)
≤ 1.25	1.0	0.533	4.9	75.5000
1.25 < hp ≤ 1.75	1.5	0.800	4.7	78.1429
1.75 < hp ≤ 2.25	2.0	1.066	4.1	88.6667
2.25 < hp ≤ 2.75	2.5	1.333	4.0	93.0910
2.75 < hp ≤ 5	3.0	1.599	4.0	101.6667

Table 387. Pool Pumps—ENERGY STAR Assumptions[571]

New pump HP	V (gal)	Turnovers/day
≤ 1.25	22,000	1.0
1.25 < hp ≤ 1.75		
1.75 < hp ≤ 2.25		
2.25 < hp ≤ 2.75		
2.75 < hp ≤ 5		

Demand Savings Algorithms

$$Peak\ Demand\ Savings\ [\Delta kW] = \frac{kWh_{base} - kWh_{ES}}{hours} \times \frac{CF_{S/W}}{days}$$

Equation 152

[568] Conventional pump PFR and EF values are taken from pump curves found in the ENERGY STAR Pool Pump Savings Calculator. Note: input assumptions will be updated once calculator has been updated for compliance with the current specification.

[569] Hhp not available in ENERGY STAR calculator. Assumed hhp calculated as follows: Ref. horsepower x AF. AF = 0.533 based on raio of hhp to hp from ENERGY STAR qualified product listing. Accessed 8/11/2023.

[570] The daily average operating hours for conventional single-speed pumps, based on 2014 residential pool pump program survey results from CenterPoint Energy.

[571] ENERGY STAR values are taken from default inputs and pump curves found in the ENERGY STAR Pool Pump Savings Calculator. Note: input assumptions will be updated once calculator has been updated for compliance with the current specification.

Where:

$CF_{S/W}$ = *Seasonal peak coincidence factor (Table 388)*

Table 388. Pool Pumps—Coincidence Factors[573]

Climate zone	Summer CF	Winter CF
Zone 1: Amarillo	0.258	-0.002
Zone 2: Dallas	0.329	0.025
Zone 3: Houston	0.276	0.108
Zone 4: Corpus Christi	0.266	0.036
Zone 5: El Paso	0.497	-0.143

Deemed Energy Savings Tables

Table 389. Pool Pumps—Energy Savings (kWh)[574]

New pump hp	Inground	Above ground
ENERGY STAR		
≤ 1.25	1,371	587
1.25 < hp ≤ 1.75	235	657
1.75 < hp ≤ 2.25	262	707
2.25 < hp ≤ 2.75	332	852
2.75 < hp ≤ 5	509	1,229
CEE Tier 1		
≤ 1.25	–	1,585
1.25 < hp ≤ 1.75	–	1,779
1.75 < hp ≤ 2.25	–	1,935
2.25 < hp ≤ 2.75	–	2,176
2.75 < hp ≤ 5	–	2,642
CEE Tier 2		
≤ 1.25	1,423	–
1.25 < hp ≤ 5	–	–

[573] Coincidence factors are calculated according to the method in Section 4 of the Texas TRM Vol 1 using data from the US Department of Energy's Building America B10 Benchmark load profiles for pool pumps. The profile used to determine coincidence factors is calculated as the difference of single speed and variable speed profiles. Summer profiles include April through September and winter profiles include October through March.

[574] The results in this table may vary slightly from results produced by the ENERGY STAR calculator because of rounding of default savings coefficients throughout the measure and pool volume.

Deemed Summer Demand Savings Tables[575]

Table 390. Pool Pumps—Summer Peak Demand Savings (kW) for Inground Pools

ENERGY STAR					
≤ 1.25	0.198	0.252	0.212	0.204	0.381
1.25 < hp ≤ 1.75	0.035	0.045	0.038	0.036	0.068
1.75 < hp ≤ 2.25	0.045	0.057	0.048	0.046	0.087
2.25 < hp ≤ 2.75	0.059	0.075	0.063	0.060	0.113
2.75 < hp ≤ 5	0.090	0.115	0.096	0.093	0.173
CEE Tier 1					
All sizes	–	–	–	–	–
CEE Tier 2					
≤ 1.25	0.206	0.262	0.220	0.212	0.396
1.25 < hp ≤ 5	–	–	–	–	–

Table 391. Pool Pumps—Summer Peak Demand Savings (kW) for Above Ground Pools

New pump HP	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
ENERGY STAR					
≤ 1.25	0.085	0.108	0.091	0.087	0.163
1.25 < hp ≤ 1.75	0.099	0.126	0.106	0.102	0.190
1.75 < hp ≤ 2.25	0.122	0.155	0.130	0.126	0.235
2.25 < hp ≤ 2.75	0.151	0.192	0.161	0.155	0.290
2.75 < hp ≤ 5	0.218	0.277	0.233	0.224	0.418
CEE Tier 1					
≤ 1.25	0.229	0.291	0.245	0.236	0.441
1.25 < hp ≤ 1.75	0.268	0.341	0.287	0.276	0.516
1.75 < hp ≤ 2.25	0.334	0.425	0.357	0.344	0.643
2.25 < hp ≤ 2.75	0.385	0.490	0.412	0.396	0.741
2.75 < hp ≤ 5	0.468	0.595	0.500	0.481	0.900

[575] Ibid.

New pump HP	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
CEE Tier 2					
All sizes	–	–	–	–	–

Deemed Winter Demand Savings Tables

Table 392. Pool Pumps—Winter Peak Demand Savings (kW) for Inground Pools

New pump HP	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
ENERGY STAR					
≤ 1.25	-0.001	0.019	0.083	0.027	-0.110
1.25 < hp ≤ 1.75	0.000	0.003	0.015	0.005	-0.020
1.75 < hp ≤ 2.25	0.000	0.004	0.019	0.006	-0.025
2.25 < hp ≤ 2.75	0.000	0.006	0.025	0.008	-0.032
2.75 < hp ≤ 5	-0.001	0.009	0.038	0.012	-0.050
CEE Tier 1					
All sizes	–	–	–	–	–
CEE Tier 2					
≤ 1.25	-0.001	0.020	0.086	0.029	-0.114
1.25 < hp ≤ 5	–	–	–	–	–

Table 393. Pool Pumps—Peak Demand Savings (kW) for Above Ground Pools

New pump HP	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
ENERGY STAR					
≤ 1.25	-0.001	0.008	0.036	0.012	-0.047
1.25 < hp ≤ 1.75	-0.001	0.010	0.042	0.014	-0.055
1.75 < hp ≤ 2.25	-0.001	0.012	0.051	0.017	-0.067
2.25 < hp ≤ 2.75	-0.001	0.014	0.063	0.021	-0.083
2.75 < hp ≤ 5	-0.001	0.021	0.091	0.030	-0.120

New pump HP	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
CEE Tier 1					
≤ 1.25	-0.001	0.022	0.096	0.032	-0.127
1.25 < hp ≤ 1.75	-0.002	0.026	0.112	0.037	-0.148
1.75 < hp ≤ 2.25	-0.002	0.032	0.140	0.046	-0.185
2.25 < hp ≤ 2.75	-0.002	0.037	0.162	0.053	-0.213
2.75 < hp ≤ 5	-0.003	0.045	0.196	0.065	-0.259
CEE Tier 2					
All sizes	–	–	–	–	–

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Additional Calculators and Tools

ENERGY STAR Pool Pump Savings Calculator, updated May 2020, can be found on the ENERGY STAR website at https://www.energystar.gov/productfinder/product/certified-pool-pumps/results.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is 10 years, as specified in the California Database of Energy Efficiency Resources (DEER) READI tool for EUL ID OutD-PoolPump.[576]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly include the below.

For all projects collect:

- Climate zone
- Unit quantity
- Manufacturer and model number of new pool pump
- ENERGY STAR certificate matching model number
- Rated hydraulic horsepower of new pool pump
- Rated horsepower of new pool pump

[576] DEER READI (Remote Ex-Ante Database Interface). http://www.deeresources.com/index.php/readi.

- Proof of purchase – with date of purchase and quantity
    - Alternative: photo of unit installed or other pre-approved method of installation verification

For a significant sample of projects where attainable (e.g., those projects that are selected for inspection, not midstream or retail programs):

- Items listed for all projects above
- Decision/action type: early retirement, replace-on-burnout, or new construction
- Rated horsepower of existing pool pump
- Existing and new pool pump operating hours

References and Efficiency Standards

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

Document Revision History

Table 394. Pool Pumps—Revision History

TRM version	Date	Description of change
v5.0	10/2017	TRM v5.0 origin.
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. Updated eligibility to include above ground pool pumps now eligible for ENERGY STAR certification. Acknowledged the forthcoming ENERGY STAR v2.0.
v8.0	10/2020	TRM v8.0 update. Incorporated ENERGY STAR v2.0 updated deemed savings.
v9.0	10/2021	TRM v9.0 update. Updated EUL reference and tracking requirements.
v10.0	10/2022	TRM v10.0 update. Verified compliance with ENERGY STAR Final Version 3.1 Requirements. Updated savings coefficient definitions.
v11.0	10/2023	TRM v11.0 update. Updated baseline to current Federal Standard. Added new savings tiers.

2.5.10 Advanced Power Strips Measure Overview

TRM Measure ID: R-AP-PS

Market Sector: Residential

Measure Category: Appliances

Applicable Building Types: Single-family, multifamily, manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Retrofit, new construction

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Deemed savings values

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure involves the installation of a multi-plug advanced power strip (APS) with the ability to automatically disconnect specific loads depending on the power draw of a specified, or "master," load.

For a Tier 1 APS, a load sensor in the strip disconnects power from the control outlets when the master power draw is below a certain threshold. This feature allows for a reduction of power draw from peripheral consumer electronics, which usually maintain some load even when in the off or standby position. Therefore, when the master device (e.g., television) is turned off, the power supply is cut to other related equipment (e.g., set-top boxes, speakers, video game consoles).

A Tier 2 APS uses an external sensor paired with a configurable countdown timer to manage both active and standby power loads for controlled devices in a complete system. A Tier 2 APS may operate either with or without a master control socket. Those without a master control socket sense power of all devices connected to the controlled sockets, while those with a master control socket sense power for the device connected to the master control socket. The external sensor of a Tier 2 APS may use an infrared-only sensor, or it may use a "multi-sensor," which detects both infrared (IR) remote control signals and motion to determine device inactivity and deliver additional savings as compared to a Tier 1 APS. Both versions of external sensors use IR filtering to prevent inappropriate switching events that may have otherwise resulted from natural interference, such as sunlight or CFL light bulbs.

Eligibility Criteria

This measure applies to all residential applications. For Tier 2 applications, the APS must control at least two audiovisual devices.

Baseline Condition

The baseline condition is assumed to be uncontrolled peripheral loads, each plugged into a traditional surge protector or wall outlet.

High-Efficiency Condition

The high-efficiency condition is peripheral loads controlled by a Tier 1 or Tier 2 APS.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Savings were developed based on reported plug load electricity consumption and hourly use data. A set of home entertainment and home office peripheral equipment and related performance data are presented in the following table. “Daily Standby Hours” and “Daily Off Hours” represent the average number of hours the device is left in standby or off mode. For each device, a weighted watt per hour value is calculated based on projected watts consumed in either mode.

There are three savings paths available for Tier 1. Savings can be estimated by:

1. Complete system type (home entertainment or home office)
2. Per APS for an average complete system if the type is unknown
3. Per individual peripheral device

Tier 2 savings are determined using the average component uses for a complete system and an energy reduction percentage.

Table 395. APS—Peripheral Watt Consumption Breakdown[577]

System type	Peripheral device	Daily standby hours	Daily off hours	Standby power (W)	Off power (W)	Weighted W/hr	Annual APS hours
Home entertainment	Audio equipment: AV receiver	0.0	18.0	19.2	3.1	3.1	6,570
	Audio equipment: Speakers	0.0	18.0	3.0	0.0	0.0	6,570
	Audio equipment: Subwoofer	0.0	18.0	7.8	0.6	0.6	6,570
	Media player: Blu-ray	2.5	20.8	7.0	0.1	0.8	8,505
	Media player: DVD	2.5	20.8	5.0	2.0	2.3	8,505
	Media player: DVD-R	2.5	20.8	7.0	3.0	3.4	8,505
	Media player: DVD/VCR	2.5	20.4	8.0	4.0	4.4	8,359
	Media player: VCR	2.2	21.4	6.0	3.0	3.3	8,614
	Set-top box: Cable	0.0	16.5	25.0	16.0	16.0	6,023
	Set-top box: Cable with DVR	0.0	16.5	45.0	43.0	43.0	6,023
	Set-top box: Satellite	0.0	15.1	10.0	15.0	15.0	5,512
	Set-top box: Satellite with DVR	0.0	15.1	27.0	28.0	28.0	5,512
	Set-top box: Stand-alone DVR	0.0	18.3	27.0	27.0	27.0	6,680
	Television: CRT	0.0	18.7	5.3	1.6	1.6	6,826
	Television: LCD	0.0	18.7	2.2	0.5	0.5	6,826
	Television: Plasma	0.0	18.7	0.9	0.6	0.6	6,826
	Television: Projection	0.0	18.7	4.4	7.0	7.0	6,826
	Video game console: Nintendo Wii	1.5	21.4	10.5	1.9	2.5	8,359
	Video game console: Wii U	1.5	21.4	34.0	0.4	2.6	8,359
	Video game console: PlayStation 2	1.5	21.4	17.0	0.2	1.3	8,359

[577] Derived from New York State Energy Research and Development Authority (NYSERDA), "Advanced Power Strip Research Report." August 2011.

System type	Peripheral device	Daily standby hours	Daily off hours	Standby power (W)	Off power (W)	Weighted W/hr	Annual APS hours
Home entertainment	Video game console: PlayStation 3	1.5	21.4	152.9	1.1	11.0	8,359
	Video game console: PlayStation 4	1.5	21.4	137.0	6.4	14.9	8,359
	Video game console: XBOX	1.5	21.4	68.0	2.0	6.3	8,359
	Video game console: XBOX 360	1.5	21.4	117.5	3.1	10.6	8,359
	Video game console: XBOX One	1.5	21.4	112.0	11.9	18.4	8,359
Home office	Computer: Desktop	4.1	16.7	11.6	3.3	4.9	7,592
	Computer: Laptop	4.1	16.7	7.6	4.4	5.0	7,592
	Computer monitor: CRT	2.4	16.5	7.6	1.5	2.3	6,899
	Computer monitor: LCD	2.4	16.5	1.9	1.1	1.2	6,899
	Computer speakers	0.0	18.7	3.7	2.3	2.3	6,826
	Copier	0.0	23.5	2.8	1.5	1.5	8,578
	Fax machine: Inkjet	0.5	23.3	6.0	5.3	5.3	8,687
	Fax machine: Laser	0.5	23.3	5.3	2.2	2.3	8,687
	Printer: Inkjet	4.4	19.5	2.5	1.3	1.5	8,724
	Printer: Laser	4.4	19.5	9.0	3.3	4.3	8,724
	Scanner	0.0	23.5	3.6	2.1	2.1	8,578

Energy Savings Algorithms

Tier 1 APS

Energy savings for a Tier 1 APS in use for home entertainment or home office are calculated using the following algorithm, where kWh saved is calculated and summed for all peripheral devices.

$$Energy\ Savings\ [\Delta kWh] = \sum \frac{W_i \times H_i}{1{,}000} \times ISR$$

Equation 153

Where:

W	=	*Weighted watts per hour consumed in standby/off mode for each peripheral device (see* Table 395*)*
H	=	*Annual hours per year controlled by APS (see Table 395)*
1,000	=	*Constant to convert from W to kW*
ISR	=	*In-service rate or the percentage of units rebated that are installed, see Table 396*

Tier 2 APS

Energy savings for a Tier 2 APS are calculated using the average household home entertainment and home office usages, multiplied by an assumed energy reduction percentage.

$$\Delta kWh_{Home\ Entertainment} = kWh_{TV} \times ERP \times ISR$$

Equation 154

$$\Delta kWh_{Home\ Office} = kWh_{Comp} \times ERP \times ISR$$

Equation 155

$$\Delta kWh_{Unspecified} = \frac{kWh_{TV} + kWh_{Comp}}{2} \times ERP \times ISR$$

Equation 156

Where:

kWh_{TV}	=	*Average annual energy consumption of Tier 2 qualifying TV systems; default = 602.8 kWh*[578]

[578] New York State Energy Research and Development Authority (NYSERDA), "Advanced Power Strip Research Report". August 2011. Page 30.

kWh_{Comp} = *Average annual energy consumption of Tier 2 qualifying computer systems; default = 197.9 kWh*[579]

ERP = *Energy reduction percentage (default = 47.5%*[580]*)*

Table 396. APS—In-Service Rates by Program Type

Program type	ISR
Low-income community kits[581]	0.69
All other kit programs[582]	0.55
Retail (time of sale)[583]	0.79
Direct install[584]	

Demand Savings Algorithms

Tier 1 and Tier 2 APS

Demand savings for a Tier 1 APS in use for a home entertainment system or home office are calculated using the following algorithm, where kWh saved is calculated and summed for all peripheral devices. Demand savings for a Tier 2 APS are calculated using the average household home office and home entertainment center usages, multiplied by an assumed energy reduction percentage.

$$Peak\ Demand\ Savings\ [\Delta kW] = \sum \frac{\Delta kWh}{hours} \times CF_{S/W}$$

Equation 157

[579] New York State Energy Research and Development Authority (NYSERDA), "Advanced Power Strip Research Report". August 2011. Page 30.

[580] Average of ERP from Northeast Energy Efficiency Partnerships (NEEP), "Case Study: Tier 2 Advanced Power Strips and Efficiency Programs". April 2015.

[581] Kits targeting low-income qualified communities. From IL TRM v10, based on 2021 Ameren IL income-qualified participant survey.

[582] From IL TRM v10, based on 2018 ComEd Home Energy Assessment participant survey.

[583] "RLPNC 17-4 and 17-5 Products Impact Evaluation of In-service and Short-Term Retention Rates Study," NMR Group on behalf of Massachusetts Electric Program Administrators and Energy Efficiency Advisory Council Consultants. October 5, 2018. Page 7, Table 5. ISR is an average of the median values specified for leave behind and online/downstream Tier 1 APS. https://ma-eeac.org/wp-content/uploads/RLPNC_1745_APSProductsSurveys_5Oct2018_Final.pdf.

[584] Ibid.

Where:

hours = *Annual hours per year controlled by APS (see Table 395 for Tier 1 APS; assume 4,380 for Tier 2 APS[585])*

$CF_{S/W}$ = *Seasonal peak coincidence factor (see Table 397)[586]*

Table 397. APS—Coincidence Factors[587]

Season	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Summer	0.33	0.43	0.36	0.30	0.66
Winter	0.89	0.88	0.86	0.85	0.87

Deemed Energy Savings Tables

Refer to Table 398 and Table 399. The savings presented in these tables must be adjusted by applying the program specific ISR values specified in Table 396Table 18.

Deemed Summer Demand Savings Tables

Refer to Table 398 and Table 399. The savings presented in these tables must be adjusted by applying the program specific ISR values specified in Table 396Table 18.

Deemed Winter Demand Savings Tables

Refer to Table 398 and Table 399. The savings presented in these tables must be adjusted by applying the program specific ISR values specified in Table 396Table 18.

[585] Estimated based on assumption that approximately half of savings are during active hours (assumed to be 5.3 hours/day, or 1,936 hours/year) and half during standby hours (8,760-1,936 = 6,824 hours/year). The resulting weighted average is 4,380 hours/year.

[586] Derived using Electric Power Research Institute (EPRI) End Use Load Shapes for Residential TV and PC. http://loadshape.epri.com/enduse.

[587] See Volume 1, Section 4.

Table 398. APS—Tier 1 Unadjusted Savings before applying ISR[588]

System type	kWh savings	Summer kW savings					Winter kW savings				
		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Home entertainment[589]	269.9	0.0132	0.0174	0.0143	0.0119	0.0265	0.0358	0.0354	0.0345	0.0342	0.0348
Home office[590]	87.1	0.0037	0.0049	0.0041	0.0034	0.0075	0.0101	0.0100	0.0098	0.0097	0.0098
Upstream/midstream [591]	178.5	0.0084	0.0112	0.0092	0.0077	0.0170	0.0230	0.0227	0.0221	0.0219	0.0223

[588] Apply in-service rate to adjust savings for specific program delivery type.
[589] Assuming Audio Equipment: AV Receiver, Media Player: Average, Set-Top Box: Average, and Video Game Console: Average.
[590] Assuming Computer: desktop, computer monitor: LCD, computer speakers, and printer: average.
[591] Average of *home entertainment* and *home office system* averages.

Table 399. APS—Tier 2 Unadjusted Savings before applying ISR[595]

System type	kWh savings	Summer kW savings					Winter kW savings				
		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Home entertainment	286.3	0.021	0.028	0.023	0.019	0.043	0.058	0.058	0.056	0.056	0.057
Home office	94.0	0.007	0.009	0.008	0.006	0.014	0.019	0.019	0.018	0.018	0.019
Upstream/midstream	190.2	0.014	0.019	0.015	0.013	0.029	0.039	0.038	0.037	0.037	0.038

[595] Apply in-service rate to adjust savings for specific program delivery type.

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Additional Calculators and Tools

Not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is 10 years for a Tier 1 APS, according to the 2011 NYSERDA Advanced Power Strip Research Report.[596] While Tier 2 APS is not covered by the NYSERDA report, assume the same 10-year EUL for Tier 2 APS.

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Program delivery type (low income targeted kits, non-low-income targeted kits, retail, direct install)
- Unit quantity
- Manufacturer and model number
- APS type (Tier 1 or Tier 2)
- System type (home entertainment, home office, unspecified)
- Proof of purchase – including date of purchase and quantity
    - Alternative: photo of unit installed or another pre-approved method of installation verification.

References and Efficiency Standards

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

[596] New York State Energy Research and Development Authority (NYSERDA), "Advanced Power Strip Research Report". August 2011. Page 30.

Document Revision History

Table 400. APS—Revision History

TRM version	Date	Description of change
v7.0	10/2019	TRM v7.0 origin.
v8.0	10/2020	TRM v8.0 update. No revision.
v9.0	10/2021	TRM v9.0 update. Updated savings with current coincidence factors.
v10.0	10/2022	TRM v10.0 update. Corrected typos in deemed savings tables from TRM v9.0 update.
v11.0	10/2023	TRM v11.0 update. Added in-service rates.

2.5.11 ENERGY STAR® Electric Vehicle Supply Equipment

TRM Measure ID: R-AP-EV

Market Sector: Residential

Measure Category: Appliance

Applicable Business Types: Single-family, manufactured

Fuels Affected: Electricity

Decision/Action Type: Retrofit, new construction

Program Delivery Type: Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure applies to the installation of ENERGY STAR qualified Level 2 electric vehicle supply equipment (EVSE) at a residential site. EVSE is the infrastructure that enables plug-in electric vehicles (PEV) to charge onboard batteries. Level 2 EVSE require 240-volt electrical service. This measure provides deemed savings for the energy efficiency improvement of an ENERGY STAR EVSE over a standard or non-ENERGY STAR EVSE.

Eligibility Criteria

Eligible equipment includes an ENERGY STAR qualified Level 2 EVSE installed at a residence. The EVSE may be installed for use on either an all-battery electric vehicle (BEV) or a plug-in hybrid electric vehicle (PHEV). Multifamily buildings should use the commercial EVSE measure.

Baseline Condition

The baseline condition is a non-ENERGY STAR qualified Level 2 EVSE.

High-Efficiency Condition

The high-efficiency EVSE is a Level 2 EVSE compliant with ENERGY STAR Final Version 1.1 specification for eligible EVSE, effective March 31, 2021.[597] Energy efficiency service providers are expected to comply with the latest ENERGY STAR requirements.

[597] ENERGY STAR EVSE Final Version 1.1 Program Requirements. https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20V1.1%20DC%20EVSE%20Final%20Specification_0.pdf.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Savings for EVSE come from efficiency gains of the ENERGY STAR equipment during operating modes when the vehicle is plugged in but not charging and when not plugged in. Deemed savings are calculated according to the following algorithms.

Demand Savings Algorithms

$$Peak\ Demand\ Savings\ [\Delta kW] = \frac{\Delta kWh \times HCF \times DCF}{days_c \times hours_{p,c}}$$

Equation 158

Where:

ΔkWh_{SS} = *Steady state energy savings (Table 402)*

HCF = *Hourly coincidence factor (Table 401)*

DCF = *Daily coincidence factor*[598] *= 0.88*

$days_c$ = *Number of charging days = 321*

$hours_{p,c}$ = *Hours per day vehicle is plugged in and charging = 2.4 hr* [599]

Table 401. EVSE—Coincidence Factors[600]

Climate zone	Summer	Winter
Zone 1: Amarillo	0.044	0.058
Zone 2: Dallas	0.040	0.053
Zone 3: Houston	0.043	0.041
Zone 4: Corpus Christi	0.042	0.059
Zone 5: El Paso	0.033	0.085

Deemed Energy Savings Tables

Table 402 presents the deemed energy savings per EVSE. Networked chargers refer to EVSE that are connected remotely to a larger network and are part of an infrastructure system of connected chargers.

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[598] Idaho National Lab (INL) EV Project, June 2015, "Characterize the Demand and Energy Characteristics of Residential Electric Vehicle Supply Equipment," page 6. Eighty-eight percent of PEV owners charge every day.

[599] INL, page 5. A vehicle plugged in for 11.7 hours and charging for 2.4 hours leaves 9.3 hours when it is plugged in and not charging.

[600] Probability weighted peak load factors are calculated according to the method in Section 4 of the Texas TRM Vol 1 using data from 3 studies: CCET Wind Integration in ERCOT, Avista Utilities Semi-Annual Report on Electric Vehicle Supply, and Xcel CO EVCS Pilot.

Table 402. EVSE—Energy Savings (kWh)[601]

EVSE type	Steady state charging (kWh)	Standby mode (kWh)	Total savings (kWh)
Non-networked charger	18	22	40
Networked charger		53	71

Deemed Summer and Winter Demand Savings Tables

Table 403 presents the deemed summer and winter peak kW savings per EVSE.

Table 403. EVSE—Summer/Winter Peak Demand Savings (kW)[602]

Climate Zone	Summer	Winter
Zone 1: Amarillo	0.0009	0.0012
Zone 2: Dallas	0.0008	0.0011
Zone 3: Houston	0.0009	0.0008
Zone 4: Corpus Christi	0.0009	0.0012
Zone 5: El Paso	0.0007	0.0017

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Additional Calculators and Tools

Not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) for an EVSE is assumed to be 10 years.[603]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly:

- Climate zone

[601] ENERGY STAR Market and Industry Scoping Report Electric Vehicle Supply Equipment (EVSE), September 2013. https://www.energystar.gov/sites/default/files/asset/document/Electric_Vehicle_Scoping_Report.pdf.

[602] Demand savings are only presented for steady state charging because those savings are higher than demand for plugged-in standby mode.

[603] US Department of Energy Vehicle Technologies Office, November 2015, "Costs Associated with Non-Residential Electric Vehicle Supply Equipment" p. 21. https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf.

- Manufacturer and model number
- EVSE type (networked, non-networked)
- ESVE quantity
- ENERGY STAR certificate matching EVSE model number
- Vehicle year, make, and model (if available)
- Estimated number of miles driven per day (if available)

References and Efficiency Standards

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

Document Revision History

Table 404. EVSE—Revision History

TRM version	Date	Description of change
v7.0	10/2019	TRM v7.0 origin.
v8.0	10/2020	TRM v8.0 update. Updated deemed savings tables
v9.0	10/2021	TRM v9.0 update. Updated documentation requirements.
v10.0	10/2022	TRM v10.0 update. Verified compliance with ENERGY STAR Final Version 1.1 Requirements. Updated savings calculation assumptions, deemed savings, and documentation requirements.
v11.0	10/2023	TRM v11.0 update. Updated algorithm with days coefficient.

2.5.12 Induction Cooking

TRM Measure ID: R-AP-IC

Market Sector: Residential

Measure Category: Appliances

Applicable Building Types: Single-family, multifamily, manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Retrofit, new construction

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

Residential cooking appliances include ovens, cooktops, and full ranges. A full range consists of an oven with a built-in cooktop. An induction range is an electric oven with a built-in induction cooktop.

Induction technology works on the principle of magnetic induction, where excited eddy currents in ferromagnetic cookware within the presence of an oscillating magnetic field dissipate heat through the Joule effect. This heat is directly generated by the cookware and is transmitted to the food within it, lessening thermal condition heat loss between the heating element and the cookware. Induction cooktops include a switching-power electronics circuit that delivers high-frequency current to a planar coil of wire embedded in the cooking surface. The cookware is magnetically coupled to the coil by the oscillating magnetic field. Current flows in the cooking vessel due to the low resistance of the metal. Resistance is a function of permeability and resistivity of the cookware as well as the frequency of excitation. Typical induction cooktops operate at switching frequency between 25 kHz and 50 kHz, which restricts coupling to ferromagnetic cookware such as cast iron, and some alloys of stainless steel.[604]

According to manufacturers, induction cooktops heat food faster, are easier to clean, are less likely to burn those using them, and have a higher cooking efficiency than electric resistance cooktops.

Eligibility Criteria

This measure requires the installation of an electric range with an induction cooktop or a standalone induction cooktop in a residential application. This measure assumes the use of small cookware typical of residential applications.

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[604] Sweeney, M., J. Dols, B. Fortenbery, and F. Sharp (EPRI), "Induction Cooking Technology Design and Assessment." Proceedings of the 2014 ACEEE Summer Study on Energy Efficiency in Buildings, p. 9-370. https://www.aceee.org/files/proceedings/2014/data/papers/9-702.pdf.

Baseline Condition

The baseline condition is defined as an electric range with electric resistance cooktop or a standalone electric resistance cooktop. This measure assumes a default of four burners.

Table 405. Induction Cooking—Baseline Electric Resistance Cooktop Energy Consumption[605]

Number of burners	Electric cooktop baseline kWh
0	84
1	89
2	95
3	101
4	106
5	112
6	118
7+	124

High-Efficiency Condition

The high efficiency condition is defined as an electric range with an induction cooktop or a standalone induction cooktop.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Energy Savings Algorithms

Energy savings are calculated as the difference between the baseline and high-efficiency condition unit energy consumption (UEC). These exclude HVAC interactive effects or savings due to reduced kitchen hood consumption. Range oven cooking efficiency varies by cooktop type. Ranges with electric resistance and induction cooktops both have electric resistance oven components. Therefore, baseline and high-efficiency condition oven cooking efficiencies are equivalent and are excluded from the savings calculation.

$$Energy\ Savings\ [\Delta kWh] = UEC_{base} - UEC_{IC}$$

Equation 159

[605] "Plug Loads and Lighting Modeling," Codes and Standards Enhancement Initiative (CASE). 2016 California Building Energy Efficiency Standards. June 2016. Table 35. https://www.caetrm.com/media/reference-documents/2016_T24CASE_Report_-_Plug_Load_and_Ltg_Modeling_-_June_2016.pdf.

$$UEC_{IC} = UEC_{base} \times \frac{CE_{base}}{CE_{IC}}$$

Equation 160

Where:

UEC_{base}	=	*Baseline annual unit energy consumption [kWh]; see Table 405*
UEC_{IC}	=	*Induction cooking annual unit energy consumption [kWh]*
CE_{base}	=	*Baseline cooking efficiency = 75 percent*[606]
CE_{IC}	=	*Induction cooking efficiency = 85 percent*[607]

Summer Demand Savings Algorithms

$$Peak\ Demand\ Savings\ [\Delta kW] = \frac{kWh_{savings}}{8{,}760} \times CF_{S/W}$$

Equation 161

8,760	=	*Total hours per year*
$CF_{S/W}$	=	*Seasonal peak coincidence factor (Table 406)*

Table 406. Induction Cooking—Coincidence Factors[608]

Season	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Summer	0.003	0.003	0.003	0.003	0.002
Winter	0.009	0.008	0.007	0.008	0.010

606 "2021-2022 Residential Induction Cooking Tops," ENERGY STAR. https://www.energystar.gov/about/2021_residential_induction_cooking_tops#:~:text=The%20per%20unit%20efficiency%20of,times%20more%20efficient%20than%20gas.

607 Ibid.

608 Calculated according to TX TRM Volume 1, Section 4 using data from the US DOE Building America B10 Benchmark load profiles for cooking equipment. Summer profiles include April through September, and winter profiles include October through March. https://www.energy.gov/eere/buildings/building-america-analysis-spreadsheets.

Deemed Energy Savings Tables

For all applications, this measure assumes a default value of four burners.[609]

Table 407. Induction Cooking—Energy Savings (kWh)

Number of burners	kWh savings
4	12

Deemed Summer Demand Savings Tables

For all applications, this measure assumes a default value of four burners.

Table 408. Induction Cooking—Summer Peak Demand Savings (kW)

Number of burners	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
4	0.000004	0.000004	0.000004	0.000004	0.000003

Deemed Winter Demand Savings Tables

For all applications, this measure assumes a default value of four burners.

Table 409. Induction Cooking—Winter Peak Demand Savings (kW)

Number of burners	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
4	0.000013	0.000011	0.000010	0.000011	0.000014

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Additional Calculators and Tools

Not applicable.

[609] Savings for 0–7+ burners only vary from 10–15 kWh.

Measure Life and Lifetime Savings

The estimated useful life (EUL) of an induction cooktop is 16 years based on the average lifetime specified for electric cooktops in the 2016 DOE life-cycle cost tool for residential cooking products.[610]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Decision/action type (new construction, retrofit)
- Baseline unit type (electric range with electric resistance cooktop, standalone electric resistance cooktop)
- New unit type (electric range with induction cooktop, standalone induction cooktop)
- Manufacturer and model number
- Unit quantity
- Burner quantity
- Proof of purchase – with date of purchase and quantity
    - Alternative: photo of unit installed or another pre-approved method of installation verification

References and Efficiency Standards

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

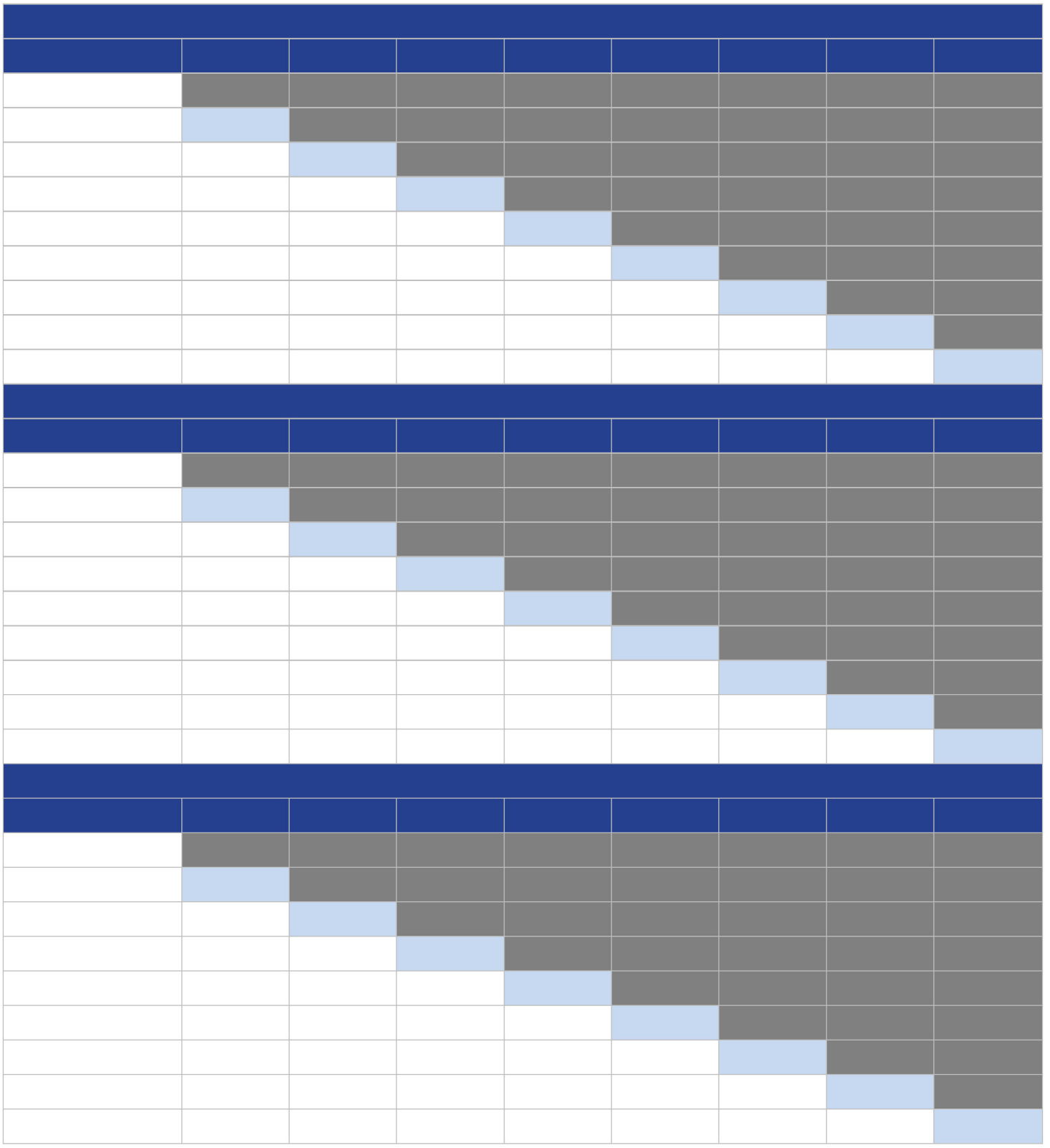
Please refer to measure citations for relevant standards and reference sources.

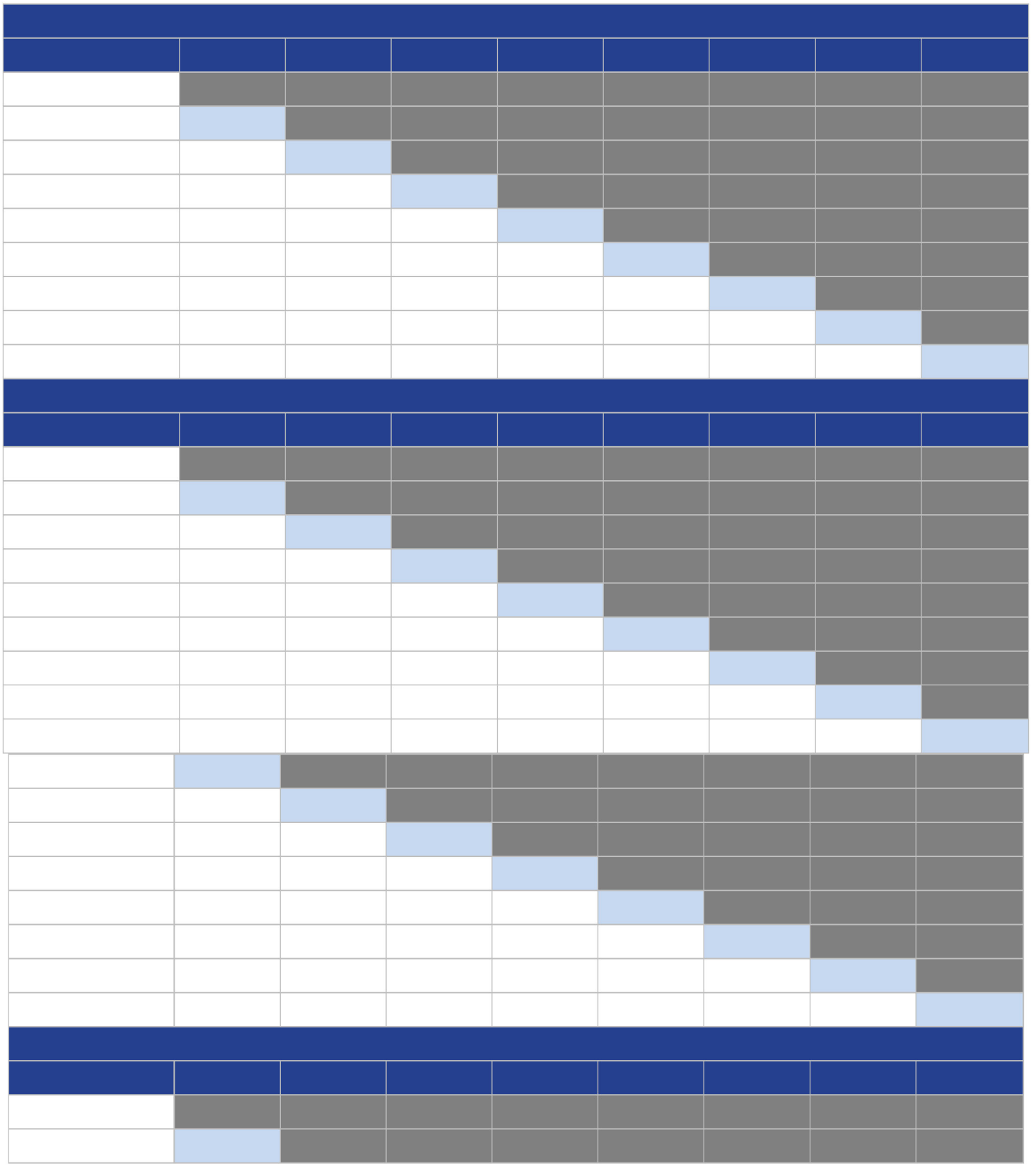
[610] US Department of Energy (DOE), Energy Efficiency and Renewable Energy Office (EERE). 2016 SNOPR Analytical Tools: Life-Cycle Cost and Payback Period Analysis Spreadsheet. "Cooking_Pds_LCC_SNOPR_DOE_2016_publication.xlsm." Dockett EERE-2014-BT-STD-0005.

Document Revision History

Table 410. Induction Cooking—Revision History

TRM version	Date	Description of change
v10.0	10/2022	TRM v10.0 origin.
v11.0	10/2023	TRM v11.0 update. No revision.





39,000-44,999	3.31	2.79	2.27	1.75	1.23	0.71		
45,000-53,999	3.93	3.41	2.89	2.37	1.85	1.33	0.82	
54,000-64,999	5.17	4.65	4.14	3.62	3.10	2.58	2.06	1.02

Public Utility Commission of Texas

Texas Technical Reference Manual

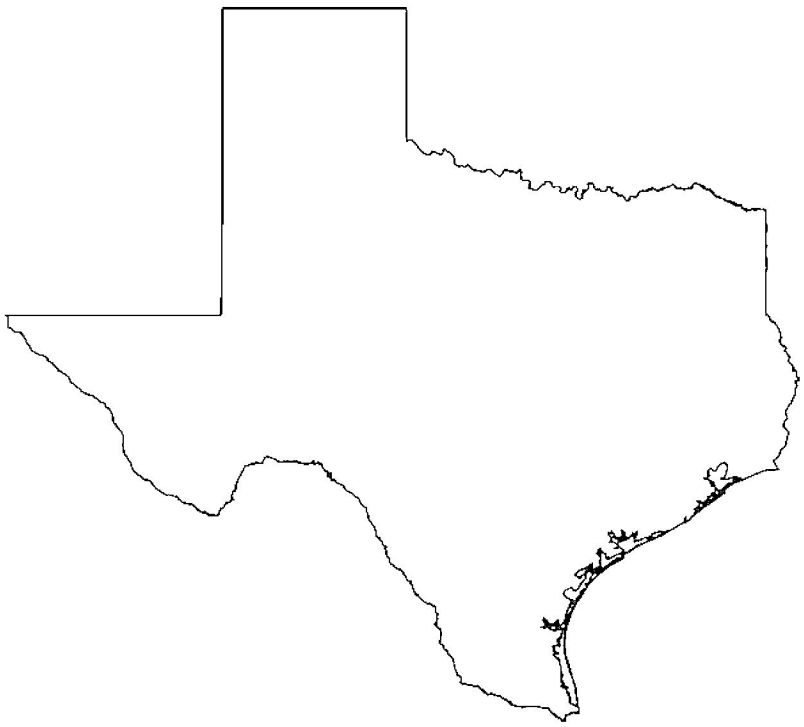
Version 11.0

Volume 3: Nonresidential Measures

Program Year 2024

Last Revision Date:

September 2023



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Texas Technical Reference Manual

Version 11.0

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Acknowledgments

The Technical Reference Manual is maintained by the Public Utility Commission of Texas' independent Evaluation, Monitoring, and Verification (EM&V) team led by Tetra Tech.

This version of the Texas Technical Reference Manual was primarily developed from program documentation and measure savings calculators used by the Texas Electric Utilities and their Energy Efficiency Services Providers (EESPs) to support their energy efficiency efforts, and original source material from petitions filed with the Public Utility Commission of Texas by the utilities, their consultants and EESPs such as Frontier Energy (TXu 1-904-705), ICF, CLEAResult and Nexant. Portions of the Technical Reference Manual are copyrighted 2001-2017 by the Electric Utility Marketing Managers of Texas (EUMMOT), while other portions are copyrighted 2001-2018 by Frontier Energy. Certain technical content and updates were added by the EM&V team to provide further explanation and direction as well as consistent structure and level of information.

TRM Technical Support

Technical support and questions can be emailed to the EM&V project manager (lark.lee@tetratech.com) and PUCT staff (therese.harris@puc.texas.gov).

1. INTRODUCTION

This volume of the TRM contains the deemed savings for nonresidential measures that have been approved for use in Texas by the PUCT. This volume includes instructions regarding various savings calculators and reference sources of the information. The TRM serves as a centralized source of deemed savings values; where appropriate, measurement and verification (M&V) methods by measure category are noted for informational purposes only regarding the basis of projected and claimed savings.

Table 1 provides an overview of the nonresidential measures contained within Volume 3 and the types of deemed savings estimates available for each one. There are five types of deemed savings estimates identified:

- Point estimates that provide a single deemed savings value that corresponds to a single measure or type of technology.
- Deemed saving tables that provide energy and peak savings as a function of size, capacity, building type, efficiency level, or other inputs.
- Savings algorithms that require user-defined inputs that must be gathered on-site and the identification of default inputs where primary data could not be collected. In many cases, these algorithms are provided as references to deemed savings tables, point estimates, or calculator explanations.
- Calculators are used by different utilities and implementers to calculate energy savings for different measures. In many cases, there are several different calculators available for a single measure. Sometimes their background calculators are similar, and in other cases, estimates can vary greatly between each calculator.
- M&V methods are also used for some measures to calculate savings in the event that standard equipment is not used, or the specified building types do not apply. For some of these measures, both a simplified M&V approach and a full M&V approach may be allowed by the utility. M&V methods as a source of claimed and projected savings are noted for informational purposes only. Standardized M&V approaches that have been reviewed by the EM&V team are incorporated into Volume 4: Measurement and Verification Protocols of this TRM.

Please consult Volume I: Overview and User Guide, Section 4: Structure and Content, for details on the organization of the measure templates presented in this volume.

Table 1. Nonresidential Deemed Savings by Measure Category

Measure category	Measure description	Point estimates	Deemed savings tables	Savings algorithm	Calculator	M&V	11.0 update
Lighting	Lamps and fixtures	–	–	X	X	X	Added guidance for delisted lighting products and for new construction lighting exterior lighting zone selection. Aligned building type names across all commercial measures.
	Lighting controls	–	–	X	X	X	Clarified new construction controls eligibility. Updated control types. Consolidated EAF and PAF into CAF and added column for new construction CAF. Added documentation requirements for NLC systems.
	Exterior photocell and time clock repair	–	–	X	X	X	No revision.
	LED traffic signals	–	–	X	X	X	No revision.
HVAC	Air conditioning and heat pump tune-ups	–	–	X	–	X	Clarified eligibility criteria.
	Split and packaged air conditioners and heat pumps	–	–	X	X	X	Removed < 5.4 ton HP sell-through exception. Updated ER baselines for compliance with updated federal standard. Updated NC/ROB 5.4+ ton baselines to incorporate current federal standard. Clarified pre and post capacity limits. Aligned building type names across all commercial measures. Incremented RUL table for code compliance.
	HVAC chillers	–	–	X	X	X	Aligned building type names across all commercial measures. Incremented RUL table for code compliance.
	Package terminal air conditioners/heat pumps, and room air conditioners	–	–	X	X	X	Corrected current federal standard effective date. Added separate RUL table for PTHP. Aligned building type names across all commercial measures. Incremented RUL table for code compliance.
	Computer room air conditioners	–	–	X	X	–	Added reference to new standard and plan to incorporate in PY2025.

Measure category	Measure description	Point estimates	Deemed savings tables	Savings algorithm	Calculator	M&V	11.0 update
	Computer room air handler motor efficiency	–	–	X	X	–	No revision.
	HVAC variable frequency drives	–	X	X	–	–	Added cooling tower fan and condenser water pump applications. Updated maximum temperatures for linear regression equations to correspond with ASHRAE design conditions. Aligned building type names across all commercial measures.
	Condenser air evaporative pre-cooling	–	–	X	–	X	Aligned building type names across all commercial measures.
	High-volume low-speed fans	–	–	X	–	–	No revision.
	Small commercial evaporative cooling	–	X	X	–	–	Aligned building type names across all commercial measures.
	Small commercial smart thermostats	–	–	X	X	X	No revision.
Building envelope	Cool roofs	X	–	X	X	–	No revision.
	Window treatments	X	–	X	X	–	Extended eligibility to windows with existing louvered or Ventian blinds. Added reduced baseline SHGC values for windows with louvered blinds.
	Entrance and exit door air infiltration	–	X	X	–	–	No revision.
Food service	ENERGY STAR® combination ovens	–	X	X	–	–	No revision.
	ENERGY STAR® electric convection ovens	–	X	X	–	–	No revision.
	ENERGY STAR® dishwashers	–	X	X	–	–	Clarified that residential dishwashing equipment can be installed in commercial applications following the methodology in Volume 2 of TRM.
	ENERGY STAR® electric griddles	–	X	X	–	–	TRM v11.0 origin.

Measure category	Measure description	Point estimates	Deemed savings tables	Savings algorithm	Calculator	M&V	11.0 update
	ENERGY STAR® electric fryers	–	X	X	–	–	Updated documentation requirements to collect fryer type rather than fryer width.
	ENERGY STAR® electric steam cookers	–	X	X	–	–	No revision.
	ENERGY STAR® hot food holding cabinets	–	X	X	–	–	No revision.
	ENERGY STAR® ice makers	–	X	X	–	–	No revision.
	Demand controlled kitchen ventilation	–	X	X	–	–	Aligned building type names across all commercial measures.
	Pre-rinse spray valves	–	X	X	–	–	Adjusted mixed water hot temperature to match CEE guidance. Aligned building type names across all commercial measures.
	Vacuum-sealing and packaging machines	–	X	–	–	–	No revision.
Refrigeration	Door heater controls	–	X	X	–	–	No revision.
	ECM evaporator fan motors	–	–	X	–	–	Clarified duty cycle assumptions and references.
	Electronic defrost controls	–	–	X	–	–	No revision.
	Evaporator fan controls	–	–	X	–	–	No revision.
	Night covers for open refrigerated display cases	–	X	X	–	–	No revision.
	Solid and glass door reach-ins	–	–	X	–	–	Updated ENERGY STAR efficiency requirements. Clarified that residential refrigerator and freezer equipment can be installed in commercial applications following the methodology in Volume 2 of TRM. Updated documentation requirements.

Measure category	Measure description	Point estimates	Deemed savings tables	Savings algorithm	Calculator	M&V	11.0 update
	Strip curtains for walk-in refrigerated storage	–	X	–	–	–	No revision.
	Zero-energy doors for refrigerated cases	–	X	X	–	–	No revision.
	Door gaskets for walk-in and reach-in coolers and freezers	–	X	X	–	–	No revision.
	High speed doors for cold storage	–	X	X	–	–	No revision.
Water heating	Heat pump water heaters	–	–	X	–	–	TRM v11.0 origin.
	Central domestic hot water controls	–	X	X	–	–	No revision.
	Showerhead temperature sensitive restrictor valves	–	–	X	–	–	No revision.
	Tub spout and showerhead temperature sensitive restrictor valves	–	–	X	–	–	No revision.
Miscellaneous	Variable frequency drives for water pumping	–	X	X	–	–	No revision.
	Premium efficiency motors	–	–	X	–	–	Aligned building type names across all commercial measures. Incremented RUL table for code compliance.
	Pump-off controllers	–	X	X	–	–	No revision.
	ENERGY STAR® pool pumps	–	X	X	–	–	No revision.
	Lodging guest room occupancy sensor controls	–	X	–	–	–	No revision.

Measure category	Measure description	Point estimates	Deemed savings tables	Savings algorithm	Calculator	M&V	11.0 update
	Vending machine controls	–	X	X	–	–	No revision.
	Computer power management	–	X	X	–	–	No revision.
	ENERGY STAR® electric vehicle supply equipment	–	X	X	–	–	No revision.
	Industrial high-frequency battery chargers	–	X	X	–	–	TRM v11.0 origin.
	Steam trap repair and replacement	–	X	X	–	–	Aligned building type names across all commercial measures.
	Hydraulic gear lubricants	–	–	X	–	–	No revision.
	Hydraulic oils	–	–	X	–	–	No revision.
	Hand dryers	–	X	X	–	–	No revision.
	Laser projectors	–	–	X	–	–	TRM v11.0 origin.

2. NONRESIDENTIAL MEASURES

2.1 NONRESIDENTIAL: LIGHTING

2.1.1 Lamps and Fixtures Measure Overview

TRM Measure ID: NR-LT-LF

Market Sector: Commercial

Measure Category: Lighting

Applicable Building Types: All commercial, multifamily common areas

Fuels Affected: Electricity (interactive HVAC effects: electric/gas space heating)

Decision/Action Types: Retrofit, and new construction

Program Delivery Type: Prescriptive, custom, direct install

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This section provides estimates of the energy and peak savings resulting from the installation of energy efficient lamps and/or ballasts. The installation can be the result of new construction or the replacement of existing lamps and/or ballasts. This TRM Measure ID covers the following lighting technologies:

- Linear fluorescent T5s; high performance or reduced watt T8s. Linear fluorescent measures may also involve delamping[1] with or without the use of reflectors.
- Fluorescent electrodeless induction lamps and fixtures
- Compact fluorescent lamp (CFL) screw-based lamps and hard-wired pin-based fixtures
- Pulse-start (PSMH) and ceramic metal halide (CMH) lamps; high-intensity discharge (HID) lamps
- Light emitting diode (LED) screw-based lamps; hard-wired LED fixtures.

Energy and demand savings are based on operating hours, coincident-load factors, and changes in pre-existing and post-installation lighting loads, as determined using an approved lighting Standard Fixture Wattage table[2], available for download from the Texas Efficiency website and in the Fixture Codes tab in the latest version of the Lighting Survey Form (LSF). The LSF is one example of a calculator that is used to determine energy and demand savings.

[1] Delamping energy savings are eligible if done in conjunction with T-8 lamp and electronic ballast retrofits.

[2] Maintained by EUMMOT/Frontier Energy: http://texasefficiency.com/index.php/regulatory-filings/lighting.

Pre- and post-retrofit lighting inventories are entered and used with the pre-loaded stipulated values and algorithms needed to calculate energy and demand savings. Components of the calculator include:

- Instructions and project information.
- Pre- and post-retrofit lighting inventories. A tab for exempt fixtures and a description of the exemptions is also present in the calculator.
- Fixture wattages and descriptions are defined in a Standard Fixture Wattage table.
- Factor tables that contain stipulated operating hours, coincidence factors, interactive HVAC factors, control adjustment factors, and new construction lighting power density (LPD) factors.
- A summary tab displaying the final energy and demand calculations. The data from this tab is entered into the utility program tracking data as the claimed savings values.

Although the generic LSF calculator is publicly available on the Texas Energy Efficiency website, several utilities have their own versions.

Eligibility Criteria

This section describes the system information and certified wattage values that must be used to estimate energy and peak savings from lighting systems installed as part of the Texas utility energy efficiency programs. The fixture codes and the demand values listed in the Table of Standard Fixture Wattages are used to calculate energy and demand savings for lighting efficiency projects.

Existing lighting fixtures must be removed or demolished in place after retrofit to count towards reduced pre-install wattage. Existing lighting fixtures that remain operable after retrofit should be listed in both the pre- and post-retrofit lighting inventory.

In addition, LED and linear fluorescent T8s need to be qualified, as follows:

- High-performance (HP) and reduced-watt (RW) T8 linear fluorescent lamps need to be qualified by the Consortium for Energy Efficiency (CEE). Their respective ballasts need to be qualified by NEMA.[3] See the High-efficiency Condition section for additional details.
- LED lamps and fixtures must have their input power (wattage) and an L70 rated life (hours) verified through some combination of the following references: DesignLights Consortium® (DLC), ENERGY STAR®, or independent lab testing[4] (e.g., LM-79, LM-80, TM-21, ISTMT). Rated life for LED fixtures should be greater than or equal to 50,000

[3] While CEE stopped qualifying ballasts in January 2015, the NEMA Premium Electronic Ballast Program has continued to be maintained and is consistent with the prior CEE specifications for high performance lamps and ballasts, tested in accordance with ANSI C82 Standards.

[4] DLC test lab requirements: https://www.designlights.org/solid-state-lighting/qualification-requirements/testing-lab-requirements/.

hours, which can be demonstrated by compliance with DLC v3.0 or later[5] or through independent lab testing. Similarly, rated life for integrated LED lamps should be greater than or equal to 10,000 hours, which can be demonstrated by compliance with ENERGY STAR Version 2.1 Specification or later[6] or through independent lab testing for integrated-ballast LED lamps. These values represent the point at which the minimum L70 was raised to levels consistent with current deemed measure life assumptions.

- DLC- and ENERGY STAR-certified model numbers should closely align with the installed model number. However, small variances are allowed for portions of the model number that may refer to aspects of the fixture that do not affect energy performance (e.g., color temperature, fixture housing). This allowance is provided at the discretion of the state evaluator and reported model numbers should always default to the closest match available.
- DLC and ENERGY STAR specifications are periodically updated. Projects may report fixture wattage from older versions of product certifications according to the following certification date guidelines if a copy of the original certification is preserved.
    1. New construction: permit date
    2. Small business: date of customer acceptance or project proposal
    3. All other: installation date
- DLC currently tracks delisted products. DLC delisted products are eligible as long as they were rated for compliance with DLC v3.0 or later. ENERGY STAR does not track delisted products. However, any delisted product may be eligible if prior compliance is documented using a downloaded copy of the prior rating certificate.
- If a product is available in various length increments but is DLC-certified for a specific fixture length, the specified DLC power may be converted to a watts-per-square-foot value to be multiplied against the installed fixture length instead of reporting as a non-qualified fixture.
- Field adjustable light output: If a product is available with field-adjustable light output (or wattage setpoints) that can be adjusted by an installation contractor to utilize some or all LED nodes on the fixture, this will be noted in the Product Capabilities section of the DLC certification. DLC will typically specify the maximum input wattage. These fixtures should be reported based on the following scenarios:

[5] Equivalent to the L70 rated life requirement for all categories as specified in DesignLights Consortium™ (DLC) Technical Requirements v3.0. ~~https://www.designlights.org/solid-state-lighting/qualification-requirements/past-technical-requirements/version-3-0-released-june-23-2015/~~ https://www.designlights.org/wp-content/uploads/2021/01/DLC_Technical-Requirements-Table_V3-0.pdf.

[6] Equivalent to the rated life requirement for all lamps as specified in the ENERGY STAR® Lamps Version 2.1 Specification . https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Lamps%20V2.1%20Final%20Specification.pdf.

- If the fixture is installed at a reduced setpoint, it should be reported at the maximum input wattage in combination with the institutional tuning control code to claim energy savings associated with a central control lighting output based on tuning sensors. This control type is similar because it is not easily adjustable over time.
- If the fixture is installed with additional controls (e.g., occupancy sensor, daylighting), then it should be reported at the maximum input wattage in combination with the multiple control code.
- If the fixture is installed without adjustment, it should be reported at the maximum input wattage with no control code.
- If the fixture is installed with no additional controls and the DLC certificate specifies a lower wattage setpoint, then it should be reported as the lower input wattage with no control code.
- For all cases, project documentation should include a screenshot of the DLC certificate and an example photo of the field-adjustable setpoint.

Exempt lighting for new construction. Some types of new construction lighting fixtures are exempt from inclusion in the interior lighting demand savings calculation, but they are still included in the total installed lighting power calculations for a project. Exempt fixtures are those that do not provide general/ambient/area lighting, have separate control devices, and are installed in one of the following applications:[7]

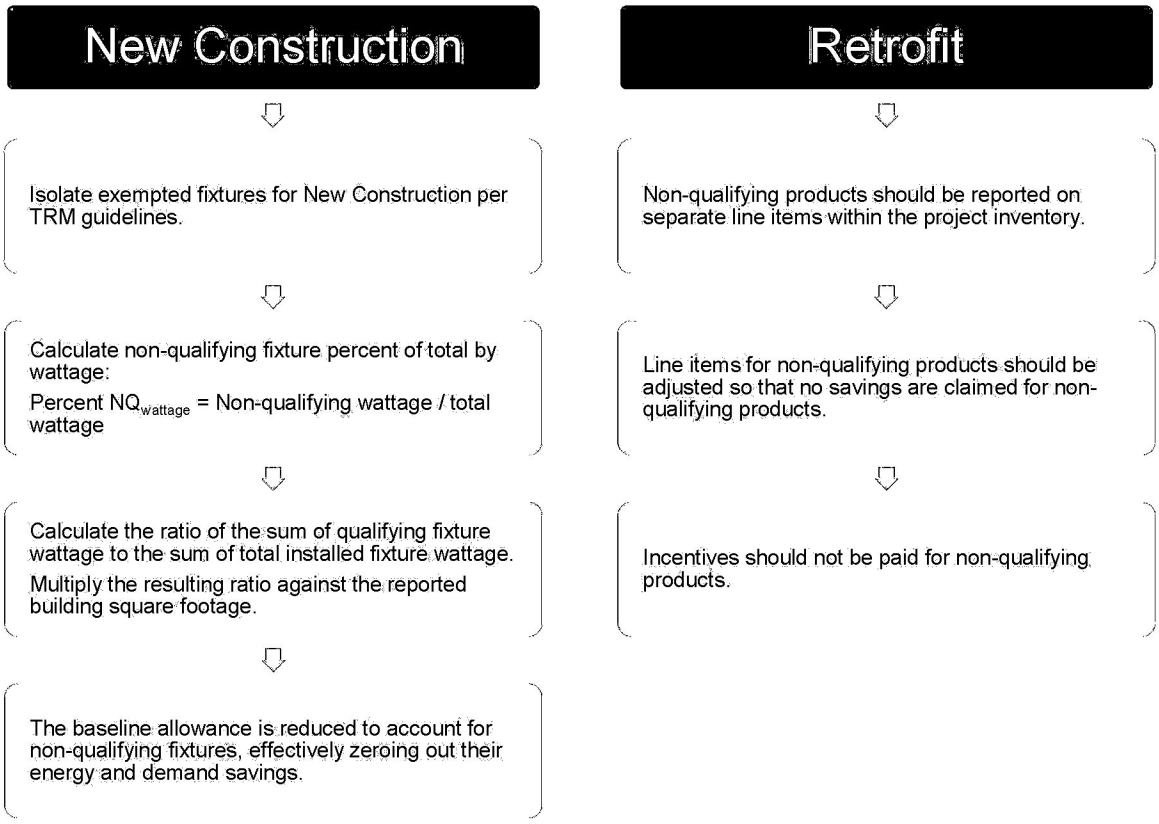
1. The connected power associated with the following lighting equipment is not included in calculating total connected lighting power
    1.1. Professional sports arena playing-field lighting
    1.2. Sleeping-unit lighting in hotels, motels, boarding houses, or similar buildings
    1.3. Emergency lighting automatically off during normal building operation
    1.4. Lighting in spaces specifically designed for use by occupants with special lighting needs including visual impairment and other medical and age-related issues
    1.5. Lighting in interior spaces that have been specifically designated as a registered interior historic landmark
    1.6. Casino gaming areas
    1.7. Mirror lighting in dressing rooms
2. Lighting equipment used for the following shall be exempt provided that it is in addition to general lighting and is controlled by an independent control device
    2.1. Task lighting for medical and dental purposes
    2.2. Display lighting for exhibits in galleries, museums, and monuments

[7] IECC 2015, Section C405.4.1.

3. Lighting for theatrical purposes, including performance, stage, film production, and video production
4. Lighting for photographic processes
5. Lighting integral to equipment or instrumentation and installed by the manufacturer
6. Task lighting for plant growth or maintenance
7. Advertising signage or directional signage
8. In restaurant building and areas, lighting for food warming or integral to food preparation equipment
9. Lighting equipment that is for sale
10. Lighting demonstration equipment in education facilities
11. Lighting approved because of safety or emergency considerations, inclusive of exit lights
12. Lighting integral to both open and glass-enclosed refrigerator and freezer cases
13. Lighting in retail display windows, provided the display area is enclosed by ceiling-height partitions
14. Furniture-mounted supplemental task lighting that is controlled by automatic shut off
15. Exit signs

Non-Qualifying LEDs. This section provides guidance to assess and calculate nonresidential lighting project savings that include non-qualifying LEDs. Figure 1 summarizes the recommended protocol for lighting system projects with non-qualifying LEDs when square footage cannot be isolated. Additional explanations and criteria for use follow.

Figure 1. Lamps & Fixtures—Non-Qualifying LED Process



Step 1: Qualify New Construction Projects. Calculate non-qualifying LED project percentage:

- Based as a percentage of demand (percent $NQ_{wattage}$ = wattage of non-qualifying fixtures / wattage of total fixtures)

Step 2: New Construction Projects Only. Non-qualifying fixtures that pass Step 1 would follow all instructions for excluded fixtures.

- List non-qualifying LEDs on separate lines (e.g., separate on lighting inventory worksheet of deemed savings calculator). Non-qualifying fixtures are identified by a unique fixture code.
- Adjust code allowable baseline wattage so that non-qualifying fixture wattage is not included as part of the ~~lighting power density (~~LPD~~)~~ code limit requirements. To do so, calculate the sum of the qualifying fixture wattage and the sum of the total installed fixture wattage. Take the ratio of qualifying fixture wattage to total fixture wattage and multiply the resulting ratio against the total treated square footage for space. The adjusted square footage is included as part of the overall LPD calculation and will decrease the total allowable baseline wattage for the project.

- **Fixture Isolation Method.** If non-qualifying fixtures are isolated to a section of the building whose square footage can be easily segmented from the total building square footage, the non-qualifying fixtures and affected square footage can be excluded from the lighting inventory. Excluded fixtures must be documented when using the fixture isolation method.

Step 3: Retrofit Projects. List non-qualifying LEDs on separate lines (e.g., separate on lighting inventory worksheet of deemed savings calculator).

- Include unique identifiers/markers for the non-qualifying LEDs within the inventory (e.g., fixture code, description, or another designator within the deemed savings tool).
- Adjust non-qualifying LED wattages, so their demand and energy savings are not included as part of the project savings. Demand and energy savings for non-qualifying LEDs shall result in zero-project savings.
- Adjust non-qualifying LED quantities so they are not included as part of the project incentive. Incentives shall not be paid on non-qualifying LEDs.
- Provide clear visibility for all changes within the savings calculation (e.g., deemed savings calculator), including changes to all input assumptions and calculation methodologies to implement the above procedure.
- All other savings procedures and requirements, as specified within the TRM for lighting measures apply to all fixtures of a lighting project.

Baseline Condition

The baseline condition or assumed baseline efficiency used in the savings calculations depends on the decision-type used for the measure. For new construction, the baseline will be based on a ~~lighting power density (~~LPD~~)~~ in watts per square foot by building/space type, as specified by the relevant energy code/standard applied to a specific project. For *retrofit* applications, the baseline efficiency would typically reflect the in-situ, pre-existing equipment, ~~with the~~ except~~ion~~ for ~~of~~ linear fluorescent T12s and first-generation T8s, as explained below. Eligible baseline fixture types and wattages are specified in the Standard Fixture Wattages table.

Major renovation projects should use a new construction baseline (for the building type after the improvement) if either of the following conditions are met:

- Building type changes in combination with the renovation
- Renovation scope includes removing drywall and gutting existing building to the studs

Linear Fluorescent T12 Special Conditions

The US Energy Policy Act of 1992 (EPACT) set energy efficiency standards that preclude certain lamps and ballasts from being manufactured or imported into the US. The latest standards covering general service linear fluorescents went into full effect July 2014. Under this provision, almost all 4-foot and some 8-foot T12 lamps, as well as first-generation 4-foot, 700 series T8 lamps were prohibited from manufacture. Because all lighting equipment for Texas energy efficiency programs must be EPACT compliant, including existing or baseline equipment, adjustments were made to the T12 fixtures in the Standard Fixture Wattage table. Certain T12 lamp/ballast combinations which are non-EPACT compliant are assigned EPACT demand values.

As such, 4-foot and 8-foot T12s are no longer an approved baseline technology for Texas energy efficiency programs. 4-foot and 8-foot T12s are still eligible for lighting retrofit projects, but an assumed electronic T8 baseline will be used for estimating the energy and demand savings instead of the existing T12 equipment. T12 fixtures will remain in the Standard Fixture Wattage table, but the label for these records will be changed to "T12 (T8 baseline)" and the fixture wattage for these records will be adjusted to use the adjusted fixture wattages shown in Table 2.

Table 2. Lamps & Fixtures—Adjusted Baseline Wattages for T12 Equipment

T12 length	Lamp count	Revised lamp wattage	Revised system wattage
48-inch—std, HO, and VHO (4 feet)	1	32	31
	2	32	58
	3	32	85
	4	32	112
	6	32	170
	8	32	224
96-inch—std (8 feet) 60/75 W	1	59	69
	2	59	110
	3	59	179
	4	59	219
	6	59	330
	8	59	438*
96-inch HO and VHO (8 feet) 95/110 W	1	86	101
	2	86	160
	3	86	261
	4	86	319
	6	86	481
	8	86	638

T12 length	Lamp count	Revised lamp wattage	Revised system wattage
2-foot u-tube	1	32	32
	2	32	60
	3	32	89

*8 lamp fixture wattage approximated by doubling 4 lamp fixture wattage.

Key: HO = high output, VHO = very high output.

General Service Lamps

On May 8, 2022, the Department of Energy (DOE) issued two final rules relating to general service lamps (GSL):

- Energy Conservation Program: Definitions for General Service Lamps, effective July 8, 2022, which expanded the definition of a GSL.[8]
- Energy Conservation Program: Energy Conservation Standards for General Service Lamps, effective July 25, 2022, which shifted the baseline to 45 lumens/watt efficacy.[9]

The baseline is assumed to be the second-tier Energy Independence and Security Act of 2007 (EISA)-mandated efficiency for a GSL (see Table 3). The EISA regulations dictate that GSLs must comply with a 45 lumen/watt efficacy standard at time of sale beginning January 1, 2023. However, due to the DOE enforcement schedule, savings may be claimed against the first-tier EISA baseline through February 28, 2023, at the utility's discretion.[10]

Table 3. Lamps & Fixtures—EISA 2007 Baseline Adjustment for GSLs [11] [12]

Minimum lumens	Maximum lumens	Incandescent equivalent wattage	2nd Tier EISA 2007 baseline wattage
250	309	25	Exempt
310	749	40	12
750	1,049	60	20
1,050	1,489	75	28
1,490	2,600	100	45

[8] DOE Final Rule: Definitions for General Service Lamps. https://www.regulations.gov/document/EERE-2021-BT-STD-0012-0022.

[9] DOE Final Rule: Energy Conservation Standards for General Service Lamps. https://www.regulations.gov/document/EERE-2021-BT-STD-0005-0070.

[10] See PY2022 TRM 9.0 for methodology and baseline.

[11] Federal standard for General Service Incandescent Lamps (GSILs): https://www1.eere.energy.gov/buildings/appliance standards/standards.aspx?productid=20.

[12] If exempt, refer to incandescent equivalent wattage.

Minimum lumens	Maximum lumens	Incandescent equivalent wattage	2nd Tier EISA 2007 baseline wattage
2,601	3,300	150	66

High-Efficiency Condition

Eligible efficient fixture types and wattages are specified in the Standard Fixture Wattages table. In addition, some technologies such as LEDs must meet the additional requirements specified under Eligibility Criteria.

High-Efficiency/Performance Linear Fluorescent T8s

All 4-foot T8 post-retrofit technologies and new construction projects must use electronic ballasts manufactured after November 2014,[13] and high-performance T8 lamps that are on the T8 Replacement Lamp products list developed by the Consortium for Energy Efficiency (CEE) as published on its website.

If CEE does not have efficiency guidelines for a T8 system (such as for 8-foot, 3-foot, 2-foot, and U-bend T8 products), the product must have higher light output or reduced wattage than its standard equivalent product (minimum efficacy of 75 mean lumens per watt), while also providing a CRI (color rendering index) greater than 80, and an average rated life of 24,000 hours at three hours per start. In addition, 2-foot and 3-foot ballasts must also use electronic ballasts manufactured after November 2014.

Solar LEDs

Solar-powered LEDs are common in several commercial applications, primarily associated with pole-mounted fixtures. Solar lighting uses photovoltaic (PV) cells, which absorb solar energy to charge a battery and power the fixture. By default, solar fixtures should use an efficient wattage of 0. Because fixture performance relies on battery performance, the measure life for solar fixtures is capped at the expected battery life.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

This section describes the deemed savings methodology for both energy and demand savings for all lighting projects. Savings are calculated using separate methods for retrofit and new construction projects.

[13] Changes to the DOE Federal standards for electronic ballasts effective November 2014 met both the CEE performance specification and the NEMA Premium requirements, so CEE discontinued their specification and qualifying product lists. A legacy ballast list from January 2015 is still available.

Retrofit[14,15]

$$Energy\ Savings\ [kWh] = \left(kW_{pre} \times Hours_{pre} \times EAF_{pre} - kW_{installed} \times Hours_{installed}\right) \times HVAC_{energy}$$

Equation 1

$$Peak\ Demand\ Savings\ [kW] = \left(kW_{pre} \times CF_{pre} \times PAF_{pre} - kW_{installed} \times CF_{S/W}\right) \times HVAC_{demand}$$

Equation 2

New Construction

$$Energy\ Savings\ [kWh] = \left(\frac{LPD \times FloorArea}{1{,}000} - kW_{installed}\right) \times Hours \times HVAC_{energy}$$

Equation 3

$$Peak\ Demand\ Savings\ [kW] = \left(\frac{LPD \times FloorArea}{1{,}000} - kW_{installed}\right) \times CF_{S/W} \times HVAC_{demand}$$

Equation 4

Where:

kW_{pre} = *Total kW of existing measure(s) (Approved baseline fixture code wattage from deemed savings tool divided by 1,000 and multiplied by fixture/lamp quantity)*

$kW_{installed}$ = *Total kW of retrofit measure(s) (Verified installed fixture code wattage from deemed savings tool divided by 1,000 and multiplied by fixture/lamp quantity)* [16]

Note: wattage for installed LED fixtures may be rounded up or down to the nearest half watt; all other wattages should be rounded to the nearest watt.

LPD = *Acceptable lighting power density based on building type from efficiency codes from Table 4 (W/ft2)*

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[14] For non-operating fixtures, the baseline demand may be adjusted by using values from the Standard Wattage Table. The number of non-operating fixtures will be limited to 10% of the total fixture count per facility.

[15] The energy and demand savings calculations should also account for lighting controls that are present on existing lighting systems. The EAF and PAF factors in the Lighting Controls measure section should be used for these calculations to adjust the deemed hours and coincidence factors on the pre-side of the equations. Savings for controls installed on new fixtures are accounted for in the Lighting Controls measure.

[16] Installed fixture wattage for fixtures defined by DLC as having "field-adjustable light output capability under the product features tab should be reported at the "default," or maximum lumen output, setting. These fixtures may also utilize the Institutional Tuning control type. Field adjustments should be tracked in project inventories and verified with lumen measurements conducted during field inspections.

Floor Area	=	*Floor area of the treated space where the lights were installed*
Hours	=	*Hours by building type from Table 9*
EAF	=	*Energy adjustment factor from Lighting Controls measure (set equal to 1 if no controls are installed on the existing fixture)*
$CF_{S/W}$	=	*Summer/winter seasonal peak coincidence factor by building type (see Table 10 or Table 11)*
PAF	=	*Power adjustment factor from Lighting Controls measure (set equal to 1 if no controls are installed on the existing fixture)*
$HVAC_{energy}$	=	*Energy interactive HVAC factor by building type*
$HVAC_{demand}$	=	*Demand interactive HVAC factor by building type*
ISR	=	*In-service rate, the percentage of incentivized units that are installed and in use (rather than removed, stored, or burnt out) to account for units incentivized but not operating = 1.0 unless otherwise specified for midstream/upstream applications (see Table 13)*

Each of the parameters in these equations, and the approach or their stipulated values, are discussed in detail below.

Lamp and Fixture Wattages (kW_{pre}, $kW_{installed}$)

Existing construction: standard fixture wattage table.[17] Another example of standard fixture wattage can be found in the Fixture Codes tab of the latest version of the LSF. This table is used to assign identification codes and demand values (watts) to common fixture types (e.g., fluorescent, incandescent, HID, LED) used in commercial applications. The table is subdivided into lamp types (e.g., linear fluorescent, compact fluorescent, mercury vapor) with each subdivision sorted by fixture code. Each record (or row) in the table contains a fixture code, serving as a unique identifier. A legend explains the rules behind the fixture codes.

Each record also includes a description of the fixture, the number of lamps, the number of ballasts if applicable, and the fixture wattage. The table wattage values for each fixture type are averages of various manufacturers' laboratory tests performed to ANSI test standards. By using standardized demand values for each fixture type, the Table simplifies the accounting procedures for lighting equipment retrofits. The table is updated periodically as new fixtures are added.

The fixture codes and the demand values listed in the watt/fixture column in the Table of Standard Fixture Wattages are used to calculate energy and demand savings for any lighting efficiency project.

[17] Maintained by EUMMOT/Frontier Energy: http://texasefficiency.com/index.php/regulatory-filings/lighting.

For implementers interested in adding new fixtures to EUMMOT's lighting table, a request should be submitted to Frontier. The request should include all information required to uniquely identify the fixture type and to fix its demand, as well as other contextual information needed for the table. If possible, the request should also be supported by manufacturer's ANSI test data. Frontier periodically releases updated versions of the LSF with new fixture codes.

New construction: ~~lighting power density~~ LPD table. For new construction projects, the post-retrofit lighting wattages are determined as they are for the existing construction projects, from the Standard Fixture Wattage table. However, the baseline wattage is determined from the treated floor area and a ~~lighting power density (~~LPD~~)~~ value, which are the allowable watts per square foot of lit floor area as specified by the relevant energy code. The applicable baseline is the code that was in effect at the time of building permit issuance. The current Commercial code for the state of Texas is IECC 2015. These values for interior space types are presented in Table 4.

In Table 6, the ~~climate~~lighting zones used for exterior space types are:

- ~~Climate~~ Zone 1: Developed areas of national parks, state parks, forest lands, and rural areas
- ~~Climate~~ Zone 2: Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited night-time use, and residential mixed-use areas
- ~~Climate~~ Zone 3: All other areas
- ~~Climate~~ Zone 4: High-activity commercial districts in major metropolitan areas as designated by the local land-use planning authority.

~~Note:~~ In most cases, the ~~Climate~~ Zone 1, 2, or 4 will be selected. Default to Zone 2 if space type is unclear. City zoning drawings can be used to validate a Zone 4 selection. At a minimum, project documentation should include the rationale for selecting Zone 4. ~~Climate~~ Zone 3 should only be selected if none of the others apply. The reported ~~climate~~ zone should match the code compliance report (COMcheck), if available.

Table 4. Lamps & Fixtures—New Construction LPDs for Interior Space Types by Building Type[18]

Facility type	~~Lighting power density~~ LPD (W/ft^2)	Facility type	LPD~~lighting power density~~ (W/ft^2)
Automotive facility	0.80	Multifamily	0.51
Convention center	1.01	Museum	1.02
Courthouse	1.01	Office	0.82
Dining: bar/lounge/leisure	1.01	Parking garage	0.21
Dining: cafeteria/fast food	0.90	Penitentiary	0.81
Dining: family	0.95	Performing arts	1.39

[18] IECC 2015 Table C405.4.2(1) and ANSI/ASHRAE/IESNA Standard 90.1-2013 Table 9.5.1.

Facility type	Lighting power density LPD (W/ft²)	Facility type	LPDighting power density (W/ft²)
Dormitory	0.57	Police stations	0.87
Exercise center	0.84	Post office	0.87
Fire station	0.67	Religious buildings	1.00
Gymnasium	0.94	Retail	1.26
Health care/clinic	0.90	School/university	0.87
Hospital	1.05	Sports arena	0.91
Hotel/motel	0.87	Town hall	0.89
Library	1.19	Transportation	0.70
Manufacturing facility	1.17	Warehouse	0.66
Motion picture theater	0.76	Workshop	1.19

In addition to the interior building types specified in IECC 2015, the following LPDs have been established for agricultural greenhouses. Greenhouse types are defined as follows:

- High intensity sole-source greenhouse: All plant lighting is provided by ceiling-mounted high intensity artificial electric lighting.
- Supplemented greenhouse: Most plant lighting is provided by natural sunlight with supplemented artificial electric lighting used to extend daylight hours during winter seasons with short periods of sunlight or on inclement weather days when sunlight levels are suboptimal.
- Vertical farming: Plants are sacked along vertical shelving from floor to ceiling to increase grow area.

Table 5. Lamps & Fixtures—New Construction LPDs for Agricultural Greenhouses[19]

Facility type[20]	LPDighting power density (W/ft²)
Agricultural: high intensity sole-source greenhouse	52.16
Agricultural: supplemented greenhouse	10.92
Agricultural: vertical farming[21]	–

[19] "Energy Savings Potential of SSL in Agricultural Applications," US Department of Energy. June 2020. Table E-1. https://www.energy.gov/sites/prod/files/2020/07/f76/ssl-agriculture-jun2020.pdf.
[20] Weighted average of LPDs specified for LED, HPS/MH, and Fluorescent lighting type categories based on 2019 technology mix from Table E-1.
[21] Vertical farming was excluded due to 100% LED adoption in the 2019 technology mix from Table E-1.

The total exterior lighting power allowance for all exterior building applications is the sum of the base site allowance plus the individual allowances for areas that are to be illuminated and are permitted in Table 6.

The reported square footage should represent the illuminated area. Each unique outdoor area should report a unique illuminated area specific to that application and should not be combined under a single space type. For example, a new construction convenience store project should have separate areas for fuel canopy, parking and drives, building facades, and any other applicable space types. Fuel canopies should reflect the area under the canopy rather than the entire exterior lot area. Building facades should reflect the total wall area where wall-mounted fixtures are installed rather than the floor area for any space type surrounding the illuminated wall.

Table 6. Lamps & Fixtures—New Construction LPDs for Exterior Space Types[22]

SpaceFacility type	LPDlighting power density (W/ft²)			
	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4
Base site allowance	500 W	600 W	750 W	1,300 W
Uncovered parking: Parking areas and drives	0.04	0.06	0.10	0.13
Building grounds: Walkways ≥ 10 ft. wide, plaza areas, and special feature areas	0.14	0.14	0.16	0.20
Building grounds: Stairways	0.75	1.00	1.00	1.00
Building grounds: Pedestrian tunnels	0.15	0.15	0.20	0.30
Building grounds: Landscaping (ASHRAE 90.1-2013 only)[23]	0.04	0.05	0.05	0.05
Building entrances and exits: Entry canopies	0.25	0.25	0.40	0.40
Building entrances, exits, and loading docks: Loading docks (ASHRAE 90.1-2013 specific)[24]	0.50	0.50	0.50	0.50
Sales canopies: Free-standing and attached	0.60	0.60	0.80	1.00
Outdoor sales: Open areas	0.25	0.25	0.50	0.70
Building facades[25]	–	0.075	0.113	0.150

[22] IECC 2015 Table C405.5.1(2) and ANSI/ASHRAE/IESNA Standard 90.1-2013 Table 9.4.2-2. Differences between the two standards are noted.

[23] In June 2016, the Texas Comptroller issued a state certification letter adopting ASHRAE 90.1-2013 as the energy code for state buildings while the Commercial building code remains IECC 2015. State-funded buildings are required to submit SECO compliance certificates as part of the NC/Renovation process. More details can be found at the Comptroller website: https://comptroller.texas.gov/programs/seco/code/state-funded.php. This space type is missing from the IECC 2015 LPD table, but the TRM authorizes the use of these LPDs for non-state-funded buildings.

[24] Ibid.

[25] ASHRAE 90.1-2013 reflects a higher baseline. The TRM specifies the higher, more conservative, baseline to allow the same LPD to apply to all buildings, regardless of whether they are state-funded.

SpaceFacility type	LPDlighting power density (W/ft^2)			
	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4
Entrances and gatehouse inspection stations	0.75	0.75	0.75	0.75
Loading areas for emergency vehicles	0.50	0.50	0.50	0.50

The following default metal halide baseline wattage assumptions have been approved for exterior athletic fields and courts, which are not included in the above LPD table. These baseline wattages were derived based on a review of reported lumen range for available LED products and their reported equivalent metal halide (MH) wattage.

Table 7. Lamps & Fixtures—New Construction Baseline Wattages for Athletic Field/Court LEDs

Equivalent MH wattage	Number of lamps	LED rated lumen range
175	1	< 7,500
250	1	7,500-12,499
400	1	12,500-19,999
400	2	20,000-39,999
1,000	1	40,000-59,999
1,500	1	60,000-74,999
1,000	2	75,000-99,999
1,000	3	100,000-124,999
1,000	4	125,000-149,999
1,000	5	150,000-199,999
1,000	6 plus 1 additional lamp for every 50,000 lumens above 200,000 (rounded down)	> 200,000

Operating Hours (Hours) and Coincidence Factors (CFs)

Operating hours and peak demand coincidence factors are assigned by building type, as shown in Table 9 through Table 11. The building types used in this table are based on Commercial Buildings Energy Consumption Survey (CBECS)[26] building types but have been modified for Texas. Refer to Volume 1, Section 4 for a description of the Texas peak demand methodology. Winter peak coincidence factors are only specified for outdoor fixtures, including for the "Parking Garage" building type.

[26] DOE-EIA Commercial Building Energy Consumption Survey.

The operating hours and coincidence factors specified in this section have been calculated at the facility level and should be applied to the entire facility. Outdoor fixtures that are not associated with the typical building lighting schedule may be claimed separately. These can include parking lot, walkway, wall pack, or another lighting, while building-mounted lighting with an operating schedule that more closely approximates the interior lighting schedule typically should not be claimed separately.

Table 8. Lamps & Fixtures—Building Type Descriptions and Examples

Building type	Principal building activity	Definition	Detailed business type examples[27]
Agriculture	Dairy buildings	Buildings used to house dairy livestock and collect milk from dairy cows.	1) Dairy buildings
	Grow house	Buildings used to grow herbs, fruits, or vegetables under artificial lighting. Sole-source greenhouses rely on 100% artificial lighting, whereas supplemented greenhouses use both natural sunlight and artificial lighting.	1) 24-hour grow house 2) Non-24-hour sole-source greenhouse 3) Non-24-hour supplemented greenhouse
Data center	Data center	Buildings used to house computer systems and associated components.	1) Data center
Education	College/university	Buildings used for academic or technical classroom instruction, such as elementary, middle, or high schools, and classroom buildings on college or university campuses. Buildings on education campuses for which the main use is not classroom are included in the category relating to their use. For example, administration buildings are part of "Office," dormitories are "Lodging," and libraries are "Public Assembly."	1) College or university 2) Career or vocational training 3) Adult education
	Primary school		1) Elementary or middle school 2) Preschool or daycare
	Secondary school		1) High school 2) Religious education
Food sales	Convenience	Buildings used for retail or wholesale of food.	1) Gas station with a convenience store 2) Convenience store
	Supermarket		1) Grocery store or food market
Food service	Full-service restaurant	Buildings used for the preparation and sale of food and beverages for consumption.	1) Restaurant or cafeteria
	Quick-service restaurant		1) Fast food

[27] Principal Building Activities are based on sub-categories from 2003 CBECS questionnaire.

Building type	Principal building activity	Definition	Detailed business type examples[27]
Healthcare	Hospital	Buildings used as diagnostic and treatment facilities for inpatient care.	1) Hospital 2) Inpatient rehabilitation
	Outpatient healthcare	Buildings used as diagnostic and treatment facilities for outpatient care. Medical offices are included here if they use any type of diagnostic medical equipment (if they do not, they are categorized as an office building).	1) Medical office 2) Clinic or outpatient health care 3) Veterinarian
Multifamily	Common area	Buildings containing multifamily dwelling units, having multiple stories, and equipped with elevators.	1) Common area
Lodging	Large hotel	Buildings used to offer multiple accommodations for short-term or long-term residents.	1) Motel or inn 2) Hotel 3) Dormitory, fraternity, or sorority 4) Retirement home, nursing home, assisted living, or other residential care 5) Convent or monastery
	Nursing home		
	Small hotel/motel		

Building type	Principal building activity	Definition	Detailed business type examples[27]
Manufacturing	1 Shift (<70 hr/week)	Buildings used for manufacturing/industrial applications.	1) Apparel 2) Beverage, food, and tobacco products 3) Chemicals 4) Computer and electronic products 5) Appliances and components 6) Fabricated metal products 7) Furniture 8) Leather and allied products 9) Machinery 10) Nonmetallic mineral products 11) Paper 12) Petroleum and coal products 13) Plastics and rubber products 14) Primary metals 15) Printing and related support 16) Textile mills 17) Transportation equipment 18) Wood products
	2 Shift (70-120 hr/week)		
	3 Shift (>120 hr/week)		
Mercantile	Stand-alone retail	Buildings used for the sale and display of goods other than food.	1) Retail store 2) Beer, wine, or liquor store 3) Rental center 4) Dealership or showroom for vehicles or boats 5) Studio or gallery
	Strip mall/enclosed mall	Shopping malls comprised of multiple connected establishments.	1) Strip shopping center 2) Enclosed malls

Building type	Principal building activity	Definition	Detailed business type examples[27]
Office	Large office	Buildings used for general office space, professional office, or administrative offices. Medical offices are included here if they do not use any type of diagnostic medical equipment (if they do, they are categorized as an outpatient health care building).	1) Administrative or professional office 2) Government office 3) Mixed-use office 4) Bank or other financial institution 5) Medical office 6) Sales office 7) Contractor's office (e.g., construction, plumbing, HVAC) 8) Non-profit or social services 9) Research and development 10) City hall or city center 11) Religious office 12) Call center
	Medium office		
	Small office		
Parking	Parking garage	Buildings used for parking applications.	No sub-categories collected.

Building type	Principal building activity	Definition	Detailed business type examples[27]
Public assembly	Public assembly	Buildings in which people gather for social or recreational activities, whether in private or non-private meeting halls.	1) Social or meeting (e.g., community center, lodge, meeting hall, convention center, senior center) 2) Recreation (e.g., gymnasium, health club, bowling alley, ice rink, field house, indoor racquet sports) 3) Entertainment or culture (e.g., museum, theater, cinema, sports arena, casino, night club) 4) Library 5) Funeral home 6) Student activities center 7) Armory 8) Exhibition hall 9) Broadcasting studio 10) Transportation terminal
Public order and safety	Jail and prison	Government establishments engaged in justice, public order, and safety.	1) Correctional institutions 2) Prison administration and operation
	Other		1) Police protection 2) Legal counsel and prosecution 3) Fire protection 4) Public order and safety, not elsewhere classified
Religious worship	Religious worship	Buildings in which people gather for religious activities (such as chapels, churches, mosques, synagogues, and temples).	No sub-categories collected.

Building type	Principal building activity	Definition	Detailed business type examples[27]
Service	Service	Buildings in which some type of service is provided, other than food service or retail sales of goods.	1) Vehicle service or vehicle repair shop 2) Vehicle storage/maintenance 3) Repair shop 4) Dry cleaner or laundromat 5) Post office or postal center 6) Car wash 7) Gas station with no convenience store 8) Photo processing shop 9) Beauty parlor or barber shop 10) Tanning salon 11) Copy center or printing shop 12) Kennel
Warehouse	Warehouse	Buildings used to store goods, manufactured products, merchandise, raw materials, or personal belongings (such as self-storage).	1) Refrigerated warehouse 2) Non-refrigerated warehouse 3) Distribution or shipping center
Other	Other	For building types not explicitly listed.	Values used for other are the most conservative values from the explicitly listed building types.

Table 9. Lamps & Fixtures—Operating Hours by Building Type

Building type	Operating hours
Agriculture: Long-day lighting[28]	6,209
Agriculture: Non-24-hour sole-source greenhouse [29]	5,479
Agriculture: Non-24-hour supplemented greenhouse[30]	2,000
Data center	4,008
Education: K-12 with summer session, college, university, vocational, and day care	3,577
Education: K-12 with partial summer session[31]	3,177
Education: K-12 without summer session	2,777
Food Sales: Non-24-hour supermarket or convenience store	4,706
Food Sales: 24-hour supermarket or convenience store	6,900
Food service: Full-service restaurant	4,368
Food service: Quick-service restaurant	6,188
Food service: 24-hour restaurant	7,311
Health-care: Inpatient	5,730
Health-care: Outpatient	3,386
~~Health care: Resident care and nursing home~~	~~4,271~~
Lodging: Hotel/motel/dorm, common area	6,630
Lodging: Hotel/motel/dorm, room	3,055
Lodging: Nursing home	4,271
Manufacturing: 1 Shift (<70 hr/week)	2,786
Manufacturing: 2 Shift (70-120 hr/week)	5,188
Manufacturing: 3 Shift (>120 hr/week)	6,414
Mercantile: Non-24-hour stand-alone retail	3,668
Mercantile: Enclosed mall	4,813
Mercantile: Strip ~~center and non-enclosed~~ mall	3,965
Mercantile/food sales: 24-hour ~~stand-alone~~ retail~~, supermarket, or convenience store~~	6,900

[28] Daily operating hours are 17 hours/day based on assumptions from the Minnesota and Wisconsin TRMs and market research indicating average 16–18 hours of daily operation. Annual operating hours are derived by multiplying 17 hours/day by 365.25 days/year.

[29] Daily operating hours are 15 hours/day based on market research indicating 14-16 hours of daily operation. Annual operating hours are derived by multiplying 15 hours/day by 365.25 days/year.

[30] "Energy Savings Potential of SSL in Agricultural Applications," US Department of Energy. June 2020. Table E-1. https://www.energy.gov/sites/prod/files/2020/07/f76/ssl-agriculture-jun2020.pdf.

[31] Assuming a partial summer session in June with no summer session in July.

Building type	Operating hours
Multifamily: Common area	4,772
Office	3,737
Outdoor: Athletic field and court[32]	767
Outdoor: Billboard[33]	3,470
Outdoor: Dusk-to-dawn[34]	4,161
Outdoor: Less than dusk-to-dawn[35]	1,998
Parking garage	7,884
Public assembly	2,638
Public order and safety: Jail and prison	7,264
Public order and safety: Other	3,472
Religious worship	1,824
Service: Excluding food	3,406
Warehouse: Non-refrigerated	3,501
Warehouse: Refrigerated	3,798
Other	2,638

Table 10. Lamps & Fixtures—Summer Peak Coincidence Factors by Building Type[36]

Building type	Summer peak CF				
	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Agriculture: Long-day lighting	1.00	1.00	1.00	1.00	1.00
Agriculture: Non-24-hour sole-source greenhouse	1.00	1.00	1.00	1.00	1.00

[32] "2015 US Lighting Market Characterization," US Department of Energy. November 2017. Value derived by multiplying average daily operating hours from Table 2-30 by 365.25 hours/year.
[33] Ibid.
[34] This space type refers to fixtures controlled either by photocells or by timers operating on a dusk-to-dawn schedule. Calculated based on average dark hours for Amarillo (northernmost) and Corpus Christi (southernmost) climate zones from sunrise to sunset excluding ½ of civil twilight period. https://www.timeanddate.com/sun/. Note: pending update to US Naval Observatory annual data once website maintenance has completed. https://aa.usno.navy.mil/data/RS_OneYear.
[35] This space type refers to fixtures controlled by timers operating on a less than dusk-to-dawn schedule.
[36] Building operating schedules are adapted from COMNET Appendix C – Schedules (Rev. 3). https://comnet.org/appendix-c-schedules. Updated 7/25/2016.

Building type	Summer peak CF				
	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Agriculture: Non-24-hour supplemented greenhouse[37]	–	–	–	–	–
Data center	0.85	0.85	0.85	0.85	0.85
Education: K-12 with summer session, college, university, vocational, and day care	0.90	0.90	0.90	0.90	0.90
Education: K-12 with partial summer session[38]	0.42	0.39	0.90	0.90	0.57
Education: K-12 without summer session	0.39	0.39	0.90	0.87	0.40
Food sales: Non-24-hour supermarket or convenience ~~Store~~store	0.90	0.90	0.90	0.90	0.90
Food sales: 24-hour supermarket or convenience store	0.90	0.90	0.90	0.90	0.90
Food service: Full-service restaurant	0.90	0.90	0.90	0.90	0.90
Food service: Quick-service restaurant	0.90	0.90	0.90	0.90	0.90
Food service: 24-hour restaurant	0.90	0.90	0.90	0.90	0.90
Health-care: Inpatient	0.80	0.83	0.81	0.80	0.90
Health-care: Outpatient	0.70	0.75	0.72	0.71	0.90
~~Health care: Resident care and nursing home~~	~~0.70~~	~~0.75~~	~~0.72~~	~~0.71~~	~~0.90~~
Lodging: Hotel/motel/dorm, common area	0.90	0.90	0.90	0.90	0.90
Lodging: Hotel/motel/dorm, room	0.30	0.30	0.30	0.30	0.30
Lodging: Nursing home	0.70	0.75	0.72	0.71	0.90
Mercantile: Non-24-hour retail ~~excluding mall and strip~~	0.90	0.90	0.90	0.90	0.90
Mercantile: Enclosed mall	0.90	0.90	0.90	0.90	0.90

[37] Assuming no peak coincidence because these fixtures are often operated exclusively during off-peak hours (ranging from 10 PM to 6 AM). This time range is not coincident with either the Texas summer or winter peak periods.

[38] Assuming a partial summer session in June with no summer session in July.

Building type	Summer peak CF				
	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Mercantile: Strip ~~center and non-enclosed~~ mall	0.90	0.90	0.90	0.90	0.90
Mercantile/food sales: 24-hour ~~stand-alone~~ retail~~, supermarket, or convenience store~~	0.90	0.90	0.90	0.90	0.90
Manufacturing: 1 Shift (<70 hr/week)	0.83	0.84	0.83	0.85	0.85
Manufacturing: 2 Shift (70-120 hr/week)	0.85	0.85	0.85	0.85	0.85
Manufacturing: 3 Shift (>120 hr/week)	0.85	0.85	0.85	0.85	0.85
Multifamily: Common area	0.90	0.90	0.90	0.90	0.90
Office	0.87	0.88	0.86	0.90	0.90
Outdoor: Athletic field and court	–	–	–	–	–
Outdoor: Billboard	–	–	–	–	–
Outdoor: Dusk-to-dawn	–	–	–	–	–
Outdoor: Less than dusk-to-dawn	–	–	–	–	–
Parking garage	1.00	1.00	1.00	1.00	1.00
Public assembly	0.65	0.65	0.65	0.65	0.65
Public order and safety: Jail and prison	0.90	0.90	0.90	0.90	0.90
Public order and safety: Other	0.70	0.75	0.72	0.71	0.90
Religious worship	0.65	0.65	0.65	0.65	0.65
Service: Excluding food	0.90	0.90	0.90	0.90	0.90
Warehouse: Non-refrigerated	0.79	0.81	0.79	0.80	0.85
Warehouse: Refrigerated	0.79	0.81	0.79	0.80	0.85
Other	0.65	0.65	0.65	0.65	0.65

Table 11. Lamps & Fixtures—Winter Peak Coincidence Factors by Building Type[39]

Space type	Winter peak CF				
	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Outdoor: Athletic field and court	0.26	0.27	0.24	0.29	0.38
Outdoor: Billboards	0.59	0.62	0.53	0.65	0.87
Outdoor: Dusk-to-dawn[40]	0.67	0.71	0.61	0.75	1.00
Outdoor: Less than dusk-to-dawn[41]	0.67	0.71	0.61	0.75	1.00
Parking garage	1.00	1.00	1.00	1.00	1.00

Building Type Selection

This section provides additional guidance on Recommendation #1b in the 2013 Statewide Annual Portfolio Evaluation Report.[42]

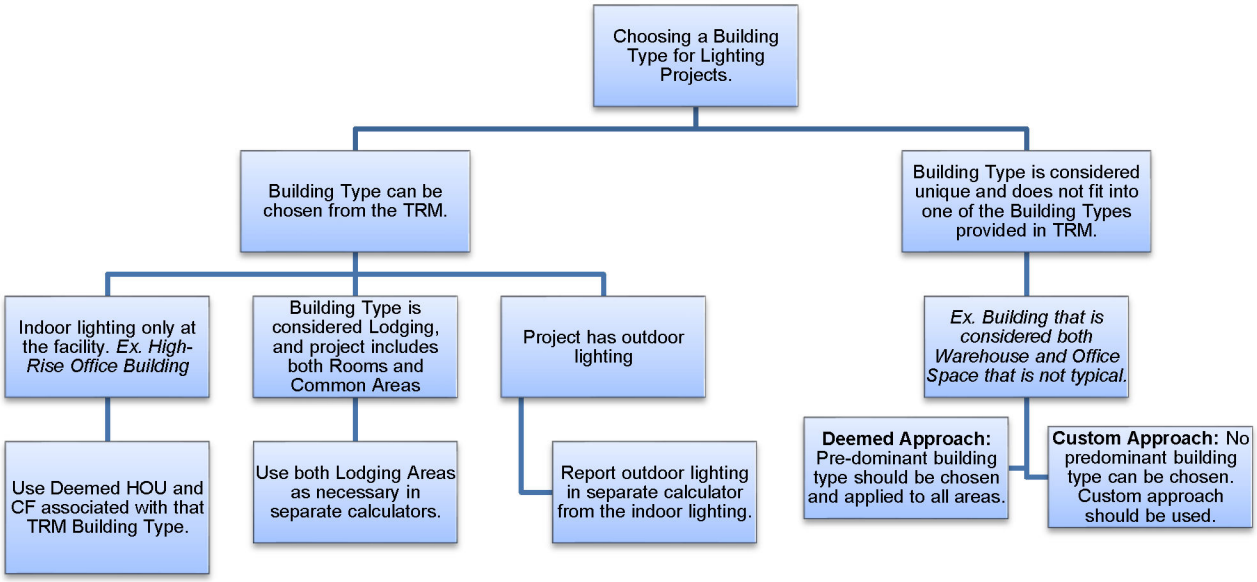
The deemed lighting hours of use (HOU) and peak summer coincidence factors (CF) for utilities to use in calculating savings associated with lighting are broken down by building type and use. If the building type changes in combination with the retrofit, the selected building type should be consistent with the space condition after improvement. These values are provided in Table 9 through Table 11. For the majority of the building types listed in this table, the HOU and CFs were created based on weighted averages of lighting usage across all activity areas of the building.[43] Therefore, the deemed HOU and CFs are representative of an entire building type, across all activity areas that are in a "typical" building for this type.

The following flow chart,

Figure 2, has been provided to assist utilities in understanding how they can use the deemed methods to calculate lighting savings based on HOU and CF provided in the TRM. Additionally, it provides guidance on how to treat lodging facilities and outdoor lighting projects as well as unique building types.

Figure 2. Lamps & Fixtures—Building Type Decision-Making

[39] Operating schedules are based on sunrise/sunset times for each climate-zone reference city, adjusted for compliance with IESNA-DG-13-96 and IESNA-DG-13-98 recommendations.
[40] This space type refers to fixtures controlled either by photocells or by timers operating on a dusk-to-dawn schedule.
[41] This space type refers to fixtures controlled by timers operating on a less than dusk-to-dawn schedule.
[42] *Annual Statewide Portfolio Report for Program Year 2013 – Volume I*. Prepared for the Public Utility Commission of Texas. October 6, 2014.
[43] More information on how these values were created can be found in PUCT Docket #39146.



Lodging sites. Lodging facilities (Hotel/Motel/Dormitories) have been identified in the TRM by *Common* and *Rooms*, both with different HOU and CF. As two different values have been provided for these areas, it is acceptable for the utilities to use either or both building types for a single project.

Exterior lighting. Projects involving outdoor lighting should be claimed in a separate calculator or separate inventory within the same calculator. The exception to this is walkway lighting that is more consistent with building operation. In this application, the utilities should use the primary building type as their HOU and CFs have been rolled up into the overall building type calculations (e.g., walkway lighting between two buildings that operates during business hours).

Combination building types. In situations where multiple TRM building types seem plausible, or a predominant TRM building type is unclear, the utilities have two choices:

- **Deemed approach.** The deemed approach is a simplified method where utilities should choose a TRM building type based on the "best fit" for the facility. For interior spaces, this is determined by the largest interior area for the potential building types. Although, if that is not best fit, the utilities will use their best judgment to make this decision and provide sufficient, defensible documentation for their decision.

  The *manufacturing* building type is specified with 1-, 2-, and 3-shift options:

  - Shift 1: Typical operation of 9.5-11.5 hours per day and 4-6 days per week (<70 hours per week)
  - Shift 2: Typical operation of 18-20 hours per day and 5-6 days per week (70–120 hours per week)
  - Shift 3: Typical operation of 24 hours per day and 5-6 days per week (>120 hours per week)

The following building type combinations are pre-authorized exceptions to this rule. For these combinations, individual fixtures can be reported as either specified building type based on location. All other interior space combinations should reference a single deemed building type unless authorized by the evaluator.

- Office: Warehouse (refrigerated or non-refrigerated)
- Office: Manufacturing (any shift number)
- Manufacturing (buildings with different shift designations by area)
- Inpatient healthcare: Outpatient healthcare
- Lodging, common areas: Lodging, rooms

The *other* building type can be used for business types that are not explicitly listed. The hours and CF values used for other are the most conservative from the explicitly listed building types (with the exception of the CF values specified for "Education: K-12 without Summer Session" and "Lodging: Hotel/Motel/Dorm, Common Areas", which are associated with very specific operating schedules that experience low coincidence with the summer peak period). When the Other building type is used, a description of the actual building type, the primary business activity, the business hours, and the lighting schedule must be collected for the project site and stored in the utility tracking data system.

"Outdoor Dusk-to-Dawn" applies to outdoor fixtures controlled by a photocell or timer with dusk-to-dawn operation throughout the entire year. Outdoor fixtures controlled by timers with less than dusk-to-dawn operation (excluding athletic fields and courts) may be claimed separately using the "Outdoor Less than Dusk-to-Dawn" building type or using a custom timer schedule.

Exterior spaces may reference multiple outdoor building types differentiated based on typical operating schedules (Outdoor Dusk-to-Dawn, Less than Dusk-to-Dawn, Athletic, or Billboard).

- **Custom approach.** In more unique situations, utilities should consider projects "custom" where (1) the deemed building types in the TRM may not represent the project's facility type, (2) the facility may represent multiple TRM building types without a clear predominant building type, or (3) the use of a predominant building type may be too conservative in the estimate of savings. The deemed methods only apply to specific scenarios and cannot be developed for all unique situations. Utilities should provide sufficient, defensible documentation for their HOU and CF values used in their savings calculations that the EM&V team can review.

Interactive HVAC Factors (HVAC Energy, Demand)

Basic lighting savings are adjusted to account for the lighting system interaction with HVAC systems in conditioned or refrigerated spaces. A reduced lighting load reduces the internal heat gain to the building, which reduces the air conditioning/cooling load while increasing the heating load. Currently, the TRM only considers additional cooling savings, and the heating penalty or increase in usage is ignored.

As Table 12 shows, four conditioned space types are used for the Texas programs: single air-conditioned space type, two options for commercial refrigeration, and refrigerated warehouses: medium and low temperature. Utility procedures state that if the actual application falls between these values, the higher temperature value should be used. The final space type is unconditioned (or more explicitly uncooled as the focus is on cooling). In the lighting calculators, these values are typically assigned at the line-item level based on the conditioning type for the space in which the fixtures are located.

Table 12. Lamps & Fixtures—Deemed Energy and Demand Interactive HVAC Factors[44]

Space conditioning type	Energy interactive HVAC factor	Demand interactive HVAC factor
Refrigerated air	1.05	1.10
Evaporative cooling[45]	1.02	1.04
Medium-temperature refrigeration (33 to 41ºF)	1.25	1.25
Low-temperature refrigeration (-10 to 10ºF)	1.30	1.30
None (unconditioned/uncooled)	1.00	1.00

Upstream/Midstream Lighting

This section provides guidance on calculating and allocating savings at the sector-level for upstream/midstream lighting programs.

An increased number of utilities are offering or planning to offer upstream and/or midstream lighting programs in Texas. It is important that savings are calculated and reported consistently across utilities and in agreement with industry-standard practice and the Energy Efficiency Rule 16 TAC § 25.181.

Upstream/Midstream Program Assumptions

For upstream/midstream program delivery, use the following AOH and CF assumptions specified by lamp type. Assumed AOH and CF values have been weighted based on building type survey data from 2012 CBECS[46] and 2014 MECS[47] as well as lamp density and lamp type distribution survey data from the DOE 2015 US Lighting Market Characterization (LMC)[48].

[44] PUCT Docket 39146. Table 7 (page 17) and Table 12 (page 24).
[45] These factors are only applicable for projects in climate zones 1 and 5. They are derived by taking a ratio of total HVAC energy use for spaces with evaporative and refrigerated cooling then applying that ratio against the IEF factors specified for refrigerated air.
[46] 2012 Commercial Building Energy Consumption Survey (CBECS). https://www.eia.gov/consumption/commercial/. 2018 version not available until mid-2020.
[47] 2014 Manufacturing Energy Consumption Survey (MECS). https://www.eia.gov/consumption/manufacturing/.
[48] 2015 US Lighting Market Characterization, Department of Energy. November 2017. https://www.energy.gov/sites/prod/files/2017/12/f46/lmc2015_nov17.pdf.

All general service, decorative, and reflector lamps with an equivalent wattage of 100 W or lower distributed though upstream or midstream programs should calculate savings using a combination of residential and non-residential savings methodologies with 95 percent of savings allocated to the residential sector and the remaining 5 percent of savings allocated to the commercial sector.[49] While only summer demand savings are specified for the commercial sector, winter demand savings are allowed for the portion of savings allocated to the residential sector.

Table 13. Lamps & Fixtures—Upstream/Midstream Input Assumptions by Lamp Type[50]

Lamp type	AOH	Coincidence factors[51]					ISR
		Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso	
General service lamp	3,748	0.69	0.69	0.73	0.73	0.71	0.98
Directional/reflector	3,774	0.78	0.79	0.78	0.79	0.82	1.00
LED tube	3,522	0.74	0.75	0.84	0.84	0.76	1.00
High-bay fixture	3,796	0.78	0.79	0.83	0.84	0.80	1.00
Garage	7,884	1.00	1.00	1.00	1.00	1.00	1.00
Outdoor	4,161	0.67	0.71	0.61	0.75	1.00	1.00

Additionally, baseline wattage for ENERGY STAR-qualified products is assumed to be equal to the equivalent wattage from the ENERGY STAR certification. Baseline wattage assumptions for DLC- and third-party-qualified products should be determined based on product technical specifications and/or delivered light output (lumens) and detailed in the program qualified product listing.

Deemed Energy and Demand Savings Tables

This section is not applicable as these calculations are entirely dependent on site-specific parameters related to lighting system operation.

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

[49] Weighting assumptions based on statewide evaluator review of LED purchasing behavior for similar program designs.
[50] 2012 CBECS and 2014 MECS.
[51] Outdoor coincidence factors are specified for winter peak. All other values reference summer peak.

Measure Life and Lifetime Savings

The estimated useful life (EUL) values are defined for the following lamp/fixture types.[52] A separate new construction EUL has been established due to account for the whole-building baseline.

- Halogen lamps: 1.5 years
- High-intensity discharge lamps: 15 years
- Integrated-ballast CCFL lamps: 4.5 years
- Integrated-ballast CFL lamps: 2.5 years
- Integral LED lamps: 9 years[53]
- LED fixtures: 15 years
- LED corn cob lamps: 15 years
- LED tubes: 15 years
- Solar LEDs[54]: 10 years
- Modular CFL and CCFL fixtures: 15 years
- T8 and T5 linear fluorescents: 15 years
- New construction interior fixtures/controls[55]: 14 years
- New construction exterior fixtures[56]: 15 years

Program Tracking Data and Evaluation Requirements

The below list of primary inputs and contextual data should be specified and tracked by the program database to inform the evaluation and apply the savings properly.

- Decision/action type: retrofit or new construction
- Building or space type
- Optional: building or space funding source (state or private)
- **For new construction only:**

[52] PUCT Docket 36779.
[53] PUCT Docket 38023.
[54] The typical solar battery life is approximately 5–15 years. A typical product warranty for a solar LED fixture is 10 years. This deemed EUL aligns with the average product life expectancy and typical warranty period.
[55] Based on review of new construction EULs claimed by Oncor and CenterPoint during the PY 2019 and 2020 weighted by energy savings.
[56] Ibid.

- ~~light power density~~ LPD factor
- Interior and/or exterior lighting schedules and plans
- Interior and/or exterior space areas and distances
- If applicable, verify whether SECO compliance certification forms were filed[57]

- ~~**For new construction only:** interior and/or exterior space square footage~~
- ~~**For new construction only:** if applicable, verify if SECO compliance certification forms were filed[58]~~
- Conditioned space type: cooling equipment type, refrigerated space temperature range, heating fuel type, percent heated/cooled for NC Only (specified per control)
- Baseline fixture configuration
- Baseline lamp wattage
- Baseline ballast type
- Baseline lighting controls
- Baseline counts of operating fixtures
- Baseline counts of inoperable fixtures
- Post-retrofit manufacturer and model number[59]
- Post-retrofit fixture configuration
- Post-retrofit lamp wattage[60]
- Post-retrofit lamp specifications sheets: Post retrofit lamp product qualification information from DLC, ENERGY STAR®, or independent lab testing
- Post-retrofit ballast type
- Post-retrofit lighting controls
- Post-retrofit counts of operating fixtures

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[57] State-funded buildings are required to submit SECO compliance forms as part of the NC/renovation process. Buildings that submit SECO compliance forms are considered state-funded and must meet the provisions of ASHRAE 90.1-2013 rather than IECC 2015. Previous tables in this section present the alternative compliance values where they are encountered in the codes.

[58] ~~State-funded buildings are required to submit SECO compliance forms as part of the NC/renovation process. Buildings that submit SECO compliance forms are considered state-funded and must meet the provisions of ASHRAE 90.1-2013 rather than IECC 2015. Previous tables in this section present the alternative compliance values where they are encountered in the codes.~~

[59] See Eligibility Criteria section for additional information and exceptions related to reporting post-retrofit model number.

[60] See Eligibility Criteria section for additional information and exceptions related to reporting post-retrofit fixture wattage.