

Public Utility Commission of Texas

Texas Technical Reference Manual

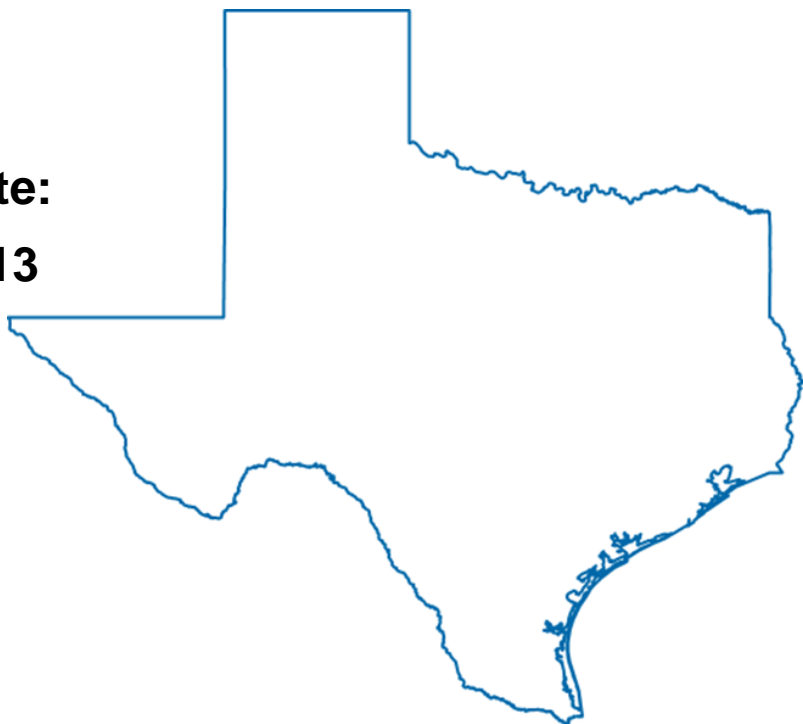
Version 1.0

Volume 1: Overview & User Guide

Guide for PY2014 Implementation

Last Revision Date:

December 13, 2013



Public Utility Commission of Texas

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Acknowledgements

The Technical Reference Manual is maintained by the Public Utility Commission of Texas' independent Evaluation, Monitoring and Verification (EM&V) team members—Tetra Tech, The Cadmus Group, Itron, and Johnson Consulting Group.

This initial version of the Texas Technical Reference Manual was primarily developed from program documentation and measure savings calculators used by the Texas Electric Utilities and their Energy Efficiency Services Providers (EESPs) to support their energy efficiency efforts, and original source material from petitions filed with the Public Utility Commission of Texas by the utilities, their consultants and EESPs such as Frontier Associates, ICF, ClearRESULT and Nexant¹. Portions of the Technical Reference Manual are copyrighted 2001-2013 by the Electric Utility Marketing Managers of Texas (EUMMOT), while other portions are copyrighted 2001-2013 by Frontier Associates. Certain technical content was 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: TexasTRM@tetrattech.com

¹ Source materials are cited throughout the TRM. For version 1.0, there are some missing citations, which the EM&V team is working to have completed by TRM version 2.1.

1. TRM PURPOSE AND SCOPE

1. TRM PURPOSE AND SCOPE

The purpose of the statewide Technical Reference Manual (TRM) is to provide a single common reference document for estimating energy and peak demand savings resulting from the installation of energy efficiency measures promoted by utility-administered programs in Texas. This document is a compilation of deemed savings values previously approved by the Public Utility Commission of Texas (PUCT) for use in estimating savings for energy efficiency measures. The data and methodologies in this document are to be used by program planners, administrators, implementers and evaluators for forecasting, reporting and evaluating energy and demand savings from energy efficiency measures installed in Texas.

The development and maintenance of the TRM is addressed in P.U.C. SUBST. R. 25.181 (§ 25.181), relating to Energy Efficiency Goal (Project No. 39674). While this first version of the TRM is specific to measures using a deemed savings approach, future versions of the TRM may also include standardized EM&V protocols for determining and/or verifying energy and demand savings for particular measures or programs ((§ 25.181(q)(6)(A)).

1.1 DEEMED SAVINGS DISCUSSION

Deemed savings refers to an approach for estimating average or typical savings for efficiency measures installed in relatively homogenous markets with well-known building characteristics and usage schedules. Previous market research and building simulation tools have been used to develop estimates of “average” or deemed energy or peak savings per measure as a function of building type, capacity, weather, building schedules and other input variables. Using this approach, program savings can be estimated by multiplying the number of measures installed by the deemed or estimated savings per measure based on previous research on the average operating schedules, baseline efficiencies and thermal characteristics of buildings in a given market.

The deemed savings approach provides reasonably accurate estimates of savings in mass markets where building operating conditions, system characteristics, and baseline efficiencies are relatively well defined. This approach is not normally used to estimate savings in more heterogeneous nonresidential facilities where the range of operating conditions and energy using processes is significant and is usually not known in advance of measure installations. Developing energy savings estimates for these more complex facilities require the use of one or more of the International Performance Measurement & Verification Protocol (IPMVP) options that require some form of on-site measurement. These will be included in future versions of the TRM.

By definition, deemed savings estimates require the development of engineering algorithms, tools or models to estimate average savings as a function of one or more average inputs including baseline usage patterns, equipment efficiency levels and building thermal characteristics. This document organizes the methods and sources used to develop these average and default values by measure category and sector, and lays out the resulting savings per measure estimates in the form of savings values, algorithms, and or calculational tools for energy efficiency measures currently offered by program administrators in Texas.

1. TRM PURPOSE AND SCOPE

1.2 TRM SCOPE AND DEVELOPMENT CYCLE

One of the primary objectives of the TRM is the uniform application of savings methods and the assumptions behind them. This will facilitate consistency in estimating savings across programs and utility areas, and estimating program-level cost effectiveness. By establishing clear qualification criteria for the development of projected and claimed savings estimates, the TRM provides transparency of savings for all interested stakeholders.

The TRM document also provides guidance on the frequency that key inputs and/or equations should be updated, based on the vintage of the input parameters, as well as the EM&V team's assessment of the level of variability in likely savings estimates across the range of likely applications. The intent is to help participants in the energy efficiency market save money and time by providing a single source of all deemed savings estimates and equations.

Finally, the EM&V team will provide clear criteria for deciding whether future efficient technologies or systems are good candidates for being included in the TRM as a deemed savings measure estimate, or a deemed algorithm with stipulated or variable parameters.

Starting with Program Year 2015, the data and algorithms housed in the TRM are to be used by electric utilities who serve as program administrators for the following purposes:

1. Projecting program savings for the next year
2. Reporting program savings for the previous year

PUCT staff has approval responsibility for this initial and any updated TRMs (§ 25.181(q) (6) (C)). To facilitate proper vetting and collaborative input into the TRM, PUCT staff will distribute the TRM annually to the Energy Efficiency Implementation Project (EEIP), and will host an EEIP meeting to review the TRM.

1.3 TRM LAYOUT

This document is divided into three separate documents for ease of use:

- **Volume 1: TRM Overview and User Guide** covers the process for TRM updates and version roll-outs, weather zones, TRM structure and the format of the TRM measure overviews, and provides a glossary of terms.
- **Volume 2: Residential Measures** contains the measure descriptions and deemed savings estimates for measures installed in residential dwellings.
- **Volume 3: Nonresidential Measures** contains the measure descriptions and deemed savings estimates for measures installed in nonresidential businesses. Volume 3 also includes one appendix:
 - *Appendix B: Nonresidential Lighting Factors Comparison Tables* provides a comparison of key lighting stipulated parameters from utility lighting calculators and program manuals.

2. TRM UPDATE AND VERSION ROLLOUT

2. TRM UPDATE PROCESS AND VERSION ROLLOUT

The TRM will be developed in stages to ensure a smooth transition from the current situation where a variety of different energy savings calculators and tools are being used to estimate savings to the future situation where a common set of deemed savings methods and calculators are used by all program administrators and EESPs in Texas.

2.1 TRM VERSIONS

This first version of the TRM, Version 1.0, organizes the deemed savings tables, algorithms and calculators currently being used to estimate deemed savings into a consistent framework with common sector, end use, and measure naming conventions across all utilities. TRM Version 1.0 also consolidates and organizes the savings tools and calculators used to deem savings per measure in one place to allow for comparison of savings methods and approaches used in different utility service areas.

The next version, Version 2.1 that will be available in February 2014 for PY2015 projected and claimed savings, will contain changes to selected deemed savings estimates and/or calculators based on the initial reviews of deemed savings tables and calculators and consistent estimates of measure useful lives for use in reporting program lifecycle saving estimates and cost-effectiveness testing. In addition, Version 2.2 will include standardized approaches to calculate summer and winter peak savings at the measure level.

Version 2.2, which will be available at the end of 2014 to use for PY2016 projected and claimed savings, will include additional prioritized updates informed by EM&V primary research with Texas customers across all utility territories. It is expected to include revisions and standardization to some input values and/or calculators, including possible consolidation of existing savings tables, and recommended seasonal time demand patterns for measures where annual hours of use is not estimated by existing tools or calculators.

2.2 TRM UPDATE PROCESS

Deemed savings input parameters in the TRM will be reviewed at least annually by the PUCT's EM&V contractor (§ 25.181(q) (6) (B)). An annual review identifies needed updates and revisions as new technologies mature and building operating environments change. The EM&V team will assess the need for changes or updates to future TRMs based primarily on (a) feedback from the organizations that use the TRM values and equations for planning or reporting purposes, (b) the EM&V team's assessment of changes in measure technology and measure baselines due to changes in common practices, codes and/or performance standards, and (c) EM&V results that indicate reasonable updates could improve the accuracy of savings estimates. The EM&V team will make recommendations about the scope and detail needed for future updates to savings algorithms and values based on input gathered from utility Program Administrators (PAs), EESPs, the PUCT and other stakeholders, EM&V research and consideration of the uncertainties and the potential for bias in current TRM estimates.

After Version 2.2² of the TRM, the PUCT and other stakeholders may want to consider the need for update frequency based on the following factors: (1) the number and complexity of new

² The EM&V team's current contract scope only include TRM Version 1.0 and TRM Versions 2.1 and 2.2.

2. TRM UPDATE AND VERSION ROLLOUT

measures proposed annually by PAs; (2) the degree of uncertainty of savings estimates determined in the initial review process; (3) the EM&V team’s relative success updating saving inputs as part of the annual savings verification process; (4) changes in baselines; (5) new data made available from site-based M&V activities; and (6) the cost of updating the TRM annually.

2.3 TRM SCHEDULE

The EM&V team maintains a detailed schedule for the TRM that includes draft submission dates, comment due dates, EEIP meeting, and the date for submitting the final versions on the PUCT EM&V SharePoint site. The publication dates for each version of the TRM indicate the date that the TRM is expected to be approved by Commission staff. The TRM will be submitted to utilities and EESPs for review two months prior to the publication date. An EEIP meeting will be held approximately one month before the publication date for presentation of key changes, providing a forum for questions and comments before each version is finalized.

The application of the TRM version for program year (PY) planning and evaluation is indicated below.

Table 2-1: TRM Rollout and Applicability to Utility Plans & Program Evaluation

TRM Version and Publication Date	Program Year for Which TRM is Used	Program Year Plan Filing Date	Program Year Evaluation Report Date ³	Notes/Comments
TRM v1.0 Nov 2013	PY2014	April 2013	June 2015	Inventory/summary of current deemed savings approaches and differences; Foreshadowing of any anticipated changes for TRM v2.1 and 2.2
TRM v2.0 Feb 2014	PY2015	Apr 2014	June 2016	First version with EM&V team recommended changes, intermediate/interim/accelerated version for use with PY2015 program planning
TRM v3.0 Oct 2014	PY2016	Apr 2015	June 2017	First full cycle version of TRM, will include revisions and may include new measures
TRM v4.0 Sep 2015	PY2017	Apr 2016	June 2018	First TRM outside of current EM&V team work scope

The existing process⁴ for establishing deemed values for new measures will continue to be the mechanism for introduction of deemed values for new measures. Any deemed values adopted by the PUCT through the established petition process at least two weeks prior to the submission of the draft TRM will be incorporated into the draft TRM. Any deemed values adopted by the

³ The EM&V team’s current contract scope only includes program year evaluation reports through PY2013, which will be finalized in June 2014, therefore these dates assume an extension of the EM&V contract with a similar timeline.

⁴ The recent modifications incorporated EM&V review of the deemed values to be submitted in the petition outlined in the memo with the subject *Deemed Savings and the Technical Reference Manual*. Submitted on March 25, 2013.

2. TRM UPDATE AND VERSION ROLLOUT

Commission at least two weeks prior to the date of the final version of the TRM will be incorporated into the final version of the TRM.

3. WEATHER DATA FOR WEATHER SENSITIVE MEASURES

3. WEATHER DATA FOR WEATHER-SENSITIVE MEASURES

For this TRM Version 1.0, the normalized deemed savings estimates for many weather-sensitive energy efficiency measures have been developed with simulation models that use Typical Meteorological Year (TMY) data. Both TMY2 and TMY3 weather data are used in the current savings estimates. To create TMY data, a single, typical meteorological year is selected and assembled from 15 to 30 years of historical data. That is, whole months of actual year weather data that represent average weather for that month over the historical period are selected from the entire range and merged together to create the TMY weather file. As such, the TMY data set represents typical rather than extreme conditions, and it is intended to represent the range of weather phenomena specific to that location with annual averages that are consistent with the location's long-term weather conditions. The TMY data sets were produced by the National Renewables Energy Laboratory's (NREL) Electric Systems Center under the Solar Resource Characterization Project, which is funded and monitored by the U.S. Department of Energy's Energy Efficiency and Renewable Energy Office. This data represents typical rather than extreme conditions. The TMY3 data sets are the third generation of TMY files. They are based on more recent and accurate data, and also use a different format than previous versions. They are derived primarily from the 1991 to 2005 National Solar Radiation Data Base (NSRDB) archives. The TMY3 data sets are publically available at: http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/ and as supporting documentation to the TRM Version 1.0.

The TMY3 data sets include the following hourly values of solar radiation and meteorological elements:

- Dry bulb and wet bulb temperature
- Relative humidity
- Wind speed and direction
- Cloud cover
- Multiple solar radiation values

Energy and demand savings for weather-sensitive measures are typically estimated using building simulation modeling as it is capable of producing hourly energy consumption estimates by applying location-specific historical weather information contained in the TMY files.

3.1 TRM CLIMATE ZONES/REGIONS

For the simulation of savings estimates for weather-sensitive energy residential efficiency measures, there are currently five TMY3 files (weather stations) that are used to represent the areas served by the Texas electric utilities⁵. The nonresidential savings estimates are derived from nine separate weather stations using TMY2 and TMY3 weather. The five TRM climate zone/regions and their representative weather station city locations are shown in Table 3-1. For application of the energy and demand savings developed on this basis, the TRM climate zones/regions are mapped to Texas counties. This mapping is represented visually in Figure 3-1, and available in table format in Appendix B.

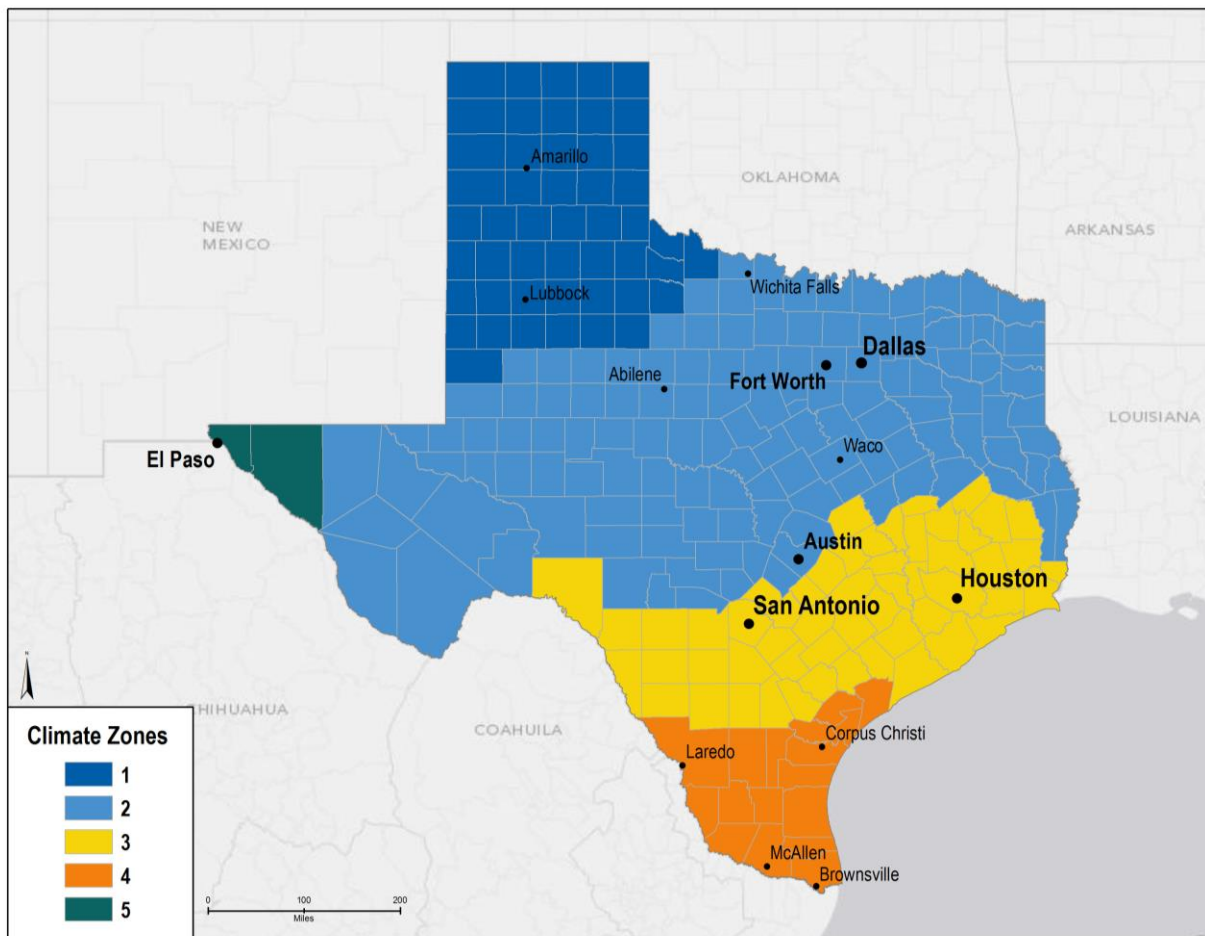
⁵ The TRM climate zone/regions and county-level assignments were created and are currently maintained by Frontier for the Electric Utilities Marketing Managers of Texas (EUMMOT).

3. WEATHER DATA FOR WEATHER SENSITIVE MEASURES

Table 3-1: Texas TRM Climate Zones

Representative City	TRM Climate Zone	TRM Region Name	Representative Weather Station
Amarillo, TX	1	Panhandle	Amarillo International Airport [Canyon - UT]
Dallas, TX	2	North	Dallas/Fort Worth International Airport
Houston, TX	3	South	George Bush Intercontinental Airport
Corpus Christi, TX	4	Valley	Corpus Christi International Airport [UT]
El Paso, TX	5	West	El Paso International Airport [UT]

Figure 3-1: TRM Climate Zone Assignments by County



3.2 HISTORY AND STATUS OF WEATHER STATION APPLICATIONS

For residential measures, Frontier initially used four climate zones for deemed savings development in Texas. They were Houston, Dallas/Fort Worth (DFW), Amarillo, and South Texas, loosely aligning with the contours of reasonable Texas climate zones and population

3. WEATHER DATA FOR WEATHER SENSITIVE MEASURES

centers of the largest IOUs (CenterPoint, Oncor, Xcel/SPS, and AEP-TCC, respectively). AEP-SWEPCO (NE Texas) and AEP-TNC (Abilene) used the deemed savings developed from the Dallas-Fort Worth (DFW) weather data. Entergy used Houston deemed savings, and TNMP used either the DFW or Houston deemed savings, depending on the relevant service territory. When El Paso Electric (EPE) was added to the Energy Efficiency Rule, EPE initially used the deemed savings that had been developed for the DFW region. That is, deemed savings for El Paso weather data were not regenerated for older measures, those measures continued to use the Dallas/Fort Worth values for the EPE service area. However, when deemed savings for newer measures were developed, the El Paso climate zone was added.

In addition, weather stations other than the five weather stations currently used for residential measures have sometimes been used for nonresidential measures, especially for savings estimates not developed by Frontier. The result is that there are currently *nine* different weather stations used by the TRM residential and nonresidential measures, as summarized in Table 3-2 and Table 3-3. Furthermore, some of the deemed savings estimates use TMY2 weather data, rather than the latest TMY3 data.

These consistency issues should be considered by future TRM development efforts, and a common set of regions and weather stations should be defined and used for all weather-sensitive measures.⁶

Table 3-2: Weather Station Codes

Weather Station Code	Weather Station City Location
AMA	Amarillo
DFW	Dallas/Fort Worth
AUS	Austin
HOU	Houston
SAT	San Antonio
CRP	Corpus Christi
BRO	Brownsville
MCA	McAllen
ELP	El Paso

⁶ There may always be exceptions for calculators and modeling tools that serve the national market, such as Energy Star calculators, which typically have a more limited selection of weather stations available.

3. WEATHER DATA FOR WEATHER SENSITIVE MEASURES

Table 3-3: Summary of Weather Files Used for Energy Efficiency Measures

Sector	Measure ID	Weather Station Code (Region)								
		AMA (1)	DFW (2)	AUS (2)	HOU (3)	SAT (3)	CRP (4)	BRO (4)	MCA (4)	ELP (5)
Resid.	All Measures* ⁷	1	1	--	1	--	1	--	--	1 & 0
Nonres.	All HVAC	1	1	--	1	--	--	1	--	1
Nonres.	VFD on AHU	1	1	--	1	1	--	--	--	1
Nonres.	Energy Star Roofs	1	1	1	1	--	--	1	--	--
Nonres.	Door Heater Controls	1	1	--	1	--	--	--	1	1
Nonres.	ECM Evap Fan Motors	1	1	--	1	--	--	--	1	1
Nonres.	Electronic Defrost Controls	1	1	--	1	--	--	--	1	1
Nonres.	Night Covers for Open Refrigerated Cases	1	1	--	1	--	--	--	1	1

⁷ As explained in this section, some older residential measures do not include deemed savings for the El Paso weather zone/region, hence the "1 & 0" for the El Paso weather station.

4. STRUCTURE AND CONTENT

4. STRUCTURE AND CONTENT

This section provides information on measure codes and the TRM measure overviews to assist the reader in using the information in Volumes 2 and 3 of the TRM.

4.1 MEASURE CODES

The EM&V team has developed a Measure ID code to allow users to quickly access the information they need for the particular market sector, end-use, and measure description. By looking at the measure code, the user can quickly identify key aspects of the measure, even if they cannot determine energy savings from the code. Due to differences in commercial and residential measures, the construction of the measure code differs slightly in each sector. The commercial codes stay at a higher level than the residential codes. Table 4-1 through Table 4-3 describe the encoding process used for the Measure ID.

Table 4-1: Residential TRM Measure ID Creation

Sequence	Category	ID	Description
1	Sector	R	Residential
2	Measure Category	LT	Lighting
		HV	HVAC
		BE	Building Envelope
		WH	Domestic Water Heating
		AP	Appliances
		HS	Whole-House
		RN	Renewable
		LM	Demand Response
5	Measure Code	XX	Per Specific Measure (See Table 4-3)

4. STRUCTURE AND CONTENT

Table 4-2: Nonresidential TRM Measure ID Creation

Sequence	Category	ID	Description
1	Sector	NR	Nonresidential
2	Measure Category	LT	Lighting
		HV	HVAC
		BE	Building Envelope
		FS	Food Service
		RF	Refrigeration
		MC	Miscellaneous
		RN	Renewable
5	Measure Code	LM	Demand Response
		XX	Per Specific Measure (See Table 4-3)

Table 4-3: Commercial and Residential Measure Code Mapping

Sector	Measure Category	Measure Description	Measure Code
Nonresidential	LT	Lamps and Fixtures	LF
	LT	Lighting Controls	LC
	HV	Package and Split-System HVAC Units (AC and Heat Pumps)	PS
	HV	Package Terminal Units and Room Air Conditioners (AC and Heat Pumps)	PT
	HV	Chillers	CH
	HV	VFDs on AHU Supply Fans	VF
	BE	Cool Roof	CR
	BE	Window Films and Solar Screens	WF
	FS	ENERGY STAR Commercial Dishwashers	DW
	FS	ENERGY STAR Commercial Electric Hot Food Holding Cabinets	HC
	FS	ENERGY STAR Electric Steam Cookers	SC
	FS	ENERGY STAR Kitchen Electric Fryers	EF
	FS	High Efficiency Electric Combination Ovens	CO
	FS	High Efficiency Electric Convection Ovens	CV
	FS	Pre-Rinse Spray Valves	SV
	RF	Door Heater Controls	DC
	RF	ECM Evaporator Fan Motors	FM
	RF	Evaporator Fan Controls	FC
	RF	Electronic Defrost Control	DF
	RF	Night Covers for Open Refrigerated Cases	RC
	RF	High-Efficiency Solid & Glass Door Reach-in Cases	RI
	RF	Strip Curtains for Walk-in Cooler/Freezer	SC
	RF	Low/No Anti-sweat Heat Glass Doors (Zero Energy Glass Doors)	ZE
MS	Vending Machine Controllers	VC	
RN	Solar Photovoltaics	PV	
LM	Load Curtailment Options	LM	

4. STRUCTURE AND CONTENT

Sector	Measure Category	Measure Description	Measure Code
Residential	LT	Compact Fluorescent Lamps	CF
	HV	Central AC	AC
	HV	Window AC	WA
	HV	Ground Source Heat Pump	GH
	HV	Central Heat Pump	HP
	HV	Split System and Single-Package Heat Pumps between 65,000 BTU/H and 240,000 BTU/H	PS
	HV	Split System and Single-Package Air Conditioners between 65,000 BTU/H and 240,000 BTU/H	SA
	HV	Duct Efficiency Improvement	DE
	BE	Air Infiltration	AI
	BE	Ceiling Insulation	CI
	BE	Wall Insulation	WI
	BE	Floor Insulation	FI
	BE	ENERGY STAR® Windows	EW
	BE	Solar Screens	SC
	WH	Faucet Aerators	FA
	WH	Low-Flow Showerheads	SH
	WH	Water Heater Jackets	WJ
	WH	Water Heater Pipe Insulation	WP
	WH	Heat Pump Water Heater	HW
	WH	Water Heater Replacement - High Efficiency	WH
	WH	Water Heater Replacement - Solar Water Heating	WS
	AP	ENERGY STAR® Clothes Washer	CW
	AP	ENERGY STAR® Dishwasher	DW
	AP	ENERGY STAR® Refrigerator	RF
	AP	ENERGY STAR® Ceiling Fans	FN
	HS	New Homes	NH
	RN	Solar Photovoltaic (PV)	PV
LM	Direct Load Control Switches Installed on Outdoor Compressor Units	OC	
LM	Direct Load Control Switches Installed on Swimming Pool Pump Motors	SP	

4.2 MEASURE OVERVIEW LAYOUT

A “measure overview” is the basic structure that is used to characterize every measure in the TRM. There is one measure overview section per TRM measure, and it encapsulates all the information needed to characterize the measure, calculate the deemed savings, document the sources used for those calculations, track changes made to the measure overview, and record any issues and recommendations for improving the approach. Note that although the basic template structure described here is generally used for all measures, there are some measures that require an adaptation or modification. Furthermore, there are some sections of the general template that are not applicable to specific measures, in which case they are not used for the measure overview. Each measure overview contains the following sections:

4. STRUCTURE AND CONTENT

Sector and TRM Measure Name. At the top of every measure overview section, the sector (residential or nonresidential) and TRM measure name are presented. The sector, end use, and TRM measure name are also shown in the page footer, to make scrolling through the TRM easier. Without the footer information, it is easy to get lost while scrolling on a specific measure, since every section uses the same layout structure (headers, etc.).

Measure Overview Summary. This section, which appears just below the measure name, contains a bulleted list that is a concise characterization of the measure. It starts with the Measure ID, as previously defined, and also includes characteristics such as the market sector, measure category, applicable building types, fuels affected, decision/action types (e.g. retrofit, replace-on-burnout), program delivery method, deemed savings type (value or calculated), and the savings methodology (e.g. engineering estimation, calculator, building simulation, billing analysis).

Measure Description. This section provides a general description of the measure, the eligibility criteria, the *baseline condition* (e.g. efficiency level, technology, performance), and the *high-efficiency condition*. Any special conditions, scenarios, or required technology/performance certifications or relevant Codes and Standards are also described in this section.

Energy and Demand Savings Methodology. This section of the measure overview presents and describes the parameters, equations, assumptions, and reference sources that are used for the energy and demand savings for the measure. An extensive set of subsections is used to describe and illustrate the details:

- **Savings Algorithms and Input Variables.** Provide the actual equations and parameters that are used for the savings calculations, and provide an explanation and references for all. This section would also contain any look-up tables of stipulated values that are used for the calculations.
- **Deemed Energy and Demand Savings Tables.** Presents the tabulated deemed energy and demand savings values developed using the algorithms and look-up table parameters. If site-specific inputs or equipment specifications are required, then a statement to that extent rather than result tables will be listed in this section.
- **Claimed Peak Demand Savings.** This section is a brief description of the current and prospective peak demand values that will be used, coincidence factors, and the basis used to derive those values. If the basis of the current peak demand value is not known, then that will be noted and the team will follow up with the utilities, implementers or others to determine the basis.
- **Additional Calculators and Tools.** If a calculator or other tool is available and typically used for calculating measure savings, then that tool and/or tools would be briefly described in this section. If a tool is not used, then “NA” would be recorded for this section, or it will be excluded from the measure overview.
- **Measure Life and Lifetime Savings.** This section notes the EUL and its source, and describes how lifetime savings should be calculated. For a subset of HVAC retrofit measures, assumptions for early retirement would also be discussed in this section. For example, for Commercial HVAC early retirement, the measure life does not necessarily equal the EUL.

Additional Parameters. This section is used for unique, measure-specific parameters that impact the savings calculations, but are not currently included in the calculation algorithms. This

4. STRUCTURE AND CONTENT

section will only appear in the measure overview for those measures that require additional parameters. Examples include In-Service Rate and Non-Energy Benefits Impact, which are targeted as future residential parameters.

Program Tracking Data & Evaluation Requirements. This section specifies the recommended list of primary inputs and contextual data needed for evaluation and proper application of the savings. For example, the application of interactive HVAC factors should, as a minimum, require tracking the space conditioning type in which a lighting system is used (air conditioned, or low/medium temperature refrigerated), otherwise the interactive HVAC savings should not be applied. As there are negative heating impacts, the heating system fuel type (electric or gas) should also be recorded.

References and Efficiency Standards. All references and citations are summarized in this section.

- **Petitions and Rulings.** Provides a running list of the relevant petitions and rulings related to deemed savings for the specific measure.
- **Relevant Standards and Reference Sources.** Provides a bulleted list of the applicable energy-efficiency standards (Federal Appliance Standards, ASHRAE 90.1, etc.), associated links and its relevance to the measure. Also lists all sources used for the development of inputs to savings, values, and deemed savings calculations.

Document Revision History. This table is used to track the revision history of the measure overview. An example is shown in Table 4-4.

Table 4-4: Nonresidential [Measure Name] Revision History

Version	Date	Description of Change
1	11/25/2013	TRM V1.0 origin

APPENDIX A: GLOSSARY

P.U.C. SUBST. R. 25.181, relating to Energy Efficiency Goal (Project No. 39674), contains definitions in section (c). Below, we provide additional definitions relevant to the TRM as well as definitions from § 25.181 denoted with a *.

Accuracy: A concept that refers to the relationship between the true value of a variable and an estimate of the value. The term can also be used in reference to a model or a set of measured data, or to describe a measuring instrument's capability.

ASHRAE Guideline 14: American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Guideline 14, *2002 Measurement of Energy and Demand Savings* (www.ashrae.org).

Benchmarking: A process that compares the energy, emissions, and other resource-related conditions of a facility against industry best practices or other benchmarks such as average per square foot energy consumption of similar buildings in the same city or climate zone.

Bias: The extent to which a measurement or a sampling or analytic method systematically underestimates or overestimates a value. Some examples of types of bias include engineering model bias; meter bias; sensor placement bias; inadequate or inappropriate estimates of what would have happened absent a program or measure installation; a sample that is unrepresentative of a population; and selection of other variables in an analysis that are too correlated with the savings variable (or each other) in explaining the dependent variable (such as consumption).

Billing Analysis: A term used to define either (1) a specific measurement and verification (M&V) approach used to estimate project savings; or (2) any analytic methodology used to determine project or program energy savings based on the use of the energy consumption data contained in consumer billing data. It compares billing data from program participant(s) over a period of time before the energy-efficient measures are installed at customer site(s) to billing data for a comparable period of time afterward. If used to describe an M&V approach, it is equivalent to IPMVP Option C, Whole Building Analysis. If used to describe an evaluation approach, it is comparable to the large-scale data analysis approach.

Building Energy Simulation Model: Computer models based on physical engineering principals and/or standards used to estimate energy use and/or savings. These models usually incorporate site-specific data on customers and physical systems, such as square footage, weather, surface orientations, elevations, space volumes, construction materials, equipment use, lighting, and building occupancy. Building simulation models can usually account for interactive effects between end uses (e.g., lighting and HVAC), part-load efficiencies, and changes in external and internal heat gains/losses. Examples of building simulation models include DOE-2, Energy Plus, and Carrier HAP.

Calibration: In economic, planning, or engineering modeling, the process of adjusting the components of the model to reflect reality as closely as possible, in order to prepare for the model's use in future applications. The term also applies to the process whereby metering and measurement equipment is periodically adjusted to maintain industry measurement standards.

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Claimed Savings: Values reported by an electric utility after the energy efficiency activities have been completed, but prior to the time an independent, third-party evaluation of the savings is performed. As with projected savings estimates, these values may utilize results of prior evaluations and/or values in technical reference manuals. However, they are adjusted from projected savings estimates by correcting for any known data errors and actual installation rates and may also be adjusted with revised values for factors such as per-unit savings values, operating hours, and savings persistence rates. Can be indicated as first year, annual demand or energy savings, and/or lifetime energy or demand savings values. Can be indicated as gross savings and/or net savings values.

Coincident Demand: The demand of a device, circuit, or building that occurs at the same time as the peak demand of a utility's system load or at the same time as some other peak of interest, such as building or facility peak demand. The peak of interest should be specified (e.g., "demand coincident with the utility system peak"). The following are examples of peak demand:

- Demand coincident with utility system peak load
- Demand coincident with independent system operator/regional transmission organization summer or winter peak or according to performance hours defined by wholesale capacity markets
- Demand coincident with high electricity demand days.

Coincidence Factors (CF)⁸: Coincidence factors are the fractions of the rated load reductions that occur during each of the peak demand windows. They are the ratio of the demand reductions during the coincident window to the connected load reductions. Other issues such as diversity and load factor are automatically accounted for, and only the coincidence factor will be necessary to determine coincident demand reductions from readily observable equipment nameplate (rated) information. In other words, coincident demand reduction will simply be the product of the coincidence factor and the connected equipment load kW reduction.

Common Practice: The predominant technology(ies) implemented or practice(s) undertaken in a particular region or sector. Common practices can be used to define a baseline.

Cooling Degree Days: See *degree days*.

Custom Program: An energy efficiency program intended to provide efficiency solutions to unique situations not amenable to common or prescriptive solutions. Each custom project is examined for its individual characteristics, savings opportunities, efficiency solutions, and often, customer incentives.

Database for Energy-Efficient Resources (DEER): A California database designed to provide publicly available estimates of energy and peak demand savings values, measure costs, and effective useful life (www.deeresources.com).

Decision/Action Types: This refers to the type of equipment installation that is performed. Acceptable values include Retrofit (RET), New Construction (NC), Early Retirement (ER), and Replace-on-Burnout (ROB). The definition of each of these values can be found in this glossary.

⁸ Source: Petition #39146, page 15

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***Deemed Savings Calculation:** An industry-wide engineering algorithm used to calculate energy and/or demand savings of the installed energy efficiency measure that has been developed from common practice that is widely considered acceptable for the measure and purpose, and is applicable to the situation being evaluated. May include stipulated assumptions for one or more parameters in the algorithm, but typically requires some data associated with actual installed measure. An electric utility may use the calculation with documented measure-specific assumptions, instead of energy and peak demand savings determined through measurement and verification activities or the use of deemed savings. (§ 25.181 (c) (7))

***Deemed Savings Value:** An estimate of energy or demand savings for a single unit of an installed energy efficiency measure that has been developed from data sources and analytical methods that are widely considered acceptable for the measure and purpose, and is applicable to the situation being evaluated. An electric utility may use deemed savings values instead of energy and peak demand savings determined through measurement and verification activities. (§ 25.181 (c) (8))

Degree Days: For any individual day, an indication of how far that day's average temperature departed from a fixed temperature, usually 18.3°C/65°F. Heating degree days, which measure heating energy needs, quantify how far the average temperature fell below 65°F. Similarly, cooling degree days, which measure cooling energy needs, quantify how far the temperature averaged above 65°F. In both cases, smaller values represent less energy consumption however, values below 0 are set equal to 0, because energy demand cannot be negative. Furthermore, because energy demand is cumulative, degree day totals for periods exceeding one day are simply the sum of each individual day's degree days total. Degree days are used in calculations of heating and cooling energy consumption and in evaluation regression analyses to adjust for differences in heating and cooling requirements between baseline and project scenarios.

***Demand Savings:** A quantifiable reduction in demand. (§ 25.181 (c) (10))

Demand-Side Management (DSM): Strategies used to manage energy demand, including energy efficiency, load management, fuel substitution, and load building.

Direct Install Program: An energy efficiency program design strategy involving the direct installation of measures in customer premises by a contractor sponsored by the program. Such programs generally involve one-for-one replacement of existing equipment with more efficient equipment, and may include a customer rebate.

Diversity: That characteristic of a variety of electric loads whereby individual maximum demands of each load usually occur at different times.

Diversity Factor: The ratio of the sum of the demands of a group of users to their coincident maximum demand during a specified period of time (e.g., summer or winter).

Early Retirement (ER): An early retirement scenario occurs when existing, functional, actively used equipment is replaced with similar, higher efficiency equipment. The equipment being replaced should have at least one year of remaining useful life (RUL). In this case, a dual baseline will have to be considered, which uses the pre-existing equipment as the baseline for savings during the RUL period, and code requirement/industry standard practice baseline for estimating the balance of the EUL period for the new equipment.

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End Use: General categories of energy efficiency measures reflecting the type of services provided (e.g., lighting, HVAC, motors, and refrigeration). Also referred to as measure category.

End-Use Metering: The direct measuring of energy consumption or demand by specific end-use equipment, typically as part of load research studies or to measure the impacts of demand-side management programs.

Energy Efficiency Ratio (EER): A measure of efficiency in air conditioning and heat pump units within a certain capacity range. This is the ratio of the cooling capacity in Btus per hour to the total electrical input in watts, under specified test conditions (expressed in Btu/ (W-hr).

***Energy Savings:** A quantifiable reduction in a customer's consumption of energy that is attributable to energy efficiency measures, usually expressed in kWh or MWh. (§ 25.181 (c) (18))

Engineering Model: Engineering equations used to calculate energy use and savings. These models are usually based on a quantitative description of physical processes that transform delivered energy into useful work, such as heat, lighting, or motor drive. In practice, these models may be reduced to simple equations in spreadsheets that calculate energy use or savings as a function of measurable attributes of customers, facilities, or equipment (e.g., lighting use = watts x hours of use).

ERCOT Weather Zones: The eight weather zones used by the Electric Reliability Council of Texas to represent distinct geographic regions of Texas.

Error: The deviation of measurements from the true value of the variable being observed; also called *measurement error*.

***Estimated Useful Life (EUL):** The number of years until 50% of installed measures is still operable and providing savings, and is used interchangeably with the term "measure life." The EUL determines the period of time over which the benefits of the energy efficiency measure are expected to accrue. (§ 25.181 (c) (19))

EUMMOT: The Electric Utility Marketing Managers of Texas (EUMMOT) is a voluntary organization of electric investor-owned utilities formed to address utility industry energy efficiency issues, and serving as a forum to facilitate coordination among the energy efficiency program managers across the state.

EUMMOT EUL Summary Spreadsheet: This is a current list of the approved EULs for residential and commercial energy efficiency measures. The list is updated and maintained by EUMMOT and available from the Texas Energy Efficiency website under the Regulatory Filings\Deemed Savings tab. It contains the EULs, as well as a reference to the source/citation, including the relevant petition number. See:

<http://www.texasefficiency.com/images/documents/RegulatoryFilings/eulsummaryspreadsheetapril2013.xls>.

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***Evaluated Savings:** Savings estimates reported by the EM&V contractor after the energy efficiency activities and an impact evaluation have been completed. Differs from claimed savings in that the EM&V contractor has conducted some of the evaluation and/or verification activities. These values may rely on claimed savings for factors such as installation rates and the Technical Reference Manual for values such as per unit savings values and operating hours. These savings estimates may also include adjustments to claimed savings for data errors, per unit savings values, operating hours, installation rates, savings persistence rates, or other considerations. Can be indicated as first year, annual demand or energy savings, and/or lifetime energy or demand savings values. Can be indicated as gross savings and/or net savings values. (§ 25.181 (c) (20))

FEMP M&V Guidelines: U.S. Department of Energy Federal Energy Management Program's *2008 M&V Guidelines: Measurement and Verification for Federal Energy Projects*.

Fuel Switching: Using an alternative fuel (usually of lower carbon intensity) to produce required energy.

Heating Degree Days: See *degree days*.

Home Energy Rating System (HERS): An indexing system, associated with ENERGY STAR®, used in residential new construction to rate the pre- and post-construction of new homes to highlight and indicate the degree of energy efficiency embedded in the construction. The HERS Index is a scoring system established by the Residential Energy Services Network (RESNET) in which a home built to the specifications of the HERS Reference Home (based on the 2006 International Energy Conservation Code) scores a HERS Index of 100, while a net zero energy home scores a HERS Index of 0. The lower a home's HERS Index, the more energy efficient it is in comparison to the HERS Reference Home. Each 1-point decrease in the HERS Index corresponds to a 1% reduction in energy consumption compared to the HERS Reference Home.

HVAC, HVAC&R: Heating, Ventilation and Air Conditioning. Heating, Ventilation, Air Conditioning and Refrigeration.

Indirect Energy (Demand) Savings (Indirect Program Energy Savings): The use of the words "indirect savings" or "indirect program savings" refers to programs that are typically information, education, marketing, or outreach programs in which the program's actions are expected to result in energy savings achieved through the actions of the customers exposed to the program's efforts, without direct enrollment in an program that has energy-savings goals.

Inspections: Site visits to facilities treated under an energy efficiency program that document the existence, characteristics, and operation of baseline or project equipment and systems, as well as factors that affect energy use. Inspections may or may not include review of commissioning or retro-commissioning documentation.

In-Service Rate (ISR): The percentage of measures that are incented by an energy efficiency program that are actually installed in a defined period of time. The installation rate is calculated by dividing the number of measures installed by the number of measures incented by an energy efficiency program in a defined period of time.

Interactive Effects: For typical definition, see "Interactive HVAC Effects". However, this can also refer to the interaction of a *package* of measures *that impact the same end use*, and the

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resulting reduction of measure savings for an *individual* measure versus that achieved by the *package*.

Interactive HVAC(&R) Factors: The factors used to adjust basic lighting savings for interactive HVAC&R effects. Space types and factors used in the TRM are shown below. Note that “Electric Refrigerated” means air-conditioned spaces, and “Refrigerated Spaces” refers to both building floor areas and equipment spaces cooled to temperatures lower than 41 degrees Fahrenheit.

Table A-1: Deemed Interactive HVAC Effects

Space Conditioning Type	Energy Interactive HVAC Factor	Demand Interactive HVAC Factor
Electric Refrigerated	1.05	1.10
Med. Temp Refrigeration (33-41°F)	1.25	1.25
Low Temp Refrigeration (-10-10°F)	1.30	1.30
None (Uncooled/Unrefrigerated)	1.00	1.00

***International Performance Measurement and Verification Protocol (IPMVP):** A guidance document issued by the Efficiency Valuation Organization with a framework and definitions describing the M&V approaches. (§ 25.181 (c) (33))

***Lifetime Energy (Demand) Savings:** The energy (demand) savings over the lifetime of an installed measure(s), project(s), or program(s). May include consideration of measure estimated useful life, technical degradation, and other factors. Can be gross or net savings. (§ 25.181 (c) (34))

Load Factor: A percentage indicating the difference between the amount of electricity a consumer used during a given time span and the amount that would have been used if the use had stayed at the consumer’s highest demand level during the whole time. The term also means the percentage of capacity of an energy facility, such as a power plant or gas pipeline, that is used in a given period of time. It is also the ratio of the average load to the peak load during a specified time interval.

Load Shapes: Representations such as graphs, tables, and databases that show the time-of-use pattern of customer or equipment energy use. These are typically shown over a 24-hour or whole-year (8,760 hours) period.

Main Meter: The meter that measures the energy used for the whole facility. There is at least one meter for each energy source and possibly more than one per source for large facilities. Typically, utility meters are used, but dataloggers may also be used as long as they isolate the load for the facility being studied. When more than one meter per energy source exists for a facility, the main meter may be considered the accumulation of all the meters involved.

Market Penetration: A measure of the diffusion of a technology, product, or practice in a defined market, as represented by the percentage of annual sales for a product or practice, the percentage of the existing installed stock for a product or category of products, or the percentage of existing installed stock that uses a practice.

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Market Saturation: A percentage indicating the proportion of a specified end-user market that contains a particular product. An example would be the percentage of all households in a given geographical area that have a certain appliance.

Market Sectors: General types of markets that a program may target or in which a service offering may be placed. Market sectors include categories such as residential, commercial, industrial, agricultural, government, and institutional.

Market Segments: A part of a market sector that can be grouped together as a result of a characteristic similar to the group. For example, within the residential sector are market segments such as renters, owners, multifamily, and single-family.

Measure: [verb] Use of an instrument to assess a physical quantity or use of a computer simulation to estimate a physical quantity.

Measure: [noun] See *energy efficiency measure*.

Measure Categories: This is also referred to as the end use, or the general category that the measure falls into. Examples include, but are not limited to, HVAC, lighting, water heating, and food service.

[TRM] Measure Overview: There is one measure overview section per TRM measure, and it encapsulates all the information needed to characterize the measure, calculate the deemed savings, document the sources used for those calculations, track changes made to the measure overview, and record any issues and recommendations for improving the approach.

Measure Persistence: The duration of an energy-consuming measure, taking into account business turnover, early retirement of installed equipment, technical degradation factors, and other reasons measures might be removed or discontinued.

Measurement Boundary: The boundary of the analysis for determining direct energy and/or demand savings.

Metering: The collection of energy-consumption data over time through the use of meters. These meters may collect information with respect to an end use, a circuit, a piece of equipment, or a whole building (or facility). *Short-term metering* generally refers to data collection for no more than a few weeks. *End-use metering* refers specifically to separate data collection for one or more end uses in a facility, such as lighting, air conditioning, or refrigeration. *Spot metering* is an instantaneous measurement (rather than over time) to determine an energy consumption rate.

Monitoring: The collection of relevant measurement data over time at a facility, including but not limited to energy consumption or emissions data (e.g., energy and water consumption, temperature, humidity, volume of emissions, hours of operation) for the purpose of savings analysis or to evaluate equipment or system performance.

New Construction: Residential and nonresidential buildings that have been newly built or have added major additions. Programs focusing on New Construction focus on the installation of equipment over the standard codes baseline at time of installation. Energy and demand savings are calculated in a similar method to those for Replace-on-Burnout (ROB) projects, as the savings are taken based on a codes/standard baseline.

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Panel Data Model: An estimation analysis model that contains many data points over time rather than averaged, summed, or otherwise aggregated data.

Petitions. Petitions are filed by the utilities as needed to update existing deemed savings or file new deemed savings for PUCT approval. The Deemed Savings Tracker on the Texas Energy Efficiency website provides a list of deemed savings petitions filed over the years. You can find the petitions and associated filings using the Project Number (also called a “Control Number”) on the [PUCT website: http://interchange.puc.state.tx.us](http://interchange.puc.state.tx.us).

Potential Studies: Studies conducted to assess market baselines and future savings that may be expected for different technologies and customer markets over a specified time horizon.

Prescriptive Program: An energy efficiency program focused on measures that are one-for-one replacements of the existing equipment and for which fixed customer incentives can be developed based on the anticipated similar savings that will accrue from their installation.

Primary Effects: Effects that the project or program are intended to achieve. For efficiency programs, this is primarily a reduction in energy use (and/or demand) per-unit of output.

Program Administrator: An entity selected by a regulatory or other government organization to contract for and administer an energy efficiency portfolio within a specific geographic region and/or market. Typical administrators are utilities selected by a public service commission or a nonprofit or state government agency, as determined by legislation.

Program Year (PY): The calendar year approved for program implementation. Note that program years can be shorter than 12 months if programs are initiated mid-year.

Project: An activity or course of action involving one or multiple energy efficiency measures at a single facility or site.

Projected Savings: Values reported by an electric utility prior to the time the energy efficiency activities are implemented. Are typically estimates of savings prepared for program and/or portfolio design or planning purposes. These values are based on pre- program or portfolio estimates of factors such as per-unit savings values, operating hours, installation rates, and savings persistence rates. These values may utilize results of prior evaluations and/or values in the Technical Reference Manual. Can be indicated as first year, annual demand or energy savings, and/or lifetime energy or demand savings values. Can be indicated as gross savings and/or net savings values.

Regression Analysis: Analysis of the relationship between a dependent variable (response variable) to specified independent variables (explanatory variables). The mathematical model of their relationship is the regression equation.

Remaining Useful Life (RUL): The RUL is an estimate of the number of years a piece of equipment would remain operational, in the event that it was not replaced due to program intervention. In the case of HVAC units, the RUL is a function of the technology, and age of the replaced unit. A separate table is provided for units in which the age of the equipment is unknown. The RUL estimate in years cannot exceed, and is usually much lower than the EUL.

Replace-on-Burnout (ROB): ROB defines a situation where an older, inoperable unit was replaced after failure or the equipment is older than the estimated average EUL. For this

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scenario, the measure baseline condition would be based on a codes/standards or “standard practice”, rather than the efficiency of the equipment that was previously installed.

Retrofit (RET): Energy efficiency activities undertaken in existing residential or nonresidential buildings, where existing inefficient equipment or systems are replaced by energy-efficient equipment or systems or where efficient equipment or systems are added to an existing facility (e.g., addition of thermal insulation). This can include both Early Retirement (ER) and Replace-on-Burnout (ROB).

Retrofit Isolation: The savings measurement approach defined in IPMVP Options A and B, as well as ASHRAE Guideline 14, that determines energy or demand savings through the use of meters to isolate the energy flows for the system(s) under consideration. IPMVP Option A involves “Key Parameter Measurement” and IPMVP Option B involves “All Parameter Measurement.”

Seasonal Energy Efficiency Ratio (SEER): A measure of efficiency in air conditioning units and heat pump units within a certain capacity range. This is the total cooling output in Btus during its normal usage period for cooling, divided by the total electrical energy input in watt-hours during the same period, as determined using specified federal test procedures.

Seasonally-Varying Measures: Any measure whose performance, energy use, and demand varies seasonally or monthly due to changes in operation (like agricultural businesses), schools, outdoor lighting, or even residential lighting (lights on sooner and higher % on during the winter due to shorter and sometimes darker days).

Secondary Effects: Unintended impacts of the project or program such as rebound effect (e.g., increasing energy use as it becomes more efficient and less costly to use), activity shifting (e.g., when generation resources move to another location), and market leakage (e.g., emission changes due to changes in supply or demand of commercial markets). Secondary effects can be positive or negative.

Simple Measurement & Verification Savings Approach: A simple M&V approach falls between a deemed calculation approach and a Full M&V approach, in that only some of the deemed calculation parameters are measured, whereas for a Full M&V approach all of the algorithm parameters would be measured.

Statistically Adjusted Engineering (SAE) Models: A category of statistical analysis models that incorporate the engineering estimate of savings as a dependent variable. The regression coefficient in these models is the percentage of the engineering estimate of savings observed in changes in energy use. For example, if the coefficient on the SAE term is 0.8, this means that the customers are on average realizing 80% of the savings from their engineering estimates.

Stipulated Values: A specified and *agreed upon* value to be used in energy and/or demand savings calculations. The basis and process for developing this value should be recorded along with the values, so that when/if better information or data becomes available, a revision of the values can be considered. Usually used in the context of “measurement” versus “stipulated” values, and considering the required rigor/accuracy/certainty required for a specific parameter and the resulting savings estimate.

Technical Degradation Factor: A multiplier used to account for time-and use-related change in the energy savings of a high-efficiency measure or practice relative to a standard-efficiency

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measure or practice due to technical operational characteristics of the measures, including operating conditions and product design.

TRM Climate Zone/Region: TMY3 weather data is used to produce normalized deemed savings estimates for weather-sensitive measures. Rather than using a multitude of weather stations, only five weather stations are used to represent the region served by the EUMMOT utilities. The five climate zone/regions and their representative cities are:

- TRM Climate Zone 1 (Panhandle Region): Amarillo International AP [Canyon - UT]
- TRM Climate Zone 2 (North Region): Dallas-Fort Worth Intl AP
- TRM Climate Zone 3 (South Region): Houston Bush Intercontinental
- TRM Climate Zone 4 (Valley Region): Corpus Christi International AP
- TRM Climate Zone 5 (West Region): El Paso International AP [UT]

TRM climate zone/region mapping is done at the county level.

Uncertainty: The range or interval of doubt surrounding a measured or calculated value within which the true value is expected to fall within some degree of confidence.

Upstream Program: A program that provides information and/or financial assistance to entities in the delivery chain of high-efficiency products at the retail, wholesale, or manufacturing level. Such a program is intended to yield lower retail prices for the products.

Utility Program Tracking Data: The data sources in which utility energy efficiency measure savings and associated project information is stored. Tracking data is used for the EM&V process. Often shortened to “program tracking data” or just “tracking data”.

Weather-Sensitive Measures: Any measure whose performance, energy use, and demand are influenced by the weather. HVAC (direct and indirect like building shell measures) and water heating measures are the most obvious example.

Whole-Building Calibrated Simulation Approach: A savings measurement approach (defined in IPMVP Option D and ASHRAE Guideline 14) that involves the use of an approved computer simulation program to develop a physical model of the building in order to determine energy and demand savings. The simulation program is used to model the energy used by the facility before and after the retrofit. The pre- or post-retrofit models are calibrated with measured energy use and demand data as well as weather data.

Whole-Building Metered Approach: A savings measurement approach (defined in the IPMVP Option C and ASHRAE Guideline 14) that determines energy and demand savings through the use of whole-facility energy (end-use) data, which may be measured by utility meters or data loggers. This approach may involve the use of monthly utility billing data or data gathered more frequently from a main meter.