	Open motors: $\eta_{baseline, ROB}$			Closed motors: $\eta_{baseline, ROB}$		
hp	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0
200	95.4	95.8	95.0	95.8	96.2	95.4
250	95.8	95.8	94.0	95.8	96.2	95.8
300	95.8	95.8	95.4	95.8	96.2	95.8
350	95.8	95.8	95.4	95.8	96.2	95.8
400	–	95.8	95.8	–	96.2	95.8
450	–	96.2	96.2	–	96.2	95.8
500	–	96.2	96.22	–	96.22	95.8

Early Retirement

Annual energy (kWh) and peak demand (kW) savings must be calculated separately for two time periods:

1. The estimated remaining life of the equipment that is being removed, designated the remaining useful life (RUL), and
2. The remaining time in the EUL period (EUL – RUL)

Annual energy and peak demand savings are calculated by weighting the early retirement and replace-on-burnout savings by the RUL of the unit and the remainder of the EUL period, as outlined in the Volume 3 appendices.

Where:

RUL	=	*Remaining useful life (see Table 302); if unknown, assume the age of the replaced unit is equal to the EUL resulting in a default RUL of 2.0 years*
EUL	=	*Estimated useful life = 15 years*

Table 302. Premium Motors—RUL of Early Retirement Motors[588]

Age of replaced motor (years)	RUL (years)	Age of replaced motor (years)	RUL (years)
1	13.9	10	5.0
2	12.9	11	4.2
3	11.9	12	3.6
4	10.9	13	3.0
5	9.9	14	2.5
6	8.9	15	2.0
7	7.9	16	1.0
8	6.9	17[589]	0.0
9	5.9		

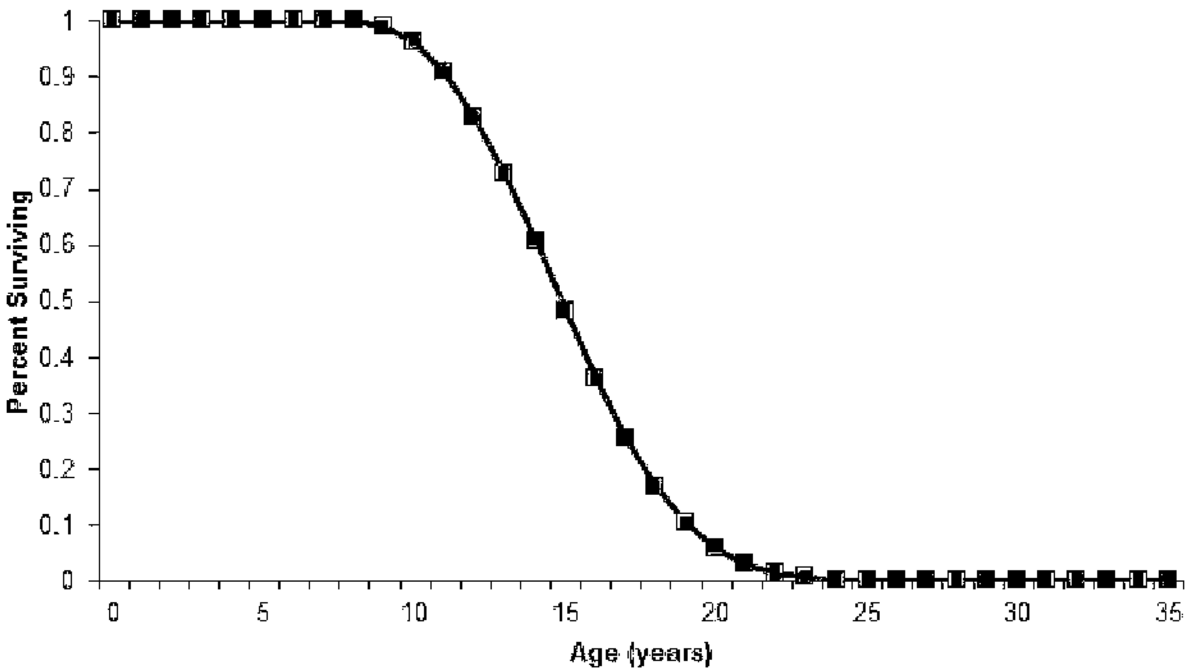
Derivation of RULs

Premium Efficiency Motors have an estimated useful life of 15 years. This estimate is consistent with the age at which approximately 50 percent of the motors installed in a given year will no longer be in service, as described by the survival function for a general fan or air compressor application in Figure 7.

588 Current federal standard effective date is 12/19/2010. Existing systems manufactured after this date are not eligible to use the early retirement baseline and should use the ROB baseline instead.

589 RULs are capped at the 75th percentile of equipment age, 17 years, as determined based on DOE survival curves (see Figure 7). Systems older than 17 years should use the ROB baseline. See the January 2015 memo, "Considerations for early replacement of residential equipment," for further detail.

Figure 7. Premium Motors—Survival Function for Premium Efficiency Motors[590]



The method to estimate the remaining useful life (RUL) of a replaced system uses the age of the existing system to re-estimate the projected unit lifetime based on the survival function shown in Figure 7. The age of the motor being replaced is found on the horizontal axis, and the corresponding percentage of surviving motors is determined from the chart. The surviving percentage value is then divided in half, creating a new estimated useful lifetime applicable to the current unit age. Then, the age (year) that corresponds to this new percentage is read from the chart. RUL is estimated as the difference between that age and the current age of the system being replaced.

For example, assume a motor being replaced is 15 years old (the estimated useful life). The corresponding percent surviving value is approximately 50 percent. Half of 50 percent is 25 percent. The age corresponding to 25 percent on the chart is approximately 17 years. Therefore, the RUL of the motor being replaced is (17 – 15) = 2 years.

Energy Savings Algorithms

For the RUL time period:

$$kWh_{savings,RUL} = hp \times 0.746 \times LF \times \left(\frac{1}{\eta_{baseline,ER}} - \frac{1}{\eta_{post}}\right) \times Hrs$$

Equation 266

[590] Department of Energy, Federal Register, 76 Final Rule 57516, Technical Support Document: 8.2.3.1 Estimated Survival Function. September 15, 2011. http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/refrig_finalrule_tsd.pdf.

For the remaining time in the EUL period, calculate annual savings as you would for a replace-on-burnout project.

$$kWh_{savings,EUL} = hp \times 0.746 \times LF \times \left(\frac{1}{\eta_{baseline,ROB}} - \frac{1}{\eta_{post}}\right) \times Hrs$$

Equation 267

It follows that total lifetime energy savings for early retirement projects are then determined by adding the savings calculated under the two preceding equations:

$$kWh_{savings,ER} = kWh_{savings,RUL} \times RUL + kWh_{savings,EUL} \times (EUL - RUL)$$

Equation 268

Demand Savings Algorithms

To calculate demand savings for the early retirement of a motor, a similar methodology is used as for replace-on-burnout installations, with separate savings calculated for the remaining useful life of the unit, and the remainder of the EUL as outlined in the section above.

For the RUL time period:

HVAC Applications

$$kW_{savings,RUL} = \frac{kWh_{savings,RUL}}{Hrs} \times CF$$

Equation 269

Industrial Applications

$$kW_{savings,RUL} = \frac{kWh_{savings,RUL}}{8{,}760\ hours}$$

Equation 270

For the remaining time in the EUL period., calculate annual savings as you would for a replace-on-burnout project:

HVAC Applications

$$kW_{savings,EUL} = \frac{kWh_{savings,EUL}}{Hrs} \times CF$$

Equation 271

Industrial Applications

$$kW_{savings,EUL} = \frac{kWh_{savings,EUL}}{8{,}760\ hours}$$

Equation 272

Annual deemed peak demand savings are calculated by weighting the early retirement and replace-on-burnout savings by the RUL of the unit and the remainder of the EUL period, as outlined in the Volume 3 appendices.

$$kW_{savings,ER} = kW_{savings,RUL} \times RUL + kW_{savings,EUL} \times (EUL - RUL)$$

Equation 273

Where:

$\eta_{baseline,ER}$ = *Assumed original motor efficiency for remaining EUL time period (Table 303 or Table 304)*[591]

$kWh_{savings,RUL}$ = *Energy savings for RUL time period in an ER project*

$kWh_{savings,EUL}$ = *Energy savings for remaining EUL time period in an ER project*

$kW_{savings,RUL}$ = *Demand savings for RUL time period in an ER project*

$kW_{savings,EUL}$ = *Demand savings for remaining EUL time period in an ER project*

$kWh_{savings,ER}$ = *Total energy savings for an ER project*

$kW_{savings,ER}$ = *Total demand savings for an ER project*

Table 303. Premium Motors—ER Baseline Efficiencies by Motor Size (%)[578,592]

	Open motors: $\eta_{baseline,ER}$			Closed motors: $\eta_{baseline,ER}$		
hp	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
1	80.0	82.5	75.5	80.0	82.5	75.5
1.5	84.0	84.0	82.5	85.5	84.0	82.5
2	85.5	84.0	84.0	86.5	84.0	84.0
3	86.5	86.5	84.0	87.5	87.5	85.5
5	87.5	87.5	85.5	87.5	87.5	87.5
7.5	88.5	88.5	87.5	89.5	89.5	88.5
10	90.2	89.5	88.5	89.5	89.5	89.5
15	90.2	91.0	89.5	90.2	91.0	90.2
20	91.0	91.0	90.2	90.2	91.0	90.2
25	91.7	91.7	91.0	91.7	92.4	91.0
30	92.4	92.4	91.0	91.7	92.4	91.0
40	93.0	93.0	91.7	93.0	93.0	91.7

591 Ibid.
592 For unlisted motor horsepower values, round down to the next lowest horsepower value.

hp	Open motors: $\eta_{baseline, ER}$			Closed motors: $\eta_{baseline, ER}$		
	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
50	93.0	93.0	92.4	93.0	93.0	92.4
60	93.6	93.6	93.0	93.6	93.6	93.0
75	93.6	94.1	93.0	93.6	94.1	93.0
100	94.1	94.1	93.0	94.1	94.5	93.6
125	94.1	94.5	93.6	94.1	94.5	94.5
150	94.5	95.0	93.6	95.0	95.0	94.5
200	94.5	95.0	94.5	95.0	95.0	95.0
250	95.4	95.4	94.5	95.0	95.0	95.4
300	95.4	95.4	95.0	95.0	95.4	95.4
350	95.4	95.4	95.0	95.0	95.4	95.4
400	–	95.4	95.4	–	95.4	95.4
450	–	95.8	95.8	–	95.4	95.4
500	–	95.8	95.8	–	95.8	95.4

Table 304. Premium Motors—ER Baseline Efficiencies by Motor Size for 250-500 hp Motors Manufactured Prior to June 1, 2016 (%)[593,594]

hp	Open motors: $\eta_{baseline, ER}$			Closed motors: $\eta_{baseline, ER}$		
	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
250	95.4	95.4	94.5	95.0	95.0	95.4
300	95.4	95.4	95.0	95.0	95.4	95.4
350	95.4	95.4	95.0	95.0	95.4	95.4
400	–	95.4	95.4	–	95.4	95.4
450	–	95.8	95.8	–	95.4	95.4
500	–	95.8	95.8	–	95.8	95.4

Deemed Energy and Demand Savings Tables

Not applicable.

593 Federal Standards for Electric Motors, Table 4.

594 For unlisted motor horsepower values, round down to the next lowest horsepower value.

Claimed Peak Demand Savings

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

Measure Life and Lifetime Savings

The estimated useful life (EUL) is 15 years.[595]

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:

- Unit quantity
- The project type of the installation (new construction, replace-on-burnout, or early retirement)
- Horsepower
- Estimated annual operating hours and estimated load factor
- Number of poles in and horsepower of original motor
- Newly-installed motor efficiency (%)
- Description of motor service application
- Photograph demonstrating functionality of existing equipment and/or customer responses to survey questionnaire documenting the condition of the replaced unit and their motivation for measure replacement for early retirement eligibility determination (early retirement only)

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.

[595] US DOE, Technical Support Document, "Energy Efficiency Program for Commercial Equipment: Energy Conservation Standards for Electric Motors", Median of "Table 8.2.23 Average Application Lifetime". Download TSD at: https://www.mercatus.org/system/files/1904-AC28-TSD-Electric-Motors.pdf

Document Revision History

Table 305. Premium Motors—Revision History

TRM version	Date	Description of change
v7.0	10/2019	TRM v7.0 origin.
v8.0	10/2020	TRM v8.0 update. General reference checks and text edits. Replace-on-burnout and Early Retirement clarifications.
v9.0	10/2021	TRM v9.0 update. General reference checks and text edits.
v10.0	10/2022	TRM v10.0 update. Added guidance for rounding down motor size in the baseline efficiency lookup table. Incremented RUL table for code compliance.
v11.0	10/2023	TRM v11.0 update. Aligned building type names across all commercial measures. Incremented RUL table for code compliance.
v12.0	10/2024	TRM v12.0 update. Updated early retirement age eligibility.

2.7.4 Pump-Off Controllers Measure Overview

TRM Measure ID: NR-MS-PC

Market Sector: Commercial

Measure Category: Controls

Applicable Building Types: Industrial

Fuels Affected: Electricity

Decision/Action Type: Retrofit

Program Delivery Type: Prescriptive

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Field study, engineering algorithms, and estimates

Measure Description

Pump-off controllers (POC) are micro-processor-based devices that continuously monitor pump down conditions (i.e., when the fluid in the well bore is insufficient to warrant continued pumping). These controllers are used to shut down the pump when the fluid falls below a certain level and “fluid pounding”[596] occurs. POCs save energy by optimizing the pump run-times to match the flow conditions of the well.

Eligibility Criteria

The POC measure is only available as a retrofit measure for existing wells (wells with an existing API number[597] prior to September 11th, 2014) with rod pumps using 15 hp or larger motors operating on time clock controls or less efficient devices. These cannot be integrated with a variable frequency drive and only apply to POCs using load cells, which measure the weight on the rod string for greater precision. Additionally, the POC must control a *conventional* well (above ground or vertical, with a standard induction motor of 480V or less).

Baseline Condition

The baseline condition is an existing conventional well (with an API number prior to September 11, 2014) with rod pumps operating on time clock controls or less efficient control devices.

[596] Fluid pounding occurs when the downhole pump rate exceeds the production rate of the formation. The pump strikes the top of the fluid column on the down stroke causing extreme shock loading of the components which can result in premature equipment failure.

[597] The API number is a unique, permanent identifier assigned by the American Petroleum Institute. The API number should correspond to a well that was in existence prior to the date of PUCT Docket 42551.

High-Efficiency Condition

The efficient condition is the same well, retrofitted with a pump-off controller.

Energy and Demand Savings Methodology

Two main sources were referenced to develop the savings methods for the POC measure: *Electrical Savings in Oil Production*[598] (SPE 16363), which identified a relationship between volumetric efficiency and pump run times and the *2006-2008 Evaluation Report for PG&E Fabrication, Process, and Manufacturing Contract Group,*[599] which showed a reduction in savings from the SPE 16363 paper. These two methods were the basis of the current savings calculations and deemed inputs listed below. To develop Texas-specific stipulated values, field and metering data will be collected when there is sufficient uptake in the measure and used to calibrate and update the savings calculation methods and input variables for a future version of the TRM.[600]

Savings Algorithms and Inputs

The energy and demand algorithms and associated input variables are listed below:

$$Energy\ Savings\ [\Delta kWh] = kW_{avg} \times (TimeClock\%On - POC\%On) \times 8{,}760$$

Equation 274

$$Demand\ Savings\ [\Delta kW] = \frac{kWh_{savings}}{8{,}760}$$

Equation 275[601]

The inputs for the energy and peak coincident demand savings are listed below:

$$kW_{avg} = HP \times 0.746 \times \frac{\frac{LF}{ME}}{SME}$$

Equation 276

[598] Bullock, J.E. "SPE 16363 *Electrical Savings in Oil Production*", (paper presented at the Society of Petroleum Engineers California Regional Meeting held in Ventura, California, April 8-10, 1987).

[599] *2006-2008 Evaluation Report for PG&E Fabrication, Process and Manufacturing Contract Group.* CALMAC Study ID: CPU0017.01. Itron, Inc. Submitted to California Public Utilities Commission. February 3, 2010.

[600] The EM&V Team will work with SPS/Xcel Energy in developing the sample plan for the field data collection effort.

[601] The equations in the petition for peak demand simplify to the equation shown.

$$POC\%On = \frac{Run_{Constant} + Run_{Coefficient} \times VolumetricEfficiency\% \times TimeClock\%On \times 100}{100}$$

Equation 277[602]

Where:

kW_{avg}	=	*The demand used by each rod pump*
HP	=	*Rated pump-motor horsepower*
0.746	=	*Constant to convert from hp to kW*
LF	=	*Motor load factor—ratio of average demand to maximum demand (see Table 306)*
ME	=	*Motor efficiency, based on NEMA Standard Efficiency Motor (see Table 307)*
SME	=	*Mechanical efficiency of sucker-rod pump (see Table 306)*
Time Clock%On	=	*Stipulated-baseline time clock setting (see Table 306)*
$Run_{constant}$, $Run_{coefficient}$	=	*8.336, 0.956, derived from SPE 16363* [603]
VolumetricEfficiency%	=	*Average well gross production divided by theoretical production (provided on rebate application)*
8,760	=	*Total hours per year*

[602] This equation from the petition deviates from that in SPE 16363 but will provide conservative savings estimates. The equation will be updated and made consistent when this measure is updated with field data. The correct equation term is ($Run_{contstant}$ + $Run_{coefficient}$ x VolumetricEfficiency%) with the volumetric efficiency expressed as percent value not a fraction (i.e., 25 not 0.25 for 25 percent).

[603] Bullock, J.E. "SPE 16363 Electrical Savings in Oil Production, (paper presented at the Society of Petroleum Engineers California Regional Meeting held in Ventura, California, April 8-10, 1987).

Deemed Energy and Demand Savings Tables

Table 306. Pump-Off Controllers—Savings Calculation Input Assumptions

Variable	Stipulated/deemed values
LF (Load factor)	25%[604]
ME (motor efficiency)	See Table 2-137
SME (pump mechanical efficiency)	95%[605]
Time clock%On	65%[606]

Table 307. Pump-Off Controllers—NEMA Premium Efficiency Motor Efficiencies[607]

Motor horsepower	Nominal full-load efficiency					
	Open motors (ODP)			Enclosed motors (TEFC)		
	6 poles	4 poles	2 poles	6 poles	4 poles	2 poles
	1200 rpm	1800 rpm	3600 rpm	1200 rpm	1800 rpm	3600 rpm
15	91.7%	93.0%	90.2%	91.7%	92.4%	91.0%
20	92.4%	93.0%	91.0%	91.7%	93.0%	91.0%
25	93.0%	93.6%	91.7%	93.0%	93.6%	91.7%
30	93.6%	94.1%	91.7%	93.0%	93.6%	91.7%
40	94.1%	94.1%	92.4%	94.1%	94.1%	92.4%
50	94.1%	94.5%	93.0%	94.1%	94.5%	93.0%
60	94.5%	95.0%	93.6%	94.5%	95.0%	93.6%
75	94.5%	95.0%	93.6%	94.5%	95.4%	93.6%
100	95.0%	95.4%	93.6%	95.0%	95.4%	94.1%
125	95.0%	95.4%	94.1%	95.0%	95.4%	95.0%
150	95.4%	95.8%	94.1%	95.8%	95.8%	95.0%
200	95.4%	95.8%	95.0%	95.8%	96.2%	95.4%

604 Comprehensive Process and Impact Evaluation of the (Xcel Energy) Colorado Motor and Drive Efficiency Program, FINAL. Tetra Tech. March 28, 2011. Adjusted based on Field Measurements provided by ADM Associates, based on 2010 custom projects.

605 Engineering estimate for standard gearbox efficiency.

606 A Time Clock%On of 80 percent is typical from observations in other jurisdictions, but that was adjusted to 65 percent for a conservative estimate. This value will be reevaluated once Texas field data is available.

607 DOE Final Rule regarding energy conservation standards for electric motors. 79 FR 30933. Full-load Efficiencies for General Purpose Electric Motors [Subtype I] https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=6&action=viewlive.

Claimed Peak Demand Savings

Because the operation of the POC coincident with the peak demand period is uncertain, a simple average of the total savings over the full year (8,760 hours) is used, as shown in Equation 275.

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

Measure Life and Lifetime Savings

The estimated useful life (EUL) is 15 years.[608]

Program Tracking Data and Evaluation Requirements

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

- Motor manufacturer
- Motor model number
- Rated motor horsepower
- Motor type (TEFC or ODP)
- Rated motor RPM
- Baseline control type and time clock percent on time (or actual on-time schedule)
- Volumetric efficiency
- Field data on actual energy use and post-run times[609]

References and Efficiency Standards

Petitions and Rulings

- PUCT Docket 42551—Provides energy and demand savings calculations and EUL

Relevant Standards and Reference Sources

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

[608] CPUC 2006-2008 Industrial Impact Evaluation "SCIA_06-08_Final_Report_Appendix_D-5": An EUL of 15 years was used for the ex-post savings, consistent with the SPC—Custom Measures and System Controls categories in the CPUC Energy Efficiency Policy Manual (Version 2) and with DEER values for an energy management control system.

[609] Per PUCT Docket 42551, Southwestern Public Service Company (SPS)/Xcel Energy has agreed to collect field data in 2015 on post-run times for a sample of wells to improve the accuracy of POC saving estimates.

Document Revision History

Table 308. Pump-Off Controllers—Revision History

TRM version	Date	Description of change
v2.1	01/30/2015	TRM v2.1 origin.
v3.0	04/10/2015	TRM v3.0 update. No revision.
v4.0	10/10/2016	TRM v4.0 update. No revision.
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	10/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. No revision.
v8.0	10/2020	TRM v8.0 update. General reference checks and text edits.
v9.0	10/2021	TRM v9.0 update. General reference checks and text edits.
v10.0	10/2022	TRM v10.0 update. No revision.
v11.0	10/2023	TRM v11.0 update. No revision.
v12.0	10/2024	TRM v12.0 update. No revision.

2.7.5 ENERGY STAR® Pool Pumps Measure Overview

TRM Measure ID: NR-MS-PP

Market Sector: Commercial

Measure Category: Appliances

Applicable Building Types: All commercial

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 pool pump.

Eligibility Criteria

This measure applies to all commercial applications, indoor or outdoor, with a pump size up to 3 hp; larger sizes should be implemented through a custom program. Motor-only retrofits are not eligible. Ineligible pump products include waterfall, integral cartridge filter, integral sand filter, storable electric spa, and rigid electric spa[610].

Multi-speed pool pumps are not permitted. 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.[611] The default pump curves provided in the ENERGY STAR Pool Pump Savings Calculator indicate that the motor operating at half-speed will be unable to meet the minimum turnover requirements for commercial pool operation as mandated by Texas Administrative Code.

[610] These pump products are ineligible for ENERGY STAR v3.0 certification: https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Version%203.1%20Pool%20Pumps%20Final%20Specification.pdf

[611] Hunt, A. and Easley, S., "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.[612] Weighted energy factor (WEF) requirements are based on rated hydraulic horsepower (hhp).

Table 309. Baseline Condition—Federal Standard Effective July 19, 2021

Pump Subtype	Size class	WEF
Self-priming (inground) pool pumps	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

High-Efficiency Condition

The high-efficiency condition is a 1 to 5 hp variable speed pool pump that is compliant with the current ENERGY STAR Version 3.1 Specification, effective July 19, 2021.[613]

Table 310. ENERGY STAR Pool Pumps—Energy Efficiency Level

Pump subtype	Size class	ENERGY STAR
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
	Standard (hhp ≥ 0.711)	

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.[614]

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612 Federal standard for dedicated purpose pool pumps. https://www.ecfr.gov/current/title-10/section-431.465.

613 ENERGY STAR Program Requirements Product Specification for Pool Pumps https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Version%203.1%20Pool%20Pumps%20Final%20Specification.pdf

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

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

Equation 278

Where:

kWh_{conv}	=	*Conventional single-speed pool pump energy [kWh]*
kWh_{ES}	=	*ENERGY STAR variable-speed pool pump energy [kWh]*

Algorithms to calculate the above parameters are defined as:

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

Equation 279

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

Equation 280

Where:

PFR_{conv}	=	*Conventional single-speed pump flow rate [gal/min] (see Table 311)*
WEF_{conv}	=	*Conventional single-speed pump weighted energy factor [gal/W·hr] (see Table 311)*
WEF_{ES}	=	*ENERGY STAR weighted energy factor [gal/W·hr] (see Table 312)*
hours	=	*Conventional single-speed pump daily operating hours (see Table 311)*
days	=	*Operating days per year = year-round operation: 365 days; seasonal operation: 7 months x 30.4 days/month = 212.8 days (default)*
V	=	*Pool volume [gal] (use actual or see Table 312)*
TO	=	*Turnovers per day, number of times the volume of the pool is run through the pump per day (see Table 312)*
60	=	*Constant to convert between minutes and hours*
1,000	=	*Constant to convert from kilowatts to watts*

Table 311. Pool Pumps—Conventional Pump Input Assumptions[615]

New pump hp	Reference hp	Reference hhp[616]	Hours, limited[617]	Hours, 24/7	PFR_{conv} (gal/min)
≤ 1.25	1.0	0.533	12	24	75.5000
1.25 < hp ≤ 1.75	1.5	0.800			78.1429
1.75 < hp ≤ 2.25	2.0	1.066			88.6667
2.25 < hp ≤ 2.75	2.5	1.333			93.0910
2.75 < hp ≤ 5	3.0	1.599			101.6667

Table 312. Pool Pumps—ENERGY STAR Pump Input Assumptions[618,619]

New pump HP	TO, limited	TO, 24/7	V [gal]
≤ 1.25	2.7	5.4	20,000
1.25 < hp ≤ 1.75	2.8	5.6	20,000
1.75 < hp ≤ 2.25	2.9	5.8	22,000
2.25 < hp ≤ 2.75	2.7	5.4	25,000
2.75 < hp ≤ 5	2.6	5.2	28,000

Demand Savings Algorithms

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

Equation 281

Where:

$CF_{S/W}$ = *Summer/winter seasonal peak coincidence factor (see Table 313)*

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615 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.

616 Hhp not available in ENERGY STAR calculator. Assumed hhp calculated as follows: Reference horsepower x AF. AF = 0.533 based on ratio of hhp to hp from ENERGY STAR QPL.

617 Limited hours assumes that pump operating hours are 12 hours per day, based on 2016 Commercial pool pump program data reviewed by the Texas Evaluation Contractor. Note: input assumptions will be updated once calculator has been updated for compliance with the current specification.

618 ENERGY STAR turnover and EF values are taken from pump curves found in the ENERGY STAR® Pool Pump Savings Calculator.

619 Turnovers calculated as TO = hours x 60 x PFR_{conv} ÷ V.

Table 313. Pool Pumps—Coincidence Factors[620]

Operation	Summer CF	Winter CF
24/7 operation	1.0	1.0
Seasonal/limited hours	1.0	0.5

Deemed Energy and Demand Savings Tables

Table 314. Pool Pumps—Energy Savings[621]

	Year-round operation		Seasonal operation (7 months)
	24/7 operation	Limited hours	
New pump HP	kWh savings	kWh savings	kWh savings
≤ 1.25	6,682	3,341	1,948
1.25 < hp ≤ 1.75	1,191	596	347
1.75 < hp ≤ 2.25	1,580	790	461
2.25 < hp ≤ 2.75	1,895	947	552
2.75 < hp ≤ 5	2,327	1,163	678

Table 315. Pool Pumps—Summer Peak Demand Savings

New pump (HP)	All schedules
≤ 1.25	0.763
1.25 < hp ≤ 1.75	0.136
1.75 < hp ≤ 2.25	0.180
2.25 < hp ≤ 2.75	0.216
2.75 < hp ≤ 5	0.266

620 Based on 2016 Commercial pool pump program data reviewed by the Texas Evaluation Contractor.
621 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.

Table 316. Pool Pumps—Winter Peak Demand Savings

New pump HP	24/7	Limited and seasonal
≤ 1.25	0.763	0.381
1.25 < hp ≤ 1.75	0.136	0.068
1.75 < hp ≤ 2.25	0.180	0.090
2.25 < hp ≤ 2.75	0.216	0.108
2.75 < hp ≤ 5	0.266	0.133

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.[622]

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:

- For all projects
  - Climate zone or county
  - Pool pump rated horsepower
  - Proof of purchase including quantity, make, and model information
  - Copy of ENERGY STAR certification
  - Facility operation type: 24/7, year-round limited hours, seasonal
  - Pool volume in gallons (only required when calculating site-specific savings in lieu of deemed savings)

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

- For a significant sample of projects where attainable (e.g., those projects that are selected for inspection, not midstream or retail programs)
    - Items listed above for all projects
    - Decision/action type: early retirement, replace-on-burnout, or new construction
    - Rated horsepower of existing pool pump
    - Existing and new pump operating hours

References and Efficiency Standards

Petitions and Rulings

- PUCT Docket 47612—Provides deemed savings for ENERGY STAR pool pumps

Relevant Standards and Reference Sources

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

Document Revision History

Table 317. Pool Pumps—Revision History

TRM version	Date	Description of change
v5.0	10/2017	TRM v5.0 origin.
v6.0	10/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. Added ineligible products list. Program tracking requirements updated.
v8.0	10/2020	TRM v8.0 update. General reference checks and text edits.
v9.0	10/2021	TRM v9.0 update. General text edits. Corrected turnovers/day values in the assumptions table.
v10.0	10/2022	TRM v10.0 update. Updated for ENERGY STAR Version 3.0 Specification. Increased upper limit for pump horsepower to 5 to better reflect product availability.
v11.0	10/2023	TRM v11.0 update. No revision.
v12.0	10/2024	TRM v120.0 update. Updated baseline condition and deemed savings to reflect current federal standard.

2.7.6 Lodging Guest Room Occupancy-Sensor Controls Measure Overview

TRM Measure ID: NR-MS-LC

Market Sector: Commercial

Measure Category: HVAC, indoor lighting

Applicable Building Types: Hotel/motel guestrooms, schools/colleges (dormitory)

Fuels Affected: Electricity

Decision/Action Type: Retrofit

Program Delivery Type: Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Energy modeling

Measure Description

This measure, commonly referred to as a guest room energy management (GREM) system, captures the potential energy and demand savings resulting from occupancy sensor control of HVAC and lighting in unoccupied hotel/motel guest rooms. Hotel and motel guest room occupancy schedules are highly variable, and guests often leave HVAC equipment and lighting on when they leave the room. Installation of occupancy controls can reduce the unnecessary energy consumption in unoccupied guest rooms. Savings have also been developed for the use of this measure in college dormitories.[623]

Eligibility Criteria

To be eligible for HVAC savings, controls must be capable of either a 5ºF or 10ºF temperature offset. To be eligible for lighting savings, at least 50 percent of all the lighting fixtures in a guest room—both hardwired and plug-load lighting—must be actively controlled.

Baseline Condition

The baseline condition is a guest room or dorm room without occupancy controls.

High-Efficiency Condition

The high-efficiency condition is a guest room or dorm room with occupancy controls. The occupancy sensors can control either the HVAC equipment only or the HVAC equipment and

[623] The original petition also includes savings for HVAC-only control in master-metered multifamily individual dwelling units. These values are not reported here because the permanent occupation of a residential unit is significantly different from the transitory occupation of hotel/motels and even dormitories. This measure is not currently being implemented and is not likely to be used in the future, but it can be added to a future TRM if warranted.

the interior lighting (including plug-in lighting).

The occupancy-based control system must include, but not be limited to, infrared sensors, ultrasonic sensors, door magnetic strip sensors, and/or card-key sensors. The controls must be able to either completely shut-off the HVAC equipment serving the space and/or place it into an unoccupied temperature setback/setup mode.

Energy and Demand Savings Methodology

Energy and demand savings are deemed values based on energy simulation runs performed using EnergyPro Version 5. Building prototype models were developed for a hotel, motel, and dormitory building types. The base case for each prototype model assumed a uniform temperature setting and was calibrated to a baseline energy use. Occupancy patterns based on both documented field studies[624] and prototypical ASHRAE 90.1-1999 occupancy schedules were used in the energy simulation runs to create realistic vacancy schedules. The prototype models were then adjusted to simulate an occupancy control system, which was compared to the baseline models.[625]

Savings Algorithms and Inputs

A building simulation approach was used to produce savings estimates.

Deemed Energy and Demand Savings Tables

Energy and demand savings are provided by region, for HVAC-only, HVAC + lighting control configurations, and for three facility types: motel guest rooms, hotel guest rooms, and dormitory rooms.

Table 318. Lodging Occupancy Sensors—Motel per Room Energy and Peak Demand Savings

	Heat pump				Electric resistance heat			
	HVAC only		HVAC and lighting		HVAC only		HVAC and lighting	
Climate zone[626]	kW	kWh	kW	kWh	kW	kWh	kW	kWh
5-degree setup/setback offset								
Climate Zone 1: Amarillo	0.059	267	0.075	380	0.059	341	0.075	441
Climate Zone 2: Dallas	0.076	315	0.091	443	0.076	365	0.091	485

624 HVAC occupancy rates appear to be based on a single HVAC study of three hotels, but not dorms or multifamily buildings. For the lighting study, a typical guest room layout was used as the basis for the savings analysis. Hotel guest rooms are quite different from either dorms or multifamily units.

625 A more detailed description of the modeling assumptions can be found in Docket 40668 Attachment A, pages A-46 through A-58.

626 Regions used in the original petition were mapped to current TRM representative weather stations and regions as follows: Amarillo was "Panhandle", Dallas-Ft Worth was "North", Houston was "South Central", El Paso was "Big Bend", and Corpus Christi was "Rio Grande Valley" using McAllen as a reference city.

Climate zone[626]	Heat pump				Electric resistance heat			
	HVAC only		HVAC and lighting		HVAC only		HVAC and lighting	
	kW	kWh	kW	kWh	kW	kWh	kW	kWh
Climate Zone 3: Houston	0.082	324	0.097	461	0.082	351	0.097	484
Climate Zone 4: Corpus Christi	0.086	354	0.103	500	0.086	369	0.103	513
Climate Zone 5: El Paso	0.063	251	0.078	379	0.063	283	0.078	406
10-degree setup/setback offset								
Climate Zone 1: Amarillo	0.111	486	0.126	598	0.111	627	0.126	726
Climate Zone 2: Dallas	0.146	559	0.161	686	0.146	640	0.161	761
Climate Zone 3: Houston	0.151	559	0.166	695	0.151	602	0.166	735
Climate Zone 4: Corpus Christi	0.163	617	0.179	761	0.163	650	0.179	792
Climate Zone 5: El Paso	0.118	432	0.133	561	0.118	482	0.133	607

Table 319. Lodging Occupancy Sensors—Hotel per Room Energy and Peak Demand Savings

Climate zone[626]	Heat pump				Electric heat			
	HVAC only		HVAC and lighting		HVAC only		HVAC and lighting	
	kW	kWh	kW	kWh	kW	kWh	kW	kWh
5-degree setup/setback offset								
Climate Zone 1: Amarillo	0.053	232	0.072	439	0.053	303	0.072	530
Climate Zone 2: Dallas	0.073	258	0.093	452	0.073	303	0.093	505
Climate Zone 3: Houston	0.074	242	0.094	430	0.074	260	0.094	450
Climate Zone 4: Corpus Christi	0.081	260	0.102	451	0.081	267	0.102	459
Climate Zone 5: El Paso	0.056	178	0.075	360	0.056	196	0.075	380
10-degree setup/setback offset								
Climate Zone 1: Amarillo	0.102	426	0.121	568	0.102	557	0.121	684
Climate Zone 2: Dallas	0.134	452	0.154	617	0.134	517	0.154	676
Climate Zone 3: Houston	0.136	423	0.156	599	0.136	446	0.156	621

Climate zone[626]	Heat pump				Electric heat			
	HVAC only		HVAC and lighting		HVAC only		HVAC and lighting	
	kW	kWh	kW	kWh	kW	kWh	kW	kWh
Climate Zone 4: Corpus Christi	0.149	467	0.169	652	0.149	483	0.169	667
Climate Zone 5: El Paso	0.106	312	0.126	479	0.106	338	0.126	501

Table 320. Lodging Occupancy Sensors—Dormitory per Room Energy and Peak Demand Savings

Climate zone[626]	Heat pump				Electric heat			
	HVAC only		HVAC and lighting		HVAC only		HVAC and lighting	
	kW	kWh	kW	kWh	kW	kWh	kW	kWh
5-degree setup/setback offset								
Climate Zone 1: Amarillo	0.034	136	0.061	319	0.034	152	0.061	316
Climate Zone 2: Dallas	0.048	214	0.076	425	0.048	223	0.076	428
Climate Zone 3: Houston	0.051	242	0.078	461	0.051	244	0.078	462
Climate Zone 4: Corpus Christi	0.053	265	0.081	492	0.053	266	0.081	492
Climate Zone 5: El Paso	0.031	110	0.059	327	0.031	110	0.059	326
10-degree setup/setback offset								
Climate Zone 1: Amarillo	0.073	261	0.084	404	0.073	289	0.084	417
Climate Zone 2: Dallas	0.078	293	0.105	505	0.078	304	0.105	511
Climate Zone 3: Houston	0.081	326	0.108	543	0.081	328	0.108	545
Climate Zone 4: Corpus Christi	0.088	368	0.114	591	0.088	370	0.114	593
Climate Zone 5: El Paso	0.045	151	0.060	448	0.045	153	0.060	450

Claimed Peak Demand Savings

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

Measure Life and Lifetime Savings

The estimated useful life (EUL) is 10 years based on the value for retrofit energy management system (EMS) HVAC control from the Massachusetts Joint Utility Measure Life Study[627]. This value is also consistent with the EUL for lighting control and HVAC control measures in PUCT Docket Nos. 36779 and 40668.

Program Tracking Data and Evaluation Requirements

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

- Climate zone or county
- HVAC system and equipment type
- Heating type (heat pump, electric resistance)
- Temperature offset category (5 or 10° F)
- Control type (HVAC only, HVAC and lighting)
- Building type (hotel, motel, dormitory)
- Number of rooms

References and Efficiency Standards

Petitions and Rulings

- PUCT Docket 40668—Provides deemed energy and demand savings values under "Guestroom, Dormitory and Multi-family Occupancy Controls for HVAC and Lighting Systems," page 25 and Attachment pages A-46 through A-58.
- PUCT Docket 36779—Provides EULs for commercial measures.

Relevant Standards and Reference Sources

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

Document Revision History

Table 321. Lodging Occupancy Sensors—Revision History

TRM version	Date	Description of change
v2.0	04/18/2014	TRM v2.0 origin.
v3.0	04/10/2015	TRM v3.0 update. No revision.
v4.0	10/10/2016	TRM v4.0 update. No revision.

[627] Energy and Resource Solutions (2005). *Measure Life Study.* Prepared for the Massachusetts Joint Utilities; Table 1-1, Prescriptive Common Measure Life Recommendations, Large C&I retrofit, HVAC Controls, EMS.

TRM version	Date	Description of change
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	10/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. No revision.
v8.0	10/2020	TRM v8.0 update. General reference checks and text edits.
v9.0	10/2021	TRM v9.0 update. No revision.
v10.0	10/2022	TRM v10.0 update. Changed Climate Zone 4 reference city from McAllen to Corpus Christi.
v11.0	10/2023	TRM v11.0 update. No revision.
v12.0	10/2024	TRM v12.0 update. No revision.

2.7.7 Vending Machine Controls Measure Overview

TRM Measure ID: NR-MS-VC

Market Sector: Commercial

Measure Category: Miscellaneous

Applicable Building Types: All building types

Fuels Affected: Electricity

Decision/Action Type: Retrofit

Program Delivery Type: Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: M&V

Measure Description

This measure is for the installation of vending machine controls to reduce energy usage during periods of inactivity. These controls reduce energy usage by powering down the refrigeration and lighting systems when the control device signals that there is no human activity near the machine. If no activity or sale is detected over the manufacturer's programmed time duration, the device safely de-energizes the compressor, condenser fan, evaporator fan, and any lighting. For refrigerated machines, it will power up occasionally to maintain cooling to meet the machine's thermostat set point. When activity is detected, the system returns to full power. The energy and demand savings are determined on a per-vending machine basis.

Eligibility Criteria

This measure applies to refrigerated beverage vending machines manufactured and purchased prior to August 31, 2012. Refrigerated beverage vending machines manufactured after this date must already comply with current federal-standard maximum daily-energy consumption requirements.

All non-refrigerated snack machines are eligible if controls are installed on equipment consistent with the baseline condition below. Display lighting must not have been permanently installed.

Baseline Condition

The baseline condition is a 120-volt single phase refrigerated beverage or non-refrigerated snack vending machine without any controls.

High-Efficiency Condition

The high-efficiency condition is a 120-volt single-phase refrigerated beverage or non-refrigerated-snack vending machine with occupancy controls and compliant with the current federal standard, effective January 8, 2019.[628]

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Energy savings are deemed based on a metering study completed by Pacific Gas & Electric (PG&E). Delta load shapes for this measure are taken from a Sacramento Municipal Utility District (SMUD) metering study. Demand savings for refrigerated cold drink units are calculated based on a probability-weighted analysis of hourly consumption impacts, and demand savings for other unit types are adjusted proportionally based on differences in rated product wattage.

Deemed Energy and Demand Savings Tables

Energy and demand savings are specified by unit type and climate zone in the following tables:

Table 322. Vending Controls—Refrigerated Cold Drink Energy and Peak Savings[629]

Climate zone	kWh savings	Summer kW savings[630]	Winter kW savings
Climate Zone 1: Amarillo	1,612	0.023	0.060
Climate Zone 2: Dallas		0.021	0.063
Climate Zone 3: Houston		0.022	0.060
Climate Zone 4: Corpus Christi		0.022	0.064
Climate Zone 5: El Paso		0.015	0.068

[628] Appliance Standards for Refrigerated Beverage Vending Machines. https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=29#current_standards.

[629] Pacific Gas and Electric, Work Paper VMCold, Revision 3, August 2009, Measure Code R97.

[630] Chappell, C., Hanzawi, E., Bos, W., Brost, M., and Peet, R. (2002). "Does It Keep the Drinks Cold and Reduce Peak Demand? An Evaluation of a Vending Machine Control Program," 2002 ACEEE Summer Study on Energy Efficiency in Buildings Proceedings, pp. 10.47-10.56. https://www.eceee.org/static/media/uploads/site-2/library/conference_proceedings/ACEEE_buildings/2002/Panel_10/p10_5/paper.pdf.

Table 323. Vending Controls—Refrigerated Reach-In Energy and Peak Demand Savings[631]

Climate zone	kWh savings	Summer kW savings	Winter kW savings
Climate Zone 1: Amarillo	1,086	0.026	0.069
Climate Zone 2: Dallas		0.024	0.073
Climate Zone 3: Houston		0.026	0.068
Climate Zone 4: Corpus Christi		0.026	0.074
Climate Zone 5: El Paso		0.017	0.078

Table 324. Vending Controls—Non-Refrigerated Snack Energy and Peak Demand Savings[632]

Climate zone	kWh savings	Summer kW savings	Winter kW savings
Climate Zone 1: Amarillo	387	0.005	0.013
Climate Zone 2: Dallas		0.004	0.013
Climate Zone 3: Houston		0.005	0.013
Climate Zone 4: Corpus Christi		0.005	0.014
Climate Zone 5: El Paso		0.003	0.014

Claimed Peak Demand Savings

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

Measure Life and Lifetime Savings

The estimated useful life (EUL) is 5 years, as specified in the California Database of Energy Efficiency Resources (DEER) READI tool for EUL ID Plug-VendCtrler.[633]

Program Tracking Data and Evaluation Requirements

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

- Vending machine type (refrigerated cold drink unit, refrigerated reach-in unit, or non-refrigerated snack unit with lighting)
- Vending machine manufacture date

[631] Pacific Gas and Electric, Work Paper VMReach, Revision 3, August 2009, Measure Code R143.
[632] Pacific Gas and Electric, Work Paper VMSnack, Revision 3, August 2009, Measure Code R98.
[633] DEER READI (Remote Ex-Ante Database Interface). http://www.deeresources.com/index.php/readi.

References and Efficiency Standards

Petitions and Rulings

- PUCT Docket 40669—Provides energy and demand savings and measure specifications. Appendix A: https://interchange.puc.texas.gov/Documents/40669_3_735684.PDF.
- PUCT Docket 36779—Provides EUL for Vending Machine Controls.

Relevant Standards and Reference Sources

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

Document Revision History

Table 325. Vending Controls—Revision History

TRM version	Date	Description of change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	04/18/2014	TRM v2.0 update. No revision.
v3.0	04/10/2015	TRM v3.0 update. No revision.
v4.0	10/10/2016	TRM v4.0 update. No revision.
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	10/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. No revision.
v8.0	10/2020	TRM v8.0 update. Clarified baseline condition and updated demand savings for compliance with current peak definition.
v9.0	10/2021	TRM v9.0 update. General text edits.
v10.0	10/2022	TRM v10.0 update. No revision.
v11.0	10/2023	TRM v11.0 update. No revision.
v12.0	10/2024	TRM v12.0 update. No revision.

2.7.8 Computer Power Management Measure Overview

TRM Measure ID: NR-MS-CP

Market Sector: Commercial

Measure Category: Miscellaneous

Applicable Building Types: All building types

Fuels Affected: Electricity

Decision/Action Type: Retrofit

Program Delivery Type: Prescriptive

Deemed Savings Type: Deemed value (per machine)

Savings Methodology: Algorithms

Measure Description

This measure presents deemed savings for implementation of computer power management strategies. Computer power management includes the use of operational settings that automate the power management features of computer equipment, including automatically placing equipment into a low power mode during periods of inactivity. This may be done either with built-in features integral to the computer operating system or through an add-on software program. Typically, this measure is implemented across an entire network of computers.

Eligibility Criteria

To be eligible for this measure, computers must not have any automatic sleep or other low power setting in place. Both conventional and ENERGY STAR computer equipment are eligible for this measure. Applicable building types include offices and schools.

Baseline Condition

The baseline conditions are the estimated number of hours that the computer spends in active, sleep, and off modes before the power settings are actively managed. Operating hours may be estimated from metering, or the default hours provided in the calculation of deemed savings may be used. The default baseline hours are taken from the ENERGY STAR modeling study assumptions contained in the Low Carbon IT Savings Calculator[634], and assume baseline computer settings never enter sleep mode, and 60% of computers are turned off each night.[635]

[634] ENERGY STAR Low Carbon IT Calculator available for download at: https://www.energystar.gov/products/low_carbon_it_campaign/put_your_computers_sleep.

[635] Based on 2015 custom project metering from El Paso Electric.

High-Efficiency Condition

The efficient conditions are the estimated number of hours that the computer spends in active, sleep, and off modes after the power settings are actively managed. Operating hours may be estimated from metering, or the default hours provided in the calculation of deemed savings may be used. The default efficient hours are taken from the ENERGY STAR modeling study assumptions contained in the Low Carbon IT Savings Calculator and assume managed computer settings enter sleep mode after 15 minutes of inactivity, and 80% of computers are turned off each night.[636]

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

$$Energy\ Savings\ [\Delta kWh] = \frac{W_{active}\left(Hrs_{active,pre} - Hrs_{active,post}\right) + W_{sleep}\left(Hrs_{sleep,pre} - Hrs_{sleep,post}\right) + W_{off}\left(Hrs_{off,pre} - Hrs_{off,post}\right)}{1{,}000}$$

Equation 282

$$Summer\ Peak\ Demand\ Savings\ [\Delta kW] = \left(W_{active} - W_{sleep}\right) \times CF_{inactive,S}$$

Equation 283

$$Winter\ Peak\ Demand\ Savings\ [\Delta kW] = 0$$

Equation 284

Where:

W_{active} = *Total wattage of the equipment, including computer and monitor, in active/idle mode (see Table 326)*

$Hrs_{active,pre}$ = *Annual number of hours the computer is in active/idle mode before computer management software is installed (see Table 327)*

$Hrs_{active,post}$ = *Annual number of hours the computer is in active/idle mode after computer management software is installed (see Table 327)*

W_{sleep} = *Total wattage of the equipment, including computer and monitor, in sleep mode (see Table 326)*

$Hrs_{sleep,pre}$ = *Annual number of hours the computer is in sleep mode before computer management software is installed (see Table 327)*

$Hrs_{sleep,post}$ = *Annual number of hours the computer is in sleep mode after computer management software is installed (see Table 327)*

[636] Based on 2015 custom project metering from El Paso Electric.

W_{off} = *Total wattage of the equipment, including computer and monitor, in off mode (see Table 326)*

$Hrs_{off,pre}$ = *Annual number of hours the computer is in off mode before computer management software is installed (see Table 327)*

$Hrs_{off,post}$ = *Annual number of hours the computer is in off mode after computer management software is installed (see Table 327)*

1,000 = *Constant to convert from W to kW*

$CF_{inactive,S}$ = *Inactive summer peak coincidence factor (see Table 328)*

Table 326. Computer Power Management—Equipment Wattages[637]

Equipment	W_{active}	W_{sleep}	W_{off}
Conventional monitor[638]	18.3	0.30	0.30
Conventional computer	48.11	2.31	0.96
Conventional notebook (including display)	14.82	1.21	0.61
ENERGY STAR monitor	15.0	0.26	0.26
ENERGY STAR computer	27.11	1.80	0.81
ENERGY STAR notebook (including display)	8.61	0.89	0.46

Table 327. Computer Power Management—Operating Hours[639]

Building activity type	$Hrs_{active,pre}$	$Hrs_{active,post}$	$Hrs_{sleep,pre}$	$Hrs_{sleep,post}$	$Hrs_{off,pre}$	$Hrs_{off,post}$
Typical office (8 hours/day, 5 days/week, 22 non-workdays/year)	4,650	1,175	0	2,105	4,110	5,480
Typical school (8 hours/day, 5 days/week, 113 non-school days/year)	4,213	727	0	1,970	4,547	6,063

[637] Equipment wattages taken from the ENERGY STAR Office Equipment Calculator, updated October 2016. Available for download at https://www.energystar.gov/buildings/save_energy_commercial_buildings/ways_save/energy_efficient_products.

[638] Average of 17.0-24.9 inches monitor sizes taken from the ENERGY STAR® Office Equipment Calculator.

[639] Hours taken from assumptions in the ENERGY STAR calculator. $Hours_{pre}$ assume baseline computer settings never enter sleep mode, and 36% of computers are turned off each night. $Hours_{post}$ assume managed computer settings enter sleep mode after 15 minutes of inactivity, and 80% of computers are turned off each night.

Table 328. Computer Power Management—Coincidence Factors

Climate zone	Summer CF		Winter CF	
	Active	Inactive	Active	Inactive
Climate Zone 1: Amarillo	0.65	0.35	0.11	0.89
Climate Zone 2: Dallas	0.62	0.38	0.12	0.88
Climate Zone 3: Houston	0.66	0.34	0.12	0.88
Climate Zone 4: Corpus Christi	0.62	0.38	0.14	0.86
Climate Zone 5: El Paso	0.75	0.25	0.28	0.72

Deemed Energy and Demand Savings Tables

Energy and demand savings are deemed values for conventional and ENERGY STAR equipment, based on the input assumptions listed in Table 326, Table 327, and Table 328. The following tables provide these deemed values.

Table 329. Computer Power Management—Energy Savings for Offices & Schools

Equipment	kWh Savings
Conventional LCD monitor	62.6
Conventional computer	161.4
Conventional notebook	48.2
ENERGY STAR monitor	51.3
ENERGY STAR computer	89.5
ENERGY STAR notebook	27.5

Table 330. Computer Power Management—Peak Demand Savings for Offices & Schools

Equipment	Climate Zone 1: Amarillo		Climate Zone 2: Dallas		Climate Zone 3: Houston		Climate Zone 4: Corpus Christi		Climate Zone 5: El Paso	
	Summer (kW)	Winter (kW)	Summer (kW)	Winter (kW)	Summer (kW)	Winter (kW)	Summer (kW)	Winter (kW)	Summer (kW)	Winter (kW)
Conventional LCD monitor	0.006	–	0.007	–	0.006	–	0.007	–	0.004	–
Conventional computer	0.016	–	0.017	–	0.015	–	0.017	–	0.011	–
Conventional notebook	0.005	–	0.005	–	0.005	–	0.005	–	0.003	–
ENERGY STAR monitor	0.005	–	0.006	–	0.005	–	0.006	–	0.004	–
ENERGY STAR computer	0.009	–	0.010	–	0.009	–	0.010	–	0.006	–
ENERGY STAR notebook	0.003	–	0.003	–	0.003	–	0.003	–	0.002	–

Claimed Peak Demand Savings

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

Winter demand savings are not specified for this measure based on an assumption that the reduced operating hours are not achieved during the winter peak period.

Measure Life and Lifetime Savings

The estimated useful life (EUL) of this measure is 3 years, based on the useful life of the computer equipment being controlled.[640]

Program Tracking Data and Evaluation Requirements

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

- Equipment type
  - Conventional or ENERGY STAR
  - Monitor, computer, or notebook
- Application type (office, school)

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 331. Computer Power Management—Revision History

TRM version	Date	Description of change
v7.0	10/2019	TRM v7.0 origin.
v8.0	10/2020	TRM v8.0 update. General reference checks and text edits. Incorporated version 2 baseline adjustments and revised savings.

[640] Internal Revenue Service, 1.35.6.10, Property and Equipment Capitalization, Useful life for Laptop and Desktop Equipment. July 2016. https://www.irs.gov/irm/part1/irm_01-035-006.

TRM version	Date	Description of change
v9.0	10/2021	TRM v9.0 update. Updated peak demand savings coefficients and deemed savings. Added application type to documentation requirements. Eliminated winter demand savings.
v10.0	10/2022	TRM v10.0 update. No revision.
v11.0	10/2023	TRM v11.0 update. No revision.
v12.0	10/2024	TRM v12.0 update. No revision.

2.7.9 ENERGY STAR® Electric Vehicle Supply Equipment Measure Overview

TRM Measure ID: NR-MS-EV

Market Sector: Commercial

Measure Category: Miscellaneous

Applicable Business Types: All

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 electric vehicle supply equipment (EVSE) meeting the specifications of ENERGY STAR Level 2 at a commercial 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 ENERGY STAR compliant Level 2 EVSE installed in a commercial application, which includes public, multifamily, workplace, and fleet locations. Public locations are sites where an EVSE is intended to be used by the public or visitors to the site. This includes locations such as retail, education, municipal, hospitality, and other similar locations. For the purposes of this measure, multifamily sites are public locations. Workplace locations include sites where an EVSE is intended to be used by employees to charge their personal vehicles when reporting to the workplace site. Fleet locations include sites where an EVSE is intended to be used to charge a fleet of company vehicles. The EVSE may be installed for use on either an all-battery electric vehicle (BEV) or a plug-in hybrid electric vehicle (PHEV). Savings estimates for this measure are based on studies of light duty vehicles; EVSE for charging heavy duty vehicles should pursue custom M&V.

Baseline Condition

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

High-Efficiency Condition

The high-efficiency condition is a Level 2 EVSE compliant with ENERGY STAR Version 1.1 Specification, effective March 31, 2021.[641]

Energy and Demand Savings Methodology

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.

Savings Algorithms and Input Variables

$$ENERGY\ STAR\ Idle\ Consumption\ [kWh] = \frac{\left(Hrs_{plug} \times W_{plug} + Hrs_{unplug,C} \times W_{unplug}\right) \times days_{C} + Hrs_{unplug,NC} \times W_{unplug} \times days_{NC}}{1{,}000}$$

Equation 285

$$Baseline\ Idle\ Consumption\ [kWh] = \frac{ENERGY\ STAR\ Idle\ Consumption}{0.6}$$

Equation 286

$$Energy\ Savings\ [\Delta kWh] = Baseline\ Idle\ Consumption - ENERGY\ STAR\ Idle\ Consumption$$

Equation 287

$$Peak\ Demand\ Savings\ [\Delta kW] = \frac{\Delta kWh}{Hrs_{unplug,C} \times days_{C} + Hrs_{unplug,NC} \times days_{NC}} \times PDPF$$

Equation 288

Where:

Hrs_{plug} = *Time per day the vehicle is plugged into the EVSE and not charging [hours]*[642] *= 2.8*

W_{plug} = *Wattage of the EVSE when the vehicle is plugged into the EVSE but not charging [W]*[643] *= 6.9 W*

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[641] ENERGY STAR Program Requirements for Electric Vehicle Supply Equipment Eligibility Criteria v1.1. https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20V1.1%20DC%20EVSE%20Final%20Specification_0.pdf.

[642] National Renewable Energy Laboratory (NREL), February 2018, "Charging Electric Vehicles in Smart Cities: An EVI-Pro Analysis of Columbus Ohio," page 26, Table 8: Charging Statistics by Location Type and Level, ChargePoint Data. Average across all location types, dwell time minus charging duration.

[643] Average Idle Mode Input Power from ENERGY STAR certified EVSE product list as of July 13, 2020.

$Hrs_{unplug,C}$	=	*Time per day the vehicle is not plugged into the EVSE on a charging day [hours]*[644] *=19*
$Hrs_{unplug,NC}$	=	*Time per day the vehicle is not plugged into the EVSE on a non-charge day [hours] = 24*
W_{unplug}	=	*Wattage of the EVSE when the vehicle is not plugged into the EVSE [W]*[645] *= 3.3*
$days_C$	=	*Number of charging days per year [days]*[646] *= 204*
$days_{NC}$	=	*Number of non-charging days per year [days] = 161*
1,000	=	*Constant to convert from W to kW*
0.6	=	*Efficiency adjustment factor*[647]
PDPF	=	*Peak demand probability factor (see Table 332)*

Table 332. EVSE—Peak Demand Probability Factors[648]

Location type	Public		Workplace		Fleet	
Climate zone	Summer PDPF	Winter PDPF	Summer PDPF	Winter PDPF	Summer PDPF	Winter PDPF
Climate Zone 1: Amarillo	0.46526	0.46032	0.87484	0.75271	0.27206	0.44421
Climate Zone 2: Dallas	0.45808	0.47380	0.86213	0.75558	0.22867	0.42040
Climate Zone 3: Houston	0.46134	0.42544	0.87173	0.68222	0.26507	0.34306
Climate Zone 4: Corpus Christi	0.46892	0.49816	0.87553	0.77324	0.25862	0.50077
Climate Zone 5: El Paso	0.42680	0.51324	0.80969	0.92091	0.15042	0.57715

644 NREL "Charging Electric Vehicles in Smart Cities: An EVI-Pro Analysis of Columbus Ohio," page 26, Table 8; 24 hours per day minus average dwell time.

645 Average No Vehicle Mode Input Power from ENERGY STAR certified EVSE product list.

646 NREL "Charging Electric Vehicles in Smart Cities: An EVI-Pro Analysis of Columbus Ohio," page 25; 0.56 charging sessions per day per plug in Austin, Texas. 365 x 0.56 = 204.

647 ENERGY STAR Electric Vehicle Chargers Buying Guidance: "ENERGY STAR certified EV charger… on average use 40% less energy than a standard EV charger when the charger is in standby mode (i.e., not actively charging a vehicle)." https://www.energystar.gov/products/other/evse.

648 Probability weighted peak load factors are calculated according to the method in Section 4 of the Texas TRM Vol 1 using data from NREL "Charging Electric Vehicles in Smart Cities: An EVI-Pro Analysis of Columbus Ohio," page 27, Figure 21: Daily distribution of ChargePoint charging events by EVSE type and day of the week.

Deemed Energy and Demand Savings Tables

Table 333 presents the deemed annual energy savings per EVSE.

Table 333. EVSE—Energy Savings

kWh Savings (all location types)
19.7

Table 334 presents the deemed summer and winter peak kW savings per EVSE.

Table 334. EVSE—Peak Demand Savings

Location type	Public		Workplace		Fleet	
Climate zone	Summer peak kW	Winter peak kW	Summer peak kW	Winter peak kW	Summer peak kW	Winter peak kW
Climate Zone 1: Amarillo	0.0012	0.0012	0.0022	0.0019	0.0008	0.0012
Climate Zone 2: Dallas	0.0012	0.0012	0.0022	0.0019	0.0006	0.0012
Climate Zone 3: Houston	0.0012	0.0011	0.0022	0.0017	0.0007	0.0010
Climate Zone 4: Corpus Christi	0.0012	0.0013	0.0022	0.0020	0.0007	0.0014
Climate Zone 5: El Paso	0.0011	0.0013	0.0021	0.0023	0.0004	0.0016

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.[649]

[649] 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.

Program Tracking Data and Evaluation Requirements

It is required that the following list of primary inputs and contextual data be specified and tracked by the program database to inform the evaluation and apply the savings properly:

- Climate zone or county
- Location Type (public, workplace, or fleet) [650]
- EVSE quantity
- EVSE manufacturer and model number

References and Efficiency Standards

Petitions and Rulings

- This section not applicable.

Relevant Standards and Reference Sources

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

Document Revision History

Table 335. EVSE—Revision History

TRM version	Date	Description of change
v8.0	10/2020	TRM v8.0 origin.
v9.0	10/2021	TRM v9.0 update. General reference checks and text edits.
v10.0	10/2022	TRM v10.0 update. Added reference for ENERGY STAR version.
v11.0	10/2023	TRM v11.0 update. No revision.
v12.0	10/2024	TRM v12.0 update. No revision.

[650] Refer to Eligibility Criteria section for location type definitions.

2.7.10Industrial High-Frequency Battery Chargers Overview

TRM Measure ID: NR-MS-BC

Market Sector: Commercial

Measure Category: Other/miscellaneous

Applicable Building Types: Any commercial

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

Industrial electric vehicle fleets used for material handling, or forklifts, use battery charging systems to convert AC source power into DC power required to charge the vehicle batteries. Traditional charging systems include Ferro resonant (FR) and silicon-controlled rectifier (SCR) charging equipment. This measure is for a single high-frequency battery charger that converts AC to DC power more efficiently than traditional systems due to switch mode operation that reduces heat and power loss throughout the system.

Baseline Condition

The baseline condition is a typical FR or SCR charging system operating in an industrial warehouse setting to power forklifts.

High-Efficiency Condition

There is no federal standard for large industrial battery chargers. Therefore, the efficient condition is the energy efficiency standard for large battery systems in California Appliance Efficiency Regulations, Title 20, which is detailed in the following table.

Table 336. Battery Chargers—Efficiency Requirements[651]

Performance factor		Requirement
Charge return factor	100 percent, 80 percent depth of discharge	≤ 1.10
	40% depth of discharge	≤ 1.15
Power conversion efficiency		≥ 89%
Power factor		≥ 90%
No battery mode power		≤ 10 W

Energy and Demand Savings Methodology

Battery charger systems operate in three modes: *charge*, *maintenance*, and *no battery*. In *charge* mode, the battery is accumulating charge. *Maintenance* mode occurs when the battery is fully charged, and the charger is simply supplying energy to counteract natural discharge. *No battery* mode indicates that the battery has been fully disconnected from the charger.

Savings Algorithms and Input Variables

The deemed savings values area calculated using the following algorithms:

$$hours = DC \times 8{,}760$$

Equation 289

$$Energy\ Savings\ [kWh_{savings}] = hours_C \times \frac{W_{C,pre} - W_{C,post}}{1{,}000} + hours_M \times \frac{W_{M,pre} - W_{M,post}}{1{,}000} + hours_{NC} \times \frac{W_{NC,pre} - W_{NC,post}}{1{,}000}$$

Equation 290

$$Summer\ Peak\ Demand\ Savings\ [kW_{savings}] = \frac{kWh_{savings}}{hours_C + hours_M + hours_{NB}} \times CF_S$$

Equation 291

$$Winter\ Peak\ Demand\ Savings\ [kW_{savings}] = \frac{kWh_{savings}}{hours_C + hours_M + hours_{NB}} \times CF_W$$

Equation 292

[651] California Appliance Efficiency Regulations, Title 20, Section 1605.3 State Standards for Non-Federally-Regulated Appliances, (w) Battery Chargers and Battery Charger Systems. https://energycodeace.com/content/reference-ace-t20-tool.

Where:

8,760	=	*Annual hours per year*
$DC_{C/M/NB}$	=	*Duty cycle in charging, maintenance, and no battery mode (see Table 337)*
$hours_{C/M/NB}$	=	*Annual number of hours in charging, maintenance, and no battery mode (see Table 337)*
$W_{C/M/NB}$	=	*Wattage draw in charging, maintenance, and no battery mode (see Table 338)*
$CF_{S/W}$	=	*Seasonal peak coincidence factor (see Table 339)*
1,000	=	*Conversion constant for W to kW*

Table 337. Battery Chargers—Charging and Idle Hours Assumptions[652]

Equipment	DC_C	DC_M	DC_{NB}	$hours_C$	$hours_M$	$hours_{NB}$
Single phase	45%	31%	24%	3,942	2,716	2,102
Three phase	94%	–	6%	8,234	–	526

Table 338. Battery Chargers—Pre/Post Charing and Idle Wattage Assumptions[653]

Equipment	$W_{C,pre}$	$W_{M,pre}$	$W_{NB,pre}$	$W_{C,post}$	$W_{M,post}$	$W_{NB,post}$
Single phase	2,000	50	50	1,767	10	10
Three phase	5,785	89	34	5,111	10	10

Table 339. Battery Charging System—Coincidence Factors[654]

Equipment	Summer	Winter
Single phase	0.19	–
Three phase	1	–

Deemed Energy and Peak Demand Savings Tables

The deemed energy and seasonal peak savings values are presented in the following table.

652 "Analysis of Standard Options for Battery Charger Systems," Ecos Consulting for Title 20 CASE Initiative. Version 2.2.2. October 1, 2010. Table 6. https://www.kannahconsulting.com/wp-content/uploads/2016/08/2010-10-11_Battery_Charger_Title_20_CASE_Report_v2-2-2.pdf.

653 "Analysis of Standard Options for Battery Charger Systems," Ecos Consulting for Title 20 CASE Initiative. Version 2.2.2. October 1, 2010. W_{pre}: Table 7, W_{post}: Table 10. https://www.kannahconsulting.com/wp-content/uploads/2016/08/2010-10-11_Battery_Charger_Title_20_CASE_Report_v2-2-2.pdf.

654 "Analysis of Standard Options for Battery Charger Systems," Ecos Consulting for Title 20 CASE Initiative. Version 2.2.2. October 1, 2010. Table 7 and Table 10. https://www.kannahconsulting.com/wp-content/uploads/2016/08/2010-10-11_Battery_Charger_Title_20_CASE_Report_v2-2-2.pdf.

Table 340. Battery Chargers—Deemed Energy and Demand Savings per Charger

Equipment	kWh savings	Summer kW savings	Winter kW savings
Single phase	1,111	0.02	–
Three phase	5,562	0.63	–

Claimed Peak Demand Savings

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

Measure Life and Lifetime Savings

The estimated useful life (EUL) for high efficiency battery chargers is 15 years.[655]

Program Tracking Data and Evaluation Requirements

It is required that the following list of primary inputs and contextual data be specified and tracked by the program database to inform the evaluation and apply the savings properly:

- Battery charger quantity
- Battery charger manufacturer and model number
- Charger type (single phase, three phase)
- Depth of discharge
- Charge return factor
- Power conversion efficiency
- Power factor
- No battery mode power (W)

Document Revision History

Table 341. Industrial High-Frequency Battery Chargers—Revision History

TRM version	Date	Description of change
v11.0	10/2023	TRM v11.0 origin
v12.0	10/2024	TRM v12.0 update. No revision.

[655] "Analysis of Standard Options for Battery Charger Systems," Ecos Consulting for Title 20 CASE Initiative. Version 2.2.2. October 1, 2010. Table 18. https://www.kannahconsulting.com/wp-content/uploads/2016/08/2010-10-11_Battery_Charger_Title_20_CASE_Report_v2-2-2.pdf.

2.7.11 Steam Trap Repair and Replacement Measure Overview

TRM Measure ID: NR-MS-ST

Market Sector: Commercial

Measure Category: Miscellaneous

Applicable Business Types: All

Fuels Affected: Electricity

Decision/Action Type: Retrofit

Program Delivery Type: Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

Faulty steam traps that allow steam to leak require makeup water to re-generate the lost steam. This measure applies to the replacement or repair of faulty mechanical (thermostatic, thermodynamic, bucket, or fixed orifice) steam traps in industrial and commercial facilities. The measure also covers annual maintenance of venturi steam traps after their deemed 20-year measure life.

Eligibility Criteria

The measure is applicable to failed steam traps in commercial and industrial applications less than 300 pounds per square in gauge (psig). Residential, multifamily, and heating radiator applications are not eligible to claim savings under the methods in this measure.

Baseline Condition

The baseline condition is a faulty (blocked, leaking, or blow-through) mechanical steam trap in need of replacement or repair.

High-Efficiency Condition

The high-efficiency condition is the repair of a faulty steam trap, replacement with a venturi steam trap installed in compliance with ASME PTC 39-2005, or annual maintenance of a venturi steam trap.

A venturi steam trap removes condensate from steam systems by utilizing the thermodynamic pressure properties of water passing through a fixed venturi orifice rather than by the moving parts found in traditional steam traps. There are numerous steam system parameters that influence operating pressure, system load, and system operations. Venturi steam traps are an engineering solution that must be designed and sized by a qualified professional based on specific site conditions.

Annual maintenance of a venturi steam trap after exhausting its deemed 20-year measure life with savings awarded on a year-to-year basis includes the removal, cleaning, and replacement of the trap strainer. Some traps may contain an integrated strainer blowdown valve for improved maintenance.

Energy and Demand Savings Methodology

Electrical energy savings for this measure are calculated based on the energy associated with makeup required to replace water lost due to steam leaks. Savings are presented per trap.

Savings Algorithms and Input Variables

$$Energy\ Savings\ [\Delta kWh] = \Delta Water\ (gallons)/1{,}000{,}000 \times E_{water\ supply}$$

Equation 293

$$\Delta Water = \frac{S_L\ (lb/hr)}{8.33\ (lbs/gal)} \times Hours \times L$$

Equation 294

$$S_L = 24.24 \times P_{ia} \times D^2 \times A \times FF$$

Equation 295

$$Peak\ Demand\ Savings\ [\Delta kW] = \frac{\Delta kWh}{Hours} \times DF$$

Equation 296

Where:

$E_{water\ supply}$	=	*Water supply energy factor: 2,300 kWh/million gallons*
S_L	=	*Average steam loss per trap (lb/hr) (see Table 342)*
Hours	=	*Annual hours when steam system is operational, equal to heating degree days by climate zone (see Table 343)*
L	=	*Percentage leakage, 1 per each leaking trap with a system audit to document leaks; for full system replacement without a system audit, use default values from Table 342*
24.24	=	*Constant lb/(hr-psia-in2)*
P_{ia}	=	*Average steam trap inlet pressure, absolute (psia),* $P_{ig} + P_{atm}$
P_{ig}	=	*Average steam trap inlet pressure, gauge (psig) (see Table 342)*
P_{atm}	=	*Atmospheric pressure, 14.7 psia*

D	=	*Diameter of orifice (inches), use actual if possible, or defaults in Table 342*
A	=	*Adjustment factor: 50% for all steam systems; this factor is to account for reducing the maximum theoretical steam flow to the average steam flow (the Enbridge factor)*
FF	=	*Flow factor for medium- and high-pressure steam systems to address industrial float and thermodynamic style traps where additional blockage is possible*
CF	=	*Peak coincidence factor, assume value of 1 for industrial and process steam applications; for commercial heating applications, see Table 36 through Table 40 in Section 2.2.2; for commercial dry cleaners, use CF for stand-alone retail*

Table 342. Steam Traps—Savings Calculation Input Assumptions[656]

Steam system	Psig	Diameter of orifice (inches)	Flow factor	Average steam loss, S_L (lb/hr/trap)	Hours	L
Commercial dry cleaners	82.8	0.125	100%	18.5	2,425	0.27
Industrial or process low pressure < 15 psig	-	-		6.9	8,282	0.16
Industrial or process medium pressure > 15 and < 30 psig	16	0.1875	50%	6.5	8,282	0.16
Industrial or process medium pressure > 30 and < 75 psig	47	0.2500		23.4	8,282	0.16
Industrial or process high pressure > 75 and < 125 psig	101			43.8	8,282	0.16
Industrial or process high pressure > 125 and < 175 psig	146			60.9	8,282	0.16
Industrial or process high pressure > 175 and < 250 psig	202			82.1	8,282	0.16
Industrial or process high pressure > 250 and < 300 psig	263			105.2	8,282	0.16
Commercial space heating low pressure steam (LPS)	-	-	100%	6.9	Table 343	0.27

[656] Default inputs for the steam trap measure are sourced from the Illinois TRM version 9.0, Volume 2, measure 4.4.16 Steam Trap Replacement or Repair. https://www.ilsag.info/wp-content/uploads/IL-TRM_Effective_010121_v9.0_Vol_2_C_and_I_09252020_Final.pdf

Table 343. Steam Traps—Commercial Heating Hours

Climate zone	Hours (HDD)[657]
Climate Zone 1: Amarillo	4,565
Climate Zone 2: Dallas	2,567
Climate Zone 3: Houston	1,686
Climate Zone 4: Corpus Christi	1,129
Climate Zone 5: El Paso	2,677

Deemed Energy and Demand Savings Tables

Table 344. Steam Traps—Energy Savings

Steam system	Climate zone	Annual kWh savings (per trap, without audit)	Annual kWh savings (per trap with audit)
Commercial dry cleaners	All	3.3	12.4
Industrial or process low pressure < 15 psig	All	2.5	15.8
Industrial or process medium pressure > 15 and < 30 psig	All	2.4	15.0
Industrial or process medium pressure > 30 and < 75 psig	All	8.6	53.4
Industrial or process high pressure > 75 and < 125 psig	All	16.0	100.2
Industrial or process high pressure > 125 and < 175 psig	All	22.3	139.2
Industrial or process high pressure > 175 and < 250 psig	All	30.0	187.7
Industrial or process high pressure > 250 and < 300 psig	All	38.5	240.5
Commercial space heating LPS	1 Amarillo	2.3	8.7
	2 DFW	1.3	4.9
	3 Houston	0.9	3.2
	4 Corpus	0.6	2.2
	5 El Paso	1.4	5.1

657 Heating degree days are calculated from TMY3 Hourly Weather Data by Climate Zone, available at http://texasefficiency.com/index.php/regulatory-filings/deemed-savings.

Claimed Peak Demand Savings

Table 345. Steam Traps—Peak Demand Savings, Without Audit

Steam type	Building type	Principal building activity	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5
Commercial dry cleaners	Mercantile	Stand-alone retail	1.36E-03	7.57E-04	5.92E-04	3.03E-04	3.58E-04
Low pressure ≤ 15 psig	All	Industrial or process	3.05E-04	3.05E-04	3.05E-04	3.05E-04	3.05E-04
Medium pressure > 15 and < 30 psig	All	Industrial or process	2.89E-04	2.89E-04	2.89E-04	2.89E-04	2.89E-04
Medium pressure ≥ 30 and < 75 psig	All	Industrial or process	1.03E-03	1.03E-03	1.03E-03	1.03E-03	1.03E-03
High pressure ≥ 75 and < 125 psig	All	Industrial or process	1.94E-03	1.94E-03	1.94E-03	1.94E-03	1.94E-03
High pressure ≥ 125 and < 175 psig	All	Industrial or process	2.69E-03	2.69E-03	2.69E-03	2.69E-03	2.69E-03
High pressure ≥ 175 and < 250 psig	All	Industrial or process	3.63E-03	3.63E-03	3.63E-03	3.63E-03	3.63E-03
High pressure ≥ 250 and < 300 psig	All	Industrial or process	4.65E-03	4.65E-03	4.65E-03	4.65E-03	4.65E-03
Commercial space heating LPS	Data center	Data center	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Education	College/ university	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		Primary school	2.21E-04	3.39E-04	2.57E-04	1.54E-04	1.90E-04
		Secondary school	2.21E-04	3.03E-04	2.78E-04	1.80E-04	2.21E-04
	Food sales	Convenience store	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		Supermarket	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Food service	Full-service restaurant	2.21E-04	2.57E-04	2.26E-04	1.80E-04	1.44E-04

Steam type	Building type	Principal building activity	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5
		24-hour full-service restaurant	2.21E-04	2.52E-04	2.26E-04	1.85E-04	1.39E-04
		Quick-service restaurant	2.47E-04	3.14E-04	2.62E-04	1.75E-04	1.34E-04
		24-hour quick-service restaurant	2.47E-04	3.09E-04	2.57E-04	1.75E-04	1.34E-04
	Healthcare	Inpatient	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		Outpatient	1.39E-04	1.44E-04	1.49E-04	4.12E-05	2.06E-05
	Large multifamily	Midrise apartment	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Lodging	Large hotel	4.42E-04	4.22E-04	1.70E-04	1.08E-04	1.08E-04
		Nursing home	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		Small hotel/motel	1.85E-04	2.16E-04	9.77E-05	5.14E-05	3.09E-05
	Office	Large office	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		Medium office	3.70E-04	3.39E-04	2.16E-04	1.23E-04	1.39E-04
		Small office	1.49E-04	2.06E-04	1.44E-04	7.20E-05	7.72E-05
	Public assembly	Public assembly	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Religious worship	Religious worship	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Retail	Stand-alone retail	5.09E-04	2.83E-04	2.21E-04	1.13E-04	1.34E-04
		24-hour retail	2.21E-04	2.93E-04	2.11E-04	1.29E-04	1.44E-04
		Strip mall	2.01E-04	2.83E-04	2.16E-04	1.08E-04	1.39E-04
	Service	Service: Excluding food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Steam type	Building type	Principal building activity	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5
	Warehouse	Warehouse	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Other	Other	1.39E-04	1.44E-04	9.77E-05	4.12E-05	2.06E-05

Table 346. Steam Traps—Peak Demand Savings, With Audit

Steam type	Building type	Principal building activity	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5
Commercial dry cleaners	Mercantile	Stand-alone retail	5.05E-03	2.80E-03	2.19E-03	1.12E-03	1.33E-03
Low pressure ≤ 15 psig	All	Industrial or process	1.91E-03	1.91E-03	1.91E-03	1.91E-03	1.91E-03
Medium pressure > 15 and < 30 psig	All	Industrial or process	1.81E-03	1.81E-03	1.81E-03	1.81E-03	1.81E-03
Medium pressure ≥ 30 and < 75 psig	All	Industrial or process	6.45E-03	6.45E-03	6.45E-03	6.45E-03	6.45E-03
High pressure ≥ 75 and < 125 psig	All	Industrial or process	1.21E-02	1.21E-02	1.21E-02	1.21E-02	1.21E-02
High pressure ≥ 125 and < 175 psig	All	Industrial or process	1.68E-02	1.68E-02	1.68E-02	1.68E-02	1.68E-02
High pressure ≥ 175 and < 250 psig	All	Industrial or process	2.27E-02	2.27E-02	2.27E-02	2.27E-02	2.27E-02
High pressure ≥ 250 and < 300 psig	All	Industrial or process	2.90E-02	2.90E-02	2.90E-02	2.90E-02	2.90E-02
Commercial space heating LPS	Data center	Data center	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Education	College/ university	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		Primary school	8.19E-04	1.26E-03	9.53E-04	5.72E-04	7.05E-04
		Secondary school	8.19E-04	1.12E-03	1.03E-03	6.67E-04	8.19E-04
	Food sales	Convenience store	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Steam type	Building type	Principal building activity	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5
		Supermarket	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Food service	Full-service restaurant	8.19E-04	9.53E-04	8.38E-04	6.67E-04	5.33E-04
		24-hour full-service restaurant	8.19E-04	9.34E-04	8.38E-04	6.86E-04	5.14E-04
		Quick-service restaurant	9.14E-04	1.16E-03	9.72E-04	6.48E-04	4.95E-04
		24-hour quick-service restaurant	9.14E-04	1.14E-03	9.53E-04	6.48E-04	4.95E-04
	Healthcare	Inpatient	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		Outpatient	5.14E-04	5.33E-04	5.52E-04	1.52E-04	7.62E-05
	Large multifamily	Midrise apartment	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Lodging	Large hotel	1.64E-03	1.56E-03	6.29E-04	4.00E-04	4.00E-04
		Nursing home	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		Small hotel/motel	6.86E-04	8.00E-04	3.62E-04	1.91E-04	1.14E-04
	Office	Large office	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		Medium office	1.37E-03	1.26E-03	8.00E-04	4.57E-04	5.14E-04
		Small office	5.52E-04	7.62E-04	5.33E-04	2.67E-04	2.86E-04
	Public assembly	Public assembly	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Religious worship	Religious worship	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Retail	Stand-alone retail	1.89E-03	1.05E-03	8.19E-04	4.19E-04	4.95E-04
		24-hour stand-alone retail	8.19E-04	1.09E-03	7.81E-04	4.76E-04	5.33E-04

Steam type	Building type	Principal building activity	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5
		Strip mall	7.43E-04	1.05E-03	8.00E-04	4.00E-04	5.14E-04
	Service	Service: Excluding food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Warehouse	Warehouse	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Other	Other	5.14E-04	5.33E-04	3.62E-04	1.52E-04	7.62E-05

Measure Life and Lifetime Savings

The estimated useful life (EUL) for this measure is 6 years for standard steam traps and 20 years for venturi steam traps.[658]

Program Tracking Data and Evaluation Requirements

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

- Application type of steam system
- Climate zone or county if application is commercial heating
- Steam trap quantity
- Type of measure undertaken for each trap: repaired, replaced, or maintained
- Audit documentation, if conducted, including count of leaking or faulty steam traps
- Maintenance documentation, if conducted, indicating strainer maintenance activities undertaken

References and Efficiency Standards

Petitions and Rulings

- This section not applicable.

Relevant Standards and Reference Sources

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

Document Revision History

Table 347. Steam Traps—Revision History

TRM version	Date	Description of change
v9.0	10/2021	TRM 9.0 origin.
v10.0	10/2022	TRM 10.0 update. No revision.

[658] EULs for the steam trap measure are sourced from the Illinois TRM 9.0, volume 2, measure 4.4.16 Steam Trap Replacement or Repair. https://www.ilsag.info/wp-content/uploads/IL-TRM_Effective_010121_v9.0_Vol_2_C_and_I_09252020_Final.pdf

TRM version	Date	Description of change
v11.0	10/2023	TRM v11.0 update. Aligned building type names across all commercial measures.
v12.0	10/2024	TRM v12.0 update. Building types realigned in tables.

2.7.12Hydraulic Gear Lubricants Measure Overview

TRM Measure ID: NR-MS-HL

Market Sector: Commercial

Measure Category: Miscellaneous

Applicable Business Types: All

Fuels Affected: Electricity

Decision/Action Type: Retrofit

Program Delivery Type: Prescriptive

Deemed Savings Type: Algorithm

Savings Methodology: Engineering algorithms and estimates

Measure Description

Hydraulic gear lubricants are used in manufacturing. Energy efficient hydraulic gear lubricants offer reduced energy consumption over standard lubricants because they have a lower coefficient of friction which reduces the friction between two moving parts (rotating pump equipment and hydraulic oil). This lower coefficient of friction reduces friction between moving components which in turn reduces the energy requirements. Additionally, efficient lubricants have a high viscosity index which reduces the effect of temperature and allows constant viscosity over a range of operating temperatures which optimizes volumetric and mechanical efficiency.

Eligibility Criteria

The measure is applicable to manufacturing and industrial sites using hydraulic gear lubricants for gearboxes.

Baseline Condition

The baseline condition is a gearbox using standard hydraulic lubricants.

High-Efficiency Condition

The high-efficiency condition is a gearbox using energy-efficiency hydraulic lubricants which have a higher viscosity index than standard lubricants.

Energy and Demand Savings Methodology

Electrical energy savings for this measure are calculated based on the energy reduction associated with a reduced coefficient of friction between moving hydraulic machine parts. There are no demand savings for this measure.

Savings Algorithms and Input Variables

$$Energy\ Savings\ [\Delta kWh] = HP_{motor} \times 0.746 \times \frac{LF}{\eta} \times hours \times EI$$

Equation 297

Where:

HP_{motor}	=	*Horsepower of the motor, actual nameplate*
0.746	=	*Constant to convert from hp to kW*
LF	=	*Motor load factor*[659] *= 75%*
η	=	*Motor efficiency (use default from Table 348 if actual is not available)*
hours	=	*Operating hours per year, actual*
EI	=	*Efficiency increase = 1.0% per gear mesh*[660]

Table 348. Hydraulic Gear Lubricants—Motor Efficiencies[661]

Motor hp	Full load efficiency	Motor hp	Full load efficiency
1	0.855	25	0.936
2	0.865	30	0.941
3	0.895	40	0.941
5	0.895	50	0.945
7.5	0.910	60	0.950
10	0.917	75	0.950
15	0.930	100	0.954
20	0.930		

Deemed Energy and Demand Savings Tables

There are no savings tables for this measure. Reference the savings equation listed above.

659 Assume motor is designed to operate at maximum efficiency, neat 75% of rated load. See DOE Motor Challenge Fact Sheet available at https://www.energy.gov/sites/prod/files/2014/04/f15/10097517.pdf. Accessed August 2021.

660 Illinois TRM v9.0 Volume 2, Measure 4.8.21 Energy Efficient Gear Lubricants, reference 1,354 identifying Exxon Mobil studies. https://www.ilsag.info/wp-content/uploads/IL-TRM_Effective_010121_v9.0_Vol_2_C_and_I_09252020_Final.pdf. Accessed September 2022.

661 Code of Federal Regulations, Title 10, Chapter II, Subchapter D, Part 431.25 Table 1, Nominal Full-Load efficiencies of General Purpose Electric Motors (Subtype 1), 4 pole motors. https://www.ecfr.gov/cgi-bin/retrieveECFR?n=pt10.3.431#se10.3.431_125.

Claimed Peak Demand Savings

There are no demand savings for this measure.

Measure Life and Lifetime Savings

The estimated useful life (EUL) for this measure is 10 years based on the expect life of the equipment that the lubricant is used with.[662]

Program Tracking Data and Evaluation Requirements

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

- Quantity
- Motor horsepower
- Motor operating hours

References and Efficiency Standards

Petitions and Rulings

- This section not applicable.

Relevant Standards and Reference Sources

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

Document Revision History

Table 349. Hydraulic Gear Lubricants—Revision History

TRM version	Date	Description of change
v9.0	10/2021	TRM v9.0 origin.
v10.0	10/2022	TRM v10.0 update. No revision.
v11.0	10/2023	TRM v11.0 update. No revision.
v12.0	10/2024	TRM v12.0 update. No revision.

662 US DOE, Technical Support Document, "Energy Efficiency Program for Commercial Equipment: Energy Conservation Standards for Electric Motors", Median of "Table 8.2.23 Average Application Lifetime". Download TSD at: https://www.mercatus.org/system/files/1904-AC28-TSD-Electric-Motors.pdf.

2.7.13Hydraulic Oils Measure Overview

TRM Measure ID: NR-MS-HO

Market Sector: Commercial

Measure Category: Miscellaneous

Applicable Business Types: All

Fuels Affected: Electricity

Decision/Action Type: Retrofit

Program Delivery Type: Prescriptive

Deemed Savings Type: Algorithm

Savings Methodology: Engineering algorithms and estimates

Measure Description

Hydraulic oils are lubricants used in manufacturing. Energy-efficient hydraulic oil lubricants offer reduced energy consumption over standard oils because they have a lower coefficient of friction, which reduces the friction between two moving parts (rotating pump equipment and hydraulic oil). This lower coefficient of friction reduces friction between moving components which, in turn, reduces the energy requirements. Additionally, efficient oils have a high viscosity index which reduces the effect of temperature and allows constant viscosity over a range of operating temperatures, optimizing volumetric and mechanical efficiency at the pumps rated output. Additionally, energy efficient hydraulic oils reduce the operating temperature of the hydraulic system.

Eligibility Criteria

The measure is applicable to manufacturing and industrial sites using hydraulic oil lubricants for hydraulic equipment performance.

Baseline Condition

The baseline condition is hydraulic equipment using standard hydraulic oils.

High-Efficiency Condition

The high-efficiency condition is hydraulic equipment using energy-efficient hydraulic oils which have a higher viscosity index than standard oils.

Energy and Demand Savings Methodology

Electrical energy savings for this measure are calculated based on the energy reduction associated with a reduced coefficient of friction between moving hydraulic machine parts. There are no demand savings for this measure.

Savings Algorithms and Input Variables

$$Energy\ Savings\ [\Delta kWh] = HP_{motor} \times 0.746 \times \frac{LF}{\eta} \times hours \times EI$$

Equation 298

Where:

HP_{motor}	=	*Horsepower of the motor, actual nameplate*
0.746	=	*Constant to convert from hp to kW*
LF	=	*Motor load factor, 75%*[663]
η	=	*Motor efficiency (use default from Table 350 if actual is not available)*
hours	=	*Operating hours per year, actual*
EI	=	*Efficiency increase*[664] *= 3.2%*

Table 350. Hydraulic Oils—Motor Efficiencies[665]

Motor hp	Full load efficiency	Motor hp	Full load efficiency
1	0.855	25	0.936
2	0.865	30	0.941
3	0.895	40	0.941
5	0.895	50	0.945
7.5	0.910	60	0.950
10	0.917	75	0.950
15	0.930	100	0.954
20	0.930		

[663] Assume motor is designed to operate at maximum efficiency, neat 75% of rated load. See DOE Motor Challenge Fact Sheet available at https://www.energy.gov/sites/prod/files/2014/04/f15/10097517.pdf. Accessed August 2021.

[664] Focus on Energy Lubricant Study, https://focusonenergy.com/newsroom/lubricant-improves-efficiency-new-study.

[665] Code of Federal Regulations, Title 10, Chapter II, Subchapter D, Part 431.25 Table 1, Nomincal Full-Load efficiencies of General Purpose Electric Motors (Subtype 1), 4 pole motors. https://www.ecfr.gov/cgi-bin/retrieveECFR?n=pt10.3.431#se10.3.431_125.

Deemed Energy and Demand Savings Tables

There are no savings tables for this measure. Reference the savings equation listed above.

Claimed Peak Demand Savings

There are no demand savings for this measure.

Measure Life and Lifetime Savings

The estimated useful life (EUL) for this measure is 10 years based on the expect life of the motor that the oil is used with.[666]

Program Tracking Data and Evaluation Requirements

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

- Quantity
- Motor horsepower
- Motor operating hours

References and Efficiency Standards

Petitions and Rulings

- This section not applicable.

Relevant Standards and Reference Sources

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

Document Revision History

Table 351. Hydraulic Oils—Revision History

TRM version	Date	Description of change
v9.0	10/2021	TRM v9.0 origin.
v10.0	10/2022	TRM v10.0 update. No revision.
v11.0	10/2023	TRM v11.0 update. No revision.

[666] US DOE, Technical Support Document, "Energy Efficiency Program for Commercial Equipment: Energy Conservation Standards for Electric Motors", Median of "Table 8.2.23 Average Application Lifetime". Download TSD at: https://www.mercatus.org/system/files/1904-AC28-TSD-Electric-Motors.pdf

TRM version	Date	Description of change
v12.0	10/2024	TRM v12.0 update. No revision.

2.7.14 Hand Dryers Measure Overview

TRM Measure ID: NR-MS-HD

Market Sector: Commercial

Measure Category: Miscellaneous

Applicable Building Types: All commercial

Fuels Affected: Electricity

Decision/Action Type: Retrofit

Program Delivery Type: Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This document presents the methodology for calculating the savings realized from installing efficient hand dryers, which save energy by drying with air movement using motion sensors, thus reducing hand-drying time.

Eligibility Criteria

Existing hand dryer must be push-button-operated and rated at more than 1,500 W. New hand dryers must be motion-sensor-operated and rated at 1,500 W or less.

Baseline Condition

The baseline efficiency case is a push-button-activated hand dryer rated at more than 1,500 W.

High-Efficiency Condition

Eligible high-efficiency equipment is a motion-sensor-operated hand dryer with a nominal input power of 1,500 W or less.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

The energy savings from the installation of efficient hand dryers are due to a decrease in power and runtime of the efficient hand dryers over the pre-retrofit equipment. The energy and demand savings are calculated using the following equations.

AOH, CF, IEF_E, and IEF_D match assumptions from the nonresidential lighting measure.[667]

$$\Delta Wh = \frac{(W_{Base} \times CT_{Base}) - (W_{Eff} \times CT_{Eff})}{3{,}600}$$

Equation 299

$$Energy\ Savings\ [\Delta kWh] = \frac{UPD \times AOD \times \Delta Wh}{1{,}000} \times IEF_E$$

Equation 300

$$Peak\ Demand\ Savings\ [\Delta kW] = \frac{UPD \times AOD \times \Delta Wh}{1{,}000 \times AOH} \times CF \times IEF_D$$

Equation 301

Where:

W_{Base}	=	*Baseline equipment nominal power*[668] *= 2,155 W*
CT_{Base}	=	Cycle time of baseline equipment[669] = *34 seconds*
W_{Eff}	=	*Efficient equipment nominal power*[670] *= 1,329 W*
CT_{Eff}	=	*Cycle time of efficient equipment*[671] *= 17 seconds*
3,600	=	*Constant to convert from seconds to hours*
UPD	=	*Number of uses per day*[672] *(see Table* 352*)*
AOD	=	*Number of days the facility operates per year*[673] *(see Table* 352*)*

[667] See Volume 3, 2.1.1 Lamps and Fixtures. It is assumed building occupancy with respect to lighting is an appropriate proxy for occupant utilization of hand dryers.
[668] Baseline and efficient nominal power and cycle times are averages of 48 surveyed individual hand dryer units by CLEAResult in Arkansas.
[669] Ibid.
[670] Ibid.
[671] Ibid.
[672] IL TRM 12 Volume 2, Section 4.8.26.
[673] Technology Data Characterizing Water Heating in Commercial Buildings: Application to End-Use Forecasting, Osman Sezgen and Jonathan G. Koomey, Lawrence Berkeley National Laboratory, December 1995. Table 2. https://eta-publications.lbl.gov/sites/default/files/lbnl-37398e.pdf.

AOH = *Annual building operating hours (see Table 352)*

CF = *Peak coincidence factor (see Table 352)*

IEF_E = *Interactive effects factor for energy, 1.05*

IEF_D= = *Interactive effects factor for demand, 1.10*

Deemed Energy and Demand Savings Tables

The deemed energy and demand savings for hand dryers with a stipulated number of operating days per year, base/efficient cycle times, and base/efficient unit wattages are shown in Table 352.

Table 352. Hand Dryers—Savings Calculation Input Assumptions

Usage level	Building type	UPD[674]	AOD[675]	AOH[676]	Coincidence factor[677]				
					Amarillo	Dallas	Houston	Corpus Christi	El Paso
Low	Office	50	250	3,737	0.87	0.88	0.86	0.90	0.90
	Warehouse	50	250	3,501	0.79	0.81	0.79	0.80	0.85
Medium/ moderate	Food sales: Non-24-hour supermarket or convenience store	125	365	4,706	0.90	0.90	0.90	0.90	0.90
	Food service: Full-service restaurant	125	365	4,368	0.90	0.90	0.90	0.90	0.90
	Food service: Quick-service restaurant	125	365	6,188	0.90	0.90	0.90	0.90	0.90
	Mercantile: Stand-alone retail	125	365	3,668	0.90	0.90	0.90	0.90	0.90
	Mercantile: Strip mall	125	365	3,965	0.90	0.90	0.90	0.90	0.90
High	Education: College, university, vocational, and day care	250	200	3,577	0.90	0.90	0.90	0.90	0.90
	Education: K-12[678]	250	200	3,177	0.42	0.39	0.90	0.90	0.57
	Food sales: 24-hour supermarket or convenience store	375	365	6,900	0.90	0.90	0.90	0.90	0.90
	Mercantile: Enclosed mall	375	365	4,813	0.90	0.90	0.90	0.90	0.90
	Public assembly	250	250	2,638	0.65	0.65	0.65	0.65	0.65
Heavy duty/ extreme	Transportation center	750	365	8,760	1.00	1.00	1.00	1.00	1.00

674 IL TRM 12 Volume 2, Section 4.8.26.
675 Technology Data Characterizing Water Heating in Commercial Buildings: Application to End-Use Forecasting, Osman Sezgen and Jonathan G. Koomey, Lawrence Berkeley National Laboratory, December 1995. Table 2. https://eta-publications.lbl.gov/sites/default/files/lbnl-37398e.pdf.
676 From 2.1.1 Lamps and Fixtures measure.
677 Ibid.
678 Assuming K–12 with partial summer session.

Table 353. Hand Dryers—Deemed Energy and Peak Demand Savings

Usage level	Building type	kWh	Summer kW				
			Amarillo	Dallas	Houston	Corpus Christi	El Paso
Low	Office	185	0.05	0.05	0.04	0.05	0.05
	Warehouse	185	0.04	0.04	0.04	0.04	0.05
Medium/ moderate	Food sales: Non-24-hour supermarket or convenience store	674	0.14	0.14	0.14	0.14	0.14
	Food service: Full-service restaurant	674	0.15	0.15	0.15	0.15	0.15
	Food service: Quick-service restaurant	674	0.10	0.10	0.10	0.10	0.10
	Mercantile: Stand-alone retail	674	0.17	0.17	0.17	0.17	0.17
	Mercantile: Strip mall	674	0.16	0.16	0.16	0.16	0.16
High	Education: College, university, vocational, and day care	739	0.19	0.19	0.19	0.19	0.19
	Education: K-12	739	0.10	0.09	0.22	0.22	0.14
	Food sales: 24-hour supermarket or convenience store	2,022	0.28	0.28	0.28	0.28	0.28
	Mercantile: Enclosed mall	2,022	0.40	0.40	0.40	0.40	0.40
	Public assembly	923	0.24	0.24	0.24	0.24	0.24
Heavy duty/ extreme	Transportation center	4,044	0.48	0.48	0.48	0.48	0.48

Claimed Peak Demand Savings

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

Measure Life and Lifetime Savings

The estimated useful life (EUL) is ten years[679] for efficient hand dryers.

Program Tracking Data and Evaluation Requirements

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

- Climate zone or county

[679] Based on studies conducted by two separate parties; Comparative Environmental Life Cycle Assessment of Hand Drying Systems by Quantis (pg. 2) and Guidelines to Reduce/Eliminate Paper Towel Use by Installing Electric Hand Dryers by Partners in Pollution Prevention P3 (pg. 17).

- Building type
- Installed quantity
- Efficient hand dryer make and model
- Efficient hand dryer nominal input power (W)
- Proof of purchase

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 354. Hand Dryers—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.
v12.0	10/2024	TRM v12.0 update. Updated building type naming convention. Updated peak demand calculation, savings calculation input assumptions, and deemed savings.

2.7.15 Laser Projectors Measure Overview

TRM Measure ID: NR-LT-LP

Market Sector: Commercial

Measure Category: Miscellaneous

Applicable Building Types: Motion picture theaters

Fuels Affected: Electricity

Decision/Action Types: Retrofit

Program Delivery Type: Prescriptive

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure is for the replacement of a lamp-based projector with a laser projector. The conversion from a traditional lamp-based projector system to a laser projector benefits from reduced energy consumption via electricity savings and HVAC savings. With advancements in solid-state technology, laser projectors typically require half the electricity to obtain the equivalent light and resolution output as lamp-based projectors. Due to this reduced electricity consumption, laser projectors also benefit from HVAC savings, with significantly less energy wasted as heat. Another benefit of laser projectors is that they do not require the use of lamps, which can be costly from an equipment and operations standpoint.

Despite the various ways laser projectors result in energy savings, this measure solely focuses on the electricity savings for operating the projector. Due to interactive effects unique to each site, this measure will not consider the corresponding HVAC savings, so annual savings estimates are conservative.

Eligibility Criteria

This measure applies to the replacement of any motion picture theater lamp-based projector. At this time, this measure is limited to retrofit applications where the baseline lamp wattage is specified to match site conditions. Eligibility may be extended to new construction applications once sufficient program implementation data can be collected to establish an appropriate baseline.

Baseline Condition

There is no federal standard applicable to lamp-based projectors. The baseline condition is any commercial cinema lamp-based projector that is replaced by a laser projector. The measure does not consider home, office, venue or any projector replacements that are outside of a professional cinema setting.

High-Efficiency Condition

The high-efficiency condition is a professional commercial cinema laser projector with an equivalent (or no greater than 110%) lumen output of the baseline projector being replaced.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

This section describes the deemed savings methodology for both energy and demand savings for laser projectors.

Energy Savings Algorithms

Energy savings for this measure are determined to be the difference in maximum operating input rate for the baseline and efficient projector multiplied by the total yearly operating hours for the facility.

$$Energy\ Savings\ [kWh] = (kW_{pre} - kW_{installed}) \times Hours$$

Equation 302

$$Summer\ Peak\ Demand\ Savings\ [kW_S] = (kW_{pre} - kW_{installed}) \times CF_S$$

Equation 303

$$Winter\ Peak\ Demand\ Savings\ [kW_W] = (kW_{pre} - kW_{installed}) \times CF_W$$

Equation 304

Where:

kW_{pre}	=	*Total kW of existing lamp-based projector*
$kW_{installed}$	=	*Total kW of efficient laser projector*
Hours	=	*Annual operating hours = 3,653 hours*[680] *(use actual hours if known)*
CF_S	=	*Summer peak coincidence factor = 0.65 (all climate zones)*[681]
CF_W	=	*Winter peak coincidence factor = 0 (all climate zones)*[682]

680 "HVAC considerations for lamp and laser projectors in cinema," Barco. July 26, 2021. The reference uses 11.5 hours per day (or 4,200 hours) as an example. This measure assumes 10 hr/day as a conservative assumption, but allows for the use of custom hours based on site conditions. Default hours are calculated as 10 hr/day x 365.25 day/year = 3,653 hours.

681 Refer to Lamps and Fixtures measure for the public assembly building type, which is applicable to motion picture theaters.

682 Ibid.

Claimed Peak Demand Savings

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

Measure Life and Lifetime Savings

The estimated useful life (EUL) is 10 years for cinema laser projectors.[683,684,685]

Program Tracking Data and Evaluation Requirements

The program database should specify and track the list of primary inputs and contextual data provided below. This will inform the evaluation process and ensure proper application of the savings.

- Building type
- Baseline lamp-based projector manufacturer and model number
- Baseline projector lamp wattage
- Baseline lamp-based projector nameplate photo
- New laser projector manufacturer and model number
- New laser projector wattage
- New projector nameplate photo
- Proof of purchase: invoice showing model number and quantity purchased

Document Revision History

Table 355. Laser Projectors—Revision History

TRM version	Date	Description of change
v11.0	10/2023	TRM v11.0 origin
v12.0	10/2024	TRM v12.0 update. No revisions.

683 Average rated life of 18 Barco and Christie cinema laser projectors = 41,667 hours. Dividing by annual operating hours yields EUL.

684 Barco cinema projector product listing. https://www.barco.com/en/products/projection/overview?facets=barco-dxp%3Aproduct%2Fproduct-category%2Fprojection%2Fcinema-projectors.

685 Christie cinema projector product listing. https://www.christiedigital.com/products/cinema/projection/.

APPENDIX A: MEASURE LIFE CALCULATIONS FOR DUAL BASELINE MEASURES

The following appendix describes the method to calculate savings for any dual baseline measure, including all early retirement measures. This supersedes the previous Measure Life Savings found in PUCT Dockets 40083 and 40885 and is revised to clarify the understanding of the measure life calculations and reduce any misrepresentation of net present value (NPV) of early retirement projects.

Option 1 provides reduced savings claimed over the full EUL. Option 2 provides higher savings claimed over a reduced EUL. The lifetime savings are the same for both options 1 and 2. Option 1 calculations were originally provided in Docket [43681].

<u>Option 1—Weighting Savings and Holding Measure Life Constant</u>

Step 1: Determine the measure life for first-tier (FT) and second-tier (ST) components of the calculated savings:

$$First\ Tier\ (FT)\ Period = ML_{FT} = RUL$$

Equation 305

$$Second\ Tier\ (ST)\ Period = ML_{ST} = EUL - RUL$$

Equation 306

Where:

RUL	=	*The useful life corresponding with the first tier-savings; for early retirement projects, RUL is the remaining useful life determined from lookup tables based on the age of the replaced unit (or default age when actual age is unknown)*
EUL	=	*The useful life corresponding with the second-tier savings; for early retirement projects, EUL is the estimated useful life as specified in applicable measure from Texas TRM (or approved petition)*

Step 2: Calculate the FT demand and energy savings and the ST demand and energy savings:

$$\Delta kW_{FT} = kW_{retired} - kW_{installed}$$

Equation 307

$$\Delta kW_{ST} = kW_{baseline} - kW_{installed}$$

Equation 308

$$\Delta kWh_{FT} = kWh_{retired} - kWh_{installed}$$

Equation 309

$$\Delta kWh_{ST} = kWh_{baseline} - kWh_{installed}$$

Equation 310

Where:

ΔkW_{FT}	=	*First-tier demand savings*
ΔkW_{ST}	=	*Second-tier demand savings*
$kW_{retired}$	=	*Demand of the first-tier baseline system, usually the retired system*[686]
$kW_{baseline}$	=	*Demand of the second-tier baseline system, usually the baseline ROB system*[687]
$kW_{installed}$	=	*Demand of the replacement system*[688]
ΔkWh_{FT}	=	*First-tier energy savings*
ΔkWh_{ST}	=	*Second-tier energy savings*
$kWh_{retired}$	=	*Energy usage of the first-tier baseline system, usually the retired system*[686]
$kWh_{baseline}$	=	*Energy usage of the second-tier baseline system, usually the baseline ROB system*[687]
$kWh_{installed}$	=	*Energy usage of the replacement system*[688]

Step 3: Calculate the avoided capacity and energy cost contributions of the total NPV for both the ER and ROB components:

$$NPV_{FT,kW} = AC_{kW} \times \frac{1+e}{d-e} \times \left\{1 - \left[\frac{1+e}{1+d}\right]^{ML_{FT}}\right\} \times \Delta kW_{FT}$$

Equation 311

$$NPV_{ST,kW} = AC_{kW} \times \frac{1+e}{d-e} \times \left\{1 - \left[\frac{1+e}{1+d}\right]^{ML_{ST}}\right\} \times \frac{(1+e)^{ML_{FT}}}{(1+d)^{ML_{FT}}} \times \Delta kW_{ST}$$

Equation 312

$$NPV_{FT,kWh} = AC_{kWh} \times \frac{1+e}{d-e} \times \left\{1 - \left[\frac{1+e}{1+d}\right]^{ML_{FT}}\right\} \times \Delta kWh_{FT}$$

Equation 313

686 Retired system refers to the existing equipment that was in use before the retrofit had occurred.
687 Baseline used for a replace-on-burnout project of the same type and capacity as the system being installed in the early retirement project (as specified in the applicable measure).
688 Replacement system refers to the installed equipment that was in place after the retrofit had occurred.

$$NPV_{ST,kWh} = AC_{kWh} \times \frac{1+e}{d-e} \times \left\{1 - \left[\frac{1+e}{1+d}\right]^{ML_{ST}}\right\} \times \frac{(1+e)^{ML_{FT}}}{(1+d)^{ML_{FT}}} \times \Delta kWh_{ST}$$

Equation 314

Where:

$NPV_{FT,\ kW}$	=	*Net Present Value (kW) of first-tier projects*
$NPV_{ST,\ kW}$	=	*Net Present Value (kW) of second-tier projects*
$NPV_{FT,\ kWh}$	=	*Net Present Value (kWh) of first-tier projects*
$NPV_{ST,\ kWh}$	=	*Net present value (kWh) of second-tier projects*
e	=	*Escalation rate* [689]
d	=	*Discount rate weighted average cost of capital (per utility)*[689]
AC_{kW}	=	*Avoided cost per kW ($/kW)*[689]
AC_{kWh}	=	*Avoided cost per kWh ($/kWh)*[689]
ML_{FT}	=	*First-tier measure life (calculated in Equation 305)*
ML_{ST}	=	*Second-tier measure life (calculated in Equation 306)*

Step 4: Calculate the total capacity and energy cost contributions to the total NPV:

$$NPV_{Total,kW} = NPV_{FT,kW} + NPV_{ST,kW}$$

Equation 315

$$NPV_{Total,kWh} = NPV_{FT,kWh} + NPV_{ST,kWh}$$

Equation 316

Where:

$NPV_{Total,\ kW}$	=	*Total capacity contributions to NPV of both first-tier and second-tier component*
$NPV_{Total,\ kWh}$	=	*Total energy contributions to NPV of both first-tier and second-tier component*

[689] The exact values to be used each year for the escalation rate, discount rate, and avoided costs are established by the PUC in Substantive Rule §25.181 and updated annually, as applicable. Please note that the discount rates are based on a utility's weighted average cost of capital and, as such, will vary by utility and may change each year.

Step 5: Calculate the capacity and energy cost contributions to the NPV without weighting by demand and energy savings for a scenario using the original EUL:

$$NPV_{EUL,kW} = AC_{kW} \times \frac{1+e}{d-e} \times \left\{1 - \left[\frac{1+e}{1+d}\right]^{EUL}\right\}$$

Equation 317

$$NPV_{EUL,kWh} = AC_{kWh} \times \frac{1+e}{d-e} \times \left\{1 - \left[\frac{1+e}{1+d}\right]^{EUL}\right\}$$

Equation 318

Where:

$NPV_{EUL,\ kW}$	=	*Capacity contributions to NPV without weighting, using original EUL*
$NPV_{EUL,\ kWh}$	=	*Energy contributions to NPV without weighting, using original EUL*

Step 6: Calculate the weighted demand and energy savings by dividing the combined capacity and energy cost contributions from the ER and ROB scenarios by the non-savings weighted capacity and energy cost contributions from the single EUL scenario. These weighted savings are claimed over the original measure EUL:

$$Weighted\ kW = \frac{NPV_{Total\ kW}}{NPV_{EUL,kW}} = \frac{\left[\left(1-\left(\frac{1+e}{1+d}\right)^{RUL}\right) \times \left(kW_{retired} - kW_{installed}\right)\right] + \left[\left(1-\left(\frac{1+e}{1+d}\right)^{EUL-RUL}\right) \times \frac{(1+e)^{RUL}}{(1+d)^{RUL}} \times \left(kW_{baseline} - kW_{installed}\right)\right]}{\left(1-\left(\frac{1+e}{1+d}\right)^{EUL}\right)}$$

Equation 319

$$Weighted\ kWh = \frac{NPV_{Total.kWh}}{NPV_{EUL,kWh}} = \frac{\left[\left(1-\left(\frac{1+e}{1+d}\right)^{RUL}\right) \times \left(kWh_{retired} - kWh_{installed}\right)\right] + \left[\left(1-\left(\frac{1+e}{1+d}\right)^{EUL-RUL}\right) \times \frac{(1+e)^{RUL}}{(1+d)^{RUL}} \times \left(kWh_{baseline} - kWh_{installed}\right)\right]}{\left(1-\left(\frac{1+e}{1+d}\right)^{EUL}\right)}$$

Equation 320

Where:

Weighted kW	=	*Weighted lifetime demand savings*
Weighted kWh	=	*Weighted lifetime energy savings*
$NPV_{Total,\ kW}$	=	*Total capacity contributions to NPV of both ER and ROB component, calculated in Equation 315*

$NPV_{Total,\ kWh}$	=	*Total energy contributions to NPV of both ER and ROB component, calculated in Equation 316*
$NPV_{EUL,\ kW}$	=	*Capacity contributions to NPV without weighting, using original EUL, calculated in Equation 317*
$NPV_{EUL,\ kWh}$	=	*Energy contributions to NPV without weighting, using original EUL, calculated in Equation 318*

Option 2—Weighting Measure Life and Holding First Year Savings Constant

Repeat Step 1 through Step 4 from Option 1.

Step 5: Reverse calculate the EUL for the capacity and energy contributions to the NPV for a scenario using the first-tier savings:

$$EUL_{kW} = \frac{ln\left[\frac{NPV_{Total,kW} \times (d-e)}{\Delta kW_{FT} \times AC_{kW} \times (1+e)}\right]}{ln\left[\frac{(1+e)}{(1+d)}\right]}$$

Equation 321

$$EUL_{kWh} = \frac{ln\left[\frac{NPV_{Total,kWh} \times (d-e)}{\Delta kWh_{FT} \times AC_{kWh} \times (1+e)}\right]}{ln\left[\frac{(1+e)}{(1+d)}\right]}$$

Equation 322

Where:

EUL_{kW}	=	*EUL for capacity contribution to NPV using first-tier savings*
EUL_{kWh}	=	*EUL for energy contribution to NPV using first-tier savings*

Step 6: Confirm that capacity EUL and energy EUL are equivalent. First-tier savings are claimed over this weighted EUL.

Public Utility Commission of Texas

Texas Technical Reference Manual

Version 12.0

Volume 5: Implementation Guidance

Program Year 2025

Last Revision Date:

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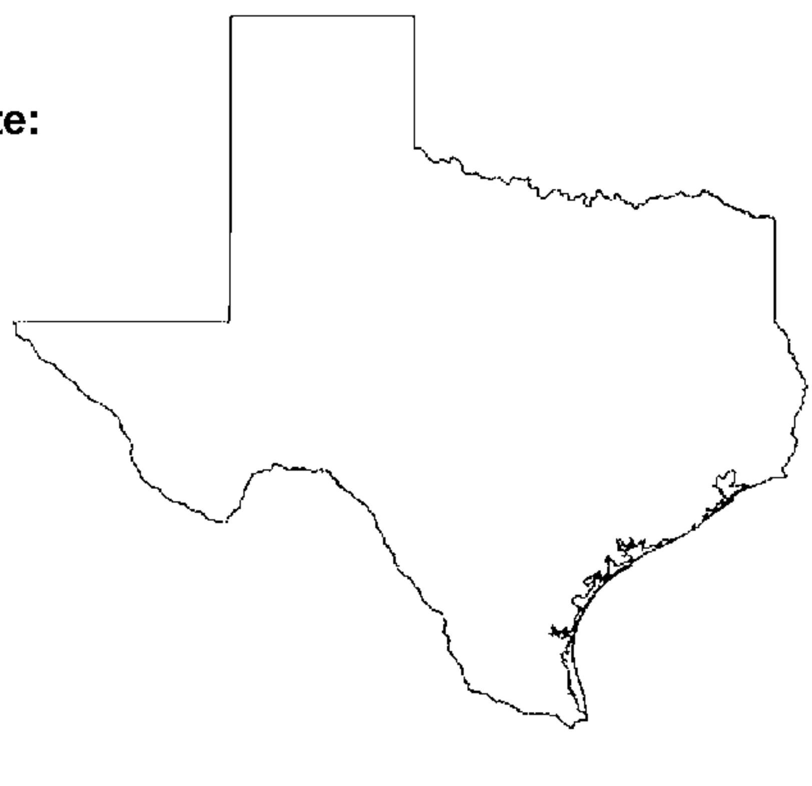

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Acknowledgments

The Texas Technical Reference Manual (TRM) is maintained by the Public Utility Commission of Texas' (PUCT) independent evaluation, measurement, and verification (EM&V) contractor, Tetra Tech.

This version of the TRM 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 Associates (TXu 1-904-705), ICF, CLEAResult, and Resource Innovations. Portions of the TRM 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 the PUCT staff (Ramya.Ramaswamy@puc.texas.gov).

1. INTRODUCTION

This volume of the technical reference manual (TRM) contains evaluation, measurement, and verification (EM&V) team recommendations regarding program implementation that may affect claimed savings. The EM&V contractor drafts guidance memos for the electric utilities' energy efficiency programs to provide clear direction on calculating or claiming savings. Guidance memos are consistent with the Energy Efficiency Rule 16 Texas Administrative Code (TAC) § 25.181 and the TRM but address areas where additional direction is needed for consistency and transparency across utilities' claimed savings from the programs. This volume compiles the various guidance memos produced during the EM&V effort.

Implementation guidance contained in this volume is summarized by sector below:

Commercial

- Project documentation
- Additional savings
- New construction

Residential

- Low-Income Income-Eligible verification forms
- Audit list for Low-Income programs

Cross-Sector

- Load management programs
- Commercial and residential HVAC split-systems without AHRI certification
- Data model

2. COMMERCIAL

2.1 PROJECT DOCUMENTATION

This section summarizes the progress and current status of the evaluation, measurement, and verification (EM&V) team's assessment of the utilities' efforts to meet and conform to project documentation standards and provides additional guidance for areas still in need of improvement as part of the annual EM&V statewide report.

2.1.1 Background

For all energy efficiency programs, critical inputs and methodologies needed to replicate claimed savings calculations are captured in a combination of the TRM, program manuals, program tracking data systems, and individual project documentation. Project-level documentation is critical to the transparency of claimed savings and facilitates efficient third-party EM&V at the project, program, and portfolio levels. This section specifically addresses individual project documentation needs; individual project documentation includes all relevant site-specific details (e.g., audit reports, worksheets, program applications, invoices, project overviews and descriptions, photos, and installation reports).

We provide detail on documentation best practices currently incorporated into many Texas programs (based on information gathered during PY2022 evaluation activities) and recommendations for improvement. The objective is to support the utilities in achieving industry-standard degrees of documentation rigor, clarity, and efficacy; these standards are necessary to organize and manage such information to yield transparency and facilitate efficient and effective evaluation.

2.1.2 Additional Documentation Guidance

In this section, we provide guidance geared specifically to help improve CSOP program documentation scores. However, the guidance may also be used to support the continued improvement of program documentation for other programs.

Recommendation 1: Clearly organize project files.

Organized project files are critical for many reasons, including:

- clear and transparent reporting of documentation used to support claimed savings,
- ease of identification of related program project files that may not have made the data transfer,
- backup support for information within tracking data systems,
- support custom parameter usage, and
- support deviation or enhancement of methodologies to gain greater accuracy.

An important part of organized project folders, files, and documents is clear naming conventions; this helps keep files organized and improves consistency in document placement and locating critical documents to support the EM&V efforts. Below are some examples of the difficulty the EM&V team has had with project-level folders and files received:

- The project folders often contained inconsistencies regarding file and document names, locations, and contents. Files with similar names often contained disparate information, while seemingly identical files contained dissimilar information.
- The project folders included multiple copies of project documents. Locating the final documents used to support the reported savings proved difficult for many projects. Distinguishing between pre- and post-equipment invoices, plans, and photos can be difficult when not organized.
- Project folders contained documents labeled as verification reports when they were still actually measurement and verification (M&V) plans with no completed verification data. Such plans provided the methodology to verify project savings estimates yet did not document the verified measurements planned or the project savings calculations.

The project file organization example below provides a list of potential project subfolders and documents that would be ideal for collecting information to determine whether a pre- and post-inspection has been completed. Many documents listed are key elements necessary to support custom project assumptions and review.

Table 1. Project File Organization Example

Stage	Retrofit and new construction
Pre-project*	• Pre-project calculator • Plans (e.g., drawings, fixture list) • Pre-project inspection photos • Pre-project audit reports • Pre-project M&V plan • Project descriptions, sponsor agreements, etc.
Post-project	• Post-project inspection calculator • Post-inspection field notes • Post-project inspection photos • As-built plans • Installation reports
Supporting documents	• Spreadsheets or other backup documentation • Specifications, cut sheets, certifications • Check requests to utility • Partner letters or savings summaries • Material purchase orders and invoices • Email communication • Documentation of assumptions (if not in pre-project or post-project folder) •

Stage	Retrofit and new construction
Final documents**	• Final calculator • Final M&V plan • Final verification documents • Final project notes

* New construction projects may not necessarily include these documents.
** These documents also support EM&V on-site minimum requirements for data collection needs.

Recommendation #2: Use photo verifications to support key measure assumptions.

When on-site fieldwork is complete—whether by trade allies, implementation staff, or utility staff—representative photos can help document and support key measure attributes and assumptions. Most programs include some form of photo documentation to support projects. The table below outlines how photos can support project documentation for some of the most common commercial project types (i.e., lighting- and HVAC-based projects).

Table 2. Project Verification Applications and Examples

Stage	Lighting projects*	HVAC projects
Pre-project	• Existing lighting system types (e.g., lamp, ballast, fixture) • Existing lighting equipment quantities • Existing control type • Existing lighting equipment operability and inoperability • Building type • Air conditioning type	• Existing HVAC equipment types and sizes • Existing HVAC equipment quantities • Existing HVAC equipment operability and inoperability (e.g., setpoint, load display shots) • Building type
Post-project	• New lighting system types (e.g., lamp, ballast, fixture) • New lighting equipment quantities • New control type • New control schedule automation (e.g., building and lighting automation system screenshots) • New lighting equipment operability • Building type • Air conditioning type	• New HVAC equipment types and sizes • New HVAC equipment quantities • New HVAC equipment operability (e.g., setpoint, load display shots) • Building type

* Note that some of these project parameters may not be possible to capture for all lighting quantities for large lighting projects. In these cases, alternative project documentation types may be preferred.

Recommendation #3: Include clear descriptors of measure type as well as quality assurance/quality control (QA/QC) inspections in the tracking system.

Different projects (e.g., retrofit versus new construction projects, inspected versus not inspected sites) have different documentation needs. Capturing participant descriptors can aid evaluation efforts immensely, keep cost burdens low, and facilitate transparency.

Many commercial programs continue to track and describe measure-level savings at the measure-category level (or savings calculator level) instead of the measure-specific level. For example, the tracking system will document the savings associated with a lighting project captured within a lighting calculator (e.g., LSF 2023.3). However, the calculator includes many different lighting fixture types, effective useful lives, and related savings. Tracking project data at the measure-specific level (e.g., integrated-ballast LED lamps, LED fxture, lighting controls) rather than the measure-category level will improve the data's transparency to readily assess measure types and individual claimed savings. This structure also supports ease for calculating cost-effectiveness.

As another example, new construction projects may not have pre-inspection forms or field notes. In contrast, retrofit projects may have many pre-project documentation types (e.g., pre-project calculator, pre-project plans, pre-inspection photos). Providing information regarding "greenfield" or complete demolition and rebuild projects as a differentiator from retrofits and small remodels upfront is a valuable population segmenting descriptor. When tracking systems use descriptors like these, they become a valuable screening tool; they can inform evaluators not to request certain documentation (that may not exist), which can misdirect time and resources. It also allows better budgeting and allocation of resources, improving overall efficacy. Another example is those sites or program participants that receive internal QA/QC versus those that do not. Some programs have modified their tracking systems to begin logging this data and provide a list as part of the EM&V data collection process; this list notifies the EM&V team that a site will not have specific project-level documentation because it was not site-inspected or verified, etc.

Recommendation #4: Complete M&V plans and reports needed for some program types, M&V projects, and custom projects.

Some specialty programs or differentiated implementation strategies of components of larger programs require program wide documentation to support the standard assumptions based on the implementation methods. This guidance applies to several scenarios, with some examples listed below.

- Midstream implementation: Equipment delivered through a midstream implementation method should identify the processes to determine equipment eligibility and the asssumptions used for the savings calculations for the program prior to the sale of the equipment. A M&V plan should identify these along with the quality assurance and quality control processes for the implementation method.
- AC/HP Tune-Up: The Tune-Up programs require a sample of the projects to include measurement in the baseline and post Tune-Up condition. These measurements will determine a implementation specific factor to be applied to the remainder of the projects. An M&V Plan for Tune-Up programs should document the development of the factors, identification fo the services provided, the use of the factors to determine savings, and quality assurance and quality control processes.

For specific projects which require M&V measurement or custom calculation of savings should document the conditions of the project with an M&V Plan. The M&V plan should contain the sections detailed in the TRM measure as well as additional pertinent information for the project. Utilities and their implementation contractors are encouraged to engage and collaborate with the EM&V team to discuss issues and options, obstacles, and possible solutions for custom calculations and M&V plans as projects and data available may not always provide ideal conditions for energy savings calculations..

2.2 INCENTIVES AND CLAIMED SAVINGS

This section provides guidance on claiming savings when a financial incentive does not cover all project savings during the implementation of energy efficiency measures.[1]

2.2.1 Background

To meet various program objectives, it is common practice for utilities to set a ceiling or cap for the financial incentive any one energy efficiency service provider (EESP) or project can receive. These "individual incentive caps" are set as an overall percentage of the total incentive budget or as a dollar amount. The established caps vary by utility and are noted in their program manuals.

Individual incentive caps are different from a "set incentive." During the application phase, utilities calculate a project incentive based on pre-installation estimated savings; reserving incentive funds are at that time. Once the project is complete, there may be some variation in the initial agreed-upon savings estimates while setting the incentive and the actual post-installation savings. This variation is due to changes in efficiency levels, quantities, or equipment types that take place between the project planning phase and the project implementation phase.

2.2.2 Considerations

In the case of incentive caps, the EM&V team has some concerns regarding claiming all project savings when reaching an incentive cap. Since all project savings are not being incentivized at the project planning phase, claiming all project savings may result in increased free-ridership. A free rider is "a program participant who would have implemented the program measure or practice in the absence of the program." (16 TAC § 25.181 (c) (24)).[2]

In the case of set incentives, the EM&V team has some concerns that spillover could be claimed incorrectly during post-project inspections. Spillover is "reductions in energy consumption and demand caused by the presence of an energy efficiency program, beyond the program-related gross savings of the participants and without financial or technical assistance from the program." ((16 TAC § 25.181 (c) (53)). Spillover is a component of net savings, and claimed savings are based on gross savings. Therefore, spillover should not be included in claimed savings if found on-site during post-project inspections.

[1] This guidance does not apply to behavioral, code or other market transformation programs where the primary program strategy is technical assistance and/or education that results in behavioral or operational changes for energy and demand savings.

[2] In addition to the incentive caps or set incentives at the individual EESP or customer-level, utilities may also set caps on incentives a customer can receive at the measure level. For example, a utility may cap lighting incentives at 50 percent of the total project incentive. The EM&V team does not have the same concerns regarding free-ridership for measure-level caps and the recommendations in this memo do not apply to these situations.

2.2.3 Recommendations

Establish greater consistency in the treatment of projects where claimed savings exceed incentive amounts and most accurately represent the savings results from these projects. The EM&V team recommends utilities either only claim the savings from the incentivized measures or the utilities apply the most updated net-to-gross (NTG) research[3] to the total project savings for the claimed savings[4] as follows:

For projects where the *claimed savings are more than 10 percent higher than the "set incentive*," the NTG ratio inclusive of free-ridership and spillover should be applied to the total project savings. No NTG ratio should be applied for projects where the set incentive and claimed savings differ by 10 percent or less to allow for normal variation between project planning and implementation.

For projects where *claimed savings exceed the "incentive cap" savings up to 20 percent of incentivized savings*, the NTG ratio inclusive of free-ridership and spillover should be applied to the total project savings.

$$NTG\ ratio_{projects\ exceeding\ set\ incentive} = 1 - Free\ Ridership + Spillover$$

Equation 1

For projects where total *claimed savings exceed the "incentive cap" by more than 20 percent of incentivized savings*, the NTG ratio only accounting for free-ridership should be applied to the total project savings. Applying the NTG ratio that is also inclusive of spillover to projects that exceed incentive amounts by a percentage of incentivized savings this large would likely result in double-counting spillover.

$$NTG\ ratio_{projects\ exceeding\ incentive\ cap} = 1 - Free\ Ridership$$

Equation 2

The PY2021 EM&V research updated NTG ratios for the commercial standard offer (CSOP) and market transformation programs (CMTP). The PY2021 NTG research accounts for free riders; spillover rates were derived from the PY2017 EM&V research. The CSOP NTG ratio is 100 percent for kWh and 99 percent for kW. The CMTP NTG ratio is 100 percent for kWh and kW.

Table 3. PY2021 Commercial Statewide NTG Ratios by Program Type

Program type/weighting	Free-ridership	Spillover	NTG
CSOP kWh	23%	24%	100%
CSOP kW	22%	21%	99%
CMTP kWh	19%	22%	100%
CMTP kW	20%	32%	100%

[3] The use of a net to gross adjustment to account for free-riders is addressed in § 25.181 (e)(5)(B)(ii).

[4] This recommendation does not apply to behavioral, code or other market transformation programs where the primary program strategy is technical assistance and education that results in behavioral or operational changes for energy and demand savings.

Projects might have multiple measures with different effective useful lives (EULs) that are taken into account when calculating lifetime savings; for these cases, the EM&V team provides the following additional guidance for adjusting claimed savings that exceed incentive levels:

1. Determine the total calculated savings by EUL.
2. Determine the percent of total project savings attributed to each EUL.
3. Adjust savings as recommended above.
4. Distribute adjusted savings to various project EULs using the percentages calculated in Step 2.

The following is an example of a project with 50 kW and 50,000 kWh of calculated savings. An RTU HVAC project with a 15-year EUL attributes twenty percent of those savings, and a chiller project with a 25-year EUL attributes the remaining 80 percent. The adjusted savings are 40 kW and 40,000 kWh. Those adjusted savings would be attributed to each EUL as follows:

1. 40 kW x 20% = 8 kW and 40,000 kWh x 20% = 8,000 kWh attributed to the 15-year EUL
2. 40 kW x 80% = 32 kW and 40,000 kWh x 80% = 32,000 kWh attributed to the 25-year EUL

2.3 NEW CONSTRUCTION

This section provides additional guidance to select the appropriate baseline for commercial new construction projects.

2.3.1 Overview

Utility programs include incentives for a variety of projects applicable to commercial new construction, such as lighting, HVAC, and roofs. To effectively implement new construction energy efficiency projects, utility programs need to reach decision-makers during the project design phase. However, it is common for several years to pass between the project design phase and project completion in commercial new construction. Since baselines change, this situation raises the question of what baseline utilities should use for commercial new construction projects to claim savings. For example, in PY2016, Texas' new construction baseline was IECC 2009 based on the state code in effect at that time. In PY2025, the statewide code is now IECC 2015 but local codes are often IECC 2018 or more recent versions.

2.3.2 Recommendation

For commercial new construction projects, utilities should use the building permit date to determine the applicable version of the Texas TRM and baseline code to calculate savings.

3. LOW-INCOME

3.1 LOW-INCOME INCOME-ELIGIBLE VERIFICATION FORMS

This section provides implementation recommendations for the program year (PY) 2024 (PY2024) eligibility verification for low-income and hard-to-reach programs.

3.1.1 Background

Texas utilities provide energy efficiency services to low-income customers through a combination of hard-to-reach and low-income programs as specified in 16 Tex. Admin. Code (TAC) § 25.181, relating to the energy efficiency goal. All regulated Texas electric utilities are required to achieve no less than 5 percent of their total demand reduction goal through programs serving hard-to-reach customers (16 TAC § 25.181(e)(3)(F)). In addition, the ERCOT utilities are required to spend no less than 10% of each program year's energy efficiency budget on a targeted low-income efficiency program (16 TAC § 25.181(r)). The qualifying income level of 200% federal poverty level is the same for hard-to-reach and low-income programs though the programs are implemented differently.

The forms differ by single-family and multi-family, but both include a way to qualify for the programs through other low-income programs and services (Category 1) as well as through self-reported income (Category 2). The PUCT has revised the income eligibility annually based on updated federal poverty level information, but the forms have not had major changes for over a decade. Due to the importance of these forms in determining program eligibility, PUCT Staff and the EM&V team agreed to incorporate the forms into Volume 5 of the Texas Technical Reference Manual (TRM) starting with program year (PY) 2022. Forms will be updated as part of the annual TRM update process. As part of integrating the eligibility certification forms into the TRM, PUCT Staff, and the EM&V team worked with the utilities to review the forms and certification processes in-depth. Appendix A contains the Single-Family and Multifamily Income Eligibility for Full-Incentive Energy Efficiency Services forms.[5]

The objectives of the in-depth process review were to "Revise low-income/hard-to-reach eligibility verification to increase the confidence program services are going to intended customers, improve program outreach and address participation barriers, and develop efficient administration processes," as presented at the March 2021 Energy Efficiency Implementation Project (EEIP) meeting. The PY2023 TRM forms expanded Category 1 options to support streamlined participation through an expanded list of qualifying programs and services (1A), direct social service or community action agency qualification (1B), and geographic qualification (1C). If a customer does not qualify through any of the three options, income information may be used to determine eligibility (Category 2). Both Category 1A and Category 2 require customers to submit supporting documentation. Because Category 2 requires income information, all parties recognize this information can be more sensitive for customers to provide and for service providers to store securely although all personal identifying information (PII) should be redacted, except name and address of customer. Given concerns about income information as a participation barrier, Category 1 is the preferred method to verify customer eligibility whenever possible.

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[5] The most current Single-Family and Multifamily Eligibilty for Full-Incentive Energy Efficiency Services forms are available on the PUCT website, ftp.puc.texas.gov - /public/puct-info/industry/electric/forms/ee/.

3.1.2 Quality Assurance/Quality Control (QA/QC)

Utilities should audit a minimum of 10 percent of all program year projects submitted through each category (1A, 1B, 1C, and 2) to ensure the processes are working correctly and the required documentation was submitted and verified to be correct. In the cases where utilities find an error in the process or documentation during their QA/QC processes, utilities should identify a solution to remedy the error. The EM&V team encourages utilities to integrate the program eligibility audit into their existing QA/QC practices to the extent possible to facilitate the most streamlined and effective implementation of this recommendation.

While utilities are not required to store customer documentation on their systems audited as part of the QA/QC process, they should provide contact information of the auditor who has verified the documentation through a visual inspection.

While audit processes can differ to best integrate with utilities' current QA/QC processes, the following are recommended practices by category:

- Category 1A: Verify form is completed and supporting program documentation was provided
- Category 1B: Verify form is completed and signed by social service or community action agency
- Category 1C: Verify address of serviced home is within one of the two qualifying geographic designations; forms are not required for geographical qualification under 1C as long as the relevant information is in the tracking data (service address, geographic qualifier)
- Category 2: Verify form is completed and supporting income information was submitted to service provider/landlord/property manager

Utilities can either conduct the audits themselves or hire a third-party to do so on their behalf. The EM&V team will request a summary of audit results at the end of each program year. The audit result summary should identify solutions to address any errors found during the audit.

A. Program Tracking and Documentation

Utilities should add a field(s) to their program tracking data to clearly track how a low-income and hard-to-reach participant was qualified for the program (Category 1A, 1B, 1C and 2). This will allow both the utility and the EM&V team to sample projects from each category for auditing purposes.

For Category 1A, 1B and 2, all completed forms and supporting documentation, if applicable, should be stored for all projects. Forms are not required for geographical qualification under 1C as long as the relevant information is in the tracking data (service address, geographic qualifier). Forms and supporting documentation should be maintained for a minimum of 24 months.

B. Claiming Master-Metered Savings

Because master-metered complexes are a commercial rate class, costs and savings should be claimed in the commercial sector. However, if the master-metered complex qualifies for hard-to-reach or low-income program services, these costs and savings may be counted toward the utilities' goals (5 percent of total demand reduction goal for hard-to-reach customers (16 TAC § 25.181(e)(3)(F)), and no less than 10% of each program year's energy efficiency budget on a targeted low-income efficiency program (16 TAC § 25.181(r)).). To avoid double-counting, master-metered projects counted toward the goal should be a separate line item.

3.1.3 New Program Strategies

Some utilities are working on partnerships to distribute energy efficiency measures to low-income and hard-to-reach customers such as distributing LEDs at food banks. In these cases, utilities should meet with the EM&V team to agree on an approach for verifying customer eligibility and claiming savings, which will then be presented to Commission Staff. The goal of these discussions is to support the new strategies in keeping with the overall objective of the in-depth process review stated above.

3.2 AUDIT LISTS FOR LOW-INCOME PROGRAMS

This section summarizes implementation guidance for program year (PY) 2024 for low-income programs. Specifically, it overviews and recommends use of the recently approved Department of Energy (DOE) audit lists as applicable. This recommendation directly addresses prior process evaluation findings that should allow more streamlined and cost-effective low-income program implementation.

Background

Households with incomes at or below 200 percent of the Federal Poverty Level are eligible to receive low-income weatherization assistance through the DOE Weatherization Assistance Program (WAP), administered through the Texas Department of Housing and Community Affairs (TDHCA). Local Community Action Agencies (also referred to as subrecipients by TDHCA) provide the weatherization services to qualifying households, including the initial audit.

In an effort to further help low-income electric customers improve the efficiency of their residences, the Texas legislature put forth that ERCOT utilities include a targeted energy efficiency program in their energy efficiency plans (PURA § 39.905(f)). Specifically, the ERCOT utilities are required to set aside a minimum of 10 percent of their energy efficiency budget for low-income programs.

Also outlined in PURA § 39.905(f)), the low-income programs are to coordinate with the federal weatherization program WAP, including complying with the same audit requirements. Therefore, all single-family homes served through the low-income programs to-date have been evaluated using the National Energy Audit Tool (NEAT). NEAT is designed to determine the most cost-effective retrofit measures for single-family and small multifamily buildings. NEAT uses each home's historic energy use data to prioritize measures for installation. Program and project cost-effectiveness is measured using the Savings-to-investment Ratio (SIR) consistent with DOE requirements.

The EM&V team conducted an in-depth process evaluation of the low-income programs in 2015,[6] which found a primary concern raised by utilities and community action agencies alike was the NEAT tool. As noted above, legislative statute requires that the program comply with the same audit requirements as the federal weatherization program. Process evaluation interviews found that, "the NEAT audit, as a modeling tool, is not transparent; therefore, agencies and implementers have difficulty understanding why certain measures do and do not qualify in various homes. Additionally, they reported it is a cumbersome tool to use and is administratively burdensome. Due to the NEAT audit requirement, an implementer (as well as several agencies) reported that training goes into working with agencies who do not work with the DOE program. Last, there was concern that equipment that should be replaced are not prioritized by the tool (e.g., central air conditioning). Several agencies speculated that this was because the tool is set up for colder climate regions and does not recognize the unique issues associated with warmer states such as Texas," (Tetra Tech, p.4-14). While Commission Staff and the EM&V team discussed the possibility of removing the NEAT audit requirement in response to this process evaluation finding, it was determined doing so could be out of keeping

[6] Annual Statewide Portfolio Report for Program Year 2014—Volume I, Section 4, Tetra Tech, October 16, 2015. PY2014v1.pdf (texasefficiency.com)

with PURA's requirement to coordinate with WAP. However, recent development of audit priority lists by DOE and adoption by THDCA now allow alternative starting with PY2023.

DOE and THDCA Priority Lists

Recognizing the need for a more streamlined audit approach for WAP than the NEAT audit, DOE developed weatherization audit priority lists in 2022. DOE approved these lists for implementation starting July 1, 2022. Please refer to the below DOE link for more information:

Weatherization Program Notice 22-8: Streamlining the Energy Audit Process–Optional Regional Weatherization Priority Lists | Department of Energy

In response, DHCA also approved priority audit lists for use in WAP in 2022. While the lists are not exhaustive in the types of homes for which they can be used, most major housing types are covered. Please refer to the below DHCA link for more information:

Community Services Program Guidance (state.tx.us)

Recommendations

The EM&V team fully supports utilities and low-income program service providers assessing and using the DOE audit priority lists available through DHCA in place of the NEAT audit. The use of the audit priority lists is to be determined as applicable to housing types and at the discretion of each utility as it makes sense for their implementation process.

4. CROSS-SECTOR

4.1 LOAD MANAGEMENT PROGRAMS

This section summarizes additional guidance from the EM&V team on two load management topics: (1) data rounding practices for commercial and residential load management programs for PY2021 and after, and (2) implementation for the ERCOT utilities' 2023 winter load management (WLM) pilots.

4.1.1 Rounding

The EM&V team previously provided guidance on rounding practices to avoid minor discrepancies in savings calculations. While rounding differences create only minor discrepancies in calculations, the differences have the potential to sum to a level that creates confusion or doubt. Using a standard practice or documenting differences will reduce the burden on the utilities and EM&V team (as discrepancies are investigated after initial calculations are developed) and will improve the consistency and transparency of savings calculations going forward. As outlined in Table 4, rounding can occur at three different levels: customer, event, and program levels.

Table 4. Load Management Savings Calculation Levels

<table>
<tr><th>Customer level</th><th>Event level</th><th>Program level</th></tr>
<tr><td>Customer 1 Curtailment kW</td><td rowspan="5">Event 1
kW savings</td><td rowspan="10">Program
kW savings</td></tr>
<tr><td>Customer 2 Curtailment kW</td></tr>
<tr><td>Customer 3 Curtailment kW</td></tr>
<tr><td>Customer 4 Curtailment kW</td></tr>
<tr><td>…</td></tr>
<tr><td>Customer 1 Curtailment kW</td><td rowspan="5">Event 2
kW savings</td></tr>
<tr><td>Customer 2 Curtailment kW</td></tr>
<tr><td>Customer 3 Curtailment kW</td></tr>
<tr><td>Customer 4 Curtailment kW</td></tr>
<tr><td>…</td></tr>
</table>

Commercial Load Management

Data rounding to the nearest whole number should only occur at the customer and program levels for commercial load management programs. Without this standard practice, utilities should document when rounding is occurring in their calculations (e.g., no rounding or rounding at the event level) and inform the EM&V team.

Residential Load Management

Data rounding to the nearest whole number should only occur at the event and program levels for residential load management programs (NOT at the customer level). Residential programs have a very large number of participants, with the potential for rounding at the participant (customer) level driving substantial differences in savings at the event or program levels. By consistently rounding at the event level (summing individual participant savings), potential discrepancies between the EM&V team and utility calculations can be reduced. Utilities that prefer not to round the savings should document that in their calculations and inform the EM&V team.

4.1.2 Winter Load Management Implementation

This section presents implementation guidance for the ERCOT utilities' 2023 winter load management (WLM) pilots.

Background

Texas electric IOUs have two channels to offer load management programs for nonresidential customers during winter months. One method is found in § 38.075(e) of the Public Utility Regulatory Act ("PURA"); i.e., Senate Bill 3. Specifically, PURA § 39.905(a)(2) states that it is the "goal of the legislature that all customers, in all customer classes, will have a choice of and access to energy efficiency alternatives and other choices from the market that allow each customer to reduce energy consumption, summer and winter peak demand, or energy costs."

The second is through their energy efficiency portfolios, governed by 16 Tex. Admin. Code § 25.181(§ 25 .181). 16 TAC § 25.181 (c)(36) defines load management as "[l]oad control activities that result in a reduction in peak demand, or a shifting of energy usage from a peak to an off-peak period or from high-price periods to lower price periods."

All four ERCOT utilities piloted winter load management (WLM) programs in 2022. CenterPoint Energy (CNP), American Electric Power (AEP) Texas and Texas New Mexico Power (TNMP) piloted programs as a regulatory asset under Senate Bill 3. Oncor Electric Delivery (Oncor) piloted a program as part of their energy efficiency program and filed the program template for comment in the Energy Efficiency Implementation Project No. 38578 in October 2021. Oncor then included a 2023 WLM pilot in their 2022 energy efficiency plan and report (EEPR) filed April 1, 2022. In November 2022, CNP, AEP Texas and TNMP also filed notification in Project No. 38578 that they would offer WLM pilots as part of their energy efficiency portfolios beginning with the 2023 winter peak period. In response to the filings and comments, PUCT Staff facilitated a coordination call with ERCOT, the IOUs and the EM&V team on December 12, 2022.

The EM&V team verifies all claimed energy savings and demand reductions for programs in the energy efficiency portfolio. The Texas Technical Reference Manual (TRM), updated annually by the EM&V team, includes the methodology for calculating energy savings and demand reductions for load management programs.

Pilot guidance for calculated savings

The EM&V team applauds the utilities implementing 24/7 programs, which we believe increases the value of the load management programs during emergency levels when ERCOT would call curtailment events. Our reading of § 25.181 limits claimed savings to peak periods defined in the Rule, which are "the hours from one p.m. to seven p.m. during the months of June, July, August, and September, and the hours of six a.m. to ten a.m. and six p.m. to ten p.m. during the months of December, January, and February, excluding weekends and Federal holidays." Therefore, even if an unscheduled emergency event is called by ERCOT outside of peak periods, those demand reductions could not be claimed by IOUs under § 25.181. We fully recognize this would likely undercount pilot savings as emergency level reductions are likely to be larger than scheduled events called in peak periods. To recognize the value to the grid, the EM&V proposes that the IOUs can use all events, even those outside of the § 25.181 defined peak hours, to calculate savings for the purpose of calculating the pilots' cost-effectiveness. If a utility chooses to do this, the difference in claimed savings and savings in the cost-effectiveness testing should be clearly documented in EEPRs. This will facilitate utilities paying incentives to customers for events outside of peak hours while remaining in compliance with § 25.181.

Secondly, the EM&V team recognizes that business responses to winter weather events that would necessitate an ERCOT winter event may result in scenarios not previously encountered in summer load management programs. One possible scenario provided by a utility on the December 12 coordination call was if a participant decides not to open in response to an unscheduled event, but the baseline period also includes days the business was not open. Recognizing the need for flexibility to support full participation in unscheduled events, the EM&V team will work with utilities on a case-by-case basis to determine the best methodology to most accurately reflect demand reductions within the peak period.

Stakeholder Working Groups

The EM&V team facilitated four topic-specific working groups in PY2023. One of the priority topics focused on demand response/load management programs. One of the objectives was to discuss changes to § 25.181 that would better support 24/7 programs. Results of the working group discussions can be found in Volume 1 of the PY2022 EMV Statewide Energy Efficiency Report.