Iowa Energy Efficiency Statewide Technical Reference Manual Version 4.0

Volume 1: Overview and User Guide

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1 TRM Purpose and Document Summary

The purpose of the Iowa Statewide Technical Reference Manual (TRM) is to unify the processes, practices, and manuals used by the state's utilities' (including investor-owned utilities (IOUs) as well as interested municipal and cooperative utilities) energy efficiency programs and to serve as a common reference document for all stakeholders, utility energy efficiency programs, and the Iowa Utilities Board (Board). The TRM is a technical document designed to:

- Provide a transparent and consistent basis for calculating gross energy (electric kilowatt-hours (kWh) and natural gas therms) and capacity (electric kilowatts (kW) and peak therms) savings, as well as documenting the underlying sources of those assumptions and calculations, including interactivity between efficiency measures. Provide information on net-to-gross adjustments to savings as available.
- Support the calculation of the Iowa Societal Cost test and other cost-benefit tests in support of program design, evaluation, and regulatory compliance. (Actual cost-benefit calculations and the calculation of avoided costs are not part of this TRM.)
- Identify significant gaps in robust, primary data for Iowa that can be addressed through future research, evaluation efforts, and/or other targeted end-use studies.
- Provide a process for periodically updating and maintaining TRM records, and preserve a clear record of what deemed parameters are/were in effect at what times to facilitate evaluation and data accuracy reviews.
- Support coincident summer 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 tracking of coincident peak capacity impacts.
- Support the use of energy efficiency savings as appropriate for environmental compliance requirements and for meeting the requirements of regional energy markets as needed.

This common reference document enables meaningful cross-program comparisons, provides a consistent basis for savings calculations, and creates stability and certainty for utility energy efficiency programs as they make program design and implementation decisions. In addition, the guidance provided for the use and applicability of the TRM may reduce costs to utility energy efficiency programs and stakeholders in preparing and reviewing energy efficiency plan filings and reporting and reviewing energy savings[1].

1.1 Acknowledgments

This Statewide Technical Reference Manual (TRM) was created through a collaboration among the members of the Iowa TRM Oversight Committee. The Oversight Committee is responsible for overseeing and managing the project, providing information to the TRM Consultant, commenting on its work products, and ensuring that the TRM meets the needs of Iowa stakeholders. The Oversight Committee is composed of utilities that offer energy efficiency programs to their customers in Iowa and other interested stakeholders—members are listed in the table below.

Iowa TRM Oversight Committee
Black Hills Energy Company
Cedar Falls Utilities
Environmental Law and Policy Center (ELPC)
Interstate Power & Light Company (IPL)/Alliant
Iowa Association of Electric Cooperatives
Iowa Association of Municipal Utilities
Iowa Environmental Council (IEC)
Iowa Office of Consumer Advocate

[1] **Disclaimer:** This document was created for the stated purposes in relation to the energy efficiency plans of Iowa utilities subject to regulatory oversight by the Iowa Utilities Board. The TRM does not create warranties or representations of any kind, and shall not give rise to new or independent duties or causes of legal action beyond the regulatory jurisdiction of the Iowa Utilities Board under Iowa Code chapter 476.

Iowa TRM Oversight Committee
MidAmerican Energy Company
Winneshiek Energy District (WED)

The development and continued maintenance of the TRM is facilitated on behalf of the Oversight Committee by the Iowa Utility Association. Further information on the TRM and the Oversight Committee is available by contacting the TRM Administrator at iatrmadministrator@veic.org.

This document was prepared for the Iowa TRM Oversight Committee by Vermont Energy Investment Corporation (VEIC). The Oversight Committee would also like to recognize technical input and support for this project from members of the Oversight Committee as well as representatives from the following organizations:

Cadmus Group, on behalf of Black Hills Energy and IPL
Energy Futures Group, on behalf of ELPC and IEC
Tetra Tech, on behalf of MidAmerican Energy
EPI
Midwest Energy Efficiency Alliance

Document Version History

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Iowa_TRM_Vol_2-Residential_Measures_080116	8/1/2016	1/1/2017
Iowa_TRM_Vol_3-Nonresidential_Measures_080116	8/1/2016	1/1/2017
Iowa_TRM_V2_Vol_1_Overview_and_User_Guide_063017	6/30/2017	1/1/2018
Iowa_TRM_V2_Vol_2_Residential_Measures_063017	6/30/2017	1/1/2018
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Iowa_TRM_V3_Vol_3_Nonresidential_Measures_07132018	7/13/2018	1/1/2019
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Iowa_TRM_V4_Vol_3_Nonresidential_Measures_08302019	8/30/2019	1/1/2020

1.2 Summary of Measure Revisions

The following tables summarize the evolution of measures that are new, revised, or errata. This version of the TRM contains changes to 63 measures as described in the following table.

Table 1.2: Summary of Measure Level Changes

Change Type	# Changes
Errata	0
Measures with Revisions	63
New Measures	0
Total Changes	63

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 January 1st, 2019. Measures that are identified as 'Revision' were included in the third edition of the TRM, and have been updated for this edition of the TRM. Both 'Revision' and 'New Measure(s)' have an effective date of January 1st, 2020.

The following table provides an overview of the 63 measure-level changes that are included in this version of the TRM.

Table 1.3: Summary of Measure Revisions

Measure # and Name (except where noted)	Change Description	Change Type
2.1.1 Clothes Washer	Performed reliability review, but no changes recommended.	Revision
2.1.2 Clothes Dryer	Updated Measure Life, Ncycles, Hours, and %Elec/%Gas assumptions	Revision
2.1.5 Refrigerator and Freezer Recycling	Change in measure life and update to deemed savings values based on more recent dataset.	Revision
2.2.2 Tier 2 Advanced Power Strips (APS) – Residential Audio Visual	Added description of two distinct control strategies. Added TOS costs. Moved from product-specific to control-specific savings assumptions.	Revision
2.3.4 Low Flow Faucet Aerators	Updated measure life, TOS incremental cost, household size, and deemed savings values. Revised the recovery efficiency of heat pump water heaters from 280% to 200% to align with the Low Flow Showerheads measure.	Revision
2.3.5 Low Flow Showerheads	Updated reference (not value) for measure life, household size, and deemed savings values.	Revision
2.4.1 Central Air Source Heat Pump	Clarified heating capacity input rating conditions. Clarified cooling capacity input rating conditions.	Revision
2.4.4 Furnace	Added a separate Definition of Baseline Equipment for early replacement.	Revision
2.4.5 Furnace Blower Motor	Corrected Furnace measure number reference in Deemed Measure Cost section. Measure retired.	Revision /Retired
2.4.6 Ground Source Heat Pump	Incremental cost update.	Revision
2.4.7 Ductless Heat Pump	Corrected EERexist table and flagged for potential errata.	Revision
2.4.14 Furnace Tune-up	Increased lifetime to 2 years.	Revision
2.4.15 Geothermal Source Heat Pump Tune-Up	Measure retired.	Retired
2.4.17 Programmable Thermostats	Updated measure life. Added note as to why we continue to use 2009 RECS data due to better specificity than data in 2015. Updated %savings adjustment and resulting values.	Revision
2.4.18 Advanced Thermostat	Fixed typo. Adjusted to be consistent with IL TRM cooling savings assumption. Additional discussions and evaluation efforts to further improve this assumption will not be complete until after this Iowa TRM review cycle.	Revision
2.4.19 Duct Insulation	Included 15% reduction in duct efficiency if ducts are not sealed. Also added unknown assumption to be a sealed duct. Edited headers in nHeating table for consistency and carried all nHeat values to two decimal places.	Revision
2.4.20 Advanced Thermostat Optimization Services	Adjusted to be consistent with IL TRM cooling savings assumption. Updated $Cooling_{OptimizedReduction}$ assumption based on new information specific to cooling savings.	Revision
2.5.3 LED Lamp – Standard	Clarified timing of baseline adjustment relating to the EISA Backstop provision to 1/1/2021. Updated ISR assumptions based on additional data from Illinois. Recalc of O&M Costs	Revision
2.5.4 LED Lamp – Specialty	Adjusted timing of baseline adjustment relating to the EISA Backstop provision due to uncertainty around final application to 1/1/2025. (Pushed back 1 year from first draft)	Revision

Measure # and Name (except where noted)	Change Description	Change Type
	Updated ISR, hours, and CF assumptions based on additional data from Illinois. Recalc of O&M Costs (Recalculated based on 2025 shift)	
2.5.6 LED Fixtures	Clarified timing of baseline adjustment relating to the EISA Backstop provision to 1/1/2021. Recalc of O&M Costs	Revision
2.6.2 Attic Ceiling Insulation	Included unknown assumption for sealed ducts, which removes a 15% reduction assumption used for unsealed ductwork. TRM now provides both sealed and unsealed ductwork options. Updated the cooling efficiency table to also include unsealed assumptions, which reduces SEER by 15%. Edited headers in nHeating table for consistency and carried all nHeat values to two decimal places.	Revision
2.6.3 Rim Band Joist Insulation	Included unknown assumption for sealed ducts, which removes a 15% reduction assumption used for unsealed ductwork. TRM now provides both sealed and unsealed ductwork options. Updated the cooling efficiency table to also include unsealed assumptions, which reduces SEER by 15%. Edited headers in nHeating table for consistency and carried all nHeat values to two decimal places.	Revision
2.6.4 Wall Insulation	Included unknown assumption for sealed ducts, which removes a 15% reduction assumption used for unsealed ductwork. TRM now provides both sealed and unsealed ductwork options. Updated the cooling efficiency table to also include unsealed assumptions, which reduces SEER by 15%. Edited headers in nHeating table for consistency and carried all nHeat values to two decimal places.	Revision
2.6.5 Insulated Doors	Included unknown assumption for sealed ducts, which removes a 15% reduction assumption used for unsealed ductwork. TRM now provides both sealed and unsealed ductwork options. Updated the cooling efficiency table to also include unsealed assumptions, which reduces SEER by 15%. Edited headers in nHeating table for consistency and carried all nHeat values to two decimal places.	Revision
2.6.1 Infiltration Control 2.6.5 Insulated Doors 2.6.6 Floor Insulation Above Crawlspace 2.6.7 Basement Sidewall Insulation 2.6.8 Efficient Windows 2.6.9 Window Insulation Kits 2.6.10 Storm Windows	Added language in description and table headers: If sealing of ducts is unknown, the sealed efficiency should be used. Provided efficiency options for unsealed ducts to be 85% less for heating and cooling. Edited headers in nHeating table for consistency, and carried all nHeat values to two decimal places.	Revision
2.7.1 Residential Pool Pumps	Revised to recognize ENERGY STAR 2.0 specifications. Removed k prefixes in WEF definitions and added footnote for clarification.	Revision
3.1.1 Circulation Fans	Corrected table header type and removed reference to rating conditions, as they are not applicable.	Revision
3.1.5 Automatic Milker Take Off	Updated default number of milking cows based on newer 2012 data.	Revision
3.1.6 Dairy Scroll Compressor	Updated default number of milking cows based on newer 2012 data.	Revision
3.1.10 Grain Dryer	Revision to capacity specifications for program qualifying equipment.	Revision
3.1.12 Low Pressure Irrigation	Added definition for *Pressure* variable in Electric Energy Savings algorithm.	Revision
3.1.13 VFD for Dairy Vacuum Pump and Milking Machine	Defined and specified a missing variable to quantify the default number of milkings per day. Updated default number of milking cows based on newer 2012 data.	Revision

Measure # and Name (except where noted)	Change Description	Change Type
3.1.14 Dairy Plate Cooler	Updated default number of milking cows based on newer 2012 data.	Revision
3.2.1 Low Flow Aerator	Revised the recovery efficiency of heat pump water heaters from 280% to 200% to align with the Low Flow Showerheads measure.	Revision
3.2.3 Gas Hot Water Heater	No substantive changes, minor wordsmithing.	Revision
EFLH Tables preceding measures in Section 3.3 Heating, Ventilation and Air Conditioning (HVAC)	Updated ELFH values based on available OpenStudio model outputs. Added New Construction values based on available OpenStudio outputs.	Revision
3.3.3 Furnace Blower Motor	Added language to disqualify Residential Product Class equipment from measure to comply with Code of Federal Standards. Revised measure life to equal that of the remaining useful life of the furnace.	Revision
3.3.5 Geothermal Source Heat Pump	Updated baseline minimum qualifying criteria and incremental cost.	Revision
3.3.7 Electric Chiller	Updated incremental costs to reflect a newer version of NEEP data.	Revision
3.3.8 Package Terminal Air Conditioner (PTAC) and Package Terminal Heat Pump (PTHP)	New measure life and costs. New federal standard updates for PTAC cooling NC and PTHP heating NC.	Revision
3.3.11 Furnace Tune-Up	Increased lifetime to 2 years.	Revision
3.3.12 Small Commercial Programmable Thermostats	Provided examples of applicable small commercial applications.	Revision
3.3.13 VFD for HVAC Pumps	Updated incremental costs and qualifying range for motor horsepower. Updated default hours table with OpenStudio model outputs as available.	Revision
3.3.14 Variable Frequency Drives for HVAC Supply and Return Fans	Updated incremental costs and qualifying range for motor horsepower. Updated default hours table with OpenStudio model outputs as available.	Revision
3.3.15 Duct Insulation	Reworked example to avoid confusion/implications related to distribution efficiency.	Revision
3.3.16 Duct Repair and Sealing	Reworked example to avoid confusion/implications related to distribution efficiency.	Revision
3.3.19 Shut Off Damper for Space Heating Boilers or Furnaces	Revised measure life and O&M assumptions.	Revision
Lighting table preceding measure characterizations in section 3.4	Updated WHFe, WHFd, CF, WHFh, IFTherms, and IFkWh values based on available OpenStudio outputs.	Revision
3.4.3 LED Standard	Clarified timing of baseline adjustment relating to the EISA Backstop provision to 1/1/2021. Updated ISR assumptions based on additional data from Illinois. Recalc of O&M Costs	Revision
3.4.4 LED Lamp Specialty	Adjusted timing of baseline adjustment relating to the EISA Backstop provision due to uncertainty around final application to 1/1/2025. (Pushed back 1 year from first draft) Updated ISR assumption based on additional data from Illinois. Recalc of O&M Costs. (Recalculated based on 2025 shift)	Revision
3.4.5 LED Fixtures	Adjusted timing of T12 midlife adjustment to 2022. Allowed for larger lumen applications by opening up highest bin based on review of available product. Added clarification for capturing instances of delamping.	Revision

Measure # and Name (except where noted)	Change Description	Change Type
3.4.9 Commercial LED Exit Sign	Revised footnote to remove mention of a superseded blended baseline of incandescent/CFL assumptions.	Revision
3.5.1 Variable Frequency Drive for Process	Updated incremental costs and qualifying range for motor horsepower. Added coincident peak demand savings algorithm.	Revision
3.6.3 Pre-Rinse Spray Valve	Updated flow rates based on Federal Standard and a more recent study for DI programs. Added a measure cost for DI. Revised the specific weight of water from 8.2 to 8.33 lb./gal.	Revision
Heating and Cooling Load Hour table preceding measure characterizations in section 3.7	Updated Load Hour values based on available OpenStudio outputs.	Revision
3.7.1 Infiltration Control	Reworked example to avoid confusion/implications related to distribution efficiency.	Revision
3.7.3 Roof Insulation	Removed references to wall assemblies and provided alternative default assumptions for wood-framed Group R (residential) building types. Clarified Code and Area variable definitions. Reworked example to avoid confusion/implications related to distribution efficiency.	Revision
3.7.5 Efficient Windows	Reworked example to avoid confusion/implications related to distribution efficiency.	Revision
3.7.6 Insulated Doors	Reworked example to avoid confusion/implications related to distribution efficiency.	Revision
3.8.5 Refrigerated Beverage Vending Machine	ENERGY STAR did not meet deadline to release new spec for vending machines. Updated measure characterization to reflect the intent to update the federal baseline and efficient condition in next iteration of TRM. Otherwise, the measure is the same.	Revision
3.8.6 Refrigerator and Freezer Recycling	Change in measure life and update to deemed savings values based on more recent dataset.	Revision
All measures referencing a Summer System Peak Coincidence Factor for Cooling in sections 3.3 and 3.7	Updated Summer System Peak Coincidence Factors for Cooling values based on available OpenStudio outputs.	Revision
All measures referencing a Gas Coincidence Factor for Heating in sections 3.3 and 3.7	Updated Gas Coincidence Factors for Heating values based on available OpenStudio outputs.	Revision

1.3 Summary of Measure Sunset Dates

This initial version of the TRM contains 133 measure characterizations. Sunset dates for the information contained therein are given for each measure in the following table (see Section 3.2.2 for description and purpose of these dates).

TRM Measure Sunset Dates

Measure Number	Residential Measure Name	Sunset Date
2.1 Appliances		
2.1.1	Clothes Washer	1/1/2023
2.1.2	Clothes Dryer	1/1/2023
2.1.3	Refrigerator	1/1/2021
2.1.4	Freezer	1/1/2021
2.1.5	Refrigerator and Freezer Recycling	1/1/2022
2.1.6	Room Air Conditioner	1/1/2021
2.1.7	Room Air Conditioner Recycling	1/1/2023
2.1.8	ENERGY STAR Air Purifier	1/1/2021

Measure Number	Residential Measure Name	Sunset Date
2.2 Consumer Electronics		
2.2.1	Tier 1 Advanced Power Strip (APS)	1/1/2020
2.2.2	Tier 2 Advanced Power Strips (APS) – Residential Audio Visual	1/1/2023
2.3 Hot Water		
2.3.1	Gas Water Heater	1/1/2022
2.3.2	Heat Pump Water Heaters	1/1/2022
2.3.3	Water Heater Temperature Setback	1/1/2023
2.3.4	Low Flow Faucet Aerators	1/1/2023
2.3.5	Low Flow Showerheads	1/1/2023
2.3.6	Domestic Hot Water Pipe Insulation	1/1/2023
2.3.7	Water Heater Wrap	1/1/2023
2.4 Heating, Ventilation, and Air Conditioning (HVAC)		
2.4.1	Central Air Source Heat Pump	1/1/2022
2.4.2	Central Air Conditioner	1/1/2022
2.4.3	Boiler	1/1/2022
2.4.4	Furnace	1/1/2020
2.4.5	Furnace Blower Motor	Retired
2.4.6	Geothermal Source Heat Pump	1/1/2023
2.4.7	Ductless Heat Pumps	1/1/2024
2.4.8	Energy Recovery Ventilator	1/1/2022
2.4.9	Gas Fireplace	1/1/2023
2.4.10	Whole House Fan	1/1/2023
2.4.11	Central Air Source Heat Pump Tune-Up	1/1/2020
2.4.12	Central Air Conditioner Tune-Up	1/1/2020
2.4.13	Boiler Tune-up	1/1/2023
2.4.14	Furnace Tune-Up	1/1/2022
2.4.15	Geothermal Source Heat Pump Tune-Up	Retired
2.4.16	Duct Sealing	1/1/2022
2.4.17	Programmable Thermostats	1/1/2023
2.4.18	Advanced Thermostats	1/1/2021
2.4.19	Duct Insulation	1/1/2022
2.4.20	Advanced Thermostats Optimization Services	1/1/2021
2.5 Lighting		
2.5.1	Compact Fluorescent Lamp - Standard	Retired
2.5.2	Compact Fluorescent Lamp - Specialty	Retired
2.5.3	LED Lamp - Standard	1/1/2021
2.5.4	LED Lamp - Specialty	1/1/2021
2.5.5	LED Exit Signs	1/1/2023
2.5.6	LED Fixtures	1/1/2021
2.6 Shell		
2.6.1	Infiltration Control	1/1/2022
2.6.2	Attic/Ceiling Insulation	1/1/2022
2.6.3	Rim/Band Joist Insulation	1/1/2022
2.6.4	Wall Insulation	1/1/2022
2.6.5	Insulated Doors	1/1/2021
2.6.6	Floor Insulation Above Crawlspace	1/1/2021
2.6.7	Basement Sidewall Insulation	1/1/2021
2.6.8	Efficient Windows	1/1/2021
2.6.9	Window Insulation Kits	1/1/2023
2.6.10	Storm Windows	1/1/2023

Measure Number	Residential Measure Name	Sunset Date
2.7 Miscellaneous		
2.7.1	Residential Pool Pumps	1/1/2021

Measure Number	Nonresidential Measure Name	Sunset Date
3.1 Agricultural Equipment		
3.1.1	Circulation Fans	1/1/2024
3.1.2	Ventilation Fans	1/1/2021
3.1.3	High Volume Low Speed Fans	1/1/2021
3.1.4	Temperature Based On/Off Ventilation Controller	1/1/2021
3.1.5	Automatic Milker Take Off	1/1/2021
3.1.6	Dairy Scroll Compressor	1/1/2021
3.1.7	Heat Lamp	1/1/2021
3.1.8	Heat Reclaimer	1/1/2021
3.1.9	Heat Mat	1/1/2021
3.1.10	Grain Dryer	1/1/2025
3.1.11	Live Stock Waterer	1/1/2021
3.1.12	Low Pressure Irrigation	1/1/2021
3.1.13	Variable Speed Frequency Drive for Dairy Vacuum Pump and Milking Machine	1/1/2023
3.1.14	Dairy Plate Cooler	1/1/2021
3.2 Hot Water		
3.2.1	Low Flow Faucet Aerators	1/1/2022
3.2.2	Low Flow Showerheads	1/1/2022
3.2.3	Gas Hot Water Heater	1/1/2022
3.2.4	Controls for Central Domestic Hot Water	1/1/2023
3.2.5	Pool Covers	1/1/2023
3.2.6	Drainwater Heat Recovery	1/1/2023
3.3 Heating, Ventilation and Air Conditioning (HVAC)		
3.3.1	Boiler	1/1/2022
3.3.2	Furnace	1/1/2020
3.3.3	Furnace Blower Motor	1/1/2023
3.3.4	Heat Pump Systems	1/1/2022
3.3.5	Geothermal Source Heat Pump	1/1/2022
3.3.6	Single-Package and Split System Unitary Air Conditioners	1/1/2022
3.3.7	Electric Chiller	1/1/2021
3.3.8	Package Terminal Air Conditioner (PTAC) and Package Terminal Heat Pump (PTHP)	1/1/2022
3.3.9	Guest Room Energy Management (PTAC)	1/1/2022
3.3.10	Boiler Tune-up	1/1/2023
3.3.11	Furnace Tune-Up	1/1/2023
3.3.12	Small Commercial Programmable Thermostats	1/1/2024
3.3.13	Variable Frequency Drives for HVAC Pumps	1/1/2022
3.3.14	Variable Frequency Drives for HVAC Supply and Return Fans	1/1/2023
3.3.15	Duct Insulation	1/1/2022
3.3.16	Duct Repair and Sealing	1/1/2022
3.3.17	Chiller Pipe Insulation	1/1/2022
3.3.18	Hydronic Heating Pipe Insulation	1/1/2022
3.3.19	Shut Off Damper for Space Heating Boilers or Furnaces	1/1/2024
3.3.20	Room Air Conditioner	1/1/2021
3.3.21	Room Air Conditioner Recycling	1/1/2023

Measure Number	Nonresidential Measure Name	Sunset Date
3.3.22	Steam Trap Replacement or Repair	1/1/2022
3.4 Lighting		
3.4.1	Compact Fluorescent Lamp - Standard	Retired
3.4.2	Compact Fluorescent Lamp - Specialty	Retired
3.4.3	LED Lamp Standard	1/1/2021
3.4.4	LED Lamp Specialty	1/1/2021
3.4.5	LED Fixtures	1/1/2022
3.4.6	T5 HO Fixtures and Lamp/Ballast Systems	1/1/2024
3.4.7	High Performance and Reduced Wattage T8 Fixtures and Lamps	Retired
3.4.8	Metal Halide	Retired
3.4.9	Commercial LED Exit Sign	1/1/2024
3.4.10	LED Street Lighting	1/1/2024
3.4.11	LED Traffic and Pedestrian Signals	1/1/2024
3.4.12	Occupancy Sensor	1/1/2021
3.4.13	Daylighting Control	1/1/2021
3.4.14	Multi-Level Lighting Switch	1/1/2021
3.5 Miscellaneous		
3.5.1	Variable Frequency Drives for Process	1/1/2023
3.5.2	Clothes Washer	1/1/2021
3.5.3	Motors	1/1/2022
3.5.4	Forklift Battery Charger	1/1/2022
3.6 Food Service		
3.6.1	Dishwasher	1/1/2022
3.6.2	Commercial Solid and Glass Door Refrigerators & Freezers	1/1/2024
3.6.3	Pre-Rinse Spray Valve	1/1/2024
3.6.4	Infrared Upright Broiler	1/1/2022
3.6.5	Infrared Salamander Broiler	1/1/2022
3.6.6	Infrared Charbroiler	1/1/2022
3.6.7	Convection Oven	1/1/2022
3.6.8	Conveyor Oven	1/1/2022
3.6.9	Infrared Rotisserie Oven	1/1/2022
3.6.10	Commercial Steam Cooker	1/1/2022
3.6.11	Fryer	1/1/2022
3.6.12	Griddle	1/1/2022
3.7 Shell		
3.7.1	Infiltration Control	1/1/2024
3.7.2	Foundation Wall Insulation	1/1/2024
3.7.3	Roof Insulation	1/1/2024
3.7.4	Wall Insulation	1/1/2024
3.7.5	Efficient Windows	1/1/2024
3.7.6	Insulated Doors	1/1/2024
3.8 Refrigeration		
3.8.1	LED Refrigerator Case Light Occupancy Sensor	1/1/2024
3.8.2	Door Heater Controls for Cooler or Freezer	1/1/2022
3.8.3	Electronically Commutated Motors (ECM) for Walk-in and Display Case Coolers / Freezers	1/1/2024
3.8.4	Night Covers for Open Refrigerated Display Cases	1/1/2021
3.8.5	Refrigerated Beverage Vending Machine	1/1/2020
3.8.6	Refrigerator and Freezer Recycling	1/1/2022

Measure Number	Nonresidential Measure Name	Sunset Date
3.8.7	Scroll Refrigeration Compressor	1/1/2023
3.8.8	Strip Curtain for Walk-in Coolers and Freezers	1/1/2022
3.8.9	Ice Maker	1/1/2024
3.8.10	Efficient Motor Controls for Walk in and Display Case Coolers/Freezers	1/1/2024

1.4 Enabling Orders and Agreements

In 1990, the State of Iowa enacted enabling legislation that requires rate-regulated gas and electric utilities to offer energy efficiency programs to their Iowa customers (Code of Iowa, sections 476.6 (14) and 476.6(16)). The Board adopted rules that guide and govern the offering of energy efficiency programs in Iowa (Iowa Administrative Code 199, Chapters 35 and 36 of the Utilities Division). The following investor-owned utilities (IOUs) have energy efficiency programs that were developed pursuant to this legislation and rules:

- MidAmerican Energy Company (MEC): Electric and Gas
- Alliant/Interstate Power & Light Company (IPL): Electric and Gas
- Black Hills Energy Company (BHE): Gas Only
- Liberty Utilities: Gas Only

In addition to these IOUs, municipal and cooperative utilities in the state of Iowa are required to offer energy efficiency programs to their customers (Code of Iowa, section 476.6(16)(c)). The Iowa gas and electric utilities and other energy efficiency providers participate in an informal statewide stakeholder collaborative group that serves to provide feedback and guidance on a wide variety of energy efficiency topics.

Electric and gas energy efficiency programs have been offered by the Iowa IOUs and other providers since the early 1990s. While the history of IOU energy efficiency programs in Iowa is long when contrasted to many other states, and the IOUs and other energy efficiency providers have developed a variety of technical manuals, processes, and practices, there had not been a significant effort to date to unify these processes, practices, and manuals prior to 2015. The Board, in orders approving the 2014-2018 electric and gas efficiency plans, agreed that a statewide TRM would be beneficial to the Board, the utilities, and stakeholders by ensuring a consistent process for determining energy savings for individual measures.

In final orders issued for the energy efficiency plans of Interstate Power & Light (Docket No. EEP-2012-0001), MidAmerican Energy Company (Docket No. EEP-2012-0002), and Black Hills Energy (Docket No. EEP-2013-0001), the Board accepted these utilities' agreements to work with interested stakeholders in the development of a technical reference manual.

In doing so, the Board noted its reliance on evidence regarding the benefits of a collaborative process to develop and maintain a statewide technical reference manual, including: (1) improved precision and more rigorous and frequent review to the deemed savings employed in the Statewide Assessment; and (2) the development of standard and defensible protocols for calculating savings, including useful life and baseline assumptions for various energy efficiency offerings, through a technical reference manual can be expected to contribute to reported savings more closely mapping to verified savings and providing structure for program planning and goal setting.

The Board concluded that a collaborative process to develop and maintain a statewide technical reference manual is a worthwhile endeavor and approved Settlement Agreement terms concerning the development of a technical reference manual. The Settlement Agreements provided that the investor-owned utilities and interested stakeholders will form a planning committee to develop an RFP for an independent, third-party contractor to be selected through a competitive bidding process. The parties' objective was to have the TRM completed in time for use in the Statewide Assessment for the 2019-2023 energy efficiency plans, targeting the beginning of the third quarter 2016 for completion.

On March 22, 2017, the Iowa Utilities Board issued an "Order Regarding Implementation of Technical Reference Manual." The Board commended the parties for working together to develop the TRM and reiterated its expectation

that the adoption of the TRM will ultimately improve the transparency and consistency in the measure assumptions used by the utilities.

Recognizing that the TRM was not intended to be a static document, the Board approved the annual TRM update process so that TRM assumptions will remain current and provide the transparency necessary for the Board and stakeholders. The Board accepted the use of the standard formulas contained in the TRM as the basis for determining savings and cost-effectiveness of energy efficiency programs, and agreed that the Board's energy efficiency Web page (https://iub.iowa.gov/energy-efficiency) should contain links to the various components of the TRM and subsequent updates.

In final orders issued for the 2019-2023 energy efficiency plans of Interstate Power & Light (Docket No. EEP-2018-0003), MidAmerican Energy Company (Docket No. EEP-2018-0002), and Black Hills Energy (Docket No. EEP-2018-0004), the Board accepted these utilities' agreements to work with interested stakeholders to continue to support the maintenance and revision of the Iowa Technical Reference Manual (TRM) and support the TRM working group.

The Iowa Statewide TRM has been developed and updated to be consistent with these orders and agreements. While municipal and cooperative utilities do not have specific requirements related to the use of the TRM, it has been developed with their input as well and may be used on a voluntary basis to support their energy efficiency programs.

2 TRM Development

2.1 Oversight Committee and Technical Advisory Committee Guidance and Input

The TRM development process is guided by the Iowa TRM Oversight Committee, which oversees and manages the project, provides information to the TRM Administrator, comments on its work products, and ensures that the TRM meets the needs of the Iowa stakeholders. The Oversight Committee has the opportunity to participate in every aspect of the development of the TRM. Committee members as well as additional technical and subject matter experts are designated as the Technical Advisory Committee (TAC) – these individuals provide data and technical input, review draft savings calculations, and attend teleconferences to review, comment, and participate in the development of the TRM.

TRM development is guided by a spirit of collaboration and shared goals. The group solicits input from and considers the advice of the TRM Administrator, TAC members, appropriate consultants, and other credible resources. Parties are expected to share relevant information and resources; be prepared to identify and explain the basis for positions; and strive for consensus on decision-making items. Frequent Oversight Committee and TAC meetings are used to maximize the level of collaboration and visibility into the measure characterization process. The Oversight Committee will make final decisions based on recommendations provided by the TAC.

In the event of any disagreement, the TRM Administrator will note the disagreement, document the grounds for disagreement, and seek feedback on whether additional research or follow-up is warranted. In keeping with the goal of transparency, all of the comments and their status to date are available through the Iowa TRM SharePoint web site. If, after a reasonable opportunity for discussion and research, consensus cannot be reached on a technical or measure-related issue after good-faith efforts, the TRM Administrator will propose a resolution for recommendation to the Oversight Committee. If consensus within the Oversight Committee cannot be reached on matters of policy, TRM usage and application, or other non-technical matters, the TRM Administrator will document the issue in a Comparison Exhibit of Non-Consensus TRM Issues that will clearly lay out the different positions on non-consensus issues, and, to the extent possible, identify the parties who support each position. The Comparison Exhibit of Non-Consensus TRM Issues will be will be submitted along with the updated TRM to the Oversight Committee and as a part of TRM filings.

The final draft of each TRM will be submitted to the Iowa Utilities Board. Any disagreements as outlined in a Comparison Exhibit of Non-Consensus TRM Issues will also be filed.

2.2 TRM Development Approach

2.2.1 Guiding Principles

A statewide TRM will only effectively serve utilities and stakeholders and their needs if it is thorough, accurate, transparent, and easy to use. However, there is also a need to balance features, function, and cost and the trade-offs inherent in improvements in each of these key features. To achieve this balance while maximizing value, this TRM was developed with the following goals in mind.

- **Best data**. Available, Iowa-specific information was used whenever possible as a starting point for developing the TRM. This approach is not only efficient but also takes advantage of the utilities' and stakeholders' insights, program knowledge, and internal expertise. This unified statewide TRM started with the common elements of TRMs and other savings estimates from the utilities and was updated with most current information and Iowa-specific inputs.
- **Best practices**. The approach of using local data as a framework and then benchmarking and supplementing with relevant information, data, and lessons from other jurisdictions leads to measure characterizations that are as accurate as possible and most relevant to Iowa's programs. This TRM is built as well on best-practice approaches to TRM development, including the US Department of Energy's Uniform Methods Project protocols, when relevant, and includes enhancements informed by experience in other jurisdictions when appropriate.
- **Prioritization**. Not all measures or savings assumptions are equally important. The development objective for

this TRM was intentionally focused on establishing highly reliable results for those measures, assumptions, and protocols that are likely to have the greatest impact on energy, savings, and cost-effectiveness for Iowa's programs. Shared information and experience, along with a focus on the most significant assumptions, provides the guidance for the development of the remaining measures. Continuing to prioritize new and evolving measures through cycles of future characterization development is an effective way to balance considerations of usefulness and cost.

- **Stakeholder involvement**. The most transparent and useful TRMs not only include data from utilities and stakeholders but also reflect their input and buy-in for the process and the final decisions made. The development of this TRM provided for extensive and inclusive opportunities for utility and stakeholder involvement through the Oversight Committee and TAC representation and participation that provided forums for input and discussion. Regular Oversight Committee and TAC meetings are used to maximize the level of collaboration and visibility into the measure characterization process. Where consensus does not emerge on specific measures or issues, items are addressed through the dispute resolution process identified in the previous section. The TRM strives to achieve and represent a broad consensus among the stakeholders.

2.2.2 Measure-level Organization

Information is organized within the TRM by individual efficient measures, such as CFL lighting and LED lighting, within an end-use category, such as Residential Lighting. Intended to answer the question "What technology defines the measure?", this organizational approach captures the common information about a measure regardless of implementation or delivery mechanism, and then provides within the measure those additional assumptions relevant to such program options. In addition, characterizations are also designed to be agnostic 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 are captured in one place and defined with formulas and variables that allow visibility into the various fuel savings values. As a result of this way of categorizing measures, the TRM is easier to use and to maintain.

Information presented for each measure is standardized and may reflect either default/deemed or customer-specific values. Many of the measures may 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. Section 5 below provides further information on measure characterization content.

3 TRM Update Process

The Iowa Statewide TRM will be revisited annually to capture new and updated information. The following sections outline the annual TRM update process for routine TRM updates, including roles and responsibilities for stakeholders in the TRM update process and a timeline for updating the TRM that is in sequence with milestones that have been set for future investor-owned utility energy efficiency Plan filings.

3.1 Schedule for TRM Implementation

Because technology and markets are dynamic, the TRM update process is a structured and ongoing process. The TRM update process is aligned with the existing program planning, evaluation, and implementation cycles. These cycles for Iowa's IOUs are summarized in the following table along with the schedule for TRM use. Iowa's municipal and cooperative utilities have different planning and implementation schedules and will use the most recently available TRM on a voluntary basis. TRM implementation cycles will continue indefinitely absent a formal review and update of this process.

Iowa IOU Program Cycles and Associated TRM Implementation and Schedule for Use

	Plan/ Informational Filing due	Savings Reports needed	TRM Effective Date: Used for planning, reporting, impact evaluation
Five-year Plan			
PY 2019-2023	Nov 2017- Feb 2018	n/a - see individual years	Jan 2018
Annual Plans/Reports			
Program Year 2019	Update Jan 2019	Jan 2020	Jan 2018/Jan 2019
Program Year 2020	Jan 2020	Jan 2021	Jan 2020
Program Year 2021	Jan 2021	Jan 2022	Jan 2021
Program Year 2022	Jan 2022	Jan 2023	Jan 2022
Program Year 2023	Jan 2023	Jan 2024	Jan 2023
Five-year Plan			
PY 2024-2028	Nov 2022- Feb 2023	n/a - see individual years	Jan 2023

3.2 TRM Update Process and Timeline

The process of incorporating new and better information into the TRM occurs annually. Prior to the start of a program year for which the updated TRM will be in effect, the utility energy efficiency programs will be making portfolio adjustments and tracking system updates based in part on changes reflected in the updated TRM. In order to provide adequate time for making these pre-program year changes, the consensus updated TRM (including any items of disagreement) will be submitted to the TRM Oversight Committee by July 31st each year. The TRM as approved by the Oversight Committee will then be submitted to the Board by September 30 and become effective the following January.

3.2.1 Updates Driven by New Information

The need to update the TRM will be driven by a number of events, including but not limited to, the following:

- Addition of new measure algorithms perceived to be reliable for TRM inclusion
- Impact of code or legislative changes to specific measures
- Introduction of new technologies and technology advancements
- Discovery of errors in existing TRM measure characterizations
- Changes to industry standard practice
- Changes to program designs and measure eligibility criteria
- Improved TRM input values developed through evaluations

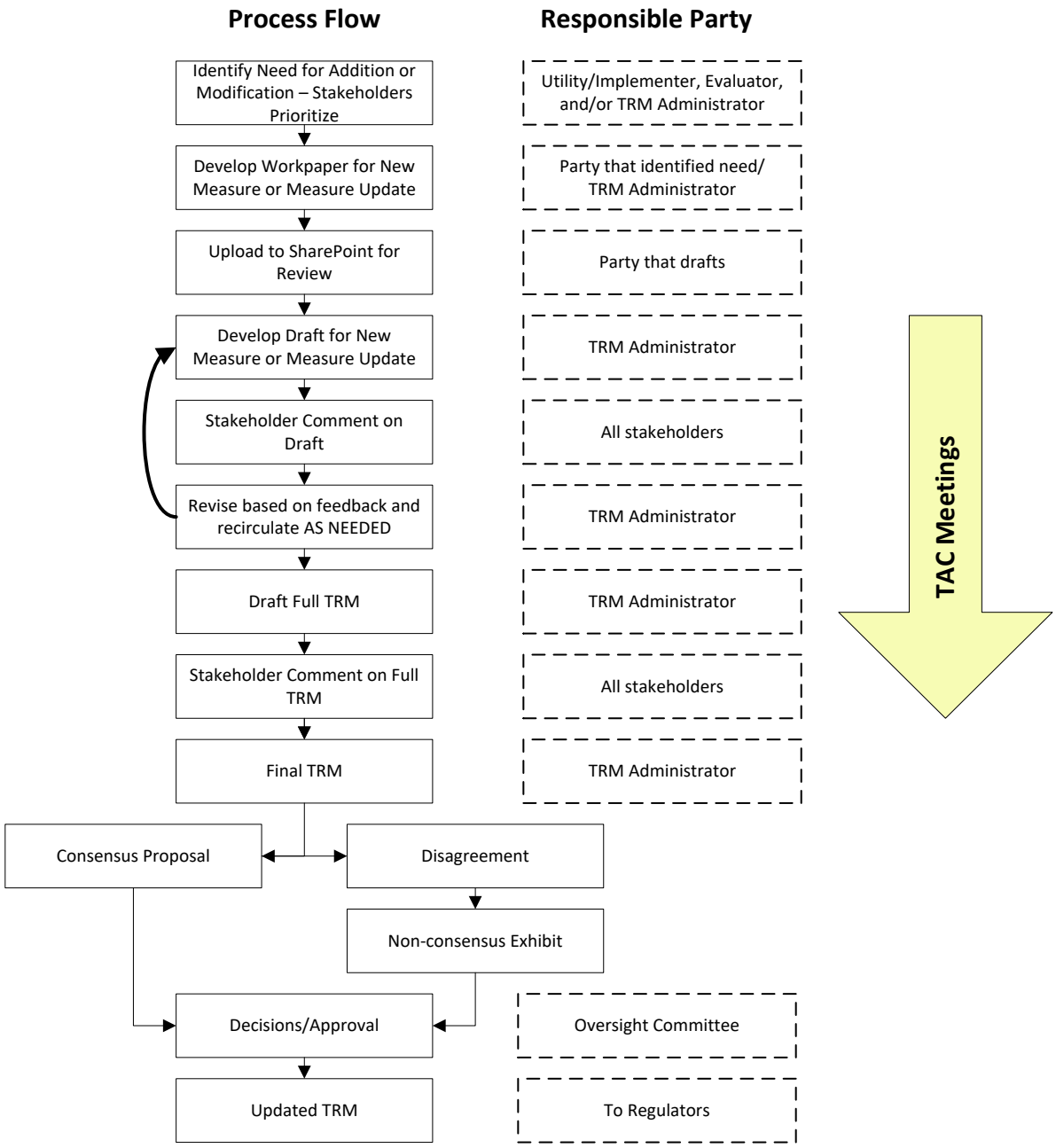
- Retirement of measures or applications no longer required

3.2.2 Reliability Review and Sunset Dates

Short of such proactively identified issues that will trigger an update to a TRM characterization, regular review should be undertaken to assess that the information in older measures is still relevant and reliable. To assure this, each measure characterization in the TRM includes a sunset date for the measure, and a table of sunset dates is included in the Overview volume of the TRM. If not otherwise updated before its sunset date, the measure will undergo a reliability review, and a new sunset date assigned. The sunset date is established for each measure based on factors such as expected revisions to energy codes or federal standards; knowledge of upcoming evaluation or research efforts; knowledge of rapidly changing technology, cost, baselines, or other factors; or expected shifts in current customer practices. Because of the importance of a robust TRM for use in five-year program planning for the IOUs, no sunset date will be later than the effective date of the TRM used for that planning effort (that is, a five-year sunset date will be the longest used).

3.2.3 Annual Work Flow

The annual process for TRM update will follow the work flow outlined below. Stakeholders and the TRM Administrator will provide input on updates driven by new information to start the process. The TRM Administrator will draft new measure characterizations based on this information, the TAC will review, and adjustments will be made until there is a consensus draft. The TRM Administrator then will draft a new full TRM for review and approval by the TAC and the Oversight Committee. This timeline will be adjusted going forward if needed to provide sufficient time for measure development and approval.



3.3 Stakeholders and Roles

The TRM update process requires a number of different roles to ensure effectiveness, sufficient review, and independence. Stakeholders are expected to contribute to the process as outlined below. The Oversight Committee and the TAC will continue to operate and serve the functions established during the initial TRM development.

- Utility Energy Efficiency Program Administrators (and their Consultants) and other Oversight Committee stakeholders
    - Identify needs for new or revised measure characterization – usually due to program changes or program/market feedback
    - Research and develop input for first draft measure characterizations – for needs that the utilities or stakeholders identify that the TAC identifies as priorities

  - Contribute to second draft measure characterizations following feedback on first draft from all parties
  - Give feedback on draft measure characterizations from other parties
  - Participate in the TAC for formal discussion and dispute resolution when needed
  - Give input to Oversight Committee if TAC process does not resolve all issues
- Independent TRM Administrator
  - Identifies needs for revised measure characterization (usually based on knowledge of local or other relevant evaluation studies)
  - Researches and develops first draft measure characterizations – for needs identified by itself and other stakeholders that the TAC identifies as priorities
  - Gives feedback on first draft measure characterizations from other parties
  - Develops second draft measure characterizations following feedback on first draft from all parties
  - Leads TAC for formal discussion and dispute resolution when needed
  - Provides input to Oversight Committee if TAC process does not resolve all issues
  - Makes recommendation for TRM revision to Oversight Committee
  - Develops any comparison exhibits for any non-consensus items
  - Manages and updates TRM manuals (after approval of changes)
- Evaluation Consultants and Technical Consultants, including Assessment Consultant (serve as information to and representatives of the Utility Energy Efficiency Program Administrators and other stakeholders)
  - Provide input to Utility Energy Efficiency Program Administrators to identify need for revised measure characterization
  - Provide input on draft measure characterizations developed by other parties
  - Participate in TAC meetings when appropriate
  - Perform program evaluations to inform the TRM - including statewide market assessment and baseline studies, savings impact studies (to measure the change in energy and / or demand use attributed to energy efficiency), and other energy efficiency program evaluation activities
  - Verify energy and capacity savings claims of each program and portfolio
  - Ensure proper utility use of TRM in savings verification/evaluation process
- Oversight Committee/ Iowa Utility Association
  - Hires and manages TRM Administrator
  - Identifies, discusses, and approves any changes needed to TRM-related policies or the TRM update process
  - Approves any changes to the TRM

3.4 Additions/Corrections Outside of Scheduled TRM Update Process

Corrections, additions, and updates included in the formal TRM process outlined here will become “effective” and approved for use in planning, reporting, evaluation, etc., by the January following each TRM update. There may be times when the utility energy efficiency program administrators have new information that they want to use before it can be formally included in the next TRM update. Appropriate cases include:

- Significant errors or omissions in TRM characterizations
- New measures that do not yet appear in the TRM

If a utility energy efficiency program administrator, the TRM Administrator, or other stakeholder believes that a current TRM measure characterization does not adequately reflect savings of a measure or a new measure is appropriate to include, then it should inform the TRM Administrator of its concern and present information in support of the change. The party that identified the issue will identify any value, approach, or assumption that is not in the TRM for comment, including a description of why they believe the deviation from the TRM is appropriate. The TRM Administrator will notify the TAC of the information and provide opportunity for review and discussion (this can happen outside of the formal TRM process timeline outlined above). If the TAC is in agreement that the new information is appropriate, it will approve the approach and the recommendation will be forwarded to the Oversight Committee for approval prior to its use. The utility energy efficiency programs would then be permitted to use these

assumptions, subject to Board review or plan modification filings that may be necessary or appropriate to address significant changes in assumptions, instead of those contained within the TRM. Utilities must also show the impacts on planning estimates and goals from using revised TRM assumptions for comparison purposes within their Fall Operations Reports and January Plan update filings. The new information will be put into the next TRM update cycle for inclusion in the next formal TRM document update.

In the case of the correction of an error found in a previously approved measure characterization that will result in a significant difference in the savings for that measure, once the TAC has reviewed and agreed to the correction, the Oversight Committee will determine whether the correction should be applied retroactively within the utility programs.

3.5 Transparency to the Board

The Board will be notified of any TRM updates, savings adjustments, baseline adjustments, and changes in assumptions, both routine and outside of the scheduled TRM update process (Sections 3 and 4) through existing reporting processes (Fall Operations Reports, January Plan Updates, and Annual Reports) or plan modification filings for significant TRM changes. This transparency is necessary for the Board to be able to fully evaluate the numerous types of energy efficiency filings (e.g., joint assessment of potential, plan filings, plan performance, and prudence reviews).

4 Applying the TRM

This TRM document has been developed to provide a transparent and consistent basis for determining savings and other assumptions necessary for the delivery of reliable energy efficiency benefits. As such, it is expected that it will be used by utility energy efficiency programs (including IOUs, interested municipal and cooperative utilities, and other program administrators), evaluators, planners, and regulators as the primary reference standard. The existence of the TRM does not preclude the utility energy efficiency programs from offering non-prescriptive programs and measures. Similarly, utility energy efficiency programs are not required to implement every measure that is included in the TRM. Subject to Board guidance/approval, the TRM will be fully incorporated into the assessment of potential, energy efficiency plan development, implementation, and evaluation within each Energy Efficiency Plan period.

It is expected that deviations from its use for the measures included will occur only in exceptional cases where alternative approaches are defensible, appropriate, and approved by the Oversight Committee. The process for identifying, reviewing, and approving such deviations is outlined in Section 3.4 above.

Other parties that deliver energy efficiency services for Iowa's utility energy efficiency programs are responsible for being familiar with and using the TRM and periodic updates to the TRM to establish savings for their services. Utility energy efficiency programs are responsible for communicating this to contractors and ensuring that contractors understand this requirement.

The major uses of the TRM and timing of implementation are discussed in the following sections.

4.1 Using the TRM in Portfolio Planning

The most current approved TRM is expected to serve as the primary source document for the savings values used for prescriptive measures included as part of Energy Efficiency Program plans, annual program adjustments and updates, and for the development and assessment of goals set as part of those plans. The TRM includes information relevant to the calculation of measure and program cost effectiveness and will serve as the primary source for these calculations. The utility energy efficiency programs will use the TRM Measure Codes (defined in Section 5.2 below) in their Plan filings to allow for easy review and transparency across programs and portfolios.

The TRM versions to be used in developing plans and setting goals are identified in the TRM Implementation and Schedule for Use table in Section 3.1 above.

The utility energy efficiency programs are permitted to use additional assumptions other than those contained within the identified TRM in their Plan and annual update filings, provided they meet the requirements and follow the process identified in Section 3.4 above for bringing such deviations to the TRM Administrator and TAC for review.

The approved TRM is also expected to serve as the primary source document for savings values for any measures contained within the TRM for use in the Statewide Assessment of Energy Efficiency Potential study. Any recommendations from the Assessment consultant for deviations from the TRM shall be submitted to the TRM Administrator and the TAC for review and comment prior to the completion of the Assessment study, in order to be reviewed and discussed as part of subsequent TRM updates.

4.2 Using the TRM to Calculate Savings

The TRM is designed to bring a high level of standardization to the prescriptive measure savings that each utility energy efficiency program uses across the state. To accomplish this goal, investor-owned utility energy efficiency programs are expected to use the prescriptive savings algorithms and inputs specified in the TRM for its prescriptive measures. Use of the TRM is optional for other utilities, including cooperative and municipal utilities.

As outlined in the TRM Implementation and Schedule for Use table in Section 3.1 above, for any given single Program Year, savings are expected to be calculated, tracked, and reported using values from the version of the TRM that was used in developing program plans or updates for that year. Findings from the most currently available TRM will be used to update each annual plan, and as such, will be the TRM values to be used in the calculation and reporting of savings for that year.

The utility energy efficiency programs are permitted to use additional assumptions other than those contained within the identified TRM in their savings calculations and reporting, provided they meet the requirements and follow the process identified in Section 3.4 above for bringing such deviations to the TRM Administrator and TAC for review.

4.3 Using the TRM in Portfolio Evaluation

For any given Program Year, evaluators are expected to use the version of the TRM identified in the sections above as appropriate for use in calculating and reporting savings as the basis for program savings verification and impact evaluation for those measures included in the TRM. Evaluators are permitted to use additional assumptions other than those contained within the identified TRM in their savings calculations and reporting should they believe them to be more appropriate, provided they meet the requirements and follow the process identified in Section 3.4 above for bringing such deviations to the TRM Administrator and TAC for review.

Any TRM research conducted by evaluators and utility energy efficiency programs shall incorporate statewide coordination to the extent practicable, for purposes of uniformity as well as cost effectiveness from pooled resources. All TRM measure-level evaluation research plans and draft results shall be submitted to the TRM Administrator and the TAC in a timely fashion for use in the development of subsequent TRM updates.

4.4 Using the TRM in Environmental and Other Compliance and Regional Energy Markets

It is not known what specific additional guidance may be needed for use of TRM in other settings. Once approved by the Board, the TRM should be the primary guiding resource for energy efficiency programs/plans funded by Iowa ratepayers and administered by Iowa investor-owned utility energy efficiency programs. The Oversight Committee may be convened as necessary to collaboratively determine appropriate guidance and process for developing such guidance.

4.5 Gross vs. Net Savings

The Iowa Administrative Code requires rate-regulated utilities to "estimate gross and net capacity and energy savings, accounting for free riders, take-back effects, and measure degradation." (199 IAC 35.8(2)"c"). Historically, these utilities met this requirement in energy efficiency plans by relying on a deemed net-to-gross (NTG) ratio of 1.0. The Board, in its orders approving the 2014-2018 electric and natural gas energy efficiency plans, agreed that a report about net-to-gross policy would be beneficial to the Board, the utilities, and stakeholders by providing a more-complete and accurate analysis of whether this approach is beneficial, given Iowa's regulatory regime and the design of energy efficiency plans and possible implementation framework.

A report was commissioned in 2015 to deliver recommendations regarding net-to-gross policy and possible implementation framework. The report also included an Iowa-specific analysis to assess whether NTG ratios should apply to all measures or programs or whether certain measures or programs should be prioritized. This analysis focused on balancing the benefits of calculating NTG values with the cost-effectiveness of obtaining those values. At its conclusion, the report[2] recommends that energy efficiency programs be divided into the following three categories: (1) programs that continue with a deemed NTG value of 1.0 due to low benefits and net savings, and where previous research suggests that the NTG value would be close to 1.0; (2) programs for which secondary research will be conducted to establish deemed values other than 1.0 because previous research indicates that 1.0 is not likely to be an accurate NTG value, but the expense of primary research is not justified; and (3) programs that contribute large savings to the utilities' energy efficiency portfolio and warrant the expense of primary NTG research. The final report identifies which programs fall into each of these categories for each of the utilities based on the cost-effectiveness of conducting primary research. The final report also suggests that NTG can be addressed by adjusting net savings from gross savings with a ratio other than 1.0, as appropriate, as well as alternatively through adjustments in the savings calculation baseline (e.g., use of a common practice baseline) for many programs or measures.

On April 8, 2016, the Board issued an order in response to the NTG report. In that order, the Board requested that

[2] Final Report: Iowa Energy-Efficiency Net-to-Gross Report. Prepared for: Iowa Utility Association and the Oversight Committee, Navigant Consulting, 2015.

the NTG Oversight Committee develop a NTG plan, including additional research to determine NTG ratios as recommended in the NTG report. The Board also stated, "The utilities should incorporate any NTG ratios that have been developed into their next energy efficiency plans' (the 2019-2023 plan) savings and benefit-cost calculations." Accordingly, as part of the assessment of potential for the 2019-2023 energy efficiency plans, the IOUs commissioned a NTG report to implement the research the recommendations contained in the 2015 report. The NTG report in the assessment of potential will include specific NTG ratios to be used in developing the 2019-2023 energy efficiency programs.[3]

The Oversight Committee continues to discuss the results of the NTG research and implementation strategies for applying NTG values as the 2019-2023 Energy Efficiency Plan period commences. Once a mutually agreeable method for any new approach to NTG in Iowa is established, the TRM will reflect this policy. Savings calculations within the TRM consider market and free-ridership effects where appropriate and are reflective of any application of NTG adjustments. Coordination between the TRM and NTG efforts will continue in order to ensure that adjustments are being appropriately reflected through one or the other mechanism in the most accurate and cost-effective manner.

[3] Iowa Gas and Electricity Potential Study Net-to-Gross Research Final Report. Opinion Dynamics, 2017.

5 TRM Organizational Structure

5.1 Overall Organization

For ease of use and update, the Iowa TRM is published in three volumes:

VOLUME 1: Overview and User Guide

VOLUME 2: Residential Measures

VOLUME 3: Nonresidential Measures

Information within Volumes 2 and 3 of the TRM is organized in a way designed to facilitate its access and use. The structure within these documents follows a two-level format, each of which becomes 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.

Level 1: End-use Category

- This level of organization represents most of the major end-use categories for which an efficient alternative exists. The following table gives examples of the end-use categories likely to be found in the TRM.

End-Use Categories in the TRM

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

Level 2: Measure and Technology

- This level of organization represents the individual efficient measures, such as CFL lighting and LED lighting, both of which are individual technologies within the Lighting end-use category.

Within a particular market, end use, and measure (e.g., LED Lighting), the TRM is not further divided by implementation or delivery methodology. For example, the characterization of a CFL installed through any residential pathway – upstream lighting, direct install, efficiency kits, hard-to-reach populations, etc. – is provided in one residential measure document, with lookup tables for the appropriate distinctions in program delivery.

This proposed 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, making the TRM easier to use and to maintain.

5.2 Measure Code Specification

Developing measure codes helps to uniquely identify each measure in the TRM. Codes are designed in a way that reflects the organization of the TRM and the needs of the TRM users. Abbreviations for each TRM section are combined with abbreviations for other relevant components of measure identification to make up a descriptive code name:

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

"Effective date" is defined as the date when a measure has been approved and is the official value for use. With abbreviations delimited by a dash ('-'), this approach results in a unique, 18-character alphanumeric code that can then be used for tracking measures and their associated savings estimates. Measure codes appear at the end of each

measure.

For example, a commercial boiler measure is coded: “NR-HVC-BOIL-V01-160101”.

Example Measure Code Specification Key

Market (@@)	End-use (@@@)	Specific Measure (@@@@)	Measure Version (V##)	Effective Date
NR (Nonresidential)	AGE (Agricultural Equipment)	BOIL	V01	YYMMDD
RS (Residential)	APL (Appliances)	T5HO	V02	YYMMDD
	CEL (Consumer Electronics)	HPT8	V03	YYMMDD
	FSE (Food Service Equipment)	…	…	…
	HVC (HVAC)			
	HWE (Hot Water)			
	LTG (Lighting)			
	MSC (Miscellaneous)			
	RFG (Refrigeration)			
	SHL (Shell)			

5.3 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 will follow the same format, flow, and function.

DESCRIPTION

A brief description of the measure, stating how it saves energy, the markets it serves, and any limitations to its applicability, including applicable program types (i.e., Time of Sale; Early Replacement; etc. – these are defined in the Program Delivery Types Table in Section 5.5 below).

DEFINITION OF EFFICIENT EQUIPMENT

A clear and specific definition of the criteria for the efficient equipment used to determine incremental savings. Includes any standards or ratings if appropriate.

DEFINITION OF BASELINE EQUIPMENT

A clear and specific definition of the efficiency level of the baseline equipment used to determine incremental savings, including any standards or ratings if appropriate. For Time of Sale measures, the baseline will be new, base level equipment (to replace existing equipment at the end of its useful life, or for a new building). For Early Replacement or Early Retirement measures, the baseline will be the existing working piece of equipment that is being removed for the assumed remaining life of the existing equipment, and then switch to new baseline level equipment for the remainder of the measure life.

DEEMED LIFETIME OF EFFICIENT EQUIPMENT

The expected duration in years (or hours) of the savings. For Early Replacement measures, the assumed life of the existing unit will also be provided.

DEEMED MEASURE COST

For Time of Sale measures, incremental cost from baseline to efficient equipment will be provided. Installation costs should only be included if there is a difference in these costs between each efficiency level. For Early Replacement measures, the full equipment and installation cost of the efficient installation will be provided in addition to the full deferred hypothetical baseline replacement cost.

LOADSHAPE

The appropriate loadshape to apply to electric savings will be provided (by reference to loadshape tables in Volume 1 of the TRM).

Algorithm

CALCULATION OF ENERGY SAVINGS

Algorithms will be provided for the following energy savings calculations, with each followed by list of variables with their definitions. The assumed values for variables will be provided either as a single deemed value, a lookup table with deemed values based on input selection, or indication that an input variable is required.

If there are no Input Variables required, there will be a finite number of Output values. These will be identified and listed in a table. All variables will be identified by type: input, output; deemed; constant; etc.

Where there are custom inputs, an example calculation will often be provided to illustrate the algorithm and provide context. Any such examples will be clearly labeled "Example" and placed within a text box, so that they do not get mistaken for a deemed result.

Interactive effects will be included as part of calculations when necessary.

1. **ELECTRIC ENERGY SAVINGS**
2. **SUMMER COINCIDENT PEAK DEMAND SAVINGS**
3. **NATURAL GAS SAVINGS**
4. **PEAK GAS SAVINGS**

WATER IMPACT DESCRIPTIONS AND CALCULATION

DEEMED O&M COST ADJUSTMENT CALCULATION

Only required if the operation and maintenance cost for the efficient case is different from that of the baseline. If so, the frequency and cost of any replacement parts or maintenance will be provided. If the O&M costs change significantly over the life of a measure (e.g., the replacement baseline bulbs due to EISA impacts), an equivalent annualized payment that provides the same present value as the actual stream of costs over the measure life will be calculated.

REFERENCE TABLES (IF NEEDED)

MEASURE CODE

SUNSET DATE

REVISION HISTORY AND/OR NOTES [FUTURE TRM VERSIONS]

FOOTNOTES

Specific references and support for assumptions and sources for deemed variables will be provided as footnotes within each measure page.

5.4 Program Delivery

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

characterizations for measures 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 abbreviations and definitions used in the measure descriptions in TRM Volumes 2 and 3. When necessary, individual measure descriptions may further refine and clarify these definitions of program delivery type.

Program Delivery Types

Program	Attributes
TOS Time of Sale	**Definition:** 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 **Baseline** = New baseline equipment **Efficient Case** = New, premium efficiency equipment above federal and state codes and standard industry practice **Example:** CFL rebate
NC New Construction	**Definition:** A program that intervenes during building design to support the use of more-efficient equipment and construction practices **Baseline** = Building code, Federal Standard or Baseline Study **Efficient Case** = The program's level of building specification **Example:** Building shell and mechanical measures
RF Retrofit	**Definition:** A program that upgrades existing equipment before the end of its useful life **Baseline** = Existing equipment or the existing condition of the building or equipment. A single baseline applies over the measure's life **Efficient Case** = New, premium efficiency equipment above federal and state codes and standard industry practice **Example:** Air sealing and insulation
EREP Early Replacement	**Definition:** A program that replaces existing equipment before the end of its expected life **Baseline** = Dual; it begins as the existing equipment and shifts to new baseline equipment after the expected life of the existing equipment is over **Efficient Case** = New, premium efficiency equipment above federal and state codes and standard industry practice **Example:** Refrigerators, freezers
ERET Early Retirement	**Definition:** A program that retires duplicative equipment before its expected life is over **Baseline** = The existing equipment, which is retired and not replaced **Efficient Case** = Zero because the unit is retired **Example:** Appliance recycling
DI Direct Install	**Definition:** A program where measures are installed during a site visit **Baseline** = Existing equipment **Efficient Case** = New, premium efficiency equipment above federal and state codes and standard industry practice **Example:** Lighting and low-flow hot water measures
KITS Efficiency Kits	**Definition:** A program where measures are provided free of charge to a customer in an Efficiency Kit **Baseline** = Existing equipment **Efficient Case** = New, premium efficiency equipment above federal and state codes and standard industry practice **Example:** Lighting and low-flow hot water measures

6 General Assumptions

The information contained in this TRM represents the Oversight Committee's recommendations for the content of the Iowa 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 Iowa-specific information into each measure characterization. TRM documents from IPL, MidAmerican, and Black Hills were reviewed, as well as program and measure-specific data from evaluations, efficiency plans, and working documents provided by the Iowa utilities.

When Iowa- or region-specific evaluations or data were not available, best practice research and data from other jurisdictions was used. In every case, VEIC used the most recent, well-designed, and best-supported studies and only if it was deemed appropriate to generalize their conclusions to the Iowa programs.

6.1 Algorithms and Variables

For each measure characterization, this TRM includes engineering algorithm(s) and a list and definitions of all the parameters in the algorithm(s). Accuracy is the overarching principle that governs what value to use for each parameter. These parameters have values that fall into one of these categories:

- 'Actual' on-site custom input. When it is explicitly allowed within the text of the measure characterization, the most accurate input will be the 'Actual' or on-site recorded value of the parameter from the actual implementation of the measure (e.g., capacity of equipment installed). This can be a customer-, equipment, or site-specific value that is verifiable and documented. Requirements for input variables and potential sources are clearly defined in the specific measures where "Actual" or "Custom" is noted. In some instances a default value is provided for instances where the recording of on-site information is not possible.
- Deemed values**. T**hese are default values provided that reflect the average of expected installations. These can be a single deemed value or a lookup table providing various options contingent on a dependent variable (e.g., hours of use assumptions for non-residential building types).The TRM makes extensive use of lookup tables because they allow for an appropriate level of measure characterization streamlining and customization within the context of an otherwise prescriptive measure.

6.1.1 Footnotes and Documentation of Sources

Each new and updated measure characterization is posted to the Iowa TRM SharePoint web site.[4] The measure characterizations 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 Iowa TRM SharePoint website. These files can be found in the 'TRM Reference Documents' folder in the main directory.

6.2 Savings Outputs

There are a number of possible forms that the outputs or results of the engineering algorithm(s) can take. Where the algorithm includes one or more 'Actual' inputs, the TRM will not provide any outputs as there could be an infinite number of possible outputs dependent on the custom entry(s). Often in this instance an example calculation is provided (within a text box and clearly labeled as an example) to illustrate a typical installation, or a default value is provided based on using defaults provided in lieu of the custom entry. For algorithms without 'Actual' values and with either a single or a limited number of deemed values (i.e., limited lookup table options), *deemed savings estimate(s)* [5] will be provided. In cases where lookup tables are provided, there will be a range of deemed savings estimates that are possible, depending on site-specific factors such as equipment capacity, location, and building type.

All information is presented on a per-measure basis. When using measure-specific information in the TRM, it is

[4] To gain access to the SharePoint site, please contact the Iowa TRM Administrator at iatrmadministrator@veic.org

[5] 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 using all of the deemed and input values in the savings algorithm.

helpful to keep the following notes in mind.

- All estimates of energy (kWh or therms) and peak (kW or therms) savings are first-year savings, not lifetime or levelized savings. All savings are gross savings – savings measured at the customer's meter.
- Where deemed savings estimates are provided, they represent the average energy (kWh or therms) or peak (kW or therms) savings that could be expected from the average of all measures that might be installed in Iowa in the program year.

6.3 Baseline Assumptions

The concept and definition of the baseline is a key element of every measure characterization and is directly related to the program delivery type described in section 5.4. 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.

For Retrofit or Direct Install measures, the baseline can easily be defined as the existing equipment that is being replaced. However for Time of Sale measures, the theoretical baseline needs to be based upon an assumed baseline efficiency level. The ideal source for defining the theoretical baseline for these measures is Iowa-specific baseline studies. Iowa utilities should endeavor to commission regular baselines studies, particularly for high-impact measures, to inform the appropriate characterization. In the absence of such studies, the TRM Technical Advisory Committee (TAC) agreed that while each measure should be reviewed individually, a general principle that can be adopted is that where Federal Standards or Building Energy Codes have been updated within 2-3 years, and where there is no clear indication of a market trend for more-efficient equipment, the standard or code can be considered a reasonable proxy for the baseline level. Where the standards are older or where there is a clear market trend for higher level equipment (absent program involvement), effort should be made to account for this through TAC-adopted adjustments.

Care should be taken to ensure that the same baseline level is used to calculate gross savings and to determine an appropriate Net to Gross (NTG) factor when such is used. For example, the TAC agreed to initially apply a blended baseline for general purpose lighting to account for the significant market trend towards more-efficient product adoption absent utility programs. Once an appropriate NTG adjustment value is determined to account for participants who would have purchased efficient equipment anyway, the blended baseline will be removed from this measure.

6.3.1 Shifting Baseline Assumptions

The TRM anticipates the effects of established planned 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 is handled in the TRM by describing the choice of and reasoning behind a shifting baseline assumption within appropriate measure characterizations.

Some examples of this can be seen in the Standard LED (where the assumption of the baseline replacement shifts from incandescent/halogen to a CFL), T5/T8 Linear Fluorescents (where the assumption includes a ceasing of T12 as a baseline replacement), and early replacement measures (where the baseline shifts from the existing equipment to new baseline efficiency equipment).

6.4 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 can 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 energy period definitions shown in the following table.

Electric Energy Period Definitions

Period Category	Period Definition (Central Prevailing Time, Hour Ending)
Winter On-Peak Energy	9AM - 10PM, weekdays, non-NERC holidays, Oct-May
Winter Off-Peak Energy	11PM - 8AM weekdays, all weekends, and NERC holiday hours, Oct-May
Summer On-Peak Energy	9AM - 10PM, weekdays, non-NERC holidays, June-Sept
Summer Off-Peak Energy	11PM - 8AM weekdays, all weekends, and NERC holiday hours, June-Sept

Loadshapes have been developed for each end-use by assigning Rating Period Factor percentages to each of the four periods above. Four different methodologies were used to divide the percentage of savings in to the four categories above:

1. End use 8760 data derived from Cadmus modeling was used for most residential Loadshapes.
2. Itron eShapes data for Missouri were used for Residential Clothes Washers, Refrigerator, and Freezer.
3. A load profile developed for Efficiency Vermont was used for Residential Outdoor Lighting.
4. All non-residential loadshapes are derived from the eQuest modeling performed by VEIC for the defined building types.

Electric Energy Loadshapes

Loadshape Number	Loadshape Name	Winter On-Peak Energy	Winter Off-Peak Energy	Summer On-Peak Energy	Summer Off-Peak Energy	Load Profile Source
E01	Flat	14.7%	18.7%	29.8%	36.8%	n/a
RE01	Residential Multifamily Central Heat	33.4%	66.2%	0.1%	0.3%	Cadmus
RE02	Residential Multifamily Cooling	11.6%	4.1%	54.7%	29.7%	Cadmus
RE04	Residential Multifamily Water Heat	31.3%	35.3%	15.2%	18.2%	Cadmus
RE05	Residential Multifamily Plug Load	32.2%	36.0%	14.3%	17.4%	Cadmus
RE06	Residential Single-Family Central Heat	33.9%	66.0%	0.0%	0.0%	Cadmus
RE07	Residential Single-Family Cooling	10.3%	3.1%	57.6%	29.1%	Cadmus
RE08	Residential Single-Family Heat Pump	29.4%	55.1%	10.3%	5.2%	Cadmus
RE09	Residential Indoor Lighting	31.7%	34.9%	16.2%	17.2%	Cadmus
RE10	Residential Outdoor Lighting	20.7%	50.4%	6.6%	22.3%	Efficiency Vermont
RE11	Residential Single-Family Vent	21.3%	29.7%	31.8%	17.1%	Cadmus
RE12	Residential Single-Family Water Heat	31.3%	35.3%	15.2%	18.2%	Cadmus
RE13	Residential Single-Family Plug Load	31.5%	36.9%	13.9%	17.8%	Cadmus
RE14	Residential Clothes Washer	34.9%	31.6%	17.3%	16.2%	eShapes
RE15	Residential Freezer	32.1%	31.6%	18.0%	18.3%	eShapes
RE16	Residential Refrigerator	30.2%	33.4%	17.0%	19.3%	eShapes
RE17	Residential Pool Pumps	0.0%	0.0%	58.8%	41.2%	Efficiency Vermont
NREL01	Non-Residential Lighting - Convenience	34.3%	25.0%	21.1%	19.6%	eQuest (COMNET)
NREL02	Non-Residential Lighting - Education	54.8%	17.8%	17.3%	10.1%	eQuest (COMNET)
NREL03	Non-Residential Lighting - Grocery	32.3%	30.0%	18.7%	19.1%	eQuest (COMNET)
NREL04	Non-Residential Lighting - Health	33.6%	23.9%	23.4%	19.1%	eQuest (COMNET)
NREL05	Non-Residential Lighting - Hospital	27.2%	31.8%	17.3%	23.8%	eQuest (COMNET)

Loadshape Number	Loadshape Name	Winter On-Peak Energy	Winter Off-Peak Energy	Summer On-Peak Energy	Summer Off-Peak Energy	Load Profile Source
NREL06	Non-Residential Lighting - Industrial	36.3%	28.2%	20.1%	15.4%	eQuest (COMNET)
NREL07	Non-Residential Lighting - Lodging	26.4%	25.5%	21.8%	26.3%	eQuest (COMNET)
NREL08	Non-Residential Lighting - Multifamily	26.4%	25.5%	21.8%	26.3%	eQuest (COMNET)
NREL09	Non-Residential Lighting - Office - Large	45.7%	15.4%	28.2%	10.8%	eQuest (COMNET)
NREL10	Non-Residential Lighting - Office - Small	44.9%	15.5%	27.1%	12.5%	eQuest (COMNET)
NREL11	Non-Residential Lighting - Religious	32.8%	27.0%	21.8%	18.4%	eQuest (COMNET)
NREL12	Non-Residential Lighting - Restaurant	29.1%	29.8%	19.2%	21.9%	eQuest (COMNET)
NREL13	Non-Residential Lighting - Retail - Large	35.9%	22.6%	23.3%	18.3%	eQuest (COMNET)
NREL14	Non-Residential Lighting - Retail - Small	40.4%	19.9%	25.0%	14.7%	eQuest (COMNET)
NREL15	Non-Residential Lighting - Warehouse	45.6%	15.1%	27.5%	11.8%	eQuest (COMNET)
NREL16	Non-Residential Lighting - Non-Residential (Avg)	42.0%	19.2%	24.5%	14.2%	eQuest (COMNET)
NREL17	Non-Residential Street Lighting	20.5%	50.6%	6.1%	22.8%	Efficiency Vermont
NREL18	Traffic Signal - Red Balls, always changing or flashing	25.8%	32.3%	18.9%	23.0%	Efficiency Vermont
NREL19	Traffic Signal - Red Balls, changing day, off night	37.0%	20.9%	27.1%	14.9%	Efficiency Vermont
NREL20	Traffic Signal - Green Balls, always changing	25.8%	32.3%	18.9%	23.0%	Efficiency Vermont
NREL21	Traffic Signal - Green Balls, changing day, off night	37.0%	20.9%	27.1%	14.9%	Efficiency Vermont
NREL22	Traffic Signal - Red Arrows	25.8%	32.3%	18.9%	23.0%	Efficiency Vermont
NREL23	Traffic Signal - Green Arrows	25.8%	32.3%	18.9%	23.0%	Efficiency Vermont
NREL24	Traffic Signal - Flashing Yellows	25.8%	32.3%	18.9%	23.0%	Efficiency Vermont
NREL25	Traffic Signal - “Hand” Don’t Walk Signal	25.8%	32.3%	18.9%	23.0%	Efficiency Vermont
NREL26	Traffic Signal - “Man” Walk Signal	25.8%	32.3%	18.9%	23.0%	Efficiency Vermont
NREL27	Traffic Signal - Bi-Modal Walk/Don’t Walk	25.8%	32.3%	18.9%	23.0%	Efficiency Vermont
NREL28	Non-Residential Lighting - Agricultural Animal Housing and Warehousing	45.6%	15.1%	27.5%	11.8%	Equal to Warehouse
NREL29	Non-Residential Exterior Lighting	23.3%	48.5%	7.7%	20.5%	OpenStudio
NREC01	Non-Residential Cooling - Convenience	11.7%	5.7%	49.1%	33.5%	eQuest (COMNET)

Loadshape Number	Loadshape Name	Winter On-Peak Energy	Winter Off-Peak Energy	Summer On-Peak Energy	Summer Off-Peak Energy	Load Profile Source
NREC02	Non-Residential Cooling - Education	18.6%	4.3%	49.2%	27.9%	eQuest (COMNET)
NREC03	Non-Residential Cooling - Grocery	12.6%	8.6%	41.3%	37.5%	eQuest (COMNET)
NREC04	Non-Residential Cooling - Health	10.6%	9.7%	45.0%	34.7%	eQuest (COMNET)
NREC05	Non-Residential Cooling - Hospital	11.6%	10.7%	35.6%	42.1%	eQuest (COMNET)
NREC06	Non-Residential Cooling - Industrial	10.2%	5.2%	45.7%	38.9%	eQuest (COMNET)
NREC07	Non-Residential Cooling - Lodging	10.0%	7.7%	40.1%	42.3%	eQuest (COMNET)
NREC08	Non-Residential Cooling - Multifamily	10.0%	7.7%	40.1%	42.3%	eQuest (COMNET)
NREC09	Non-Residential Cooling - Office - Large	11.5%	16.3%	46.2%	26.1%	eQuest (COMNET)
NREC10	Non-Residential Cooling - Office - Small	13.1%	3.2%	57.3%	26.4%	eQuest (COMNET)
NREC11	Non-Residential Cooling - Religious	9.0%	5.5%	54.4%	31.1%	eQuest (COMNET)
NREC12	Non-Residential Cooling - Restaurant	8.6%	5.6%	46.4%	39.3%	eQuest (COMNET)
NREC13	Non-Residential Cooling - Retail - Large	10.3%	5.0%	52.3%	32.4%	eQuest (COMNET)
NREC14	Non-Residential Cooling - Retail - Small	9.0%	4.5%	52.9%	33.5%	eQuest (COMNET)
NREC15	Non-Residential Cooling - Warehouse	10.5%	2.1%	65.2%	22.2%	eQuest (COMNET)
NREC16	Non-Residential Cooling - Non-Residential (Avg)	11.3%	3.8%	56.8%	28.1%	eQuest (COMNET)
NREC17	Non-Residential Cooling – Small Programmable Thermostat	7.7%	9.0%	-2.8%	86.1%	eQuest (COMNET)
NREH01	Non-Residential Electric Heat - Convenience	35.7%	64.3%	0.0%	0.0%	eQuest (COMNET)
NREH02	Non-Residential Electric Heat - Education	34.4%	65.6%	0.0%	0.0%	eQuest (COMNET)
NREH03	Non-Residential Electric Heat - Grocery	32.8%	67.2%	0.0%	0.0%	eQuest (COMNET)
NREH04	Non-Residential Electric Heat - Health	31.5%	68.3%	0.0%	0.1%	eQuest (COMNET)
NREH05	Non-Residential Electric Heat - Hospital	26.8%	73.2%	0.0%	0.1%	eQuest (COMNET)
NREH06	Non-Residential Electric Heat - Industrial	25.5%	74.3%	0.0%	0.2%	eQuest (COMNET)
NREH07	Non-Residential Electric Heat - Lodging	31.7%	67.7%	0.1%	0.5%	eQuest (COMNET)
NREH08	Non-Residential Electric Heat - Multifamily	31.7%	67.7%	0.1%	0.5%	eQuest (COMNET)
NREH09	Non-Residential Electric Heat - Office - Large	32.2%	62.5%	1.4%	3.9%	eQuest (COMNET)

Loadshape Number	Loadshape Name	Winter On-Peak Energy	Winter Off-Peak Energy	Summer On-Peak Energy	Summer Off-Peak Energy	Load Profile Source
NREH10	Non-Residential Electric Heat - Office - Small	31.0%	68.5%	0.1%	0.5%	eQuest (COMNET)
NREH11	Non-Residential Electric Heat - Religious	37.1%	62.5%	0.1%	0.3%	eQuest (COMNET)
NREH12	Non-Residential Electric Heat - Restaurant	39.5%	60.0%	0.0%	0.5%	eQuest (COMNET)
NREH13	Non-Residential Electric Heat - Retail - Large	34.5%	65.4%	0.0%	0.1%	eQuest (COMNET)
NREH14	Non-Residential Electric Heat - Retail - Small	29.4%	70.5%	0.0%	0.1%	eQuest (COMNET)
NREH15	Non-Residential Electric Heat - Warehouse	38.0%	61.6%	0.0%	0.4%	eQuest (COMNET)
NREH16	Non-Residential Electric Heat - Non-Residential (Avg)	34.7%	65.0%	0.0%	0.3%	eQuest (COMNET)
NREP01	Non-Residential Electric Heat Pump - Convenience	19.6%	22.8%	33.5%	24.2%	eQuest (COMNET)
NREP02	Non-Residential Electric Heat Pump - Education	26.0%	31.4%	25.8%	16.9%	eQuest (COMNET)
NREP03	Non-Residential Electric Heat Pump - Grocery	16.5%	18.4%	32.9%	32.2%	eQuest (COMNET)
NREP04	Non-Residential Electric Heat Pump - Health	19.9%	38.2%	23.0%	18.9%	eQuest (COMNET)
NREP05	Non-Residential Electric Heat Pump - Hospital	14.6%	24.5%	27.8%	33.1%	eQuest (COMNET)
NREP06	Non-Residential Electric Heat Pump - Industrial	21.2%	63.7%	7.6%	7.4%	eQuest (COMNET)
NREP07	Non-Residential Electric Heat Pump - Lodging	21.2%	40.6%	17.9%	20.2%	eQuest (COMNET)
NREP08	Non-Residential Electric Heat Pump - Multifamily	21.2%	40.6%	17.9%	20.2%	eQuest (COMNET)
NREP09	Non-Residential Electric Heat Pump - Office - Large	21.0%	40.0%	21.8%	17.1%	eQuest (COMNET)
NREP10	Non-Residential Electric Heat Pump - Office - Small	23.4%	37.4%	25.4%	13.8%	eQuest (COMNET)
NREP11	Non-Residential Electric Heat Pump - Religious	27.2%	39.2%	20.7%	12.8%	eQuest (COMNET)
NREP12	Non-Residential Electric Heat Pump - Restaurant	22.9%	28.5%	24.8%	23.8%	eQuest (COMNET)
NREP13	Non-Residential Electric Heat Pump - Retail - Large	23.2%	35.2%	24.8%	16.9%	eQuest (COMNET)
NREP14	Non-Residential Electric Heat Pump - Retail - Small	20.6%	42.7%	21.9%	14.8%	eQuest (COMNET)
NREP15	Non-Residential Electric Heat Pump - Warehouse	28.5%	37.7%	24.5%	9.3%	eQuest (COMNET)
NREP16	Non-Residential Electric Heat Pump - Non-Residential (Avg)	25.2%	37.2%	24.0%	13.6%	eQuest (COMNET)
NREV01	Non-Residential Ventilation - Convenience	31.0%	39.9%	16.2%	12.9%	eQuest (COMNET)
NREV02	Non-Residential Ventilation - Education	37.2%	35.5%	16.2%	11.2%	eQuest (COMNET)

Loadshape Number	Loadshape Name	Winter On-Peak Energy	Winter Off-Peak Energy	Summer On-Peak Energy	Summer Off-Peak Energy	Load Profile Source
NREV03	Non-Residential Ventilation - Grocery	30.2%	32.9%	16.0%	20.9%	eQuest (COMNET)
NREV04	Non-Residential Ventilation - Health	24.4%	31.7%	25.4%	18.6%	eQuest (COMNET)
NREV05	Non-Residential Ventilation - Hospital	22.5%	33.7%	19.2%	24.5%	eQuest (COMNET)
NREV06	Non-Residential Ventilation - Industrial	33.9%	32.1%	18.4%	15.6%	eQuest (COMNET)
NREV07	Non-Residential Ventilation - Lodging	23.7%	45.4%	13.4%	17.5%	eQuest (COMNET)
NREV08	Non-Residential Ventilation - Multifamily	23.7%	45.4%	13.4%	17.5%	eQuest (COMNET)
NREV09	Non-Residential Ventilation - Office - Large	30.7%	36.6%	20.5%	12.2%	eQuest (COMNET)
NREV10	Non-Residential Ventilation - Office - Small	31.1%	40.7%	15.7%	12.6%	eQuest (COMNET)
NREV11	Non-Residential Ventilation - Religious	32.1%	41.5%	16.7%	9.6%	eQuest (COMNET)
NREV12	Non-Residential Ventilation - Restaurant	28.9%	35.8%	15.4%	19.9%	eQuest (COMNET)
NREV13	Non-Residential Ventilation - Retail - Large	29.7%	43.8%	14.8%	11.7%	eQuest (COMNET)
NREV14	Non-Residential Ventilation - Retail - Small	29.1%	43.8%	14.3%	12.9%	eQuest (COMNET)
NREV15	Non-Residential Ventilation - Warehouse	32.3%	42.2%	16.1%	9.4%	eQuest (COMNET)
NREV16	Non-Residential Ventilation - Non-Residential (Avg)	31.7%	41.0%	15.8%	11.6%	eQuest (COMNET)
NREV17	Non-Residential Ventilation - Agricultural Animal Housing and Warehousing	32.3%	42.2%	16.1%	9.4%	Equal to Warehouse
NREW01	Non-Residential Electric Hot Water - Convenience	40.5%	30.2%	16.9%	12.4%	eQuest (COMNET)
NREW02	Non-Residential Electric Hot Water - Education	60.3%	21.3%	11.5%	6.9%	eQuest (COMNET)
NREW03	Non-Residential Electric Hot Water - Grocery	38.9%	31.6%	16.5%	13.1%	eQuest (COMNET)
NREW04	Non-Residential Electric Hot Water - Health	42.9%	27.3%	17.9%	11.9%	eQuest (COMNET)
NREW05	Non-Residential Electric Hot Water - Hospital	28.5%	42.3%	12.1%	17.1%	eQuest (COMNET)
NREW06	Non-Residential Electric Hot Water - Industrial	35.5%	34.1%	15.6%	14.8%	eQuest (COMNET)
NREW07	Non-Residential Electric Hot Water - Lodging	28.0%	42.7%	12.2%	17.1%	eQuest (COMNET)
NREW08	Non-Residential Electric Hot Water - Multifamily	28.0%	42.7%	12.2%	17.1%	eQuest (COMNET)
NREW09	Non-Residential Electric Hot Water - Office - Large	47.4%	23.8%	18.6%	10.2%	eQuest (COMNET)

Loadshape Number	Loadshape Name	Winter On-Peak Energy	Winter Off-Peak Energy	Summer On-Peak Energy	Summer Off-Peak Energy	Load Profile Source
NREW10	Non-Residential Electric Hot Water - Office - Small	45.3%	25.0%	18.6%	11.0%	eQuest (COMNET)
NREW11	Non-Residential Electric Hot Water - Religious	39.0%	31.5%	17.4%	12.1%	eQuest (COMNET)
NREW12	Non-Residential Electric Hot Water - Restaurant	31.4%	39.1%	14.0%	15.5%	eQuest (COMNET)
NREW13	Non-Residential Electric Hot Water - Retail - Large	30.0%	38.8%	14.0%	17.2%	eQuest (COMNET)
NREW14	Non-Residential Electric Hot Water - Retail - Small	42.2%	28.5%	17.7%	11.5%	eQuest (COMNET)
NREW15	Non-Residential Electric Hot Water - Warehouse	46.6%	24.6%	18.3%	10.5%	eQuest (COMNET)
NREW16	Non-Residential Electric Hot Water - Non-Residential (Avg)	43.9%	27.7%	17.1%	11.4%	eQuest (COMNET)
NRE01	Non-Residential Refrigeration - Grocery	28.4%	38.2%	14.8%	18.7%	eQuest (COMNET)
NRE02	Non-Residential Electric Cooking - Restaurant	34.4%	32.1%	17.9%	15.5%	eQuest (COMNET)
NRE03	Industrial Motor	54.8%	11.8%	27.5%	5.9%	Efficiency Vermont
NRE04	VFD - Supply fans	44.7%	18.4%	22.5%	14.4%	Efficiency Vermont
NRE05	VFD - Return fans	44.7%	18.4%	22.5%	14.4%	Efficiency Vermont
NRE06	VFD - Exhaust fans	40.0%	26.6%	15.0%	18.4%	Efficiency Vermont
NRE07	VFD - Boiler feedwater pumps	49.4%	50.5%	0.0%	0.1%	Efficiency Vermont
NRE08	VFD - Chilled water pumps	12.9%	6.4%	38.9%	41.8%	Efficiency Vermont
NRE09	VFD - Boiler circulation pumps	49.4%	50.5%	0.0%	0.1%	Efficiency Vermont
NRE10	Evaporator Fan Control	27.6%	41.0%	13.0%	18.4%	Efficiency Vermont
NRE11	Non-Residential Agricultural	27%	39%	14%	20%	Cadmus
NRE12	Night Covers for Refrigeration Display Cases	0.0%	66.0%	0.0%	33.0%	Calculation[6]
NRE13	Indust. 1-shift (8/5)	58.3%	8.3%	29.2%	4.2%	Efficiency Vermont
NRE14	Indust. 2-shift (16/5)	54.8%	11.8%	27.5%	5.9%	Efficiency Vermont
NRE15	Indust. 3-shift (24/5)	40.0%	26.6%	20.1%	13.3%	Efficiency Vermont
NRE16	Indust. 4-shift (24/7)	29.6%	37.0%	14.9%	18.5%	Efficiency Vermont

6.5 Summer Peak Period Definition (kW)

To estimate the impact that an efficiency measure has on a utility's system peak, the peak period needs to be

[6] Assumes all off peak and evenly split across the year.

defined. Iowa falls mainly within the Midcontinent Independent System Operators (MISO) electrical control area, with some areas served by in the Southwest Power Pool. Because Iowa is primarily a summer peaking state, only the summer peak period is defined for the purpose of this TRM. The coincident summer peak period for non-weather sensitive measures is defined as the hours ending 3PM - 6PM Central Prevailing Time on non-holiday weekdays, June through August. For weather-sensitive measures the coincidence during the utility's representative peak hour is used. This hour has been established by consensus to be the hour ending at 6PM Central Prevailing Time on July 30th, as this is likely to be the most indicative of actual peak benefits. 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, or through a calculation using stated assumptions.

6.6 Gas Loadshapes

Gas loadshapes are also provided that can be used to divide gas therm savings into 12 monthly periods. All residential loadshapes are based upon end use data derived from Cadmus modeling, and all non-residential loadshapes are derived from the eQuest modeling performed by VEIC for the defined building types.

Natural Gas Loadshapes

Loadshape Number	Loadshape Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Load Profile Source
G01	Flat	8.5%	7.7%	8.5%	8.2%	8.5%	8.2%	8.5%	8.5%	8.2%	8.5%	8.2%	8.5%	n/a
RG01	Residential Boiler	27.1%	20.1%	11.7%	3.9%	0.1%	0.0%	0.0%	0.0%	0.2%	3.6%	10.8%	22.5%	Cadmus
RG02	Residential Cooking	9.4%	8.5%	8.5%	7.6%	7.8%	7.9%	8.0%	7.9%	7.7%	8.3%	8.6%	9.7%	Cadmus
RG03	Residential Dryer	9.4%	8.5%	8.5%	7.6%	7.8%	7.9%	8.0%	7.9%	7.7%	8.3%	8.6%	9.7%	Cadmus
RG04	Residential Other Heating	28.7%	20.7%	11.2%	3.4%	0.0%	0.0%	0.0%	0.0%	0.0%	2.9%	10.0%	23.0%	Cadmus
RG05	Residential Other	9.4%	8.5%	8.5%	7.6%	7.8%	7.9%	8.0%	7.9%	7.7%	8.3%	8.6%	9.7%	Cadmus
RG06	Residential Pool Heat	9.4%	8.5%	8.5%	7.6%	7.8%	7.9%	8.0%	7.9%	7.7%	8.3%	8.6%	9.7%	Cadmus
RG07	Residential Water Heat	8.5%	7.7%	8.5%	8.2%	8.5%	8.2%	8.5%	8.5%	8.2%	8.5%	8.2%	8.5%	Cadmus
NRGH01	Non-Residential Gas Heating - Convenience	27.3%	22.5%	11.4%	3.0%	0.1%	0.0%	0.0%	0.0%	0.0%	2.8%	10.3%	22.6%	eQuest (COMNET)
NRGH02	Non-Residential Gas Heating - Education	26.7%	21.2%	10.9%	3.3%	0.0%	0.0%	0.0%	0.0%	0.0%	3.4%	11.2%	23.3%	eQuest (COMNET)
NRGH03	Non-Residential Gas Heating - Grocery	32.0%	26.1%	8.8%	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	1.3%	6.9%	23.6%	eQuest (COMNET)
NRGH04	Non-Residential Gas Heating - Health	24.4%	20.3%	12.2%	3.9%	0.4%	0.0%	0.0%	0.0%	0.2%	4.9%	12.5%	21.2%	eQuest (COMNET)
NRGH05	Non-Residential Gas Heating - Hospital	29.8%	24.2%	9.4%	1.6%	0.1%	0.0%	0.0%	0.0%	0.1%	2.7%	8.8%	23.3%	eQuest (COMNET)
NRGH06	Non-Residential Gas Heating - Industrial	24.0%	19.5%	12.3%	4.5%	0.9%	0.0%	0.0%	0.0%	0.2%	5.3%	13.1%	20.2%	eQuest (COMNET)
NRGH07	Non-Residential Gas Heating - Lodging	23.0%	19.8%	12.5%	5.5%	1.1%	0.1%	0.0%	0.0%	0.5%	5.6%	11.6%	20.4%	eQuest (COMNET)
NRGH08	Non-Residential Gas Heating - Multifamily	23.0%	19.8%	12.5%	5.5%	1.1%	0.1%	0.0%	0.0%	0.5%	5.6%	11.6%	20.4%	eQuest (COMNET)
NRGH09	Non-Residential Gas Heating - Office - Large	20.7%	17.0%	11.4%	5.8%	2.3%	1.2%	1.1%	1.2%	1.9%	6.8%	11.7%	19.0%	eQuest (COMNET)
NRGH10	Non-Residential Gas Heating - Office - Small	23.2%	19.5%	12.3%	5.6%	1.1%	0.1%	0.0%	0.0%	0.5%	5.6%	11.7%	20.5%	eQuest (COMNET)

Loadshape Number	Loadshape Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Load Profile Source
NRGH11	Non-Residential Gas Heating - Religious	22.9%	19.6%	12.7%	5.7%	1.0%	0.0%	0.0%	0.0%	0.4%	5.3%	12.0%	20.5%	eQuest (COMNET)
NRGH12	Non-Residential Gas Heating - Restaurant	23.8%	20.7%	12.4%	5.2%	0.9%	0.1%	0.0%	0.0%	0.4%	5.1%	10.7%	20.7%	eQuest (COMNET)
NRGH13	Non-Residential Gas Heating - Retail - Large	23.8%	20.1%	12.9%	4.5%	0.5%	0.0%	0.0%	0.0%	0.1%	4.5%	12.7%	20.9%	eQuest (COMNET)
NRGH14	Non-Residential Gas Heating - Retail - Small	23.8%	20.3%	13.0%	5.1%	0.6%	0.0%	0.0%	0.0%	0.1%	4.4%	11.9%	20.8%	eQuest (COMNET)
NRGH15	Non-Residential Gas Heating - Warehouse	23.6%	20.1%	12.4%	5.1%	0.9%	0.0%	0.0%	0.0%	0.3%	5.1%	11.3%	21.0%	eQuest (COMNET)
NRGH16	Non-Residential Gas Heating - Nonresidential Average	23.7%	20.0%	12.4%	5.1%	0.8%	0.0%	0.0%	0.0%	0.3%	5.0%	11.6%	20.9%	eQuest (COMNET)
NRGB01	Non-Residential Gas Boiler Heat and Hot Water - Convenience	27.1%	22.3%	11.4%	3.1%	0.2%	0.1%	0.1%	0.1%	0.1%	2.8%	10.3%	22.4%	eQuest (COMNET)
NRGB02	Non-Residential Gas Boiler Heat and Hot Water - Education	24.8%	20.0%	11.1%	4.2%	1.3%	0.7%	0.2%	0.2%	1.0%	4.0%	10.9%	21.6%	eQuest (COMNET)
NRGB03	Non-Residential Gas Boiler Heat and Hot Water - Grocery	31.3%	25.5%	8.8%	1.6%	0.3%	0.3%	0.2%	0.2%	0.2%	1.5%	6.9%	23.1%	eQuest (COMNET)
NRGB04	Non-Residential Gas Boiler Heat and Hot Water - Health	21.0%	17.8%	11.7%	5.3%	2.4%	2.0%	1.8%	1.7%	1.7%	5.2%	11.1%	18.4%	eQuest (COMNET)
NRGB05	Non-Residential Gas Boiler Heat and Hot Water - Hospital	21.4%	17.9%	9.6%	4.9%	3.8%	3.3%	3.1%	2.9%	2.9%	4.6%	8.4%	17.3%	eQuest (COMNET)
NRGB06	Non-Residential Gas Boiler Heat and Hot Water - Industrial	24.0%	19.5%	12.3%	4.5%	0.9%	0.0%	0.0%	0.0%	0.3%	5.3%	13.0%	20.1%	eQuest (COMNET)
NRGB07	Non-Residential Gas Boiler Heat and Hot Water - Lodging	18.3%	16.0%	11.6%	6.9%	3.8%	2.8%	2.6%	2.5%	2.7%	6.2%	10.3%	16.3%	eQuest (COMNET)

Loadshape Number	Loadshape Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Load Profile Source
NRGB08	Non-Residential Gas Boiler Heat and Hot Water - Multifamily	18.3%	16.0%	11.6%	6.9%	3.8%	2.8%	2.6%	2.5%	2.7%	6.2%	10.3%	16.3%	eQuest (COMNET)
NRGB09	Non-Residential Gas Boiler Heat and Hot Water - Office - Large	20.2%	16.6%	11.4%	6.0%	2.5%	1.5%	1.3%	1.4%	2.1%	6.8%	11.6%	18.6%	eQuest (COMNET)
NRGB10	Non-Residential Gas Boiler Heat and Hot Water - Office - Small	23.1%	19.4%	12.3%	5.6%	1.2%	0.1%	0.1%	0.1%	0.5%	5.6%	11.6%	20.4%	eQuest (COMNET)
NRGB11	Non-Residential Gas Boiler Heat and Hot Water - Religious	22.5%	19.3%	12.7%	5.7%	1.2%	0.2%	0.2%	0.2%	0.5%	5.3%	11.9%	20.2%	eQuest (COMNET)
NRGB12	Non-Residential Gas Boiler Heat and Hot Water - Restaurant	19.7%	17.4%	11.8%	6.4%	3.1%	2.3%	2.1%	2.0%	2.2%	5.7%	9.8%	17.3%	eQuest (COMNET)
NRGB13	Non-Residential Gas Boiler Heat and Hot Water - Retail - Large	23.7%	20.1%	12.9%	4.5%	0.5%	0.0%	0.0%	0.0%	0.1%	4.5%	12.7%	20.8%	eQuest (COMNET)
NRGB14	Non-Residential Gas Boiler Heat and Hot Water - Retail - Small	23.6%	20.2%	13.0%	5.1%	0.7%	0.1%	0.1%	0.1%	0.2%	4.5%	11.8%	20.6%	eQuest (COMNET)
NRGB15	Non-Residential Gas Boiler Heat and Hot Water - Warehouse	23.5%	20.0%	12.4%	5.2%	1.0%	0.1%	0.1%	0.1%	0.4%	5.1%	11.3%	20.9%	eQuest (COMNET)
NRGB16	Non-Residential Gas Boiler Heat and Hot Water - Nonresidential Average	23.1%	19.6%	12.4%	5.3%	1.2%	0.3%	0.2%	0.2%	0.6%	5.1%	11.5%	20.4%	eQuest (COMNET)
NRGW01	Non-Residential Gas Hot Water - Convenience	9.3%	8.9%	10.1%	9.4%	8.7%	7.9%	7.4%	7.1%	6.9%	7.5%	7.9%	8.9%	eQuest (COMNET)
NRGW02	Non-Residential Gas Hot Water - Education	10.1%	11.2%	12.8%	10.2%	10.5%	6.1%	2.1%	2.0%	8.1%	8.7%	8.9%	9.2%	eQuest (COMNET)
NRGW03	Non-Residential Gas Hot Water - Grocery	9.2%	8.9%	10.1%	9.6%	8.9%	8.0%	7.5%	7.2%	6.8%	7.4%	7.5%	8.8%	eQuest (COMNET)
NRGW04	Non-Residential Gas Hot Water - Health	8.8%	8.9%	10.6%	10.0%	8.6%	8.3%	7.5%	7.2%	6.8%	7.1%	7.6%	8.7%	eQuest (COMNET)

Loadshape Number	Loadshape Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Load Profile Source
NRGW05	Non-Residential Gas Hot Water - Hospital	9.5%	9.0%	10.0%	9.5%	8.9%	7.9%	7.5%	7.0%	6.8%	7.3%	7.8%	8.8%	eQuest (COMNET)
NRGW06	Non-Residential Gas Hot Water - Industrial	8.8%	8.6%	10.0%	9.2%	8.3%	8.0%	7.6%	7.5%	7.3%	7.7%	8.1%	8.9%	eQuest (COMNET)
NRGW07	Non-Residential Gas Hot Water - Lodging	9.5%	8.9%	10.0%	9.4%	8.9%	7.9%	7.5%	7.1%	6.8%	7.4%	7.8%	8.8%	eQuest (COMNET)
NRGW08	Non-Residential Gas Hot Water - Multifamily	9.5%	8.9%	10.0%	9.4%	8.9%	7.9%	7.5%	7.1%	6.8%	7.4%	7.8%	8.8%	eQuest (COMNET)
NRGW09	Non-Residential Gas Hot Water - Office - Large	9.4%	9.2%	10.5%	10.1%	8.7%	8.2%	7.4%	6.7%	6.5%	7.1%	7.3%	9.0%	eQuest (COMNET)
NRGW10	Non-Residential Gas Hot Water - Office - Small	9.2%	8.9%	10.1%	9.7%	8.6%	8.2%	7.6%	7.0%	6.9%	7.4%	7.4%	9.0%	eQuest (COMNET)
NRGW11	Non-Residential Gas Hot Water - Religious	9.3%	8.9%	10.0%	9.5%	9.0%	8.0%	7.4%	7.2%	6.8%	7.4%	7.6%	8.7%	eQuest (COMNET)
NRGW12	Non-Residential Gas Hot Water - Restaurant	9.2%	8.9%	10.3%	9.7%	9.0%	8.1%	7.4%	7.2%	6.7%	7.3%	7.5%	8.5%	eQuest (COMNET)
NRGW13	Non-Residential Gas Hot Water - Retail - Large	9.2%	8.9%	10.1%	9.7%	8.6%	8.2%	7.6%	7.0%	6.9%	7.4%	7.4%	9.0%	eQuest (COMNET)
NRGW14	Non-Residential Gas Hot Water - Retail - Small	9.5%	9.0%	10.0%	9.5%	8.9%	8.0%	7.5%	7.1%	6.8%	7.4%	7.7%	8.9%	eQuest (COMNET)
NRGW15	Non-Residential Gas Hot Water - Warehouse	9.4%	9.1%	10.4%	10.1%	8.7%	8.1%	7.4%	6.7%	6.6%	7.2%	7.3%	9.0%	eQuest (COMNET)
NRGW16	Non-Residential Gas Hot Water - Nonresidential Average	9.4%	9.2%	10.4%	9.8%	8.9%	7.9%	7.0%	6.6%	6.9%	7.5%	7.6%	8.9%	eQuest (COMNET)
NRGC01	Non-Residential Gas Cooking - Restaurant	8.5%	7.7%	8.5%	8.2%	8.5%	8.2%	8.5%	8.5%	8.2%	8.5%	8.2%	8.5%	eQuest (COMNET)

6.7 Peak Therm Calculation

Peak Therm is defined as the therm savings expected during the peak day. For non-weather sensitive measures and those without annual fluctuation, this is simply assumed to be the annual therm savings divided by the number of days in the year or savings period. For weather sensitive measures, a gas coincidence factor is calculated by dividing the Cadmus/VEIC modeling data derived peak therm savings day by the annual savings, that is, the percentage of total savings occurring in the peak day.

6.8 Weather Data for Weather-sensitive Measures

Many measures are weather sensitive. Because there is a range of climactic conditions across the state, VEIC engaged the utilities to provide their opinions as to which airports and cities are the best proxies for the weather in their service territories. The TAC agreed upon using three cities, one representative of IECC Climate Zone 5 (BURLINGTON MUNICIPAL AIRPORT IA US), one representative of IECC Climate Zone 6 (MASON CITY MUNICIPAL AIRPORT IA US), and a Statewide average/unknown location (DES MOINES INTERNATIONAL AIRPORT IA US).

The following table provides the IECC Climate Zone identifier for each Iowa County. This information is used extensively throughout the TRM for heating degree day and cooling degree day based assumptions.

Climate Zone County Table

IA County	IECC Climate Zone (HDD/CDD)	IA County	IECC Climate Zone (HDD/CDD)
Adair	5	Jefferson	5
Adams	5	Johnson	5
Allamakee	6	Jones	5
Appanoose	5	Keokuk	5
Audubon	5	Kossuth	6
Benton	5	Lee	5
Black Hawk	6	Linn	5
Boone	5	Louisa	5
Bremer	6	Lucas	5
Buchanan	6	Lyon	6
Buena Vista	6	Madison	5
Butler	6	Mahaska	5
Calhoun	6	Marion	5
Carroll	5	Marshall	5
Cass	5	Mills	5
Cedar	5	Mitchell	6
Cerro Gordo	6	Monona	5
Cherokee	6	Monroe	5
Chickasaw	6	Montgomery	5
Clarke	5	Muscatine	5
Clay	6	O'Brien	6
Clayton	6	Osceola	6
Clinton	5	Page	5
Crawford	5	Palo Alto	6
Dallas	5	Plymouth	6
Davis	5	Pocahontas	6
Decatur	5	Polk	5
Delaware	6	Pottawattamie	5
Des Moines	5	Poweshiek	5
Dickinson	6	Ringgold	5

IA County	IECC Climate Zone (HDD/CDD)
Dubuque	5
Emmet	6
Fayette	6
Floyd	6
Franklin	6
Fremont	5
Greene	5
Grundy	6
Guthrie	5
Hamilton	6
Hancock	6
Hardin	6
Harrison	5
Henry	5
Howard	6
Humboldt	6
Ida	6
Iowa	5
Jackson	5
Jasper	5

IA County	IECC Climate Zone (HDD/CDD)
Sac	6
Scott	5
Shelby	5
Sioux	6
Story	5
Tama	5
Taylor	5
Union	5
Van Buren	5
Wapello	5
Warren	5
Washington	5
Wayne	5
Webster	6
Winnebago	6
Winneshiek	6
Woodbury	5
Worth	6
Wright	6

6.9 Use of O&M costs

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 present value (PV) 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 usually specify the PV of the O&M costs. Instead, the necessary cost and timeline information required to calculate the PV is included. An example is provided below to demonstrate how to calculate the PV 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 these cash flows in the Baseline Case and the Efficient Case separately using the applicable WACC. Then the PV of the incremental O&M costs is calculated by subtracting one PV from the other. This value is used in each utility's cost-effectiveness screening process.

The effect of O&M costs for 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 PV to the actual stream of O&M costs) and as PVs using a statewide average real discount rate of 7.20%.

6.10 Treatment of Interactive Effects in the TRM

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 deemed 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. 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, for example, because it is impossible to know the specifics of each 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[7].

[7] For guidance on protocols for these estimations, see the Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, NREL/DOE, January 2012 — March 2013 http://energy.gov/sites/prod/files/2013/07/f2/53827_complete.pdf

7 Glossary

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

Building Types[8]: The following list provides the definitions for each nonresidential building type modelled as a basis for multiple assumptions throughout the TRM. For TRM versions 3 and 4, the modeling is transitioning from eQuest to OpenStudio (an open-source platform developed by NREL). From TRM version 4 forward, the modeling will be conducted in OpenStudio.

Building Type	Definition
Convenience	Applies to facility space used for the retail sale of a limited selection of food and beverage products. 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), and administrative areas.
Education	Applies to a school serving any grades, colleges and universities. The total gross floor area should include all supporting functions such as administrative space, conference rooms, kitchens used by staff, lobbies, cafeterias, gymnasiums, auditoriums, laboratory classrooms, portable classrooms, greenhouses, stairways, atriums, elevator shafts, small landscaping sheds, storage areas, etc.
Grocery	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, atriums, lobbies, etc.
Health – Outpatient	Applies to a facility space used to provide diagnosis and treatment for medical, dental, or psychiatric outpatient care. Gross floor area should include all space within the building(s) including offices, exam rooms, laboratories, lobbies, atriums, conference rooms and auditoriums, employee break rooms and kitchens, rest rooms, elevator shafts, stairways, mechanical rooms, and storage areas.
Hospital	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. Spaces more accurately characterized as a Healthcare Clinic should use the 'Health – Outpatient' definition. The definition of Hospital accounts for all space types that are located within the 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, atriums, cafeterias, storage areas, elevator shafts, and any space affiliated with emergency medical care, or diagnostic care.
Industrial	Applies to buildings that are dedicated to manufacturing activities. Includes light industry buildings characterized by consumer product and component manufacturing and heavy industry buildings typically characterized by a plant that includes a main production area that has high-ceilings and contains heavy equipment used for assembly line production.
Lodging	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, atriums, 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.
Multifamily	Applies to residential multifamily buildings including all public and multiuse spaces

[8] Source: US EPA, www.energystar.gov, Space Type Definitions used for HVAC and Lighting eQuest models.

Building Type	Definition
	within the building envelope. Gross floor area should include all fully-enclosed space within the exterior walls of the building(s) including living space in each unit (including occupied and unoccupied units), interior common areas (e.g., lobbies, offices, community rooms, common kitchens, fitness rooms, indoor pools), hallways, stairwells, elevator shafts, connecting corridors between buildings, storage areas, and mechanical space such as a boiler room. Open air stairwells, breezeways, and other similar areas that are not fully-enclosed should not be included in the gross floor area.
Office – Large	Applies to facility spaces in buildings with five floors or more 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, atriums, conference rooms and auditoriums, fitness areas for staff, storage areas, stairways, elevator shafts, etc.
Office – Small	Applies to facility spaces in buildings with four floors or fewer 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, atriums, conference rooms and auditoriums, fitness areas for staff, storage areas, stairways, elevator shafts, etc.
Religious	Applies to buildings that are used as places of worship. This includes churches, temples, mosques, synagogues, meetinghouses, or any other buildings that primarily function as a place of religious worship. Gross floor area should include all areas inside the building that includes the primary worship area, including food preparation, community rooms, classrooms, and supporting areas such as restrooms, storage areas, hallways, and elevator shafts.
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 – Large	Applies to facility space used to conduct the retail sale of consumer product goods. Stores must be at least 30,000 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: Grocery, Convenience Stores, Automobile Dealerships, and Restaurants.
Retail – Small	Applies to facility space used to conduct the retail sale of consumer product goods. Stores must less than 30,000 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 excluded under this definition are: Grocery, 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.
Nonresidential	Weighted average used for instances where building type is unknown. The weighting is

Building Type	Definition
Average	based on the number of buildings matching each building type in the 2012 Commercial Buildings Energy Consumption Survey (CBECS) Data for the Midwest Region, West North Central Division, which includes Iowa. Building types that comprise less than 5% of the total population are excluded from the weighted averaging.

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.

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 savings 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 Section 5.1 for a list of the end-use categories that are incorporated in this TRM.

Energy Efficiency: "Energy efficiency" refers to measures that reduce the amount of electricity or natural gas required to achieve a given end use. "Energy efficiency" also includes measures that reduce the total Btus of electricity and natural gas needed to meet the end use or uses.

Equivalent Full Load Hours (EFLH): 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) or therms.

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 residential 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. If the RUL cannot be determined from the age of the measure, 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: A high efficiency technology or procedure that results in energy savings as compared to the baseline efficiency.

Nonresidential: 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.

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

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 2.4 for a list of program descriptions that are presently operating in Iowa.

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

Appendix A – High Impact Measures from Iowa Energy Efficiency Statewide Technical Reference Manual

High-impact measures are defined as those energy efficiency measures in Version 1 of the Iowa TRM that together contributed to ninety percent of the utilities' 2014-2018 Plan impact goals. The following table is provided to identify High Impact Measures for use by the utilities as they do the work necessary to estimate impact on energy savings from adopting or not adopting TRM assumptions for these measures.

Residential High Impact Measures	
End Use	**Measure Name**
Appliances	2.1.1 - Clothes Washer
Appliances	2.1.5 - Refrigerator and Freezer Recycling
Appliances	2.1.7 - Room Air Conditioner Recycling
Hot Water	2.3.2 - Heat Pump Water Heaters
Hot Water	2.3.3 - Water Heater Temperature Setback
Hot Water	2.3.4 - Low Flow Faucet Aerators
Hot Water	2.3.5 - Low Flow Showerheads
Heating, Ventilation, and Air Conditioning	2.4.1 - Central Air Source Heat Pump
Heating, Ventilation, and Air Conditioning	2.4.2 - Central Air Conditioning
Heating, Ventilation, and Air Conditioning	2.4.3 - Boiler
Heating, Ventilation, and Air Conditioning	2.4.4 - Furnace
Heating, Ventilation, and Air Conditioning	2.4.5 - Furnace Blower Motor
Heating, Ventilation, and Air Conditioning	2.4.6 - Geothermal Source Heat Pump
Heating, Ventilation, and Air Conditioning	2.4.13 - Boiler Tune-up
Heating, Ventilation, and Air Conditioning	2.4.14 - Furnace Tune-Up
Heating, Ventilation, and Air Conditioning	2.4.16 - Duct Sealing
Heating, Ventilation, and Air Conditioning	2.4.17 - Programmable Thermostats
Lighting	2.5.1 - Compact Fluorescent Lamp - Standard
Lighting	2.5.2 - Compact Fluorescent Lamp - Specialty
Lighting	2.5.3 - LED Lamp - Standard
Lighting	2.5.4 - LED Lamp - Specialty
Shell	2.6.1 - Infiltration Control
Shell	2.6.2 - Attic/Ceiling Insulation
Shell	2.6.3 - Rim/Band Joist Insulation
Shell	2.6 4 - Wall Insulation

Nonresidential High Impact Measures	
End Use	**Measure Name**
Agricultural Equipment	3.1.1 - Circulation Fans
Agricultural Equipment	3.1.2 - Ventilation Fans
Agricultural Equipment	3.1.3 - High Volume Low Speed Fans
Agricultural Equipment	3.1.4 - Temperature Based On/Off Ventilation Controller
Hot Water	3.2.1 - Low Flow Faucet Aerators
Hot Water	3.2.2 - Low Flow Showerheads
Hot Water	3.2.3 - Gas Hot Water Heater
Heating, Ventilation and Air Conditioning	3.3.1 - Boiler
Heating, Ventilation and Air Conditioning	3.3.2 - Furnace
Heating, Ventilation and Air Conditioning	3.3.5 - Geothermal Source Heat Pump
Heating, Ventilation and Air Conditioning	3.3.10 - Boiler Tune-up

Nonresidential High Impact Measures	
End Use	**Measure Name**
Heating, Ventilation and Air Conditioning	3.3 11 - Furnace Tune-Up
Heating, Ventilation and Air Conditioning	3.3.12 - Small Commercial Programmable Thermostats
Heating, Ventilation and Air Conditioning	3.3.13 - Variable Frequency Drives for HVAC Pumps
Heating, Ventilation and Air Conditioning	3.3.14 - Variable Frequency Drives for HVAC Supply and Return Fans
Lighting	3.4.1 - Compact Fluorescent Lamp - Standard
Lighting	3.4.2 - Compact Fluorescent Lamp - Specialty
Lighting	3.4.3 - LED Lamp Standard
Lighting	3.4.4 - LED Lamp Specialty
Lighting	3.4.5 - LED Fixtures
Lighting	3.4.6 - T5 HO Fixtures and Lamp/Ballast Systems
Lighting	3.4.7 - High Performance and Reduced Wattage T8 Fixtures and Lamps
Lighting	3.4.12 - Occupancy Sensor
Miscellaneous	3.5.1 - Variable Frequency Drives for Process