

**Illinois Statewide  
Technical Reference Manual  
for Energy Efficiency  
Version 3.0**

**February 24, 2014**

**Effective:  
June 1<sup>st</sup>, 2014**

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## Acknowledgements

This document was created through a collaboration amongst the members of the Illinois Energy Efficiency Stakeholder Advisory Group (SAG). The SAG is an open forum where interested parties may participate in the evolution of Illinois’ energy efficiency programs. Parties wishing to participate in the SAG process may do so by visiting <http://www.ilsag.info/questions.html> and contacting the Independent Facilitator at [Annette.Beitel@FutEE.biz](mailto:Annette.Beitel@FutEE.biz). Parties wishing to participate in the Technical Advisory Committee (TAC), a subcommittee of the SAG, may do so by contacting the TRM Administrator at [iltrmadministrator@veic.org](mailto:iltrmadministrator@veic.org).

SAG Stakeholders <sup>1</sup>
Ameren Illinois Company (Ameren)
Center for Neighborhood Technology (CNT)
Citizen's Utility Board (CUB)
City of Chicago
Commonwealth Edison Company (ComEd)
Energy Resources Center at the University of Illinois, Chicago (ERC)
Environment IL
Environmental Law and Policy Center (ELPC)
Future Energy Enterprises LLC
Illinois Attorney General's Office (AG)
Illinois Commerce Commission Staff (ICC Staff)
Illinois Department of Commerce and Economic Opportunity (DCEO)
Independent Evaluators (ADM, Cadmus, Itron, Navigant)
Integrus (Peoples Gas and North Shore Gas)
Metropolitan Mayor's Caucus (MMC)
Midwest Energy Efficiency Association (MEEA)
Natural Resources Defense Council (NRDC)
Nicor Gas

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<sup>1</sup> Being an open forum, this list of SAG stakeholders and participants may change at any time.

**Table 1.1: Document Revision History**

Document Title	Applicable to PY Beginning
Illinois_Statewide_TRM_Effective_060112_Version_1.0_091412_Clean.doc	6/1/12
Illinois_Statewide_TRM_Effective_060113_Version_2.0_060713_Clean.docx	6/1/13
Illinois_Statewide_TRM_Effective_060114_Version_3.0_022414_Clean.docx	6/1/14

### Summary of Measure Revisions

The following tables summarize the evolution of measures that are new, revised or errata. This version of the TRM contains 68 measure-level changes as described in the following table.

**Table 1.2: Summary of Measure-Level Changes**

Change Type	# Changes
Errata	8
Revision	47
New Measure	13
<b>Total Changes</b>	<b>68</b>

The ‘Change Type’ column indicates what kind of change each measure has gone through. Specifically, when a measure error was identified and the TAC process resulted in a consensus, the measure is identified here as an ‘Errata’. In these instances the measure code indicates that a new version of the measure has been published, and that the effective date of the measure dates back to June 1<sup>st</sup>, 2013. Measures that are identified as ‘Revised’ were included in the second edition of the TRM, and have been updated for this edition of the TRM. Both ‘Revised’ and ‘New Measure(s)’ have an effective date of June 1<sup>st</sup>, 2014.

The following table provides an overview of the 68 measure-level changes that are included in this version of the TRM.

**Table 1.3: Summary of Measure Revisions**

Mkt	End Use	Measure Name	Measure Code	Change Type	Explanation	Impact on Savings
Res	Appliances	ENERGY STAR and CEE Tier 2 and 3 Clothes Washers	RS-APL-ESCL-V02-140601	Revision	Updated analysis to be based on models available in last 3 years	Increased kWh/ kW / Therms
Res	Appliances	ENERGY STAR Dishwasher	RS-APL-ESDI-V02-130601	Errata	Updated Federal Standard effective May 30, 2013. Removed Compact units since new standard is equal to ENERGY STAR level.	Reduced kWh/kW
Res	Appliances	ENERGY STAR Freezer	RS-APL-ESFR-V02-140601	Revision	Added assumptions for post September 2014 with new Federal Standard baseline and ENERGY STAR specifications.	Reduced kWh/kW
Res	Appliances	ENERGY STAR and CEE Tier 2 Refrigerator	RS-APL-ESRE-V02-140601	Revision	Added early replacement assumptions. Added assumptions for post September 2014 with new Federal Standard baseline and ENERGY STAR specifications.	Reduced kWh/kW
Res	Appliances	ENERGY STAR and CEE Tier 1 Room Air Conditioner	RS-APL-ESRA-V03-140601	Revision	Added early replacement assumptions.	N/A

Mkt	End Use	Measure Name	Measure Code	Change Type	Explanation	Impact on Savings
Res	Appliances	Refrigerator and Freezer Recycling	RS-APL-RFRC-V03-140601	Revision	Updated language on Part Use Factor to use survey results from most recent evaluation. Used PY5 Ameren evaluation for illustrative purposes.	No change
Res	HVAC	Air Source Heat Pump	RS-HVC-ASHP-V03-140601	Revision	Added footnote to explain HSPF ratings being seasonal averages from zone 4 and therefore not requiring adjustments due to back up heat requirements. Updated Coincidence Factor	Reduced kW
Res	HVAC	Central Air Conditioning	RS-HVC-CAC1-V03-140601	Revision	Updated Coincidence Factor	Reduced kW
Res	HVAC	Duct Insulation and Sealing	RS-HVC-DINS-V02-140601	Revision	Updated Coincidence Factor Clarified input heating v cooling capacity	Reduced kW
Res	HVAC	Furnace Blower Motor	RS-HVC-FBMT-V02-140601	Revision	Updated Coincidence Factor	Reduced kW
Res	HVAC	Gas High Efficiency Furnace	RS-HVC-GHEF-V03-140601	Revision	Heating Load estimates updated using PY1 Nicor Furnace Metering Study, August 2013.	Increased Therms
Res	HVAC	Ground Source Heat Pump	RS-HVC-GSHP-V03-140601	Revision	Updated Coincidence Factor	Reduced kW
Res	HVAC	HVAC Tune Up	RS-HVC-TUNE-V02-140601	Revision	Updated Coincidence Factor	Reduced kW
Res	HVAC	Programmable Thermostats	RS-HVC-PROG-V03-140601	Revision	Added text to confirm savings are at household level. Updated consumption values based on PY1 Nicor Furnace Metering Study, August 2013.	Increased Therms
Res	HVAC	Ductless Heat Pumps	RS-HVC-DHP-V01-140601	New	New DHP that calculates savings for use as supplemental heating and cooling	N/A
Res	Hot Water	Gas Water Heater	RS-HWE-GWHT-V02-140601	Revision	Adjusted algorithm such that water consumption now based upon household size and Gallons Per Day per person.	Reduced Therms
Res	Hot Water	Heat Pump Water Heaters	RS-HWE-HPWH-V02-140601	Revision	Adjusted algorithm such that water consumption now based upon household size and Gallons Per Day per person.	Reduced Therms
Res	Hot Water	Low Flow Faucet Aerators	RS-HWE-LFFA-V03-140601	Revision	Consumption and temperature assumptions updated based upon Michigan metering study. Clarification that base flow rate assumption includes existing low flow fixtures and therefore freerider rate should be 0.	Increased kWh/ kW / Therms

Mkt	End Use	Measure Name	Measure Code	Change Type	Explanation	Impact on Savings
Res	Hot Water	Low Flow Showerheads	RS-HWE-LFSH-V03-140601	Revision	Consumption and temperature assumptions updated based upon Michigan metering study. Direct Install Multi Family In Service Rate updated based on Final ComEd-Nicor Gas evaluation.	Reduced kWh/ kW / Therms
Res	Hot Water	Water Heater Temperature Setback	RS-HWE-TMPS-V03-140601	Revision	Algorithm adjusted to allow custom entry of pre and post temperatures.	No change
Res	Lighting	ENERGY STAR Compact Fluorescent Lamp (CFL)	RS-LTG-ESCF-V03-140601	Revision	First phase of EISA adjustments removed. Deemed RES v non-RES assumption updated. Time of Sale In Service Rate assumption updated. Costs updated based upon pricing forecast developed by Applied Proactive Technologies Inc. O&M assumptions updated.	Increased kWh / kW
Res	Lighting	ENERGY STAR Specialty Compact Fluorescent Lamp (CFL)	RS-LTG-ESCC-V03-140601	Revision	First phase of EISA adjustments removed. Deemed RES v non-RES assumption updated. Time of Sale In Service Rate assumption updated.	Increased kWh / kW
Res	Lighting	Exterior Hardwired Compact Fluorescent Lamp (CFL) Fixture	RS-LTG-EFIX-V03-140601	Revision	First phase of EISA adjustments removed. Costs updated. O&M assumptions updated.	No change
Res	Lighting	Interior Hardwired Compact Fluorescent Lamp (CFL) Fixture	RS-LTG-IFIX-V03-140601	Revision	First phase of EISA adjustments removed. O&M assumptions updated.	No change
Res	Lighting	LED Downlights	RS-LTG-LEDD-V02-140601	Revision	WattsBase table updated to be consistent with other measures.	Dependent on inputs
Res	Lighting	LED Screw Based Omnidirectional Bulbs	RS-LTG-LEDA-V01-140601	New	New measure for LED Screw Based Omnidirectional (A-Type) lamps.	N/A
Res	Shell	Airsealing	RS-SHL-AIRS-V02-140601	Revision	Updated Coincidence Factor	Reduced kW
Res	Shell	Basement Sidewall Insulation	RS-SHL-BINS-V04-140201	Mid year Errata / Revision	Fixed default baseline R-value assumption. Adjustment Factors added. Framing Factor assumption updated.	Reduced kWh / kW / Therms

Mkt	End Use	Measure Name	Measure Code	Change Type	Explanation	Impact on Savings
Res	Shell	Floor Insulation Above Crawlspace	RS-SHL-BINS-V04-140201	Mid year Errata / Revision	Fixed default baseline R-value assumption. Adjustment Factors added. Framing Factor assumption updated.	Reduced kWh / kW / Therms
Res	Shell	Wall and Ceiling/Attic Insulation	RS-SHL-AINS-V04-140201	Mid year Errata / Revision	Adjustment Factors added. Framing Factor assumption updated.	Reduced kWh / kW / Therms
C&I	Hot Water	Low Flow Faucet Aerators	CI-HW_-LFFA-V04-130601	Errata	Fixed error in Usage table, calculation of annual gallons mixed water per faucet.	Dependent on inputs
C&I	Hot Water	Ozone Laundry	CI-HW-OZLD-V01-140601	New	New measure for add-on ozone laundry system.	N/A
C&I	HVAC	Guest Room Energy Management	CI-HVC-GREM-V02-140601	Revision	New modeling methodology	Dependent on inputs
C&I	HVAC	Package Terminal Air Conditioner (PTAC) and Package Terminal Heat Pump (PTHP)	CI-HVC-PTAC-V04-140601	Revision	Added early replacement assumptions.	N/A
C&I	HVAC	Small Commercial Programmable Thermostat	CI-HVC-PROG-V01-140601	New	New measure for programmable thermostats in select single zone buildings.	N/A
C&I	Lighting	Hours / Interactive Effects Table	V02_140601	Revision	Added electric resistance and heat pump waste heat factors.	N/A
C&I	Lighting	Commercial ENERGY STAR Compact Fluorescent Lamp (CFL)	CI-LTG-CCFL-V03-140601	Revision	First phase of EISA adjustments removed. Deemed RES v non-RES assumptions updated. In Service Rate assumption updated. Costs updated based upon pricing forecast developed by Applied Proactive Technologies Inc. Electric heating penalty section added. O&M assumptions updated.	Increased kWh / kW
C&I	Lighting	Fluorescent Delamping	CI-LTG-DLMP-V02-140601	Revision	Electric heating penalty section added.	N/A
C&I	Lighting	High Performance and Reduced Wattage T8 Fixtures and Lamps	CI-LTG-T8FX-V02-140601	Revision	In Service Rate assumption updated. Electric heating penalty section added.	Increased kWh / kW

Mkt	End Use	Measure Name	Measure Code	Change Type	Explanation	Impact on Savings
C&I	Lighting	LED Bulbs and Fixtures	CI-LTG-LEDB-V02-140601	Revision	First phase of EISA adjustments removed. Watts assumptions updated to be consistent with other measures. Electric heating penalty section added. O&M assumptions updated.	N/A
C&I	Lighting	Commercial LED Exit Signs	CI-LTG-LEDE-V02-140601	Revision	Electric heating penalty section added.	N/A
C&I	Lighting	Lighting Power Density	CI-LTG-LPDE-V02-140601	Revision	Electric heating penalty section added. Baseline updated to IECC 2012	Dependent on inputs
C&I	Lighting	Miscellaneous Commercial/Industrial Lighting	CI-LTG-MSCI-V02-140601	Revision	Electric heating penalty section added.	N/A
C&I	Lighting	Multi-Level Lighting Switch	CI-LTG-MLLC-V02-140601	Revision	Electric heating penalty section added.	N/A
C&I	Lighting	Occupancy Sensor Lighting Controls	CI-LTG-OSLC-V02-140601	Revision	Vacancy sensor assumptions added. Electric heating penalty section added.	N/A
C&I	Lighting	Solar Light Tubes	CI-LTG-STUB-V02-140601	Revision	Electric heating penalty section added.	N/A
C&I	Lighting	T5 Fixtures and Lamps	CI-LTG-T5FX-V02-140601	Revision	Electric heating penalty section added. In Service Rate updated	Increased kWh / kW
C&I	Lighting	Occupancy Controlled Bi-Level Lighting Fixtures	CI-LTG-OCBL-V01-140601	New	New measure for replacing existing uncontrolled continuous lighting fixtures with bi-level light fixtures.	N/A
C&I	HVAC	Demand Controlled Ventilation	CI-HVC-DCV-V01-140601	New	New Measure for demand controlled ventilation in commercial buildings	N/A
C&I	HVAC	Linkageless Boiler Controls	CI-HVC-LBC-V04-140601	New	New Measure for Linkageless Boiler Controls in commercial buildings	N/A
C&I	HVAC	Oxygen Trim Boiler Controls	CI-HVC-O2TC-V01-140601	New	New Measure for Oxygen Trim Boiler Controls in commercial buildings	N/A
C&I	HVAC	Shut Off Damper for Space heating Boilers	CI-HVC-SODP-V01-140601	New	New Measure for Boiler Draft Damper Controls in commercial buildings	N/A
C&I	HVAC	High Turndown Burner Control for Space Heating Boiler	CI-HVAC-HTBC-V04-140601	New	New Measure for Boiler Improved Turndown Burner in commercial buildings	N/A
C&I	FSE	Kitchen Hood Demand Control Ventilation	CI-FSE-VENT-V02-140601	Revision	Added space heating savings for Kitchen Hood Demand Control Ventilation	Increases therms

Mkt	End Use	Measure Name	Measure Code	Change Type	Explanation	Impact on Savings
C&I	HVAC	Space Heating Boiler Tune-up	CI-HVC-BLRT-V03-130601	Errata	Moved EFLH table to 1.4 HVAC section. Errata as to change savings formula from using input capacity for calculating savings by removing efficiency variable.	Decrease therms
C&I	HVAC	Boiler Lockout/Reset Controls	CI-HVC-BLRC-V02-130601	Errata	moved EFLH table to 1.4 HVAC section. Errata was to change savings formula from using input capacity for calculating savings by removing efficiency variable.	Decrease therms
C&I	HVAC	Electric Chiller	CI-HVC-CHIL-V021-140601	Revision	Moved EFLH to 1.4 HVAC section. Changed baseline to IECC 2012	N/A
C&I	HVAC	Heat Pump Systems	CI-HVC-HPSY-V021-140601	Revision	Moved EFLH to 1.4 HVAC section. . Changed baseline to IECC 2012	N/A
C&I	HVAC	High Efficiency Boiler	CI-HVC-BOIL-V04-130601	Errata	Moved EFLH table to 1.4 HVAC section. Errata was to change savings formula from using input capacity for calculating savings by removing efficiency variable.	Decrease Therms
C&I	HVAC	High Efficiency Furnace	CI-HVC-FRNC-V03-130601	Errata	Moved EFLH table to 1.4 HVAC section. Errata was to change savings formula from using input capacity for calculating savings by removing efficiency variable.	Decrease Therms
C&I	HVAC	Pipe Insulation	CI-HVC-PINS-V02-140601	Revision	Added equivalent straight lengths for tees and valves. Included Thermal regain factor for pipes depending on location.	Reduced Therms for some installation, no change for others
C&I	HVAC	Single-Package and Split System Unitary Air Conditioners	CI-HVC-V02-140601	Revision	Moved EFLH to 1.4 HVAC section. Changed baseline to IECC 2012	N/A
C&I	HVAC	Steam Trap Replacement or Repair	CI-HVC-STRE-V03-140601	Revision	Added High pressure to leaking and blow through table	N/A
C&I	RFG	Refrigeration Economizers	CI-RFG-ECON-V04-140601	New	New Measure for refrigeration economizers	N/A
C&I	MISC	Compressed Air Low Pressure Drop Filters	CI-MSC-CALPDF-V01-140601	New	New Measure for Compressed Air Low Pressure Drop Filters	N/A
C&I	MISC	Compressed Air No-Loss Condensate Drain	CI-MSC-CANLCD-V01-140601	New	New measure for Compressed Air No-Loss Condensate Drain	N/A

## 1 Purpose of the TRM

The purpose of the Illinois Statewide Technical Reference Manual (TRM) is to provide a transparent and consistent basis for calculating energy (electric kilowatt-hours (kWh) and natural gas therms) and capacity (electric kilowatts (kW)) savings generated by the State of Illinois' energy efficiency programs<sup>2</sup> which are administered by the Department of Commerce and Economic Opportunity (DCEO) and the state's largest electric and gas Utilities<sup>3</sup> (collectively, Program Administrators).

The TRM is a technical document that is filed with the Illinois Commerce Commission (Commission or ICC) and is intended to fulfill a series of objectives, including:

- “Serve as a common reference document for all... stakeholders, [Program Administrators], and the Commission, so as to provide transparency to all parties regarding savings assumptions and calculations and the underlying sources of those assumptions and calculations.
- Support the calculation of the Illinois Total Resource Cost test<sup>4</sup> (“TRC”), as well as other cost-benefit tests in support of program design, evaluation and regulatory compliance. Actual cost-benefit calculations and the calculation of avoided costs will not be part of this TRM.
- Identify gaps in robust, primary data for Illinois, that can be addressed via evaluation efforts and/or other targeted end-use studies.
- [Provide] a process for periodically updating and maintaining records, and preserve a clear record of what deemed parameters are/were in effect at what times to facilitate evaluation and data accuracy reviews.
- ...[S]upport coincident peak capacity (for electric) savings estimates and calculations for electric utilities in a manner consistent with the methodologies employed by the utility's Regional Transmission Organization (“RTO”), as well as those necessary for statewide Illinois tracking of coincident peak capacity impacts.”<sup>5</sup>

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<sup>2</sup> 220 ILCS 5/8-103 and 220 ILCS 5/8-104.

<sup>3</sup> In addition to DCEO, the Program Administrators include: Ameren Illinois, ComEd, Peoples Gas, North Shore Gas, and Nicor Gas (collectively, the Utilities).

<sup>4</sup> The Illinois TRC test is defined in 220 ILCS 5/8-104(b) and 20 ILCS 3855/1-10.

<sup>5</sup> Illinois Statewide Technical Reference Manual Request for Proposals, August 22, 2011, pages 3-4, [http://ilsag.org/yahoo\\_site\\_admin/assets/docs/TRM\\_RFP\\_Final\\_part\\_1.230214520.pdf](http://ilsag.org/yahoo_site_admin/assets/docs/TRM_RFP_Final_part_1.230214520.pdf)

## 1.1 Enabling ICC Policy

This Illinois Statewide Technical Reference Manual (TRM) was developed to comply with the Illinois Commerce Commission (ICC or Commission) Final Orders from the electric and gas Utilities<sup>6</sup> Energy Efficiency Plan dockets. In the Final Orders, the ICC required the utilities to work with DCEO and the SAG to develop a statewide TRM. See, e.g., ComEd’s Final Order (*Docket No. 10-0570, Final Order*<sup>7</sup> at 59-60, December 21, 2010); Ameren’s Final Order (*Docket No. 10-0568, Order on Rehearing*<sup>8</sup> at 19, May 24, 2011); Peoples Gas/North Shore Gas’ Final Order (*Docket No. 10-0564, Final Order*<sup>9</sup> at 76, May 24, 2011), and Nicor’s Final Order (*Docket No. 10-0562, Final Order*<sup>10</sup> at 30, May 24, 2011).

As directed in the Utilities’ Efficiency Plan Orders, the SAG had the opportunity to, and also participated in, every aspect of the development of the TRM. Interested members of the SAG participated in weekly teleconferences to review, comment, and participate in the development of the TRM. The active participants in the TRM were designated as the “Technical Advisory Committee” (TAC). The TAC participants were representatives from the following organizations: the Utilities (ComEd, Ameren IL, Nicor Gas, Peoples Gas/North Shore Gas), DCEO, the Illinois Attorney General’s Office (AG), Natural Resources Defense Council (NRDC), the Environmental Law and Policy Center (ELPC), the Citizen’s Utility Board (CUB), CNT Energy, the independent evaluators (Navigant and Opinion Dynamics Corporation), The University of Illinois at Chicago, and ICC Staff.

## 1.2 Development Process

The first edition of the IL-TRM was approved by the Commission in ICC Docket No. 12-0528<sup>11</sup>. The second edition of the IL-TRM was approved by the Commission in ICC Docket No. 13-0437<sup>12</sup>. The policies surrounding the applicability and use of the IL-TRM in planning, implementation, and evaluation were established by the Commission in ICC Docket No. 13-0077<sup>13</sup>. This document represents the third edition of the IL-TRM. It contains a series of new measures, as well as a series of errata items and updates to existing measures that were already present in the first and second editions.

Like the first and second editions, it is a result of an ongoing review process involving the Illinois Commerce Commission (ICC) Staff (Staff or ICC Staff), the Utilities, DCEO, the Evaluators, the SAG TAC, and the SAG. VEIC meets with the SAG and/or the TRM TAC at least once each month to create a high level of transparency and vetting in the development of this TRM. As measure requests are finalized leading up to the next update of the TRM, weekly TAC meetings are often scheduled to maximize the level of collaboration and visibility into the measure characterization process. Where consensus does not emerge on specific measures or issues, those items are identified in a memo, and are not included in the TRM. As a result, this TRM represents a broad consensus amongst the SAG and TAC participants. In keeping with the goal of transparency, all of the comments and their status to-date are available through the TAC SharePoint web site, <https://portal.veic.org>.

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<sup>6</sup> The Illinois Utilities subject to this TRM include: Ameren Illinois Company d/b/a Ameren Illinois (Ameren), Commonwealth Edison Company (ComEd), The Peoples Gas Light and Coke Company and North Shore Gas Company (Integrus), and Northern Illinois Gas Company d/b/a Nicor Gas.

<sup>7</sup> <http://www.icc.illinois.gov/docket/files.aspx?no=10-0570&docId=159809>

<sup>8</sup> <http://www.icc.illinois.gov/docket/files.aspx?no=10-0568&docId=167031>

<sup>9</sup> <http://www.icc.illinois.gov/docket/files.aspx?no=10-0564&docId=167023>

<sup>10</sup> <http://www.icc.illinois.gov/docket/files.aspx?no=10-0562&docId=167027>

<sup>11</sup> <http://www.icc.illinois.gov/docket/files.aspx?no=12-0528&docId=187554>

<sup>12</sup> <http://www.icc.illinois.gov/docket/files.aspx?no=13-0437&docId=200492>

<sup>13</sup> <http://www.icc.illinois.gov/docket/files.aspx?no=13-0077&docId=203903>;

<http://www.icc.illinois.gov/docket/files.aspx?no=13-0077&docId=195913>;

<http://www.icc.illinois.gov/downloads/public/edocket/339744.pdf>

## 2 Using the TRM

For each measure characterization, this TRM includes engineering algorithm(s) and a value(s) for each parameter in the equation(s)<sup>14</sup>. These parameters have values that fall into one of three categories: a single deemed value, a lookup table of deemed values or an actual value such as the capacity of the equipment. The TRM makes extensive use of lookup tables because they allow for an appropriate level of measure streamlining and customization within the context of an otherwise prescriptive measure.

Accuracy is the overarching principle that governs what value to use for each parameter. When it is explicitly allowed within the text of the measure characterization, the preferred value is the actual or on-site value for the individual measure being implemented. The *deemed values*<sup>15</sup> in the lookup tables are the next most accurate choice, and in the absence of either an actual value or an appropriate value in a lookup table, the single, *deemed value* should be used. As a result, this single, *deemed value* can be thought of as a default value for that particular input to the algorithm.

A single *deemed savings estimate* is produced by any given combination of an algorithm and the allowable input values for each of its parameters. In cases where lookup tables are provided, there is a range of deemed savings estimates that are possible, depending on site-specific factors such as equipment capacity, location and building type.

Algorithms and their parameter values are included for calculating estimated:

- Gross annual electric energy savings (kWh)
- Gross annual natural gas energy savings (therms)
- Gross electric summer coincident peak demand savings (kW)

To support cost-effectiveness calculations, parameter values are also included for:

- Incremental costs (\$)
- Measure life (years)
- Operation and maintenance costs (\$)
- Water (gal) and other resource savings where appropriate.

To facilitate the use of the TRM as measures are revised, updated, and removed, a unique code is provided for each measure that identifies the measure and the applicable installed program year.

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<sup>14</sup> As noted in the RFP, the net-to-gross ratios are provided by the evaluators and are listed in the appendices.

<sup>15</sup> Emphasis has been added to denote the difference between a “deemed value” and a “deemed savings estimate”. A deemed value refers to a single input value to an algorithm, while a deemed savings estimate is the result of calculating the end result of all of the values in the savings algorithm.

## 2.1 Organizational Structure

The organization of this document follows a three-level format, each of which is a major heading in the Table of Contents. These levels are designed to define and clarify what the measure is and where it is applied.

### 1. Market Sectors<sup>16</sup>

- This level of organization specifies the type of customer the measure applies to, either Commercial and Industrial or Residential.
- Answers the question, “What category best describes the customer?”

### 2. End-use Category

- This level of organization represents most of the major end-use categories for which an efficient alternative exists. The following table lists all of the end-use categories in this version of the TRM.
- Answers the question, “To what end-use category does the measure apply?”

**Table 2.1: End-Use Categories in the TRM<sup>17</sup>**

Residential Market Sector	Commercial and Industrial Market Sector
Appliances	Agricultural Equipment
Consumer Electronics	Food Service Equipment
Hot Water	Hot Water
HVAC	HVAC
Lighting	Lighting
Shell	Miscellaneous
	Refrigeration

### 3. Measure & Technology

- This level of organization represents individual efficient measures such as CFL lighting and LED lighting, both of which are individual technologies within the Lighting end-use category.
- Answers the question, “What technology defines the measure?”

This organizational structure is silent on which fuel the measure is designed to save; electricity or natural gas. By organizing the TRM this way, measures that save on both fuels do not need to be repeated. As a result, the TRM will be easier to use and to maintain.

<sup>16</sup> Note that the Public sector buildings and low income measures that DCEO administers are not listed as a separate Market Sector. The Public building type is one of a series of building types that are included in the appropriate measures in the Commercial and Industrial Sector.

<sup>17</sup> Please note that this is not an exhaustive list of end-uses and that others may be included in future versions of the TRM.

## 2.2 Measure Code Specification

In order to uniquely identify each measure in the TRM, abbreviations for the major organizational elements of the TRM have been established. When these abbreviations are combined and delimited by a dash ('-') a unique, 18-character alphanumeric code is formed that can be used for tracking the measures and their associated savings estimates. Measure codes appear at the end of each measure and are structured using five parts.

**Code Structure = Market + End-use Category + Measure + Version # + Effective Date**

For example, the commercial boiler measure is coded: “CI-HVC-BLR\_-V01-120601”

**Table 2.2: Measure Code Specification Key**

Market (@@)	End-use (@@@)	Measure (@@@@)	Version (V##)	Effective Date
CI (C&I)	AGE (Agricultural Equipment)	BLR_	V01	YYMMDD
RS (Residential)	APL (Appliances)	T5F_	V02	YYMMDD
	CEL (Consumer Electronics)	T8F_	V03	YYMMDD
	FSE (Food Service Equipment)	...	...	...
	HVC (HVAC)			
	HW_ (Hot Water)			
	LTG (Lighting)			
	MSC (Miscellaneous)			
	RFG (Refrigeration)			
	SHL (Shell)			

## 2.3 Components of TRM Measure Characterizations

Each measure characterization uses a standardized format that includes at least the following components. Measures that have a higher level of complexity may have additional components, but also follow the same format, flow and function.

**DESCRIPTION**

**DEFINITION OF EFFICIENT EQUIPMENT**

**DEFINITION OF BASELINE EQUIPMENT**

**DEEMED LIFETIME OF EFFICIENT EQUIPMENT**

**DEEMED MEASURE COST**

**LOADSHAPE**

**COINCIDENCE FACTOR**

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**Algorithm**

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**CALCULATION OF ENERGY SAVINGS**

**ELECTRIC ENERGY SAVINGS**

**SUMMER COINCIDENT PEAK DEMAND SAVINGS**

**NATURAL GAS SAVINGS**

**WATER IMPACT DESCRIPTIONS AND CALCULATION**

**DEEMED O&M COST ADJUSTMENT CALCULATION**

**MEASURE CODE**

## 2.4 Variable Input Tables

Many of the measures in this TRM require the user to select the appropriate input value from a list of inputs for a given parameter in the savings algorithm. Where the TRM asks the user to select the input, look-up tables of allowable values are provided. For example, a set of input parameters may depend on building type; while a range of values may be given for each parameter, only one value is appropriate for any specific building type. If no table of alternative inputs is provided for a particular parameter, then the single deemed value will be used, unless the measure has a custom allowable input.

### 2.4.1 C&I Custom Value Use in Measure Implementation

This section defines the requirements for capturing custom variables stated in the commercial and industrial (C&I) prescriptive measures defined in this statewide TRM. This approach is to be used when a variable in a measure formula can be replaced by a verifiable and documented value that is not presented in the TRM. This approach assumes that the algorithms presented in the measure are used as stated and only allows changes to certain variable values and is not a replacement algorithm for the measure.

### 2.4.2 Custom Variables

The following table defines which C&I measures this custom approach can be applied to and further, what variables can be adjusted. This table does not include variables that require actually installed numbers that are collected from the customer, but maps those values where a default value is provided that can be replaced with a custom value. Also indicated is the type of validation required to update a custom figure. Information should be collected and stored based on existing utility procedures.

**Table 2.3: Allowable Custom C&I Variables**

Measure Number	Measure Title	Adjustable Variable	Adjustable Variable Description	Documentation	Notes
4.2.3	Commercial Steam Cooker	HOURS <sub>day</sub>	Average Daily Operation (hours)	Customer input or measured value	
		F	Food cooked per day (lb)	Customer input or measured value	
		Days <sub>Year</sub>	Annual Days of Operation (days)	Customer input or measured value	
4.2.2	Commercial Solid and Glass Door Refrigerators & Freezers	V	Chilled or frozen compartment volume, ft <sup>3</sup>	Customer input or measured value	

Measure Number	Measure Title	Adjustable Variable	Adjustable Variable Description	Documentation	Notes
4.2.5	ENERGY STAR Convection Oven	HOURSday	Average Daily Operation (hours)	Customer input or measured value	
		Days	Annual Days of Operation (days)	Customer input or measured value	
		LB	Food cooked per day (lb)	Customer input or measured value	
		EffENERGYSTAR	Cooking Efficiency ENERGY STAR	From ENERGY STAR product data	
		EffBase	Cooking Efficiency Baseline	Customer input or measured value	
		PCENERGYSTAR	Production Capacity ENERGY STAR (lbs/hr)	Customer input or measured value	
		PCBase	Production Capacity base (lbs/hr)	Customer input or measured value	
		PPreheatNumberENERGYSTAR	Number of preheats per day ENERGY STAR	From ENERGY STAR product data	
		PreheatNumber base	Number of preheats per day Base	Customer input or measured value	
		PreheatTimeENERGYSTAR	preheat length ENERGY STAR, min	From ENERGY STAR product data	
		PreheatTimeBase	preheat length base, min	Customer input or measured value	
		PreheatRateENERGYSTAR	preheat energy rate ENERGY STAR, btu/h	From ENERGY STAR product data	
		PreheatRateBase	preheat energy rate baseline, btu/h	Customer input or measured value	
		IdleENERGYSTAR	Idle energy rate ENERGY STAR, btu/h	From ENERGY STAR product data	
		IdleBase	Idle energy rate baseline, btu/h	Customer input or measured value	
IdleBaseTime	BASE Idle Time, hours	Customer input or measured value			

Measure Number	Measure Title	Adjustable Variable	Adjustable Variable Description	Documentation	Notes
4.2.5	ENERGY STAR Convection Oven	HOURSday	Average Daily Operation (hours)	Customer input or measured value	
		Days	Annual Days of Operation (days)	Customer input or measured value	
		LB	Food cooked per day (lb)	Customer input or measured value	
		EffENERGYSTAR	Cooking Efficiency ENERGY STAR	From ENERGY STAR product data	
		EffBase	Cooking Efficiency Baseline	Customer input or measured value	
		PCENERGYSTAR	Production Capacity ENERGY STAR (lbs/hr)	Customer input or measured value	
		PCBase	Production Capacity base (lbs/hr)	Customer input or measured value	
		PPreheatNumberENERGYSTAR	Number of preheats per day ENERGY STAR	From ENERGY STAR product data	
		PreheatNumberbase	Number of preheats per day Base	Customer input or measured value	
		PreheatTimeENERGYSTAR	preheat length ENERGY STAR, min	From ENERGY STAR product data	
		PreheatTimeBase	preheat length base, min	Customer input or measured value	
		PreheatRateENERGYSTAR	preheat energy rate ENERGY STAR, Btu/hr	From ENERGY STAR product data	
		PreheatRateBase	preheat energy rate baseline, Btu/hr	Customer input or measured value	
		IdleENERGYSTAR	Idle energy rate ENERGY STAR, Btu/hr	From ENERGY STAR product data	
		IdleBase	Idle energy rate baseline, Btu/hr	Customer input or measured value	
IdleBaseTime	BASE Idle Time, hours	Customer input or measured value			

Measure Number	Measure Title	Adjustable Variable	Adjustable Variable Description	Documentation	Notes
4.2.7	ENERGY STAR Fryer	HOURSday	Average Daily Operation (hours)	Customer input or measured value	
		Days	Annual Days of Operation (days)	Customer input or measured value	
		LB	Food cooked per day (lb)	Customer input or measured value	
		EffENERGYSTAR	Cooking Efficiency ENERGY STAR	From ENERGY STAR product data	
		EffBase	Cooking Efficiency Baseline	Customer input or measured value	
		PCENERGYSTAR	Production Capacity ENERGY STAR (lbs/hr)	Customer input or measured value	
		PCBase	Production Capacity base (lbs/hr)	Customer input or measured value	
		PPreheatNumberENERGYSTAR	Number of preheats per day ENERGY STAR	From ENERGY STAR product data	
		PreheatNumberbase	Number of preheats per day Base	Customer input or measured value	
		PreheatTimeENERGYSTAR	preheat length ENERGY STAR, min	From ENERGY STAR product data	
		PreheatTimeBase	preheat length base, min	Customer input or measured value	
		PreheatRateENERGYSTAR	preheat energy rate ENERGY STAR, Btu/hr	From ENERGY STAR product data	
		PreheatRateBase	preheat energy rate baseline, Btu/hr	Customer input or measured value	
		IdleENERGYSTAR	Idle energy rate ENERGY STAR, Btu/hr	From ENERGY STAR product data	
		IdleBase	Idle energy rate baseline, Btu/hr	Customer input or measured value	
IdleBaseTime	BASE Idle Time, hours	Customer input or measured value			

Measure Number	Measure Title	Adjustable Variable	Adjustable Variable Description	Documentation	Notes
4.4.8	ENERGY STAR Griddle	HOURSday	Average Daily Operation (hours)	Customer input or measured value	Electric and Gas
		Days	Annual Days of Operation (days)	Customer input or measured value	Electric and Gas
		LB	Food cooked per day (lb)	Customer input or measured value	Electric and Gas
		Width	Width of griddle (ft)	Customer input or measured value	Electric and Gas
		Depth	Depth of griddle (ft)	Customer input or measured value	
		EffENERGYSTAR	Cooking Efficiency ENERGY STAR	From ENERGY STAR product data	Electric and Gas
		EffBase	Cooking Efficiency Baseline	Customer input or measured value	Electric and Gas
		PCENERGYSTAR	Production Capacity ENERGY STAR (lbs/hr)	Customer input or measured value	Electric and Gas
		PCBase	Production Capacity base (lbs/hr)	Customer input or measured value	Electric and Gas
		PreheatNumber ENERGYSTAR	Number of preheats per day ENERGY STAR	From ENERGY STAR product data	Electric and Gas
		PreheatNumber base	Number of preheats per day Base	Customer input or measured value	Electric and Gas
		PreheatTimeENERGYSTAR	preheat length ENERGY STAR, min	From ENERGY STAR product data	Electric and Gas
		PreheatTimeBase	preheat length base, min	Customer input or measured value	Electric and Gas
		IdleENERGYSTAR	Idle energy rate ENERGY STAR, Btu/hr	From ENERGY STAR product data	Electric and Gas
IdleBase	Idle energy rate baseline, Btu/hr	Customer input or measured value	Electric and Gas		
4.2.9	ENERGY STAR Hot Food Holding Cabinet	PowerBaseline	Baseline power of cabinet, Watts	Customer input or measured value	
		PowerENERGYSTAR	cabinet, Watts	From ENERGY STAR product data	
		HOURSday	Average Daily Operation (hours)	Customer input or measured value	
		Days	Annual Days of Operation (days)	Customer input or measured value	

Measure Number	Measure Title	Adjustable Variable	Adjustable Variable Description	Documentation	Notes
4.2.10	ENERGY STAR Ice Maker	H	Harvest rate (lb/hr)	Custom input or measures value	
4.2.11	High Efficiency Pre-Rinse Spray Valve	Tout	Outlet Water Temperature	Customer input or measured value	
		Tin	Inlet Water Temperature	Customer input or measured value	
		EFF	Efficiency of water heater supplying hot water	Customer input or measured value or Manufacturer specification	Electric and Gas
		FLObase	Base case flow in gallons per minute	Customer input or measured value or Manufacturer specification	
		FLOeff	Efficient case flow in gallons per minute	Customer input or measured value or Manufacturer specification	
		HOURS <sub>day</sub>	Hours of use per day	Customer input or measured value	
		Days <sub>Year</sub>	Days of use per year	Customer input or measured value	
4.2.16	Kitchen Demand Ventilation Controls	HP	Fan Horsepower	Customer input or measured value	
		Eff(heat)	Heating Efficiency	Customer input or measures value	
4.3.2	Low Flow Faucet Aerators	NOFF	Number of occupants per faucet	Customer input	
		GPM_base	Average flow rate, in gallons per minute, of the baseline faucet "as-used"	Documented value based on study or report	
		GPM_low	Average flow rate, in gallons per minute, of the low-flow faucet aerator "as-used"	Documented value based on study or report	
		L_base	Average baseline length faucet use per capita for all faucets in minutes	Documented value based on study or report	
		L_low	Average retrofit length faucet use per capita for all faucets in minutes	Documented value based on study or report	

Measure Number	Measure Title	Adjustable Variable	Adjustable Variable Description	Documentation	Notes
4.3.3	Low Flow Showerheads	GPM_base	Average flow rate, in gallons per minute, of the baseline faucet “as-used”	Documented flow rate from installed equipment	
		NSPF	Number of showers per faucet	Customer input	
4.3.4	Commercial Pool Cover	Size of Pool	Size of pool	Customer input or measured value	
4.3.5	Tankless Water Heater	Wgal	Annual Water use for equipment	Customer input or measured value	
		Tout	Outlet Water Temperature	Customer input or measured value	
		Tin	Inlet Water Temperature	Customer input or measured value	
		SL	Stand-by Loss in Base Case Btu/hr	Customer input or measured value	
		Eff_ee	Rated Efficiency of water Heater	Customer input or documented value based on study or report	
		Tank Volume	Tank Volume	Customer input or documented value based on study or report	
4.3.6	Ozone Laundry	HP	Brake horsepower of boiler feed water pump	Customer input or measured value	Electric
		Hours	Actual associated boiler feed water pump hours	Customer input or measured value	Electric
		WUtiliz	Washer utilization factor: the annual pounds of clothes washed per year	Customer input or measured value	Gas
4.4.2	Space Boiler Tune-up	Ngi	Boiler gas input size	Customer input or measured value	
		SF	Savings Factor	Customer input or measured value	
		Effpre	Boiler Efficiency before Tune-up	Customer input or measured value	
4.4.3	Process Boiler Tune-up	Ngi	Boiler gas input size	Customer input or measured value	
		UF	Utilization Factor	Customer input or measured value	
		Effpre	Boiler Combustion Efficiency before Tune-up	Customer input or measured value	
		Eff <sub>measured</sub>	Boiler Combustion Efficiency before Tune-up	Customer input or measured value	

Measure Number	Measure Title	Adjustable Variable	Adjustable Variable Description	Documentation	Notes
4.4.4	Boiler Lockout/Reset Controls	Binput	Boiler Input Capacity	Customer input or measured value	
		SF	Savings Factor	Customer input or measured value	
		Effpre	Boiler Efficiency	Customer input or measured value	
4.4.6	Electric Chiller	TONS	Chiller nominal cooling capacity in tons	Customer input or measured value	
		IPLVbase	Efficiency of baseline equipment expressed as Integrated Part Load Value(kW/ton)	Customer input or measured value	
		IPLVee	Efficiency of high efficiency equipment expressed as Integrated Part Load Value (kW/ton)	Customer input or measured value	
		PEbase	Peak efficiency of baseline equipment expressed as Full Load EER	Customer input or measured value	
		PEee	Peak efficiency of high efficiency equipment expressed as Full Load EER	Customer input or measured value	
4.4.7	ENERGY STAR and CEE Tier 1 Room Air Conditioner	Btu/H	Size of unit	Customer input or measured value	
		EERee	Efficiency of ENERGY STAR or CEE Tier 1 unit	Customer input or measured value or Manufacturer specification	

Measure Number	Measure Title	Adjustable Variable	Adjustable Variable Description	Documentation	Notes
4.4.9	Heat Pump Systems	kBtu/hr <sub>cool</sub>	capacity of the cooling equipment in kBtu per hour	Customer input or measured value or Manufacturer specification	
		SEER <sub>ee</sub>	Seasonal Energy Efficiency Ratio of the energy efficient equipment	Customer input or measured value or Manufacturer specification	
		HSPF <sub>ee</sub>	Heating Seasonal Performance Factor of the energy efficient equipment	Customer input or measured value or Manufacturer specification	
		EER <sub>ee</sub>	Energy Efficiency Ratio of the energy efficient equipment	Customer input or measured value or Manufacturer specification	
		COPE <sub>ee</sub>	Coefficient of performance of the energy efficient equipment	Customer input or measured value or Manufacturer specification	
4.4.10	High Efficiency Boiler	Capacity	Nominal Heating Capacity Boiler Size	Customer input or measured value	
		AFUE(base)	Efficient Furnace Annual Fuel Utilization Efficiency Rating	Customer input or measured value	
		AFUE(eff)	Efficient Furnace Annual Fuel Utilization Efficiency Rating	Customer input or measured value	

Measure Number	Measure Title	Adjustable Variable	Adjustable Variable Description	Documentation	Notes
4.4.11	High Efficiency Furnace	Capacity	Nominal Furnace input capacity	Customer input or measured value	
		AFUE(base)	Efficient Furnace Annual Fuel Utilization Efficiency Rating	Customer input or measured value	
		AFUE(eff)	Efficient Furnace Annual Fuel Utilization Efficiency Rating	Customer input or measured value	
4.4.13	Package Terminal Air Condition (PTAC) and Package Terminal Heat Pump (PTHP)	kBtu/hr <sub>cool</sub>	Capacity of the cooling equipment in kBtu per hour	Customer input or measured value or Manufacturer specification	
		EERexist	Energy Efficiency Ratio of existing equipment	Customer input or measured value	
		EERee	Energy Efficiency Ratio of the energy efficient equipment	Customer input or measured value or Manufacturer specification	
		kBtu/hr <sub>heat</sub>	Capacity of heating equipment in kBtu per hour	Customer input or measured value or Manufacturer specification	
		COPexist	Coefficient of performance of the existing equipment	Customer input or measured value	
		COPee	Coefficient of performance of the energy efficient equipment	Customer input or measured value or Manufacturer specification	
4.4.14	Pipe Insulation	HOURS	Annual	Customer input or measured value	
		L <sub>sp</sub>	Length of straight pipe to be insulated (linear foot)	Customer input or measured value	
		L <sub>oc,l</sub>	Total equivalent length of the other components (valves and tees) of pipe to be insulated	Calculated value based on custom count of fittings	

Measure Number	Measure Title	Adjustable Variable	Adjustable Variable Description	Documentation	Notes
4.4.15	Single Package and Split System Unitary Air Conditioners	kBtu/hr <sub>cool</sub>	Capacity of the cooling equipment in kBtu per hour	Customer input or measured value	
		SEER <sub>ee</sub>	Seasonal Energy Efficiency Ratio of the energy efficient equipment	Customer input or measured value or Manufacturer specification	
		EEER <sub>ee</sub>	Energy Efficiency Ratio of the energy efficient equipment	Customer input or measured value or Manufacturer specification	
4.4.16	Steam Trap Replacement or Repair	B	Boiler Efficiency	Customer input or measured value	
		L	Leaking and blow-thru percentage	Customer input or documented value based on study or report	
4.4.17	VSD for HVAC	HP	Motor HP	Customer input or measured value	
		Load Factor	Motor Load Factor	Customer input or measured value	
		Hours	Actual hours for equipment operations	Customer input or measured value	
		ESF	VDS Energy Savings Factors	Custom calculated values	
		CF	Coincidence factor	Custom calculated values	
4.4.18	Small Commercial Programmable Thermostats	Capacity	Nominal Input Heating Capacity Furnace Size (Btu/hr.)	Customer input or measured value	
		Degree of Setback	The degrees in Farenheit the temperature is setback from the space temperature setpoint (°F)	Customer input or measured value	
4.4.19	Demand Control Ventilation	Conditioned Space	actual square footage of conditioned space controlled by sensor	Customer input or measured value	
4.4.20	High Turndown Burner for Space Heating Boilers	Ngi	Boiler gas input size (kBtu/hr)	Customer input or measured value	
		H_cycling	Hours base boiler is cycling at % of base boiler load	Customer input or measured value	
		H	Total Number of Hours in Heating Season	Customer input or measured value	

Measure Number	Measure Title	Adjustable Variable	Adjustable Variable Description	Documentation	Notes
4.4.21	Linkageless Boiler Controls for Space Heating	Ngi	Boiler gas input size (kBtu/hr)	Customer input or measured value	
4.4.22	Oxygen Trim Controls for Space Heating Boilers	Ngi	Boiler gas input size (kBtu/hr)	Customer input or measured value	
4.4.23	Shut Off Damper for Space Heating Boilers or Furnaces	Ngi	Boiler gas input size (kBtu/hr)	Customer input or measured value	
4.5.1	Commercial ENERGY STAR Compact Fluorescent Lamp (CFL)	Watts <sub>base</sub>	Base Wattage	Customer input or measured value	
		Watts <sub>EE</sub>	Efficiency Wattage	Customer input or measured value	
4.5.3	HPT8 Lighting	Watts <sub>base</sub>	Base Wattage	Customer input or measured value	This will allow for reduced wattage applications
		Watts <sub>EE</sub>	Efficiency Wattage	Customer input or measured value	This will allow for reduced wattage applications
		Hours	Average use hours	Customer input or documented value based on study or report	

Measure Number	Measure Title	Adjustable Variable	Adjustable Variable Description	Documentation	Notes
4.5.5	Commercial LED Exit Signs	Watts <sub>base</sub>	Base Wattage	Customer input or measured value	
		Watts <sub>EE</sub>	Efficiency Wattage	Customer input or measured value	
		Hours	Average use hours	Customer input or documented value based on study or report	
4.5.7	Lighting Power Density Reduction	WSF <sub>effic</sub>	The actual installed lighting watts per square foot or linear foot	Customer input	
		SF	Square footage of the building area applicable to the lighting design	Customer input	
		Hours	Hours of use	Customer input	
4.5.8	Miscellaneous Commercial/Industrial Lighting	Watts <sub>base</sub>	Base Wattage	Customer input or measured value	
		Watts <sub>EE</sub>	Efficiency Wattage	Customer input or measured value	
		Hours	Average use hours	Customer input or documented value based on study or report	
4.5.9	Multi-Level Lighting Switch	KW <sub>connected</sub>	Total Connected kW load	Customer input or measured value	
		Hours	Hours of use	Customer input or documented value based on study or report	
		ESF	Energy Savings Factor	Customer input or documented value based on study or report	
4.5.10	Occupancy Sensor Lighting Controls	KW <sub>controlled</sub>	Total Controlled kW load	Customer input or measured value	
		Hours	Hours of use	Customer input or documented value based on study or report	
		ESF	Energy Savings Factor	Customer input or documented value based on study or report	

Measure Number	Measure Title	Adjustable Variable	Adjustable Variable Description	Documentation	Notes
4.5.12	T5 Lighting	Watts <sub>base</sub>	Base Wattage	Customer input or measured value	This will allow for reduced wattage applications
		Watts <sub>EE</sub>	Efficiency Wattage	Customer input or measured value	This will allow for reduced wattage applications
		Hours	Average use hours	Customer input or documented value based on study or report	
4.5.13	Occupancy Controlled Bi-Level Lighting Fixture	KW <sub>baseline</sub>	Total baseline lighting load of the existing/baseline fixture	Customer input or measured value	
		KW <sub>controlled</sub>	Total Controlled kW load	Customer input or measured value	
		Hours	Hours of use	Customer input or documented value based on study or report	
		ESF	Energy Savings Factor	Customer input or documented value based on study or report	
4.6.3	Door Heater Controls for Cooler or Freezer	kW <sub>base</sub>	Connected load kW for typical reach-in refrigerator or freezer door and frame with a heater	Customer input or measured value	
		NUMdoors	number of reach-in refrigerator or freezer doors controlled by sensor	Customer input or measured value	
4.6.8	Refrigeration Economizers	HP	Compressor HP	Customer input or measured value	
		Hours	Actual hours for economizer operations	Customer input or measured value	
		kWEvap	Connected load kW of each evaporator fan	Customer input or measured value	
		kWCirc	Connected load kW of the circulating fan	Customer input or measured value	
		nFans	Number of evaporator fans	Customer input or measured value	

Measure Number	Measure Title	Adjustable Variable	Adjustable Variable Description	Documentation	Notes
4.7.1	VSD Air Compressor	hp <sub>compressor</sub>	Compressor motor nominal	Customer input or measured value	
		DCEcon	Duty cycle of the economizer fan on days that are cool enough for the economizer to be working	Customer input or measured value	
		kWEcon	Connected load kW of the economizer fan	Customer input or measured value	

## 2.5 Program Delivery & Baseline Definitions

The measure characterizations in this TRM are not grouped by program delivery type. As a result, the measure characterizations provided include information and assumptions to support savings calculations for the range of program delivery options commonly used for the measure. The organizational significance of this approach is that multiple baselines, incremental costs, O&M costs, measure lives and in-service rates are included in the measure characterization(s) that are delivered under two or more different program designs. Values appropriate for each given program delivery type are clearly specified in the algorithms or in look-up tables within the characterization.

Care has been taken to clearly define in the measure’s description the types of program delivery that the measure characterization is designed to support. However, there are no universally accepted definitions for a particular program type, and the description of the program type(s) may differ by measure. Nevertheless, program delivery types can be generally defined according to the following table. These are the definitions used in the measure descriptions, and, when necessary, individual measure descriptions may further refine and clarify these definitions of program delivery type.

**Table 2.4: Program Delivery Types**

Program	Attributes
Time of Sale (TOS)	<p><u>Definition:</u> A program in which the customer is incented to purchase or install higher efficiency equipment than if the program had not existed. This may include retail rebate (coupon) programs, upstream buydown programs, online store programs or contractor based programs as examples.</p> <p><u>Baseline</u> = New equipment.</p> <p><u>Efficient Case</u> = New, premium efficiency equipment above federal and state codes and standard industry practice.</p> <p><u>Example:</u> CFL rebate</p>
New Construction (NC)	<p><u>Definition:</u> A program that intervenes during building design to support the use of more-efficient equipment and construction practices.</p> <p><u>Baseline</u> = Building code or federal standards.</p> <p><u>Efficient Case</u> = The program’s level of building specification</p> <p><u>Example:</u> Building shell and mechanical measures</p>
Retrofit (RF)	<p><u>Definition:</u> A program that <i>upgrades</i> existing equipment before the end of its useful life.</p> <p><u>Baseline</u> = Existing equipment or the existing condition of the building or equipment. A single baseline applies over the measure’s life.</p> <p><u>Efficient Case</u> = New, premium efficiency equipment above federal and state codes and standard industry practice.</p> <p><u>Example:</u> Air sealing and insulation</p>
Early Replacement (EREP)	<p><u>Definition:</u> A program that <i>replaces</i> existing equipment before the end of its expected life.</p> <p><u>Baseline</u> = Dual; it begins as the existing equipment and shifts to new baseline equipment after the expected life of the existing equipment is over.</p> <p><u>Efficient Case</u> = New, premium efficiency equipment above federal and state codes and standard industry practice.</p> <p><u>Example:</u> Refrigerators, freezers</p>
Early Retirement (ERET)	<p><u>Definition:</u> A program that <i>retires</i> duplicative equipment before its expected life is over.</p> <p><u>Baseline</u> = The existing equipment, which is retired and not replaced.</p> <p><u>Efficient Case</u> = Zero because the unit is retired.</p> <p><u>Example:</u> Appliance recycling</p>
Direct Install (DI)	<p><u>Definition:</u> A program where measures are installed during a site visit.</p> <p><u>Baseline</u> = Existing equipment.</p> <p><u>Efficient Case</u> = New, premium efficiency equipment above federal and state codes and</p>

Program	Attributes
	standard industry practice. <u>Example:</u> Lighting and low-flow hot water measures
Efficiency Kits (KITS)	<u>Definition:</u> A program where measures are provided free of charge to a customer in an Efficiency Kit. <u>Baseline = Existing equipment.</u> <u>Efficient Case = New, premium efficiency equipment above federal and state codes and standard industry practice.</u> <u>Example:</u> Lighting and low-flow hot water measures

The concept and definition of the baseline is a key element of every measure characterization and is directly related to the program delivery type. Without a clear definition of the baseline, the savings algorithms cannot be adequately specified and subsequent evaluation efforts would be hampered. As a result, each measure has a detailed description (and in many cases, specification) of the specific baseline that should be used to calculate savings. Baselines in this TRM fall into one of the following five categories, and are organized within each measure characterization by the program delivery type to which it applies.

1. **Building Code:** As defined by the minimum specifications required under state energy code or applicable federal standards.
2. **Existing Equipment:** As determined by the most representative (or average) example of equipment that is in the existing stock. Existing equipment baselines apply over the equipment’s remaining useful life.
3. **New Equipment:** As determined by the equipment that represents standard practice in the current market environment. New equipment baselines apply over the effective useful life of the measure.
4. **Dual Baseline:** A baseline that begins as the existing equipment and shifts to new equipment after the expected life of the existing equipment is over.

## 2.6 High Impact Measures

Measures that are expected to collectively account for at least 80% of statewide energy savings are considered high impact measures. The following tables list these measures and show the section in which they may be found.

**Table 2.5: Commercial and Industrial High Impact Measures**

Section	End-use	Technology / Measure
4.2.3	Food Service	Commercial Steam Cooker
4.2.11	Food Service	High Efficiency Pre-Rinse Spray Valve
4.3.5	Hot Water	Tankless Water Heater
4.4.3	HVAC	Process Boiler Tune-up
4.4.4	HVAC	Boiler Lockout/Reset Controls
4.4.10	HVAC	High Efficiency Boilers
4.4.11	HVAC	High Efficiency Furnace
4.4.16	HVAC	Steam Trap Replacement or Repair
4.4.17	HVAC	Variable Speed Drives for HVAC
4.5.1	Lighting	Commercial ENERGY STAR CFL
4.5.3	Lighting	High Performance and Reduced Wattage T8 Fixtures and Lamps
4.5.4	Lighting	LED Bulbs & Fixtures
4.5.6	Lighting	LED Traffic and Pedestrian Signals
4.5.7	Lighting	Lighting Power Density Reduction
4.5.10	Lighting	Occupancy Sensor Lighting Controls
4.5.12	Lighting	T5 Fixtures & Lamps

**Table 2.6: Residential High Impact Measures**

Section	End-use	Technology / Measure
5.1.2	Appliances	Clothes Washer
5.1.8	Appliances	Refrigerator & Freezer Recy.
5.4.2	Hot Water	Gas Water Heater
5.4.3	Hot Water	Heat Pump Water Heater
5.4.4	Hot Water	Low Flow Faucet Aerator
5.4.5	Hot Water	Low Flow Showerhead
5.3.3	HVAC	Central Air Conditioning > 14.5 SEER
5.3.5	HVAC	Furnace Blower Motor
5.3.6	HVAC	Gas High Efficiency Boiler
5.3.7	HVAC	Gas High Efficiency Furnace
5.3.11	HVAC	Programmable Thermostats
5.5.1	Lighting	Energy Star Compact Florescent Lamp
5.5.2	Lighting	ENERGY STAR Specialty CFL
5.5.6	Lighting	LED Downlights
5.6.1	Shell	Air Sealing
5.6.2	Shell	Basement Sidewall Insulation
5.6.4	Shell	Wall and Ceiling Insulation

### 3 Assumptions

The information contained in this TRM contains VEIC's recommendations for the content of the Illinois TRM. Sources that are cited within the TRM have been chosen based on two priorities, geography and age. Whenever possible and appropriate, VEIC has incorporated Illinois-specific information into each measure characterization. The Business TRM documents from Ameren and ComEd were reviewed, as well as program and measure specific data from evaluations, efficiency plans, and working documents.

The assumptions for these characterizations rest on our understanding of the information available. In each case, the available Illinois and Midwest-specific information was reviewed, including evaluations and support material provided by the Illinois Utilities.

When Illinois or region-specific evaluations or data were not available, best practice research and data from other jurisdictions was used, often from west and east-coast states that have allocated large amounts of funding to evaluation work and to refining their measure characterization parameters. As a result, much of the most-defensible information originates from these regions. In every case, VEIC used the most recent, well-designed, and best-supported studies and only if it was appropriate to generalize their conclusions to the Illinois programs.

#### 3.1 Footnotes & Documentation of Sources

Each new and updated measure characterization is supported by a work paper, which is posted to the SharePoint web site (<https://portal.veic.org>).<sup>18</sup> Both the work paper and the measure characterizations themselves use footnotes to document the references that have been used to characterize the technology. The reference documents are too numerous to include in an Appendix and have instead been posted to the TRM's Sharepoint website. These files can be found in the 'Sources and Reference Documents' folder in the main directory, and may also be posted to the SAG's public web site ([www.ilsag.info](http://www.ilsag.info)).

#### 3.2 General Savings Assumptions

The TRM savings estimates are expected to serve as average, representative values, or ways to calculate savings based on program-specific information. All information is presented on a per-measure basis. In using the measure-specific information in the TRM, it is helpful to keep the following notes in mind.

- All estimates of energy (kWh or therms) and peak (kW) savings are for first-year savings, not lifetime savings.
- Unless otherwise noted, measure life is defined to be the life of an energy consuming measure, including its equipment life and measure persistence.
- Where deemed values for savings are provided, they represent the average energy (kWh or therms) or peak (kW) savings that could be expected from the average of all measures that might be installed in Illinois in the program year.
- In general, the baselines included in the TRM are intended to represent average conditions in Illinois. Some are based on data from the state, such as household consumption characteristics provided by the Energy Information Administration. Some are extrapolated from other areas, when Illinois data are not available.

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<sup>18</sup> To gain access to the SharePoint web site, please contact the TRM Administrator, Nikki Clace at [iltrmadministrator@veic.org](mailto:iltrmadministrator@veic.org).

### 3.3 Shifting Baseline Assumptions

The TRM anticipates the effects of changes in efficiency codes and standards on affected measures. When these changes take effect, a shift in the baseline is usually required. This complicates the measure savings estimation somewhat, and will be handled in future versions of the TRM by describing the choice of and reasoning behind a shifting baseline assumption. In this version of the TRM, this applies to CFLs and T5/T8 Linear Fluorescents, Furnaces and Early Replacement Measures.

#### 3.3.1 CFL and T5/T8 Linear Fluorescents Baseline Assumptions

Specific reductions in savings have been incorporated for CFL measures that relate to the shift in appropriate baseline due to changes in Federal Standards for lighting products. Federal legislation (stemming from the Energy Independence and Security Act of 2007) mandates a phase-in process beginning in 2012 for all general-purpose light bulbs between 40W and 100W to be approximately 30% more energy efficient than current incandescent bulbs, in essence beginning the phase-out of the current style, or “standard”, incandescent bulbs. In 2012, standard 100W incandescent bulbs will no longer be manufactured, followed by restrictions on standard 75W bulbs in 2013 and 60W and 40W bulbs in 2014. The baseline for the CFL measure in the corresponding program years starting June 1 each year will therefore become bulbs (improved or “efficient” incandescent, or halogen) that meet the new standard and have the same lumen equivalency. Those products can take several different forms we can envision now and perhaps others we do not yet know about. Halogens are one of those possibilities and have been chosen to represent a baseline at that time. To account for this shifting baseline, annual savings are reduced within the lifetime of the measure.

Other lighting measures will also have baseline shifts (for example screw based LED and CFL fixtures) that will result in significant impacts to annual estimated savings in later years. Finally, as of July 14, 2012, Federal Standards will require that practically all linear fluorescents meet strict performance requirements essentially requiring all T12 users, when they need to purchase new bulbs, to upgrade to high performance T8 lamps and ballasts<sup>19</sup>. We have assumed that this standard will become fully effective in 2016. To account for this, we have included a methodology to address the shifting baseline in the high performance T8 measure and T5 measure which is defined specifically in each measure characterization.

#### 3.3.2 Early Replacement Baseline Assumptions

A series of measures have an option to choose an Early Replacement Baseline. For these measures, the baseline assumption of the existing unit efficiency is based upon the average efficiency of units that were classified in Ameren’s PY3-PY4 as functioning and that meet efficiency and cost of replacement criteria in the following table.

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<sup>19</sup> At the time of this draft, we understand that some standard T8 lamps may meet the federal standard, and in that event, some T12 retrofits may end up being completed with standard T8s instead of high performance T8s.

**Table 3.1: Early Replacement Baseline Criteria<sup>20</sup>**

Measure	Section	Criteria
Air Source Heat Pump	5.3.1	SEER <=10 and cost of any repairs <\$249 per ton
Central	Air 5.3.3	SEER <=10 and cost of any repairs <\$190 per ton
Boiler	5.3.6	AFUE <= 75% and cost of any repairs <\$709
Furnace	4.4.11, 5.3.7	AFUE <= 75% and cost of any repairs <\$528
Ground Source Heat Pump	5.3.8	SEER <=10 and cost of any repairs <\$249 per ton

It is only appropriate to use these Early Replacement assumptions where these conditions are met. The TAC defined “functioning” as the unit is fully operational – providing sufficient space conditioning (i.e. heat exchanger, compressors, pumps work effectively) and/or the cost of repair is under 20% of the new baseline replacement cost. Therefore in order to apply early replacement assumptions the programs should apply the following eligibility criteria for the existing heating or cooling system in the home:

### 3.3.3 Furnace Baseline

“The prior national standard for residential oil and gas furnaces was 78% AFUE. DOE raised the standard in 2007 to 80% AFUE, effective 2015. However, virtually all furnaces on the market have an AFUE of 80% or better, which prompted states and environmental and consumer groups to sue DOE over its 2007 decision. In April 2009, DOE accepted a “voluntary remand” in that litigation. In October 2009, manufacturers and efficiency advocates negotiated an agreement that, for the first time, included different standard levels in three climate regions: the North, South, and Southwest. DOE issued a direct final rule (DFR) in June 2011 reflecting the standard levels in the consensus agreement. The DFR became effective on October 25, 2011 establishing new standards: In the North, most furnaces will be required to have an AFUE of 90%. The 80% AFUE standard for the South and Southwest will remain unchanged at 80%. Oil furnaces will be required to have an AFUE of 83% in all three regions. The amended standards will become effective in May 2013 for non-weatherized furnaces and in January 2015 for weatherized furnaces. DOE estimates that the standards will save about 3.3 quads (quadrillion Btu) of energy over 30 years and yield a net present value of about \$14 billion at a 3 percent discount rate.

Update: On January 14th, the U.S. Department of Energy (DOE) proposed to settle a lawsuit brought by the American Public Gas Association (APGA) that seeks to roll back gas furnace efficiency standards. As a result, the new standards, completed in 2011 and slated to take effect in May 2013, would be eliminated in favor of yet another round of DOE hearings and studies. Even if DOE completes a new rulemaking in two years, it's unlikely to take effect before 2020.”<sup>21</sup>

As a result, each of the furnace measures contain the following language describing the baseline assumption.

“Although the current Federal Standard for gas furnaces is an AFUE rating of 78%, based upon review of available product in the AHRI database, the baseline efficiency for this characterization is assumed to be 80%. The baseline will be adjusted when the Federal Standard is updated.”<sup>22</sup>

<sup>20</sup> These criteria were documented in a memo entitled, “Early Replacement Measure Issue Summary\_0409.docx.”

<sup>21</sup> Appliance Standards Awareness Project, <http://www.appliance-standards.org/product/furnaces>

<sup>22</sup> Illinois Statewide Technical Reference Manual, May 13, 2013, pp 191, 439

### 3.4 Glossary

**Baseline Efficiency:** The assumed standard efficiency of equipment, absent an efficiency program.

**Building Types<sup>23</sup>:**

Building Type	Definition
College/University	Applies to facility space used for higher education. Relevant buildings include administrative headquarters, residence halls, athletic and recreation facilities, laboratories, etc. The total gross floor area should include all supporting functions such as kitchens used by staff, lobbies, atria, conference rooms and auditoria, fitness areas for staff, storage areas, stairways, elevator shafts, etc.
Exterior	Applies to unconditioned spaces that are outside of the building envelope.
Garage	Applies to unconditioned spaces either attached or detached from the primary building envelope that are not used for living space.
Grocery/Convenience	Applies to facility space used for the retail sale of food and beverage products. It should not be used by restaurants. The total gross floor area should include all supporting functions such as kitchens and break rooms used by staff, storage areas (refrigerated and non-refrigerated), administrative areas, stairwells, atria, lobbies, etc.
Heavy and Light Industry	Applies to buildings that are dedicated to manufacturing activities. Light industry buildings are characterized by consumer product and component manufacturing while Heavy industry buildings are characterized by products that require full assembly under closely regulated conditions. These building types may be distinguished by categorizing NIACS (SIC) codes according to the needs of the Program Administrator, but are generally similar in terms of their energy performance and operating characteristics.
Hotel/Motel	Applies to buildings that rent overnight accommodations on a room/suite basis, typically including a bath/shower and other facilities in guest rooms. The total gross floor area should include all interior space, including guestrooms, halls, lobbies, atria, food preparation and restaurant space, conference and banquet space, health clubs/spas, indoor pool areas, and laundry facilities, as well as all space used for supporting functions such as elevator shafts, stairways, mechanical rooms, storage areas, employee break rooms, back-of-house offices, etc. Hotel does not apply to fractional ownership properties such as condominiums or vacation timeshares. Hotel properties should be owned by a single entity and have rooms available on a nightly basis.
K-12 School	Applies to facility space used as a school building for Kindergarten through 12th grade students. This does not include college or university classroom facilities and laboratories, vocational, technical, or trade schools. The total gross floor area should include all supporting functions such as administrative space, conference rooms, kitchens used by staff, lobbies, cafeterias, gymnasiums, auditoria, laboratory classrooms, portable classrooms, greenhouses, stairways, atria, elevator shafts, small landscaping sheds, storage areas, etc. The K-12 school model does not apply to preschool or day care buildings; in order to classify as K-12 school, more than 75% of the students must be in kindergarten or older.
Medical	Applies to a general medical and surgical hospital (including critical access hospitals and children’s hospitals) that is either a stand-alone building or a campus of buildings.  The definition of Hospital accounts for all space types that are located within the

<sup>23</sup> Source: US EPA, [www.energystar.gov](http://www.energystar.gov), Space Type Definitions

Building Type	Definition
	Hospital building/campus, such as medical offices, administrative offices, and skilled nursing. The total floor area should include the aggregate floor area of all buildings on the campus as well as all supporting functions such as: stairways, connecting corridors between buildings, medical offices, exam rooms, laboratories, lobbies, atria, cafeterias, storage areas, elevator shafts, and any space affiliated with emergency medical care, or diagnostic care.
Miscellaneous	Applies to spaces that do not fit clearly within any available categories should be designated as “miscellaneous”.
Multifamily	Applies to residential buildings of three or more units, including all public and multiuse spaces within the building envelope.
Office	Applies to facility spaces used for general office, professional, and administrative purposes. The total gross floor area should include all supporting functions such as kitchens used by staff, lobbies, atria, conference rooms and auditoria, fitness areas for staff, storage areas, stairways, elevator shafts, etc.
Restaurant	Applies to a subcategory of Retail/Service space that is used to provide commercial food services to individual customers, and includes kitchen, dining, and common areas.
Retail/Service	Applies to facility space used to conduct the retail sale of consumer product goods. Stores must be at least 5,000 square feet and have an exterior entrance to the public. The total gross floor area should include all supporting functions such as kitchens and break rooms used by staff, storage areas, administrative areas, elevators, stairwells, etc. Retail segments typically included under this definition are: Department Stores, Discount Stores, Supercenters, Warehouse Clubs, Drug Stores, Dollar Stores, Home Center/Hardware Stores, and Apparel/Hard Line Specialty Stores (e.g., books, clothing, office products, toys, home goods, electronics). Retail segments excluded under this definition are: Supermarkets (eligible to be benchmarked as Supermarket space), Convenience Stores, Automobile Dealerships, and Restaurants.
Warehouse	Applies to unrefrigerated or refrigerated buildings that are used to store goods, manufactured products, merchandise or raw materials. The total gross floor area of Refrigerated Warehouses should include all temperature controlled area designed to store perishable goods or merchandise under refrigeration at temperatures below 50 degrees Fahrenheit. The total gross floor area of Unrefrigerated Warehouses should include space designed to store non-perishable goods and merchandise. Unrefrigerated warehouses also include distribution centers. The total gross floor area of refrigerated and unrefrigerated warehouses should include all supporting functions such as offices, lobbies, stairways, rest rooms, equipment storage areas, elevator shafts, etc. Existing atriums or areas with high ceilings should only include the base floor area that they occupy. The total gross floor area of refrigerated or unrefrigerated warehouse should not include outside loading bays or docks. Self-storage facilities, or facilities that rent individual storage units, are not eligible for a rating using the warehouse model.

**Coincidence Factor (CF):** Coincidence factors represent the fraction of connected load expected to be coincident with a particular system peak period, on a diversified basis. Coincidence factors are provided for summer peak periods.

**Commercial & Industrial:** The market sector that includes measures that apply to any of the building types defined

in this TRM, which includes multifamily common areas and public housing<sup>24</sup>.

**Connected Load:** The maximum wattage of the equipment, under normal operating conditions.

**Deemed Value:** A value that has been assumed to be representative of the average condition of an input parameter.

**Default Value:** When a measure indicates that an input to a prescriptive saving algorithm may take on a range of values, an average value is also provided in many cases. This value is considered the default input to the algorithm, and should be used when the other alternatives listed in the measure are not applicable.

**End-use Category:** A general term used to describe the categories of equipment that provide a service to an individual or building. See Table 2.1.1 for a list of the end-use categories that are incorporated in this TRM.

**Full Load Hours (FLH):** The equivalent hours that equipment would need to operate at its peak capacity in order to consume its estimated annual kWh consumption (annual kWh/connected kW).

**High Efficiency:** General term for technologies and processes that require less energy, water, or other inputs to operate.

**Lifetime:** The number of years (or hours) that the new high efficiency equipment is expected to function. These are generally based on engineering lives, but sometimes adjusted based on expectations about frequency of removal, remodeling or demolition. Two important distinctions fall under this definition; Effective Useful Life (EUL) and Remaining Useful Life (RUL).

**EUL** – EUL is based on the manufacturers rating of the effective useful life; how long the equipment will last. For example, a CFL that operates x hours per year will typically have an EUL of y. A house boiler may have a lifetime of 20 years but the EUL is only 15 years since after that time it may be operating at a non-efficient point. An estimate of the median number of years that the measures installed under a program are still in place and operable.

**RUL** – Applies to retrofit or replacement measures. For example, if an existing working refrigerator is replaced with a high efficiency unit, the RUL is an assumption of how many more years the existing unit would have lasted. As a general rule the RUL is usually assumed to be 1/3 of the EUL.

**Load Factor (LF):** The fraction of full load (wattage) for which the equipment is typically run.

**Measure Cost:** The incremental (for time of sale measures) or full cost (both capital and labor for retrofit measures) of implementing the High Efficiency equipment.

**Measure Description:** A detailed description of the technology and the criteria it must meet to be eligible as an energy efficient measure.

**Measure:** An efficient technology or procedure that results in energy savings as compared to the baseline efficiency.

**Residential:** The market sector that includes measures that apply only to detached, residential buildings or duplexes.

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<sup>24</sup> Measures that apply to the multifamily and public housing building types describe how to handle tenant versus master metered buildings.

**Operation and Maintenance (O&M) Cost Adjustments:** The dollar impact resulting from differences between baseline and efficient case Operation and Maintenance costs.

**Operating Hours (HOURS):** The annual hours that equipment is expected to operate.

**Program:** The mode of delivering a particular measure or set of measures to customers. See Table 2.5.1 for a list of program descriptions that are presently operating in Illinois.

**Rating Period Factor (RPF):** Percentages for defined times of the year that describe when energy savings will be realized for a specific measure.

**Stakeholder Advisory Group (SAG):** The Illinois Energy Efficiency Stakeholder Advisory Group (SAG) was first defined in the electric utilities’ first energy efficiency Plan Orders to include “... the Utility, DCEO, Staff, the Attorney General, BOMA and CUB and representation from a variety of interests, including residential consumers, business consumers, environmental and energy advocacy organizations, trades and local government... [and] a representative from the ARES (alternative retail electric supplier) community should be included.”<sup>25</sup> A group of stakeholders who have an interest in Illinois’ energy efficiency programs and who meet regularly to share information and work toward consensus on various energy efficiency issues. The Utilities in Illinois have been directed by the ICC to work with the SAG on the development of a statewide TRM. A list of current SAG participants appears in the following table.

**Table 3.2: SAG Stakeholder List**

SAG Stakeholder
Ameren Illinois Company (Ameren)
Center for Neighborhood Technology (CNT)
Citizen's Utility Board (CUB)
City of Chicago
Commonwealth Edison Company (ComEd)
Energy Resources Center at the University of Illinois, Chicago (ERC)
Environment IL
Environmental Law and Policy Center (ELPC)
Future Energy Enterprises LLC
Illinois Attorney General's Office (AG)
Illinois Commerce Commission Staff (ICC Staff)
Illinois Department of Commerce and Economic Opportunity (DCEO)
Independent Evaluators (ADM, Cadmus, Itron, Navigant and Opinion Dynamics Corporation)
Integrus (Peoples Gas and North Shore Gas)
Metropolitan Mayor's Caucus (MMC)
Midwest Energy Efficiency Association (MEEA)
Natural Resources Defense Council (NRDC)
Nicor Gas

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<sup>25</sup> Docket No. 07-0540, Final Order at 32-33, February 6, 2008.  
<http://www.icc.illinois.gov/downloads/public/edocket/215193.pdf>

### 3.5 Electrical Loadshapes (kWh)

Loadshapes are an integral part of the measure characterization and are used to divide energy savings into appropriate periods using Rating Period Factors (RPFs) such that each have variable avoided cost values allocated to them for the purpose of estimating cost effectiveness.

For the purposes of assigning energy savings (kWh) periods, the TRM TAC has agreed to use the industry standards for wholesale power market transactions as shown in the following table.

**Table 3.3: On and Off Peak Energy Definitions**

Period Category	Period Definition (Central Prevailing Time)
Winter On-Peak Energy	8AM - 11PM, weekdays, Oct – Apr, No NERC holidays
Winter Off-Peak Energy	All other hours
Summer On-Peak Energy	8AM - 11PM, weekdays, May – Sept, No NERC holidays
Summer Off-Peak Energy	All other hours

Loadshapes have been developed for each end-use by assigning Rating Period Factor percentages to each of the four periods above. Two methodologies were used:

1. Itron eShapes<sup>26</sup> data for Missouri, reconciled to Illinois loads and provided by Ameren, were used to calculate the percentage of load in to the four categories above.
2. Where the Itron eShapes data did not provide a particular end-use or specific measure load profile, loadshapes that have been developed over many years by Efficiency Vermont and that have been reviewed by the Vermont Department of Public Service, were adjusted to match Illinois period definitions. Note – no weather sensitive loadshapes were based on this method. Any of these load profiles that relate to High Impact Measures should be an area of future evaluation.

The following pages provide the loadshape values for all measures provided in the TRM. To distinguish the source of the loadshape, they are color coded. Rows that are shaded in green are Efficiency Vermont loadshapes adjusted for Illinois periods. Rows that are unshaded and are left in white are Itron eShapes data provided by Ameren.

The Illinois electric utilities use the DSMore™ (Integral Analytics DSMore™ Demand Side Management Option/Risk Evaluator) software to screen the efficiency measures for cost effectiveness. Since this tool requires a loadshape value for weekdays and weekends in each month (i.e., 24 inputs), the percentages for the four period categories above were calculated by weighting the proportion of weekdays/weekends in each month to the total within each period. The results of these calculations are also provided below.

<sup>26</sup> All loadshape information has been posted to the project’s Sharepoint site, and may be provided publically through the Stakeholder Advisory Group’s web site at their discretion. <http://www.ilsag.info/technical-reference-manual.html>

**Table 3.4: Loadshapes by Season**

		Winter Peak	Winter Off-peak	Summer Peak	Summer Off-peak
	Loadshape Reference Number	Oct-Apr, M-F, non-holiday, 8AM - 11PM	Oct-Apr, All other time	May-Sept, M-F, non-holiday, 8AM - 11PM	May- Sept, All other time
Residential Clothes Washer	R01	47.0%	11.1%	34.0%	8.0%
Residential Dish Washer	R02	49.3%	8.7%	35.7%	6.3%
Residential Electric DHW	R03	43.2%	20.6%	24.5%	11.7%
Residential Freezer	R04	38.9%	16.4%	31.5%	13.2%
Residential Refrigerator	R05	37.0%	18.1%	30.1%	14.7%
Residential Indoor Lighting	R06	48.1%	15.5%	26.0%	10.5%
Residential Outdoor Lighting	R07	18.0%	44.1%	9.4%	28.4%
Residential Cooling	R08	4.1%	0.7%	71.3%	23.9%
Residential Electric Space Heat	R09	57.8%	38.8%	1.7%	1.7%
Residential Electric Heating and Cooling	R10	35.2%	22.8%	31.0%	11.0%
Residential Ventilation	R11	25.8%	32.3%	18.9%	23.0%
Residential - Dehumidifier	R12	12.9%	16.2%	31.7%	39.2%
Residential Standby Losses - Entertainment Center	R13	26.0%	32.5%	18.9%	22.6%
Residential Standby Losses - Home Office	R14	23.9%	34.6%	17.0%	24.5%
Commercial Electric Cooking	C01	40.6%	18.2%	28.7%	12.6%
Commercial Electric DHW	C02	40.5%	18.2%	28.5%	12.8%
Commercial Cooling	C03	4.9%	0.8%	66.4%	27.9%
Commercial Electric Heating	C04	53.5%	43.2%	1.9%	1.4%
Commercial Electric Heating and Cooling	C05	19.4%	13.5%	47.1%	19.9%
Commercial Indoor Lighting	C06	40.1%	18.6%	28.4%	12.9%
Grocery/Conv. Store Indoor Lighting	C07	31.4%	26.4%	22.8%	19.3%
Hospital Indoor Lighting	C08	29.1%	29.0%	21.0%	20.9%
Office Indoor Lighting	C09	42.1%	16.0%	30.4%	11.5%
Restaurant Indoor Lighting	C10	32.1%	25.7%	23.4%	18.8%
Retail Indoor Lighting	C11	35.5%	22.3%	25.8%	16.3%
Warehouse Indoor Lighting	C12	39.4%	18.5%	28.6%	13.5%
K-12 School Indoor Lighting	C13	45.8%	22.6%	20.2%	11.4%

		Winter Peak	Winter Off-peak	Summer Peak	Summer Off-peak
	Loadshape Reference Number	Oct-Apr, M-F, non-holiday, 8AM - 11PM	Oct-Apr, All other time	May-Sept, M-F, non-holiday, 8AM - 11PM	May- Sept, All other time
Indust. 1-shift (8/5) (e.g., comp. air, lights)	C14	50.5%	7.2%	37.0%	5.3%
Indust. 2-shift (16/5) (e.g., comp. air, lights)	C15	47.5%	10.2%	34.8%	7.4%
Indust. 3-shift (24/5) (e.g., comp. air, lights)	C16	34.8%	23.2%	25.5%	16.6%
Indust. 4-shift (24/7) (e.g., comp. air, lights)	C17	25.8%	32.3%	18.9%	23.0%
Industrial Indoor Lighting	C18	44.3%	13.6%	32.4%	9.8%
Industrial Outdoor Lighting	C19	18.0%	44.1%	9.4%	28.4%
Commercial Outdoor Lighting	C20	23.4%	35.3%	13.0%	28.3%
Commercial Office Equipment	C21	37.7%	20.9%	26.7%	14.7%
Commercial Refrigeration	C22	38.5%	20.6%	26.7%	14.2%
Commercial Ventilation	C23	38.1%	20.6%	29.7%	11.6%
Traffic Signal - Red Balls, always changing or flashing	C24	25.8%	32.3%	18.9%	23.0%
Traffic Signal - Red Balls, changing day, off night	C25	37.0%	20.9%	27.1%	14.9%
Traffic Signal - Green Balls, always changing	C26	25.8%	32.3%	18.9%	23.0%
Traffic Signal - Green Balls, changing day, off night	C27	37.0%	20.9%	27.1%	14.9%
Traffic Signal - Red Arrows	C28	25.8%	32.3%	18.9%	23.0%
Traffic Signal - Green Arrows	C29	25.8%	32.3%	18.9%	23.0%
Traffic Signal - Flashing Yellows	C30	25.8%	32.3%	18.9%	23.0%
Traffic Signal - "Hand" Don't Walk Signal	C31	25.8%	32.3%	18.9%	23.0%
Traffic Signal - "Man" Walk Signal	C32	25.8%	32.3%	18.9%	23.0%
Traffic Signal - Bi-Modal Walk/Don't Walk	C33	25.8%	32.3%	18.9%	23.0%
Industrial Motor	C34	47.5%	10.2%	34.8%	7.4%
Industrial Process	C35	47.5%	10.2%	34.8%	7.4%
HVAC Pump Motor (heating)	C36	38.7%	48.6%	5.9%	6.8%
HVAC Pump Motor (cooling)	C37	7.8%	9.8%	36.8%	45.6%
HVAC Pump Motor (unknown use)	C38	23.2%	29.2%	21.4%	26.2%
VFD - Supply fans <10 HP	C39	38.8%	16.1%	28.4%	16.7%
VFD - Return fans <10 HP	C40	38.8%	16.1%	28.4%	16.7%
VFD - Exhaust fans <10 HP	C41	34.8%	23.2%	20.3%	21.7%
VFD - Boiler feedwater pumps <10 HP	C42	42.9%	44.2%	6.6%	6.3%

		Winter Peak	Winter Off-peak	Summer Peak	Summer Off-peak
	Loadshape Reference Number	Oct-Apr, M-F, non-holiday, 8AM - 11PM	Oct-Apr, All other time	May-Sept, M-F, non-holiday, 8AM - 11PM	May- Sept, All other time
VFD - Chilled water pumps <10 HP	C43	11.2%	5.5%	40.7%	42.6%
VFD Boiler circulation pumps <10 HP	C44	42.9%	44.2%	6.6%	6.3%
Refrigeration Economizer	C45	36.3%	50.8%	5.6%	7.3%
Evaporator Fan Control	C46	24.0%	35.9%	16.7%	23.4%
Standby Losses - Commercial Office	C47	8.2%	50.5%	5.6%	35.7%
VFD Boiler draft fans <10 HP	C48	37.3%	48.9%	6.4%	7.3%
VFD Cooling Tower Fans <10 HP	C49	7.9%	5.2%	54.0%	32.9%
Engine Block Heater Timer	C50	26.5%	61.0%	4.1%	8.5%
Door Heater Control	C51	30.4%	69.6%	0.0%	0.0%
Beverage and Snack Machine Controls	C52	10.0%	48.3%	7.4%	34.3%
Flat	C53	36.3%	21.8%	26.2%	15.7%
Religious Indoor Lighting	C54	26.8%	31.4%	18.9%	22.8%

**Table 3.5: Loadshapes by Month and Day of Week**

		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
		M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S
Residential Clothes Washer	R01	7.0%	1.6%	6.3%	1.5%	6.6%	1.7%	6.7%	1.5%	6.9%	1.6%	6.5%	1.6%	7.1%	1.5%	6.8%	1.7%	6.6%	1.6%	7.0%	1.5%	6.5%	1.7%	6.9%	1.6%
Residential Dish Washer	R02	7.3%	1.2%	6.6%	1.2%	7.0%	1.4%	7.1%	1.2%	7.3%	1.2%	6.9%	1.3%	7.4%	1.2%	7.1%	1.3%	7.0%	1.2%	7.4%	1.2%	6.8%	1.3%	7.2%	1.3%
Residential Electric DHW	R03	6.4%	2.9%	5.8%	2.7%	6.1%	3.3%	6.2%	2.8%	5.0%	2.3%	4.7%	2.4%	5.1%	2.2%	4.9%	2.5%	4.8%	2.3%	6.5%	2.8%	6.0%	3.1%	6.3%	3.0%
Residential Freezer	R04	5.8%	2.3%	5.2%	2.2%	5.5%	2.6%	5.6%	2.2%	6.4%	2.6%	6.1%	2.7%	6.6%	2.5%	6.3%	2.8%	6.1%	2.6%	5.8%	2.2%	5.4%	2.4%	5.7%	2.4%
Residential Refrigerator	R05	5.5%	2.6%	4.9%	2.4%	5.2%	2.9%	5.3%	2.5%	6.2%	2.9%	5.8%	3.0%	6.3%	2.8%	6.0%	3.1%	5.9%	2.9%	5.5%	2.5%	5.1%	2.7%	5.4%	2.6%
Residential Indoor Lighting	R06	7.1%	2.2%	6.4%	2.1%	6.8%	2.4%	6.9%	2.1%	5.3%	2.1%	5.0%	2.2%	5.4%	2.0%	5.2%	2.2%	5.1%	2.1%	7.2%	2.1%	6.6%	2.3%	7.0%	2.2%
Residential Outdoor Lighting	R07	2.7%	6.2%	2.4%	5.9%	2.6%	7.0%	2.6%	6.0%	1.9%	5.7%	1.8%	5.8%	2.0%	5.3%	1.9%	6.0%	1.8%	5.7%	2.7%	6.0%	2.5%	6.6%	2.6%	6.4%
Residential Cooling	R08	0.6%	0.1%	0.5%	0.1%	0.6%	0.1%	0.6%	0.1%	14.6%	4.8%	13.7%	4.9%	14.9%	4.5%	14.2%	5.0%	13.9%	4.8%	0.6%	0.1%	0.6%	0.1%	0.6%	0.1%
Residential Electric Space Heat	R09	8.6%	5.5%	7.7%	5.1%	8.2%	6.1%	8.3%	5.3%	0.3%	0.3%	0.3%	0.3%	0.4%	0.3%	0.3%	0.4%	0.3%	0.3%	8.7%	5.3%	8.0%	5.8%	8.5%	5.6%
Residential Electric Heating and Cooling	R10	5.2%	3.2%	4.7%	3.0%	5.0%	3.6%	5.0%	3.1%	6.3%	2.2%	6.0%	2.3%	6.5%	2.1%	6.2%	2.3%	6.0%	2.2%	5.3%	3.1%	4.9%	3.4%	5.2%	3.3%
Residential Ventilation	R11	3.8%	4.6%	3.4%	4.3%	3.6%	5.1%	3.7%	4.4%	3.8%	4.6%	3.6%	4.7%	3.9%	4.3%	3.8%	4.8%	3.7%	4.6%	3.9%	4.4%	3.6%	4.8%	3.8%	4.7%
Residential - Dehumidifier	R12	1.9%	2.3%	1.7%	2.2%	1.8%	2.6%	1.8%	2.2%	6.5%	7.8%	6.1%	8.0%	6.6%	7.3%	6.3%	8.2%	6.2%	7.8%	1.9%	2.2%	1.8%	2.4%	1.9%	2.4%
Residential Standby Losses - Entertainment Center	R13	3.8%	4.6%	3.5%	4.3%	3.7%	5.1%	3.7%	4.4%	3.9%	4.5%	3.7%	4.6%	4.0%	4.2%	3.8%	4.8%	3.7%	4.5%	3.9%	4.4%	3.6%	4.8%	3.8%	4.7%
Residential Standby Losses - Home Office	R14	3.5%	4.9%	3.2%	4.6%	3.4%	5.5%	3.4%	4.7%	3.5%	4.9%	3.3%	5.0%	3.5%	4.6%	3.4%	5.2%	3.3%	4.9%	3.6%	4.7%	3.3%	5.2%	3.5%	5.0%

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		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
		M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S
Commercial Electric Cooking	C01	6.0%	2.6%	5.4%	2.4%	5.7%	2.9%	5.8%	2.5%	5.9%	2.5%	5.5%	2.6%	6.0%	2.4%	5.7%	2.6%	5.6%	2.5%	6.1%	2.5%	5.6%	2.7%	5.9%	2.6%
Commercial Electric DHW	C02	6.0%	2.6%	5.4%	2.4%	5.7%	2.9%	5.8%	2.5%	5.8%	2.5%	5.5%	2.6%	6.0%	2.4%	5.7%	2.7%	5.6%	2.5%	6.1%	2.5%	5.6%	2.7%	5.9%	2.6%
Commercial Cooling	C03	0.7%	0.1%	0.6%	0.1%	0.7%	0.1%	0.7%	0.1%	13.6%	5.5%	12.8%	5.7%	13.9%	5.2%	13.3%	5.9%	13.0%	5.5%	0.7%	0.1%	0.7%	0.1%	0.7%	0.1%
Commercial Electric Heating	C04	7.9%	6.1%	7.1%	5.7%	7.6%	6.8%	7.7%	5.9%	0.4%	0.3%	0.4%	0.3%	0.4%	0.3%	0.4%	0.3%	0.4%	0.3%	8.0%	5.9%	7.4%	6.5%	7.8%	6.3%
Commercial Electric Heating and Cooling	C05	2.9%	1.9%	2.6%	1.8%	2.8%	2.1%	2.8%	1.9%	9.6%	4.0%	9.1%	4.1%	9.8%	3.7%	9.4%	4.2%	9.2%	4.0%	2.9%	1.9%	2.7%	2.0%	2.8%	2.0%
Commercial Indoor Lighting	C06	5.9%	2.6%	5.3%	2.5%	5.7%	2.9%	5.7%	2.6%	5.8%	2.6%	5.5%	2.6%	5.9%	2.4%	5.7%	2.7%	5.5%	2.6%	6.0%	2.6%	5.5%	2.8%	5.9%	2.7%
Grocery/Conv. Store Indoor Lighting	C07	4.7%	3.7%	4.2%	3.5%	4.4%	4.2%	4.5%	3.6%	4.7%	3.8%	4.4%	3.9%	4.8%	3.6%	4.6%	4.1%	4.5%	3.8%	4.7%	3.6%	4.3%	3.9%	4.6%	3.8%
Hospital Indoor Lighting	C08	4.3%	4.1%	3.9%	3.8%	4.1%	4.6%	4.2%	4.0%	4.3%	4.2%	4.0%	4.3%	4.4%	3.9%	4.2%	4.4%	4.1%	4.2%	4.4%	4.0%	4.0%	4.3%	4.3%	4.2%
Office Indoor Lighting	C09	6.2%	2.3%	5.6%	2.1%	6.0%	2.5%	6.0%	2.2%	6.2%	2.3%	5.9%	2.4%	6.4%	2.2%	6.1%	2.4%	5.9%	2.3%	6.3%	2.2%	5.8%	2.4%	6.2%	2.3%
Restaurant Indoor Lighting	C10	4.8%	3.6%	4.3%	3.4%	4.5%	4.1%	4.6%	3.5%	4.8%	3.7%	4.5%	3.8%	4.9%	3.5%	4.7%	4.0%	4.6%	3.7%	4.8%	3.5%	4.4%	3.8%	4.7%	3.7%
Retail Indoor Lighting	C11	5.3%	3.1%	4.7%	3.0%	5.0%	3.5%	5.1%	3.1%	5.3%	3.2%	5.0%	3.3%	5.4%	3.1%	5.2%	3.4%	5.0%	3.2%	5.3%	3.1%	4.9%	3.3%	5.2%	3.2%
Warehouse Indoor Lighting	C12	5.8%	2.6%	5.2%	2.5%	5.6%	2.9%	5.6%	2.5%	5.8%	2.7%	5.5%	2.8%	6.0%	2.5%	5.7%	2.8%	5.6%	2.7%	5.9%	2.5%	5.4%	2.8%	5.8%	2.7%
K-12 School Indoor Lighting	C13	6.8%	3.2%	6.1%	3.0%	6.5%	3.6%	6.6%	3.1%	4.1%	2.3%	3.9%	2.3%	4.2%	2.1%	4.0%	2.4%	3.9%	2.3%	6.9%	3.1%	6.3%	3.4%	6.7%	3.3%
Indust. 1-shift (8/5) (e.g., comp. air, lights)	C14	7.5%	1.0%	6.7%	1.0%	7.1%	1.1%	7.2%	1.0%	7.5%	1.1%	7.1%	1.1%	7.7%	1.0%	7.4%	1.1%	7.2%	1.1%	7.6%	1.0%	7.0%	1.1%	7.4%	1.0%
Indust. 2-shift	C15	7.0%	1.4%	6.3%	1.4%	6.7%	1.6%	6.8%	1.4%	7.1%	1.5%	6.7%	1.5%	7.3%	1.4%	6.9%	1.6%	6.8%	1.5%	7.1%	1.4%	6.6%	1.5%	7.0%	1.5%

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		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
		M-F	S-S																						
(16/5) (e.g., comp. air, lights)																									
Indust. 3-shift (24/5) (e.g., comp. air, lights)	C16	5.1%	3.3%	4.6%	3.1%	4.9%	3.7%	5.0%	3.2%	5.2%	3.3%	4.9%	3.4%	5.3%	3.1%	5.1%	3.5%	5.0%	3.3%	5.2%	3.2%	4.8%	3.5%	5.1%	3.4%
Indust. 4-shift (24/7) (e.g., comp. air, lights)	C17	3.8%	4.6%	3.4%	4.3%	3.6%	5.1%	3.7%	4.4%	3.8%	4.6%	3.6%	4.7%	3.9%	4.3%	3.8%	4.8%	3.7%	4.6%	3.9%	4.4%	3.6%	4.8%	3.8%	4.7%
Industrial Indoor Lighting	C18	6.6%	1.9%	5.9%	1.8%	6.3%	2.1%	6.3%	1.9%	6.6%	1.9%	6.2%	2.0%	6.8%	1.8%	6.5%	2.0%	6.3%	1.9%	6.6%	1.9%	6.1%	2.0%	6.5%	2.0%
Industrial Outdoor Lighting	C19	2.7%	6.2%	2.4%	5.9%	2.6%	7.0%	2.6%	6.0%	1.9%	5.7%	1.8%	5.8%	2.0%	5.3%	1.9%	6.0%	1.8%	5.7%	2.7%	6.0%	2.5%	6.6%	2.6%	6.4%
Commercial Outdoor Lighting	C20	3.5%	5.0%	3.1%	4.7%	3.3%	5.6%	3.3%	4.8%	2.7%	5.6%	2.5%	5.8%	2.7%	5.3%	2.6%	5.9%	2.5%	5.6%	3.5%	4.8%	3.2%	5.3%	3.4%	5.1%
Commercial Office Equipment	C21	5.6%	3.0%	5.0%	2.8%	5.3%	3.3%	5.4%	2.9%	5.4%	2.9%	5.1%	3.0%	5.6%	2.7%	5.3%	3.1%	5.2%	2.9%	5.6%	2.9%	5.2%	3.1%	5.5%	3.0%
Commercial Refrigeration	C22	5.7%	2.9%	5.1%	2.7%	5.4%	3.2%	5.5%	2.8%	5.5%	2.8%	5.1%	2.9%	5.6%	2.7%	5.3%	3.0%	5.2%	2.8%	5.8%	2.8%	5.3%	3.1%	5.6%	3.0%
Commercial Ventilation	C23	5.6%	2.9%	5.1%	2.7%	5.4%	3.3%	5.4%	2.8%	6.1%	2.3%	5.7%	2.4%	6.2%	2.2%	5.9%	2.4%	5.8%	2.3%	5.7%	2.8%	5.3%	3.1%	5.6%	3.0%
Traffic Signal - Red Balls, always changing or flashing	C24	3.8%	4.6%	3.4%	4.3%	3.6%	5.1%	3.7%	4.4%	3.8%	4.6%	3.6%	4.7%	3.9%	4.3%	3.8%	4.8%	3.7%	4.6%	3.9%	4.4%	3.6%	4.8%	3.8%	4.7%
Traffic Signal - Red Balls, changing day, off night	C25	5.5%	2.9%	4.9%	2.8%	5.2%	3.3%	5.3%	2.9%	5.5%	3.0%	5.2%	3.1%	5.7%	2.8%	5.4%	3.1%	5.3%	3.0%	5.5%	2.9%	5.1%	3.1%	5.4%	3.0%
Traffic Signal - Green Balls, always changing	C26	3.8%	4.6%	3.4%	4.3%	3.6%	5.1%	3.7%	4.4%	3.8%	4.6%	3.6%	4.7%	3.9%	4.3%	3.8%	4.8%	3.7%	4.6%	3.9%	4.4%	3.6%	4.8%	3.8%	4.7%
Traffic Signal - Green Balls,	C27	5.5%	2.9%	4.9%	2.8%	5.2%	3.3%	5.3%	2.9%	5.5%	3.0%	5.2%	3.1%	5.7%	2.8%	5.4%	3.1%	5.3%	3.0%	5.5%	2.9%	5.1%	3.1%	5.4%	3.0%

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		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
		M-F	S-S																						
changing day, off night																									
Traffic Signal - Red Arrows	C28	3.8%	4.6%	3.4%	4.3%	3.6%	5.1%	3.7%	4.4%	3.8%	4.6%	3.6%	4.7%	3.9%	4.3%	3.8%	4.8%	3.7%	4.6%	3.9%	4.4%	3.6%	4.8%	3.8%	4.7%
Traffic Signal - Green Arrows	C29	3.8%	4.6%	3.4%	4.3%	3.6%	5.1%	3.7%	4.4%	3.8%	4.6%	3.6%	4.7%	3.9%	4.3%	3.8%	4.8%	3.7%	4.6%	3.9%	4.4%	3.6%	4.8%	3.8%	4.7%
Traffic Signal - Flashing Yellows	C30	3.8%	4.6%	3.4%	4.3%	3.6%	5.1%	3.7%	4.4%	3.8%	4.6%	3.6%	4.7%	3.9%	4.3%	3.8%	4.8%	3.7%	4.6%	3.9%	4.4%	3.6%	4.8%	3.8%	4.7%
Traffic Signal - "Hand" Don't Walk Signal	C31	3.8%	4.6%	3.4%	4.3%	3.6%	5.1%	3.7%	4.4%	3.8%	4.6%	3.6%	4.7%	3.9%	4.3%	3.8%	4.8%	3.7%	4.6%	3.9%	4.4%	3.6%	4.8%	3.8%	4.7%
Traffic Signal - "Man" Walk Signal	C32	3.8%	4.6%	3.4%	4.3%	3.6%	5.1%	3.7%	4.4%	3.8%	4.6%	3.6%	4.7%	3.9%	4.3%	3.8%	4.8%	3.7%	4.6%	3.9%	4.4%	3.6%	4.8%	3.8%	4.7%
Traffic Signal - Bi-Modal Walk/Don't Walk	C33	3.8%	4.6%	3.4%	4.3%	3.6%	5.1%	3.7%	4.4%	3.8%	4.6%	3.6%	4.7%	3.9%	4.3%	3.8%	4.8%	3.7%	4.6%	3.9%	4.4%	3.6%	4.8%	3.8%	4.7%
Industrial Motor	C34	7.0%	1.4%	6.3%	1.4%	6.7%	1.6%	6.8%	1.4%	7.1%	1.5%	6.7%	1.5%	7.3%	1.4%	6.9%	1.6%	6.8%	1.5%	7.1%	1.4%	6.6%	1.5%	7.0%	1.5%
Industrial Process	C35	7.0%	1.4%	6.3%	1.4%	6.7%	1.6%	6.8%	1.4%	7.1%	1.5%	6.7%	1.5%	7.3%	1.4%	6.9%	1.6%	6.8%	1.5%	7.1%	1.4%	6.6%	1.5%	7.0%	1.5%
HVAC Pump Motor (heating)	C36	5.7%	6.9%	5.2%	6.4%	5.5%	7.7%	5.5%	6.6%	1.2%	1.4%	1.1%	1.4%	1.2%	1.3%	1.2%	1.4%	1.2%	1.4%	5.8%	6.6%	5.3%	7.3%	5.7%	7.1%
HVAC Pump Motor (cooling)	C37	1.2%	1.4%	1.0%	1.3%	1.1%	1.5%	1.1%	1.3%	7.5%	9.1%	7.1%	9.3%	7.7%	8.5%	7.3%	9.6%	7.2%	9.1%	1.2%	1.3%	1.1%	1.5%	1.1%	1.4%
HVAC Pump Motor (unknown use)	C38	3.4%	4.1%	3.1%	3.9%	3.3%	4.6%	3.3%	4.0%	4.4%	5.2%	4.1%	5.4%	4.5%	4.9%	4.3%	5.5%	4.2%	5.2%	3.5%	4.0%	3.2%	4.4%	3.4%	4.2%
VFD - Supply fans <10 HP	C39	5.7%	2.3%	5.2%	2.1%	5.5%	2.5%	5.6%	2.2%	5.8%	3.3%	5.5%	3.4%	5.9%	3.1%	5.7%	3.5%	5.5%	3.3%	5.8%	2.2%	5.4%	2.4%	5.7%	2.3%
VFD - Return fans <10 HP	C40	5.7%	2.3%	5.2%	2.1%	5.5%	2.5%	5.6%	2.2%	5.8%	3.3%	5.5%	3.4%	5.9%	3.1%	5.7%	3.5%	5.5%	3.3%	5.8%	2.2%	5.4%	2.4%	5.7%	2.3%
VFD - Exhaust fans <10 HP	C41	5.1%	3.3%	4.6%	3.1%	4.9%	3.7%	5.0%	3.2%	4.1%	4.3%	3.9%	4.4%	4.2%	4.1%	4.1%	4.6%	4.0%	4.3%	5.2%	3.2%	4.8%	3.5%	5.1%	3.4%
VFD - Boiler feedwater	C42	6.4%	6.2%	5.7%	5.9%	6.1%	7.0%	6.1%	6.0%	1.3%	1.3%	1.3%	1.3%	1.4%	1.2%	1.3%	1.3%	1.3%	1.3%	6.4%	6.0%	5.9%	6.6%	6.3%	6.4%

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		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
		M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S	M-F	S-S
pumps <10 HP																									
VFD - Chilled water pumps <10 HP	C43	1.7%	0.8%	1.5%	0.7%	1.6%	0.9%	1.6%	0.8%	8.3%	8.5%	7.8%	8.7%	8.5%	8.0%	8.1%	8.9%	7.9%	8.5%	1.7%	0.8%	1.6%	0.8%	1.6%	0.8%
VFD Boiler circulation pumps <10 HP	C44	6.4%	6.2%	5.7%	5.9%	6.1%	7.0%	6.1%	6.0%	1.3%	1.3%	1.3%	1.3%	1.4%	1.2%	1.3%	1.3%	1.3%	1.3%	6.4%	6.0%	5.9%	6.6%	6.3%	6.4%
Refrigeration Economizer	C45	5.4%	7.2%	4.8%	6.7%	5.1%	8.0%	5.2%	7.0%	1.1%	1.5%	1.1%	1.5%	1.2%	1.4%	1.1%	1.5%	1.1%	1.5%	5.4%	7.0%	5.0%	7.6%	5.3%	7.4%
Evaporator Fan Control	C46	3.6%	5.1%	3.2%	4.8%	3.4%	5.7%	3.4%	4.9%	3.4%	4.7%	3.2%	4.8%	3.5%	4.4%	3.3%	4.9%	3.3%	4.7%	3.6%	4.9%	3.3%	5.4%	3.5%	5.2%
Standby Losses - Commercial Office	C47	1.2%	7.1%	1.1%	6.7%	1.2%	8.0%	1.2%	6.9%	1.1%	7.1%	1.1%	7.3%	1.2%	6.7%	1.1%	7.5%	1.1%	7.1%	1.2%	6.9%	1.1%	7.5%	1.2%	7.3%
VFD Boiler draft fans <10 HP	C48	5.5%	6.9%	5.0%	6.5%	5.3%	7.7%	5.3%	6.7%	1.3%	1.5%	1.2%	1.5%	1.3%	1.4%	1.3%	1.5%	1.2%	1.5%	5.6%	6.7%	5.2%	7.3%	5.5%	7.1%
VFD Cooling Tower Fans <10 HP	C49	1.2%	0.7%	1.1%	0.7%	1.1%	0.8%	1.1%	0.7%	11.0%	6.5%	10.4%	6.7%	11.3%	6.2%	10.8%	6.9%	10.5%	6.5%	1.2%	0.7%	1.1%	0.8%	1.2%	0.8%
Engine Block Heater Timer	C50	3.9%	8.6%	3.5%	8.1%	3.7%	9.6%	3.8%	8.3%	0.8%	1.7%	0.8%	1.7%	0.8%	1.6%	0.8%	1.8%	0.8%	1.7%	4.0%	8.3%	3.7%	9.1%	3.9%	8.9%
Door Heater Control	C51	4.5%	9.8%	4.0%	9.2%	4.3%	11.0%	4.3%	9.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.5%	9.5%	4.2%	10.4%	4.4%	10.1%
Beverage and Snack Machine Controls	C52	1.5%	6.8%	1.3%	6.4%	1.4%	7.6%	1.4%	6.6%	1.5%	6.8%	1.4%	7.0%	1.5%	6.4%	1.5%	7.2%	1.4%	6.8%	1.5%	6.6%	1.4%	7.2%	1.5%	7.0%
Flat	C53	5.4%	3.1%	4.8%	2.9%	5.1%	3.4%	5.2%	3.0%	5.3%	3.1%	5.0%	3.2%	5.5%	2.9%	5.2%	3.3%	5.1%	3.1%	5.4%	3.0%	5.0%	3.3%	5.3%	3.2%
Religious Indoor Lighting	C54	4.0%	4.4%	3.6%	4.2%	3.8%	5.0%	3.8%	4.3%	3.9%	4.5%	3.6%	4.7%	3.9%	4.3%	3.8%	4.8%	3.7%	4.5%	4.0%	4.3%	3.7%	4.7%	3.9%	4.6%

### 3.6 Summer Peak Period Definition (kW)

To estimate the impact that an efficiency measure has on a utility's system peak, the peak itself needs to be defined. Illinois spans two different electrical control areas, the Pennsylvania – Jersey – Maryland (PJM) and the Midwest Independent System Operators (MISO). As a result, there is some disparity in the peak definition across the state. However, only PJM has a forward capacity market where an efficiency program can potentially participate. Because ComEd is part of the PJM control area, their definition of summer peak is being applied statewide in this TRM.

Because Illinois is a summer peaking state, only the summer peak period is defined for the purpose of this TRM. The coincident summer peak period is defined as 1:00-5:00 PM Central Prevailing Time on non-holiday weekdays, June through August.

Summer peak coincidence factors can be found within each measure characterization. The source is provided and is based upon evaluation results, analysis of load shape data (e.g., the Itron eShapes data provided by Ameren), or through a calculation using stated assumptions.

For measures that are not weather-sensitive, the summer peak coincidence factor is estimated whenever possible as the average of savings within the peak period defined above. For weather sensitive measures such as cooling, the summer peak coincidence factor is provided in two different ways. The first method is to estimate demand savings during the utility's peak hour (as provided by Ameren). This is likely to be the most indicative of actual peak benefits. The second way represents the average savings over the summer peak period, consistent with the non-weather sensitive end uses, and is presented so that savings can be bid into PJM's Forward Capacity Market.

### 3.7 Heating and Cooling Degree-Day Data

Many measures are weather sensitive. Because there is a range of climactic conditions across the state, VEIC engaged the Utilities to provide their preferences for what airports and cities are the best proxies for the weather in their service territories. The result of this engagement is in the table below. All of the data represents 30-year normals<sup>27</sup> from the National Climactic Data Center (NCDC). Note that the base temperature for the calculation of heating degree-days in this document does not follow the historical 65F degree base temperature convention. Instead VEIC used several different temperatures in this TRM to more accurately reflect the outdoor temperature when a heating or cooling system turns on.

Residential heating is based on 60F, in accordance with regression analysis of heating fuel use and weather by state by the Pacific Northwest National Laboratory<sup>28</sup>. Residential cooling is based on 65F in agreement with a field study in Wisconsin<sup>29</sup>. These are lower than typical thermostat set points because internal gains such as appliances, lighting, and people provide some heating. In C&I settings, internal gains are often much higher; the base temperatures for both heating and cooling is 55F<sup>30</sup>. Custom degree-days with building specific base temperatures are recommended for large C&I projects.

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<sup>27</sup> 30-year normals have been used instead of Typical Meteorological Year (TMY) data due to the fact that few of the measures in the TRM are significantly affected by solar insolation, which is one of the primary benefits of using the TMY approach.

<sup>28</sup> Belzer and Cort, Pacific Northwest National Laboratory in "Statistical Analysis of Historical State-Level Residential Energy Consumption Trends," 2004.

<sup>29</sup> Energy Center of Wisconsin, May 2008 metering study; "Central Air Conditioning in Wisconsin, A Compilation of Recent Field Research", p. 32 (amended in 2010).

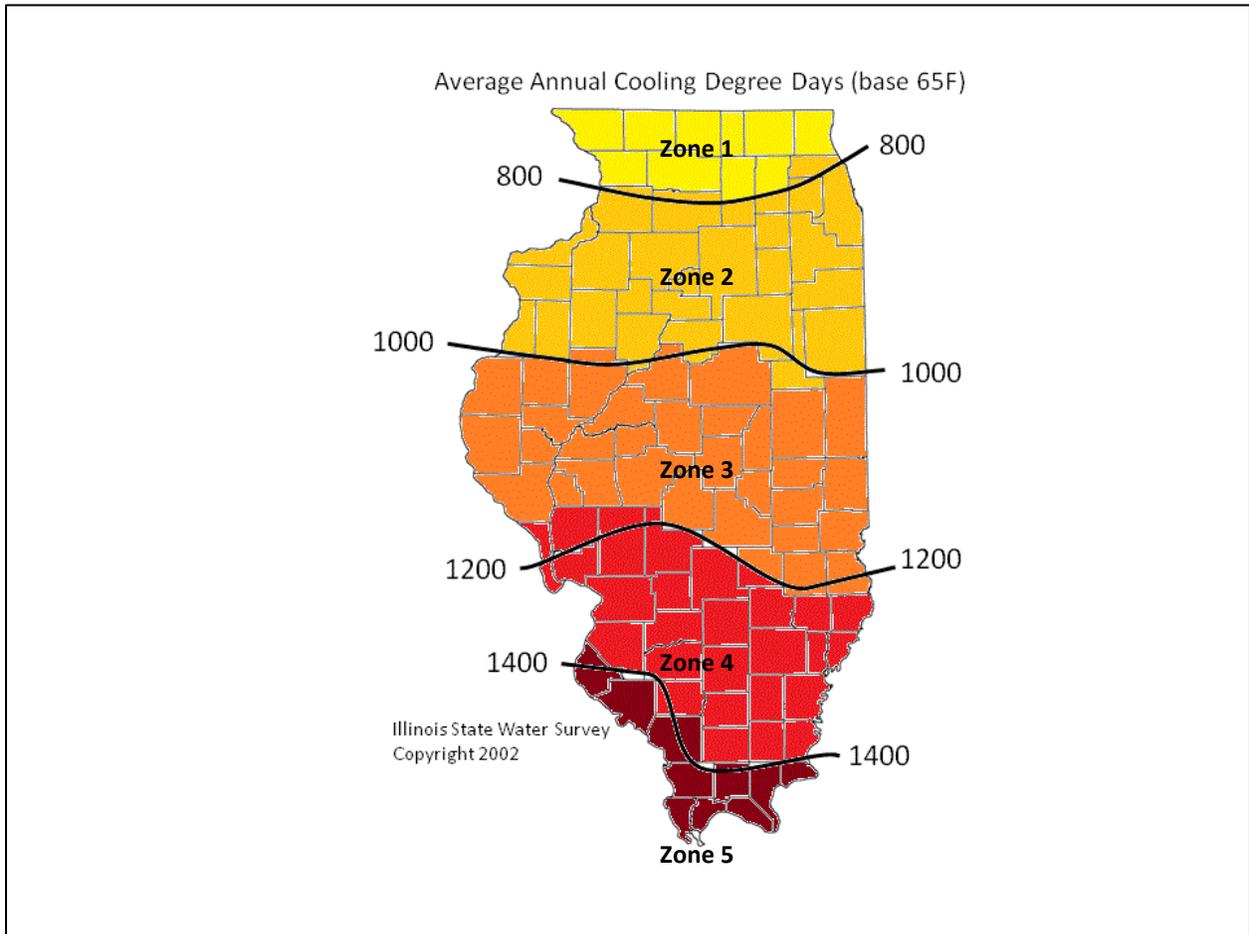
<sup>30</sup> This value is based upon experience, and it is preferable to use building-specific base temperatures when available.

**Table 3.6: Degree-Day Zones and Values by Market Sector**

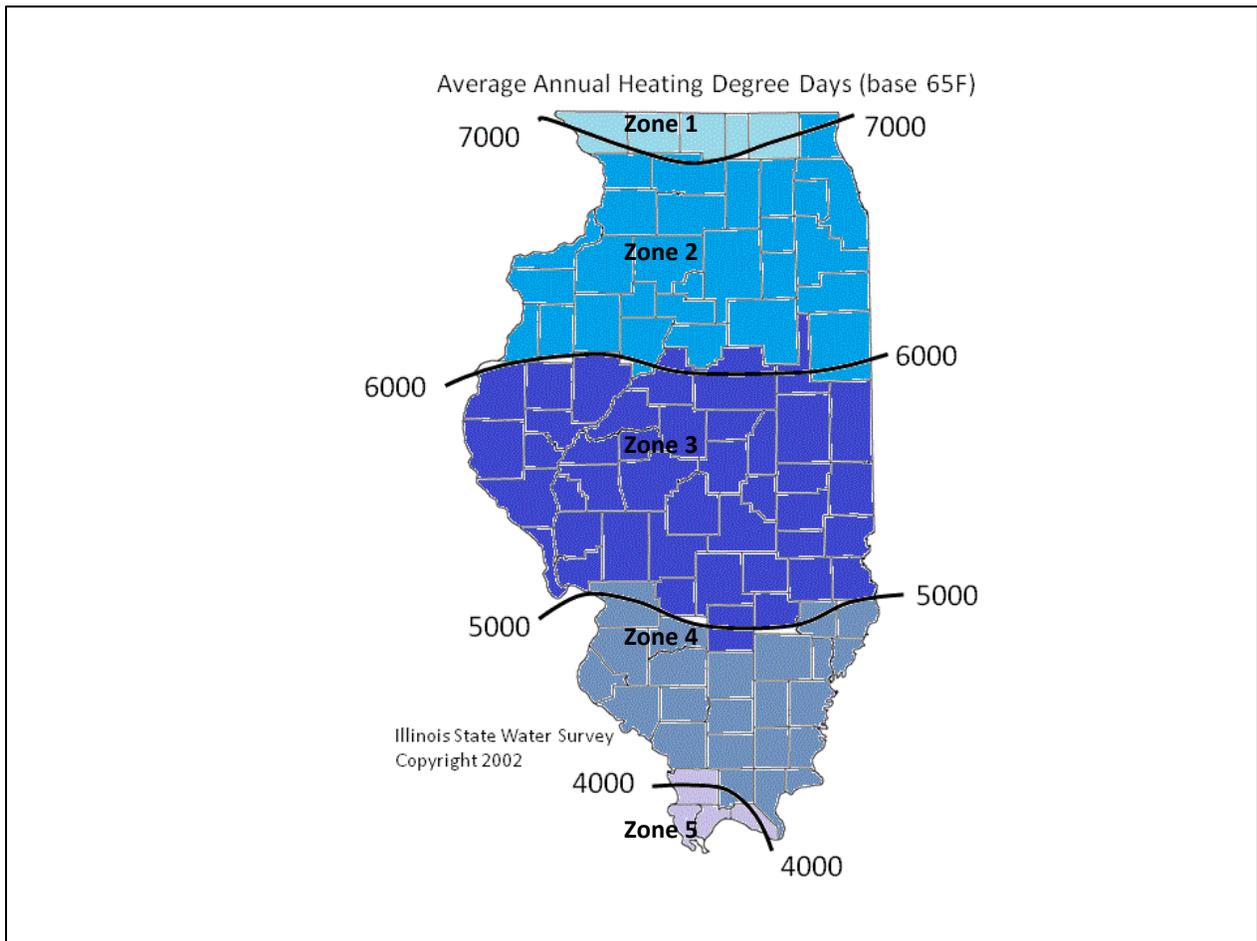
Zone	Residential		C&I		Weather Station / City
	HDD	CDD	HDD	CDD	
1	5,352	820	4,272	2,173	Rockford AP / Rockford
2	5,113	842	4,029	3,357	Chicago O'Hare AP / Chicago
3	4,379	1,108	3,406	2,666	Springfield #2 / Springfield
4	3,378	1,570	2,515	3,090	Belleville SIU RSCH / Belleville
5	3,438	1,370	2,546	2,182	Carbondale Southern IL AP / Marion
Average	4,860	947	3,812	3,051	Weighted by occupied housing units
Base Temp	60F	65F	55F	55F	30 year climate normals, 1981-2010

This table assigns each of the proxy cities to one of five climate zones. The following graphics from the Illinois State Water Survey show isobars (lines of equal degree-days) and we have color-coded the counties in each of these graphics using those isobars as a dividing line. Using this approach, the state divides into five cooling degree-day zones and five heating degree-day zones. Note that although the heating and cooling degree-day maps are similar, they are not the same, and the result is that there are a total of 10 climate zones in the state. The counties are listed in the tables following the figures for ease of reference.

**Figure 1: Cooling Degree-Day Zones by County**



**Figure 2: Heating Degree-Day Zones by County**



**Table 3.7: Heating Degree-Day Zones by County**

Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Boone County	Bureau County	Adams County	Clinton County	Alexander County
Jo Daviess County	Carroll County	Bond County	Edwards County	Massac County
Stephenson County	Cook County	Brown County	Franklin County	Pulaski County
Winnebago County	DeKalb County	Calhoun County	Gallatin County	Union County
	DuPage County	Cass County	Hamilton County	
	Grundy County	Champaign County	Hardin County	
	Henderson County	Christian County	Jackson County	
	Henry County	Clark County	Jefferson County	
	Iroquois County	Clay County	Johnson County	
	Kane County	Coles County	Lawrence County	
	Kankakee County	Crawford County	Madison County	
	Kendall County	Cumberland County	Marion County	
	Knox County	De Witt County	Monroe County	
	Lake County	Douglas County	Perry County	
	LaSalle County	Edgar County	Pope County	
	Lee County	Effingham County	Randolph County	
	Livingston County	Fayette County	Richland County	
	Marshall County	Ford County	Saline County	
	McHenry County	Fulton County	St. Clair County	
	Mercer County	Greene County	Wabash County	
	Ogle County	Hancock County	Washington County	
	Peoria County	Jasper County	Wayne County	
	Putnam County	Jersey County	White County	
	Rock Island County	Logan County	Williamson County	
	Stark County	Macon County		
	Warren County	Macoupin County		
	Whiteside County	Mason County		
	Will County	McDonough County		
	Woodford County	McLean County		
		Menard County		
		Montgomery		
		Morgan County		
		Moultrie County		
		Piatt County		
		Pike County		
		Sangamon County		
		Schuyler County		
		Scott County		
		Shelby County		
		Tazewell County		
		Vermilion County		

**Table 3.8: Cooling Degree-day Zones by County**

Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Boone County	Bureau County	Adams County	Bond County	Alexander County
Carroll County	Cook County	Brown County	Clay County	Hardin County
DeKalb County	DuPage County	Calhoun County	Clinton County	Johnson County
Jo Daviess County	Grundy County	Cass County	Edwards County	Massac County
Kane County	Henderson County	Champaign County	Fayette County	Pope County
Lake County	Henry County	Christian County	Franklin County	Pulaski County
McHenry County	Iroquois County	Clark County	Gallatin County	Randolph County
Ogle County	Kankakee County	Coles County	Hamilton County	Union County
Stephenson County	Kendall County	Crawford County	Jackson County	
Winnebago County	Knox County	Cumberland County	Jefferson County	
	LaSalle County	De Witt County	Jersey County	
	Lee County	Douglas County	Lawrence County	
	Livingston County	Edgar County	Macoupin County	
	Marshall County	Effingham County	Madison County	
	Mercer County	Ford County	Marion County	
	Peoria County	Fulton County	Monroe County	
	Putnam County	Greene County	Montgomery	
	Rock Island County	Hancock County	Perry County	
	Stark County	Jasper County	Richland County	
	Warren County	Logan County	Saline County	
	Whiteside County	Macon County	St. Clair County	
	Will County	Mason County	Wabash County	
	Woodford County	McDonough County	Washington County	
		McLean County	Wayne County	
		Menard County	White County	
		Morgan County	Williamson County	
		Moultrie County		
		Piatt County		
		Pike County		
		Sangamon County		
		Schuyler County		
		Scott County		
		Shelby County		
		Tazewell County		
		Vermilion County		

### 3.8 O&M Costs and the Weighted Average Cost of Capital (WACC)

Some measures specify an operations and maintenance (O&M) parameter that describes the incremental O&M cost savings that can be expected over the measure's lifetime. When estimating the cost effectiveness of these measures, it is necessary to calculate the net present value (NPV) of O&M costs over the life of the measure, which requires an appropriate discount rate. The utility's weighted average cost of capital (WACC) is the most commonly used discount rate that is used in this context.

Each utility has a unique WACC that will vary over time. As a result, the TRM does not specify the NPV of the O&M costs. Instead, the necessary information required to calculate the NPV is included. An example is provided below to demonstrate how to calculate the NPV of O&M costs.

**EXAMPLE**

Baseline Case: O&M costs equal \$150 every two years.

Efficient Case: O&M costs equal \$50 every five years.

Given this information, the incremental O&M costs can be determined by discounting the cash flows in the Baseline Case and the Efficient Case separately using the applicable WACC. Then the NPV of the incremental O&M costs is calculated by subtracting one NPV from the other. This value is then used in each utility's cost-effectiveness screening process.

Those measures that include baseline shifts that result in multiple component costs and lifetimes cannot be calculated by this standard method. In only these cases, the O&M costs are presented both as Annual Levelized equivalent cost (i.e., the annual payment that results in an equivalent NPV to the actual stream of O&M costs) and as NPVs using a statewide average real discount rate of 5.23%.

### 3.9 Interactive Effects

The TRM presents engineering equations for most measures. This approach is desirable because it conveys information clearly and transparently, and is widely accepted in the industry. Unlike simulation model results, engineering equations also provide flexibility and the opportunity for users to substitute local, specific information for specific input values. Furthermore, the parameters can be changed in TRM updates to be applied in future years as better information becomes available.

One limitation is that some interactive effects between measures are not automatically captured. Because we cannot know what measures will be implemented at the same time with the same customer, we cannot always capture the interactions between multiple measures within individual measure characterizations. However, interactive effects with different end-uses are included in individual measure characterizations whenever possible<sup>31</sup>. For instance, waste heat factors are included in the lighting characterizations to capture the interaction between more-efficient lighting measures and the amount of heating and/or cooling that is subsequently needed in the building.

By contrast, no effort is made to account for interactive effects between an efficient air conditioning measure and an efficient lighting measure, because it is impossible to know the specifics of the other measure in advance of its installation. For custom measures and projects where a bundle of measures is being implemented at the same time, these kinds of interactive effects should be estimated.

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<sup>31</sup> For more information, please refer to the document, ‘Dealing with interactive Effects During Measure Characterization’ Memo to the Stakeholder Advisory Group dated 12/9/11.