Appendix I - TRM - Vol. 3: Residential Measures.

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Volume 3: Residential Measures

2025 MEEIA 4 2019-21 Plan

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Appendix I - TRM – Vol. 3: Residential Measures

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<u>2025 MEEIA 4 2019-21 Plan</u>

Revision <u>8</u>7.0

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Appendix I - TRM - Vol. 3: Residential Measures

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Ameren Missouri TRM – Volume 3: Residential Measures Revision LogRevisionDateDescription

Revision	Date	Description
1.0	05/30/2018	Initial version filed for Commission approval.
2.0	12/21/2018	Updated "Deemed Tables" with PY2017 Evaluation results per Stipulation and Agreement (File No. EO-2018-0211). Added Demand Response language per Science of Agreement
3.0	1/01/2020	Stipulation and Agreement. Updated "Deemed Tables" with PY2018 Evaluation results. Also includes revisions to HVAC measures and multifamily measures, based on feedback from evaluation contractor. This includes updates to Volume 3 of the TRM.
4.0	10/15/2020	Updated "Deemed Tables" with PY2019 Evaluation results and other revisions to improve consistency with Deemed tables.
5.0	09/15/21	Updated "Deemed Tables" with PY2020 Evaluation results and other revisions to improve consistency with Deemed tables.
6.0	09/26/2022	Updated "Deemed Tables" with PY2021 Evaluation results and other revisions to improve consistency with Deemed Tables. Other revisions include updates to incremental costs for low flow showerheads, in-service rates for low flow showerheads and faucet aerators based on PY2021 evaluation, incorporation of SEER to SEER2 and HSPF to HSPF2 conversion factors due to upcoming Code of Federal Regulation testing procedures, and updates to PTHP and PTAC baseline code efficiencies.
7.0	10/05/2023	Addition of Pay As You Save (PAYS [®]) ISR's. Added language to clarify that ccASHP's must meet the majority of a home's heating needs. Updated HVAC baselines for heat pumps to CFR standards, with a TRM effective date of 1/1/2024 to allow for sell-through; Updates to lighting measures to address EISA updates to general service lamps (GSL), effective 8/1/2023. Updated deemed costs of light bulbs to reflect first year cost per bulb.
<u>8.0</u>	<u>+201/+xx15/20245</u>	Removed measures to align with approved measure list from Commission on 01/xx15/25. Removed several measures currently not active in the programs and added cool roof measures. Updated incremental cost for some measures, including Heating and Cooling CAC/ASHP. Reviewed and updated all measures including source documentation.

2025_MEEIA 4_2019-21-Plan

Revision <u>8</u>7.0

1

Appendix I - TRM - Vol. 3: Residential Measures

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Volume 3: Residential Measures	
3.1 Appliances	<u>95</u>
3.1.1 Air Purifier/Cleaner	
3.1.2 Clothes Dryer	
3.1.3 Clothes Washer	
3.1.4 Dehumidifier	
3.1.5 Refrigerator	
3.2 Electronics	
3.2.1 Advanced Tier 1 Power Strips	
3.2.2 Tier 2 Advanced Power Strip – Residential Audio Visual	
3.3 Hot Water	
3.3.1 Low Flow Faucet Aerator	
3.3.2 Low Flow Showerhead	
3.3.3 Heat Pump Water Heater	67 <u>41</u>
3.3.4 Hot Water Pipe Insulation	
<u>3.4 HVAC</u>	
3.4.1 Advanced Thermostat	
3.4.2 Air Source Heat Pump Including Dual Fuel Heat Pumps	<u>9054</u>
3.4.3 Duct Sealing and Duct Repair	<u>9759</u>
3.4.4 Mini/Multi-Split Air Source Heat Pump and Air Conditioners	
3.4.5 Standard Programmable Thermostat	
3.4.6 HVAC Tune-Up (Central Air Conditioning or Air Source Heat Pump)	
3.4.7 Blower Motor	
3.4.8 Central Air Conditioner	
3.4.9 Filter Cleaning or Replacement and Dirty Filter Alarms	
3.4.10 Packaged Terminal Air Conditioner (PTAC) and Packaged Terminal Heat Pum 132 86	ı <u>p (PTHP)</u>
3.4.11 Room Air Conditioner	<u></u>
3.4.12 Ground Source Heat Pump	<u>14193</u>
3.5 Lighting	
3.5.1 LED Screw Based Omnidirectional Bulb	
3.5.2 LED Specialty Lamp	
3.5.3 LED Nightlights	
3.5.4 Ultra-Efficient LED Lighting	
3.6 Motors	<u> 170116</u>
3.6.1 High Efficiency Pool Pumps	
3.7 Building Shell	<u></u>

2025_MEEIA 4_2019-21-Plan

Revision <u>8</u>7.0

Ameren	Missouri Appendix I - TRM – Vol. 3: Resid	ential Measures
<u>3.7.1</u>	Air Sealing	<u>173119</u>
3.7.2	Ceiling Insulation	
3.7.3	Duct Insulation	
<u>3.7.4</u>	Floor Insulation	
3.7.5	Storm Windows	
3.7.6	Cool Roof	
<u>3.8</u>	Residential Demand Response	
<u>3.9.1</u>	Residential Demand Response Analysis Approach	
3.9.2	Demand Response Advanced Thermostat	<u>218144</u>
3.9.3	Demand Response Water Heater Switch	
<u>3.9.4</u>	Demand Response Electric Vehicle Charger	
3.9.5	Behavioral Demand Response	
Volume 3	: Residential Measures	<u>5</u>
3.1	Appliances	5
3.1.1	Refrigerator and Freezer Recycling (Retired, effective 1/1/2025)	5
3.1.2	Air Purifier/Cleaner	9
	Clothes Dryer	
	Clothes Washer	
	Dehumidifier	
	Dehumidifier Recycling (Retired, effective 1/1/2025)	
	-Refrigerator	
	Room Air Conditioner Recycling (Retired, effective 1/1/2025)	
	Electronics	
	Advanced Tier 1 Power Strips	
	Tier 2 Advanced Power Strip – Residential Audio Visual	
	Hot Water	
	Low Flow Faucet Aerator	
	Low Flow Flow Showerhead	
	Water Heater Wrap (Retired, effective 1/1/2025)	
	Heat Pump Water Heater	
3.3.5	Hear rump water reater Hot Water Pipe Insulation	
	Thermostatic Restrictor Shower Valve (Retired, effective 1/1/2025)	
	HVAC	
	Advanced Thermostat	
	Air Source Heat Pump Including Dual Fuel Heat Pumps	
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2025_MEEIA <u>4_2019-21</u>-Plan

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Revision <u>8</u>7.0

Appendix I - TRM - Vol. 3: Residential Measures

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3.4.4 Mini/Multi Split Air Source Heat Pump and Air Conditioners	79
3.4.5 Standard Programmable Thermostat	
3.4.6 HVAC Tune Up (Central Air Conditioning or Air Source Heat Pump)	
3.4.7 Blower Motor	
3.4.8 Central Air Conditioner	
3.4.9 — Filter Cleaning or Replacement and Dirty Filter Alarms	
3.4.10 Packaged Terminal Air Conditioner (PTAC) and Packaged Terminal Heat Pump	
3.4.11 Room Air Conditioner	
2.4.12 Ground Source Heat Pump	
3.5 Lighting	
3.5.1 LED Screw Based Omnidirectional Bulb	
3.5.2 LED Specialty Lamp	
3.5.3 LED Nightlights	
3.5.4 Ultra Efficient LED Lighting	<u>121</u>
3.6 Motors	
3.6.1 High Efficiency Pool Pumps	<u></u>
3.7 Building Shell	
3.7.1 Air Sealing	
3.7.2 Ceiling Insulation	
3.7.3 Duct Insulation	
3.7.4 Floor Insulation	
3.7.5 Foundation Sidewall Insulation (Retired, effective 1/1/2025)	
3.7.6 Storm Windows	
3.7.7 Kneewall and Sillbox Insulation (Retired. effective 1/1/2025)	
3.7.8 Cool Roof	
3.7.9 Residential New Construction	
3.8 Miscellaneous	
3.8.1 Home Energy Report (Retired, effective 1/1/2025)	
3.9 Residential Demand Response	
3.9.1 Residential Demand Response Analysis Approach	
3.9.2 Demand Response Advanced Thermostat	
3.9.3 Demand Response Water Heater Switch	
3.9.4 Demand Response Electric Vehicle Charger	
3.9.5 Behavioral Demand Response	
olume 3: Residential Measures	
3.1 Appliances	

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2025_MEEIA 4_2019-21-Plan

Revision 87.0

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3.1.1 Refrigerator and Freezer Recycling		
3.1.2 Air Purifier/Cleaner		
3.1.3 Clothes Dryer	Formatted	
3.1.4 Clothes Washer		
3.1.5 — Dehumidifier		
3.1.6 Dehumidifier Recycling		
3.1.7 Refrigerator		
3.1.8 Room Air Conditioner Recycling		
2 Electronics		
3.2.1 Advanced Tier 1 Power Strips		
3.2.2 Tier 2 Advanced Power Strip Residential Audio Visual		
3.3.1 Low Flow Faucet Aerator		
3.3.2 Low Flow Showerhead	40 Formatted	
3.3.3 Water Heater Wrap		
3.3.4 Heat Pump Water Heater		
3.3.5 Hot Water Pipe Insulation		
3.3.6 Thermostatic Restrictor Shower Valve		
4 HVAC		
3.4.1 Advanced Thermostat		
3.4.2 — Air Source Heat Pump Including Dual Fuel Heat Pumps		
3.4.3 — Duet Scaling and Duet Repair		
3.4.4 — Mini/Multi Split Air Source Heat Pump and Air Conditioners		
3.4.5 Standard Programmable Thermostat		
3.4.6 HVAC Tune-Up (Central Air Conditioning or Air Source Heat Pump)		
3.4.7 Blower Motor		
3.4.8 Central Air Conditioner		
2.4.9 — Filter Cleaning or Replacement and Dirty Filter Alarms		
3.4.9—Priter Cleaning of Replacement and Dirty Filter Alarms		
3.4.11 Room Air Conditioner		
3.4.12 Ground Source Heat Pump		
5 Lighting		
3.5.1 LED Screw Based Omnidirectional Bulb		
3.5.2 LED Specialty Lamp		
6 Motors	Formatted	

<u>2025</u>MEEIA <u>4</u> 2019-21 Plan

I

Revision <u>8</u>7.0

Appendix I - TRM - Vol. 3: Residential Measures

3.7 Building Shell	
3.7.1 Air Sealing	110
3.7.2 Ceiling Insulation	 115
3.7.3 Duct Insulation	 118
3.7.4 Floor Insulation	 121
3.7.5 Foundation Sidewall Insulation	 124
3.7.6 Storm Windows	 128
3.7.7 Kneewall and Sillbox Insulation	 131
3.8 Miseellaneous	 134
3.8.1 Home Energy Report	134
3.9 Residential Demand Response	 136
3.9.1—Baseline Approach	 136
3.9.2 Demand Response Advanced Thermostat	 136

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Revision <u>8</u>7.0

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Volume 3: Residential Measu	ires	Formatted: Normal
3.1 Appliances		
3.1.1 Refrigerator and Freezer Rec	veling (Retired, effective 1/1/2025)+	
Description		Formatted: Font color: Background 1
This measure describes savings from the	retirement and recycling of inefficient but operational refrigerators and freezers. Sa	wings are
	quation is provided that requires the use of key inputs describing the retired unit (or p r provided by Cadmus using data from a 2012 ComEd metering study and metering da	
Michigan study. The second methodology	is a deemed approach based on 2011 Cadmus analysis of data from a number of evalua	ttions. ²
The savings are equivalent to the unit ener	gy consumption of the retired unit and should be claimed for the assumed remaining u account for those secondary units that are not in use throughout the entire year. The use	useful life
note that the regression algorithm is design	ted to provide an accurate portrayal of savings for the population as a whole and inclu	ides those
parameters that have a significant effect o	n the consumption. The precision of savings for individual units will vary. This mer ctive effect of reduced waste heat on the heating and cooling loads.	asure also
This measure was developed to be applicat		
If applied to other program types, the meas		
Definition of Efficient Equipment		
N/A		
Definition of Baseline Equipment		
The existing inefficient unit must be operated	tional and have a capacity of between 10 and 30 cubic feet.	
Deemed Lifetime of Efficient Equipment		
The estimated remaining useful life of the	recycling units is 8 years."	
Deemed Measure Cost Measure cost includes the cost of pickup (and recycling of the refrigerator and should be based on actual costs of running the pr	oeram_If
unknown, assume \$140 per unit.4		
Loadshape		
Refrigeration RES Freezer RES		
	Algorithm	
Calculation of Savings		
Energy Savings		
Regression analysis: Refrigerators		
Daily energy savings for refrigerators are t	based upon a linear regression model using the following coefficients:5	
<u>+ "Retire" indicates that the measure is not anticipate effectiveness.</u>	ed to be offered through an Ameren Missouri administered demand side program during the period of TRI	Formatted: Font color: Background 1
² Cadmus "2010 Residential Great Refrigerator Rou Evaluation.pdf".	ndup Program — Impact Evaluation," 2011. <u>See file '2010 Residential Great Refrigerator Roundup Progra</u>	≞
³ KEMA "Residential Refrigerator Recycling Ninth 'RARP report to SCE 040726ES.pdf', page E 1	Year Retention Study," 2004, https://www.calmac.org/publications/RARP_report_to_SCE_040726ES.pdf	f
⁴ Based on average program costs for SCE Refrigera	tor Appliance Recycling Program. Innovologie, "Appliance Recycling Program Retailer Trial Final Repo :://www.epa.gov/sites/default/files/2014-06/documents/sce-appliance-recycling-program_retailer trial fina	rt," a report
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https://www.efis.psc.mo.gov/Document/Display/138		
<u>2025 MEEIA 4 2019 21 Plan</u>	Revision <u>8</u> 7.0	Page 9

meren Missouri	A	<u>ppendix I - TRM – Vol. 3: Resid</u> ential Measu	IFES Formatted: Font: (Default) Arial, 12 pt
3	Independent Variable Description	Estimate Coefficient	Formatted: Normal
	Intercept	0.5822	Formatted: Font color: Background 1
	Age (years)	0.0269	Formatted: Font color: Background 1
	Pre-1990 (=1 if manufactured pre-1990)	1.0548	
-	Size (cubic feet)	0.0673	Formatted: Font color: Background 1
1	Dummy: Side by Side (= 1 if side by side)	1.0706	Formatted: Font color: Background 1
1	Dummy: Single Door (= 1 if single door)	-1.9767	Formatted: Font color: Background 1
1	Dummy: Primary Usage Type (in absence of the program)	0.6046	Formatted: Font color: Background 1
	(= 1 if primary unit)		
	Interaction: Located in Unconditioned Space x CDD/365	0.0200	Formatted: Font color: Background 1
1	Interaction: Located in Unconditioned Space x HDD/365	-0.0447	Formatted: Font color: Background 1
A			Formatted: Font color: Background 1
(HD (36	- * Unconditioned * -0.0447) * Days * Part Use Fac	* 0.6046) + (^{EDD} * Unconditioned * 0.0200)- tor	Formatted: Font color: Background 1, Check spelli and grammar
	<u>.5822 + (Age * 0.0269) + (Pre-1990 * 1.0548) + (Size * 0.06)</u> nary Usage * 0.6046) + (CDD/365 * Unconditioned * 0.02		
there:	<u>Use Factor</u>		
Age Pre-1990	= Age of retired unit = Pre-1990 dummy (=1 if manufactured pre-1990, else 0)		
Size	= Capacity (cubic feet) of retired unit		Formatted: Font color: Background 1, Check spelli and grammar
Side-by-Side	= Side by side dummy (= 1 if side by side, else 0)		
Single-Door	= Single door dummy (= 1 if single door, else 0)		Formatted: Font color: Background 1, Check spelli
Primary Usage	= Primary Usage Type (in absence of the program) dummy (= 1 if Primary, else 0. If unknown, assume 0.262. ⁶)		and grammar
CDD	Cooling Degree Days = Cooling Degree Days = 1678; ²		Formatted: Font color: Background 1, Check spelli and grammar
Unconditioned	= If unit in unconditioned space = 1, otherwise 0. If unknown, a	ssume 0.64. ⁸	Formatted: Font color: Background 1, Check spelli
HDD	= Heating Degree Days		and grammar
Days	= 4,486 ⁴ = Days per year		Formatted: Font color: Background 1, Check spelli and grammar
D	= 365		
Part Use Factor	= To account for those units that are not running throughout the results should be used. If not available, assume 0.864. ¹⁰	entire year. If available, Part-Use Factor participant survey	
aamad approach: P	efricerators		Formatted: Font color: Background 1, Check spelli and grammar
enned approacht it			Formatted: Font color: Background 1
(Wh_{Unit}	 = UEC * Part Use Factor		Formatted: Font color: Background 1, Check spelli and grammar
ΔkN here:	/h _{unit} = UEC * Part Use Factor		Formatted: Font color: Background 1, Check spelli and grammar
UEC	= Unit Energy Consumption = 1181 kWh ⁺⁺		Formatted: Font color: Background 1, Check spelli and grammar
Part Use Factor	= To account for those units that are not running throughout the results should be used. If not available, assume 0.864. ¹² = 1181 * 0.864	entire year. If available, Part-Use Factor participant survey	Formatted: Font color: Background 1, Check spelli and grammar
			Formatted: Font color: Background 1, Check spelli and grammar
	ance Recycling Impact and Process Evaluation: PY2019, https://www.efis.	psc.mo.gov/Document/Display/15876.	Formatted: Font color: Background 1
	ds CDD data, with a base temp of 65°F. ance Recycling Impact and Process Evaluation: PY2019,-https://www.efis	psc.mo.gov/Document/Display/15876	
Ameren Missouri Appli			
Based on climate norma Ameren Missouri Appl	iance Recycling Impact and Process Evaluation: PY2019, https://www.efis	s.psc.mo.gov/Document/Display/15876.	
Based on climate norma Ameren Missouri Appl		.psc.mo.gov/Document/Display/15876 . PY2015 <u>, https://www.efis.psc.mo.gov/Document/Display/1381(</u>	<u>0.</u>

	= 1020 kWh	<u>idix I - TRM – Vol. 3: Residentia</u>	Formatted: Font: (Default) Arial, 12 pt
	= 1020 kWh		Formatted: Normal
			Formatted: Font color: Background 1, Check and grammar
ression analysis: I	Freezers:		
	for freezers are based upon a linear regression model using the fo	lowing coefficients:13	
-,8,8,	Independent Variable Description	Estimate Coefficient	
	Intercept	-0.8918	Formatted: Font color: Background 1
	Age (years)	0.0384	Formatted: Font color: Background 1
	Pre-1990 (=1 if manufactured pre-1990)	0.6952	
	Size (cubic feet)	0.1287	Formatted: Font color: Background 1
	Chest Freezer Configuration (=1 if chest freezer)	0.3503	Formatted: Font color: Background 1
	Interaction: Located in Unconditioned Space x CDD	0.0695	Formatted: Font color: Background 1
	Interaction: Located in Unconditioned Space x HDD	-0.0313	Formatted: Font color: Background 1
			Formatted: Font color: Background 1
Vh _{Unit}	= [-0.8918 + (Age * 0.0384) + (Pre-1990 * 0.6952) + (Size * 0.0384) + (Pre-1990 * 0.6952) + (Pre		CDD/365 * Formatted: Font color: Background 1, Check
	Unconditioned *0.0695) + (HDD/365 * Unconditioned * 0.03	3) * Part Use Factor	and grammar
AkW	h = [-0.8918 + (Age * 0.0384) + (Pre - 1990 * 0.6	(Chast) = (Cize + 0.1297) + (Chast)	Freezer * Formatted: Indent: Left: 0", Hanging: 1.5"
-Part ere:	03) + (CDD/365 * Unconditioned * 0.0695) + (HDD/36 Use Factor = Age of retired unit	5 * Unconditioned * - 0.0313)] *	
Part	Use Factor	5 * Unconditioned * -0.0313)] *	
-Part -Part Pre- Pre-1990 Size	- Use Factor - Age of retired unit - Pre-1990 dummy (=1 if manufactured pre-1990, else 0) - Capacity (cubic feet) of retired unit	5 * Unconditioned * -0.0313)] *	Formatted: Font color: Background 1, Check and grammar
-Part -Part Sre: Age Pre-1990 Size Chest Freezer	-Use Factor - Age of retired unit - Pre-1990 dummy (=1 if manufactured pre-1990, else 0) - Capacity (cubic feet) of retired unit - Chest Freezer dummy (= 1 if chest freezer, else 0)	5 * Unconditioned * -0.0313)] *	Formatted: Font color: Background 1, Check and grammar
-Part Sre: Age Pre-1990 Size Chest Freezer CDD	- Use Factor - Age of retired unit - Pre-1990 dummy (=1 if manufactured pre-1990, else 0) - Capacity (cubic feet) of retired unit - Chest Freezer dummy (= 1 if chest freezer, else 0)		Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check
Age Pre: 1990 Size Chest Freezer CDD			Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar
Age Pre-1990 Size Chest Freezer CDD	- Use Factor - Age of retired unit - Pre-1990 dummy (=1 if manufactured pre-1990, else 0) - Capacity (cubic feet) of retired unit - Chest Freezer dummy (= 1 if chest freezer, else 0)		Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check
Per 1990 Free 1990 Size Chest Freezer CDD Linconditioned HDD	- Use Factor - Age of retired unit - Pre-1990 dummy (=1 if manufactured pre-1990, else 0) - Capacity (cubic feet) of retired unit - Chest Freezer dummy (=1 if chest freezer, else 0) - Cooling Degree Days (see table in refrigerator section) - If unit in unconditioned space = 1, otherwise 0. If unknown, assume - Heating Degree Days (see table in refrigerator section) - Days per year = 365 - To account for those units that are not running throughout the entire	0.67. ⁴⁴	Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar
Part Pre-1990 Size Chest Freezer CDD Unconditioned HDD Days		0.67. ⁴⁴	Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1
Age Pre-1990 Size Chest Freezer CDD Unconditioned HDD Days Part Use Factor	 Heating Degree Days (see table in refrigerator section) Event State Construction (section) Event State Construction (section) Event Freezer dummy (= 1 if chest freezer, else 0) Event Freezer dummy (= 1 if chest freezer, else 0) Event Event State Construction (section) If unit in unconditioned space = 1, otherwise 0. If unknown, assume Heating Degree Days (see table in refrigerator section) Event Event State Construction (section) Event Event For those units that are not running throughout the entire results should be used. If not available, assume 0.778.⁴⁵ 	0.67. ⁴⁴	Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1 Formatted: Font color: Background 1
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Age Pre-1990 Size Chest Freezer EDD Unconditioned HDD Pays Part Use Factor Mode approach: Fr		0.67. ⁴⁴	Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1 Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1
Age Pre-1990 Size Chest Freezer EDD Unconditioned HDD Pays Part Use Factor Mode approach: Fr	 -Use Factor - Age of retired unit - Pre-1990 dummy (=1 if manufactured pre-1990, else 0) - Capacity (cubic feet) of retired unit - Chest Freezer dummy (=1 if chest freezer, else 0) - Cooling Degree Days (see table in refrigerator section) - If unit in unconditioned space = 1, otherwise 0. If unknown, assume - Heating Degree Days (see table in refrigerator section) - Days per year = 365 - To account for those units that are not running throughout the entire results should be used. If not available, assume 0.778,⁴⁵ 	0.67. ⁴⁴	Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1 Formatted: Font color: Background 1 Formatted: Font color: Background 1, Check and grammar
Age Pre-1990 Size Chest Freezer CDD Unconditioned HDD Pays Part Use Factor Multi- med approach: Fr		0.67. ⁴⁴	Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1 Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1 Formatted: Font color: Background 1 Formatted: Font color: Background 1
Age Pre-1990 Size Chest Freezer EDD Unconditioned HDD Part Use Factor med approach: Fr Why Link UEC Rolmad	- Use Factor = Age of retired unit = Pre 1990 dummy (=1 if manufactured pre 1990, else 0) = Capacity (cubic feet) of retired unit = Chest Freezer dummy (=1 if chest freezer, else 0) = Cooling Degree Days (see table in refrigerator section) = If unit in unconditioned space = 1, otherwise 0. If unknown, assume = Heating Degree Days (see table in refrigerator section) = Days per year = 365 = To account for those units that are not running throughout the entire results should be used. If not available, assume 0.778. ¹⁵ eczers = UEC * Part Use Factor = UEC * Part Use Factor = Unit Energy Consumption of retired unit = 1061 kWh ^{4*}	0.67. ¹⁴ year. If available, Part Use Factor particip	Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1 Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar
Part Part Pre-1990 Size Chest Freezer EDD Unconditioned HDD Part Use Factor Part Use Factor med approach: Fr Whunk	 Hard Construction of the second second	0.67. ¹⁴ year. If available, Part Use Factor particip	Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1 Formatted: Font color: Background 1 Formatted: Font color: Background 1 Formatted: Font color: Background 1 Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar
Part Pre-1990 Size Pre-1990 Size Chest Freezer CDD Unconditioned HDD Part Use Factor med approach: Fr Whunt Cree: UEC Retired Part Use Factor	 Here a start and a start of the start of the	0.67. ¹⁴ year. If available, Part Use Factor particip	Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check
Age Pre-1990 Size Chest Freezer CDD Unconditioned HDD Pary Part Use Factor med approach: Fr Vh _{Unit} Ere: UECReined	 Hard Construction of the second second	0.67. ¹⁴ year. If available, Part Use Factor particip	Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1 Formatted: Font color: Background 1 Formatted: Font color: Background 1 Formatted: Font color: Background 1 Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar Formatted: Font color: Background 1, Check and grammar

⁴⁴Coefficients provided in May 13, 2016, Cadmus evaluation report; Ameren Missouri Refrigerator Recycling Impact and Process Evaluation: PY2015, https://www.efis.psc.mo.gov/Document/Display/13810, page 21,
 ⁴⁴Ameren Missouri Appliance Recycling Impact and Process Evaluation: PY2019, <u>https://www.efis.psc.mo.gov/Document/Display/15877.</u>
 ⁴⁵Ameren Missouri Appliance Recycling Impact and Process Evaluation: PY2019, <u>https://www.efis.psc.mo.gov/Document/Display/15877.</u>
 ⁴⁵Ameren Missouri Appliance Recycling Impact and Process Evaluation: PY2019, <u>https://www.efis.psc.mo.gov/Document/Display/15877.</u>
 ⁴⁶Ameren Missouri Appliance Recycling Impact and Process Evaluation: PY2019, <u>https://www.efis.psc.mo.gov/Document/Display/15877.</u>
 ⁴⁶Ameren Missouri Appliance Recycling Impact and Process Evaluation: PY2019, <u>https://www.efis.psc.mo.gov/Document/Display/15877.</u>
 ⁴⁶Ameren Missouri Appliance Recycling Impact and Process Evaluation: PY2019, <u>https://www.efis.psc.mo.gov/Document/Display/15877.</u>
 ⁴⁶Ameren Missouri Appliance Recycling Impact and Process Evaluation: PY2019, <u>https://www.efis.psc.mo.gov/Document/Display/15877.</u>
 ⁴⁶Ameren Missouri Applicance Recycling PY2015, <u>https://www.efis.psc.mo.gov/Document/Display/15877.</u>

page 21. ¹⁷ Ameren Missouri Appliance Recycling Impact and Process Evaluation: PY2019, https://www.efis.psc.mo.gov/Document/Display/15877.

<u>2025 MEEIA <u>4</u> 2019 21 Plan</u>

Revision <u>8</u>7.0

Ameren Missouri			Appendix I - TRM – Vol. 3:	Residential Measures	Formatted: Font: (Default) Arial, 12 pt
Summer Coineident F	Peak Demand Savings				Formatted: Normal
$\Delta kW = \Delta kW h_{unit} *$	CE				Formatted: Font color: Background 1
$\frac{\Delta k W_{\text{Unit}}}{\Delta k}$	Wh_{Unic} * CF				Formatted: Indent: Left: 0"
				+	Formatted: Normal, Indent: Left: 0.5"
Where:					
AkWh _{unit}	 Savings provided in algorithms Summer peak coincidence 				
<u>CF</u>	- Summer peak concluence Refrigerators = 0.00		ergy (kwii) lactor		Formatted: Font color: Background 1
	Freezers = 0.00012	285253			
					Formatted: Font color: Background 1, Check spelling and grammar
Natural Gas Savings					
Δ Therms = Δ kWh _{LIB}	* WUEsUestCas * 0.02/	412 AThomas = AlsWhere	* WHFeHeatGas* 0.03412		
$\Delta Herms = \Delta KWH_{UR}$	nit * whreneutous * 0.034	TI⊿IIICIIIS -∆KWII⊔nii	* WHFeffeatGas* 0.03412		Formatted: Indent: Left: 0"
Where:					Tomatea indent Eff. 0
AkWh _{Unit}			ot including the AkWh _{WasteHeat}		
WHFeHeatGas	= Waste Heat Factor for End = - (HF / ηHeat _{Gas}) * %GasH		ing increase from removing waste heat fro	n refrigerator/freezer	Formatted: Font color: Background 1, Check spelling
	 (HF / (Heat_{Gas}) · %Oasr If unknown, assume 0	neat			and grammar
<u>HF</u>	= Heating Factor or percenta		hat must now be heated		Formatted: Font color: Background 1, Check spelling
	= 58% for unit in heated spa = 0% for unit in heated spac				and grammar
nHeat _{Gas}	= Efficiency of heating syste				Formatted: Font color: Background 1, Check spelling
0/ Castlast	$= 71\%^{20}$				and grammar
%GasHeat 0.03412	= Percentage of homes with = Converts kWh to therms	gas near - see table below.			Formatted: Font color: Background 1, Check spelling
					and grammar
		Heating Fuel Electric	%GasHeat		Formatted: Font color: Background 1, Check spelling
		Gas			and grammar
		Unknown	65%²¹	•	Formatted: Font color: Background 1, Check spelling and grammar
Water Impact Descrip	ptions and Calculation				Formatted: Font color: Background 1
I/A					Formatted: Font color: Background 1
Deemed O&M Cost /	Adjustment Calculation				Formatted: Font color: Background 1
V/A	. .			\ \	Formatted Table
Measure Code:					Formatted: Font color: Background 1
Heusure Code.					Formatted: Fort color. Background 1
*Based on Ameren Misso		ial Refrigeration and Freezer F	nd Use Ameren Missouri TRM Volume I - Ar	pendix G: "Table 1	Formatted: Font color: Background 1
Residential End Use Categ	gory Monthly Shapes and Coincide	ent Peak Factors"	nd Use <u>Ameren Missouri TRM Volume I Ar</u>	pendix G: "Table I_	Formatted: Font color: Background 1
Residential End Use Categ ⁹ Based on 212 days wher ⁹ This has been estimated	gory Monthly Shapes and Coincide re HDD-65>0, divided by 365.25. I assuming that natural gas central	ent Peak Factors" furnace heating is typical for !	- Aissouri residences. The predominant heating i	gas furnace with 48% of	Formatted: Font color, Background 1
Residential End Use Categ ¹⁹ Based on 212 days wher ¹⁹ This has been estimated Missouri homes (based on	gory Monthly Shapes and Coincide re HDD 65>0, divided by 365.25. I assuming that natural gas central 1 Energy Information Administratio	ent Peak Factors" furnace heating is typical for P on, 2009 Residential Energy C	Aissouri residences. The predominant heating i onsumption Survey). In 2000, 29% of furnaces	gas furnace with 48% of purchased in Missouri were	Formatted: Font color: Background 1
Residential End Use Categ ¹⁹ Based on 212 days wher ²⁰ This has been estimated Missouri homes (based on condensing (based on data	gory Monthly Shapes and Coincide re HDD 65>0, divided by 365.25. Lassuming that natural gas central I Energy Information Administration 1 from GAMA, provided to Depart	ent Peak Factors" furnace heating is typical for 1 on, 2009 Residential Energy C tment of Energy during the fed	- Aissouri residences. The predominant heating i	gas furnace with 48% of purchased in Missouri were ing equipment see Furnace	Formatted: Font color: Background 1
Residential End Use Categ ¹⁰ Based on 212 days wher ²⁰ This has been estimated Missouri homes (based on condensing (based on data Penetration.xls). Furnaces	gory Monthly Shapes and Coincide re HDD 65>0, divided by 365-254 lassuming that natural gas central tenergy Information Administration from GAMA, provided to Depart tend to last up to 20 years, so unit densing and non-condensing furm	ent Peak Factors" furnace heating is typical for 1 on, 2009 Residential Energy C urnent of Energy during the fed ts purchased 16 years ago prov	Aissouri residences. The predominant heating i onsumption Survey). In 2000, 29% of furnaces eral standard setting process for residential hea	gas furnace with 48% of purchased in Missouri were ing equipment — see Furnace rances in the state. Assuming	Formatted: Font color: Background 1

<u>2025</u>MEEIA <u>4 2019 21 Plan</u>

Revision <u>8</u>7.0

Ameren Missouri		Appendix I - TRM – Vol. 3:	Residential Measures	Formatted: Font: (Default) Arial, 12 pt
				Formatted: Normal
3.1.2 Air Purifier/Cleaner				
DESCRIPTION				
An air purifier (cleaner) meeting the efficiency	specifications of ENERGY STAR® is p	purchased and installed in place of a	model meeting the current	
èderal standard.				
THIS MEASURE WAS DEVELOPED TO BE APPI	LICABLE TO THE FOLLOWING PROGRA	M TYPES: _TOS AND, NC.	4	Formatted: Heading 4
F APPLIED TO OTHER PROGRAM TYPES, THI	E MEASURE SAVINGS SHOULD BE VERI	FIED.		
DEFINITION OF EFFICIENT EQUIPMENT				
	rifier meeting the efficiency specificati			Formatted: Normal
1. Must produce a minimum 50 <u>30</u> Clean			sectication.	
2Minimum Performance Requirement:				
 Standby Powerand it shall be greater to perform secondary consumer function 	han or equal to the Minimum Smoke C s (e.g., clock, remote control) must mee	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		Formatted: List Paragraph,TT - List Paragraph, Space Before: 5 pt, After: 6 pt, Bulleted + Level: 1 + Aligned
perform secondary consumer function	CADP Pange	CADR/W		at: 0.25" + Indent at: 0.5"
	-30 ≤ Smoke CADR < 100	1.90		
	<u>100 ≤ Smoke CADR < 150</u>	2.40		
	$\frac{150 \leq \text{Smoke CADR} \leq 200}{200 \leq 5}$	<u>2.90</u>		
	200 ≤ Smoke CADR	<u>2.90</u>		
 <u>Partial On Mode² Requirements are</u> <u>UL Safety Requirement: Models that</u> 	to be calculated as per Section 3.4.1 of (emit ozone as a byproduct of air cleanir		<u></u>	Formatted: List Paragraph,TT - List Paragraph, Space
exceed 50ppb)			F	Before: 5 pt, After: 6 pt, Bulleted + Level: 1 + Aligne
DEFINITION OF BASELINE EQUIPMENT				at: 0.25" + Indent at: 0.5"
Fhe baseline equipment is assumed to be a	conventional unit.²⁴²⁵ that does not m	eet ENERGY STAR Efficiency Re	quirements. ²⁶	Formatted: Normal (Web)
DEEMED LIFETIME OF EFFICIENT EQUIPME	NT			
he measure life is assumed to be 9 years. ²⁷			4	Formatted: Normal
EEMED MEASURE COST				
'he incremental cost for this measure is \$70.24	dependent on the Air Purifier size in C.	ADR of Smoke. ²⁹	4	Formatted: Normal
		Average		
Product	Size Minimum ENERG	rage V STAD		Formette de Forste (Defende) Timere Neue Domon
router	CADR/W ENERG	<u>+ Cost (\$)</u> Non IO IO ³⁰		Formatted: Font: (Default) Times New Roman
² Measured according to the latest ANSI/AHAM AC-1	(AC-1) Standard https://ahamverifide.org/wp-co	ntent/uploads/2020/06/Air Cleaner Perforn	nance FAQs.pdf.; 'Air Cleaner	
<u>erformance_FAQs.pdf²</u> <u>2-ENERGY_STAR® Product Specification_for Room A</u>				
ttps://www.energystar.gov/sites/default/files/asset/docu 2022%29.pdf.; *ENERGY STAR Version 2.0 Room A			ation%20%28Rev.%20May%2	
As defined as the average of non ENERGY STAR® p	roducts found in EPA research, 2011, ENERGY	STAR [®] Qualified Room Air Cleaner Calcu		
As defined in ENERGY STAR v.2.0 Room Air Clean ENERGY STAR® Product Specification for Room A	ir Cleaners Eligibility Criteria Version 2.0,			
ttps://www.energystar.gov/sites/default/files/asset/docu 2022%29.pdf.; ENERGY STAR Version 2.0 Room A	ment/ENERGY%20STAR%20Version%202.09		ation%20%28Rev.%20May%2	
ENERGY STAR [®] Qualified Room Air Cleaner Calcu			STAR Appliance	Formatted: Normal
'alculator.xlsx'. ³ Ameren Missouri MEEIA 2016-18 TRM, January 1, 2				
⁹ <u>ENERGY STAR V2 Room Air Cleaners Data Packag</u> ⁹ <u>IQ Incremental costs factor in the assumption that a se</u>				
he secondhand market. See "IQ Appliance Calculation				
<u>:025</u> MEEIA <u>4 2019-21</u> Plan	Revision <u>8</u> 7.0		Page 13	
<u>2025</u> MEEIA <u>4 2019-21 -</u> Plan	Revision <u>8</u> 7.0		Page 13	

			Арре		<u>wi – vol. 3. itesi</u>	dential Measures	Formatted: Font: (Default) Arial, 12 pt
				i .	1		Formatted: Normal
	$\frac{30 \leq \text{Smoke CADR} < 100}{100 \leq 0}$	<u>1.9</u>	<u>\$82.49</u>	<u>\$8.44</u>	<u>\$20.78</u>		Formatted: Font: (Default) Times New Roman
	$\frac{100 \leq \text{Smoke CADR} < 150}{150 \leq \text{Smoke CADR} < 200}$	2.4 2.9	<u>\$140.43</u> \$349.00	\$22.33 \$92.34	<u>\$42.01</u> \$135.12		Formatted: Font: (Default) Times New Roman
	$\frac{1.50 \times \text{Smoke CADR} \times 200}{200 < \text{Smoke CADR}}$	2.9	<u>\$264.49</u>	<u>\$92.34</u> \$44.50	<u>\$133.12</u> <u>\$81.17</u>		Formatted: Font: (Default) Times New Roman
	200 _ BINOKE CHIDA	2.7	<u>4201.17</u>	<u> </u>	<u> 401.17</u>		Formatted: Font: (Default) Times New Roman
Loadshape HVAC RES							
CALCULATION OF SA	ATNOS	Algorit	thm				
ELECTRIC ENERGY S		1/Eff)			× (24 Um))	× 265 /1000 + JCD	
Energy Savu	$rgs (kWh_{Year}) = \{CADR \times (1/Eff_B)\}$	$\frac{1}{E} = \frac{1}{E} \int \frac{1}{ES}$	$+ \times (HT_{oper}) + (3B)$	вь — звез)	$\times (24 - HT_{oper})$	× 365/1000 * <i>1</i>3K	
	<u>AkWh = (kWh_base - kWh_eff) * IS</u>	<u>R</u>					
kWh_base		wkeCADR_p	er_watt_base * 100)())+			
	(8760 - hours) * PartialOnModePow	er_base / 1000))) * IQAdj				
kWh_eff	= (hours * (SmokeCADR_eff / (Smo		<u>_watt_eff * 1000))</u>	+			
	(8760 hours) * PartialOnModePow	<u>er_eff / 1000)</u>					
Where:							Formatted: Normal, Space After: 6 pt
kWh_base	= Annual Electrical	Usage for bas	eline unit (kWh)				
kWh_eff	= Annual Electrical	Usage for effi	icient unit (kWh)				
hours	= Annual active ope	erating hours					
	= 5840³²						
SmokeCADR	base = Smoke CADR for	baseline unit	s, as provided in ta	ble below			
SmokeCADR			watt for baseline u	nits, as			
	provided in table						
PartialOnMod	ePower_base = Partial On Model (watts), as provid			tory			
1000	· · · · · · · · ·						
<u>1000</u>	= Conversion factor					e	
<u>IQAdj</u>	= Baseline consump who would have util			articipants to	account for a porti	on of participants	
	= 1.25 if IO, 1.0 if n						
SmokeCADR							
BHIOKECADK				Jow			
			provided in table be				
Cm-1CADD		nvery rate per	watt for efficient u				
SmokeCADR		1	provided in table be				

en Missouri			Append	IXI-IRIVI	- vol. 3: Reside	ntial Measures	<u> </u>	ormatted: Font: (Default) Arial, 12 pt
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PartialOnModePower_		or efficient units b	y categor	ž				
	(watts)							
	Actual, if unknown use va	lues provided in t	able below	¥				
ISR	= In service rate. Actual, or i	f unknown, 948%	,34					
ter assumptions for unit	s by CADR Range: ³⁵							
		= Clean air	Smoke	Partial			lr	nserted Cells
		recovery rate	CADR	<u>On</u> Mode			Ir	nserted Cells
	CADR <u>Range</u>	for dustSmoke	per	Mode Bower			F	ormatted: Centered, Widow/Orphan control
	Eff _{BL}	CADR	Watt	(watts)		<pre></pre>	S	plit Cells
		= Clean air reco	very rate f	for dust per		•	F	ormatted: Font: Calibri, Bold, Font color: White
		watt for baselin	e unit <mark>Bas</mark>	eline Units			F	ormatted: Centered, Widow/Orphan control
		= Clean air recovery rate					_	· · ·
		for dust per						
	Eff_{ES} <u>30 \leq Smoke CADR $<$ 100</u>	watt for ENERGY	<u>1.64</u>	<u></u> ≩		•	lr	nserted Cells
		STAR® unit					Ir	nserted Cells
		<u>83.3</u>					F	ormatted: Centered, Widow/Orphan control
	Hr. 100 < Smoke CADR <	= Hours per					_	
	HT _{oper} 100 S SMOKE CADK < 150	day of operation	<u>1.83</u>	길		•	F	ormatted: Centered, Widow/Orphan control
		127.6						
	SBBL150 ≤ Smoke CADR ←	= Standby for		-		+	F	ormatted: Centered, Widow/Orphan control
	<u>200</u>	baseline unit 175.2	<u>1.94</u>	길			<u> </u>	
		= Standby for						
	SBES200 ≤ Smoke CADR	ENERGY	<u>1.89</u>	고		•	F	ormatted: Centered, Widow/Orphan control
		STAR [®] -unit 292.9		_			Ċ	
	365_		ient Units			•	F	ormatted: Centered, Widow/Orphan control
		= Conversion					\sim	ormatted: Centered, Space After: 0 pt, Line spa
	1,000 <u>30 ≤ Smoke CADR < 100</u>	factor	<u>2.9</u>	<u>0.478</u>				ingle, Keep lines together
	100 < Smoke CADR < 150	(Wh/kWh) <u>83.3</u> 127.6	4.08	0.325			F	ormatted Table
	150 ≤ Smoke CADR < 200	175.2	4.47	0.562		-/	Ir	nserted Cells
	200 ≤ Smoke CADR	292.9	5.05	0.638				nserted Cells

 ²⁴ PY2018 participant survey Ameren Missouri PY2018 Efficient Products Evaluation Report, https://www.efis.psc.mo.gov/Document/Display/15869, page 1-7.
 ³⁶ Baseline values are consistent with ENERGY STAR v.2.0 Room Air Cleaners Data Package and analysis. See file: 'ICF EPA AirPurifier Summary Savings Calculations 043021.stxsICF EPA AirPurifier Summary Savings Calculations.sks:'. Efficient values are averages within each CADR range for all models on the ENERGY STAR Qualified products list (QPL accessed: Echrary 18, 2021). Both Baseline & Efficienct Capacities (CADR) are also sourced from the ENERGY STAR QPL. For Final Savings Calculations 06152021.stxx'. IL TRM v12.0. https://www.ikag.info/wp-content/uploads/IL_ TRM Effective 010124 v12.0 Vol 3 Res 09222023 FINAL clean.pdf, page 8.

<u>2025</u>MEEIA <u>4 2019-21</u> Plan

Revision <u>8</u>7.0

Page 15

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meren Missour	ri	Appendix I - TRM – Vol. 3: Residential Measur	Formatted: Font: (Default) Arial, 12 pt
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	B _{ES} 0.391		
ł	SR 94%		
LADIER COLICID	ENT PEAK DEMAND SAVINGS		
UMMER COINCID	ENT FEAK DEMAND SAVINGS		
$\Delta kW = \Delta kV$	Wh * CF		
571			
<u>Vhere:</u>			
AkWh CF	Electric energy savings, as calculated above. Summer peak coincidence demand (kW) to annu	al energy (kWh) factor $\Delta kW = \Delta kWh * CF$	
<u>er</u>	= Summer peak concretence demand (k w) to annu	$\frac{dl \text{energy} (k W l) lactor}{\Delta k W} = \Delta k W l * C P$	Formatted: Indent: First line: 0.5", Space After: 0
	<u>= 0.0004660805</u> Where:		
AkWh	- Gross customer annual kWh savings for the meas	ure	Formatted: Indent: Left: 1", First line: 0.5"
CF	= 0.0004660805		
ATURAL GAS SAV	VINCS		
₩A			
VATER IMPACT D ₩A	ESCRIPTIONS AND CALCULATION		
	ST ADJUSTMENT CALCULATION ion and maintenance cost adjustments for this measure. ³		
	uir cleaners require filter replacement or periodic cleaning, but this is	likely to be true for both efficient and baseline units and so no difference in cost is	
ⁱ -Some types of room a ssumed.	ur cleaners require filter replacement or periodic cleaning, but this is	likely to be true for both efficient and baseline units and so no difference in cost is	

Ameren Missouri	Appendix I - TRM – Vol. 3: Residential	Measures Formatted: Font: (Default) Arial, 12 pt
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3.1.3 Clothes Dryer		
Description		
This measure relates to the installation of a dryers save energy through a combination of r increased insulation, modifying operating cor booster fans, and improving efficiency of mot	residential clothes dryer meeting the ENERGY STAR [®] criteria. ENERGY STAR [®] quali nore efficient drying and reduced runtime of the drying cycle. More efficient drying is achie aditions such as air flow and/or heat input rate, improving air circulation through better dru ors. Reducing the runtime of dryers through automatic termination by temperature and mois reducing energy use in clothes dryers. ²⁷ ENERGY STAR [®] provides criteria for both gas	eved through 1m design or sture sensors
This measure was developed to be applicable	to the following program types: TOS and NC.	
If applied to other program types, the measur	e savings should be verified.	
DEFINITION OF EFFICIENT EQUIPMENT Clothes dryer must meet the ENERGY STAF	2 [®] criteria, as required by the program.	
DEFINITION OF BASELINE EQUIPMENT The baseline condition is a clothes dryer mee	ting the minimum federal requirements for units manufactured on or after January 1, 2015	.
DEEMED LIFETIME OF EFFICIENT EQUIPM The expected measure life is assumed to be 1		
DEEMED MEASURE COST	+ yours.	Formatted: Normal
DEEMED WEASURE COST		
	Dryer Size Incremental Cost ^{an} Standard \$75	Formatted Table
	Compact \$105	
LOADSHAPE Miscellaneous RES		
	Algorithm	
CALCULATION OF SAVINGS		
ELECTRIC ENERGY SAVINGS		
<u>AkWh = (Load/(CEFbase)</u>	<u>(Load)/CEFeff) * Neycles * % Electric</u>	
	$\Delta kWh = \left(\frac{Load}{CEFbase} - \frac{Load}{CEFeff}\right) * Ncycles * % Electric$	Formatted: Normal, Space Before: 0 pt
Where:	$\frac{dKWR}{CEFbase} = \frac{CEFeff}{CEFeff} + \frac{Keftles}{Keftles} + K$	
	eight (lbs) of clothes per drying cycle. If dryer size is unknown, assume standard.	
	Drver Size Load (lbs)**	Formatted Table
	Standard 8.45	
²⁷ -ENERGY STAR [®] -Market & Industry Scoping Report http://www.energystar.gov/ia/products/downloads/ENE	t. Residential Clothes Dryers. Table 8. November 2011. RGY_STAR_Scoping_Report_Residential_Clothes_Dryers.pdf;	Field Code Changed
<u>*ENERGY_STAR_Scoping_Report_Residential_Cloth</u> ³⁸ Based on an average estimated range of 12-16 years.	es_Dryers.pdf". ENERGY STAR [®] Market & Industry Scoping Report. Residential Clothes Dryers. November 2011.	
http://www.energystar.gov/ia/products/downloads/ENE LCC Chapter, 2011, as recommended in Navigant 'Cor	RGY_STAR_Scoping_Report_Residential_Clothes_Dryers.pdf Based on DOE Rulemaking Technical Suppo nEd Effective Useful Life Research Report, 'ComEd Effective Useful Life Research Report.pdf'', May 2018.	·····
calculator.xlsx; 'energy star appliance calculator.xlsx'.	for ENERGY STAR [®] Qualified Appliances. <u>https://dnr.mo.gov/sites/dnr/files/media/file/2021/01/energy-star</u> _https://www.energystar.gov/sites/default/files/asset/document/appliance_calculator.xlsx	
	anna an anna ta an	Field Code Changed
** Based on ENERGY STAR* test procedures. https://	www.energystar.gov/index.cfm?c=clothesdry.pr_crit_clothes_dryers	

			Appendix I	-11XIVI = VOI. C	3: Residential N		Formatted: Font: (Default) Arial, 12 pt
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		Co	mpact	3			
EFbase	= Combined energy factor (CEF) (lbs/l factor and adjusted to CEF as performed)			0			
	electric. standard.	a in the ENERGY of		n product class ui	iknown, assume		
	Pr (oduct Class	CEFbase			4	Formatted Table
	Vented Electric, Star	(=)	3.11				
	Vented Electric, Con	1 1 1	3.01				
	Vented Electric, Con	1 ()(2.73				
	Ventless Electric, Co	mpact (240V) (<4.4					
	Vented Gas	04	2.84 ⁴²				
	Electric Heat Pump,		<u>3.11</u> 2.01				
	Electric Heat Pump,	$\overline{\text{compact}(120 \text{ v})}(<$	<u>3.01</u>				
EFeff	= CEF (lbs/kWh) of the ENERGY ST/	\ R[®] unit based on E	NERGY STAR® o	r ENERGY STAI	R [®] -Most		
		<u>E</u>	NERCY STAR	<u>Most Efficien</u>	t		Formatted: Font: (Default) Times New Roman
	Product Class		CEF (lbs/kWh)	Most Efficien CEF (lbs/kWl	<u>±</u> <u>±</u>		Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman
	Product Class Vented or Ventess Electric, Standard Vented or Ventess Electric, Compac	= d (≥ 4.4 ft ³)	CEF (lbs/kWh) <u>3.93</u>	Most Efficien CEF (lbs/kWl 4.3 4.3	<u>±</u>		
	Vented or Ventless Electric, Compac	= <u>d (≥ 4.4 ft²)</u> tt (120V) (< 4.4	CEF (lbs/kWh) <u>3.93</u> <u>3.80</u>	<u>4.3</u>	<u>€</u> ₩		Formatted: Font: (Default) Times New Roman
		$\frac{1}{(\geq 4.4 \text{ ft}^3)}$ $\frac{1}{(120V) (< 4.4}$ $\frac{4.4 \text{ ft}^3)}{(\geq 4.4 \text{ ft}^3)}$	CEF (lbs/kWh) <u>3.93</u>				Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman
	Vented or Ventless Electric, Compact Vented Electric, Compact (240V) (<	$\frac{1}{(\geq 4.4 \text{ ft}^3)}$ $\frac{1}{(120V)(<4.4)}$ $\frac{4.4 \text{ ft}^3)}{(\leq 4.4 \text{ ft}^3)}$	<u>CEF (lbs/kWh)</u> <u>3.93</u> <u>3.80</u> <u>3.45</u>	<u>4.3</u> <u>4.3</u>			Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman
	<u>Vented or Ventless Electric, Compact</u> <u>Vented Electric, Compact (240V) (<</u> <u>Ventless Electric, Compact (240V) (</u>	$\frac{1}{(\geq 4.4 \text{ ft}^3)}$ $\frac{1}{(120V)(<4.4)}$ $\frac{4.4 \text{ ft}^3)}{(\leq 4.4 \text{ ft}^3)}$	CEF-(lbs/kWh) <u>3.93</u> <u>3.80</u> <u>3.45</u> <u>2.68</u>	43 43 43 37			Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman
i cycles	<u>Vented or Ventless Electric, Compac</u> <u>Vented Electric, Compact (240V) (<</u> <u>Ventless Electric, Compact (240V) (</u> <u>Vented Gas</u>	$\frac{1}{4(\frac{2}{2}4.4 \text{ ft}^{3})}{\frac{1}{2}(\frac{1}{2}0V)(<4.4)}$ $\frac{4.4 \text{ ft}^{3}}{<4.4 \text{ ft}^{3})}$	CEF (lbs/kWh) <u>3.93</u> <u>3.80</u> <u>3.45</u> <u>2.68</u> <u>3.48</u> ⁴⁴	4.3 4.3 3.7 3.8			Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman
leyclos 6 Electric	<u>Vented or Ventless Electric, Compact</u> <u>Vented Electric, Compact (240V) (<</u> <u>Ventless Electric, Compact (240V) (</u>	$\frac{1}{(2 + 4 + R^{2})} + \frac{1}{(2 + 4 + R^{2})} + \frac{1}$	CEF (lbs/kWh) <u>3.93</u> <u>3.80</u> <u>3.45</u> <u>2.68</u> <u>3.48</u> ⁴⁴	4.3 4.3 3.7 3.8			Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman
	Vented or Ventless Electric, Compact Vented Electric, Compact (240V) (< Ventless Electric, Compact (240V) (Vented Gas – Number of dryer cycles per year. Use	$\frac{1}{(24.4 \text{ ft}^2)}$ $\frac{1}{(120V)(<4.4)}$ $\frac{4.4 \text{ ft}^2}{(4.4 \text{ ft}^2)}$ $\frac{2}{(4.4 \text{ ft}^2)}$ $\frac{1}{(2000)}$ $\frac{1}{(2000)}$	CEF (lbs/kWh) <u>3.93</u> <u>3.80</u> <u>3.45</u> <u>2.68</u> <u>3.48</u> ⁴⁴	4.3 4.3 3.7 3.8	3)		Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman
6Electric	Vented or Ventless Electric, Compact Vented Electric, Compact (240V) (Ventless Electris, 5% for gas	$\frac{1}{(24.4 \text{ ft}^2)}$ $\frac{1}{(120V)(<4.4)}$ $\frac{4.4 \text{ ft}^2}{(4.4 \text{ ft}^2)}$ $\frac{2}{(4.4 \text{ ft}^2)}$ $\frac{1}{(2000)}$ $\frac{1}{(2000)}$	CEF (lbs/kWh) 3.93 3.80 3.45 2.68 3.48 ⁴⁴	4.3 4.3 3.7 3.8	3)		Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman
	Vented or Ventless Electric, Compact Vented Electric, Compact (240V) (Ventless Electris, 5% for gas	$\frac{1}{(24.4 \text{ ft}^2)}$ $\frac{1}{(120V)(<4.4)}$ $\frac{4.4 \text{ ft}^2}{(4.4 \text{ ft}^2)}$ $\frac{2}{(4.4 \text{ ft}^2)}$ $\frac{1}{(2000)}$ $\frac{1}{(2000)}$	CEF (lbs/kWh) 3.93 3.80 3.45 2.68 3.48 ⁴⁴	4.3 4.3 3.7 3.8	- year. ⁴⁵		Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman
6Electric	Vented or Ventless Electric, Compact Vented Electric, Compact (240V) (Ventless Electris, 5% for gas	$\frac{1}{(24.4 \text{ ft}^2)}$ $\frac{1}{(120V)(<4.4)}$ $\frac{4.4 \text{ ft}^2}{(4.4 \text{ ft}^2)}$ $\frac{2}{(4.4 \text{ ft}^2)}$ $\frac{1}{(2000)}$ $\frac{1}{(2000)}$	CEF (lbs/kWh) 3.93 3.80 3.45 2.68 3.48 ⁴⁴	4.3 4.3 3.7 3.8	3)		Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman
éÉlectric	Vented or Ventless Electric, Compact Vented Electric, Compact (240V) (Ventless Electric, Compact (240V) ($\frac{1}{4} \left(\geq 4.4 \text{ ft}^{2} \right)$ $\frac{1}{(120V) (< 4.4}$ $\frac{4.4 \text{ ft}^{2}}{(< 4.4 \text{ ft}^{2})}$ $= \text{actual data if availuity}$ g from electricity dryers ⁴⁶	CEF (lbs/kWh) 3.93 3.80 3.45 2.68 3.48 ⁴⁴	4.3 4.3 3.7 3.8	3)) 		Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman
6 Électric lefaults provid	Vented or Ventless Electric, Compact Vented Electric, Compact (240V) (Ventless Electric, Compact (240V) (Vented Gas - Number of dryer cycles per year. Use = The percent of overall savings comin = 100% for electric dryers, 5% for gas- ed above: -2 Version 1.0 Clothes Dryers Data and Analysis;	$\frac{1}{(24.4 \text{ ft}^2)}$ $\frac{1}{(20V)(<4.4)}$ $\frac{4.4 \text{ ft}^2}{(4.4 \text{ ft}^2)}$ $\frac{(4.4 \text{ ft}^2)}{(4.4 \text{ ft}^2)}$ $\frac{(4.4 \text{ ft}^2)}{(4.4 \text{ ft}^2)}$	CEF (Ibs/kWb) <u>3.93</u> <u>3.80</u> <u>2.45</u> <u>2.68</u> <u>3.48⁴⁴</u> able. If unknown, t	4.3 4.3 3.7 3.8 3.8 3.8			Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman
6 Électric lefaults provid GY STAR® Draf www.energystar.gc Y STAR Draft 2	Vented or Ventless Electric, Compact Vented Electric, Compact (240V) (Ventless Electric, Compact (240V) (Ventless Electric, Compact (240V) (Vented Gas = Number of dryer cycles per year. Ust = The percent of overall savings comin = 100% for electric dryers, 5% for gas ed above:	= d (≥ 4.4 ft ²) (< (20V) (< 4.4 <u>4.4 ft²)</u> < <u>4.4 ft²)</u> e actual data if availu g from electricity dryers ⁴⁶ 20Draft% 202% 20Versio k _	CEF (1bs/kWk) <u>3.93</u> <u>3.80</u> <u>2.45</u> <u>2.68</u> <u>3.48⁴⁴</u> able. If unknown, w	4.3 4.3 3.7 3.8 3.8 use 283 cycles per		<u>X:</u>	Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman
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6Électrie lefaults provié GY STAR [®] Draf www.energystar.ge Y STAR [®] Clott Istandards repor GY STAR [®] Clott	Vented or Ventless Electric, Compact Vented Electric, Compact (240V) (Vented Electric, Compact (240V) (Vented Electric, Compact (240V) (Vented Gas = Number of dryer cycles per year. Use = The percent of overall savings comin = 100% for electric dryers, 5% for gas ied above:	20Draft% 202% 20Versio x (120V) (< 4.4 4.4 ft ²) < 4.4 ft ²) < 4.4 ft ²) < 4.4 ft ²) < actual data if availt ug from electricity dryers ⁴⁶ 20Draft% 202% 20Versio x - 2 o determine gas savings og star gov/index.cfm?c o determine gas savings og the Energy Consumpt the savings on gas dryers- hy ENERGY STAR® D	CEF (Ibs/kWb) 3.93 3.80 2.45 2.68 3.48 ⁴⁴ able. If unknown, u able. If unknown, u able. If unknown, u able. If unknown, u is later et clothesdry.pr_crit_clot dis number is later et clothesdry.pr_crit_clot dis number is later et clothesdry.pr_crit_clot dis number is later et clothesdry.pr_crit_clot	4.3 4.3 3.7 3.7 3.8 3.8 3.8 3.8 3.7 3.7 3.7 3.7 3.8 3.7 3.7 3.8 3.7 3.7 3.8 3.7 3.7 3.8 3.7 3.7 3.7 3.8 3.7 3.7 3.7 3.7 3.7 3.7 3.7 3.7 3.7 3.7	20and%20Analysis.xl 20/Appendix D.; 'Titl 2.), Five percent for ga Analysis, Value repor	2 10 Part 430 s dryers was	Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman
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					Formatted: Normal
	Product Class	AkWh			
	Product Class Vented Electric, Standard (> 4.4 ft ²)	145.7	-	-	Formatted Table
	Vented Electric, Standard (2 111 H)	53.8	_		
	Vented Electric, Compact (1207) (<4.4 ft ³)	58.9	_		
	$\frac{\text{Ventless Electric, Compact (240V) (<4.4 ft2)}}{\text{Ventless Electric, Compact (240V) (<4.4 ft2)}}$	74.3	-		
	Vented Gas	7.0	-		
IMMER COINCIDEN	TPEAK DEMAND SAVINGS	7.0			
$\Delta kW = \Delta kWh$					
$\Delta K W = \Delta K W H$	AkW = AkWh * CF				Formatted: Indent: Left: 0.5"
Where:					
AkWh	= Energy Savings as calculated above				
CF	= Summer peak coincidence demand (kW) to annual energy (kW = 0.0001148238	/h) factor			
Jsing defaults provide					
ising dolutio provide		A 1-XX/			
	Product Class	4kW 0.0251		4	Formatted Table
	Vented Electric, Standard (\geq 4.4 ft ³)	0.0251 0.0092			
	Vented Electric, Compact (120V) (< 4.4 ft ³)	0.0092 0.0101			
	Vented Electric, Compact $(240V)$ (<4.4 ft ³)				
	Ventless Electric, Compact (240V) (<4.4 ft ²) Vented Gas	0.0128 0.0012	-		
	Venteu Gas	0.0012			
NATURAL GAS ENER	CY SAVINGS				
	GY SAVINGS ily apply to ENERGY STAR [®] vented gas clothes dryers.				
		vert * %Gas			
Natural gas savings or	ily apply to ENERGY STAR [®] vented gas clothes dryers.	vert * %Gas			
Natural gas savings or	ily apply to ENERGY STAR [®] vented gas clothes dryers.	vert * % Gas			
Natural gas savings or	ily apply to ENERGY STAR [®] vented gas clothes dryers.	vert * %Gas			
Natural gas savings or	ily apply to ENERGY STAR [®] vented gas clothes dryers. <u>= (Load/(CEFbase) (Load)/CEFeff) * Neycles * Therm_con</u>				
latural gas savings or	ily apply to ENERGY STAR [®] vented gas clothes dryers. <u>= (Load/(CEFbase) (Load)/CEFeff) * Neycles * Therm_con</u>		* %Gas		
Vatural gas savings or ATherm	ily apply to ENERGY STAR [®] vented gas clothes dryers.		* %Gas		
Natural gas savings or	ily apply to ENERGY STAR [®] vented gas clothes dryers. <u>= (Load/(CEFbase) (Load)/CEFeff) * Neycles * Therm_con</u>		* %Gas		
Vatural gas savings or ATherm	Hy apply to ENERGY STAR [®] vented gas clothes dryers. = (Load/(CEFbase) (Load)/CEFeff) * Neycles * Therm_con $\Delta Therm = \left(\frac{Load}{CEFbase} - \frac{Load}{CEFeff}\right) * Neycles * Therm_con$ = Conversion factor from kWh to therm		* %Gas		
Natural gas savings or MTherm Where: Therm_convert	Hy apply to ENERGY STAR [®] vented gas clothes dryers. = (Load/(CEFbase) (Load)/CEFeff) * Neycles * Therm_con $\Delta Therm = \left(\frac{Load}{CEFbase} - \frac{Load}{CEFeff}\right) * Neycles * Therm_con + CEFbase + CEFeff$		* %Gas		
Natural gas savings or NTherm Where:	$\frac{dy apply to ENERGY STAR* vented gas clothes dryers.}{= (Load/(CEFbase) - (Load)/CEFeff) * Neycles * Therm_con}$ $\Delta Therm = \left(\frac{Load}{CEFbase} - \frac{Load}{CEFbase}\right) * Neycles + \frac{Load}{CEFbase} + Loa$		* %Gas		
Natural gas savings or NTherm Where: Therm_convert	Hy apply to ENERGY STAR [®] vented gas clothes dryers. = (Load/(CEFbase) (Load)/CEFeff) * Neycles * Therm_con $\Delta Therm = \left(\frac{Load}{CEFbase} - \frac{Load}{CEFeff}\right) * Neycles * Therm_con + CEFbase + CEFeff$		* %Gas		
Natural gas savings or NTherm Where: Therm_convert	aly apply to ENERGY STAR* vented gas clothes dryers. = (Load/(CEFbase) (Load)/CEFeff) * Neycles * Therm_con $\Delta Therm = \left(\frac{Load}{CEFbase} - \frac{Load}{CEFbase}\right) * Neycles * Therm_con = Conversion factor from kWh to therm = 0.03413 = Percent of overall savings coming from gas = 0.05413$		* %Gas		
Natural gas savings or ATherm Where: Therm_convert %Gas	aly apply to ENERGY STAR* vented gas clothes dryers. = (Load/(CEFbase) (Load)/CEFeff) * Neycles * Therm_con $\Delta Therm = \left(\frac{Load}{CEFbase} - \frac{Load}{CEFbase}\right) * Neycles * Therm_con = Conversion factor from kWh to therm = 0.03413 = Percent of overall savings coming from gas = 0.05413$		* %Gas		
Natural gas savings or ATherm Where: Therm_convert % Gas Jsing defaults provide	uly apply to ENERGY STAR [®] vented gas clothes dryers. <u>= (Load/(CEFbase) (Load)/CEFeff) * Neycles * Therm_con</u> Δ <i>Therm</i> = $\left(\frac{Load}{CEFbase} - \frac{Load}{CEFbase}\right)$ * Neycles 4 <u>= Conversion factor from kWh to therm</u> <u>= 0.03413</u> <u>= Percent of overall savings coming from gas</u> <u>= 0% for electric units and 84% for gas units</u> ⁴¹ <u>-</u> d above:		* %Gas		
Natural gas savings or ATherm Where: Therm_convert % Gas Jsing defaults provide	uly apply to ENERGY STAR [®] vented gas clothes dryers. = (Load/(CEFbase) (Load)/CEFeff) * Neycles * Therm_con ΔTherm = $\left(\frac{Load}{CEFbase} - \frac{Load}{CEFeff}\right)$ * Neycles * = Conversion factor from kWh to therm = 0.03413 = Percent of overall savings coming from gas = Ow for electric units and 84% for gas units ⁴⁷ - st above: = (8.45/2.84 - 8.45/3.48) * 257 * 0.03413 * 0.84		* %6as		
Natural gas savings or ATherm Where: Therm_convert % Gas Jsing defaults provide	uly apply to ENERGY STAR [®] vented gas clothes dryers. = (Load/(CEFbase) (Load)/CEFeff) * Neycles * Therm_con ΔTherm = $\left(\frac{Load}{CEFbase} - \frac{Load}{CEFeff}\right)$ * Neycles * = Conversion factor from kWh to therm = 0.03413 = Percent of overall savings coming from gas = Ow for electric units and 84% for gas units ⁴⁷ - st above: = (8.45/2.84 - 8.45/3.48) * 257 * 0.03413 * 0.84		* %6as		
Natural gas savings or MTherm Where: Therm_convert %Gas Using defaults provide ATherm	ely apply to ENERGY STAR* vented gas clothes dryers. = (Load/(CEFbase) (Load)/CEFeff) * Neycles * Therm_con $\Delta Therm = \left(\frac{Load}{CEFbase} - \frac{Load}{CEFbase}\right) * Neycles * Therm_con = Conversion factor from kWh to therm = 0.03413 = Percent of overall savings coming from gas = 0% for electric units and 84% for gas units*2$	► Therm_convert			
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Natural gas savings or ATherm Where: Therm_convert %Gas Using defaults provide ATherm ² Zero-percent for gas drys ratio of the sav to total se	ely apply to ENERGY STAR* vented gas clothes dryers. = (Load/(CEFbase) (Load)/CEFeff) * Neycles * Therm_con $\Delta Therm = \left(\frac{Load}{CEFbase} - \frac{Load}{CEFbase}\right) * Neycles * Therm_con = Conversion factor from kWh to therm = 0.03413 = Percent of overall savings coming from gas = 0% for electric units and 84% for gas units*2$	← <i>Therm_conver</i>	etc.). Eighty four percent was dete		

Ameren Missouri	Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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Water Impact Descriptions and Calculation N/A		
DEEMED O&M COST ADJUSTMENT CALCULATION N/A		
Maxima Copp.		

<u>2025 MEEIA 4 2019-21 Plan</u>

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Revision <u>8</u>7.0

Ameren Missouri	Appendix I - TRM – Vo	ol. 3: Residential Measures	(Formatted: Font: (Default) Arial, 12 pt
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3.1.4 Clothes Washer				
DESCRIPTION				
This measure relates to the installation of a clothes washer meeting the ENERGY ST/				
2), or CEE Tier 3Advanced Tier minimum qualifications. If the Domestic Hot Water				
example through a retail program), savings are based on a weighted blend using RECS	S data (the resultant values (kV	Wh, therms and gallons of water)		
are provided). The algorithms can also be used to calculate site-specific savings when	re DHW and dryer fuels are kr	own.		
This measure was developed to be applicable to the following program types: TOS ar	nd NC.			
If applied to other program types, the measure savings should be verified.				

DEFINITION OF EFFICIENT EOUPMENT

Clothes washer must meet the ENERGY STAR* (CEE Tier1), ENERGY STAR* Most Efficient (CEE Tier 2), or CEE Advanced Tier 3 minimum qualifications (provided in the table below), as

DEFINITION OF BASELINE EQUIPMENT

The baseline condition is a standard sized clothes washer meeting the minimum federal baseline as of January 2018.⁴⁸

Efficiency Level	Top Loading >2.5 Cu <u>ft</u>	Front Loading >2.5 Cu ft
Federal Standard	<u>≥1.57 IMEF, ≤6.5 IWF</u>	<u>≥1.84 IMEF, ≤4.7 IWF</u>
ENERGY STAR®	<u>≥2.06 IMEF, ≤4.3 IWF</u>	<u>≥2.76 IMEF, ≤3.2 IWF</u>
ENERGY STAR [®] Most Efficient/CEE Tier 2	<u>≥2.92 IM</u>	EF, <u>≤</u>3.2 IWF
CEE Advanced Tier	<u>≥3.1 IMI</u>	3F, ≤3.0 IWF

eline condition is a standard sized clothes washer meeting the minimum federal baseline as of March 2015.49 The h

	Efficiency Level	Top loading >2.5 Cu ft	Front Loading >2.5 Cu ft
Baseline	Federal Standard	<u>≥1.29 IMEF, ≤8.4 IWF</u>	<u>≥1.84 IMEF, ≤4.7 IWF</u>
	ENERGY STAR®, CEE Tier 1	<u>≥2.06 IMEF, ≤4.3 IWF</u>	<u>≥2.38 IMEF, ≤3.7 IWF</u>
Efficient	ENERGY STAR [®] Most Efficient, CEE Tier 2	<u>≥2.76 IMEF, ≤3.5 IWF</u>	<u>≥2.74 IMEF, ≤3.2 IWF</u>
	CEE Tier 3	<u>≥2.92 IM</u>	£ F, ≤3.2 IWF

The Integrated Modified Energy Factor (IMEF) includes unit operation, standby, water heating, and drying energy use, with the higher the value the more efficient the unit: "The quotient of the cubic foot (or liter) capacity of the clothes container divided by the total clothes washer energy consumption per cycle, with such energy consumption expressed as the sum of the machine electrical energy consumption, the hot water energy consumption, the energy required for removal of the remaining moisture in the wash load, and the combined low-power mode energy consumption."

The Integrated Water Factor (IWF) indicates the total water consumption of the unit, with the lower the value the less water required: "The quotient of the total weighted per cycle water consumption for all 67 wash cycles in gallons divided by the cubic foot (or liter) capacity of the clothes washer."50

DEEMED LIFETIME OF EFFICIENT EQUIPMENT

The expected measure life is assumed to be 14 years.5

48 DOE Energy Conservation Standards for Clothes Washers, Appliance and Equipment Standard, 10 CFR Part 430.32(g), https://www.ecfr.gov/current/title-10/chapter-

H/subchapter D/part 430/subpart C/section 430.32 ⁴⁰See http://www.l.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/39. ⁴⁰Definitions provided in ENERGY STAR[®] v7.1 specification on the ENERGY STAR[®] websiter. https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Version%208.1%20Clothes%20Washer%20Final%20Specification%20-2005 %20Partner%20Commitments%20and%20Eligibility%20Criteria.pdf.: ENERGY STAR Version 8.1 Clothes Washer Final Specification – Partner Commitments and Eligibility

energy-conservation standards for residential clothes washers.

<u>2025 MEEIA 4 2019-21 Plan</u>

Revision 87.0

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	assumptions are provided below: 5233		
	Ffficiency Level	Incremental Cost	4
	ENERGY STAR [®] ENERGY STAR [®] , CEE Tier 1	\$8732	Formatted Table
	ENERGY STAR® Most Efficient/CEE Tier		
	2ENERGY STAR® Most Efficient, CEE TIER 2	\$ <u>85</u> 393	
	CEE Advanced TierCEE TIER 3	\$ <u>99</u> 454	
.OADSHAPE Aiscellaneous RES			
	Algorithm		
CALCULATION OF SA			
CLECTRIC ENERGY S	AVINGS		
wwh = [(C [(Cap	apacity * 1/IMEFbase * Neycles) * (%CWbase + (%DHWbr acity * 1/IMEFeff * Neycles) * (%CWeff + (%DHWeff * %		
			Formatted: Normal
.kWh = [(Capacit ;	y * ¹ IMEFbase * Ncycles) * (%CWbase + (%DHWbase *	· %Electric_{onw}) + (%Dryerbase * %El	(Formatted: Indent: Left: 0"
$\left(\frac{Capacity}{F} * \frac{4}{F}\right)$	$\frac{1}{f} + Ncycles + (%CWeff + (%DHWeff + %Electric_{D})$	gpw) + (%Dryereff * %Electric_{Dryer}))]	
Vhere:			Formatted: Normal, Space After: 12 pt
	- Clothes washer capacity (cubic feet)		
	- Actual – If capacity is unknown, assume 3.45 cubic feet ⁵⁴ - Integrated Modified Energy Factor of baseline unit		
	- Integrated Modified Energy Factor of efficient unit		
	- Actual. If unknown, assume average values provided below.		
	= Number of Cycles per year = 271⁵⁵		
	= Percentage of total energy consumption for Clothes Washer opera	ation (different for baseline and efficient unit—se	e table below)
	- Percentage of total energy consumption used for water heating (d	lifferent for baseline and efficient unit — see table	below)
	 Percentage of total energy consumption for dryer operation (diffe 	erent for baseline and efficient unit see table belo	ow)
	 Percentage of DHW savings assumed to be electric Percentage of dryer savings assumed to be electric 		
Cost estimates are based	on analysis of cost data provided in the 2017 Department of Energy Tech	nical Support Document (see 'IL TRM_CW Analysis_	<u>042022.xlsx'). This</u>
	ntal cost and market data from the CEC Appliance Database and attempts		
	es a mix of top and front loading machines available in each efficiency tie or these machines, the T2 incremental cost is lower than ENERGY STAR.		
	age of top loading and front loading units (based on available product from	n the California Energy Commission (CEC) Appliance	database
states of the second second lines			
Vasher Analysis.xls" for d	thes washer volume of all units that pass the new federal standard on the (08/28/2014). If utilities
Vasher Analysis.xls" for d ⁴ Based on the average clo			
Vasher Analysis.xls" for d ⁴ Based on the average clo ave specific evaluation re	sults providing a more appropriate assumption for homes in a particular m	arket or geographical area, then they should be used. Imption Survey (RECS) national sample survey of how	sing appliances section.
Vasher Analysis.xls" for é ⁴ Based on the average clo ave specific evaluation re ⁵ Weighted average of 27 Aidwest Census Region fo	sults providing a more appropriate assumption for homes in a particular m I clothes washer cycles per year (based on 2009 Residential Energy Consu r state of Missouri): <u>http://www.eia.gov/consumption/residential/data/200</u>	Imption Survey (RECS) national sample survey of house 19/2. See <u>1</u> 2015 Clothes Washer Analysis.xls <u>x</u> ² for detailed and the same set of	Field Code Changed
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				Front						
		Efficiency Level To	n loading H	oading >2.5						
			2.5 Cu ft	<u>Cu</u>						
				<u>Heighted</u>						
			1 201 57	Average**						
	ł	Federal Standard	1.29 <u>1.57</u>	<u>1.84</u> 1.66						
			Percentage	of Total Ener	gy Consumpti	on ⁵⁷		- Eo	rmatted Table	
			% CW	%DH₩	*** ***	F				
	Federal Standard		<u>6.7%</u> 8%	<u>15.8%</u> 319	77.5% 61	%				
	ENERGY STAR [®] , CE	E Tier 1	<u>6.6%</u> 8%	13.0% 239	<u>80.4%</u> 69	%				
	ENERGY STAR® Mos	st Efficient, CEE Tier	2 <u>8.2%</u> 14%	<u>8.8%</u> 10%	<u>82.9%</u> 76	%				
	CEE Advanced TierCE	EE Tier 3	<u>8.9%</u> 14%	<u>7.0%</u> 10%	<u>84.1%</u> 76	%				
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	ļ	Electric)0%						
	-	Natural Gas)%						
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	ult assumptions provided above, the	Natural Gas Unknown	90)%) %⁵⁹ guration are pr	esented below:	0				
	• •	Natural Gas Unknown	90)% ⁵⁹	esented below:	0		Fo	rmatted Table	
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		Electric DHW Electric Dryer	Gas DHW	Electric DHW Gas Drver	Gas DHW Gas Drver		
	ENERGY STAR [®] , CEE Tier 1	149.3	97.0	77.0	24.8		
	ENERGY STAR [®] Most Efficient, CEE Tier 2	222.1	132.6	117.1	27.5		
	CEE Tier 3	243.1	374.4	230.5	42.0		
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igineu /ive	rage.			****			
		Electric DHW	Gas DHW	Electric DHW	Gas DHW		Formatted Table
		Electric Dryer	Electric Drye	F Gas Dryer	Gas Dryer		
	ENERGY STAR®, CEE Tier 1	149.3	70.6	88.0	9.4		
	ENERGY STAR [®] Most Efficient, CEE Tier 2	222.1	<u>80.9</u>	137.5	3.7		
	CEE Tier 3	243.1	98. 4	143.2	-1.5		
ne DHW au	d dryer fuel is unknown, the prescriptive kWH savi	ings based on de	efaults provided	above should be	:		
	,,,		-	ALWH			Formatted Table
	Efficiency Level				Weighted	-	
		Front L		- Loaders	Average		
	ENERGY STAR®, CEE Tier 1	112		89.6	99.0		
	ENERGY STAR [®] Most Efficient, CEE Tier 2 CEE Tier 3	161 424		136.6 154.8	134.3 151.8		
		•					
	ncident Peak Demand Savings <u>- AkWh * CF</u>						
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ALW Intere: ARWA CF AKWA CF ing the defe ing the defe	<u>- AkWh * CF</u> <u>- Electric energy savings, as calculated al</u> <u>- Summer peak coincidence demand (kW</u> <u>- 0.0001148238</u> AkW = AkWh + CF <u>- Energy Savings as calculated above</u> <u>- Summer peak coincidence factor for mer</u> <u>- 0.0001148238</u> <u></u> ult assumptions provided above, the prescriptive saving <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u>	7) to annual ener asure vings for each c Electric DHW Gleetric Dryer 0.022 0.033	onfiguration are Cas DHW Electric Dryer 0.008 0.013	Presented below Electric DHW Gas-Dryer 0.015 0.020	Z Gas DHW Gas Dryer 0.000 -0.001	۹ 	Formatted: Indent: Left: 0°, First line: 0°
ALW ere: <u>ARWF</u> CF Mere: <u>ARWF</u> CF ing the defe	<u>- AkWh * CF</u> <u>= Electric energy savings, as calculated al</u> <u>= Summer peak coincidence demand (kW</u> <u>- 0.0001148238</u> <u>- AkWh * CF</u> <u>= Energy Savings as calculated above</u> <u>- Summer peak coincidence factor for mer</u> <u>- 0.0001148238</u> <u>- ult assumptions provided above, the prescriptive saving</u> <u>ENERGY STAR*, CEE Tier 1</u> <u>ENERGY STAR*, CEE Tier 1</u> <u>ENERGY STAR* Most Efficient, CEE Tier 2</u>	7) to annual ener asure vings for each c Electric DHW Gleetric Dryer 0.022 0.033	onfiguration are Cas DHW Electric Dryer 0.008 0.013	Presented below Electric DHW Gas-Dryer 0.015 0.020	Z Gas DHW Gas Dryer 0.000 -0.001	•	Formatted: Indent: Left: 0°, First line: 0°
AkW here: <u>AkWh</u> CF AkWh CF	<u>- AkWh * CF</u> <u>= Electric energy savings, as calculated al</u> <u>= Summer peak coincidence demand (kW</u> <u>- 0.0001148238</u> <u>- AkWh * CF</u> <u>= Energy Savings as calculated above</u> <u>- Summer peak coincidence factor for mer</u> <u>- 0.0001148238</u> <u>- ult assumptions provided above, the prescriptive saving</u> <u>ENERGY STAR*, CEE Tier 1</u> <u>ENERGY STAR*, CEE Tier 1</u> <u>ENERGY STAR* Most Efficient, CEE Tier 2</u>	7) to annual ener asure vings for each c Electric DHW Gleetric Dryer 0.022 0.033	onfiguration are Cas DHW Electric Dryer 0.008 0.013	Presented below Electric DHW Gas-Dryer 0.015 0.020	Z Gas DHW Gas Dryer 0.000 -0.001	•	Formatted: Indent: Left: 0°, First line: 0°
ALW ere: <u>ARW</u> <u>CF</u> ere: <u>ARW</u> CF ng the defe nt Loaders	<u>- AkWh * CF</u> <u>= Electric energy savings, as calculated al</u> <u>= Summer peak coincidence demand (kW</u> <u>- 0.0001148238</u> <u>- AkWh * CF</u> <u>= Energy Savings as calculated above</u> <u>- Summer peak coincidence factor for mer</u> <u>- 0.0001148238</u> <u>- ult assumptions provided above, the prescriptive saving</u> <u>ENERGY STAR*, CEE Tier 1</u> <u>ENERGY STAR*, CEE Tier 1</u> <u>ENERGY STAR* Most Efficient, CEE Tier 2</u>	7) to annual ener asure vings for each c Electric DHW Gleetric Dryer 0.022 0.033	onfiguration are Cas DHW Electric Dryer 0.008 0.013	Presented below Electric DHW Gas-Dryer 0.015 0.020	Z Gas DHW Gas Dryer 0.000 -0.001	•	Formatted: Indent: Left: 0°, First line: 0°
ALW ere: <u>ALW</u> CF ere: <u>ALW</u> CF ng the defe nt Loaders	<u>- AkWh * CF</u> <u>= Electric energy savings, as calculated al</u> <u>= Summer peak coincidence demand (kW</u> <u>- 0.0001148238</u> <u>- AkWh * CF</u> <u>= Energy Savings as calculated above</u> <u>- Summer peak coincidence factor for mer</u> <u>- 0.0001148238</u> <u>- ult assumptions provided above, the prescriptive saving</u> <u>ENERGY STAR*, CEE Tier 1</u> <u>ENERGY STAR*, CEE Tier 1</u> <u>ENERGY STAR* Most Efficient, CEE Tier 2</u>	7) to annual ener asure vings for each c Electric DHW Gleetric Dryer 0.022 0.033	onfiguration are Cas DHW Electric Dryer 0.008 0.013	Presented below Electric DHW Gas-Dryer 0.015 0.020	Z Gas DHW Gas Dryer 0.000 -0.001	•	Formatted: Indent: Left: 0°, First line: 0°

	ouri		Appendi	<u>ix I - TRM – Vc</u>	DI. 3: Resident	al measures.	Formatted: Font: (Default) Arial, 12	2 pt
							Formatted: Normal	
			A	«W		•	Formatted Table	
		Electric DHW	Gas DHW	Electric DHW	Cas DHW			
_		Electric Dryer	Electric Dryer	Gas Dryer	Gas Dryer			
	NERGY STAR [®] , CEE Tier 1	0.022	0.015	0.012	0.004			
	NERGY STAR [®] Most Efficient, CEE Tier 2 EE Tier 3	0.033 0.037	0.020 0.056	0.018 0.035	0.004 0.006			
C.	EE HCI 3	0.037	0.030	0.055	0.000	1		
ighted Avera	ige:							
	-		A	₩]	Formatted Table	
		Electric DHW	Gas DHW	Electric DHW	Gas DHW			
17	NERGY STAR [®] . CEE Tier 1	Electric Dryer	Electric Dryer	Gas Dryer	Cas Dryer			
	NERGY STAR [®] , CEE Her I NERGY STAR [®] Most Efficient, CEE Tier 2	0.022	0.011	0.013	0.001			
	EE Tier 3	0.033	0.012	0.021	0.001	1		
<u> </u>						4		
e DHW and	dryer fuel is unknown, the prescriptive kW savi	ings should be:						
			A	₩		•	Formatted Table	
	Efficiency Level	Front Lo	adona Ton J	-oaders 4	Veighted			
			-	4	Average			
	ENERGY STAR [®] , CEE Tier 1	2 0.02		017 024	0.015			
	ENERGY STAR [®] -Most Efficient, CEE Tier 2 CEE Tier 3	2 0.02		024 064	0.020			
	CLL HOLD	0.02	5 0.	00-	0.025			
	<mark>∏(Capacity* 1/IMEFbase * Ncycles) * ((%DH\</mark> <u>* Ncycles) * ((%DHW * %Gas_{DHW} * %Gas_{DHW}</u>					<u>y * 1/IMEFeff</u> <		ng: 1"
:	* Neycles) * ((%DHW * %Gas _{phw} * %Gas _{phw}	<u>* R__{eff})+ (%Dry</u>	ereff * %Gas _{Dryer}))]] * Therm_cor	wert	<u>y * 1/IMEFeff</u> ◄	Formatted: Indent: Left: 0", Hangi	ng: 1"
<u> AThern</u>	$\frac{* \text{Neycles}) * ((\% \text{DHW} * \% \text{Gas}_{\text{DHW}} * \% \text{Gas}_{\text{DHW}}}{\text{ns} = \left[\left[(Capacity * \frac{1}{IMEEbase} * Neycles) * ((\% \text{Capacity}) * ($	<u>** R__{eff})+ (%D</u> ry	ereff * %Gas _{Dryer} %Natural Gas _D	$\frac{2}{2} + \frac{2}{2} + \frac{2}$	wert %Dryerbase *	•		ng: 1"
<u> AThern</u>	$\frac{* \text{Neycles}) * ((\% \text{DHW} * \% \text{Gas}_{\text{DHW}} * \% \text{Gas}_{\text{DHW}}}{\text{ns} = \left[\left[(Capacity * \frac{1}{IMEEbase} * Neycles) * ((\% \text{Capacity}) * ($	<u>** R__{eff})+ (%D</u> ry	ereff * %Gas _{Dryer} %Natural Gas _D	$\frac{2}{2} + \frac{2}{2} + \frac{2}$	wert %Dryerbase *	•		ng: 1"
<u> ATherm</u>	$\frac{* \text{Neycles} * ((\%\text{DHW} * \%\text{Gas}_{\text{DHW}} * \%\text{Gas}_{\text{DHW}}}{as} = \left[\left[(Capacity * \frac{1}{IMEEbase} * Ncycles) * ((\frac{1}{3}) + \frac{1}{IMEEbase} + \frac{1}{IMEb$	<u>v * R__{eff})+ (%Dry</u> (%DHWbase + vcles) + ((%DH	ereff * %Gas _{Dryer} %Natural Gas _D	$\frac{2}{2} + \frac{2}{2} + \frac{2}$	wert %Dryerbase *	•		ng: 1"
<u> ATherm</u>	$\frac{* \text{Neycles} * ((\%\text{DHW} * \%\text{Gas}_{\text{DHW}} * \%\text{Gas}_{\text{DHW}}}{as} = \left[\left[(Capacity * \frac{1}{IMEEbase} * Ncycles) * ((\frac{1}{3}) + \frac{1}{IMEEbase} + \frac{1}{IMEb$	<u>v * R__{eff})+ (%Dry</u> (%DHWbase + vcles) + ((%DH	ereff * %Gas _{Dryer} %Natural Gas _D	$\frac{2}{2} + \frac{2}{2} + \frac{2}$	wert %Dryerbase *	•		ng: 1"
<u> ATherm</u>	$\frac{* \text{Neycles}) * ((\% \text{DHW} * \% \text{Gas}_{\text{DHW}} * \% \text{Gas}_{\text{DHW}}}{\text{ns} = \left[\left[(Capacity * \frac{1}{IMEEbase} * Neycles) * ((\% \text{Capacity}) * ($	<u>v * R__{eff})+ (%Dry</u> (%DHWbase + vcles) + ((%DH	ereff * %Gas _{Dryer} %Natural Gas _D	$\frac{2}{2} + \frac{2}{2} + \frac{2}$	wert %Dryerbase *	•		ng: 1"
<u>ATherm</u>	$\frac{* \text{Neycles} * ((\%\text{DHW} * \%\text{Gas}_{\text{DHW}} * \%\text{Gas}_{\text{DHW}}}{as} = \left[\left[(Capacity * \frac{1}{IMEEbase} * Ncycles) * ((\frac{1}{3}) + \frac{1}{IMEEbase} + \frac{1}{IMEb$	<u>v * R__{eff})+ (%Dry</u> (%DHWbase + vcles) + ((%DH	ereff * %Gas _{Dryer} %Natural Gas _D	$\frac{2}{2} + \frac{2}{2} + \frac{2}$	wert %Dryerbase *	•		ng: 1"
<u> ATherm</u>	$\frac{* \text{Neycles} * ((\%\text{DHW} * \%\text{Gas}_{\text{DHW}} * \%\text{Gas}_{\text{DHW}}}{as} = \left[\left[(Capacity * \frac{1}{IMEEbase} * Ncycles) * ((\frac{1}{3}) + \frac{1}{IMEEbase} + \frac{1}{IMEb$	<u>**R__{ett})+ (%Dry</u> (%DHW base +_ veles) * ((%DH mvert	ereff * % Gas_{Dver} %Natural Gas _D W _{eff} + %Gas _D	$\frac{2}{2} + \frac{2}{2} + \frac{2}$	wert %Dryerbase *	•		ng: 1"
<u>AThern</u>	* Neycles) * ((%DHW * %Gas _{DHW} * %Gas _{DHW} ns = [[(Capacity + ¹ / _{IMEFbase} * Ncycles) * ((%Gas _{Dryer}))] - [(Capacity + ¹ / _{IMEFeff} * Ncy (%Dryereff * %Gas _{Dryer}))]] * Therm_co = Percentage of DHW savings assumed = Recovery efficiency factor	<u>**R__{ett})+ (%Dry</u> (%DHW base +_ veles) * ((%DH mvert	ereff * % Gas_{Dver} %Natural Gas _D W _{eff} + %Gas _D	$\frac{2}{2} + \frac{2}{2} + \frac{2}$	wert %Dryerbase *	•		ng: 1"
<u>∆Thern</u> wre: *Gas _{pinw} R _{wr}	$\frac{* \text{Neycles} * ((\%\text{DHW} * \%\text{Gas}_{\text{DHW}} * \%\text{Gas}_{\text{DHW}} * \%\text{Gas}_{\text{DHW}} * \%\text{Gas}_{\text{DHW}} * \text{Gas}_{\text{DHW}} * \text{Meycles} * ((\%\text{Gas}_{\text{Dryser}}))] = [(Capacity * \frac{1}{HEFeff} * Neycles) * ((\%\text{Dryereff} * \%\text{Gas}_{Dryser}))]] * Therm_color = Percentage of DHW savings assumed = Recovery efficiency factor = 1.26^{64}$	u <u>* R_{ell})+ (%Dry</u> (%DHWbase + reles) + ((%DH mvert to be <u>n</u> Natural g	ereff * % Gas_{Dres} %Natural Gas _D W _{eff} + %Gas _D Gas	$\frac{2}{2} + \frac{2}{2} + \frac{2}$	wert %Dryerbase *	•		ng: 1"
<u>∆Thern</u> Nere: [%] Gas _{DHW} R _{eff} [%] Gas _{Diyer}	* Neycles) * ((%DHW * %Gas _{DHW} * %Gas _{DHW} ns = [[(Capacity + 1 (%Gas _{Dryer}))] = [(Capacity + 1 (%Dryereff * %Gas _{Dryer}))]] * Therm_co (%Dryereff * %Gas _{Dryer}))]] * Therm_co = Percentage of DHW savings assumed = Recovery efficiency factor = 1.26 ⁴⁴ = Percentage of dryer savings assumed	<u>u[*] R_{elt})+ (%Dry</u> (%DHW base + reles) + ((%DH mvert -to be <u>n</u> Natural ge to be <u>n</u> Natural ge	ereff * % Gas_{Dres} %Natural Gas _D W _{eff} + %Gas _D Gas	$\frac{2}{2} + \frac{2}{2} + \frac{2}$	wert %Dryerbase *	•		ng: 1"
<u>∆Thern</u> wre: *Gas _{pinw} R _{wr}	* Neycles) * ((%DHW * %Gas _{DHW} * %Gas _{DHW} ns = [[(Capacity + 1 (%Gas _{Dryer}))] = [(Capacity + 1 (%Dryereff * %Gas _{Dryer}))]] * Therm_co (%Dryereff * %Gas _{Dryer}))]] * Therm_co = Percentage of DHW savings assumed = Recovery efficiency factor = 1.26 ⁴⁴ = Percentage of dryer savings assumed	<u>u[*] R_{elt})+ (%Dry</u> (%DHW base + reles) + ((%DH mvert -to be <u>n</u> Natural ge to be <u>n</u> Natural ge	ereff * % Gas_{Dres} %Natural Gas _D W _{eff} + %Gas _D Gas	$\frac{2}{2} + \frac{2}{2} + \frac{2}$	wert %Dryerbase *	•		ng: 1"
<u>∆Thern</u> were: %Gas _{puw} R _{uff} %Gas_{puyer} Therm_co	$\frac{* \text{Neycles} * ((\%\text{DHW} * \%\text{Gas}_{\text{DHW}} * \%\text{Gas}_{\text{DHW}} * \%\text{Gas}_{\text{DHW}}}{\text{ms}} = \left[\left[(Capacity * \frac{1}{IMEFbase} * Ncycles) * ((\%\text{Dryereff} * \%\text{Gas}_{Dryer})) \right] - \left[(Capacity * \frac{1}{IMEFeff} * Ncycles) * ((\%\text{Dryereff} * \%\text{Gas}_{Dryer})) \right] \right] * Therm_co$ $= \text{Percentage of DHW savings assumed}$ $= \text{Recovery efficiency factor}$ $= 1.26^{64}$ $= \text{Percentage of dryer savings assumed}$ $= \text{Conversion factor from kWh to therm}$ $= 0.03412$	<u>u[*] R_{elt})+ (%Dry</u> (%DHW base + reles) + ((%DH mvert -to be <u>n</u> Natural ge to be <u>n</u> Natural ge	ereff * % Gas_{Dres} %Natural Gas _D W _{eff} + %Gas _D Gas	$\frac{2}{2} + \frac{2}{2} + \frac{2}$	wert %Dryerbase *	•		ng: 1"
<u>∆Therm</u> ere: %Gas _{DHW} R _{eff} %Gas_{Diper} Therm_co	$\frac{* \text{Neycles} * ((\% \text{DHW} * \% \text{Gas}_{\text{DHW}} * \% \text{Gas}_{\text{DHW}}}{(Gapacity * \frac{1}{IMEFbase} * Ncycles) * ((} \\ \% \text{Gas}_{pryer}))] - [(Capacity * \frac{1}{IMEFeff} * Ncycles) + ((} \\ \% \text{Dryereff} * \% \text{Gas}_{pryer}))]] * Therm_co$ $= \frac{\text{Percentage of DHW savings assumed}}{= \frac{1}{2} - \frac{1}{2}$	<u>u[*] R_{elt})+ (%Dry</u> (%DHW base + reles) + ((%DH mvert -to be <u>n</u> Natural ge to be <u>n</u> Natural ge	ereff * % Gas_{Dres} %Natural Gas _D W _{eff} + %Gas _D Gas	$\frac{2}{2} + \frac{2}{2} + \frac{2}$	wert %Dryerbase *	•		ng: 1"
<u>∆Therm</u> ere: %Gas _{DHW} R _{eff} %Gas_{Diper} Therm_co	$\frac{* \text{Neycles} * ((\%\text{DHW} * \%\text{Gas}_{\text{DHW}} * \%\text{Gas}_{\text{DHW}} * \%\text{Gas}_{\text{DHW}}}{\text{ms}} = \left[\left[(Capacity * \frac{1}{IMEFbase} * Ncycles) * ((\%\text{Dryereff} * \%\text{Gas}_{Dryer})) \right] - \left[(Capacity * \frac{1}{IMEFeff} * Ncycles) * ((\%\text{Dryereff} * \%\text{Gas}_{Dryer})) \right] \right] * Therm_co$ $= \text{Percentage of DHW savings assumed}$ $= \text{Recovery efficiency factor}$ $= 1.26^{64}$ $= \text{Percentage of dryer savings assumed}$ $= \text{Conversion factor from kWh to therm}$ $= 0.03412$	<u>u[*] R_{elt})+ (%Dry</u> (%DHW base + reles) + ((%DH mvert -to be <u>n</u> Natural ge to be <u>n</u> Natural ge	ereff * % Gas_{Dres} %Natural Gas _D W _{eff} + %Gas _D Gas	$\frac{2}{2} + \frac{2}{2} + \frac{2}$	wert %Dryerbase *	•	Formatted: Normal	ng: 1"
<u>∆Therm</u> ere: %Gas _{DHW} R _{sff} %Gas_{Dhysr} Therm_co	$\frac{* \text{Neycles} * ((\%\text{DHW} * \%\text{Gas}_{\text{DHW}} * \%\text{Gas}_{\text{DHW}} * \%\text{Gas}_{\text{DHW}}}{\text{ms}} = \left[\left[(Capacity * \frac{1}{IMEFbase} * Ncycles) * ((\%\text{Dryereff} * \%\text{Gas}_{Dryer})) \right] - \left[(Capacity * \frac{1}{IMEFeff} * Ncycles) * ((\%\text{Dryereff} * \%\text{Gas}_{Dryer})) \right] \right] * Therm_co$ $= \text{Percentage of DHW savings assumed}$ $= \text{Recovery efficiency factor}$ $= 1.26^{64}$ $= \text{Percentage of dryer savings assumed}$ $= \text{Conversion factor from kWh to therm}$ $= 0.03412$	<u>u[*] R_{elt})+ (%Dry</u> (%DHW base + reles) + ((%DH mvert -to be <u>n</u> Natural ge to be <u>n</u> Natural ge	ereff * % Gas_{Dres} %Natural Gas _D W _{eff} + %Gas _D Gas	$\frac{2}{2} + \frac{2}{2} + \frac{2}$	wert %Dryerbase *	•		ng: 1"
<u>∆Therm</u> ere: %Gas _{DHW} R _{sff} %Gas_{Dhysr} Therm_co	$\frac{* \text{Neycles} * ((\% \text{DHW} * \% \text{Gas}_{\text{DHW}} * \% \text{Gas}_{\text{DHW}}}{\text{s} = \left[\left[(Capacity * \frac{1}{IMEFbase} * Ncycles \right) * ((\% \text{Capacity} * \frac{1}{IMEFeff} * Ncycles) + ((\% \text{Dryereff} * \% \text{Gas}_{Dryer})) \right] - \left[(Capacity * \frac{1}{IMEFeff} * Ncycles) + ((\% \text{Dryereff} * \% \text{Gas}_{Dryer})) \right] + Therm_colored = \text{Recovery officiency factor} = 1.26^{c4} = \text{Percentage of DHW savings assumed} + \text{Conversion factor from kWh to therm} = 0.03412$	<u>u[*] R_{elt})+ (%Dry</u> (%DHW base + reles) + ((%DH mvert -to be <u>n</u> Natural ge to be <u>n</u> Natural ge	ereff * %Gas _{Dres} %Natural Gas _B W _{eff} * %Gas _B Gas Gas Gas	$\frac{2}{2} + \frac{2}{2} + \frac{2}$	wert %Dryerbase *	•	Formatted: Normal	ng: 1"
<u>∆Thern</u> were: %Gas _{puw} R _{uff} %Gas_{puyer} Therm_co	$\frac{* \text{Neycles} * ((\% \text{DHW} * \% \text{Gas}_{\text{DHW}} * \% \text{Gas}_{\text{DHW}}}{\text{Second}} \frac{* \% \text{Gas}_{\text{DHW}} * ((\% \text{Gas}_{\text{DHW}} + \frac{1}{1\text{MEFbase}} * \text{Ncycles}) * ((\% \text{Oryereff} + \% \text{Gas}_{\text{Dryer}}))] - [(Capacity + \frac{1}{1\text{MEFeff}} + \text{Ncycles}) * ((\% \text{Dryereff} + \% \text{Gas}_{\text{Dryer}}))]] * Therm_colored = \frac{1}{10000000000000000000000000000000000$	<u>u[*] R_{elt})+ (%Dry</u> (%DHW base + reles) + ((%DH mvert -to be <u>n</u> Natural ge to be <u>n</u> Natural ge	ereff * % Gas _{Dres} %Natural Gas _D W _{EJJ} * %Gas _D Gas Gas Jas	$\frac{2}{2} + \frac{2}{2} + \frac{2}$	wert %Dryerbase *	•	Formatted: Normal	ng: 1"
<u>∆Thern</u> were: %Gas _{puw} R _{uff} %Gas_{puyer} Therm_co	$\frac{* \text{Neycles} * ((\% \text{DHW} * \% \text{Gas}_{\text{DHW}} * \% \text{Gas}_{\text{DHW}}}{\text{Second}} + \frac{1}{(MEFbase} * Ncycles) * ((% \text{Cas}_{Dryer}))] - [(Capacity * \frac{1}{(MEFeff} * Ncycles)) * ((% \text{Dryereff} * \% \text{Gas}_{Dryer}))]] * Therm_color = 0.03 \text{ Percentage of DHW savings assumed} = \frac{126^{44}}{1000000000000000000000000000000000$	<u>u[*] R_{elt})+ (%Dry</u> (%DHW base + reles) + ((%DH mvert -to be <u>n</u> Natural ge to be <u>n</u> Natural ge	ereff * % Gas _{Dres} %Natural Gas _D W _{EJJ} * %Gas _D Gas Gas Jas	$\frac{2}{2} + \frac{2}{2} + \frac{2}$	wert %Dryerbase *	•	Formatted: Normal	ng: 1"
<u>ATherm</u> Here: *Gas _{DHW} R _{eff} *Gas_{DHyse} Therm_co	* Neyeles) * ((%DHW * %Gas _{DHW} * ((%Gas _{DFyer}))] - [(Capacity + [±] / _{IMEFeff} + Ncy (%Dryereff * %Gas _{DFyer}))]] * Therm_co (%Dryereff * %Gas _{DFyer}))]] * Therm_co = Percentage of DHW savings assumed = Recovery efficiency factor = 1.26 ^{c4} = Percentage of dryer savings assumed = Conversion factor from kWh to therm = 0.03412 tors as defined above.	<u>x * R_ett</u>) + (%Dry (%DHWbase * (%DH weles) * ((%DH wwert to be <u>n</u> Natural <u>g</u> to be <u>n</u> Natural <u>g</u> fuel	ereff * % Gas _{Dres} %Natural Gas _D W _{EJJ} * %Gas _D Gas Gas Jas	}} * Therm_cor	wert % Dryerbase * G as_DHW * R_	+ <i>ff</i>)+	Formatted: Normal	ng: 1"
AThern Here: %Gas _{briv} R _{eff} %Gas _{brive} Therm_co Other fact	$\frac{* \text{Neycles} * ((\% \text{DHW} * \% \text{Gas}_{\text{DHW}} * \% \text{Gas}_{\text{DHW}}}{* (Gas}_{\text{DHW}} * ((\% \text{DHW} * \frac{1}{IMEFbase} * Ncycles) * ((\% \text{Capacity} * \frac{1}{IMEFeff} * Ncycles)) + ((\% \text{Dryereff} * \% \text{Gas}_{\text{Dryer}}))]] + Therm_color = 0$ $= \text{Percentage of DHW savings assumed} = \text{Recovery officiency factor} = 1.26^{c4}$ $= \text{Percentage of dryer savings assumed} + \text{Conversion factor from kWh to therm} = 0.03412$ tors as defined above: $\frac{\text{DHWW}}{\text{Electric}} = \frac{1}{\text{Natural Gas}} + \frac{1}{\text{Matural Gas}} + \frac{1}{\text{Matural Gas}} + \frac{1}{\text{Matural Gas}} + \frac{1}{10} + $	L [*] R _{ell})+ (%Dry (%DHWbase * (%DHWbase *	ereff * % Gas _{Dres} %Natural Gas _p W _{eff} + %Gas _p Gas Gas Jas <u>%Gasuuw</u> 0% 100%)}] * Therm_cor HW * R _{eff}) + (9 HW * %Natural (HW * %Natural (Wet %Dryerbase * Gas_DHW * R_	t ff)+	Formatted: Normal	ng: 1"
AThern Here: %Gas _{briv} R _{eff} %Gas _{brive} Therm_co Other fact	* Neyeles) * ((%DHW * %Gac _{DHW} * %Gac _{DHW} * %Gas _{DHW} and an end of the second se	L [*] R _{ell})+ (%Dry (%DHWbase * (%DHWbase *	ereff * % Gas _{Dres} %Natural Gas _p W _{eff} + %Gas _p Gas Gas Jas <u>%Gasuuw</u> 0% 100%)}] * Therm_cor HW * R _{eff}) + (9 HW * %Natural (HW * %Natural (Wet %Dryerbase * Gas_DHW * R_	t ff)+	Formatted: Normal	ng: 1"
<u>ATherm</u> were: %Gas _{Dryer} Reff %Gas_{Dryer} Therm_co Other fact	$\frac{* \text{Neycles} * ((\% \text{DHW} * \% \text{Gas}_{\text{DHW}} * \% \text{Gas}_{\text{DHW}}}{* (Gas}_{\text{DHW}} * ((\% \text{DHW} * \frac{1}{IMEFbase} * Ncycles) * ((\% \text{Capacity} * \frac{1}{IMEFeff} * Ncycles)) + ((\% \text{Dryereff} * \% \text{Gas}_{\text{Dryer}}))]] + Therm_color = 0$ $= \text{Percentage of DHW savings assumed} = \text{Recovery officiency factor} = 1.26^{c4}$ $= \text{Percentage of dryer savings assumed} + \text{Conversion factor from kWh to therm} = 0.03412$ tors as defined above: $\frac{\text{DHWW}}{\text{Electric}} = \frac{1}{\text{Natural Gas}} + \frac{1}{\text{Matural Gas}} + \frac{1}{\text{Matural Gas}} + \frac{1}{\text{Matural Gas}} + \frac{1}{10} + $	L [*] R _{ell})+ (%Dry (%DHWbase * (%DHWbase *	ereff * % Gas _{Dres} %Natural Gas _p W _{eff} + %Gas _p Gas Gas Jas <u>%Gasuuw</u> 0% 100%)}] * Therm_cor HW * R _{eff}) + (9 HW * %Natural (HW * %Natural (Wet %Dryerbase * Gas_DHW * R_	t ff)+	Formatted: Normal	ng: 1"

								tial Measure		Formatted: Font: (Default) Arial, 12 pt	
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		Unknown	Tuel	%Gas buw 57%⁶²						Formatted Table	
		UIKHOWH		3170]						
		Dryer	-fuel	%Gas _{Drve}					•	Formatted Table	
		Electric		0%							
		Natural Gas		100%							
		Unknown		10% 6252							
Using the de	efault assumptions provided above,	the preseriptive	savings for	each configuratio	m are present	ed below					
Front Loade	• •	- r-toonpare		garatic	- present						
i ioni Loade		-			AThorne					(
		_	Electric DH	W Gas DH	A I nerms V Electr	ic DHW	Gas DHW			Formatted Table	
				er Electric Di	yer Gas		Gas Dryer				
	ENERGY STAR [®] , CEE Tier 1		0.0	2.2		2.5	4.7				
	ENERGY STAR [®] Most Efficient	, CEE Tier 2	0.0	3.8		3.6	7.4	_			
	CEE Tier 3		0.0	8.1	4	1.3	19.4				
Top Loader	'8:										
1					AThorms		_			•	
			Electric DH	W Gas DH	¥ Electr	ie DHW	Gas DHW	_		Formatted Table	
			Electric Dry	er Electric Di	yer Gas	Dryer	Gas Dryer				
	ENERGY STAR [®] , CEE Tier 1		0.0	4.2		1.8	6.0				
	ENERGY STAR® Most Efficient	, CEE Tier 2	0.0	<u>5.9</u>		3.1	<u>8.9</u>	_			
	CEE Tier 3		0.0	5.9		3.6					
				0.0		5.0	9.6				
Weighted A				0.0		5.0	9.0]			
Weighted A					ATherms		9.0		4	Formatted Table	
Weighted A			Electric DH		ATherms	ie DHW	9.0 Cas DHW		•	Formatted Table	
Weighted A	tverage:		Electric DH	W Cas DH yer Electric D	ATherms W Electr Tyer Gas	'ie DHW Dryer	Gas DHW Gas Dryer		•	Formatted Table	
Weighted A	werage: ENERGY STAR [®] , CEE Tier 1	CEE Tion 2	Electric DF Electric Dr 0.0	IW. Cas DH yer Electric D 3.4	ATherms ¥ Electr yer Gas	tie DHW Dryer 2.1	Cas DHW Gas Dryer 5.5		•	Formatted Table	
Weighted A	werage: ENERGY STAR®, CEE Tier 1 ENERGY STAR® Most Efficient	, CEE Tier 2	Electric DF Electric Dr 0.0 0.0 0.0	W Cas DH yer Electric D 3.4 6.1	ATherms W Electr Yer Gas	ic DHW Dryer 2.1 2.9	Cas DHW Gas Dryer 5.5 9.0			Formatted Table	
	tverage: ENERGY STAR [®] , CEE Tier 1 ENERGY STAR [®] Most Efficient CEE Tier 3	,	Electric DF Electric Dr 0.0 0.0 0.0	W Cas DH Fleetrie D 3.4 6.1 6.2	ATherms W Electr Yer Gas	tie DHW Dryer 2.1	Cas DHW Gas Dryer 5.5			Formatted Table	
	werage: ENERGY STAR®, CEE Tier 1 ENERGY STAR® Most Efficient	,	Electric DF Electric Dr 0.0 0.0 0.0	W Cas DH Fleetrie D 3.4 6.1 6.2	ATherms W Electr Yer Gas	ic DHW Dryer 2.1 2.9	Cas DHW Gas Dryer 5.5 9.0		•	Formatted Table	
	tverage: ENERGY STAR [®] , CEE Tier 1 ENERGY STAR [®] Most Efficient CEE Tier 3	,	Electric DF Electric Dr 0.0 0.0 0.0	W Cas DH Fleetrie D 3.4 6.1 6.2	ATherms W Electr Yer Gas	ie DHW Dryer 2.1 2.9 3.4	Cas DHW Gas Dryer 5.5 9.0 9.6		•	Formatted Table Formatted: Keep with next	
	tverage: ENERGY STAR [®] , CEE Tier 1 ENERGY STAR [®] Most Efficient CEE Tier 3	,	Electric DF Electric Dr 0.0 0.0 0.0	IW Gas DH Fleetrie D 3.4 6.1 6.2 Id be:	ATherms AF Electr Yer Gas	ic DHW Dryer 2.1 2.9	Cas DHW Gas Dryer 5.5 9.0 9.6				
	ENERGY STAR [®] , CEE Tier 1 ENERGY STAR [®] Most Efficient CEE Tier 3 ⁷ and dryer fuel is unknown, the pre	scriptive therm (Electric DF Electric Dr 0.0 0.0 0.0	W Gas DH ver Electric D 3.4 6.1 6.2 Id be:	ATherms W Ekett Gas ATherms Sp Loaders	ie DHW Dryer 2.1 2.9 3.4 Weighte Averag	Cas DHW Gas Dryer 5.5 9.0 9.6			Formatted: Keep with next	
	Werage: ENERGY STAR®, CEE Tier 1 ENERGY STAR® Most Efficient CEE Tier 3 'and dryer fuel is unknown, the pre Efficiency Level ENERGY STAR®, CI	scriptive therm :	Electric DF 0.0 0.0 0.0 0.0 savings show	W Gas DH yer Electric D 3.4 6.1 6.2 Id be:	ATherms W Electr Gas ATherms op Loaders 2.52	ie DHW Dryer 2.1 2.9 3.4 Weighte Averag 2.11	Cas DHW Gas Dryer 5.5 9.0 9.6			Formatted: Keep with next Formatted Table	
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If the DHW	ENERGY STAR [®] , CEE Tier 1 ENERGY STAR [®] , Most Efficient CEE Tier 3 ⁷ and dryer fuel is unknown, the pre Efficiency Level ENERGY STAR [®] , CI ENERGY STAR [®] , CI ENERGY STAR [®] , Mo CEE Tier 3	seriptive therm (EE Tier 1 est Efficient, CE	Electric DF 0.0 0.0 0.0 0.0 savings show	Gas DH ver Electric D 3.4 6.1 6.2 6.2 Id be: 5.1 2.52 2.52	ATherms ATherms ATherms Sp-Loaders 2.52 3.60	te DHW 2.1 2.9 3.4 Weighte Average 2.11 3.71	Cas DHW Gas Dryer 5.5 9.0 9.6			Formatted: Keep with next Formatted Table Formatted: Keep with next Formatted: Keep with next Formatted: Keep with next	
If the DHW	ENERGY STAR [®] , CEE Tier 1 ENERGY STAR [®] Most Efficient CEE Tier 3 ⁷ and dryer fuel is unknown, the pre Efficiency Level ENERGY STAR [®] , CI ENERGY STAR [®] , CI	seriptive therm (EE Tier 1 est Efficient, CE	Electric DF 0.0 0.0 0.0 0.0 savings show	Gas DH ver Electric D 3.4 6.1 6.2 6.2 Id be: 5.1 2.52 2.52	ATherms ATherms ATherms Sp-Loaders 2.52 3.60	te DHW 2.1 2.9 3.4 Weighte Average 2.11 3.71	Cas DHW Gas Dryer 5.5 9.0 9.6			Formatted: Keep with next Formatted Table Formatted: Keep with next Formatted: Keep with next Formatted: Keep with next	
If the DHW WATER IM	ENERGY STAR [®] , CEE Tier 1 ENERGY STAR [®] Most Efficient CEE Tier 3 'and dryer fuel is unknown, the pre Efficiency Level ENERGY STAR [®] , CI ENERGY STAR [®] , CI ENERGY STAR [®] , MC	Seriptive therm (SE Tier 1 SE Efficient, CE STION	Electric DF 0.0 0.0 0.0 savings show E Tier 2	Gas DH ver Electric D 3.4 6.1 6.2 6.2 Id be: 5.1 2.52 2.52	ATherms ATherms ATherms Sp-Loaders 2.52 3.60	te DHW 2.1 2.9 3.4 Weighte Average 2.11 3.71	Cas DHW Gas Dryer 5.5 9.0 9.6			Formatted: Keep with next Formatted Table Formatted: Keep with next Formatted: Keep with next Formatted: Keep with next	
If the DHW	ENERGY STAR [®] , CEE Tier 1 ENERGY STAR [®] , Most Efficient CEE Tier 3 ⁷ and dryer fuel is unknown, the pre Efficiency Level ENERGY STAR [®] , CI ENERGY STAR [®] , CI ENERGY STAR [®] , Mo CEE Tier 3	Seriptive therm (SE Tier 1 SE Efficient, CE ATION - IWF _{aff}) * Never	Electric DF Electric DF 0.0 0.0 0.0 Savings show Electric DF 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	Gas DH yer Electric D 3,4 6,1 6,2 6,2 ld be:	ATherms ATherms ATherms Sp-Loaders 2.52 3.60	te DHW 2.1 2.9 3.4 Weighte Average 2.11 3.71	Cas DHW Gas Dryer 5.5 9.0 9.6			Formatted: Keep with next Formatted Table Formatted: Keep with next Formatted: Keep with next Formatted: Keep with next	
If the DHW WATER IM	ENERGY STAR®, CEE Tier 1 ENERGY STAR® Most Efficient CEE Tier 3 ⁷ and dryer fuel is unknown, the pre Efficiency Level ENERGY STAR®, CI ENERGY STAR® Mo CEE Tier 3 PACT DESCRIPTIONS AND CALCUT = Capacity * (IWFinger	Seriptive therm (SE Tier 1 SE Efficient, CE ATION - IWF _{aff}) * Never	Electric DF Electric DF 0.0 0.0 0.0 Savings show Electric DF 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	Gas DH ver Electric D 3.4 6.1 6.2 6.2 Id be: 5.1 2.52 2.52	ATherms ATherms ATherms Sp-Loaders 2.52 3.60	te DHW 2.1 2.9 3.4 Weighte Average 2.11 3.71	Cas DHW Gas Dryer 5.5 9.0 9.6			Formatted: Keep with next Formatted Table Formatted: Keep with next Formatted: Keep with next Formatted: Keep with next	
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If the DHW WATER IM AWater Where: IWFb	ENERGY STAR®, CEE Tier 1 ENERGY STAR®, Most Efficient CEE Tier 3 ' and dryer fuel is unknown, the pre Efficiency Level ENERGY STAR®, CI ENERGY STAR®, CI	Seriptive therm (SET Tier 1 SST Efficient, CE SATION -IWF _{eff}) * Neyce STION -IWF _{eff}) * Neyce tor of baseline c	Electric Dr 0.0 0.0 savings shou E Tier 2 E Tier 2 Se — IWFe lothes washe	W Gas DH Electric D 3.4 6.1 6.2 Id be: 6.2 id be: 1.51 2.52 5.66 ff) + Neycles 5.66	ATherms W Electric Gas ATherms op Londers 2.52 3.60 3.70	He DHW Dryer 2.1 2.9 3.4 Weighte Average 2.11 3.71 3.84	Cas DHW Gas Dryer 5.5 9.0 9.6 9.6			Formatted: Keep with next Formatted Table Formatted: Keep with next Formatted: Keep with next Formatted: Keep with next	
If the DHW WATER IM AWater Where: IWFb	ENERGY STAR®, CEE Tier 1 ENERGY STAR® Most Efficient CEE Tier 3 ⁷ and dryer fuel is unknown, the pre Efficiency Level ENERGY STAR®, CI ENERGY STAR® Mo CEE Tier 3 PACT DESCRIPTIONS AND CALCUT = Capacity * (IWFInner AWater (gallons) = Capaci	Seriptive therm (SETier 1 Set Efficient, CE ATION - IWF _{eff}) * Neyce ity - + (IWFba, tor of baseline e idential Energy Cor	Electric DF Electric DF 0.0 0.0 savings show E Savings show E E E E E E E E E E E E E	W Gas DH Electric D 3.4 6.1 6.2 Id be: 6.2 id be: 1.51 2.52 5.66 \$.66 5.66 \$ff) + Neyclos \$ff \$ge (RECS) 2009 for \$ff	ATherms Fleets Gas ATherms op Loaders 2.52 3.60 3.70 Midwest Region	te DHW Dryer 2.1 2.9 3.4 Weighte Average 2.11 3.71 3.84	Cas DHW Gas DHW 5.5 9.0 9.6 9.6			Formatted: Keep with next Formatted Table Formatted: Keep with next Formatted: Keep with next Formatted: Keep with next	

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Appendix I - TRM - Vol. 3: Residential Measures

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 = 5.92⁶³

 IWFeff
 = Water Factor of efficient clothes washer

 - Actual - If unknown assume successe values provided below

Other factors as defined above.

Using the default assumptions provided above, the prescriptive water savings for each efficiency level are presented below:

		1WP ^{ar}			Awater (gallons per year)			
Efficiency Level	Front	Top						
Entrency Level	Loaders	Loaders	Average	Loaders	Loaders	Average		
Federal Standard	4.7	8.4	5.92		N/A			
ENERGY STAR®, CEE Tier 1	3.7	4 .3	3.93	93 4	3,828	1,857		
ENERGY STAR® Most Efficient, CEE Tier 2	3.2	3.5	3.21	1,400	4 ,575	2,532		
CEE Tion 2	2	2	2.20	1.400	7 942	2 5 2 9		

DEEMED O&M COST ADJUSTMENT CALCULATION

MEASURE CODE:

N/A

 ⁴³ Weighted average IWF of Federal Standard rating for front loading and top loading units. Weighting is based upon the relative top vs. front loading percentage of available non-ENERGY STAR[®] products in the CEC database.
 ⁴⁴ IWF values are the weighted average of the new ENERGY STAR[®] specifications. Weighting is based upon the relative top vs. front loading percentage of available ENERGY STAR[®] and ENERGY STAR[®] Most Efficient products in the CEC database. See "2015 Clothes Washer Analysis:xls" for the calculation.

<u>2025</u>MEEIA <u>4</u> 2019-21 Plan

Revision <u>8</u>7.0

			Ар	<u>pendix I - TRM – Vol</u>	I. 3: Residential Mea	sures.	Formatted: Font: (Default) Arial, 12 pt
							Formatted: Normal
1.5 Dehumidifier							
SCRIPTION							
dehumidifier meeting the mini	mum qualifying efficiene	y standard establis	shed by the eur	rent ENERGY STAR® Ve	ersion 45.0 (effective	4	Formatted: Normal
1/2016 <u>10/31/2019) and ENER</u> ace of a unit that meets the mir			<u>ective 01/01/20</u>	<u>920) is purchased and inst</u>	talled in a residential set	ting in	
is measure was developed to t	be applicable to the follow	ving program type:	s: TOS and, N	C.			
applied to other program types	s, the measure savings sho	uld be verified.				•	Formatted: Normal
EFINITION OF EFFICIENT EQU							
qualify for this measure, the r	new dehumidifier must me	eet the ENERGY :	STAR [®] standar	ds as defined below:		4	Formatted: Normal
		Product	ENERGY	ENERGY STAR		•	Inserted Cells
	Specification	Capacity	STAR* Criteria	Most Efficient			Formatted: Line spacing: single, Widow/Orphan
	<75	(pints/day)	$\left(\frac{1}{k}\right)$	(Litteria)			control
	Portable	2.00 <u>(Pints/Day)</u> <u>≤ 25</u>	<u>(L/k₩h)</u> ≥1.57	<u>{L/kWh}</u> ≥1.70			Inserted Cells
		$\rightarrow 25$ and ≤ 50	<u>21.80</u>	<u>≥1.90</u>		•	Inserted Cells
		50 and < 155	<u>≥3.30</u>	<u>≥3.40</u>			Inserted Cells
							Inserted Cells
lifying units must <u>shall</u> be eq ole Home option for Dehur							Formatted: Font: Calibri
ENUTION OF PASELINE FOU	<u>els.</u>						control
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	Porta	ble Dehumidi	<u>fiers</u>	
<u>Capacity</u> <u>Range</u>				
(pints/day)	(pints/day)	<u>(≥ L/kWh)</u>	<u>(≥ L/kWh)</u>	<u>(≥ L/kWh)</u>
<u> 425</u>	20	<u>1.3</u>	<u>1.57</u>	<u>1.7</u>
<u>>25 and ≤50</u>	37.5	<u>1.6</u>	1.8	<u>1.9</u>
<u>>50 and</u> < <u>155</u>	<u> 102.5</u>	<u>2.8</u>	3.3	<u>3.4</u>
Average ⁷³	38.9	<u>1.54</u>	1.75	1.86

Portable Dehun	Energy Savings (ΔkWh)					
Portable Denan	Noi					
Capacity Range	Capacity Used		ENERGY STAR Most		ENERGY STAR Most	
(pints/day)	(pints/day)	<u>517411</u>	Efficient	<u>91//m</u>	Efficient	
<u> 425</u>	<u>20</u>	<u>115</u>	<u>157</u>	179	<u>221</u>	
<u>>25 and ≤50</u>	37.5	<u>113</u>	160	210	<u>257</u>	
>50 and <155	102.5	241	280	392	<u>432</u>	
Average	<u>38.9</u>	134	188	238	<u>293</u>	

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 ²² <u>Capacity Used in calculations for each bin is an av ²⁴ Weighted Overall average based on ENERGY ST Dehumidifier TRM Analysis 2021 xIsx².</u> 	erage. See next footnote regarding-overall average for Portable Dehumidifiers RR Products List 2020 for Dehumidifiers, accessed May 2020. See sheet <i>ESTAR 2020. 5</i> in file 'ENERGY ST.	AR	Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman
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		Porta	ble Dehumid	lifiers			Annu	al kWh]
	Avg Capacity	Average capacity of the unit (pints/day Actual, if unknown assume capaci in each capaci range as provided in tall below, or if eapacity rang unknown assume capacity capacity unknown unkno unkno unkno unkno unkno unkno unkno unkno unkn	iy <u>Federa</u> Standa e	rd STAR		<u>R</u> <u>Baseline</u> <u>H</u> <u>Federal</u>	E LQ Baseline	ENERGY STAR	ENERGY STAR Most Efficient	
0.473 24		nstant to conve			:					1
Hours		1 hours per yea								
		, (pints/day)	<u>(≥</u> L/kWh }	Eliters of water per kWh consumed, as provided in tables	<u>{≥⊥/k</u> W	/h}	•	<u>^</u>		
				above <u>(≥</u> L/kWh)						
	425	20	<u>1.3</u>	<u>1.57</u>	<u>1.7</u>	667	731	552	510	
	<u>>25 and ≤50</u>	<u>37.5</u>	<u>1.6</u>	<u>1.8</u>	<u>1.9</u>	<u>1016</u>	<u>1113</u>	903	856	
	<u>≻50 and</u> <u><155</u>	<u>102.5</u>	<u>2.8</u>	<u>3.3</u>	<u>3.4</u>	<u>1587</u>	<u>1739</u>	1347	1307	
	Average ⁷⁶	<u>38.9</u>	<u>1.54</u>	<u>1.75</u>	<u>1.86</u>	1095	<u>1200</u>	962	907]
Annual kWh r		Capacity U	Jsed	below: <u>Non-IQ</u> Federal	Energy	y Savings (ΔkW Annual		STAR Most		
	(pints/day) (pints/day)	Capacit Used(pints)	¥ Si (day) € (<u>t</u>)	caeran t andard ∑riteria (⊇ Vh) <u>ENERGY</u> <u>STAR</u>	STAR [®] Criteria (≥ L/kWh) <u>Most</u> Efficient	kWh <u>ENERGY</u> STAR Federal Standard	ENERGY STAR®	icient Saving	\$	

²⁴ Capacity Used in calculations for each bin is an average. See next footnote regarding overall average for Portable Dehumidifiers ²⁸ Based on 24 hour operation over 68 days of the year. ENERGY STAR[®] Qualified Room Air Cleaner Calculator. (ENERGY STAR[®] Appliance Calculator.xlsx). ²⁴ Weighted Overall average based on ENERGY STAR Products List 2020 for Dehumidifiers, accessed May 2020. See sheet ESTAR 2020 5 in file "ENERGY STAR Dehumidifi Analysis 2021.xlsx"

<u>2025</u>MEEIA <u>4 2019-21</u> Plan

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Page 31

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Appendix I - TRM – Vol. 3: Residential Measures

	<u>£25</u>	2	0	1.35<u>115</u>	2.0 <u>157</u>	477 <u>179</u>	<u> 322<u>221</u></u>	155			•
Ē	<u>> 25 to ≤35anc</u> <u>≤50</u>	303	1 <u>7.5</u>	1.35 <u>113</u>	<u>2.0160</u>	714 <u>210</u>	482 <u>257</u>	232			
-		40									
	≤45 <u>50 and</u> < <u><155</u>	1 <u>10</u>	1 <u>2.5</u>	2.0<u>241</u>	857 <u>280</u>	643 <u>392</u>	214<u>43</u>	2			1
	$>$ 45 to \leq 54	50		1.6		2.0	1005		80 4	201	
ĺ	<u>> 54 to ≤ 75</u>	65		1.7		2.0	1,229)	1,045	184	
	>75 to ≤ 185	130		2.5		2.8	1,672	2	1,493	179	
	Average ⁷⁷	38	.9	<u>134</u>	<u> 188</u>	238	<u>293</u>	204			4

SUMMER COINCIDENT PEAK DEMAND SAVINGS

$\Delta kW = \Delta kWh * CF$

Where:

ALW/b	- Electric energy covinge	as calculated above.
ZAR VV II	- Electric chergy savings,	as calculated above.

CF = Summer peak coincidence demand (kW) to annual energy (kWh) factor

∆kWh CF - Energy Savings as calculated above

= Summer peak coincidence demand (kW) to annual energy (kWh) factor = 0.0009474181

Summer coincident peak demand results for each capacity class are presented below:

Capacity Range (pints/day)	Annual Summer peak kW Savings	<u>= 0.0009474181</u>
_25	0.095	
> 25 to ≤35	0.142	
<u>> 35 to ≤45</u>	0.131	
≻ 45 to ≤ 54	0.123	
$> 54 \text{ to} \leq 75$	0.113	
> 75 to ≤ 185	0.110	
Average	0.125	
NATURAL GAS SAVINGS		

N/A

WATER IMPACT DESCRIPTIONS AND CALCULATION N/A

DEEMED O&M COST ADJUSTMENT CALCULATION N/A

MEASURE CODE:

²⁷ The relative weighting of each product class is based on number of units on the ENERGY STAR[®] certified list. See "Dehumidifier Cales.xls."

<u>2025</u>MEEIA <u>4</u> 2019-21 Plan

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Revision <u>8</u>7.0

Page 32

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Ameren Missouri		Appendix I - TRM – Vol. 3: Residential	Measures •	Formatted: Font: (Default) Arial, 12 pt
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3.1.6 Dehumidifier Recycling <u>(Retir</u>	ed, effective 1/1/2025)-78			
Description				Formatted: Font color: Background 1
their natural life. This measure assumes tha	t a percentage of these units will be replaced	 I, inefficient dehumidifier units from service prid 1 with a baseline standard efficiency unit (note that between baseline and ENERGY STAR[®]-will be 	tt if the unit	
This measure was developed to be applicat	le to the following program type: ERET.			
If applied to other program types, the meas	ure savings should be verified.			
Definition of Efficient Equipment N/A. This measure relates to the retiring of	an existing inefficient unit.			
Definition of Baseline Equipment The baseline condition is the existing ineffi	cient dehumidifier unit.			
Deemed Lifetime of Efficient Equipment The measure life is assumed to be <u>8</u> 5 years				
Deemed Measure Cost The incremental cost for this measure is \$4	2.76 <u>49.00</u> . [∞]			
Loadshape HVAC RES				
	Algorithm			
Calculation of Savings				
Electric Energy Savings ⁸⁴ Program Deemed Savings estimate:	Gross Electric Savings Gross Dem	and Savings		
	(RWHMM) (RWH	648	•>	Formatted: Font color: Background 1
Summer Coincident Peak Demand Savings				Formatted Table
$\frac{\text{Summer Coincident Peak Demand Savings}}{\Delta kW = \Delta kWh * CF}$				Formatted: Font color: Background 1
AkW = AkWh * CF			4	Formatted: Heading 4, Space Before: 12 pt
Where:				
	avings, as calculated above. incidence demand (kW) to annual energy (l	(Wh) factor	4	Formatted: Indent: First line: 0"
	ual kWh savings for the measure			
~· - 0.000 1000005				Formatted: Font color: Background 1
⁹⁹ -2024 MEMD database, measure code N-RE-AP-0 BRM/mi-master measure database 2024 1130202	21 to be offered through an Ameren Missouri-admini 21 0111 E. XX. XX. XX. 02. https://www.michigan 3.xlsx?rev=3fd5e407267e4f9ean344d1e22edf4ea&ha	stered demand-side program during the period of TRM effec gov/mpsc//media/Project/Websites/mpsc/regulatory/ewr/M sh=8DE2A37856418390B47236A0368B9F06_	tiveness. EMD and	
²⁰ <u>Ibid.</u> ²⁴ Deemed value per 2018 <u>24</u> MEMD database for a c BRM/mi-master-measure-database-2024-1130202	kop-off program <u>, https://www.michigan.gov/mpsc/ /</u> 3.xkx?rev=3fd5e407267c4f9eaa344d1e22edf4ea&ha	media/Project/Websites/mpsc/regulatory/ewr/MEMD-and- sh=&DE2A37856418390B47236A0368B9F06Ibid		
<u>2025 MEEIA <mark>4</mark> 2019-21</u> Plan	Revision <u>8</u> 7.0		Page 33	

	Ameren Missouri	Appendix I - TRM – Vol. 3: Residential Measures	\neg	Formatted: Font: (Default) Arial, 12 pt
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<u>2025</u>MEEIA <u>4 2019-21</u> Plan

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	ri				esidential Measures	Formatted: Font: (Default) Arial, 12 pt Formatted: Normal
17211 D	efrigerator					
	errigerator					
	ting either ENERGY STAR [®] /CEE Tier 1 specification of baseline efficiency. The measure approximation of the second statement				Tier 2 or CEE Tier 3 is	
his measure also	includes a section accounting for the interactive eff	ect of reduced wa	ste heat on the hea	ting and cooling le	oads.	
This measure was	developed to be applicable to the following program	n types: TOS, NO	, and EREP.			
	program types, the measure savings should be verif		,			
Energy usage spec	ifications are defined in the table below (note, Adju	sted Volume is c			* Freezer Volume):	Formatted: Indent: Left: 0", Space After: 6 pt
	Product Category	Existing Unit Based on		<u>iter September</u> 14 <u>ENERGY</u> STAR		
	<u>a i duice curegory</u>	Refrigerator Recycling algorithm	<u>Maximum</u> <u>Energy Usage</u> in kWh/year ⁸²	Maximum Energy Usage in kWh/year ⁸³		
	1. Refrigerators and Refrigerator-freezers		<u>6.79AV +</u>	<u>6.11 * AV +</u>		Formatted: Font: 11 pt
	with manual defrost	_	<u>193.6</u>	174.2		
	2. Refrigerator-Freezerpartial automatic defrost		<u>7.99AV +</u> 225.0	<u>7.19 * AV +</u> 202.5		
	3. Refrigerator-Freezersautomatic defrost	-	223.0	202.5		
	with top-mounted freezer without through-		<u>8.07AV +</u>	7.26 * AV +		
	the-door ice service and all-refrigerators		<u>233.7</u>	<u>210.3</u>		
	automatic defrost 4. Refrigerator-Freezersautomatic defrost	Method to			-	
	with side-mounted freezer without through-	measure to	<u>8.51AV +</u>	<u>7.66 * AV +</u>		
	the-door ice service	estimate	<u>297.8</u>	<u>268.0</u>		
	5. Refrigerator-Freezersautomatic defrost	existing unit	<u>8.85AV +</u>	7.97 * AV +		
	with bottom-mounted freezer without through-the-door ice service	consumption defined	317.0	285.3		
	5A Refrigerator-freezer—automatic defrost	below.			1	
	with bottom-mounted freezer with through-	1	$\frac{9.25 \text{AV}}{475 4}$	$\frac{8.33 * AV +}{426.3}$		
	the-door ice service	_	<u>475.4</u>	<u>436.3</u>		
	6. Refrigerator-Freezersautomatic defrost		8.40AV +	7.56 * AV +		
	with top-mounted freezer with through-the- door ice service		385.4	355.3		
	7. Refrigerator-Freezersautomatic defrost	1	0 54 437	7.0 * 131	1	
	with side-mounted freezer with through-the-		<u>8.54AV +</u> 432.8	<u>7.69 * AV +</u> 397.9		
	door ice service		<u>+52.0</u>	371.7	J	

⁸² See Department of Energy Federal Standards (10 CFR Part 430.32(a)), effective September 15th, 2014,
 ⁸³ See Version 5.1 ENERGY STAR specification.

<u>2025</u>MEEIA <u>4</u>2019-21 Plan

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	ing refrigerator for the assumed remaining useful life of the unit sure life. Application of early replacement baseline is applicable nfiguration.		
DEEMED LIFETIME OF EFFICIENT EQUIPM The measure life is assumed to be 157 years			
Remaining life of existing equipment is assu	umed to be 5 years. ⁸⁵		
DEEMED MEASURE COST The full cost of a baseline unit is \$742. ⁸⁶			
The incremental cost to the ENERGY STAF	R^{\otimes} level is $\frac{2811}{1220}$, to CEE Tier 2 level is $\frac{11220}{1220}$, and to CEE Ti	er 3 is \$ <u>134</u> 59. ⁸⁷	
LOADSHAPE Refrigeration RES			
	Algorithm		
CALCULATION OF SAVINGS			
	from will be calculated based on model ENERGY STAR® data, 2, savings by product class may be calculated according to the al		
Time of sale:			
$\Delta kWh_{\text{Unit}} = kWh_{\text{base}} - kWh_{\text{ee}}$			Formatted: Subscript
$\Delta kWh_{unit} = kWh_{base} - (kWh_{new} * (1 - \%))$ Early replacement:	Savings)) –	•	Formatted: Indent: Left: 0"
<u>AkWH for remaining life of existing unit (1:</u>	st 5 years):	¢	Formatted: Indent: Left: 0", First line: 0"
$= kWh_{exist} - kWh_{ee}$			
ΔkWH for remaining measure life (next 10 y	<u>years):</u>	4	Formatted: Indent: Left: 0", First line: 0"
DOE Rulemaking Technical Support Document, 'DO Standards for Residential Refrigerators, Refrigerator-J	wp-content/uploads/IL-TRM_Effective_010124_v12.0_Vol_3_Res_0922202; E LCC Spreadsheet.xlsm' Mean from Figure 8.2.3, DOE, 2011-08-23 Technic Freezers, and Freezers.	al Support Document for Energy Conservation	
/pdfs/refrig_finalrule_tsd.pdf, page 8-32	=0900006480f0c7df&disposition=attachment&contentType=pdfhttps://www	1.eere.energy.gov/buildings/appliance_standards	Formatted: Font color: Auto
for Energy Conservation Standards for Residential Re	Energy Savings. Values inflated 8.9% from 2009 dollars to 2015. Table 8.1.1, I		Formatted: Footnote, Don't keep with next
/pdfs/refrig_finalrule_tsd.pdf-; 'refrig_finalrule_tsd.pd 87 Illinois TRM Version 12.0, https://www.ilsag.info/u using the data provided in the Department of Energy,	df'. wp-content/uploads/IL-TRM_Effective_010124_v12.0_Vol_3_Res_09222022 "Refrigerator, Refrigerator-Freezer, and Freezer Life-Cycle Cost (LCC) Anal-	3_FINAL_clean.pdf, p. 35. Costs are estimated ysis Spreadsheet" posted November 9, 2021 as	
data was trended to provide estimates at the efficiency	Imer Refrigerators, Refrigerator-Freezers, and Freezers' rulemaking docket (se y levels specified in this measure, and then weighted based on available product r Energy Savings. Values inflated 8.9% from 2009 dollars to 2015. Table 8.2.3	ct on the ENERGY STAR® Refrigerator	Formatted: Font: 9 pt
Document for Energy Conservation Standards for Res	releasing of the second s		
dings/appliance_standards/pdfs/refrig_finalrule_tsd.pd		, , , , , , , , , , , , , , , , , , ,	
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	= kWh _{base} - kWh _{ee}												
Where:													
kWh _{ee}	= Actual. If unknown,			uct class	<u>:</u>						•		Formatted: Space After: 0 pt
	$= (kWh_{base} * (1 - \%Sa))$												
<u>kWh</u> _{base}	= Annual electric ener known; otherwise, assu											\sim	Formatted: Subscript
	use value 415.28.	<u></u>	on adj	usted voi	unic u	sing un	renigeraa	ors auton		<u>ionna</u>	u 0.0711 + 233.7,		Formatted: Indent: Left: 0.5", Hanging: 1"
1 3 3 7	T O 1		e										
kWh _{exist}	= If pre-existing unit ag unit based on unit age				n: see ta	ible belov	v to deteri	nine elec	tric energy	/ consumpt	tion of pre-existing		Formatted: Indent: Left: 0.5", Hanging: 1"
	If pre-existing unit age				own: do	not apply	y early re	placemen	t baseline	<u>.</u>	•		Formatted: Indent: Left: 1", First line: 0.5"
0/ Servines	= Specification of ener			kalam Da	damal C	buchned	ooo toblo	halam					Formatted: Indent: Left: 2", First line: 0"
<u>%Savings</u> kWh _{base}	= Specification of ener						see table	below.					Formatted: Indent: First line: 0.5", Space After: 0 pt
	= Calculated using algo	rithms in	table be	low, or u	ising de	faults pro			.5 ft ³ adju	sted volum	ne-⁶⁴		<u> </u>
%Savings	= Specification of energy	gy consur	nption b	elow Fee	leral Sta	undard – «	see table l	elow.					
			Tie	er			%Sav	ings	1		•		Formatted Table
	Energy	Star [®] and					10	<u> </u>					
	Energy	Star® Mo	ost Effic	ient and	CEE Ti	er 2	15	%					
	CEE T	ier 3					20	%					
For low income mean	anali an ambi mulaaan	ant hoost		mliachte	the fel	lowing to		he wood a		a tha haaa	line was a word to		
	ams <u>If an early replacem</u> ne first six years of meas		ine is ar	<u>pricable</u>	, the fol	lowing ta	able may	be used i	o calcula	te <u>the</u> base	enne usage <u>used to</u>		
			Side-	Side-	Side-								Formatted: Centered
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	Age	Freezer (16 cu	Side	Side	Side	Freezer (cu ft	Freezer (15 cu	Freezer (16 cu	Freezer (17 cu	Freezer (18 cu			
		ft)	(14 cu ft)	(15 cu ft)	(16 cu ft)	14)	ft)	ft)	ft)	ft)			
	2011-2015	483	592	592	592	374	374	374	412	412			
	2001 (after July-2010	724	747	747	747	556	556	556	613	613		/	
								861					
	1993-2001(before June)	962	1,139	1,139	1,139	861	861		962	962			
	1990-1992	1,519	1,617	1,617	1,617	1,272	1,272	1,272	1,432	1,432			
	1980-1989	1,992	2,119	2,119	2,119	1,668	1,668	1,668	1,877	1,877			
	Before 1980	2,523	2,684	2,684	2,684	2,112	2,112	2,112	2,377	2,377			
Additional Waste Hea	t Impacts												
For units in conditione	d spaces in the home (if	unknown	. assume	e unit is i	n condi	tioned sp	ace).						
	Vh * (WHFeHeatElectric					P							Parman March Carls and the
AK W II waste Heat		- will c	<u>C001)</u>										Formatted: Subscript
	ΔkWh_{H}	Vastelleat	$= \Delta k H$	/h * (W I	IFeHe t	itElectri	c + WH	FeCool)					
⁸⁸ According to Federal Sta ⁸⁹ DOE Building Energy D	ndard effective 9/15/14. ata Book _a , https://ieer.org/wp/v	wn-content/	unloads/2	012/03/DC	E-2011-1	Ruildings-F	nerov-Data	Book-BED	B ndf [.] 'DO	E-2011-Build	tings-Energy-		
DataBook-BEDB.pdf [*] http	://buildingsdatabook.erei	1.doe.gov	/TableV	iew.aspx	?table=	<u>5.7.5.</u>	arergy-17ata	DOUK-DED	<u>D.put, DO</u>	2-2011-Duild	amgo-tonet <u>gy-</u>		
⁹⁰ According to Federal Sta ⁹¹ DOE Building Energy D	ndard effective 9/15/14. ata Book, <u>http://buildingsdatab</u>		a gov/Te	hlaView or	ny?table	-575							
Dor Dunaling Energy Di	am 19 00k, <u>map#/bunumgsdatat</u>	o ok.cren.d	70 .507/18	or e v rew.ill	p x rable	- 3.1.3.							
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meren Missouri			Ap	<u>opendix I - TRM – Vol. 3</u>	: Residential Measures	Formatted	
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ΔkWh	= kWh savings ca	lculated from eit	her method above			Formatted	
	0			increase from removing was	te heat from	Formatted	
	refrigerator/freeze	er (if fossil fuel h	eating - see calculation of he	eating penalty in that section)).	Formatted	
	= - (HF / η Heat _{Elec}					Formatted	
HF	= Heating Factor $=$ 58% for unit in		reduced waste heat that must	t now be heated			
	= 0% for unit in u		IIIKIIOWII			Formatted	
$\eta Heat_{Electric}$	= Efficiency in CO					Formatted	
	= Actual - If not a					Formatted	
%ElecHeat	= Percentage of he	ome with electric	heat			Formatted Table	
	Age of	HSPF	ŋHeat			Formatted	
System Type	Equipment	Esitmate	(COP Estimate)			Formatted	
	Before 2006	6.8	2.00			Formatted	
Heat Pump	2006-2014	7.7	2.26			Formatted	
	2015 on	8.2	2.40			Formatted	
Resistance	N/A	N/A	1.00			//>	
Unknown	N/A	N/A	1.28 ⁹⁴			Formatted	
				nHeat		Formatted	
	System Type	Age of	Equipment,HSPF2 Estimate	e (COP Estimate)		Formatted	
	Heat Pump	Before 20	06 5.8	= (HSPF2/3.413)*0.85 1.44.		Formatted	
	(if age unknown as			1.62		Formatted	
	2006-2014)	2015 on	7.0	1.74		Formatted	
	Resistance Unknown ⁹⁵	<u>N/A</u> N/A	N/A N/A	1.00		Formatted	
	Olikilowi		N/A	1.20		Formatted	
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			ng Fuel %ElecHe	eat	-		
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			il Fuel 0% nown 35% ⁹⁶			Formatted	
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WHFeCool	- Waste Heat Facto	r for Energy to s	ecount for cooling savings fr	rom removing waste heat from	m	Formatted	
	refrigerator/freezer.		ecount for cooming savings in	toin temoving waste near itoi		Formatted	
	$= (CoolF / (\eta Cool))$					Formatted	
			duced waste heat that no lon	iger needs to be cooled		Formatted	
	= 40% for unit in co	ooled space or u	known ⁹⁷			Formatted	
	= 0% for unit in uno					Formatted	
ηCool	= Efficiency in COI	P of Cooling equ	ipment			Formatted	
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Based on 212 days where HE These default system efficien			deral Standards. In 2006 and 2015	the federal standard for heat pump	s was adjusted. While one would	Formatted	
pect the average system effici	iency to be higher than th	his minimum, the lik	ely degradation of efficiencies ove	r time mean that using the minimur	n standard is appropriate.	Formatted Table	
				Administration, 2009 Residential I nat 50% are units from before 2006		Formatted	
Calculation assumes 35% He	at Pump and 65% Resist	tance, which is based	upon data from Energy Information	on Administration, 2009 Residentia	l Energy Consumption Survey, -	Formatted	
				ump is based on assumption that 50	% are units from before 2006 and	Formatted	
9% from 2006-2014. Program 6 Based on data from Energy 1	Information Administrati		E this assumption if available. I Energy Consumption Survey, see	"HC6.9 Space Heating in Midwest	Region xls"	Formatted	
tps://www.eia.gov/consumpti							

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$\frac{1}{10000} = \frac{1}{10000} = \frac{1}{10000} = \frac{1}{100000} = \frac{1}{10000000000000000000000000000000000$,	<i>.</i>		_					
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$\frac{\text{Product Class}}{\text{Non-interval}} = \frac{\text{Non-interval}}{\text{Non-interval}} = \frac{\text{Non-interval}}{Non-inte$	Wh savings is provid	ed below:	-					-				
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$\frac{ \mathbf{x} _{\mathbf{x}} \mathbf{x} _{$			Usage	ENERGY	CEE CI	E ENERG	Y CE	E CEE	ENERGY	CEE	CEE	
$\frac{h_{1}}{C_{2}} \frac{h_{1}}{M_{1}} \frac{h_{1}}{M_{1}} \frac{h_{2}}{M_{1}} \frac{h_{2}}{M_{$		Standard		STAK-7 CEE Tier 1	Tier-2 Tie	r-3 CEE Tie	→ -++e r-1 2	+ + + + + + + + + + + + + + + + + + +	CEE Tier	1 Tier 2	Tier-3	
$\frac{C_{22}}{(22)} = \frac{1}{2} + \frac{1}{2$		8.40AV + 385.4	574	57.4	86.1 114	4.8 -0.9	-1.4	4 -1.9	56.5	84.7	112.9	Formatted Table
$\frac{1}{1} \frac{1}{1} \frac{1}$		8.54AV + 432.8	625	62.5	93.75 12	-1.0	-1.:	5 -2.1	61.5	92.2	122.9	
$\frac{V_{2} \leq \lambda_{1}}{V_{2} \leq \lambda_{1} + 1/2} es es es 1426 1468 146 147 42 et 147 42 et 140 1446$ product class is unknown, the following table provides a market weighting that is applied to give a single deemed saving: for each efficiency et it is the second state of the single deemed saving: for each efficiency et it is the second state of the single deemed saving: for each efficiency et it is the second state of the second state of the single deemed saving: for each efficiency et it is the second state of the single deemed saving: for each efficiency et it is the second state of the single deemed saving: for each efficiency et it is the second state of the single deemed saving: for each efficiency et it is the second state of the single deemed saving: for each efficiency et it is the second state of the single deemed saving: for each efficiency et it is the second state of the single deemed saving: for each efficiency et it is the second state of the single deemed saving: for each efficiency et it is the second state of the single deemed saving: for each efficiency et it is the second state of the single deemed saving: for each efficiency et it is the second state of the single deemed saving: for each efficiency et it is the second state of the single deemed saving: for each efficiency et it is the second state of the single definition of the second state of the	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	8.85AV + 317.0	516	51.6	77.4 10	3.2 -0.8	-4.3	3 -1.7	50.8	76.1	101.5	
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			Appendix	<u>I - TRM – Vol. 3: Re</u>	esidential Measu	es	Formatted: Font: (Default) Arial, 12 p
CE							Formatted: Normal
CF	= Summer Peak Coincident Factor = 0.0001285253 ¹⁰¹						
ault valuas for a	ash maduat alaas and unlungum building abaa		wided helens				
Fault values for e	ach product class and unknown building chai	acteristics are pro					
	Product Class	The second Classifier (∆k₩				
	Froduct Cluss		CEE Tier 2	CEE Tier 3			Formatted Table
	Top Freezer (PC 3)	0.0086	0.0130	0.0173			Formatted Table
	Side-by-Side w/ TTD (PC 7)	0.0094	0.0141	0.0188			
	Bottom Freezer (PC 5)	0.0078	0.0117	0.0155			
	Bottom Freezer w/ TTD (PC 5A)	0.0103	0.0155	0.0206			
oduct class is u I:	nknown, the following table provides a mar	ket weighting the	at is applied to give	e a single deemed savi	ngs for each efficie	icy	
URAL GAS SAV	INGS						
ating penalty for	reduction in waste heat, only for units from co	onditioned space	in gas heated home	e (if unknown, assume	unit is from conditio	ned	
nce).							
Therms $=\Delta$	kWh _{Unit} * WHFeHeatGas * 0.03412						Formatted: Subscript
HF ηHeat _{Gas} %GasHeat 0.03412	 Heating Factor or percentage of reduce 58% for unit in heated space or unknow 0% for unit in unheated space Efficiency of heating system 74%¹⁰³ Percentage of homes with gas heat Converts kWh to therms 		must now be heat	ed			
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Ameren Missouri

Heating Fuel	%GasHeat
Electric	0%
~	1001

Electric	0%
Gas	100%
Unknown	65% ¹⁰⁴

Default values for each product class and unknown building characteristics are provided below:

		∆Therms	
Product Class	Energy Star®/ CEE Tier 1	CEE Tier 2	CEE Tier 3
Top Freezer (PC 3)	-1.19	-1.78	-2.37
Side-by-Side w/ TTD (PC 7)	-1.29	-1.94	-2.58
Bottom Freezer (PC 5)	-1.07	-1.60	-2.13
Bottom Freezer w/ TTD (PC 5A)	-1.41	-2.12	-2.83

If product class is unknown, the following table provides a market weighting that is applied to give a single deemed savings for each efficiency level:

			Δ Therms	
Product Class	Market Weight ¹⁰⁵	Energy Star®/ CEE Tier 1	CEE Tier 2	CEE Tier 3
Top Freezer (PC 3)	52%			
Side-by-Side w/ TTD (PC 7)	22%	-1.22	-1.84	-2.45
Bottom Freezer (PC 5)	13%	-1.22	-1.04	-2.43
Bottom Freezer w/ TTD (PC 5A)	13%			

WATER IMPACT DESCRIPTIONS AND CALCULATION

N/A

DEEMED O&M COST ADJUSTMENT CALCULATION $N\!/\!A$

MEASURE CODE:

 ¹⁰⁴ Based on data from Energy Information Administration, 2009 Residential Energy Consumption Survey, see <u>"HC6.9 Space Heating in Midwest Region.xls."</u>, https://www.eia.gov/consumption/residential/data/2009/hc/hc6.9.xls.; hc6.9.xls.;
 ¹⁰⁵ Personal Communication from Melisa Fiffer, ENERGY STAR[®] Appliance Program Manager, EPA 10/26/14.

<u>2025 MEEIA <u>4 2019-21</u> Plan</u>

Revision <u>8</u>7.0

Page 41

Appendix I - TRM – Vol. 3: Residential Measures Formattee

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3.1.8 Room Air Conditioner Recycling (Retired, ef	fective 1/1/2025) ⁺⁺⁺	
Description		Formatted: Font color: Background 1
	nent of existing residential, inefficient room air conditioner units from service prior to age of these units will be replaced with a baseline standard efficiency unit (note that if	
	gunit, the savings increment between baseline and ENERGY STAR [®] will be recorded	
This measure was developed to be applicable to the followin	g program type: ERET.	
If applied to other program types, the measure savings shoul		
Definition of Efficient Equipment		
N/A. This measure relates to the retiring of an existing ineffi	cient unit.	
Definition of Baseline Equipment	a distanti a conte	
The baseline condition is the existing inefficient room air co	nditioning unit.	
Deemed Lifetime of Efficient Equipment The assumed remaining useful life of the existing room air c	onditioning unit being retired is 4 years. ⁴⁰⁷	
Deemed Measure Cost		
The actual implementation cost for recycling the existing un	it should be used.	
Loadshape		
Cooling RES		
	Algorithm	
Calculation of Savings		
Electric Energy Savings		
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$\frac{DkWh}{DkWh} = kWhexist - (%replaced + kWhexist)$		
Hours * BtuH (0(under a dia Hours *	Btull	
= <u>EERexist + 1000</u> (%replaced + <u>EERNewBas</u>	<u>e * 1000⁷</u>	
Where:		
Hours = Full <u>Load hHours of room air condition</u> = 860 for primary use; and 556 for secon		
EERexist = Efficiency of recycled unit Actual if recorded If not, assume 9.0		Formatted: Font color: Background 1, Check spelling
BtuhH = Average size of rebated unit. Use actur		and grammar Formatted: Font color: Background 1, Check spelling
		and grammar
	10h an Ameren Miccouri administered demand side program during the period of TDM affectiveness.	
¹⁰⁷ One third of assumed measure life for room air conditioners.	ugh an Ameren Missouri-administered demand-side program during the period of TRM effectiveness, the most common type of unit (8.000–13.999 Blub with side years), the federal minimum efficiency.	Formatted: Font color: Background 1
 ¹⁰⁷ One third of assumed measure life for room air conditioners. ¹⁴⁸ Retirement programs will see a wide range of ages for retired units. Fo standards have changed over time: from 1990-2000, it was 9.0 EER; from 	r the most common type of unit (8:000-13:099 Btuh with side vents), the federal minimum efficiency 2000-2014, it was 9.8 EER; and since 2015, it has been 10.9 CEER. The efficiency standard for 2000-	Formatted: Font color: Background 1
⁴⁴⁷ One third of assumed measure life for room air conditioners. ⁴⁴⁸ Retirement programs will see a wide range of ages for retired units. For standards have changed over time: from 1990 2000, it was 9.0 EER; from 2014 was chosen, acknowledging that the actual EER of many units will I ⁴⁹⁰ Based on maximum capacity average from the RLW Report; "Final Re- tire actual to the second seco	r the most common type of unit (8:000-13:099 Btuh with side vents), the federal minimum efficiency 2000-2014, it was 9.8 EER; and since 2015, it has been 10.9 CEER. The efficiency standard for 2000-	Formatted: Font color: Background 1
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¹⁴⁷ One third of assumed measure life for room air conditioners. ¹⁴⁸ Retirement programs will see a wide range of ages for retired units. For standards have changed over time: from 1990 2000, it was 9.0 EER; from 2014 was chosen, acknowledging that the actual EER of many units will I ⁴⁰⁹ Based on maximum capacity average from the RLW Report; "Final Re- tire and the second sec	r the most common type of unit (8.000–13.999 Btuh with side vents), the federal minimum efficiency 2000-2014, it was 9.8 EER: and since 2015, it has been 10.9 CEER. The efficiency standard for 2000- ave significantly degraded over time. port Coincidence Factor Study Residential Room Air Conditioners, June 23, 2008.", <u>'117_RLW_CF Res</u>	Formatted: Font color: Background 1

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%replaced EERNewBase	= Percentage of unit = Estimated Efficient	ts that are replaced ncy of baselinereplacen					•		Formatted: Font color: Background 1, Chec and grammar
	= 1 <u>0.9</u> 0.9 ¹¹¹							$\overline{\ }$	Formatted: Font color: Background 1, Chec and grammar
	Wei	ather Basis	ц	lours ¹¹²				/	Formatted Table
	(City St Lou	based upon) is, MO	60 for primary use ar		ndary use <u>. If</u>		4		Formatted: Font color: Background 1, Chec and grammar
			unknown	n <u>, assume 556</u>		1		\swarrow	Formatted: Font color: Background 1
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ummer Coincident	t Peak Demand Saving	/	323.4	91.0	195.7				Formatted: Font color: Background 1, Chec and grammar
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AkWh		savings, as calculate							and grammar Formatted: Normal
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AkWh CF CF	<u>= Summer peak c</u> <u>= 0.0009474181</u> + = Summer Peak Coi = 0.0009474181¹⁴⁵ lts provided above:	voincidence demand (<u>+</u> incidence Factor for me wenther Basis	kW) to annual energy	gy (kWh) factor AkW Unit]			Formatted: Normal Formatted: Left Formatted: Font color: Background 1 Formatted: Left Formatted: Font color: Background 1
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<u>AkWh</u> <u>CF</u> CF ecults using defaul ² The federal minimum 015) 10.9 CEER, Reti sonable estimate of it ravings calculations uates to: 10.9 EER/1.2 Minimum federal sta selines, https://www. ndtitioners.https://www. ptp://www.pue.nh.gov/ cations (provided by / cations (provided by / mater normal data to j	Summer peak c = 0.0009474184 ⁺ = Summer Peak Coi = 0.0009474181 ^{++s} (the provided above: the provided above: St Loui St Loui an for the most common type rement programs will see a he average retried unit. This for a 10 year old room air a ceptalations gov/document/ wil cere energy gov/buildit Y2013 CoolSavers evaluatii Electric/Monitoring% 20anc ArRU, http://www.energys provide an assumption for 1 provide an assumption for 1 provide an assumption for 1 serged and serger and the provide an assumption for 1 provide an approximation for provide an approximation for 1 provide an approximation fo	eof unit (8000 – 13999 B stype based upon) s, MO e of unit (8000 – 13999 B large array of ages being s is supported ages being s is supported ages being s is supported ages being s is supported ages being agestar gov/ia/products/r d most popular class (will ERE 2014 BT STD 005 ngs/appliance_standards/p on_https://www.sfie.psea ds/20Evaluation%20Repo tar.gov/ia/business/Dulk_p ELH for Room AC.	kW) to annual energy ensure	AkW Unit replaced 0.0868 0.0868 n 1990 2000 was 9. Rof many will have "website, which, if what are at least 10 AirConditionerFur Jouvered sides, and gov/product/roor h;=EERE_2014_BT louvered sides, and gov/product/roor h;=EERE_2014_BT h;=CRC_2014_CT h;=CRC_2014	0.1854 0.EER, from 2000 been significantly Freverse engineere years old use 20% m InAndRecycling 8,000 to 13,999 B m air F STD 0059 0057 es%20RAC.pdf) to s 31%. This factor	y degraded. We have so of, indicates that an EF more energy than a nu <u>Programs pdf</u> ttu/h). <u>Federal standard</u> <u>eontent.pdf</u> . o FLH for Central Cool was applied to publish	Hected 9.0 as a R of 9.16 is used w ES unit, which air conditioner ing for the same ed CDD65		Formatted: Normal Formatted: Left Formatted: Font color: Background 1 Formatted: Left Formatted: Font color: Background 1 Formatted: Normal Formatted: Indent: First line: 0" Formatted: Font color: Background 1, Chec and grammar Formatted: Font color: Background 1 Formatted Table
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Natural Gas Savings		Formatted: Font color: Background 1
N/A		
Water Impact Descriptions and Calculation		
Deemed O&M Cost Adjustment Calculation N/A		
Measure Code		
VIEASURE CODE		
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Appendix I - TRM - Vol. 3: Residential Measures

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3.2 Electronics

3.2.1 Advanced Tier 1 Power Strips

DESCRIPTION

This measure applies to Tier 1 Advanced Power Strips (APS), which are multi-plug power strips with the ability to automatically disconnect specific connected loads depending upon the power draw of a master control load, also plugged into the strip. Power is disconnected from the switched (controlled) outlets when the master control load power draw is reduced below a certain adjustable threshold, thus turning off the appliances plugged into the switched outlets. By disconnecting, the standby load of the controlled devices, the overall load of a centralized group of equipment (i.e. entertainment centers and home office) can be reduced. Uncontrolled outlets are also provided that are not affected by the control device and are always providing power to any device plugged into it. This measure characterization provides savings for use of an APS in a home entertainment system, home office, or unknown setting.

This measure was developed to be applicable to the following program types: TOS, NC, DI, and KITS.

If applied to other program types, the measure savings should be verified.

DEFINITION OF EFFICIENT EQUIPMENT

The efficient case is the use of a 4-8 plug Tier 1 master-controlled APS.

DEFINITION OF BASELINE EQUIPMENT

For TOS and NC applications, the baseline is a standard power strip that does not control connected loads. For DI and KITS, the baseline is the existing equipment used in the home.

DEEMED LIFETIME OF EFFICIENT EQUIPMENT The assumed lifetime of the Tier 1 APS is 10 years.¹¹⁶

DEEMED MEASURE COST

For TOS and NC, the incremental cost of an APS over a standard power strip with surge protection is assumed to be \$20.¹¹⁷ For DI-and KITS, the actual full installation cost of an APS (including equipment and labor) should be used. If DI cost is unknown, cost is assumed to be \$30.00.¹¹⁸

LOADSHAPE

Miscellaneous RES

Algorithm

CALCULATION OF SAVINGS

ELECTRIC ENERGY SAVINGS

 $\Delta kWh = (kWh_{office} * Weighting_{office} + kWh_{ene} * Weighting_{ene}) * ISR$

¹¹⁶ "Advanced Power Strip Research Report," NYSERDA, August 2011, https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/EERP/Residential/Power-Management-Research-Report.pdf;, "NYSERDA Advanced Power Strip Research Report.pdf", page 30.⁴⁴² Incremental cost based on "Advanced Power Strip Research Report.pdf", page 6, Typical cost of an advanced power strip is \$35, and average cost of a standard power strip is \$15.
¹¹⁸ Ibid.

<u>2025</u>MEEIA <u>4 2019-21</u> Plan

Revision <u>8</u>7.0

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∆kWh		= (kWh _{Office} * Weig	<u>ghting_{Office} + kWh</u> E	int * Weighting	Ent) * ISR				-	Formatted: Subscript	
Where:									\backslash	Formatted: Subscript	
	kWh _{Office}	= Estimated energy	savings from usir	ng an APS in a	home office					Formatted: Subscript	
	Weighting	= 31.0 kWh ¹¹⁹ = Relative penetrati	ion of use in home	office						Formatted: Subscript	
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	kWh _{Ent}	Estimated energy = 75.1 kWh ⁺²⁺	savings from usir	ng an APS in a	home entertainment	system					
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		-	Installation	Location	Weighting						
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			Home Entertainr	nent System	100% TOS, NC, DI: 64%	<u>6</u>					
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	ISR	- In carvice rate A	ctual or if unknow	un reference -	values in the table be	lowIn convice and	dependent on	rogram tuno			
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			KITS ¹²⁴		93.8%						
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Ameren Missouri	,	Appendix I - TRM – Vol. 3: Residential I	Measures Forma	atted: Font: (Default) Arial, 12 pt
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Where:				
	tric energy savings, as calculated above. mer peak coincidence demand (kW) to annual energy (kW <u>AkW</u> = AkWh * CF	h) factor		
Where:				
<u> </u>	-= Electric energy savings, as calculated above.			
CF = Sun = 0.00	mer peak coincidence demand (kW) to annual energy (kW 01148238 ¹²⁶	h) factor		
NATURAL GAS SAVINGS N/A				
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DEEMED O&M COST ADJUST N/A	MENT CALCULATION			
MEASURE CODE:				
	_			
126 Based on Ameron Missouri TDM	/olume 1 - Appendix G: "Table 1 – Residential End Use Category Mo	the Shapes and Coincident Dask Easters" Amount Min-	Nuri 2016	
loadshape for residential miscellaneou	s end-use. This is deemed appropriate, because savings occur during he	ours when the controlled standby loads are turned off by t	he APS. This	
https://www.nyserda.ny.gov/-/media/ Report.pdf'.	O, which representing the average of hours for controlled TV and comp roject/Nyserda/Files/EERP/Residential/Power-Management-Research-	Report.pdf; 'NYSERDA Advanced Power Strip Researc	1	
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3.2.2 Tier 2 Advanced Power Strip – Residential Audio Visual	
-	
DESCRIPTION This measure relates to the installation of a Tier 2 Advanced Power Strip / surge protector for household audio visual environments (Tier 2 AV	
This measure exacts to the instantation of a TeU 2 Advanced rower stup protection to induction a data visual environments (TeU 2 Adv PS). Tier 2 AV APS are multi-plug power strips that remove power from audio visual equipment through intelligent control and monitoring	
in order to the and many page power surger and reasons of power from action from a quipping and garphing an	
By utilizing advanced control strategies such as a countdown timer, external sensors (e.g. of infra-red remote usage and/or occupancy sensors, t	rue
RMS (Root Mean Square) power sensing; both active power loads and standby power loads of controlled devices are managed by Tier 2 AV A	<u>PS</u>
levices. ¹²⁷ Monitoring and controlling both active and standby power loads of controlled devices will reduce the overall load of a centralized	
group of electrical equipment (i.e. the home entertainment center). This more intelligent sensing and control process has been demonstrated to deliver increased energy savings and demand reduction compared with 'Tier 1 Advanced Power Strips'.	
enver increased energy savings and demand reduction compared with Ther T Advanced Power Surps.	
THIS MEASURE APPLIES TO THE INSTALLATION OF A THER 2 ADVANCED POWER STRIP FOR HOUSEHOLD AUDIO VISUAL ENVIRONMENTS	Formatted: Underline
THER 2 AV APS). THER 2 AV APS ARE MULTI-PLUG POWER STRIPS THAT REMOVE POWER FROM AUDIO VISUAL EQUIPMENT THROUGH	Formatted: Heading 4, Left, Space After: 0 pt
NTELLIGENT CONTROL AND MONITORING STRATEGIES. USING ADVANCED CONTROL STRATEGIES SUCH AS TRUE RMS (ROOT MEAN Souare) power sensing, and/or external sensors, 128 both active power loads and standby power loads of controlled	
NORME/TO TRADUCED BY THE 2 AV APS DEVICES. MONITORING AND CONTROLLING BOTH ACTIVE AND STANDBY POWER LOADS OF	
2011 AND A DEVICES WILL REDUCE THE OVERALL LOAD OF A CENTRALIZED GROUP OF ELECTRICAL FOURMENT (I.E. THE HOME)	
INTERTAINMENT CENTER). THIS INTELLIGENT SENSING AND CONTROL PROCESS HAS BEEN DEMONSTRATED TO DELIVER INCREASED	
ENERGY SAVINGS AND DEMAND REDUCTION COMPARED WITH THER 1 ADVANCED POWER STRIPS.	
THE TIER 2 AV APS MARKET IS A RELATIVELY NEW AND DEVELOPING ONE. WITH SEVERAL NEW TIER 2 AV APS PRODUCTS COMING TO	
THE THREE AT MID MARKET IS A REPORT HEW AND RECEARLY DEMONSTRATED THROUGH INDEPENDENT FIELD TRIALS. FIELD TRIAL	•
HOULD EFFECTIVELY ADDRESS THE INHERENT VARIABILITY IN AV SYSTEM USAGE PATTERNS. UNTIL THERE IS ENOUGH INDEPENDENT	
EVIDENCE TO DEMONSTRATE DEEMED SAVINGS FOR EACH OF THE VARIOUS CONTROL STRATEGIES, IT IS RECOMMENDED THAT PRODUCT	<u>8</u>
WITH INDEPENDENT FIELD TRIAL RESULTS BE PLACED INTO PERFORMANCE BANDS AND SAVINGS CLAIMED ACCORDINGLY.	
THIS MEASURE WAS DEVELOPED TO BE APPLICABLE TO THE FOLLOWING PROGRAM TYPE: DI. IF APPLIED TO OTHER PROGRAM TYPES, T	HE
NSTALLATION CHARACTERISTICS, INCLUDING THE NUMBER OF AV DEVICES UNDER CONTROL AND AN APPROPRIATE IN SERVICE RATE,	
INSTALLATION CHARACTERISTICS, INCLUDING THE NUMBER OF AV DEVICES UNDER CONTROL AND AN APPROPRIATE IN SERVICE RATE, SHOULD BE VERIFIED THROUGH EVALUATION.	
nstallation characteristics, including the number of AV devices under control and an appropriate in service rate, should be verified through evaluation. Definition of Efficient Equipment	
INSTALLATION CHARACTERISTICS, INCLUDING THE NUMBER OF AV DEVICES UNDER CONTROL AND AN APPROPRIATE IN SERVICE RATE, SHOULD BE VERIFIED THROUGH EVALUATION.	
NSTALLATION CHARACTERISTICS, INCLUDING THE NUMBER OF AV DEVICES UNDER CONTROL AND AN APPROPRIATE IN SERVICE RATE, HOULD BE VERIFIED THROUGH EVALUATION. DEFINITION OF EFFICIENT EQUIPMENT [The efficient case is the use of a Tier 2 AV APS in a residential AV (home entertainment) environment that includes control of at least 2 AV devi one being the television. ¹²⁹	
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ERP	upon independent f	ield trials of two product ma	nufacturers and the savings litional evaluation will be re-	e as provided below. Savings are based differences are assumed to relate to eviewed in future cycles to confirm if	
		Product Type	ERP used	•	Formatted: Font: (Default) Times New Roman
		Infrared Only Infrared and	40% ¹³³		Formatted Table
		Occupancy Sensor	25% ¹²⁴	/	Formatted: Font: (Default) Times New Roman
ergy reduction percentage	of qualifying Tier 2 A Product Class	V APS product Class; see ta Field Trial FRP Ra	ble below: ⁴⁵⁵		Formatted: Font: Times New Roman
	A	55 60%	55%		Formatted: Font: (Default) Times New Roman
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rding what action the APS would ies.	l have taken, but where equ	uipment is not actually switched of	f allowing evaluation of the expe	cted length of savings), and pre/post metering	Formatted: Left, Don't keep with next
AESC (page 30) - Valmiki, MM.			in Residential and Commercial A	Applications. Prepared for San Diego Gas &	Formatted: Left, Don't keep with next
Electric by Alternative Energy S AESC- Valmiki, MM., Corradini			Power Strips in Residential AV S	Systems. (Simulated 50%, pre/post 29%)	Formatted: Left, Don't keep with next
CalPlug research (Page 12) - Wa Irvine. (Simulated 51%)	ng, M. e. 2014. " <i>Tier 2 Ad</i> y	vanced Power Strip Evaluation for	Energy Saving Incentive". Califo	rnia Plug Load Research Center (CalPlug), UC	Formatted: Indent: First line: 0"
NMR Group Inc., RLPNC 17-3:		ering Study, Revised March 18, 20	19, submitted to Massachusetts P	rogram Administrators and EEAC. (Pre/post	Formatted: Font: (Default) Times New Roman
with regression 50%, Pre/post on Representative savings assumption		ndependent field tests on TrickeSta	r IR-OS product and reflect both	simulated and pre/post meter study results.	Formatted: Font: (Default) Times New Roman
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				rogram Administrators and EEAC. (Pre/post	Formatted: Font: (Default) Times New Roman

¹³⁷ "Energy Savings of Tier 2 Advanced Power Strips in Residential AV Systems," AESC, Inc., February 2016. Note this load represents the average *controlled* AV devices only and will likely be lower than total AV usage. <u>https://www.aesc-inc.com/wp-content/uploads/2017/07/tier 2 aps final report et13pge1441.pdf</u>; <u>'tier 2 aps final report et13pge1441.pdf</u>, page 7.

<u>2025</u>MEEIA <u>4 2019-21</u> Plan

Revision <u>8</u>7.0

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ISR	——————————————————————————————————————	Formatted: Indent: Left: 0.5", Hanging: 1.5"
	Program/Channel In Service Rate (ISR) TOS, NC, DIIncome Eligible ¹³⁸ 95%	
	Efficient Kits ¹³⁹ 93.8%	
	SF Low Income Kits ¹⁴⁰ 93.8%	
ased on the default value	s above, default savings are provided in the table below:	
	<u>AkWh</u>	
	Program Type Infrared and	
	<u>Only</u> <u>Oecupancy</u>	
	TOS, NC, DIIncome Eligible 177.08 410.68	
	<u>TOS, NC, DI</u> Income Eligible 177.08 <u>110.68</u> <u>Efficient Kits</u> <u>174.84</u> <u>109.28</u>	
	Efficient Kits 177-84 109-28 SF Low Income Kits 174.84 109-28	
	<u>51 Low Income Ands</u> <u>177.07</u> <u>107.20</u>	Formatted: Space After: 6 pt
	Program Type AkWh	
	TOS, NC, DI 153.90	
	Efficient Kits 151.96	
	CEL on Loone Kite 151 oc	
$\Delta kW = \Delta kWh * C$		
$\frac{\Delta kW = \Delta kWh * C}{\frac{here:}{\Delta kWh}}$	Electric energy savings, as calculated above, Summer peak coincidence demand (kW) to annual energy (kWh) factor	
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Ameren Missouri	Appendix I - TRM – Vol. 3: Residential Mea	SUICES Formatted: Font: (Default) Ar	iai, 12 pt
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3.3 Hot Water			
3.3.1 Low Flow Fauce	t Aerator		
	installation of a low flow faucet aerator in a household kitchen or bath faucet fixture.		
	for units provided through efficiency kits. However, the in-service rate for such measures should be derived t lly for this implementation methodology.	hrough	
This measure was developed	d to be applicable to the following program types: TOS, NC, RF, DI, and KITS.		
If applied to other program	types, the measure savings should be verified.		
	r EQUIPMENT the installed equipment must be a low flow faucet aerator for bathrooms rated at 1.5 gallons per minute (GPM) GPM or less. Savings are calculated on an average savings per faucet fixture basis.	or less	
at 2.75 GPM or greater. Ave	ssumed to be a standard bathroom faucet aerator rated at 2.25 GPM or greater or a standard kitchen faucet aerator erage measured flow rates are used in the algorithm and are lower, reflecting the penetration of previously install the freerider rate for this measure should be 0), use of the faucet at less than full flow, debris buildup, and lowe	ed low	
DEEMED LIFETIME OF EFF The expected measure life is	FICIENT EQUIPMENT is assumed to be 10 years. ¹⁴²		
DEEMED MEASURE COST The incremental cost for thi	is measure is \$11.33 ¹⁴³ or program actualactual cost.		
E - francista			
reference cost of use \$3.00 <u>.</u> " LOADSHAPE	d in efficiency kits, the actual program delivery costs should be utilized. Absent of program data, <u>for efficien</u> 	cy kto	
reference cost of use \$3.00 <u>.</u> " LOADSHAPE			
reference cost ofuse \$3.00, ¹⁺ LOADSHAPE Water Heating RES	Algorithm		
reference cost of use \$3.00, ⁴⁺ LOADSHAPE Water Heating RES CALCULATION OF SAVING ELECTRIC ENERGY SAVIN	Algorithm		
reference cost ofuse \$3.00, ⁴ LOADSHAPE Water Heating RES CALCULATION OF SAVING ELECTRIC ENERGY SAVING Note these savings are <i>per</i> f	Algorithm S GS faucet retrofitted ¹⁴⁵ (unless faucet type is unknown, then it is per household).	Formatted: Space After: 6 pt	
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			Formatted: Normal
	Electric 100%		
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	Unknown 42% ¹⁴⁶		
GPM _{base}	= Average flow rate, in gallons per minute, of the baseline	faucet "as-used" This includes the effect of e	vieting
JI WIbase	low flow fixtures and therefore the freerider rate for this me		Aisting
	$= 2.2^{147}$ or custom based on metering studies ¹⁴⁸ or if measured		
	= Measured full throttle flow $*$ 0.83 throttling factor ¹⁴⁹	6	
GPM _{low}	= Average flow rate, in gallons per minute, of the low-flow	faucet aerator "as-used"	
	= 1.5 ¹⁵⁰ or custom based on metering studies ¹⁵¹ or if measur	red during DI:	
	= Rated full throttle flow * 0.95 throttling factor ¹⁵²		
L _{base}	= Average baseline daily length faucet use per capita for fa		
	= if available custom based on metering studies, if not use:		
	Faucet Type	L _{base} (min/person/day) Kitchen Bathroom	
	Efficient Kits (School Kits, MF, ARP Kits)	Kitchen Bathroom 4.5 ¹⁵³ 1.6 ¹⁵⁴	
	Income Eligible ; MFMR, PAYS , Efficient Kits (SF LI		Formatted Table
	Kits) ¹⁵⁵	3.7 3.7	
	If location unknown (total for household): Single Family	7.8 ¹⁵⁶	Formatted Table
	If location unknown (total for household): Multi-Family	6.7 ¹⁵⁷	Tormatted Table
L _{low}	= Average retrofit daily length faucet use per capita for fau	cet of interest in minutes	
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	Faucet Type	(min/person/day)	
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	Income Eligible; MFMR, PAYS, Efficient Kits (SFLI	3.7 3.7	
	Kits)Efficient Kits (Multifamily, SFLI Kits); MFMR ¹⁶⁰		
	Income Eligible Common Area ¹⁶¹ If location unknown (total for household): Single Family	N/A 1.5 7.8 ¹⁶²	
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Ameren Missouri	Ap	pendix I - TRM – Vol. 3: Resider	ntial Measures	Formatted: Font: (Default) Arial, 12 pt
				Formatted: Normal
	Faucet Type	L _{low} (min/person/day) Kitchen Bathroom		
	If location unknown (total for household): Multi-Family	6.7 ¹⁶³] •	Formatted Table

463 One kitchen faucet plus 1.4 bathroom faucets. Based on findings from an Ameren Missouri PY2013 data for multifamily h

<u>2025</u>MEEIA <u>4</u>2019-21 Plan

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Revision <u>8</u>7.0

en Missouri		Appendix I -	TRM – Vol. 3: Resi	dential Measures	Formatted: Font: (Default) Arial, 12 pt
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Household	= Average number of people per household			•	Formatted: Space After: 6 pt
	Program Delivery and Household Unit Type	Valu	e		
	Single-Family	2.67 ⁴			Formatted Table
	School Kits	4.286			Formatted Table
	Efficient Kits (MF)	1.777	166		
	Multi-Family MR - Deemed	1.56 ⁴	67		Formatted Table
	Income Eligible, Efficient Kits (SFLI Kits),	1.564	168		(
	PAYS ARP Kits	2.654	69		
		Actual Occupancy			
	Custom	Bedroor		•	Formatted Table
365.25	= Days in a year, on average.				Formatted: Space Before: 6 pt
DF	= Drain Factor				Formatted: Indent: Left: 0.5", First line: 0", Space
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	Program Delivery	Drain Factor Kitchen Bath			(P,
	Non SFLI Kits ¹⁷¹				
	Income Eligible, MFMR.; SFLI Kits,	100%		-	Formatted Table
	PAYS ¹⁷²	100%			
	Unknown	79.5% N/A		4	Formatted Table
FPH	= Faucets Per Household			•	Formatted: Space Before: 4 pt, After: 6 pt
		FP	H		C
	Program Delivery	Kitchen	Bathroom		
		(KFPH)	(BFPH)		
	Single Family	1.19 ¹⁷³	2.04 ¹⁷⁴	•	Formatted Table
	School Kits	1.19 ⁴⁷⁵	2.28 ¹⁷⁶		
	Efficient Kits (MF)	$\frac{1.00^{177}}{1.00^{177}}$	1.337 ¹⁷⁸		
	Multi-Family (MFMRIncome Eligible), PAYS	1.00^{179}	1.86 ¹⁸⁰		
	Income Eligible, Efficient Kits (SFLI Kits)	1.00	1.86 ¹⁸¹		
	If location unknown (total for household): Single-Family			4	Formatted Table
	If location unknown (total for household): Multi-Family	2.4	ł		
EPG_electric	= Energy per gallon of water used by faucet supp		heater		
	= (8.33 * 1.0 * (WaterTemp - SupplyTemp)) / (F	RE_electric * 3412)			
en Missouri Efficient P en Missouri Energy Eff	roducts Impact and Process Evaluation: Planning Year 2015, provid icient Kits Program Impact and Process Evaluation: PY2019 <u>, https</u>	ded by Cadmus. <u>https://ww</u> ://www.efis.psc.mo.gov/Do	w.efis.psc.mo.gov/Document cument/Display/15876_page	t/Display/13805, page 36	
18 Energy Efficiency k	its Property Manager Survey results (I1-I2), https://www.efis.psc.n	no.gov/Document/Display/	15870, page 34.	<u></u> .	
en Missouri Communit	y Savers Evaluation: PY2018, https://www.efis.psc.mo.gov/Docum	ent/Display/36053.			
	ported in PY2016). Ameren Missouri Low Income and Process Ev Recycling Program Evaluation: PY2019 <u>, https://www.efis.psc.mo.</u> ;				
oms are suitable proxie	s for household occupancy and may be preferable to actual occupat	ncy due to turnover rates in	residency and non-adult pop	ulation impacts.	
	imes dictated by volume (e.g., filling a cooking pot), only usage of hat has determined this specific factor and so recommends these va				
wn, an average of 79.59	δ should be used, which is based on the assumption that 70% of ho				
5)+(0.3*0.9)=0.795. en Missouri Communit	y Savers Evaluation PY2018 <u>, https://www.efis.psc.mo.gov/Docume</u>	ant/Display/36052			
en Missouri Energy Efi	icient Kits Evaluation: PY2018, https://www.efis.psc.mo.gov/Docu	iment/Display/15870, page	<u>34</u> .		
l on findings from a 20	2 Ameren Missouri potential study for single family homes.				
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		Appendix I - I	<u> RIVI – VOI. 3:</u>	Residential Measu	Formatted: Font: (Default) Arial	il, 12 pt
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		n)				
1.0 WaterTemp	————————————————————————————————————				Formatted: Indent: Left: 0"	
water remp	= Assumed temperature of mixed water = 86F for Bathroom	(80F for Income E	ligible, PAYS a	nd MFMR), 93F for	Formatted: Indent: First line: 0)"
hen, 91F for Unkr			U			
SupplyTemp	= Assumed temperature of water entering house				Formatted: Indent: Left: 0"	
RE_electric	$\frac{1}{1} = \frac{5861.43}{1} \text{ as } \text{ and } an$				Formatted: Indent: Left: 0.5", F	inst lines Of
RE_clocule	= 1000 very enherency of creating which header == 98% ¹⁸⁴				Formatted: Indent. Leit. 0.5 , F	first line. 0
3,412	= Converts Btu to kWh (btu/kWh)				Formatted: Indent: Left: 0"	
ISR	 In-service rate. Actual, or if unknown, reference applicable aerators dependant on install method as listed in table below 	assumed value in f	the table below:	In service rate of fauce		
	actators dependant on mistan method as instea in table below	Ter Com	D-4-	1		
	Selection	In-Serv Kitchen	ice Rate Bathroom			
	Direct Install, Efficiency Kit Low Income ¹⁸⁵	89%	89%	4	Formatted Table	
	Efficiency Kit (School) Single Family ¹⁸⁶	40%	48%	1	Formatted Table	
	Efficiency Kit Appliance Recycling ¹⁸⁷	20%	24%]		
	Efficiency Kit (School) — Multi Family ¹⁸⁸	100%	100%			
	Income Eligible, <u>PAYS</u> Direct Install (Income Eligible and MFMR) ¹⁸⁹	95%	95%			
	Income Eligible, Non-Direct Install ¹⁹⁰	40%	48%	1		
	Income Eligible, Common Area	N/A	97.7%]		
	Pay As You Save ¹⁸¹	80.9%	80.9%			
<u>Leakage</u>	= Percent homes outside service territory Program Leakage School Kits 28% ¹⁴³ Other ProgramsIncome 0% Eligible, PAYS 0%				Formatted Table	
<u>Leakage</u>	Program Leakage School Kits 28% ¹⁹² Other ProgramsIncome 0%				Formatted Table	er: 6 pt
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Ameren Missouri	Appendix I - TRM – Vol. 3: Residential Measu	Formatted: Font: (Default) Arial, 12 pt
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	alculated above Imer peak coincidence demand (kW) to annual energy (kWh) factor	
	00887318 ¹⁹³	
NATURAL GAS SAVIN	GS	
ΔTherms	= %GasDHW * (GPMbase * L_base - GPMlow * Llow) * Household * 365.25 *DF / FPH * EPG_gas * ISR * (1 - Leakag	re)
		-
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<u>ATherms</u> = Where:	%GasDHW * ((GPM _{base} * L _{base} – GPM _{tow} * L _{tow}) * Household * 365.25 * DF / FPH) * EPG_gas * ISR	
%GasDHW	= proportion of water heating supplied by Natural Gas heating	
	DHW fuel %GasHW	
	Electric 0% Natural Gas 100%	
	Unknown 48% ¹⁹⁴	
EPG_gas	= Energy per gallon of Hot water supplied by gas	
RE_gas	= (8.33 * 1.0 * (WaterTemp - SupplyTemp)) / (RE_gas * 100,000) = Recovery efficiency of gas water heater	
	= 78% For SF homes ¹⁹⁵ = 67% For MF homes ¹⁹⁶	
100,000	= Converts Btus to therms (btu/therm)	
Other	variables as defined above.	
WATER IMPACT DESC	CRIPTIONS AND CALCULATION	
ΔGallons	= ((GPMbase * L_base - GPMlow * Llow) * Household * 365.25 *DF / FPH) * ISR * (1 - Leakage)	
$\Delta aallons = ((GPM)$	base * L base – GPM low * L low) * Household * 365.25 * DF / FPH) * ISR	Formatted: Normal
Variables as d		Formatted: Indent: Left: 0"
	Adjustment Calculation	
N/A		
MEASURE CODE:		
	uri TRM Volume 1 - Appendix G: "Table 1 - Residential End Use Category Monthly Shapes and Coincident Peak Factors", Ameren Missouri 2016	
	inknown fuel is based on EIA Residential Energy Consumption Survey (RECS) 2009 for Midwest Region, data for the state of Missouri, 'HC8.9 W.	
that should be used.	xls'. If utilities have specific evaluation results providing a more appropriate assumption for homes in a particular market or geographical area, the	
to 0.95 for the highest effici	recovery efficiency with an average around 0.76 for gas- fired storage water heaters and 0.78 for standard efficiency gas fired tankless water heater iency gas fired condensing tankless water heaters. These numbers represent the range of new units however, not the range of existing units in stock.	s up
196 Water heating in multifa	suggests range of recovery efficiency ratings for new gas DHW units of 70-87%. Average of existing units is estimated at 78%. mily buildings is often provided by a larger central boiler. This suggests that the average recovery efficiency is somewhere between a typical central	
boiler efficiency of 0.59 and	d the 0.75 for single family homes. An average efficiency of 0.67 is used for this analysis as a default for multifamily buildings.	
<u>2025 MEEIA 4 2019</u>	-21-Plan Revision 87.0 Page	57
<u>2020</u> WILLIA <u>4</u> 2013		

Ameren Missouri	Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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3.3.2 Low Flow Showerhead		
DESCRIPTION		
This measure relates to the installation of a low flo	ow showerhead in a single or multifamily household.	
This measure may be used for units provided three evaluation results specifically for this implementation	ough efficiency kit's. However, the in-service rate for such measures should be derived through tion methodology.	
This measure was developed to be applicable to th	ne following program types: TOS, RF, NC, DI, and KITS.	
If applied to other program types, the measure sav	rings should be verified.	
DEFINITION OF EFFICIENT EQUIPMENT To qualify for this measure the installed equipmen are calculated on a per showerhead fixture basis.	tt must be a low flow showerhead, typically rated at 2.0 gallons per minute (GPM) or less. Savings	
For RF and TOS programs, the baseline condition	ed to be a standard showerhead rated at 2.5 GPM ¹⁹⁷ or greater. m is assumed to be a representative average of existing showerhead flow rates of participating eads, standard flow showerheads, and high flow showerheads.	
DEEMED LIFETIME OF EFFICIENT EQUIPMENT The expected measure life is assumed to be 10 year	ars. ¹⁹⁸	
DEEMED MEASURE COST The incremental cost for TOS_NC_or KITS is \$7 ⁺	¹⁰⁹ for standard showerheads and \$15.02 for handheld showerheads or program actual.	
	programs, the actual program delivery costs should be utilized; if unknown assume \$15.33 ²⁰⁰ for	
standard showerheads and \$23.35 for handheld sho		
LOADSHAPE		
Water Heating RES		
	Algorithm	
CALCULATION OF SAVINGS		
ELECTRIC ENERGY SAVINGS Note these savings are per showerhead fixture		
ΔkWh = %ElectricDHW * ((GP	PM _{base} * L _{base} - GPM _{low} * L _{low} * Household * SPCD * 365.25 / SPH) * EPG_electric * ISR * (1	Formatted: Subscript
<u>– Leakage)</u>	le la	Formatted: Subscript
		Formatted: Subscript
$\frac{AkWh}{Wh} = \frac{\%ElectricDHW}{EPC}$	/ * ((GPM _{Base} + L _{Base} - GPM _{tow} * L _{tow}) * Household * SPCD * 365.25 / SPH)- ctric * ISR	Formatted: Subscript
+ DI U_CICI		
		Formatted: Indent: Left: 0", Hanging: 1.5"
Where: %ElectricDHW = proportion of w	vater heating supplied by electric resistance heating	Formatted: Indent: Left: 0", Hanging: 1.5"
		Formatted: Indent: Left: 0", Hanging: 1.5"
%ElectricDHW = proportion of w ¹⁹⁷ Maximum showerhead flow rate at 80 PSI is 2.5 GPM in a https://www.regulations.gov/document?D=EERE-2011-BT-7 ¹⁹⁸ Table C-6, "Measure Life Report, Residential and Comme dissatifaction may lead to reductions in persistence, particulu 'HVAC Lig measure life GDS 2007.pdf, page C-6 https: 'HVAC Lig measure life GDS 2007.pdf, page C-6 https://	vater heating supplied by electric resistance heating accordance with federal standard 10 CFR Part 430.32(p). See docket filed at	Formatted: Indent: Left: 0", Hanging: 1.5"
%ElectricDHW = proportion of w ¹⁹⁷ Maximum showerhead flow rate at 80 PSI is 2.5 GPM in a https://www.regulations.gov/document?D=EERE-2011-BT-1 ¹⁹⁸ Table C-6, "Measure Life Report, Residential and Comme dissatisfaction may lead to reductions in persistence, particulu ; "HVAC Ltg measure life GDS 2007.pdf", page C-6 https: ¹⁹⁹ Based on online pricing market research 2/6/2017. ²⁰⁰ Direct-install price per showerhead assumes cost of showe	vater heating supplied by electric resistance heating accordance with federal standard 10 CFR Part 430.32(p). See docket filed at <u>IP-0061-0039</u> reial/Industrial Lighting and HVAC Measures," GDS Associates, June 2007. Evaluations indicate that consumer arly in Multifamily. https://www.caetm.com/media/reference-documents/HVAC Ltg measure life GDS 2007.pdf;	Formatted: Indent: Left: 0", Hanging: 1.5"
 %ElectricDHW = proportion of w ⁹⁷ Maximum showerhead flow rate at 80 PSI is 2.5 GPM in a type://www.regulations.gov/document?D=EERE-2011-8T-1 %8 Table C-6, "Measure Life Report, Residential and Comme lissatisfaction may lead to reductions in persistence, particula 'HVAC Ltg measure life GDS 2007.pdf', page C-6 http://wBased on online-prieing-market research-20/2017. ⁰⁰ Direct-install price per showerhead assumes cost of showe s in line with the typical prevailing wage of a General Labore 	vater heating supplied by electric resistance heating accordance with federal standard 10 CFR Part 430.32(p). See docket filed at <u>TP-0061-0039</u> reial/Industrial Lighting and HVAC Measures," GDS Associates, June 2007. Evaluations indicate that consumer arly in Multifamily. <u>https://www.caetrm.com/media/reference-documents/HVAC_Ltg_measure_life_GDS_2007.pdfr</u> <u>//neep.org/uploads/EMV%20Forum/EMV%20Studies/measure_life_GDS%5B1%5D.pdf</u> .	Formatted: Indent: Left: 0", Hanging: 1.5"

en Missouri		Appendix I - TRM –	Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12
				Formatted: Normal
	DHW fuel %ElectricDHW			
	Electric 100%			
	Natural Gas 0% Unknown 42% ²⁰¹			Formatted Table
	Unknown 42% ²⁰¹			
				Formatted: Space Before: 6 pt
GPM _{base}	= Flow rate of the baseline showerhead			
	Program Delivery	GPM base		
	Direct-install , SFLI Kits	2.2 ²⁰²		
	Retrofit, Efficiency Kits, NC or TOS	2.35²⁰³		Formatted Table
	MFMR	2.5 ²⁰⁴		
GPM _{low}	= As-used flow rate of the lowflow shower	head ²⁰⁵ , which may, as a result of me	asurements of program	Formatted: Space After: 0 pt
	evaulations deviate from rated flows. If the			
	applied, see table below:			
	Rated Flow			
	2.0 GPM			
	1.75 GPM			
	1.5 GPM			
	Custom or Actual ²⁰⁶			
L _{base}	= Shower length in minutes with baseline s = $\frac{7.8 \text{ min}^{207} \text{ and }}{8.66}$ for Income Eligible a			Formatted: Space Before: 0 pt
Llow	= $\frac{7.8 \text{ mm}^{-3}}{100000000000000000000000000000000000$			
-low	= 500 wer rength in minutes with 10w-10w = $\frac{7.8 \text{ min}^{209} \text{ and } 8.66 \text{ for Income Eligible a}$			
Household	= Average number of people per househol			
	Program Delivery	Household		
	Program Delivery Single-Family TOS, Income Eligible (SFIE Kits)	Household 2.67 ²¹¹		
	Program Delivery Single-Family <u>TOS, Income Eligible (SFIE Kits)</u> School Kits	Household 2.67 ²¹¹ 4.29 ²¹²		
	Single-Family TOS, Income Eligible (SFIE Kits)	2.67 ²¹¹		
	Single-Family <u>TOS</u> , Income Eligible (SFIE Kits) School Kits Efficient Kits (MF)	2.67 ²¹¹ 4.29 ²¹² 1.777 ²⁴³	876, page 73.	
n Missouri Communit entative value from se	Single-Family <u>TOS</u> , Income Eligible (SFIE Kits) School Kits Efficient Kits (MF) fficient Kits Impact and Process Evaluation: <u>PY2019</u> , <u>https://</u> y Savers Evaluation: <u>PY2018</u> , <u>https://www.cfis.cf.mo.gov</u>	2.67 ²¹¹ 4.29 ³¹³ 1.777 ³⁴³ 4.777 ³⁴³ www.efis.psc.mo.gov/Document/Display/150 Document/Display/36053. exection adjusted slightly upward to account	t for program participation, which is	
en Missouri Communit sentative value from se to target customers wi	Single-Family <u>TOS</u> , Income Eligible (SFIE Kits) School Kits Efficient Kits (MF) fficient Kits Impact and Process Evaluation: PY2019, https:// ty Savers Evaluation: PY2018, https://www.efis.psc.mo.gov/ purces 1, 2, 4, 5, 6, and 7 (See Source Table at end of measur th existing higher flow devices rather than those with existing	2.67 ²¹¹ 4.29 ²¹² 1.777 ²⁴³ <u>1.777²⁴³</u> <u>www.efis.pse.mo.gov/Document/Display/15</u> Document/Display/36053. e section) adjusted slightly upward to accoun jow flow devicesIL TRM v12.0, Volume 3,	t for program participation, which is	
n Missouri Communit entative value from se o target customers wi loads/IL TRM Effec	Single-Family <u>TOS</u> , Income Eligible (SFIE Kits) School Kits Efficient Kits (MF) fficient Kits Impact and Process Evaluation: <u>PY2019</u> , <u>https://</u> y Savers Evaluation: <u>PY2018</u> , <u>https://www.cfis.cf.mo.gov</u>	2.67 ²¹¹ 4.29 ³⁴³ 4.7777 ²⁴³ <u>4.7777²⁴³</u> <u>www.efis.pse.mo.gov/Document/Display/150</u> Document/Display/36053. e-section) adjusted slightly upward to accoun glow flow devices <u>IL_TRM v12.0, Volume 3,</u> <u>if</u>	t for program participation, which is	
en Missouri Communit sentative value from so to target customers wi ploads/IL_TRM_Effec 19 Program Data <u>, https</u> hat actual values may	Single-Family <u>TOS</u> , Income Eligible (SFIE-Kits) School Kits Efficient Kits (MF)	2.67 ²¹¹ 4.29 ²¹³ 1.777 ²⁴³ <u>1.777²⁴³</u> <u>www.efis.pse.mo.gov/Document/Display/15</u> Document/Display/36053. e-section) adjusted slightly upward to accoun e-section) adjusted slightly upward to accoun e-section) adjusted slightly upward to accoun e-section account to account the section of	t for program participation, which is page 271, https://www.ilsag.info/wp-	
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Appendix I - TRM – Vol. 3: Residential Measures

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Program Delivery	Household
Income Eligible Multi-Family <u>, PAYS Multi-</u> Family	1.52^{214}
Appliance Recycling Kits	2.65²¹⁵
Multi-Family TOS, MFMR	2.07 ²¹⁶
Custom	Actual Occupancy or Number of Bedrooms217

<u>2025 MEEIA 4 2019-21 Plan</u>

Revision <u>8</u>7.0

 ²¹⁴ Ameren Missouri Community Savers Evaluation: PY2018, https://www.cfis.psc.mo.gov/Document/Display/36053, page 39.
 ³¹⁴ Ameren Missouri Appliance Recycling Evaluation PY2019 (Appendix Table 55), https://www.efis.psc.mo.gov/Document/Display/15876, page 92.
 ³¹⁴ Matches PY2015 Community Savers EM&V, https://www.efis.psc.mo.gov/Document/Display/13809, page 20.
 ²¹⁷ Bedrooms are suitable proxies for household occupancy and may be preferable to actual occupancy due to turnover rates in residency and non-adult population impacts.

		Appendix I	- TRM – Vol. 3: Residential Me	asures.	Formatted: Font: (Default) Arial, 12 pt
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SPCD	= Showers Per Capita Per Day				
	$=$ $\frac{0.832^{218}}{0.832^{218}}$ and 0.66 for Incomem Eligible, MF	MR, SFIE Kits, and PAYS ²¹⁹			
365.25 SPH	= Days per year, on average.	wanta and accelerate functions can	he determined		
SPIT	= Showerheads Per Household so that per-sho	<u> </u>	be determined		
	Program Delivery	SPH			
	Single Family, Income Eligible Single Family, PAYS(SFIE Kits)	2.05 ²²⁰			
	School Kits	2.14221			
	Efficient Kits (MF)	1.34 ²²²			
	Income Eligible Multi-Family, PAYS Multi-	1.0223			
	Family				
	MFMR	1.4 ²²⁴			
	Custom	Actual			
EPG_electric	= Energy per gallon of hot water supplied by e = (8.33 * 1.0 * (ShowerTemp - SupplyTemp)) = (8.33 * 1.0 * (101 - 60.83)) / (0.98 * 3412) = 0.100 kWh/gal = Specific weight of water (lbs/gallon)				Formatted: Indent: First line: 0.5", Space Before:
1.0	= Heat capacity of water (btu/lb-°)				
ShowerTemp	= Assumed temperature of water = 105.0 F^{225}				
SupplyTemp	= Assumed temperature of water entering hous = $58.4F^{226}61.3F^{227}$	se			
RE_electric	= Recovery efficiency of electric water heater = $98\%^{228}$				
3,412 ISR	= Converts Btu to kWh (btu/kWh) = In service rate of showerhead				
	listed in table below: Program Delivery Direct Install ²²⁹	ISR 100%		•(Formatted Table
	Efficiency Kit School (Single Family) ²³⁰	54%			
	Efficiency Kit—Multifamily ²³¹	100%			
	Efficiency Kit Appliance Recycling ²³²	24%			
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	Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
		Formatted: Normal
RE_gas	= 0.00499 therm/gal for MF homes = Recovery efficiency of gas water heater	
KL_gas	= 78% For SF homes ²⁴⁰	Formatted: Indent: Left: 0"
100,000	= 67% For MF homes ²⁴¹ = Converts Btus to therms (btu/Therm)	
100,000	Other variables as defined above.	Formatted: Indent: Left: 0"
WATER IMPACT DES	CRIPTIONS AND CALCULATION	
Gallons = ((G	PM _{base} * L _{base} - GPM _{low} * L _{low}) * Household * SPCD * 365.25 / SPH) * ISR * (1 – Leakage)	
	4	Formatted: Normal
Igallons = ((GP M	I_base + L_base GPM_low + L_low) + Household + SPCD + 365.25/SPH) + ISR	
Variables as defined a	bove	
DEEMED O&M COST N/A	ADJUSTMENT CALCULATION	
MEASURE CODE:		
0.95 for the highest effic	s recovery efficiency with an average around 0.76 for gas-fired storage water heaters and 0.78 for standard efficiency gas fired tankless water heaters up iency gas-fired condensing tankless water heaters up	
b 0.95 for the highest efficiency Review of AHRI Directory	s recovery efficiency with an average around 0.76 for gas-fired storage water heaters and 0.78 for standard efficiency gas fired tankless water heaters up izency gas-fired condensing tankless water heaters. However, these numbers represent the range of new units, not the range of existing units in stock. suggests range of recovery efficiency ratings for new gas DHW units of 70-87%. Average of existing units is estimated at 78%.	

<u>2025 MEEIA 4 2019-21 Plan</u>

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Revision <u>8</u>7.0

Page <mark>63</mark>

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		Formatted: Normal
.3.3 Water H	Heater Wrap (Retired, effective 1/1/2025) ²⁴²	
ESCRIPTION		Formatted: Font color: Background 1
	EFFICIENT EQUIPMENT dition is an electric or gas DHW tank with wrap installed that has an R-value that meets program requirements.	
	BASELINE EQUIPMENT dition is an uninsulated electric or gas DHW tank.	
	ME OF EFFICIENT EQUIPMENT is assumed to be 12 years. ²⁴³	
DEEMED MEASUI The measure cost	RE COST is the actual cost of material and installation. If actual costs are unknown, assume \$58 ²⁴⁴ for material and installation.	
.OADSHAPE Vater Heating RE		
0		
ALCULATION O	Algorithm	
CALCULATION OF	Algorithm	
CALCULATION OF	Algorithm OF SAVINGS GY SAVINGS on below for electric DHW tanks, otherwise use default values from table that follows:	Formatted: Font color: Background 1
ALCULATION OF LECTRIC ENER(ustom calculatio	Algorithm bF SAVINGS GY SAVINGS on below for electric DHW tanks, otherwise use default values from table that follows: = (($A_{Base}/R_{Base} - A_{EE}/R_{EE}$) * ΔT * Hours) / (η DHW _{Elec} * 3,412)	Formatted: Font color: Background 1 Formatted: Font color: Background 1
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ALCULATION OF LECTRIC ENERC ustom calculatio kWh /here: A _{Base}	Algorithm F SAVINGS GY SAVINGS on below for electric DHW tanks, otherwise use default values from table that follows: $= ((A_{Base}/R_{Base} - A_{EE}/R_{EE}) * \Delta T * Hours) / (\eta DHW_{Elec} * 3,412)$ $\Delta kWh = ((A_{Base}/R_{Base} - A_{EE}/R_{EC}) * \Delta T * Hours) / (\eta DHW_{Elec} * 3,412)$ = Surface area (ft ²) of storage tank prior to adding tank wrap ²⁴⁵ = Actual or if unknown, use default based on tank capacity (gal) from table below	Formatted: Font color: Background 1 Formatted: Font color: Background 1
ALCULATION OF LECTRIC ENERG ustom calculatio kWh	Algorithm F SAVINGS GY SAVINGS on below for electric DHW tanks, otherwise use default values from table that follows: $= ((A_{Base} - A_{EE}/R_{EE}) * \Delta T * Hours) / (\eta DHW_{Elec} * 3,412)$ $\Delta kWh = ((A_{Base} - A_{EE}/R_{EE}) * \Delta T * Hours) / (\eta DHW_{Elec} * 3,412)$ = Surface area (ft ²) of storage tank prior to adding tank wrap ²⁴⁵ = Actual or if unknown, use default based on tank capacity (gal) from table below = Thermal resistance coefficient (hr-°F-ft ² /BTU) of uninsulated tank	Formatted: Font color: Background 1 Formatted: Font color: Background 1 Formatted: Font color: Background 1
ALCULATION OF LECTRIC ENERC ustom calculatio kWh /here: A _{Base}	Algorithm F SAVINGS GY SAVINGS on below for electric DHW tanks, otherwise use default values from table that follows: $= ((A_{Base} - A_{EE}/R_{EE}) * \Delta T * Hours) / (\eta DHW_{Elec} * 3.412)$ $\Delta kWh = ((A_{Rase}/R_{Rase} - A_{EE}/R_{EC}) * \Delta T * Hours) / (\eta DHW_{Elec} * 3.412)$ = Surface area (ft ²) of storage tank prior to adding tank wrap ²⁴⁵ = Actual or if unknown, use default based on tank capacity (gal) from table below = Thermal resistance coefficient (hr-°F-ft ² /BTU) of uninsulated tank = Surface area (ft ²) of storage tank after addition of tank wrap ²⁴⁷	Formatted: Font color: Background 1 Formatted: Font color: Background 1 Formatted: Font color: Background 1 Formatted: Font color: Background 1
CALCULATION OF LECTRIC ENERG ustom calculatio kWh /here: ABase RBase	Algorithm JF SAVINGS GY SAVINGS on below for electric DHW tanks, otherwise use default values from table that follows: $= ((A_{Base} - A_{EE}/R_{EE}) * \Delta T * Hours) / (\eta DHW_{Elec} * 3,412)$ $\Delta kWh = ((A_{Rase}/R_{Rase} - A_{er}/R_{er}) * \Delta T * Hours) / (\eta DHW_{elec} * 3,412)$ = Surface area (ft ²) of storage tank prior to adding tank wrap ²⁴⁵ = Actual or if unknown, use default based on tank capacity (gal) from table below Thermal resistance coefficient (hr-°F-ft ² /BTU) of uninsulated tank = Actual or if unknown, assume 14 ³⁴⁶	Formatted: Font color: Background 1 Formatted: Font color: Background 1 Formatted: Font color: Background 1 Formatted: Font color: Background 1 Formatted: Font color: Background 1
ALCULATION OF LECTRIC ENERG ustom calculatio cWh There: ABase RBase	Algorithm F SAVINGS GY SAVINGS on below for electric DHW tanks, otherwise use default values from table that follows: $= ((A_{Base} - A_{EE}/R_{EE}) * \Delta T * Hours) / (\eta DHW_{Elec} * 3.412)$ $\Delta kWh = ((A_{Rase}/R_{Rase} - A_{EE}/R_{EC}) * \Delta T * Hours) / (\eta DHW_{Elec} * 3.412)$ = Surface area (ft ²) of storage tank prior to adding tank wrap ²⁴⁵ = Actual or if unknown, use default based on tank capacity (gal) from table below = Thermal resistance coefficient (hr-°F-ft ² /BTU) of uninsulated tank = Surface area (ft ²) of storage tank after addition of tank wrap ²⁴⁷	Formatted: Font color: Background 1 Formatted: Font color: Background 1
ALCULATION OF LECTRIC ENERG ustom calculatio kWh /here: ABase RBase	Algorithm F SAVINGS GY SAVINGS on below for electric DHW tanks, otherwise use default values from table that follows: $= ((A_{Base} - A_{EE}/R_{EE}) * \Delta T * Hours) / (\eta DHW_{Elec} * 3.412)$ $\Delta kWh = ((A_{Rase}/R_{Rase} - A_{EE}/R_{EC}) * \Delta T * Hours) / (\eta DHW_{Elec} * 3.412)$ = Surface area (ft ²) of storage tank prior to adding tank wrap ²⁴⁵ = Actual or if unknown, use default based on tank capacity (gal) from table below = Thermal resistance coefficient (hr-°F-ft ² /BTU) of uninsulated tank = Surface area (ft ²) of storage tank after addition of tank wrap ²⁴⁷	Formatted: Font color: Background 1 Formatted: Font color: Background 1
ALCULATION OF LECTRIC ENERG ustom calculation (Wh /here: ABase RBase AEE	Algorithm F SAVINGS on below for electric DHW tanks, otherwise use default values from table that follows: $= ((A_{Base} - A_{EE}/R_{EE}) * \Delta T * Hours) / (\eta DHW_{Elec} * 3.412)$ $\Delta kWh = ((A_{Rase}/R_{Rase} - A_{EE}/R_{ECE}) * \Delta T * Hours) / (\eta DHW_{Elec} * 3.412)$ = Surface area (ft ²) of storage tank prior to adding tank wrap ²⁴⁵ = Actual or if unknown, use default based on tank capacity (gal) from table below = Thermal resistance coefficient (hr=°F-ft²/BTU) of uninsulated tank = Surface area (ft²) of storage tank after addition of tank wrap ²⁴⁵ = Actual or if unknown, use default based on tank capacity (gal) from table below = Thermal resistance coefficient (hr=°F-ft²/BTU) of uninsulated tank = Surface area (ft²) of storage tank after addition of tank wrap ²⁴⁷ = Actual or, if unknown, use default based on tank capacity (gal) from table below	Formatted: Font color: Background 1 Formatted: Font color: Background 1
ALCULATION OI ECTRIC ENERG istom calculation (Wh here: RBase RBase AEE "Retire" indicates (2014 Database for	Algorithm F SAVINGS GY SAVINGS on below for electric DHW tanks, otherwise use default values from table that follows: $= ((A_{Base} - A_{EE}/R_{EE}) * \Delta T * Hours) / (\eta DHW_{Elec} * 3,412)$ $\Delta kWh = ((A_{Base} - A_{EE}/R_{EE}) * \Delta T * Hours) / (\eta DHW_{Elec} * 3,412)$ $= Surface area (ft2) of storage tank prior to adding tank wrap245 = Actual or if unknown, use default based on tank capacity (gal) from table below = Thermal resistance coefficient (hr-°F-ft2/BTU) of uninsulated tank = Actual or if unknown, assume 1436 Surface area (ft2) of storage tank after addition of tank wrap247 = Actual or if unknown, use default based on tank capacity (gal) from table below = Thermal resistance coefficient (hr-°F-ft2/BTU) of uninsulated tank = Actual or if unknown, use default based on tank capacity (gal) from table below = Actual or, if unknown, use default based on tank capacity (gal) from table below = Actual or, if unknown, use default based on tank capacity (gal) from table below $	Formatted: Font color: Background 1 Formatted: Font color: Background 1
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ALCULATION OF LECTRIC ENERG Vustom calculation kWh /here: ABase AEE ³ - <u>"Retire" indicates (</u> ³ - <u>2014 Database for</u> verage of values for verage of values for for typ://www.nrcl.gy	Algorithm of SAVINGS GY SAVINGS on below for electric DHW tanks, otherwise use default values from table that follows: $= ((A_{Base}/R_{Base} - A_{FE}/R_{FE}) * \Delta T * Hours) / (\eta DHW_{Elec} * 3.412)$ $\Delta kWh = ((\underline{A_{Ease}/R_{Ease} - A_{FE}/R_{FE}) * \Delta T * Hours) / (\eta DHW_{Elec} * 3.412)$ $= Surface area (R^2) of storage tank prior to adding tank wrap249 = Actual or if unknown, use default based on tank capacity (gal) from table below = Thermal resistance coefficient (hr-Pr-ft2/BTU) of uninsulated tank = Actual or if unknown, assume 14^{246}= Surface area (R^2) of storage tank after addition of tank wrap247 = Actual or, if unknown, use default based on tank capacity (gal) from table below = Thermal resistance coefficient (hr-gr-ft2/BTU) of uninsulated tank = Actual or, if unknown, use default based on tank capacity (gal) from table below = Thermal resistance coefficient (hr-gr-ft2/BTU) of uninsulated tank = Actual or, if unknown, use default based on tank capacity (gal) from table below = Thermal resistance coefficient (hr-gr-ft2/BTU) of uninsulated tank = Actual or, if unknown, use default based on tank capacity (gal) from table below = Thermal resistance coefficient (hr-gr-ft2/BTU) of uninsulated tank capacity (gal) from table below = Thermal resistance of the based on tank capacity (gal) from table below$	Formatted: Font color: Background 1 Formatted: Font color: Background 1
CALCULATION OF CLECTRIC ENERG Custom calculation kWh Vhere: ABase ABase AEE ² -Retire ^{**} indicates t ³ -2014 Database for vorage of values for vorage of values for ⁴ -Average cost of R- ttp://www.nrel.gu	$\frac{\text{Algorithm}}{\text{F SAVINGS}}$ FF SAVINGS On below for electric DHW tanks, otherwise use default values from table that follows: $= ((A_{Base}/R_{Base} - A_{EE}/R_{EE}) * \Delta T * Hours) / (\eta DHW_{Elec} * 3.412)$ $\Delta kWh = ((A_{Base}/R_{Base} - A_{EE}/R_{EE}) * \Delta T * Hours) / (\eta DHW_{Elec} * 3.412)$ $= \text{Surface area (}h^2) \text{ of storage tank prior to adding tank wrap^{245}}$ $= Actual or if unknown, use default based on tank capacity (gal) from table below = \text{Thermal resistance coefficient (}hr - P - ft^2/B TU) of uninsulated tank = Actual or if unknown, use default based on tank capacity (gal) from table below = \text{Thermal resistance coefficient (}hr - P - ft^2/B TU) of uninsulated tank = Actual or, if unknown, use default based on tank capacity (gal) from table below = Thermal resistance coefficient has a different different different has a different different different has a different differe$	Formatted: Font color: Background 1 Formatted: Font color: Background 1

				Appendix I - TRM		
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		nown, assume 24 rature difference (°F) be				
		tor from Btu to kWh				
ne following table c	ontains default savin	gs for various tank capa	icities.			
	Capacity (gal)	$A_{\text{Base}} (\mathbf{ft}^2)^{250}$ 19.16	$A_{EE} (ft^2)^{251}$ 20.94	ΔkWh	ΔkW 0.00890	
	40	23.18	25.31	78.0 94.6	0.01079	Formatted: Font color: Background 1
	50	24.99	27.06	103.4	0.01180	Formatted: Font color: Background 1
	80	31.84	34.14	134.0	0.01528	Formatted: Font color: Background 1 Formatted: Font color: Background 1
JMMER COINCIDEN	TT PEAK DEMAND S	AVINGS				Formatted: Font color: Background 1
$\Delta kW = \Delta kWl$	h * CF					
$\Delta kWh \Delta kW$ Where:	$= \Delta kWh * CF$ = Electric energ = Summer peak c = 0.0000887318 ²⁴					← Formatted: Indent: First line: 0"
<u>AkWh</u> ΔkW Where: ΔkWh CF he table above conta ATURAL GAS SAVE	= = Electric energ = Summer peak c = 0.0000887318 ²⁴ ins default kW savir NGS elow for gas DHW ta					
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<u>AkWh</u> <i>AkW</i> Where: <i>AkWh</i> <u>CF</u> ne table above conta ATURAL GAS SAVE istom calculation be Therms	<u>=</u> = Electric energ = Summer peak c = 0.0000887318 ²³ ins default kW savir NGS clow for gas DHW ta = ((A _{Base} /R _{Base} – A ΔTherms	oincidence demand (kW ags for various tank capa unks, otherwise use defa Δ_{EE}/R_{EE}) * ΔT * Hours) / M_{EE}/R_{EE}	to annual energy (kW acities. ault values from table th $\sqrt{(\eta DHW_{Gas} * 100,000)}$ $es \sqrt{Rec} (* \Delta T * Hours)$		000)	Formatted: Font color: Background 1 Formatted: Font color: Background 1 Formatted: Font color: Background 1
<u>AkWh</u> <i>AkW</i> Where: <i>AkWh</i> CF table above conta ATURAL GAS SAVI ustom calculation be Therms	= Electric energ = Summer peak c = 0.0000887318 ²³ ins default kW savir vGS elow for gas DHW ta = $((A_{Base}/R_{Base} - A))$ $\Delta Therms$ = Recovery effici	oincidence demand (kW r_{2}^{22} ags for various tank capa unks, otherwise use defa r_{EE}/R_{EE}) * ΔT * Hours) /	to annual energy (kW acities. ault values from table th $\sqrt{(\eta DHW_{Gas} * 100,000)}$ $es \sqrt{Rec} (* \Delta T * Hours)$		000)	Formatted: Font color: Background 1 Formatted: Font color: Background 1 Formatted: Font color: Background 1 Formatted: Font color: Background 1
$ \Delta kWh \Delta kW Where: \Delta kWh CF CF the table above conta ATURAL GAS SAVE ustom calculation be Therms 'here: \eta DHW_{Gas} 100,000$	$= = \text{Electric energy}$ $= \text{Summer peak c}$ $= 0.0000887318^{23}$ ins default kW savir ins default kW savir ins default kW savir ins default kW savir ins default kW savir (GS elow for gas DHW tz $= ((A_{Base}/R_{Base} - A))$ $\Delta Therms$ $= \text{Recovery effici}$ $= 0.78^{253}$ $= \text{Coversion fact}$	oincidence demand (kW ags for various tank capa unks, otherwise use defa Δ_{EE}/R_{EE}) * ΔT * Hours) / M_{EE}/R_{EE}	to annual energy (kW acities. ault values from table th $\sqrt{(\eta DHW_{Gas} * 100,000)}$ $es \sqrt{Rec} (* \Delta T * Hours)$		000)	Formatted: Font color: Background 1 Formatted: Font color: Background 1
$ \Delta kWh \Delta kW Where: \Delta kWh CF CF the table above conta ATURAL GAS SAVE ustom calculation be Therms 'here: \eta DHW_{Gas} 100,000$	= = Electric energ = Summer peak c = 0.0000887318 ²³ ins default kW savir SGS clow for gas DHW tz = $((A_{Base}/R_{Base} - A))$ $\Delta Therms$ = Recovery effici = 0.78 ²⁵³	oincidence demand (kW ags for various tank capa anks, otherwise use defa N_{EE}/R_{EE}) * ΔT * Hours) / $r = ((A_{Base}/B_{Base} - A_{EE})$ ency of gas hot water he	to annual energy (kW acities. ault values from table th $\sqrt{(\eta DHW_{Gas} * 100,000)}$ $es \sqrt{Rec} (* \Delta T * Hours)$		000)	Formatted: Font color: Background 1 Formatted: Font color: Background 1
<u>AkWh</u> AkWh Where: <u>AkWh</u> CF CF he table above conta ATURAL GAS SAVE ustom calculation be C Therms Therms 'here: 	= = Electric energy = Summer peak c = 0.0000887318^{23} ins default kW savir XGS elow for gas DHW ta = $((A_{Base}/R_{Base} - A$ $\Delta Therms$ = Recovery effici = 0.78^{253} = Conversion fact es as defined above	oincidence demand (kW ags for various tank capa anks, otherwise use defa N_{EE}/R_{EE}) * ΔT * Hours) / $r = ((A_{Base}/B_{Base} - A_{EE})$ ency of gas hot water he	(k) to annual energy (k) acities. acities. acities from table th (<u>nDHW_{Gas} * 100,000</u>) <u>(nDHW_{Gas} * 100,000</u>) <u>(nDHW_{Gas} * 100,000)</u> (nDHW _{Gas} * 100,000) (nDHW _{Gas} * 100,000)		000)	Formatted: Font color: Background 1
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<u>AkWh</u> <i>AkW</i> Where: <i>AkWh</i> <u>CF</u> the table above conta ATURAL GAS SAVE ustom calculation be Therms There: ¶DHWGas 100,000 Other variable the following table contained Surface area assumption Here measured to the cent	= = Electric energ = Summer peak c = 0.0000887318 ²² ins default kW savir SGS elow for gas DHW ta = $((A_{Base}/R_{Base} - A$ $\Delta Therms$ = Recovery effici = 0.78 ²³³ = Conversion fact es as defined above ontains default savin ter tank temperature and a covery efficiency from A as from the June 2016 Pe	oincidence demand (kW as for various tank capa anks, otherwise use defa x_{EE}/R_{EE}) * ΔT * Hours) / x = ((Acase/Retaser - Acaser - Ac	() to annual energy (kW acities. ault values from table th $(\eta DHW_{Gas} * 100,000)$ $cr_{A}(Ber_{a}) * \Delta T * Hours$ eater acities. e of 65°F. aridirectory.org/ahridirectory is were calculated from aver to account for typical wrap	at follows:)/(nDHW _{Gas} * 100,)/ageofiome.aspx. age dimensions of several	commercially available units, with	Formatted: Font color: Background 1
Where: <u>AkWh</u> CF he table above conta ATURAL GAS SAVE ustom calculation be Therms /here: nDHWGas 100,000 Other variable he following table co 	= = Electric energ = Summer peak c = 0.0000887318 ²² ins default kW savir VGS elow for gas DHW ta = $((A_{Base}/R_{Base} - A$ $\Delta Therms$ = Recovery effici = 0.78 ²³³ = Conversion fact es as defined above ontains default savin ter tank temperature and a sovery efficiency from A as from the June 2016 Pe ter of the insulation. Are a from the June 2016 Pe	oincidence demand (kW $_{2}^{2}$ ags for various tank capt anks, otherwise use defa $_{MEE}/R_{EE}$) * ΔT * Hours) / $_{2} = ((Acase/Bease - A))$ ency of gas hot water he tor from Btu to therms gs for various tank capa average basement temperature HII database http://www.al macylvania TRM. Area value a includes tank sides and top mocylvania TRM. Area value	() to annual energy (kW acities. ault values from table th $((\eta DHW_{Gas} * 100,000)$ $e_{F}(Re_{F}) * \Delta T * Hours$ eater acities. exter so account for typical way to account for typical way to account for typical way the lated by assuming that	An follows:)/(nDHW.cos.* 100, /pages/home.aspx. upd dimensions of several coverage. e water heater wrap is a 2	commercially available units, with	Formatted: Font color: Background 1 Formatted: Font color: Background 1

				<u> / – Vol. 3: Residentia</u>		matted: Font: (Default) Arial, 12 matted: Normal
Capacity (gal)	A _{Base} (ft ²) ²⁵⁴	$A_{EE} (ft^2)^{255}$	ΔTherms	ΔPeakTherms		natten. Normai
30	19.16	20.94	3.3	0.0092	For	matted: Font color: Background
40	23.18	25.31	4.1	0.0111	_	matted: Font color: Background
50	24.99	27.06	4.4	0.0121	For	natted: Font color. Background
80	31.84	34.14	5.7	0.0157	For	matted: Font color: Background

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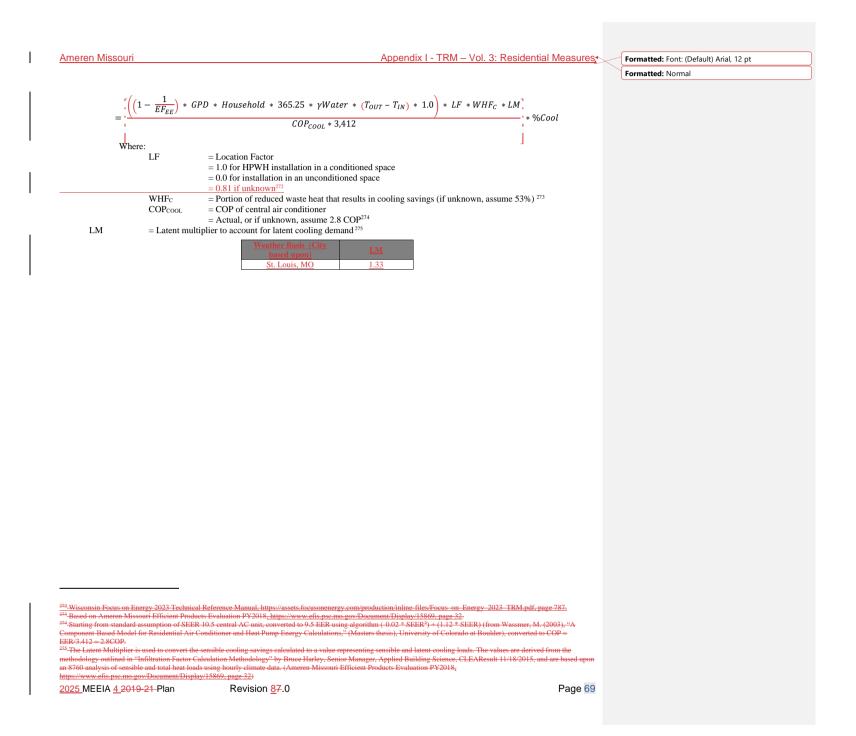
²⁵⁴ Area values were calculated from average dimensions of several commercially available units, with radius values measured to the center of the insulation. Area includes tank sides and top to account for typical wrap coverage. Recommend updating with Missouri specific data when available.
²⁵⁵ Area was calculated by assuming that the water heater wrap is a 2" thick fiberglass material. Recommend updating with Missouri specific data when available.

<u>2025</u>MEEIA <u>4</u> 2019-21 Plan

Revision <u>8</u>7.0

3.4 Heat Pump Water Heater		Formatted: Font: (Default) Arial, 12 pt
3.4 Heat Pump Water Heater		Formatted: Normal
3.4 Heat I ump Water Heater		
ESCRIPTION	n of a heat pump water heater (HPWH) in place of a standard electric water heater in a home. Savings are	
	tem installed in the home due to the impact of the heat pump water heater on the heating and cooling loads.	
is measure was developed to be appli	icable to the following program types: TOS, and NC.	
applied to other program types, the m	leasure savings should be verified.	
EFINITION OF EFFICIENT EQUIPMEN	Ϋ́Τ	
qualify for this measure, the installed	d equipment must be an ENERGY STAR [®] heat pump water heater with a storage volume \leq 55 gallons. ²⁵⁶	
EFINITION OF BASELINE EQUIPMENT	Т	
e baseline equipment is assumed to b	e a new, electric storage water heater meeting federal minimum efficiency standards ²⁵⁷ for units ≤55 gallons:	
Draw Pattern	Federal Standard – Uniform Energy Factor ²⁵⁸	
Very small	UEF = 0.8808 – (0.0008 * Rated Storage Volume in Gallons)	
Low Medium	<u>UEF = 0.9254 – (0.0003 * Rated Storage Volume in Gallons)</u> UEF = 0.9307 – (0.0002 * Rated Storage Volume in Gallons)	
High	UEF = 0.9307 - (0.0002 + Rated Storage Volume in Gallons) $UEF = 0.9349 - (0.0001 * Rated Storage Volume in Gallons)$	
cient units.	ns). The same draw pattern (very small, low, medium and high draw) should be used for both baseline and	
e expected measure life is assumed to EEMED MEASURE COST tual costs should be used where avail		
e expected measure life is assumed to EMED MEASURE COST tual costs should be used where avail OW. ²⁶¹	o be 13 years. ²⁶⁰ lable. The <u>D</u> default <u>incremental cost</u> values for incremental capital costs is \$588 <u>are provided in the table</u>	Formattade Forth Times New Downer
e expected measure life is assumed to EMED MEASURE COST tual costs should be used where avail ow. ²⁶¹	o be 13 years. ²⁶⁰ lable. The <u>D</u> default <u>incremental cost</u> valu <u>es</u> e for incremental capital costs is \$588 <u>are provided in the table</u>	Formatted: Font: Times New Roman
e expected measure life is assumed to EMED MEASURE COST tual costs should be used where avail ow. ²⁶¹	o be 13 years. ²⁶⁰ lable. The <u>D</u> default <u>incremental cost</u> valuese for incremental capital costs is \$588 <u>are provided in the table</u> <u>ency Range</u> <u>Baseline Installed</u> <u>Efficient Installed</u> <u>Incremental</u> <u>Cost</u> <u>Cost</u>	Formatted: Font: Times New Roman Formatted: Font: Times New Roman Formatted: Font: Times New Roman
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Antipage 261	o be 13 years. ²⁶⁰ lable. The <u>D</u> default <u>incremental cost</u> valuese for incremental capital costs is \$588 <u>are provided in the table <u>arcv Range <u>Baseline Installed</u> <u>Efficient Installed</u> <u>Incremental</u> <u>Cost <u>Cost</u> <u>Installed Cost</u> <u>2.6 UEF \$1.032 \$2.062 \$1.030</u> <u>5.6 UEF \$1.032 \$2.231 \$1.199</u> <u>Algorithm</u> s a heat pump water heater for units over 55 gallons, this measure is limited to units ≤ 55 gallons. <u>152024as of 4/16/2015.</u> subchapter D/part 430: '10 CFR Part 430 (up to date as of 8 15 2024).pdf. http://www.gpo.gov/fdsys/pkg/CFR 2012 title10. 0 vol3/pdf/CFR 2012 title10 vol3 see430.32.pdf.</u></u></u>	Formatted: Font: Times New Roman Formatted: Font: Times New Roman
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meren Missour	Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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CALCULATION OF	SAVINGS	
LECTRIC ENERGY	SAVINGS	
kWh	$= [(((1/EF_{BASE} - 1/EF_{EE}) * GPD * Household * 365.25 * \gamma Water * (T_{OUT} - T_{Jn}) * 1.0)) / 3.412) + kWh_{cool} - kWh_{hout}] * $	Formatted: Subscript
	ISR	Formatted: Subscript
[(1/E)	$T_{BASE} = 1/EF_{FE}$ * GPD * Household * 365.25 * γ Water * $(T_{Out} - T_{In})$ * 1.0)	Formatted: Subscript
$kWh = \left[\left(\begin{array}{c} \cdots \end{array}\right)\right]$	$\frac{S_{BASE} - 1/EF_{EE}) * GPD * Household * 365.25 * \gamma Water * (T_{Out} - T_{In}) * 1.0)}{3,412} + kWh_{cool} - kWh_{heat} * ISR$	Formatted: Subscript
Vhere:		Formatted: Subscript
UEFBASE	= UEF of standard electric water heater according to federal standards = If new unit draw pattern unknown.0.96 – (0.0003 * rated volume in gallons 0.9207 ²⁶² .)	Formatted: Subscript
	$= If new unit draw pattern unknown, 0.96 - (0.0003 * rated volume in gallons 0.9207^{-aa}.)$	Formatted: Indent: Left: 0", Hanging: 1.5"
	U= If rated volume is unknown, assume 0.945 for a 50-gallon water heater	Formatted: Normal
EF_{EE}	= UEF of heat pump water heater	Formatted: Indent: Left: 0", First line: 0"
	= Actual	
GPD	= Gallons per day of hot water use per person = 17.6^{263}	
Household	= Average number of people per household	
	Household Unit Type ²⁶⁴ Household	
	Single Family DeemedAll 2.65 ²⁶⁵	
	Multi Family Deemed 2.07 ²⁶⁶	Formatted Table
	Custom Actual Occupancy or Number of Bedrooms ²⁶⁷	
365.25	= Days per year	
γWater	= Specific weight of water = 8.33 pounds per gallon	
T _{OUT}	= Tank temperature	
	= Actual, if unknown assume 125°F	
T_{IN}	= Incoming water temperature from well or municipal system = 58.4F ²⁰⁸ 57.898°F ²⁶⁹	
1.0	$= \frac{56.41}{100} (1.596 \text{ F})$	
3,412	= Conversion factor from Btu to kWh	
ISR	= <u>In-service rate. Actual, or if unknown, assume</u> In Service Rate = $100\%^{270}$	
kWh_cool	= Cooling savings from conversion of heat in home to water heat ²⁷¹ = $[(((1 - 1/UEF_{EE}) * GPD * Household * 365.25 * \gamma Water * (TOUT - TIn) * 1.0) * LF * WHFC *LM) / (COPCOOL *$	Formatted: Subscript
	3,412)] * %Cool	Formatted: Subscript
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		romatted. indent. Leit. 1.5 , First line. 0
² -Federal Register :: E ² GPD based on 45.5 a	nergy Conservation Program: Energy Conservation Standards for Consumer Water Heaters allons of hot water per day per household and 2.59 people per household, from "Residential End Uses of Water Study 2013 Update," by Deoreo, B., and P.	
ayer, for the Water Re	search Foundation, 2014, https://www.awwa.org/Portals/0/AWWA/ETS/Resources/WaterConservationResidential_End_Uses_of_Water.pdf.;	
✓aterConservationRes If household type is ι	dential_End_Uses_of_Water.pdf'. nknown, as may be the case for TOS measures, then single family deemed value shall be used.	
⁵ Ameren Missouri Eff	icient Products Evaluation: PY2018, https://www.efis.psc.mo.gov/Document/Display/15869, page 32. icient Products Evaluation: PY2015, https://www.efis.psc.mo.gov/Document/Display/13805, page 36.	
² Bedrooms are suitabl	e proxies for household occupancy and may be preferable to actual occupancy due to turnover rates in residency and non-adult population impacts.	
	vice. Average soil temperature at 40" depth during 2015—2023 data of six stations in Ameren Missouri service territory. //ncrfc/LML_SoilTemperatureDepthMaps.	
9 Using 40" deep soil t	mp as a proxy at Powell Gardens SCAN site. Average by month of available data from 3/28/02 10/11/14: 12 month average is 57.898.	
	a.gov/nwcc/site?sitenum=2061. icient Products Evaluation: PY2019, https://www.efis.psc.mo.gov/Document/Display/15877, page 140.	
	ates the heat removed from the air by subtracting the heat pump water heater electric consumption from the total water heating energy delivered. This is for location of the heat pump unit and the coincidence of the waste heat with cooling requirements, the efficiency of the central cooling, and latent cooling	
mands.	· · ·	
	19-21-Plan Revision 87.0 Page 68	



Ameren Missouri	Appendix I - TRM – Vol. 3: Residential	I Measures	Formatted: Font: (Default) Arial, 12 pt
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Weath	er Basis (City based upon) LM	4	Formatted: Page break before

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	Weather Basis (City based upon)	LM		4		Formatted: Page break before
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eren Missouri					sidential Measures	Formatted: Font: (Default) Arial, 12 pt Formatted: Normal
ool = Per	rcentage of homes with cen	tral cooling				romatted. Nomai
-10	contage of nonices white con	Home	%Cool			
		Cooling	100%			
		No Cooling	0%			
		Unknown	95% ²⁷⁶			
kWh heat	= Heating cost from cor	nversion of heat in home to v	water heat (dependent on h	eating fuel)		
		PD * Household * 365.25 *			_M) / (COP _{HEAT} *	
	3,412)] * %ElectricHeat	<u>t</u>				
d e	1)			
/((1	$1 - \frac{1}{EF_{EE}}$ * GPD * House	ehold * 365.25 * γWater COP _{HEAT} * 3,412	$* (T_{OUT} - T_{IN}) * 1.0$	* LF * WHF _H		
=		СОР _{НЕАТ} * 3,412	/	* %E	ElectricHeat	
]		
X				/		
Whe				1 1/2 1	1201 277	
		on of reduced waste heat that of electric heating system	t results in increased heating	ig load (if unknown, a	assume 43%) 2//	
		al, or if unknown, assume: ²⁷⁸				
		.,				
	<u>System Type</u>	Age of Equipment	HSPF2 Estimate (CO	<u>nHeat</u> P Estimate)		
	<u>system 1 ype</u>	Age of Equipment		<u>F2/3.413)*0.85</u>		Formatted Table
	Heat Pump	Before 2006	<u>5.8</u>	<u>1.44</u>		
	(if age unknown assume 2006-2014)	After 2006 - 2014 2015 on	<u>6.5</u> 7.0	<u>1.62</u> 1.74		
	Resistance	<u>N/A</u>	<u>/.0</u> N/A	1.00		
	Unknown ²⁷⁹	N/A	N/A	1.28		
		Heating	СОР			
		Age of Seasonal Performance	(Effective COP			
	System Type E	Equipment Factor	Estimate)			
		(HSPF) Estimate	(HSPF/3.412)* 0.85			
	Befo	bre 2006 6.8	1.7			
		6 - 2014 7.7	1.92			
		5 and after 8.2 N/A	2.04			
	Resistance N/A	IN/A	1			
	%ElectricHeat = Perce	entage of homes with electric	: heat			
	Electric		tricHeat 00%			
	Natural		0%			
		· · · · ·				
		C-4				
norm Miggard DVO		Saturation of non-low income hom on PY2018, https://www.efis.psc.m	io.gov/Document/Display/15869	, page 31 .		
sed on Ameren Miss	souri Efficient Products Evaluatio		In 2006, the federal standard for	heat pumps was adjusted.		
ised on Ameren Miss iese default system e	souri Efficient Products Evaluatio fficiencies are based on the applic	cable minimum federal standards. I	and a construction of the second second			
sed on Ameren Miss ese default system e erage system efficie	souri Efficient Products Evaluatio fficiencies are based on the applic	cable minimum federal standards. I um, the likely degradation of efficie	encies over time means that usin	g the minimum standard is	s appropriate. An 85%	
sed on Ameren Miss ese default system e rage system efficie sution efficiency is the sution assumes 35	souri Efficient Products Evaluatio fficiencies are based on the applic ncy to be higher than this minimu hen applied to account for duct lo 5% Heat Pump and 65% Resistant	cable minimum federal standards. I um, the likely degradation of efficio osses for heat pumps. ice, which is based upon data from-	Energy Information Administra	- tion, 2009 Residential Ene	rgy Consumption Survey.	Formatted: Font: (Default) Times New Roman
sed on Ameren Miss ese default system e erage system efficie pution efficiency is the leulation assumes 3: //www.eia.gov/const	souri Efficient Products Evaluatio fficiencies are based on the applic ncy to be higher than this minimu hen applied to account for duct lo 5% Heat Pump and 65% Resistan umption/residential/data/2009/he/	cable minimum federal standards. I um, the likely degradation of efficie osses for heat pumps.	Energy Information Administra ficiency of heat pump is based o	- tion, 2009 Residential Ene	rgy Consumption Survey.	Formatted: Font: (Default) Times New Roman

Andero Mussour Concated: from: Cleading from: Clea	I	Ameren Missouri	Appendix I - TRM – Vol. 3: Residential Measures		10 A 1 L 40
Heating fuel % ElectricHeat Unknown $35\%^{280}$ SUMMER COINCIDENT PEAK DEMAND SAVINGS $\Delta kW = \Delta kWh * CF$ Where: $\Delta kWh \Delta kW = kWh * CF$ Where: $kWh = kWh * CF$ Where: $kWh = kWh * CF$	1				uit) Ariai, 12 pt
Unknown $35\%^{280}$ SUMMER COINCIDENT PEAK DEMAND SAVINGS $\Delta kW = \Delta kWh * CF$ Where: $\Delta kWh \Delta kW = kWh * CF$ Where: $kWh = E$ $KWh = E$ $Formatted:$ Indent: Left: 0", First line: 0.5", Space $After: 0 pt$ Formatted: Indent: Left: 0", First line: 0.5" Formatted: Indent: Left: 0", First line: 0.5"		Heating fuel % Electric Heat		Formatted: Normal	
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Where: $\Delta k Wh \Delta k W = k Wh * CF$ Formatted: Indent: Left: 0", First line: 0.5", Space Where: kWh					
$\frac{\Delta k Wh}{\Delta k W} = k Wh * CF$ Where: $k Wh \qquad = Electric energy savings, as calculated above$ CF $= Summer peak coincidence demand (kW) to annual energy (kWh) factor$ Formatted: Indent: Left: 0", First line: 0.5" Formatted: Indent: Left: 0", First line: 0.5"		$\Delta kW = \Delta kWh * CF$			
Where: kWh= Electric energy savings, as calculated above CFSummer peak coincidence demand (kW) to annual energy (kWh) factor		Where:			
Where:		$\Delta kWh\Delta kW = kWh * CF$	4	Formatted: Indent: Lef	t: 0", First line: 0.5", Space
CF = Summer peak coincidence demand (kW) to annual energy (kWh) factor			•	After: 0 pt	
	I	CF = Summer peak coincidence demand (kW) to annual energy (k	Wh) factor	Formatted: Indent: Lef	t: 0", First line: 0.5"
		$= 0.0000887318^{281}$			
280 Average (default) value of 35% electric space heating from 2009 Residential Energy Consumption Survey for Missouri. If utilities have specific evaluation results providing a	Í -	180 Average (default) value of 35% electric space heating from 2000 Desidential Energy Consumption Sur	rev for Missouri If utilities have specific avaluation results providing a		
more appropriate assumption for homes in a particular market or geographical area, then they should be used.		more appropriate assumption for homes in a particular market or geographical area, then they should be us	ed.		
²⁸⁴ Based on Ameren Missouri TRM Volume 1 – Appendix G: "Table 1 – Residential End Use Category Monthly Shapes and Coincident Peak Factors" Ameren Missouri 2016 loadshape for residential water heating end use.			tonthly Shapes and Coincident Peak Factors" Ameren Missouri 2016		
2025 MEEIA <u>4 2019-21 Plan</u> Revision <u>87</u> .0 Page 73		2025 MEEIA <u>4 2019-21 Plan</u> Revision <u>8</u> 7.0	Page 73		

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<pre>Support for the state of t</pre>	NATURAL GAS SAVIN	GS			
<pre>start = c = c = c = c = c = c = c = c = c =</pre>	<u>ATherms</u>		$OUT - T_{In}$ * 1.0) * LF * 0.43) / (η Heat * 100,000	<u>0)] *</u>	Formatted: Indent: Hanging: 1.5"
<pre>true = (((</pre>		<u>% Gasheat</u>			Formatted: Normal
<pre>Wrate final and the set of the</pre>	/((1-	$\frac{1}{EFrr}$ + GPD * Household * 365.25 * γ Water * $(T_{OUT} - T_{IN})$ * 1.0 + LF * 439	6)		
Where: The start is a class of from conversion of heat in home to water heat for homes with Natural Gas head ²² . With the start is a class of the start is thes	$1Therms = -\left(\frac{1}{2}\right)$	ηHeat * 100,000	- * %GasHeat	•	
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mem entropy The memory of the memo			for homes with Natural Gas heat282		
%GaHer Percentage of homes with gas best		= Efficiency of heating system			
Image: A constraint of the second of the	%GasHeat				
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Ameren Missouri Appendix I - TRI	M – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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3.3.5 Hot Water Pipe Insulation		
DESCRIPTION This measure applies to the addition of insulation to uninsulated domestic hot water (DHW) pipes. The mer on the first length of both the hot and cold pipes up to the first elbow or the first three feet of pipe length, wh effective section to insulate since, close to the tank, the water pipes act as an extension of the hot water tan	hichever is longer. This is the most cost- nk, which acts as a heat trap. Insulating	
this section helps to reduce standby losses This measure applies to the addition of insulation to uninsulated measure assumes the pipe wrap is installed on the first length of both the hot and cold pipe up to the hot and cold pipe up t		
section to insulate since the water pipes act as an extension of the hot water tank up to the first elbow, which the helps to reduce standby losses.	acts as a heat trap. Insulating this section	
This measure was developed to be applicable to the following program types: DI, and RF		
If applied to other program types, the measure savings should be verified.		
DEFINITION OF EFFICIENT EQUIPMENT The efficient condition is a domestic hot or cold water pipe with pipe wrap installed that has an R value that	meets program requirements.	
DEFINITION OF BASELINE EQUIPMENT The baseline condition is an uninsulated, domestic hot or cold water pipe.		
DEEMED LIFETIME OF EFFICIENT EQUIPMENT The expected measure life is assumed to be 12 years. ²⁸⁵		
DEEMED MEASURE COST The measure cost is the actual cost of material and installation. If the actual cost is unknown, For a kit proportion of the set of		
LOADSHAPE Water Heating RES		
Algorithm		
CALCULATION OF SAVINGS		
ELECTRIC ENERGY SAVINGS Custom calculation below for electric systems, otherwise assume 24.7 kWh per 6 linear feet of ¾ in, R-4 in: of 1 in, R-6 insulation:	sulation or 35.4 kWh per 6 linear feet	
$\Delta kWh = \% Electric DHW * ((C_{\underline{Base}}/R_{\underline{Base}} - C_{\underline{FE}}/R_{\underline{FE}}) * L * \Delta T * Hours)/(\eta DHW_{\underline{Flec}} * 3,412) * ISR$	* (1 – Leakage)	Formatted: Subscript
ΔkWh = %ElectricDHW * ((C _{base} /R _{ease} - C _{bb} /R _{bb}) * L * ΔT * Hours)/(ηDHW _{blec} *	- 3,412) * ISR	Formatted: Subscript Formatted: Subscript
Where: %ElectricDHW = proportion of water heating supplied by electric resistance heating		Formatted: Subscript Formatted: Subscript
DHW fuel % ElectricDHW Electric 100%		
 ²⁸⁵ 2014 Database for Energy-Efficiency Resources (DEER), Version 2014, "Cost Values and Summary Documentation," Californi Average of values for electric DHW (13 years) and gas DHW (11 years). ²⁸⁶ Cost based on R5 Means 2018 data ²⁸⁷ Average cost of R-5 pipe wrap installation from the National Renewable Energy Laboratory's National Residential Efficiency N http://www.nel.gov/ap/retrofiti-measure.cfm?gld=6&ctld=323 ²⁸⁶ Cost based on R5 Means 2018 data 		

<u>2025</u>MEEIA <u>4</u> 2019-21 Plan

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Revision <u>8</u>7.0

		Formatted: Normal
	Natural Gas 0%	Formatted Table
	Unknown 42% ³⁸⁹	Formatted Table
~		
C _{Base}	= Circumference (ft) of uninsulated pipe = Diameter (in) * $\pi/12$	
	= Actual or, if unknown, assume 0.144" based on a weighted average of 80% 0.50-inch diameter pipe and 20% 0.75-inch	
	diameter pipe.	
R _{Base}	= Thermal resistance coefficient (hr-°F-ft ²)/Btu) of uninsulated pipe	
	$=1.0^{290}$	
CEE	= Circumference (ft) of insulated pipe	
	= Diameter (in) * $\pi/12$	
	<u>=</u> Based on actual pipe diameter and insulation thickness; if unknown, assume 0.55" pipe diameter based on a weighted average of 80% 0.50-inch diameter pipe and 20% 0.75-inch diameter pipe and 0.5" insulation thickness – using both	
	assumed values results in C _{EE} of $(0.55 + (0.5 \times 2)) \times \pi / 12 = 0.4058$	
	. For instance, for a pipe insulated with $3/4$ in, R-4 wrap, assume 0.524 ft for a 0.46 in diameter pipe ((0.75 + $1/2$ + $1/2$) *	
	<u>π/12)</u>	
	= Actual or if unknown, assume 0.524 ft for a 0.46 in diameter pipe insulated with $3/4$ in, R-4 wrap ((0.75 + $1/2$ + $1/2$) *	
	= reduction in unknown, assume 0.52+ it for a 0.40 in unanceer pipe insulated with 0.4 in, Re4 with $((0.75 + 1/2 + 1/2))$	
R _{EE}	= Thermal resistance coefficient (hr-°F-ft ²)/Btu) of insulated pipe	
	= 1.0 + R value of insulation	
	= Actual or if unknown, assume 5.0 for R 4 wrap or 7.0 for R 6 wrap	
L	= Length of pipe from water heating source covered by pipe wrap (ft)	
ΔT	= Actual-or if unknown, assume 6 ft = Average temperature difference (°F) between supplied water and outside air	
<u></u>	= Actual or if unknown, assume $58.9^{\circ}F^{291}$ for low income programs or $60^{\circ}F^{292}$ for other programs.	
Hours	= Hours per year	
	= 8,766	
ηDHW_{Elec}	= Recovery efficiency of electric hot water heater = 0.98^{293}	
3,412	= Conversion factor from Btu to kWh	
ISR	= Installation rate (varies by program <u>Actual</u> , or if unknown, <u>d</u> Dependent on program delivery method as listed in table	
	below	
	Program ISR	
	School Kits 56% ²⁹⁴	Formatted Table
	Multifamily 100% ²⁰⁵	
	SPIE Kits noome 96% ²⁹⁶	
	Eligible, PAYS 2000 PAYS 100% 2007	
	$\underline{PAYS} \qquad \underline{100\%^{297}}$	
Leakage	= Percent homes outside service territory	
n Missouri Energ	ty Efficient Kits Impact and Process Evaluation: PY2019. https://www.efis.psc.mo.gov/Document/Display/15876. page 78.	
ures and Assump	tions for Demand Side Management (DSM) Planning; Appendix C Substantiation Sheets," Navigant, April 2009,	
vw.oeb.ca/oeb/ I 	Documents/EB-2008-0346/Navigant Appendix C substantiation sheet 20090429.pdf; 'Navigant Appendix C substantiation sheet 20090429.pdf',	
n Missouri Com	munity Savers Evaluation PY2018, page 24.	
	eaving the hot water tank and average basement temperature of 65°F. covery efficiency from AHRI database: <u>http://www.ahridirectory.org/ahridirectory/pages/home.aspx.</u>	
n Missouri EE K	its Evaluation PY2019 Appendices Page 78.	
Energy Efficienc	y Kits School Evaluation Report, page 39.	
n Missouri Comi n Missouri PAY	nunity Savers Evaluation PY2018, page 24. <u>5 Evaluation PY2022 Appendix, page 7.</u>	

Appendix 1-FRM - Vol. 3. Residential Measures					
Important Text Important Section Se	Ameren Missouri		Appendix I - TRM - V	Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
<pre> https://www.income</pre>					Formatted: Normal
<pre>pinet provide pro</pre>		Program	Leakage		
main Statistical production of the statistical productic			8.13% ²⁹⁸	4	Formatted Table
<pre>built of the second of th</pre>		Eligible, PAYS	0%		
<pre>but we have a state of the state of the</pre>					
<pre>Nume:</pre>	SUMMER COINCIDENT PEAK	DEMAND SAVINGS			
MVY	$\Delta kW = \Delta kWh * CF$				
Where diffield Control Contero Contecontero Control Control Contecontero Control	Where:				
<pre>##WF</pre>		$= \Delta kWh * CF$		•	Formatted: Indent: First line: 0"
CF = Summer peak coincidence demand (kW) to annual energy (kWh) factor = 0.0000887318 XATURAL GAS SAVINOS Castom calculation below for gas DHW systems, otherwise assume 1.1 therms per 6 linear feet of % in, R-4 insulation or 1.5 therms per 6 linear feet of 1 in, R-6 insulation: STHERMS = (1 + %ElectricDHW) + ((Cgwc/Rgwc - Cgr/R, qp) + L + AT + Hours)/(nDHWcw + 100,000) ATherms = (1 + %ElectricDHW) + ((Cgwc/Rgwc - Cgr/R, qp) + L + AT + Hours)/(nDHWcw + 100,000) Where: n = Recovery efficiency of gas hot water heater = 0.78 ²⁰ = 0.78 ²⁰ 00,000 = 0.78 ²⁰ Water horAct Descentritions AND CALCULATION NA DEscence O&M Cost ADJUSTMENT CALCULATION NA DEscence O&M Cost ADJUSTMENT CALCULATION NA MEASURE CODE:		energy savings, as calculated above.			
Custom calculation below for gas DHW systems, otherwise assume 1.1 therms per 6 linear feet of 34 in, R-4 insulation or 1.5 therms per 6 linear feet of 1 in, R-6 insulation Therms = (1 - %ElectricDHW) * ((C _{Bec} /R _{Bec} - C _{BE} /R _E) * L * AT * Hours) (nDHW _{Gec} * 100,000) ATherms = ((C _{Bec} /R _{Bec} - C _{BE} /R _E) + L + AT + Hours) (nDHW _{Gec} * 100,000) Therms = (C _{BEC} /R _{Bec} - C _{BE} /R _E) + L + AT + Hours) (nDHW _{Gec} * 100,000) Therms = (C _{BEC} /R _{Bec} - C _{BE} /R _E) + L + AT + Hours) (nDHW _{Gec} * 100,000) Therms = (C _{BEC} /R _{Bec} - C _{BE} /R _E) + L + AT + Hours) (nDHW _{Gec} * 100,000) Therms = (C _{BEC} /R _{Bec} - C _{BE} /R _E) + L + AT + Hours) (nDHW _{Gec} * 100,000) Therms = (C _{BEC} /R _{Bec} - C _{BE} /R _E) + L + AT + Hours) (nDHW _{Gec} * 100,000) Therms = (C _{BEC} /R _{Bec} - C _{BEC} /R _{Bec}) + L + AT + Hours) (nDHW _{Gec} * 100,000) Therms = (C _{BEC} /R _{Bec} - C _{BEC} /R _{Bec}) + L + AT + Hours) (nDHW _{Gec} * 100,000) Therms = (C _{BEC} /R _{Bec} - C _{BEC} /R _{Bec}) + L + AT + Hours) (nDHW _{Gec} * 100,000) Therms = (C _{BEC} /R _{Bec} - C _{BEC} /R _{Bec}) + L + AT + Hours) (nDHW _{Gec} * 100,000) Therms = (C _{BEC} /R _{Bec} - C _{BEC} /R _{Bec}) + L + AT + Hours) (nDHW _{Gec} * 100,000) Therms = (C _{BEC} /R _{Bec} - C _{BEC} /R _{Bec}) + L + AT + Hours) (nDHW _{Gec} * 100,000) Therms = (C _{BEC} /R _{Bec} - C _{BEC} /R _{Bec}) + L + AT + Hours) (nDHW _{Gec} * 100,000) Therms = (C _{BEC} /R _{Bec} - C _{BEC} /R _{Bec}) + L + AT + Hours) (nDHW _{Gec} * 100,000) Therms = (C _{BEC} /R _{BEC} /R _{BEC} /R _{BEC}) + L + AT + Hours) (nDHW _{Gec} * 100,000) Therms = (C _{BEC} /R	CF = Su	mmer peak coincidence demand (kW) to annual energy (kWh) factor		
feet of 1 in, R-6 insulation: ATherms = (1 - % ElectricDHW) * ((C _{hece} /R _{Bace} - C _{EE} /R _{-EE}) * L * AT * Hours) (nDHW _{Gac} * 100,000) ATherms = ((C _{Bace} /R _{Baces} - C _{EE} /R _{ec}) + L * AT * Hours) (nDHW _{Gac} * 100,000) Where: nDHW _{Gac} = Recovery efficiency of gas hot water heater 2 0.78 ⁵⁰ 1 00,000 0 = Conversion factor from Bu to therms Other variables as defined above. WATER MPACT DESCRIPTIONS AND CALCULATION NA DEEMED 0&M Cost ADJUSTMENT CALCULATION NA MEASURE CODE: ¹⁰		D1			
ATherms = ((G _{based} /R _{base} - G _{bas} /R _{bas}) + L + ΔT + Hours)/(ηDHW _{cas} + 100,000) Where: ηDHW _{cas} = Recovery efficiency of gas hot water heater = 0.78 ⁹⁹ 100,000 = Conversion factor from Bu to therms Other variables as defined above. WATER IMPACT DESCRIPTIONS AND CALCULATION NA DEEMED O&M Cost ADJUSTMENT CALCULATION NA MEASURE CODE:		gas DHW systems, otherwise assun	ne 1.1 therms per 6 linear feet of 3/4 in, R-4 ins	sulation or 1.5 therms per 6 linear	
ATherms = ((G _{based} /R _{base} - G _{bas} /R _{bas}) + L + ΔT + Hours)/(ηDHW _{cas} + 100,000) Where: ηDHW _{cas} = Recovery efficiency of gas hot water heater = 0.78 ⁹⁹ 100,000 = Conversion factor from Bu to therms Other variables as defined above. WATER IMPACT DESCRIPTIONS AND CALCULATION NA DEEMED O&M Cost ADJUSTMENT CALCULATION NA MEASURE CODE:	Δ Therms = (1 ·	- %ElectricDHW) * ((Cpace/Rpace - Cp	$(\mathbf{R} \in \mathbb{R}) * \mathbf{L} * \mathbf{AT} * Hours) / (\mathbf{nDHW}_{Cos} * 100.00)$)())	
Where: ^{III} PUHW _{Gau} = Recovery efficiency of gas hot water heater ^{IIII} 0,000 = Conversion factor from Bu to therms Other variables as defined above. WATER IMPACT DESCRIPTIONS AND CALCULATION NA DEEMED O&M COST ADJUSTMENT CALCULATION NA MASSURE CODE: ^{IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII}	(1	<u> </u>		<u></u>	
PHW Can = Recovery efficiency of gas hot water heater = 0.78 ⁻²⁰ 100,000 = Conversion factor from Btu to therms Other variables as defined above. WATER INFACT DESCRIPTIONS AND CALCULATION NA DEEMED O&M COST ADJUSTMENT CALCULATION N/A MEASURE CODE: Provide Code: *** PV2018 Energy: Efficiency Kits: School Evaluation Report, page 39. *** PV2018 Energy: Efficiency Kits: School Evaluation Report, page 39. *** PV2018 Energy: Efficiency Kits: School Evaluation Report, page 39. *** PV2018 Energy: Efficiency Kits: School Evaluation Report, page 39.	<u> </u>	$\frac{((C_{Base}/R_{Base} - C_{EE}/R_{EE}) * L * \Delta T}{(C_{Base}/R_{Base} - C_{EE}/R_{EE}) * L * \Delta T}$	' * Hours)/(ηDHW _{cas} * 100,000)		
 a. 7.8³⁹ Homos = 0.7.8³⁹ Homos = 0.7.8³⁹ Homos = 0.7.8³⁹ Homos = 0.7.8³⁹ WATER IMPACT DESCRIPTIONS AND CALCULATION N/A DEEMED Q&M COST ADJUSTMENT CALCULATION N/A DEEMED Q&M COST ADJUSTMENT CALCULATION N/A MEASURE CODE: 		covery efficiency of gas hot water he	ater		
Other variables as defined above. WATER INPACT DESCRIPTIONS AND CALCULATION NA Description Content of the content	= 0.7	8 ²⁹⁹			
N/A DEEMED O&M COST ADJUSTMENT CALCULATION NA MEASURE CODE:					
N/A DEEMED O&M COST ADJUSTMENT CALCULATION NA MEASURE CODE:	WATER IMPACT DESCRIPTION	ONS AND CALCULATION			
N/A MEASURE CODE:					
PY2018 Energy Efficiency Kits School Evaluation Report, page 39. 299 Review of AHRI directory suggests range of recovery efficiency ratings for new gas DHW units of 70-87%. Average of existing units is estimated at 78%.		TMENT CALCULATION			
²⁹⁹ Review of AHRI directory suggests range of recovery efficiency ratings for new gas DHW units of 70-87%. Average of existing units is estimated at 78%.	MEASURE CODE:				
²⁹⁹ Review of AHRI directory suggests range of recovery efficiency ratings for new gas DHW units of 70-87%. Average of existing units is estimated at 78%.					
²⁹⁹ Review of AHRI directory suggests range of recovery efficiency ratings for new gas DHW units of 70-87%. Average of existing units is estimated at 78%.					
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²⁹⁹ Review of AHRI directory suggests range of recovery efficiency ratings for new gas DHW units of 70-87%. Average of existing units is estimated at 78%.					
²⁹⁹ Review of AHRI directory suggests range of recovery efficiency ratings for new gas DHW units of 70-87%. Average of existing units is estimated at 78%.					
			ew gas DHW units of 70-87%. Average of existing units	is estimated at 78%.	
2025 MEEIA <u>4 2019-21 Plan</u> Revision <u>87</u> .0 Page 77					
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Ameren Missouri	Appendix I - TRM – Vol. 3: Residential Me	Casures Formatted: Font: (Default) Arial, 12 pt
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3.3.6 Thermostatic Restrictor Shower Valve (Retired, effective 1/1/2	00751-300	
		
Description The measure is the installation of a thermostatic restrictor shower value in a sing	le or multifamily household. This is a valve attached to a re	Formatted: Font color: Background 1
showerhead which restricts hot water flow through the showerhead once the wat		
This measure was developed to be applicable to the following program types: R	F, NC, and DI.	
If applied to other program types, the measure savings should be verified.		
Definition of Efficient Equipment To qualify for this measure the installed equipment must be a thermostatic restri	ctor shower valve installed on a residential showerhead.	
Definition of Baseline Equipment The baseline equipment is the residential showerhead without the restrictor valv	e installed.	
Deemed Lifetime of Efficient Equipment The expected measure life is assumed to be 10 years. ³⁰¹		
Deemed Measure Cost The incremental cost of the measure should be the actual program cost (includin	g labor if applicable) or \$30 ²⁰² plus \$20 labor ²⁰³ if not avai	lable.
Loadshape Water Heating RES		
Coincidence Factor		
CF = Summer peak coincidence demand (kW) to annual en = 0.0000887318	ergy (kWh) factor	
Algorithm		
Calculation of Savings		
Electric Energy Savings		
<u>AkWh = %ElectricDHW * ((GPM base S * L showerdevice) * Hous</u>	ehold * SPCD * 365.25 / SPH) * EPG_electric * ISR	
Where:		
		Formatted: Normal
<u>AkWh = %ElectricDHW * ((GPM_base_S * L_showerdevice) * He</u> Where:	NUSEROUU * 3PCD * 365.25/3PH) * EPG_EUECUTIC *	-15K
%ElectricDHW = proportion of water heating supplied by electric resist	ance heating	
DHW fuel %ElectricDHW		
Electric 100% Natural Gas 0%		Formatted: Font color: Background 1
Unknown 16% ³⁰⁴		Formatted: Font color: Background 1
<u>ــــــــــــــــــــــــــــــــــــ</u>		Formatted: Font color: Background 1
²⁰⁰ "Retire" indicates that the measure is not anticipated to be offered through an Ameren Missour	administered demand side program during the period of TDM -fff-	Formatted: Font color: Background 1
³⁰¹ Assumptions based on NY TRM, Pacific Gas and Electric Company Work Paper PGECODHW	/113 and measure life of lowflow showerhead.	Formatted: Font color: Background 1
²⁰² Based on actual cost of the SS 1002CP SB Ladybug Water Saving Shower Head adapter from ²⁰³ Estimate for contractor installation time.		
²⁰⁴ Default assumption for unknown fuel is based on EIA Residential Energy Consumption Survey <u>Heating in Midwest Region.xls</u> 'Default assumption for unknown fuel is based on EIA Residential	Energy Consumption Survey (RECS) 2009 for Midwest Region, data	for the
state of Illinois. If utilities have specific evaluation results providing a more appropriate assumption		
<u>2025</u> MEEIA <u>4 2019-21</u> Plan Revision <u>87</u> .0	F	Page 78

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ı				0.	

			Appendix I - TRM – Vol. 3: Residentia	I Measures	Formatted: Font: (Default) Arial, 12 pt
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PM_base_S = Flow rate of	of the base case showerhead, or	r actual if available			
	Program	CPM			
	Direct-install, device only	+ 2.241.5305			Formatted: Font color: Background 1
	New Construction or dire	et Rated or actual flow		<u> </u>	Formatted: Font color: Background 1
	install of device and low flow showerhead	of program-installed showerhead		C.	Formatted. Fort color. Background T
	Retrofit or TOS	2.35 ³⁰⁶			Formatted: Font color: Background 1
-1	· · · · · · · · · · · · · · · · · · ·				Formatted: Font color: Background 1
<u>showerdevice</u> = Hot = 0.89 minute	t water waste time avoided du es ³⁰⁷	e to thermostatic restricto.	varve		offiatted. Font color. Dackground T
	umber of people per household	ł			
	Household Unit Tune ²⁰⁸	Hausshald			
	Single Family - Deemed	2.67 ³⁰⁹			Formatted: Font color: Packground 1
	Multi-Family - Deemed	2.07 ³¹⁰		<u> </u>	Formatted: Font color: Background 1
	Custom	Actual Occupancy or Nur	ber of Bedrooms ³¹¹		Formatted: Font color: Background 1
PCD = Showers Pe	er Capita Per Day				Formatted: Font color: Background 1
$= 0.66^{312}$	or capture of Duy			1. C	Formatted: Font color: Background 1
	ear, on average.				
PH = Showerhead	ds Per Household so that per s	showerhead savings fracti	ons can be determined		
	Household Type	SPH			
	Single Family	2.05 ³¹³			Formatted: Font color: Background 1
	Multi-Family	1.4 ³¹⁴		<u> </u>	Formatted: Font color: Background 1
	Custom	Actual			Formatted: Font color: Background 1
PG electric = Energy per	gallon of hot water supplied b	y electric			Formattade Cont. color: Roskaround 1
$= (8.33 \times 1.0^{-3})$	gallon of hot water supplied t * (ShowerTemp - SupplyTem	p)) / (RE_electric * 3,412)	▲ < >	Formatted: Font color: Background 1
$= \frac{(8.33 \times 1.0)}{(8.33 \times 1.0)}$	* (ShowerTemp - SupplyTem * (105 - 61.3)) / (0.98 * 3,412	p)) / (RE_electric * 3,412	}	▲ < >	Formatted: Font color: Background 1 Formatted: Indent: Left: 0.5", First line: 0.5"
$= \frac{(8.33 \times 1.0)}{= (8.33 \times 1.0)}$ $= 0.109 \text{ kWh/}$	* (ShowerTemp - SupplyTem * (105 - 61.3)) / (0.98 * 3,412 /gal	p)) / (RE_electric * 3,412)	▲ < >	
= (8.33 * 1.0 = (8.33 * 1.0 = (8.33 * 1.0 = 0.109 kWh/ .33 = Specific we	* (ShowerTemp – SupplyTem * (105 – 61.3)) / (0.98 * 3,412 /gal sight of water (Ibs/gallon)	p)) / (RE_electric * 3,412	•	▲ < >	
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= (8.33 * 1.0 = (8.33 * 1.0 = 0.109 kWh/ .33 = Specific we .0 = Heat capaci howerTemp = Assumed te	* (ShowerTemp – SupplyTem * (105 – 61.3)) / (0.98 * 3,412 /gal sight of water (lbs/gallon) ity of water (btu/lb °) smperature of water	p)) / (RE_electric * 3,412			Formatted: Indent: Left: 0.5", First line: 0.5"
	* (ShowerTemp – SupplyTem * (105 – 61.3)) / (0.98 * 3,412 /gal sight of water (lbs/gallon) ity of water (bts/h °) smperature of water 	p)) / (RE_electric * 3,412 2) <u>%/IL_TRM_Effective_010124 +</u> -2016.	12.0 Vol 3 Res 09222023 FINAL clean.pdf. page 2851	linois Statewide	
⁶ <u>(8.33 ± 1.0</u> = (<u>8.33 ± 1.0</u> = (<u>8.33 ± 1.0</u> = 0.100 kWh/ 33 = Specific we 0 = Heat capaci howerTemp = Assumed te ⁶ <u>Hinois TRM Version 12.0. https:</u> <u>schnical Reference Manual for Ene</u> <u>tp://dsagfiles.org/SAG_files/Techn</u>	(ShowerTemp – SupplyTem * (105 – 61.3)) / (0.98 * 3,412 //gal ujght of water (lbs/gallon) ity of water (btu/lb °) omperature of water //www.ilsag.info/wp_content/upload rey Efficiency Version 50. pp. 184. ited Reference Manual Version 50. pp. 184.	p))/(RE_electric * 3,412 2) <u>*/IL_TRM_Effective_010124 -</u> 2016. Final/IL_TRM_Version_5.0_df	<u>12.0 Vol 3 Res 09222023 FINAL elean.pdf. page 285</u> F ed February 11 2016 Final Compiled Volumes 1 4.pdf	linois Statewide	Formatted: Indent: Left: 0.5", First line: 0.5"
⁴ Illinois TRM Version 12.0, https:// ewvernements.conducted from June - direct installation.	* (ShowerTemp – SupplyTem * (105 – 61.3)) / (0.98 * 3,412 /gal sight of water (bk/gallon) ity of water (bk/bc [°]) smperature of water //www.ilsag.info/wp.content/upload orgyEfficiency Version 5.0. pp. 184, nical Reference Manual/Version 5./ 2013 to January 2014 by Franklin E	p)) / (RE_electric * 3,412 2) %/IL_TRM_Effective_010124 + -2016. Final/IL_TRM_Version_5.0_da nergy_Over 300 residential site	12.0 Vol. 3. Res. 09222023. FINAL, clean.pdf, page 2851 ed. February 11. 2016. Final. Compiled. Volumes. 1.4.pdf in the Chicago area were tested.Assumes low flow shower	linois Statewide	Formatted: Indent: Left: 0.5", First line: 0.5"
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⁴ <u>Hlinois TRM Version 12.0, https:</u> ⁶ <u>Assumed te</u> ⁶ <u>Hlinois TRM Version 12.0, https:</u> ⁶ <u>Heat capaci</u> howerTemp = Assumed te ⁶ <u>Assumed te</u>	(ShowerTemp – SupplyTem (Jo5 – 61.3)) / (0.98 * 3,412 //gal jght of water (bs/gallon) ity of water (btu/lb °) mperature of water //www.ilsag.info/wp_content/upload rey Efficiency Version 50. pp. 184, itical Reference Manual Version 5/ 2013 to January 2014 by Franklin Ei sa 1, 2, 4, 5, 6 and 7 (See Source Tab isting higher flow devices rather than showerStart LLC survey: "Identify	p))/(RE_electric * 3,412 2) <u>s/IL_TRM_Effective_010124 -</u> 2016. Find/IL_TRM_Version_5.0 df nergy, Over 300 residential site le at end of measure section) ad a those with existing low flow (ing. Quantifying and Reducing	12.0 Vol. 3 Res 09222023 FINAL clean.pdf, page 2851 ed February 11 2016 Final Compiled Volumes 1 4.pdf in the Chicago area were testedAssumes low flow shower usted slightly upward to account for program participation evices.	linois Statewide Based on head is included which is tential of	Formatted: Indent: Left: 0.5", First line: 0.5"
⁶ <u>Hinois TRM Version 12.0, https:</u> <u>- (8.33 * 1.0)</u> <u>= (0.109 kWH/)</u> . <u>- (8.33 * 1.0)</u> <u>- (8.35 * 1</u>	* (ShowerTemp – SupplyTem * (105 – 61.3)) / (0.98 * 3,412 /gal ight of water (bs/gallon) ity of water (bt/lb °) mperature of water ///www.ilsag.info/wp_content/upload orgy_Efficiency Version 5.0, pp. 184 ///www.ilsag.info/wp_content/upload orgy_Efficiency Version 5.0, pp. 184 ///www.ilsag.info/wp_content/upload orgy_Efficiency Version 5.0, pp. 184 ///www.ilsag.info/wp_content/upload orgy_Efficiency Version 5.0, pp. 184 ///www.ilsag.info/wp_content/upload isting higher flow devices rather than is ShowerStart LLC survey; "Identify ther Department survey; "Water Cons	p))/(RE_electric * 3,412)/(RE_electric * 3,412)////////////////////////////////////	12.0 Vol 3 Res 09222023 FINAL clean.pdf, page 2851 ed February 11 2016 Final Compiled Volumes 1 4.pdf in the Chicago area were tested Assumes low flow shower usted slightly upward to account for program participation evices. Behavioral Waste in the Shower: Exploring the Savings Pc Plot Project White Paper," and PG&E Work Paper PGEC	linois Statewide Based on head is included which is tential of	Formatted: Indent: Left: 0.5", First line: 0.5"
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Krz retrights/water issues/mgramchear teris/his/water issues/mgramchear teris/his/water issues/mgramchear teris Impact and Process Evaluation I Showerheads 7.3.2.	p)) / (RE_electric * 3,412 <u>2)</u> <u>5/IL_TRM_Effective_010124 - 3</u> 2016. <u>2016.</u> <u>2016.</u> <u>2016.</u> <u>2016.</u> <u>2016.</u> <u>2016.</u> <u>2016.</u> <u>2017.</u> <u>2016.</u> <u>2016.</u> <u>2017.</u> <u>2016.</u> <u>2017.</u> <u>2016.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2016.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017.</u> <u>2017</u>	12.0 Vol. 3. Res. 09222023 FINAL_clean.pdf, page 2851 ed. February. 11.2016. Final_Compiled_Volumes_1.4.pdf in the Chicago area were tested.Assumes low flow shower usted slightly upward to account for program participation exicos. Behavioral Waste in the Shower: Exploring the Savings Pc Pilot Project White Paper," and PG&E Work Paper PGEC should be used. c Cadmus_https://www.efis.psc.mo.gov/Document/Display et o turnover rates in residency and non-adult population j	Inois Statewide r Based on read is included r which is r stantial of >DHW113, r /13805, page r /13805, page r /13805, page r /13805, page r	Formatted: Indent: Left: 0.5", First line: 0.5"

A			and the TDM AVE OD AT A		
<u>Ameren Missou</u>	าน	Ар	<u>pendix I - TRM – Vol. 3: Residential I</u>	Measures.	Formatted: Font: (Default) Arial, 12 pt
					Formatted: Normal
	105F ³¹⁵				
upply lemp =	Assumed temperature of water ente = 58.4F ³¹⁶ 61.3F ³¹⁷	ring house			
E_electric =	Recovery efficiency of electric wate	er heater			
	98% ³¹⁸				
	Converts Btu to kWh (btu/kWh)				
	In service rate of showerhead	on program delivery method as listed	Lin table below		
	rietuai, or ir unknown, dipependent	on program derivery method as instee			
	Selection	ISR			
	Direct Install - Single Family	0.91			Formatted: Font color: Background 1
	Direct Install – Multi Family	0.91 ³¹⁹			Formatted: Font color: Background 1
	Efficiency Kits	To be determined through evaluation	///		Formatted: Font color: Background 1
EXAMPLE					Formatted: Font color: Background 1
EXAMILE					Pormatted. Point color. Background 1
For example, a d	lirect installed valve in a single-fam	ily home with electric DHW:			
		0.66 * 365.25 / 2.05) * 0.108 * 0.91			
	= 42 kWh				
ummer Coincid	ent Peak Demand Savings				
$\frac{\Delta \mathbf{K} \mathbf{W} = \Delta \mathbf{r}}{\mathbf{here:}}$	«Wh / Hours * CF				
	AkWh/Hours * CF				
/here:					
kWh = calculate CF		demand (kW) to annual energy (kWh	factor		
CI	= 0.0000887318	demand (kw) to annual energy (kwn	- lactor		
Hours		very hours for wasted showerhead use		4	Formatted: Indent: First line: 0.5"
CDU		rdevice) * Household * SPCD * 365.		·/·· ·	Formatted: Indent: Left: 1"
GPH	and typical 4.5kW electric res		65.9F temp rise (120-54.1), 98% recovery ef	ficiency,	Formatted: Indent: Left: 0.5", Hanging: 1"
	= 27.51	sistance storage talk.			
	= 34.4 for SF direct install; 2	8.3 for MF direct install			Formatted: Indent: Left: 1"
		OS; 24.8 for MF Retrofit and TOS			Formatted: Space After: 6 pt
), page 32Illinois Statewide Technical Reference Manu		
fficiency Version 5.0)16_Final_Compiled		agfiles.org/SAG_files/Technical_Reference_M	Ianual/Version_5/Final/IL_TRM_Version_5.0_dated_1	February-11-	
⁶ National Weather S	Service. Average soil temperature at 40" dep	oth during 2015 - 2023 data of six stations in /	ameren Missouri service territory.		Formatted: Font color: Background 1
	ov/nerfc/LMI_SoilTemperatureDepthMaps		/commoncomponents/viewdocument.asp?DocId=9356	58483	
⁸ Electric water heate	ers have recovery efficiency of 98%: http://v	www.ahridirectory.org/ahridirectory/pages/ho	me.aspx.		
⁹ Based on Ameren N	Missouri Community Savers Evaluation.		-		
"/1.2% is the propor	rtion of hot 120F water mixed with 54.1F st	ipply water to give 101F shower water.			
<u>.025 MEEIA 4 </u> 2	019-21 Plan Revisi	ion <u>8</u> 7.0		Page 81	

	buri		Appendix I - TRM – Vol. 3	B: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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EXAMPLE					Formatted: Indent: First line: 0"
	direct installed thermostati showers is not known. $\Delta kW = 85.3/34.4 * 0.0$ $= 0.0055 \text{ kW}$	_	nily home with electric DHW where		
Water H	eating RES				
EXAMPLE					Formatted: Indent: First line: 0"
	direct installed thermostati showers is not known. $\Delta kW = 85.3/34.4 * 0.0$ $= 0.0055 \text{ kW}$	0	nily home with electric DHW where		
Natural Gas Sav	vings				
ATherms	= %FossilDHW *	((GPM_base_S * L_showerdevi	ce) * Household * SPCD * 365.25 / SPH) *	EPG_gas * ISR	
11 nerms = % Where:	FossiiDHW + ((GPM_Da	ise_5 * L_snoweraevice) * H	vusehold * SPCD * 365.25 / SPH) * E	PG_gas + ISK	
%FossilDHW =	= proportion of water heating	ng supplied by Natural Gas heat	ng		
	DHW fuel	%Fossil_DHW		•	Formatted: Keep with next
	Electric Natural Gas	0%- 100%		•	Formatted: Font color: Background 1
	Unknown	84% ³²¹		•	Formatted: Keep with next
PG_gas	= Energy per gallor	n of Hot water supplied by gas		/	Formatted: Font color: Background 1
	= (8.33 * 1.0 * (ShowerTen	np - SupplyTemp)) / (RE_gas *	100,000)		Formatted: Keep with next
	= 0.00501 therm/gal for SF			\ \	Formatted: Font color: Background 1
E_gas =	= 0.00583 therm/gal for MI = Recovery efficiency of ga				Formatted: Keep with next
-6***	= 78% For SF homes ³²²				Formatted: Font color: Background 1
	= 67% For MF homes ³²³	(la tao / the anna)			
	= Converts Btus to therms ((btu/therm)			
Other variables a	is defined above.				
			urvey (RECS) 2009 for Midwest Region, data for the		Formatted: Font color: Background 1
			market or geographical area, then that should be use prage water heaters and 0.78 for standard efficiency g		
	st efficiency gas fired condensing	g tankless water heaters. These numbers	represent the range of new units however, not the ra	nge of existing units in stock.	
			nite of 111 x 1%. A version of existing units is estimate	d at 78%.	
Review of AHRI Dir	rectory suggests range of recover multifamily buildings is often pro			where between a typical central	
Review of AHRI Dir ²³ Water heating in 1	multifamily buildings is often pro	ovided by a larger central boiler. This si	is used for this analysis as a default for multifamily l	where between a typical central buildings.	
Review of AHRI Dir ²³ Water heating in 1	multifamily buildings is often pro	ovided by a larger central boiler. This si	ggests that the average recovery efficiency is somew	rhere between a typical central wildings. Page 82	

leren	Missouri Appendi:	<u>x I - TRM – Vol. 3: Res</u>	Formatted: Font: (Default) Arial, 12 pt
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EXAMP	 LE		
	mple, a direct installed thermostatic restrictor device in a gas fired DHW single family ho	ome	
where t	he number of showers is not known:		
	$\Delta \text{Therms} = 1.0 * ((2.67 * 0.89) * 2.56 * 0.6 * 365.25 / 1.79) * 0.00501 * 0.98$		
	= 3.7 therms		
/ater Iı	npact Descriptions and Calculation		
G 11			
Gallons	= ((GPM_base_S * L_showerdevice) * Household * SPCD * 365.25 / SPH) * ISR		
0	s = ((GPM_base_S * L_showerdevice) * Household * SPCD * 365.25 / SPH) *	<u>ISR</u>	
Examp	i as defined above		
LAMP	LE		
For exa	mple, a direct installed thermostatic restrictor device in a single family home where the		
number	of showers is not known:		
	$\Delta gallons = ((2.67 * 0.89) * 2.56 * 0.6 * 365.25 / 1.79) * 0.98$		
	= 730 gallons		
4	O&M Cost Adjustment Calculation		
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Į∕A	O&M Cost Adjustment Calculation B Reference 2011, DeOreo, William. California Single Family Water Use Efficiency Study. April 20, 20: 'California Single Family Water Use Study.pdf'	++-	 Formatted: Font color: Background 1 Formatted: Font color: Background 1
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<u>2025 MEEIA <u>4</u> 2019-21 Plan</u>

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Appendix I - TRM - Vol. 3: Residential Measures

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3.4 HVAC

3.4.1 Advanced Thermostat

DESCRIPTION

This measure characterizes the household energy savings from the installation of a new thermostat(s) for reduced heating and cooling consumption through a configurable schedule of temperature setpoints (like a programmable thermostat) and automatic variations to that schedule to better match HVAC system runtimes to meet occupant comfort needs. These schedules may be defaults, established through user interaction, and be changed manually at the device or remotely through a web or mobile app. Automatic variations to that schedule could be driven by local sensors and software algorithms and/or through connectivity to an internet software service. Data triggers to automatic schedule changes might include, for example: occupancy/activity detection, arrival & departure of conditioned spaces, optimization based on historical or population-specific trends, or weather data and forecasts.³²⁴ This class of products and services are relatively new, diverse, and rapidly changing. Generally, the savings expected for this measure aren't yet established at the level of individual features, but rather at the system level and how it performs overall. Like programmable thermostats, it is not suitable to assume that heating and cooling savings follow a similar pattern of usage and savings opportunity, so this measure treats these savings independently. This is a very active area of ongoing study to better map features to savings value and establish standards of performance measurement based on field data so that a standard of efficiency can be developed.325 That work is not yet complete but does inform the treatment of some aspects of this characterization and recommendations. Energy savings are applicable at the household level; installation of multiple advanced thermostats per home does not accrue additional savings.

This measure was developed to be applicable to the following program types: TOS, NC, RF, and DI.

If applied to other program types, the measure savings should be verified.

DEFINITION OF EFFICIENT EOUIPMENT

This measure involves replacement of a manual-only or programmable thermostat with one that has the default-enabled capability or the automatic capability to establish a schedule of temperature setpoints according to driving device inputs above and beyond basic time and temperature data of conventional programmable thermostats. As summarized in the description, this category of products and services is broad and rapidly advancing with regard to thermostat capability, usability, and sophistication. At a minimum, a qualifying thermostat must be capable of two-way communication³²⁶ and exceed the typical performance of manual and conventional programmable thermostats through the automatic or default capabilities described above.

DEFINITION OF BASELINE EQUIPMENT

The baseline is either the actual thermostat type (manual or programmable), if known,³²⁷ or an assumed mix of both types based upon information available from evaluations or surveys that represent the population of program participants. This mix may vary by program, but as a default, 44% programmable and 56% manual thermostats may be assumed.³²⁸

DEEMED LIFETIME OF EFFICIENT EQUIPMENT

The expected measure life for advanced thermostats is assumed to be 11 years. The expected measure life for advanced thermostats is assumed to be similar to that of a progr at. 10 vec

324 For example, the capabilities of products and added services that use ultrasound, infrared, or geofencing sensor systems, automatically develop individual models of a home's thermal projection to produce and addee so that as unasolity, instruction based on equipment type and performance traits, such as using n weather forecasts, to demonstrate the type of automatic schedule change functionality that apply to this measure characterization. ³²⁵ The ENERGY STAR® program discontinued its support for basic programmable thermostats effective 12/31/09 and is presently developing a new specification for "Residential

Climate Controls." 326 This measure recognizes that field data may be available, through the thermostat's two-way communication capability, to more accurately establish efficiency criteria and make

³²⁷ If the actual thermostat is programmable and is found to be used in override mode or otherwise is effectively being operated like a manual thermostat, then the baseline may be

¹³²⁸ Value for blend of baseline thermostat.
³²⁸ Value for blend of baseline thermostat.
³²⁸ Value for blend of baseline thermostats comes from an Illinois potential study conducted by ComEd in 2013; Opinion Dynamics Corporation, "ComEd Residential Saturation/End Use, Market Penetration & Behavioral Study," Appendix 3: Detailed Mail Survey Results, April 2013, p. 34.

Saturation Lind Use, Market remetation & Benavioral Study, "Appendix 3: Defailed Mail Survey Kesults, April 2013, p. 34. ³²⁹Illinois TRM Version 12.0, https://www.ilsag.info/wp-content/uploads/IL-TRM_Effective_010124_v12.0_Vol_3_Res_09222023_FINAL_clean.pdf_page 204. Based on 2017_ Residential Smart Thermostat Workpaper, prepared by SCE and Nest for SCE (Work Paper SCE17HC054, Revision #0, https://www.peakload.org/assets/SCE17HC054.0_Residential_Sma.pdf; SCE17HC054.0_Residential_Sma.pdf;). Estimate ability of smart systems to continue providing savings after disconnection and conduct statistical survival analysis which yields 9.2-13.8 year rangeTable 1, HVAC Controls, Measure Life Report, Residential and Commercial/Industria

Lighting and HVAC Measures, GDS Associates. 2007. there evaluation is strongly conclusion and inform the persistence of savings to further refine measure life assumption. As this characterization depends heavily upon a number vings studies that lasted a single year or less, the longer term impacts should be assessed.

2025_MEEIA 4_2019-21_Plan

Revision 87.0

Page 84

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Ameren Missouri	Appendix I - TRM – Vol. 3: Resider	tial Measures Formatted: Font: (Default) Arial, 12 pt
DEEMED MEASURE COST		Formatted: Normal
For DI and other programs where installation services are pro- cost of the advanced thermostat is equal to the actual total ad	ovided, the actual material, labor, and other costs should be referenced, dvanced thermostat material, labor, and other costs, minus the \$50 bas s are provided, the actual material, labor, and other costs should be use	seline thermostat
	ermostat costs are known, the incremental cost of the advanced them seline thermostat costFor retail, Bring Your Own Thermostat (BYOT	
-If actual costs are unknown, then the incremental cost for the incremental cost for the new installation measure is assumed	advanced thermostat is assumed to be \$79H actual costs are unknown, to be \$125.333	then the average
LOADSHAPE Cooling RES Heating RES		
	Algorithm	
CALCULATION OF SAVINGS		
ELECTRIC ENERGY SAVINGS Electrical savings are a function of both heating and cooling (heat pumps) and fan savings in the case of a natural gas furn	energy usage reductions. For heating, this is a function of the percent nace.	of electric heat
$\Delta k W h = \Delta k W h_{\text{beating}} + \Delta k W h_{\text{gooling}}$		Formatted: Subscript
$\Delta kWh_{heating} = \% ElectricHeat * HeatingConsumption_{ElectricHeat}$	_{ic} * HF * HeatingReduction* Eff ISR + (ΔTherms * Fe * 29.3)	Formatted: Subscript
$\Delta kWh_{cool} = \%AC * ((EFLH_{cool} * Capacity_{Cool} * 1/SEEF$	22)/1000) * CoolingPeduction * Eff. ISP	Formatted: Subscript
$\frac{\Delta K W \Pi_{\text{gool}}}{2} = 70 \text{ AC} \cdot ((\text{EPLH}_{\text{gool}} \cdot \text{Capacity}_{\text{Gool}} \cdot 1/\text{SEEP})$	(2) 1000) * CoolingReduction * En_ISK	Formatted: Subscript
$\Delta kWh = \Delta kWh_{neating} + \Delta kWh_{cooling}$		Formatted: Subscript
$\Delta kWh_{nearing} = \% ElectricHeat * HeatingConsumption$	n _{electric} * HF * HeatingReduction * Eff_ISR + (ΔTherms * I	Formatted: Subscript Formatted: Subscript
AkWh _{coot} = %AC * ((EFLHcool * CapacityCool * 1/.	SEER)/1000) * CoolingReduction * Eff_ISR	
Where:		Formatted: Indent: Left: 0", First line: 0"
%ElectricHeat = Percentage of heating savings assu Heating fuel %ElectricHeat	ectricHeat	
Electric Natural Gas	100% 0% 33% ³³⁴	
	s or other trade ally partners that support customer participation through thermostat d	istribution,
eligibility criteria are available on units readily available in the market rou	maintenance, and/or individual device energy feature fees. vith thermostat capability and sophistication. The core suite of functions required by t ghly in the range of \$100 and \$150, excluding the availability of time or market-limit	ted wholesale or
baseline equipment (blend of manual and programmable thermostats) is \$2 https://www.ilsag.info/wp-content/uploads/IL-TRM_Effective_010124_v1 category, generally increasing with thermostat capability and sophisticatio variable in the market. Prices are in the range of \$200 and \$250, excludin middle of the range (\$175) minus a cost of \$50 for the baseline equipment	uets Program finds an average retail cost of \$129 for Advanced Thermostats. The assu 50 which leads to an incremental cost of \$79 for the measure. Illinois TRM Version 1 12.0 Vol 3 Res (09222023 FINAL clean.pdf, page 204Market prices vary consider n. The core suite of functions required by this measure's eligibility criteria can be fou g the availability of any wholesale or volume discounts. The assumed incremental co- blend of manual. Add on energy service costs, which may include one time stup an	2.0. ably in this nd on units readily- st is based on the
device costs, are not included in this assumption. 334 Ameren Missouri Efficient Products Evaluation: PY2020, https://www.		
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		Appendix I - TRM – Vo	1. 5. Residential Measures	Formatted: Font: (Default) Arial, 12 pt
				Formatted: Normal
$eatingConsumption_{Electric}$		ics are known, equals ((EFLHheat * CapacityH		
	otherwise, eEstimate of annual hou	sehold heating consumption for electrically hea	ed single-family-homes.335	
		Elec_Heating_ Consumption (kWh) ³³⁶		
	Weather Basis	Electric Electric Heat Unkn	own	
	(Ameren Missouri Average)	Resistance Pump Elect		
	SF or MF	<u>14,202</u> 8,355 11,4 4,832 2,843 3,8		
1	MFc (comprehensive envelope)	4,832 2,845 5,6	0	
			•	Formatted: Space Before: 6 pt, After: 6 pt
EFLHheat = I	Equivalent Full Load Heating Hours: 337			
	Weather Basis (Ameren Miss	ouri <u>EFLHheat</u>		
	Average)	(Hours)		
	SF or MF	<u>1496</u> 510		
	MFc (comprehensive envelope)			
		Note: One ton is equal to 12,000 Btu/hr.)	•	Formatted: Space Before: 6 pt
	Actual the cooling equipment's Seasonal Energ	v Efficiency Ratio rating (kBtu/kWh)		
	Actual	<u>y Efficiency Ratio fating (Rbtark wity</u>		
¹ Ameren Missouri Efficient Pr		prehensive Envelope (CompE) Measures, the ratio of MF	effective full load hours (1496) to the	
pinion Dynamic recommendati ⁵ Ibid.	on for Comprehensive Envelope full load hours (:	509) was used to scale heating consumption values.		
pinion Dynamic recommendation ⁵ Ibid. 7 <u>Evaluation - Opinion Dynami</u> on	on for Comprehensive Envelope full load hours (:	509) was used to scale heating consumption values. constructed based on weather conditions (heating degree d		

<u>2025 MEEIA 4 2019-21 Plan</u>

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Revision <u>8</u>7.0

eren Missouri			Appendix I - TRM – Vol. 3: Residential M	leasures•	Formatted: Font: (Default) Arial, 12 pt
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HF	= Household factor, to adjus Household Type Single-Family Multi-Family	t heating consumption for non- HF 100% 65% ³³⁸	single-family households.	4	Formatted: Indent: Left: 0", First line: 0.5", Space After: 8 pt. Line spacing: Multiple 1.08 li, Widow/Orphan control, Don't keep lines together, Tab stops: Not at 2.5"
	If heating equipment	0.5 %			Formatted: Left
	characteristics are	100%			Formatted Table
	referenced to calculate				
	HeatingConsumption _{Electri} Actual	Custom ³³⁹			
HeatingPadue			d heating energy consumption due to advanced thermo	octat d	
HeatingReduc	non — Assumed percenta	ige reduction in total nousenon	i nearing energy consumption due to advanced merine	istat	Formatted: Indent: Hanging: 1", Space Before: 6 pt, After: 6 pt
	Existing Thermostat Ty	vpe Heating_Reduction ³⁴⁰	1		Formatted: Indent: Left: 0", First line: 0"
	Manual	8.8%	-		
	Programmable	5.6%	_		
	Blended Average	6.67%			
Eff ISR	= Effective In-Service Rate.	the percentage of thermostats	installed and configured effectively for 2-way commu	nication	
ΔTherms	is captured within the saving	rs percentage, ISR should be 19 frams, ilf using default savings	en custom ISR assumptions should be applied. If in see 30%- = Actual, or if unknown, for Efficient Products , use 100%. ³⁴²		
	= See calculation in natural				
Fe		nption as a percentage of annu	al fuel consumption		
29.3	$= 3.14\%^{343}$ = kWh per therm				
%AC		h thermostat-controlled air-con	ditioning		
	Thermostat control of air	%AC			
	conditioning?				
	Yes	100%			
	Unknown	Actual population data, or 91	96 344		
	Chikhown	rietuai population data, or yr			
$EFLH_{cool}$	= Equivalent full loa	ad hours of air conditioning:			
on factor is applied to t than single family h gram-specific housel se values represent a vings findings (page t/uploads/SAG files/ <u>Tstat Preliminary</u> (stats by their respect 7, https://www.efis.p eren Missouri Efficie	o multifamily homes with electric res- tomes. and factors may be utilized on the ba- djusted baseline savings values for di 28) <u>https://www.ilsag.info/wp-</u> Meeting Materials/2015/December- Gas Impact Findings 2015-12-08 t ive share of baseline. Further evaluat sc.mo.gov/Document/Display/14206 ant Products Evaluation PY2019, http	istance, based on professional judgm sis of sufficiently validated program of fferent existing thermostats, as preser 2015 Meetings/Presentations/Smart 0 IL SAG.pdf, The unknown assum ion and regular review of this key ass 1, page 47. s://www.efis.psc.mo.gov/Document/	tted in Navigant's IL TRM Workpaper on Impact Analysis from I <u>Tstat Preliminary Gas Impact Findings 2015-12-08 to IL SA</u> ption is calculated by multiplying the savings for manual and prop umption is encouraged. Ameren Missouri Efficient Products Eval Display/15877, page 140-(Table 6-9).	sseholds are Preliminary G. <u>pdf-;</u> grammable uation	Formatted: Not Highlight
s not one of the AHR BTU/yr) and Eae (kV a 3 criteria for 2% Fe. 5 of homes have cent	I certified ratings provided for reside Wh/yr). An average of a 300- record See <u>"</u> Programmable Thermostats F	ntial furnaces but can be reasonably e sample (non-random) out of 1495 wa urnace Fan Analysis.xlsx. ²² for referen	are already incorporated into the savings value for heating reduct stimated from a calculation based on the certified values for fuel s 3.14%. This is appropriately ~50% greater than the ENERGY S ice. urvey, see <u>"#RECS 2009 Air Conditioning_hc7.9.xls"</u>),	energy (Ef	
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<pre>Cupre_c</pre>	SF or MF	869 ³⁴⁵		
<pre>training the formation of the second prove of the second prov</pre>	MFc (comprehensive envelope)	632-40		
SER2 = the colling squipment's Seasonal Energy Efficiency Ratio rating (RBuKWB)				
The second SEEK? and years is possible to measure or reasonably estimate. If unknown assure [3.4 SEEK23, ¹⁰⁷ J. ¹⁰⁷ J				
CoolingReduction - Assumed precentage reduction in total household cooling energy consumption due to installation of advanced installation of advanced in the restor.	= Use actual SEER $\frac{2}{2}$ rating where		<u>ER213</u> . ³⁴⁷	
Hermostal Control Contrel Control Control Control Control Control Control Control Cont		eduction in total household cooling energy consumption due to installation of	advanced	
Ubic view use: = 0.000 view SMARE CONCIDENT PLAK DEMAND SAVINGS ALW = AkWh _{tectume} = CE Miles Miles </td <td>thermostat</td> <td></td> <td></td>	thermostat			
= 2.0%± ³ MARE CONCIDENT PLAK DEALAND SATINGS		ted during program deployment then custom savings assumptions should be ap	pplied.	
AWW = AWWh_come, *CF Wr_ender, AWW = +AWH_komeng +CF. Wreenew = AWWH_komeng +CF. Wreenew = Commerce performance (AWW) to annual energy (AWW) factor:				
Numerical and the second s	MMER COINCIDENT PEAK DEMAND SAVINGS			
Why come $AW = AWh_ensure_+ CF$ Wree A concerned and the second s	$\Lambda kW = \Lambda kWh_{c} + *CE$			
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emery #H-beating - Electric energy savings for cooling, calculated above Electric energy savings for cooling, calculated above CF = 00009474181 ¹⁰⁰ TURI CAS ENERGY SAVINGS Electric energy savings for cooling, calculated above Electric energy savings for cooling, calculated above Memms = %FossilHeat + HeatingConsumptiong_m + HF + HeatingReduction + Eff_SR Formatted: Subscript Memms = %FossilHeat + HeatingConsumptiong_m + HF + HeatingReduction + Eff_SR WrossilHeat = Percentage of heating savings assumed to be pNatural gGas Emerge Consumptiones Electric in devit / fossilHeat + MeatingConsumptiong_m + HF + HeatingReduction + Eff_SR WrossilHeat = Percentage of heating savings assumed to be pNatural gGas Matural Cas in 000% Electric in devit / fossilHeat + MeatingConsumptiong (fos % Lavin and Kamer City) taken from the diverse indevice				
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Values in table are based on average household heating load (834 therms) for Chicago based on Illinois furnace mete sponse Nicor Gas Plan Year 1: Research Report: Furnace Metering Study, Draft, https://www.icc.illinois.gov/docket/		

provided by Laciede Gas, which showed an average pre-turnace replacement consumption of 1009 therms for St Louis, and a post-replacement consumption of 909. Assuming trypical hot water consumption at 252 therms (using defaults from <u>http://energy.cost-ceref_emp/energy-cost-cellator-electric-ad-gas-water-heaters-fdworput)</u>, this indicates a heating load of 684-784 therms. Ameren Missouri Efficient Products Evaluation PY2017, <u>https://www.efis.psc.mo.gov/Document/Display/14206, page 47</u>.

<u>2025 MEEIA <u>4 2019-21</u> Plan</u>

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Revision <u>8</u>7.0

Appendix I - TRM - Vol. 3: Residential Measures

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3.4.2 Air Source Heat Pump Including Dual Fuel Heat Pumps

DESCRIPTION

An air source heat pump (ASHP) provides heating and/or cooling by moving heat between indoor and outdoor air. A cold climate air source heat pump (ccASHP) operates the same as a traditional ASHP, but is able to meet a home's full heating load at lower outdoor temperatures approaching 0°F. A dual fuel heat pump (DFHP) pairs an air source heat pump with a gas furnace such that the air source heat pump provides heating in mild weather, and as temperature drops the heat pump shuts off and the furnace provides heating. This measure may also apply to replacing a Central Air Conditioner with non-electric heating with an Air Source Heat Pump. In this case, only cooling savings (ER1, ER2, ROF) may be claimed using the ASHP cooling algorithm. This measure applies to central ducted systems and single zone split-systems with ductless indoor units that are capable of meeting a home's full cooling and heating demand.

This measure characterizes:

- TOS, NC: The installation of a new residential sized (<= 65,000 Btu/hr) air source heat pump that is more efficient than required by federal standards. This could relate to the replacement of an existing ASHP at the end of its useful life or the installation of a new ASHP in a new home.
- 2. EREP: The early removal of functioning electric heating and cooling systems from service, prior to its natural end of life, and replacement with a new high efficiency ASHP unit. For the early replacement baseline to apply, program participants or installation contractors must provide documentation asserting that the existing units operated when turned on—whether or not they provided cooling—and the existing unit be documented; or, if the nameplate is not readable, a photograph of the unit in context and the nameplate specifically must be provided Fo qualify as Early Replacement, the existing unit must be operational when replaced. If the SEER and/or haseline HSPF of the existing unit are known, the baseline SEER and/or baseline HSPF should be the actual values of the unit replaced. If unknown, use the assumptions provided in the variable list below! the SEER of the existing unit is known and the Baseline SEER is the actual SEER value of the unit replaced and if unknown use cassumptions in the variable list below (SEER2exist). If the operational status of the existing unit is unknown, use TOS assumptions.

This measure was developed to be applicable to the following program types: TOS, NC, and EREP.

If applied to other program types, the measure savings should be verified.

DEFINITION OF EFFICIENT EQUIPMENT

A new residential-sized (<= 65,000 Btu/hr) air source heat pump with specifications to be determined by the program.

The heating capacity of the efficient heat pump should be within 90% to 120% of the capacity of the existing equipment, unless the trade ally can provide documentation confirming the existing system is oversized. It is recommended to collect the existing and new unit capacities to confirm that the heat pump has sufficient capacity to minimize use of backup electric resistance heating.

Using a dual fuel heat pump, which uses a gas furnace for heating at lower outside air temperatures, or a cold climate rated heat pump are two options to ensure minimal use of backup electric resistance heating.

DEFINITION OF BASELINE EQUIPMENT

A new residential-sized (<= 65,000 Btu/hr) air source heat pump meeting federal standards.

New federal standards affecting heat pumps became effective January 1, 2023; however, these new federal standards will be adopted by the program, beginning 1/1/2024. Under the new standards, The baseline for the TOS measure is the federal standard efficiency level; 15 SEER (14.3 SEER2)14.3 SEER2 and 8.6 HSPF (7.5 HSPF2), 7.5 HSPF2, when replacing an existing air source heat pump; and 14 SEER (13.4 SEER2)13.4 SEER2 and 3.41 HSPF when replacing a central air conditioner and electric resistance heating. Non-electric heating replaced with an air source heat pump can only claim cooling savings. Under the new federal standards, the M1 testing protocol was revised, resulting in new SEER and HSPF performance metrics, now called SEER2 and HSPF2. When quantifying energy savings, the <u>SEER2 and HSPF2-same</u> metrics should be used for the existing, baseline, and new equipment. The following conversion formulas can be used to convert between efficiency metrics:

SEER2 = SEER $\times 0.96$ HSPF2 = HSPF $\times 0.87$

Through December 31, 2023, the baseline for the TOS measure is the previous federal standard efficiency level; 14 SEER and 8.2 HSPF, when replacing an existing air source heat pump; and 14 SEER and 3.41 HSPF when replacing a central air conditioner and electric resistance heating. Non-electric heating replaced with an air source heat pump can only claim cooling savings.

<u>2025 MEEIA <u>4 2019-21</u> Plan</u>

Revision 87.0

meren Missouri			Append	<u>ix I - TRM – Vol. 3: Res</u> i	idential Measures	Formatted: Font: (Default) Arial, 12 pt
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e baseline for the ea	rly replacement measure	e is the efficiency of	the existing equipment for the	assumed remaining useful li	fe of the unit and the	
w baseline as define	d above for the remaind	er of the measure life	<u>)</u> .			
EEMED LIFETIME O	F EFFICIENT EQUIPME	NT				
	life is assumed to be 18					
emaining life of exist	ing ASHP/CAC equipm	nent is assumed to be	6 years ³⁵³ and 18 years for elec	ctric resistance.		
EEMED MEASURE C	OST					
al Fuel Heat Pump:						
	Efficient	w (FFD)	Cost (including l	abor) per		
	DFHP SEER 191		measure \$2,936.6	8		
		MF heat pump base	\$2,930.0 \$3.176.6			
		MF heat pump base	+3,626.6			
r Source Heat Pump	+					
		e maseura ie dapanda	ent on the efficiency and capaci	ity of the new unit :		
5/ROL The merein	entar capitar cost for th	s measure is depende	and on the efficiency and capaci	ity of the new difft.		
	Efficiency	ROF Incremental	Source			
	(SEER) SEER 15	Cost (\$) \$303.00	IL TRM V8.0			
	SEER 15 SEER 16	\$438.00	IL TRM V8.0			
	SEER 17	\$724.00	IL TRM V8.0			
	SEER 18	\$962.92	Derived using IL TRM			
	SEER 19	\$1,203.65 \$1.444.38	(\$/unit) and the % change in Mid Atlantic TRM V9			
	SEER 19 SEER 20 SEER 21	\$1,203.65 \$1,444.38 \$1,689.92	(S-unit) and the % change in Mid Atlantic TRM V9 (\$/ton)			
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	SEER 20 SEER 21	\$1,444.38 \$1,689.92 for this measure is th	in Mid Atlantic TRM V9 (\$/ton) the actual cost of removing the	existing unit and installing t	he new one. If this is	
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	SEER-20 SEER-21 2): The full install cost collowing (note these co Efficiency (SEER)	\$1,444.38 \$1,689.92 for this measure is the sts are per ton of unit #ER-Incremental Cost for 3 ton-unit (\$)	in Mid Atlantic TRM V9 (\$/ton) te actual cost of removing the t capacity): Source	existing unit and installing t	he new one. If this is	
	SEER 20 SEER 21 R): The full install cost ollowing (note these co	\$1,444.38 \$1,689.92 for this measure is th sts are per ton of unit #ER-Incremental	in Mid Atlantic TRM V9 (\$40n) the actual cost of removing the teapacity):	existing unit and installing t	he new one. If this is	
	SEER-20 SEER-21 Collowing (note these co Efficiency (SEER) SEER-15 SEER-16 SEER-17	\$1,444.38 \$1,689.92 for this measure is the sts are per ton of unit Cost for 3 ton-unit (\$1 \$1,019.81 \$1,154.81 \$1,440.81	in Mid Atlantic TRM V9 (\$/on) te actual cost of removing the teapacity): Source H_TRM V8.0 H_TRM V8.0 H_TRM V8.0	existing unit and installing t	he new one. If this is	
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used. The assumed deferred cost (after the is assumed to be \$7,722 + \$674 per ton for AFUE boiler and \$3,670 for new baseline	tion cost of the ASHP (including any necessary electrical or distribution upgrades required) should be appropriate number of years described above) of replacing existing equipment with a new baseline unit a new baseline ASHP, or \$2,296 for a new baseline 80% AFUE furnace or \$4,627 for a new 84% Central AC replacement. ³⁶⁷ This future cost should be discounted to present value using a 2.31% e ten year average (1/1/2014 – 12/31/2023) of the 10 year Treasury bond yield rates. ³⁵⁸	Formatted: Not Highlight
If the install cost of the efficient ASHP is u	inknown, assume the following (note these costs are per ton of unit capacity);359	
	$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	
	aced with an ASHP, and the program administrator is only claiming energy savings from cooling (i.e., uel switch), the incremental costs should be adjusted to reflect the proportion of claimed savings.	
potential energy savings (inclusive of both	adjusted by applying a factor that represents the ratio of the claimed cooling savings to the total cooling and unclaimed heating savings). This adjustment ensures that the incremental cost used in cost- benefits being claimed, thus avoiding a mismatch between costs and benefits.	
Calculation Method:		
 <u>Determine Total Potential Savings</u> savings are not being claimed). 	: Calculate the sum of the potential energy savings from both cooling and heating (even if heating	Formatted: Underline
2. Determine Claimed Savings: Ident	ify the portion of energy savings that is being claimed, typically the cooling savings only, adjustment factor is calculated as the ratio of claimed savings to total potential savings. This factor is l cost of the ASHP.	Formatted: List Paragraph,TT - List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, + Start at: 1 + Alignment: Left + Aligned at: 0.25" + Indent at: 0.5"
Adjusted Incremental Cost = (Claimed	Savings (kWh) / Total Potential Savings (kWh)) * Full Incremental Cost)	Formatted: Underline
Assumed deferred cost (after 6 years) of re- cost should be discounted to present value	eplacing existing equipment with new baseline unit is assumed to be \$1,525 ²⁴⁰ per ton of capacity. This using the utilities' real discount rate.	Formatted: Underline
LOADSHAPE Cooling RES Heating RES		
	Algorithm	
CALCULATION OF SAVINGS	Algorithm	
Calculation of Savings Electric Energy Savings	Algorithm	
	Algorithm	Formatted: Foot: (Default) Times New Perman
ELECTRIC ENERGY SAVINGS	Algorithm	Formatted: Font: (Default) Times New Roman
ELECTRIC ENERGY SAVINGS TOS:	a their respective measures and include inflation rate of 1.98%.	Formatted: Font: (Default) Times New Roman
ELECTRIC ENERGY SAVINGS TOS: ³⁵⁷ All baseline replacement costs are consistent with ³⁵⁸ Societal Discount Rate Calculation 08082024 ³⁵⁹ Full install ASPP costs are based upon data prov	their respective measures and include inflation rate of 1.98%. xlsx*, ided by Ameren. See 'ASHP Costs 06242022'. Efficiency cost increment consistent with Cadmus "HVAC Program;	Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman, 9 pt
ELECTRIC ENERGY SAVINGS TOS: ²⁵⁷ All baseline replacement costs are consistent with ³⁵⁸ (Societal Discount Rate Calculation 08082024	n their respective measures and include inflation rate of 1.98%, xlsx', ided by Ameren. See 'ASHP Costs. 06242022'. Efficiency cost increment consistent with Cadmus "HVAC Program; 016 study results.	Formatted: Font: (Default) Times New Roman
ELECTRIC ENERGY SAVINGS TOS: ²⁵⁷ All baseline replacement costs are consistent wiff ³⁸⁸ Societal Discount Rate Calculation 08082024 ³⁹⁹ Full install ASHP costs are based upon data prov Incremental Cost Analysis Update", December 19.2	n their respective measures and include inflation rate of 1.98%, xlsx', ided by Ameren. See 'ASHP Costs. 06242022'. Efficiency cost increment consistent with Cadmus "HVAC Program; 016 study results.	Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman, 9 pt Formatted: Not Highlight

Ameren Misso	uri Appendix I - TRM – Vol. 3: Residential M	leasures	Formatted: Font: (Default) Arial, 12 pt	
			Formatted: Normal	
	[((EFLH _{gool} * Capacity _{gool} * (1/SEER2 _{pase} - 1/SEER2 _{go})) / 1000) + ((EFLH _{heat} * Capacity _{beat} * (1/HSPF2 _{pase} - 1/HSFF	<u>2_{ce}))/ •></u>	Formatted	
<u>1</u>	000)] * ISR		Formatted: Indent: Left: 0", Hanging: 1"	
	<u>Central Air Conditioning and Non-Electric Heating Backup</u> [((EFLH _{cool} * Capacity _{cool} * (1/SEER2 _{base} - 1/SEER2 _{ec})) / 1000) * ISR		Formatted	
			l'omateu	(
EREP: ³⁶¹				
	ing life of existing unit (1st 6 years for replacing an ASHP, 18 years for replacing electric resistance): [((EFLH _{cool} * Capacity _{cool} * (1/SEER2 _{exist} - 1/SEER2 _{ec})) / 1000) + ((EFLH _{heat} * Capacity _{heat} * (1/HSPF2 _{exist} - 1/HSF	P2 _{ee}))/	Formatted	
	0000)] * ISR		Formatted: Indent: Left: 1"	<u> </u>
	Central Air Conditioning and Non-Electric Heating Backup			
$\Delta kWh =$	[((EFLH _{gool} * Capacity _{gool} * (1/SEER2 _{gxist} - 1/SEER2 _{gc})) / 1000) *ISR		Formatted	
	ing measure life (next 12 years if replacing an ASHP):	2		
	[((EFLH _{gool} * Capacity _{gool} * (1/SEER2 _{puse} - 1/SEER2 _{ge})) / 1000) + ((EFLH _{heat} * Capacity _{heat} * (1/HSPF2 _{puse} - 1/HSFP 000)] * ISR	2 _{ce})) / •>	Formatted	
Cooling only for	Control Air Conditioning and Non Electric Heating Desland		Formatted: Indent: Left: 1"	
	Central Air Conditioning and Non-Electric Heating Backup [((EFLH _{eool} * Capacity _{eool} * (1/SEER2 _{base} - 1/SEER2 _{ec})) / 1000) * ISR		Formatted	
TOS:		•	Formatted: Normal	<u>(</u>
	(EFLH _{cont} * Capacity _{cont} * (1/SEER _{base} - 1/SEER _{ce})) / 1000) + ((EFLH _{heat} * Capacity _{heat} * (1/HSPF - 1/HSFP _{ce})) / 1,000)] * ISR	ase 4	Formatted: Indent: Left: 0"	
Cooling only for (Central Air Conditioning and Non-Electric Heating Backup	4	Formatted: Indent: Left: 0", First line: 0"	
	<u> AkWh = [((EFLH_{eoot} * Capacity_{eoot} * (1/SEER_{base} - 1/SEER_{ee})) / 1000) * ISR</u>			
EREP.363		4	Formatted: Indent: Left: 0"	
AkWh for remain	ng life of existing unit (1st 6 years for replacing an ASHP, 18 years for replacing electric resistance):	•	Formatted: Indent: First line: 0"	
= [((EF	LH _{cool} * Capacity _{cool} * (1/SEER _{exist} — 1/SEER _{ee})) / 1000) + ((EFLH _{keat} * Capacity _{keat} * (1/HSPF _{exist} — 1/HSFP _{ee})) / 1,000)] * ISR	- •	Formatted: Indent: Left: 0"	
Cooling only for (Central Air Conditioning and Non-Electric Heating Backup	•	Formatted: Indent: Left: 0", First line: 0"	
	$\Delta kWh = [((EFLH_{cool} * Capacity_{cool} * (1/SEER_{extsr} - 1/SEER_{ee})) / 1000) * ISR$			
AkWh for remain	ng measure life (next 12 years if replacing an ASHP):		Formatted: Indent: First line: 0"	
= [((EF	LH _{ecool} * Capacity _{ecool} * (1/SEER _{base} – 1/SEER _{ee})) / 1000) + ((EFLH _{heat} * Capacity _{heat} * (1/HSPF _{base}		Formatted: Indent: Left: 0", First line: 0"	
	$\frac{-1}{HSFP_{ee}} + \frac{1}{1000} + \frac{1}{SR}$			
Cooling only for (Central Air Conditioning and Non-Electric Heating Backup	•	Formatted: Indent: Left: 0", First line: 0"	
	<u> AkWh = [((EFLH_{cool} * Capacity_{cool} * (1/SEER_{base} - 1/SEER_{ce})) / 1000) * ISR</u>			
Where:		4	Formatted: Indent: Left: 0", First line: 0"	
	are provided to show how savings are determined during the initial phase of the measure (existing to efficient) and the remaining phase (new bas			
adjustment" input, wh	the screening tools used may either require a first year savings (using the first equation) and then a "number of years to adjustment" and "savings ich would be the either the new base to efficient savings or the (existing to efficient savings.			
efficient). In practice,	are provided to show how savings are determined during the initial phase of the measure (existing to efficient) and the remaining phase (new bas the screening tools used may either require a first year savings (using the first equation) and then a "number of years to adjustment" and "savings			
adjustment" input, wł	ich would be the either the new base to efficient savings or the (existing to efficient savings.			
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		Commentate de Niermel
EFLH _{cool}	= Equivalent full load hours of air conditioning. ³⁶³	Formatted: Normal
ET EFICIOI		
	Weather Basis (Ameren Missouri Average) EFLH _{cool} (Hours)	
	SF or MF 869	
	MFe (comprehensive envelope) 632 ³⁶⁴	
Capacity _{cool}	= Cooling Capacity of Air Source Heat Pump (Btu/hr)	
SEER _{2exist}	= Actual (1 ton = 12,000Btu/hr) = Seasonal Energy Efficiency Ratio of existing cooling system (kBtu/kWh)	
SEEK <u>2</u> exist	= Use actual SEER2 rating where it is possible to measure or reasonably estimate. If using rated efficiencies, derate the	
	efficiency value based on the age of the existing equipment (up to a maximum of 30 years) to account for degradation	
	over time. ³⁶⁵ If age is unknown, use 12 years.	
	= SEER 2 * (1-0.011-1.44%) ^{Age} If rated efficiency is unknown, use defaults provided below, which are already adjusted to account for age-related	
	degradation:	
	Existing Cooling System SEER Crist ³⁶⁶	
	Air Source Heat Pump 7.26.91	
	Central AC 6.853 No central cooling ³⁶⁷ Let '1/SEER2 _{evist} ' = 0	
	For central cooling	
SEER _{2base}	= Seasonal Energy Efficiency Ratio of baseline Air Source Heat Pump (kBtu/kWh) ³⁶⁸	
	= 14 ²⁴⁰ through 12/31/2023 and 15 (14.3 SEER2) beginning 1/1/2024 ³⁷⁰ when replacing an ASHP	
GEEDO	= 14 (SEER2 13.4) when replacing a CAC	
SEER _{2ee}	= Seasonal Energy Efficiency Ratio of efficient Air Source Heat Pump (kBtu/kWh)	
EFLH _{heat}	= Seasonal Energy Efficiency Katio of efficient Air Source Heat Pump (KBtu/KWn) = Actual = Equivalent full load hours of heating: ³⁷¹	
	= Actual = Equivalent full load hours of heating: ³⁷¹	
	= Actual = Equivalent full load hours of heating: ³⁷¹ Weather Basis (Ameren Missouri EELH (Hours)	
	= Actual = Equivalent full load hours of heating: ³⁷¹ Weather Basis (Ameren Missouri Average) EFLH _{heat} (Hours) 1496 for ASHP, 1119 for DEHP	
	= Actual = Equivalent full load hours of heating: ³⁷¹ Weather Basis (Ameren Missouri EELH (Hours)	
	= Actual = Equivalent full load hours of heating: ³⁷¹ Weather Basis (Ameren Missouri Average) EFLH _{heat} (Hours) (FE = ME	
	= Actual = Equivalent full load hours of heating: ³⁷¹ Weather Basis (Ameren Missouri Average) EFLH _{heat} (Hours) (FE = ME	
EFLH _{heat}	= Actual = Equivalent full load hours of heating: ³⁷¹ Weather Basis (Ameren Missouri EFLH _{heat} (Hours) Average) SF or MF 1496 for ASHP, 1119 for DFHP, and 1769 ³⁷² for ccAHSP tion, https://www.efis.psc.mo.gov/Document/Display/13830, page 4_ Based on Full Load Hour assumptions (for St Louis and Kansas City) taken from	
EFLHheat	= Actual = Equivalent full load hours of heating: ³⁷¹ Weather Basis (Ameren Missouri EFLH _{heat} (Hours) Average) 1496 for ASHP, 1119 for DFHP, and 1769 ³⁷² for ccAHSP tion, https://www.cfis.psc.mo.gov/Document/Display/13830, page 4_ Based on Full Load Hour assumptions (for St Louis and Kansas City) taken from ulator	
EFLHheat 2019 HVAC Evaluat ERGY STAR® ende www.energystar.got y.suggesting an app	= Actual = Equivalent full load hours of heating: ³⁷¹ $ \frac{Weather Basis (Ameren Missouri Average)}{Average} EFLHheat (Hours) $ SF or MF 1496 for ASHP, 1119 for DFHP, and 1769 ³⁷² for ccAHSP tion, https://www.cfis.psc.mo.gov/Document/Display/13830, page 4. Based on Full Load Hour assumptions (for St Louis and Kansas City) taken from elator witabusiness/bulk_purchasing/bpsavings_cale/Cale_CAC.xls) and reduced by 28.5% based on the evaluation results in Ameren Missouri's service surpriste FLH of 869.The other weather basis values are calculated using the relative climate normals cooling degree day ratios (at 65F set point).	
EFLH _{heat}	= Actual = Equivalent full load hours of heating: ³⁷¹ $ \frac{Weather Basis (Ameren Missouri EFLH_{beat} (Hours))}{Average} = \frac{1496 \text{ for ASHP, 1119 for DFHP, and 1769372 for ccAHSP}}{\text{SF or MF}} $ tion, https://www.efis.psc.mo.gov/Document/Display/13830, page 4_ Based on Full Load Hour assumptions (for St Louis and Kansas City) taken from ulator windowinese/bulk_purchasing/bpsavings_calc/Calc_CAC_xls) and reduced by 28.5% based on the evaluation results in Ameren Missouri's service morprise EFLH of 869. The other weather basis values are calculated using the relative climate normals cooling degree days and cooling degree days in select	
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EFLH _{heat} 2019 HVAC Evalua ERGY STAR® cale www.energystar.gov y. suggesting an app mi cities (St. Louis, t louis TRM Version 1 tois TRM Version 2	= Actual = Equivalent full load hours of heating: ³⁷¹ Weather Basis (Ameren Missouri Average) EFLHbeat (Hours) SF or MF 1496 for ASHP, 1119 for DFHP, and 1769 ³⁷² for ccAHSP	
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<u>2025 MEEIA 4 2019-21 Plan</u>

Revision <u>8</u>7.0

meren Missouri	Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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	Weather Basis (Ameren Missouri Average) EFLH _{heat} (Hours)	
	Mileger 510 ²²² for ASHP and DFHP, and MFc (comprehensive envelope) 602 for as APHP	
	Afree (comprenensive envelope) 603 for ccASHP	
Capacity _{heat}	= Heating Capacity of Air Source Heat Pump (Btu/hr)	
HSPF ₂ _{exist}	= Actual (1 ton = 12,000Btu/hr) = Heating Seasonal Performance Factor of existing heating system (kBtu/kWh)	
1151 1 ⁻² exist	= Use actual HSPF2 rating where it is possible to measure or reasonably estimate. If using rated efficiencies, derate the	
	efficiency value based on the age of the existing equipment (up to a maximum of 30 years) to account for degradation	
	over time. ³⁷⁴ If age is unknown, use 12 years. = HSPF2 * $(1-0.01)^{Age}$	
	=If rated efficiency is unknown, use defaults provided below, which should not be further adjusted to account for age-	
	related degradationUse actual HSPF rating where it is possible to measure or reasonably estimate. If not available use:	
	Existing Heating System HSPF _{exist}	Formatted: Indent: Left: 0"
	Air Source Heat Pump 5.444.91 ³⁷⁵ Electric Resistance 3.41 ³⁷⁶	
HSPF _{2base}	= Heating Seasonal Performance Factor of baseline Air Source Heat Pump (kBtu/kWh) ³⁷⁷ = 8.33 ²⁷⁸ through 12/31/2023 and 8.6 (7.5 HSPF2) beginning 1/1/2024 ³⁷⁹	
HSFP _{2ee}	= Heating Seasonal Performance Factor of efficient Air Source Heat Pump	
	(kBtu/kWh)	
ISR	= Actual = In-s-Service rRate. Actual, or if unknown, assume= 100% ³⁸⁰	
	T PEAK DEMAND SAVINGS	
here: ΔkWh _{Cooling}	= Electric energy savings for cooling, calculated above	
CF	= Summer peak coincidence demand (kW) to annual energy (kWh) factor	
me of sale:	= 0.0009474181	
$W = \Delta k W h_{coolin}$	g * CF	
CF	<u>-= 0.0009474181</u>	
TURAL GAS SAVIN	GS	
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	mamics review PY2019. The recommended values are constructed based on weather conditions (heating degree days and cooling degree days) in select Cape Girardeau, Kansas City), weighted by partial year 2019 installations.	
Illinois TRM Version 12	2.0, https://www.ilsag.info/wp-content/uploads/IL-TRM Effective 010124 v12.0 Vol 3 Res 09222023 FINAL clean.pdf, page 112. Justification for found on page 14 of *AIC HVAC Metering Study Memo FINAL 2 28 2018.docx'. Estimate efficiency as (Rated Efficiency * (1-0.01)*Equipment	
<u>(e).</u>		
<u>Ibid., page 110[,]This is earned and applying to the a</u>	ttimated based on finding the average HSPF/SEER ratio from the AHRI directory data (using the least efficient models — SEER 12 and SEER 13) — verage nameplate SEER rating of all early replacement qualifying equipment in Ameren PY2003 PY2004. This estimation methodology appears to	
ovide a result within 10% Electric resistance has a	of actual HSPF. COP of 1.0 which equals 1/0.293 = 3.41 HSPF.	
HSPF to HSPF2 conver	sion factor: HSPF2 = HSPF 🗽 87%. Conversion factor for HSPF to HSPF2 is used when converting an existing system that is rated in HSPF to HSPF2.	
g., both HSPF or HSPF2	I CFR Standard beginning January 1, 2023. The efficiency levels of the existing, baseline, and efficient case must be expressed in the same metrics terms before applying formulas.	
³ Ameren Missouri HVA ⁹ Based on minimum fede	ral standard effective 1/1/2023: 10 CFR 430.32(c)(5)	
Ameren Missouri HVA	C Evaluation: PY2020, https://www.efis.psc.mo.gov/Document/Display/13831, page 53.	
<u>25 MEEIA 4 2019</u>	-21-Plan Revision 87.0 Page 95	

Appendix I - TRM – Vol. 3: Residential Measures

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WATER IMPACT DESCRIPTIONS AND CALCULATION N/A DEEMED O&M COST ADJUSTMENT CALCULATION N/A

MEASURE CODE:

<u>2025 MEEIA 4 2019-21 Plan</u>

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Revision <u>8</u>7.0

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3.4.3 Duct Sealing and Duct Repair			
DESCRIPTION This measure describes evaluating the savings associated with performing duct seal and/or a ducted heating system. While sealing ducts in conditioned space can help w sealing ducts in unconditioned space where the heat loss is to outside the thermal enve of ducts should be within unconditioned space (e.g., attic with floor insulation, vented conditioned space).	ith control and comfort, energy savings are largely lin lope. Therefore, for this measure to be applicable at lea	nited to 1st 30%	
Three methodologies for estimating the savings associate from sealing the ducts are p	rovided.		
 Modified Blower Door Subtraction – this technique is described in detail or http://dev.energyconservatory.com/wp-content/uploads/2014/07/Blower-Doo It involves performing a whole house depressurization test and repeating the to Duct Blaster Testing - as described in RESNET Test 803.7: http://www.resnet.us/standards/DRAFT_Chapter 8_July_22.pdf-https://ener Standards-Chapter-8.pdf This involves using a blower door to pressurize the house to 25 Pascals and p equilibrium with the inside. The air required to reach equilibrium provides a deemed conserva performance testing described above is not possible. 	r-model-3-and-4.pdf. est with the ducts excluded. gyconservatory.com/wp-content/uploads/2014/09/RES ressurizing the duct system using a duct blaster to reac luct leakage estimate.	<u>NET-</u> h	
This measure was developed to be applicable to the following program type: RF.			
If applied to other program types, the measure savings should be verified.			
DEFINITION OF EFFICIENT EQUIPMENT The efficient condition is sealed duct work throughout the unconditioned space in the	home.		
DEFINITION OF BASELINE EQUIPMENT The existing baseline condition is leaky duct work with at least 30% of the ducts with	in the unconditioned space in the home.		
DEEMED LIFETIME OF EFFICIENT EQUIPMENT The assumed lifetime of this measure is 20 years. ³⁸¹			
DEEMED MEASURE COST The actual duct sealing measure cost should be used.			
LOADSHAPE HVAC RES			
Algorithm			
CALCULATION OF SAVINGS			
ELECTRIC ENERGY SAVINGS <u>Methodology 1: Modified Blower Door Subtraction</u> <u>a.</u> Determine Duct Leakage rate before and after performing duct sealing:			
Duct Leakage (CFM50 _{DL}) = (CFM50 _{Whole House} $-$ CFM50 _{EnvelopeOnly}) * SCF		•	Formatted: Indent: Left: 0.5", No bullets or
a.		11	Formatted: Subscript
<u>Duct Leakage (CFM50_{DL}) = (CFM50_{Whole House} - CFM50_{Envelope Onty}</u> Where:) * 56#	//	Formatted: Subscript
where.			Formatted: Subscript
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³⁸¹ Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures, GDS As documents/HVAC Ltg measure life GDS 2007.pdf; 'HVAC Ltg measure life GDS 2007.pdf', page			Formatted: Normal, No bullets or numbering
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Appendix I - TRM - Vol. 3: Residential Measures

CFM50whole House CFM50Envelope Only SCF

Blower Door test result finding Cubic Feet per Minute at 50 Pascal pressure differentials with all supply and return registers sealed
 Subtraction Correction Factor to account for underestimation of duct leakage due to connections between the duct system and the home. Determined by measuring pressure with respect to the building in the sealed duct system, with the building pressurized to 50 Pascals with respect to the outside. Use the following look up table provided by energy conservatory to determine the appropriate subtraction correction factor:

= Standard Blower Door test result finding Cubic Feet per Minute at 50 Pascal pressure differentials

House	Subtraction	House	Subtraction
to Duct	Correction	to Duct	Correction
ressure	Factor	Pressure	Factor
50	1.00	30	2.23
49	1.09	29	2.32
48	1.14	28	2.42
47	1.19	27	2.52
46	1.24	26	2.64
45	1.29	25	2.76
44	1.34	24	2.89
43	1.39	23	3.03
42	1.44	22	3.18
41	1.49	21	3.35
40	1.54	20	3.54
39	1.60	19	3.74
38	1.65	18	3.97
37	1.71	17	4.23
36	1.78	16	4.51
35	1.84	15	4.83
34	1.91	14	5.20
33	1.98	13	5.63
32	2.06	12	6.12
31	2.14	11	6.71

b. Calculate duct leakage reduction, convert to CFM25_{DL,³⁸²} and factor in Supply and Return Loss Factors:

Duct Leakage Reduction ($\Delta CFM25_{DL}$) = (PreCFM50_{DL} - PostCFM50_{DL}) * 0.64 * (SLF + RLF)

Where:

 Converts CFM50_{DL} to CFM25_{DL}³⁸³
 Supply Loss Factor³⁸⁴
 % leaks sealed located in Supply ducts * 1 Default = 0.5³⁸⁵

³⁸² 25 Pascals is the standard assumption for typical pressures experienced in the duct system under normal operating conditions.
 ³⁸³ To convert CFM50 to CFM25, multiply by 0.64 (inverse of the "Can't Reach Fifty" factor for CFM25; see Energy Conservatory Blower Door Manual).
 ³⁸⁴ Assumes that for each percent of supply air loss there is one percent annual energy penalty. This assumes supply leaks are direct losses to the outside and are not recaptured back to the house. This could be adjusted downward to reflect regain of usable energy to the house from duct leaks. For example, during the winter some of the energy lost from supply leaks in a crawlspace will probably be regained back to the house (sometimes 1/2 or more may be regained). More information provided in "Appendix E Estimating HVAC System Loss From Duct Airtightness Measurements" from Energy Conservatory Blower Door Manual.
 ³⁸⁵ Assumes 50% of leaks are in supply ducts.

<u>2025 MEEIA 4 2019-21 Plan</u>

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Revision <u>8</u>7.0

Page <mark>98</mark>

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meren Missouri	Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
RLF	= Return Loss Factor ³⁸⁶	Formatted: Normal
KLF	= % leaks sealed located in Return ducts * 0.5	
	Default = 0.25^{387}	
cCalculate elec	0	
<u>kWh</u>	$= \Delta k W h_{\underline{fcooling}} + \Delta k W h_{\underline{fleating}}$	Formatted: Subscript
	l cooling, the electric energy saved in annual cooling due to the duct sealing and repair is:	Formatted: Subscript
$\Delta kWh_{Cooling}$	$= (\Delta CFM25_{DL}/((Capacity_{Cool}/12,000 * 400)) * EFLHcool * Capacity_{Cool})/(1,000 * SEER2)$	Formatted: Normal, No bullets or numbering
AkW1	α = ΔkWhCooling + ΔkWhHeating	
	<u>ACFM25_{pf}</u> (Canadia Carl 112 000 + EFLHcool + CapacityCool	
<u> AkWhCoolin</u>	$a = \frac{(-apacityCool/12,000 * 400)}{(-apacityCool/12,000 * 400)}$	
	ACFM25	
<u> AkWhHeatin</u>	$\frac{G_{\text{Heartre}}}{g_{\text{Heartre}}} = \frac{(GapacityHeat/12,000 + 400)}{(GapacityHeat/12,000 + 200)}$	
AkWhHeatin	$\frac{9EEEEFE}{G_{Fas}} = (\Delta Therms * Fe * 29.3)$	
Vhere:		
$\Delta CFM25_{DL}$	= Duct leakage reduction in CFM2 as calculated above	
CapacityCool	= Capacity of Air Cooling system (Btu/hr) = Actual	
12,000	= Converts Btu/H capacity to tons	
400 EFLHcool	= Conversion of Capacity to CFM (400CFM / ton) ³⁸⁸ = Equivalent Full Load Cooling Hours: ³⁸⁹	
EFERCOOI	- Equivalent Fun Load Cooling Hours.	
	Weather Basis (Ameren Missouri EFLHcool	
	Average) (Hours) SF or MF 869	
	MFc (comprehensive envelope) 632 ²⁰⁰	
1,000	= Converts Btu to kBtu	
SEER ²	= Seasonal Energy Efficiency Ratio of Air Conditioning equipment (kBtu/kWh)	
	= Actual - If not available, <u>following: 391</u>	
	Age of Equipment <u>nCool Estimate</u>	Formatted Table
	<u>Before 2006</u> <u>9.5</u>	
6 A	ercent of return air loss there is a half percent annual energy penalty. Note that this assumes that return leaks contribute less to energy losses than do	
pply leaks. This value co	uld be adjusted upward if there was reason to suspect that the return leaks contribute significantly more energy loss than "average" (e.g., pulling return	
formation provided in "A	c), or can be adjusted downward to represent significantly less energy loss (e.g., pulling return air from a moderate temperature crawl space). More ppendix E Estimating HVAC System Loss From Duct Airtightness Measurements" from Energy Conservatory Blower Door Manual.	
7 Assumes 50% of leaks a 8 This conversion is an in	re in return ducts. dustry rule of thumb. E.g., see <u>http://www.hvacsalesandsupply.com/Linked%20Documents/Tech%20Tips/61</u>	
/hy%20400%20CFM%20	per%20ton.pdf. https://www.brinco.com/2016/02/04/is-there-a-rule-of-thumb-that-i-can-use-that-would-tell-me-how-many-cfms-an-ac-would-need-	
	r assumptions (for St Louis and Kansas City) taken from the ENERGY STAR [⊕] calculator	
propriate EFLH of 869.7	<u>/ia/business/bulk_purchasing/bpsavings_cale/Cale_CAC.xls</u>) and reduced by 28.5% based on the evaluation results in Ameren territory suggesting an he other weather basis values are calculated using the relative climate normals cooling degree day ratios (at 65F set point).	
tps://www.efis.psc.mo.go	v/Document/Display/15876, page 30 mamics review PY2019. The recommended values are constructed based on weather conditions (heating degree days and cooling degree days) in select	
lissouri cities (St. Louis, C	Cape Girardeau, Kansas City), weighted by partial year 2019 installations.	
* These default system ef e average system efficien	ficiencies are based on the applicable minimum Federal Standards. In 2006 the Federal Standard for Central AC was adjusted. While one would expect cy to be higher than this minimum, the likely degradation of efficiencies over time mean that using the minimum standard is appropriate. Note all	
	to SEER2 equivalents – since the new rating better reflects the actual efficiency of the units.	

I

 	meren Missouri		Appen	dix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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EFLHear = Equivalent Full Load Heating Hours: ²⁸ Watter Basis (Ameren Missouri Eff-Habes) Average) (Hamis) (Habe) (Massouri Effettion) STOP = Effective in COP of Heating equipations: The analysis of the a			Stu/hr) of electric heat		Formatted: Indent: First line: 0", Space Before: 6
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f the home is heated w	vith natural gas, the electri	c energy saved ir	n annual hea	ating due to	the added	nsulation is:			-	Formattee	d: Widow/Orphan control, Tab stops: 2"
Thorms - Tho	m savings as calculated in	Natural Gas Sar	rings	-					4	Formattee	d: Indent: Left: 0", First line: 0"
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	= Duct leakage in CFM2	25 as measured b								/	
	All other variables as pro-	ovided above							<i> /</i>	/	d: No underline, Subscript
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MMBtu/yr) and Eae (kW	h/yr). An average of a 300 record									Formattee	d: No underline, Subscript
ersion 3 criteria for 2% Fe.										1	

version 3 criteria for 2% Fe. ³⁹⁷ Savings per unit are based upon analysis performed by Cadmus for the 2011 Iowa Joint Assessment of Potential. It was based on 10% savings in system efficiency. This would represent savings from homes with significant duct work outside of the thermal envelope. With no performance testing or verification, a deemed savings value should be very conservative and therefore the values provided in this section represent half of the savings – or 5% improvement. These values are provided as a conservative deemed estimate for Missouri, while encouraging the use of performance testing and verification for determination of more accurate savings estimates.

<u>2025 MEEIA <u>4 2019-21</u> Plan</u>

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Page 101

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⁸ MO TRM, page 97, https://dnr.mo.gov/document-search/missouri-techr	ical-reference-manual-2017-volume-3-residential-measure	<u>s</u>	
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$\eta \text{System} = \text{Pr}$ $= \text{A}$ $100,000 = \text{Ce}$	ctual ⁴⁰² - If not available, use 83.5% ⁴⁰³ re duct sealing Heating System Efficiency (Equipment Efficiency * Pre Distribution Efficiency) ⁴⁰⁴ ctual - If not available use 71.0% ⁴⁰⁵ onverts Btu to therms	Formatted: Normal
Methodology 2: Duct Blaste	<u>r Testing</u>	
Therms = ((Pre_CFN	M25 – Post_CFM25)/(ACFM25DL/CapacityHeat) * 0.0136 * EFLHgasheat * Equipment / nSystem)/100,000	Formatted: Indent: Left: 0", Hanging: 1"
	CFM25 Post_CFM25 acityHeat + 0.0136 100.000	
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Aethodology 3: Deemed Sa		Formatted: Don't keep with next, Adjust space between Latin and Asian text, Adjust space betwee Asian text and numbers
	eatSavingsPerUnit*Ductgength	Formatted: No underline
Therms = HeatSavings	:PerUnit * Duct _{Length}	Formatted: No underline
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HeatSavingsPerUnit	= Annual heating savings per linear foot of duct ⁴⁰⁷	Formatted: Check spelling and grammar
	Building True HeatSavingsPerUnit	Formatted: Indent: Left: 0"
	Building Type HVAC System (Therms/ft)	Formatted: Font: Not Bold, Not Small caps
	Multifamily Heat Central Furnace 0.19 Single-family Heat Central Furnace 0.21 Manufactured Heat Central Furnace 0.26	Formatted: Indent: First line: 0.5"
Duct _{Length}	= Linear foot of duct = Actual	
eating system, the weighted (by c i' the heating system or distribution sed. 13 In 2000, 29% of furnaces purch issidential heating equipment; see urnaces in the state. Assuming typ 1,29%0,92) + (0.71*0.8) = 0.835. "4 The distribution efficiency can in https://www.bpi.org/ms/docs/ Guidance on Estimating Distributi 16 Estimated as follows: 0.835 * (1)	Efficiency can be obtained either by recording the AFUE of the unit, or performing a steady state efficiency test. If there is more than one onsumption) average efficiency should be used. In is being upgraded within a package of measures together with the insulation upgrade, the new average heating system efficiency should be ased in Missouri were condensing (based on data from GAMA, provided to Department of Energy during the federal standard setting process for Furnace Penet of last up to 20 years, so units purchased 16 years ago provide a reasonable proxy for the current mix of bical efficiencies for condensing and non-condensing furnaces and duct losses, the average heating system efficiency is estimated as follows: be estimated via a visual inspection and by referring to a look-up table such as that provided by the Building Performance Institute - 20idance% 200n% 20Estimating% 20Esfficiency.pdfhtp://www.bpi.org/files/pdf/DistributionEfficiencyTable BlueSheet.pdf}; 10.15) = 0.710. analysis performed by Cadmus for the 2011 Joint Assessment of Potential. It was based on 10% savings in system efficiency. This would be very with no performance testing or verification, a deemed savings value should be very	
epresent savings from homes with onservative and therefore the value	tes provided in this section represent half of the savings – or 5% improvement. These values are provided as a conservative deemed estimate for se of performance testing and verification for determination of more accurate savings estimates.	Formatted: Font: 9 pt

Appendix I - TRM – Vol. 3: Residential Measures

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WATER IMPACT DESCRIPTIONS AND CALCULATION N/A

Deemed O&M Cost Adjustment Calculation $N\!/\!A$

MEASURE CODE:

<u>2025 MEEIA <u>4 2019-21</u> Plan</u>

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Appendix	I - TRM – 1	Vol. 3: Re	esidential	Measures.
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3.4.4 Mini/Multi-Split Air Source Heat Pump and Air Conditioners

DESCRIPTION

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This measure is designed to calculate electric savings from retrofitting existing electric HVAC systems with ductless and/or ducted mini/multi-split heat pumps (MMSHPs) or mini/multi-split air conditioners. MMSHPs save energy in heating mode because they provide heat more efficiently than electric resistance heat and central ASHP systems. Additionally, MMSHPs use less fan energy to move heat and don't incur heat loss through a lengthy duct distribution system while operating at very low static pressure. Often MMSHPs are installed in addition to (do not replace) existing heating or cooling equipment because the existing heating or cooling equipment is inadequate to efficiently heat or cool the space. Both ductless and ducted indoor units can be installed as a mixed mini/multi-split heat pump or air conditioner under this measure. Duct runs for a ducted mini/multi-split indoor unit should be installed within the conditioned envelope, be well-sealed and insulated ducts, and maintain low static pressure per manufacturer specifications for the installation configuration to maximize energy savings.

For cooling, the proposed savings calculations are aligned with those of typical replacement systems. MMSHPs save energy in cooling mode because they provide cooling capacity more efficiently than other types of unitary cooling equipment. A MMSHPs installed in a home with an existing central ASHP or CAC system will save energy by offsetting some of the cooling energy of the ASHP or CAC. In order for this measure to apply, the control strategy for the heat pump or air conditioner is assumed to be chosen to maximize savings per installer recommendation.⁴⁰⁸

This measure was developed to be applicable to the following program type: NC, ROF, and ER.

If applied to other program types, the measure savings should be verified.

DEFINITION OF EFFICIENT EOUIPMENT

In order for this characterization to apply, the new equipment must be a high-efficiency, variable-capacity (typically "inverter-driven" DC motor) ductless and/or ducted mini/multi-split heat pump or air conditioning system that exceeds the program minimum efficiency requirements.

DEFINITION OF BASELINE EQUIPMENT

In order for this characterization to apply, baseline equipment must include a permanent electric resistance heating source or a ducted air-source heat pump or ducted air conditioner. For residences with central air conditioner/non-electric heating, cooling savings will only apply. For multifamily buildings, each residence must have existing individual heating equipment. Multifamily residences with central heating do not qualify for this characterization. Existing cooling equipment is assumed to be standard efficiency. Note that in order to claim cooling savings, there must be an existing air conditioning system (e.g. central air conditioning, Window ACs, or air source heat pump).

New federal standards affecting heat pumps became effective January 1, 2023. These new federal standards will be adopted by programs on January 1, 2024. Under the new standards, the baseline for a ROF measure is the federal standard efficiency; 15 SEER (14.3 SEER2)14.3 SEER2 and 8.6 HSPF (7.5 HSPF2)7.5 HSPF2 when replacing a ducted air-source heat pump; 14 SEER (13.4 SEER2)13.4 SEER2 and 3.41 HSPF2 when replacing a central air conditioner and electric resistance heating; 14 SEER (13.4 SEER2)13.4 SEER2 when replacing central air conditioner with non-electric heating or no heating.

Under the new federal standards, the M1 testing protocol was revised, resulting in new SEER and HSPF performance metrics, now called SEER2 and HSPF2. When quantifying energy savings, the SEER2 and HSPF2 metrics should be used for the existing, baseline, and new equipment. When quantifying energy savings, the same metric should be used for the existing, baseline, and new equipment. The following conversion formulas can be used to convert between efficiency metrics:

SEER2 = SEER ** 0.96 HSPF2 = HSPF ** 0.87

⁴⁰⁸ The whole purpose of installing ductless heat pumps is to conserve energy, so the installer can be assumed to be capable of recommending an appropriate control strategy. For most applications, the heating setpoint for the ductless heat pump should be at least 2F higher than any remaining existing system and the cooling setpoint should be at least 2F cooler than the existing system (this should apply to all periods of a programmable schedule, if applicable). This helps ensure that the ductless heat pump will be used to meet as much of the load as possible before the existing system operates to meet the remaining load. Ideally, the new ductless heat pump controls should be set to the current comfort settings, while the existing system setpoints should be adjusted down (heating) and up (cooling) to capture savings.

2025 MEEIA 4 2019-21 Plan

Revision 87.0

Page 106

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	apply, program participants or installation contractors must provide documentation asserting that	
	ther or not they provided cooling—and the existing unit brand name and model number must be dephotograph of the unit in context and the nameplate specifically must be provided. The baseline f	
	y of the existing equipment for the assumed remaining useful life of the unit and the new baseline	
ove for the remainder of the measure	re life.	
EEMED LIFETIME OF EFFICIENT E		
e expected measure life is assumed		Formatted: Space After: 0 pt
maining life of existing ASHP/CA	C equipment is assumed to be 6 years <u>410 and 18 years for electric resistance</u> .	Formatted: Default Paragraph Font, Font:
		Formatted: Superscript
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EEMED MEASURE COST		
e incremental cost for this measure at of \$2,000 should be applied: ⁴¹¹	e is provided below:Default full cost of the MMSHP is provided below. Note, for smaller units a m	Formatted: Font: Not Italic
st of \$2,000 should be applied.	Full Install Cost	
	Unit HSPF2	
	<u>8.1-8.9</u> <u>\$1,443</u>	Formatted: Not Highlight
	<u>9-9.8</u> <u>\$1,605</u> 9.9-11.6 \$1,715	Formatted: Not Highlight
	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Formatted: Not Highlight
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	If the unit is not displacing electric resistance heating or facilitating fuel switching, apply the incre	
he MMSHP compared to a baselin	ne minimum efficiency MMSHP provided in the table below: ⁴¹³ Incremental Cost	Formatted: Font: Not Italic
	Efficiency (\$/ton) over an HSPE?	Formatted: Font: Not Italic
	$\frac{(\text{HSPF2})}{7.5 \text{ MMSHP}}$	
	<u>8.1-8.9</u> <u>\$62</u>	
	<u>9-9.8 \$224</u> 9.9-11.6 \$334	
	<u>9.5-11.0</u> <u>9554</u> 11.7+ \$660	
herwise, the incremental cost shoul		
	1MSHP should be used (defaults are provided above), minus the assumed installation cost of the ba baseline 80% AFUE furnace, ⁴¹⁴ and \$3,338 for new baseline Central AC replacement ⁴¹⁵). If repla	
	is no deferred cost for replacing the electric resistance heating unit.	Bulleted + Level. 1 + Alighed at. 0.25 + Indent a
	relative to MMSHP identified in the table above.	
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	nmercial/Industrial Lighting and HVAC Measures, GDS Associates, Inc., June 2007, <u>https://www.caetrm.com/media/refi</u> 2007.pdf; 'HVAC Ltg measure life GDS 2007.pdf', page 1-3.	Formatted: Font: (Default) Times New Roman
Assumed to be one third of effective useful	ıl life.	Former the de Forste (Defaulte) Times New Domes
The cost per ton table provides reasonable.	estimates for installation costs of DMSHP, which can vary significantly due to requirements of the home. It is estimated to install.	that all units. Formatted: Font: (Default) Times New Roman
those 1 ton or less will be at least \$2000		human in the street way with the street way would be a street way way would be a street way way would be a str
n those 1 ton or less will be at least \$2000 Full costs based upon full install cost of an	ASHP plus incremental costs provided in Memo from Opinion Dynamics Evaluation Team, Ductless Mini-Split Heat P	Eormatted: Font: (Default) Timer New Person
n those 1 ton or less will be at least \$2000 Full costs based upon full install cost of an remental Cost Analysis, April 27, 2017.	i ASHP plus incremental costs provided in Memo from Opinion Dynamics Evaluation Team, Ductless Mini-Split Heat P n Team, Ductless Mini-Split Heat Pumps: Incremental Cost Analysis, April 27, 2017	Formatted: Font: (Default) Times New Roman
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Early Replacement/retrofit (replacing existing equipment): TheIf available, the actual full install unavailable, the default full cost specified abve should be used. The assumed deferred cost of runit is assumed to be \$7.722+\$6741,518 ⁴⁶ per ton for a new baseline Air Source Heat PumpM furnace and \$3,670 for new baseline Central AC replacement. ⁴¹⁷ If replacing electric resistance 1 replacing the electric resistance heating unit. This future cost should be discounted to present va based on the ten year average (1/1/2014 – 12/31/2023) of the 10 year Treasury bond yield rates. If the deferred replacement cost exceeds the full installation cost of the MMSHP, the incrementation of the full cost o	placing existing equipment with a new baseline MSHP, or \$2,296 for a new baseline 80% AFUE eat, there is no deferred replacement costcost for ue using a 2.31% nominal societal discount rate. 19	Formatted: Normal
When a non-electric heating system is replaced with an MMSHP, and the program administrator	is only claiming energy savings from cooling	Formatted: Font: Not Italic
(i.e., no heating savings are claimed due to the fuel switch), the incremental costs should be adju		
The incremental cost of the MMSHP shall be adjusted by applying a factor that represents the ra potential energy savings (inclusive of both cooling and unclaimed heating savings). This adjustre effectiveness testing is proportional to the benefits being claimed, thus avoiding a mismatch betw	ent ensures that the incremental cost used in cost-	Formatted: Font: Not Italic
Calculation Method:		
1. Determine Total Potential Savings: Calculate the sum of the potential energy savings fro	m both cooling and heating (even if heating	
 savings are not being claimed). Determine Claimed Savings: Identify the portion of energy savings that is being claimed Apply the Adjustment Factor: The adjustment factor is calculated as the ratio of claimed then applied to the full incremental cost of the MMSHP. 		Formatted: Font: Not Italic
Adjusted Incremental Cost = (Claimed Savings (kWh) / Total Potential Savings (kWh)) * Fu		
LOADSHAPE Cooling RES Heating RES		
Algorithms		
CALCULATION OF SAVINGS		
ELECTRIC ENERGY SAVINGS Electric savings		
$\underline{\Delta kWh} = \underline{\Delta kWh_{penting} + \underline{\Delta kWh_{cooling}}}$		Formatted: Subscript
Heating savings:		Formatted: Subscript
TOS:		
$\Delta kWh_{heating} = ((Capacity_{heat} * EFLH_{heat} * (1/HSPF2_{base} - 1/HSPF2_{ce})) / 1000) * HF * ISR$		
EREP:		
$\underline{\Delta kWh_{heating}} = ((Capacity_{heat} * EFLH_{heat} * (1/HSPF2_{exist} - 1/HSPF2_{ec})) / 1000) * HF * ISR$		
416 Based on implicit standard efficiency cost of \$1,381 per ton (8.1-8.9 HSPF2 per ton full cost minus incremental co	st), account for inflation rate of 1.91%.	
⁴¹⁷ All baseline replacement costs are consistent with their respective measures and include inflation rate of 1.91%. ⁴¹⁸ Societal Discount Rate Calculation 08082024.xlsx'.		Formatted: Not Highlight
<u>2025</u> MEEIA <u>4</u> .2019-21 Plan Revision <u>8</u> 7.0	Page 108	

Ameren Missouri	Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
		Formatted: Normal
Where: = Heating capacity of the ductless heat pump unit in Btu/hr		
\underline{EFLH}_{heat} = Equivalent Full Load Hours for heating. See table below:		
Weather Basis (Ameren Missouri Average)EFL Home410 1,034SF or MF MFe (comprehensive envelope)1,034MFe (comprehensive envelope)303		
	reasonably estimate. HSPF2 rating of existing equipment. If	Formatted: Indent: Left: 0.5", Hanging: 1"
rated efficiency is unknown, use defaults provided below Existing Equipment Type Electric resistance heating Air Source Heat Pump	HSPF2 _{ccc} ⁴²⁰ <u>3.412</u> <u>6.58</u>	
HSPF2 _{base} = HSPF2 rating of baseline equipment (kBtu/kWh)		
$= 7.5 \text{ HSPF}2^{421} \text{ when replacing an ASHP}$ $= 3.412 \text{ when replacing electric resistance heating}$		
<u>HSPF2_{ee} = HSPF rating of new equipment (kBtu/kWh)</u> = Actual installed		
$\frac{\text{ISR}}{\Delta kWh} = \text{In-service rate. Actual, or if unknown, assume 100\%^{422}}$		Formatted: Space After: 0 pt
		Tormatted. Space Arter. 0 pt
$\begin{array}{l} \underline{\Delta kWh_{neating}} = & ((Capacity_{neat} * EFLH_{neat} * (1/HSPF_{exist} - 1/HSPF_{ee})) / 1 \\ \underline{\Delta kWh_{eooting}} = & ((Capacity_{coot} * EFLH_{eoot} * (1/SEER_{exist} - 1/SEER_{ee})) / 1 \\ \underline{\Delta kW} = & \underline{\Delta kWh_{cooting}} * CF - & \underline{\Delta kW} = - & \underline{\Delta kWh_{neating}} * CF \end{array}$	1 000) + HF + ISR 1 00) + HF + ISR	
Electric savingsCeooling savings calculated only in presence of non-electric heating	g or MMAC (Mini/Multi-Split AC) <u>:</u>	
TOS:		
$\Delta kWh_{cooling} = ((Capacity_{cool} * EFLH_{cool} * (1/SEER2_{base} - 1/SEER2_{ee})) / 1000) * H$	F * ISR	
EREP:		
$\Delta kWh_{cooling} = ((Capacity_{cool} * EFLH_{cool} * (1/SEER2_{exist} - 1/SEER2_{es})) / 1000) * H$	F * ISR	
Where:		
<u> AkWh_{cooting} = ((Capacity_{eoot} * EFLH_{eoot} * (1/SEER_{exist} – 1/SEER_{ee})) / 10</u>	00) * <i>HF * ISR</i>	
$\underline{AkW} = \underline{AkWh}_{cooling} * CF$		
-		
 ⁴¹⁹ Evaluation - Opinion Dynamics review PY2019. The recommended values are constructed based on v Missouri cities (St. Louis, Cape Girardeau, Kansas City), weighted by partial year 2019 installations. ⁴²⁰ Ameren Missouri Heating and Cooling Evaluation PY2018, https://www.efis.psc.mo.gov/Document/I ⁴²¹ Based on minimum federal standard effective 1/1/2023: 10 CFR 430.32(c)(5) ⁴²² Ameren Missouri HVAC Evaluation: PY2020, https://www.efis.psc.mo.gov/Document/Display/1383 	Display/15871, page 36.	
2025 MEEIA <u>4 2019-21 Plan</u> Revision <u>8</u> 7.0	Page 109	

meren Missouri		Appendix I - TRM	- Vol. 3: Residential M	leasures.	Formatted: Font: (Default) Arial, 12 pt
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here:					
	—= Heating capacity of the ductless heat pump unit in Btu/hr —= Actual				
EFLH _{heat}	—= Equivalent Full Load Hours for heating. See table below:				
	Weather Basis (Ameren Missouri EFLH _{basi} Average) 3 SF or MF 1.034				
	MFc (comprehensive 393 envelope)				
HSPF _{exist}	= HSPF rating of existing equipment (kBtu/kWh)				
	Existing Equipment Type Electric resistance heating Air Source Heat Pump	HSPF _{exist} ⁴²⁴ 3.412 6.58			
HSPF _{base}	- HSPF rating of baseline equipment (kBtu/kWh)	0.00			
	= 8.2 ⁴²⁵ through 12/31/2023 and 8.6 (7.5 HSPF2) beginning 1/ = 3.412 when replacing electric resistance heating	1/2024 ⁴²⁶ when replaci	ng an ASHP		
HSPF _{cc} Capacity _{cool}	 HSPF rating of new equipment (kBtu/kWh) Actual installed the cooling capacity of the ductless heat pump unit in Btu/hr. 	. 427			
SEER ² _{exist}	 Actual installed SEER rating of existing equipment (kBtu/kWh) 				
	 Use actual SEER rating where possible to measure or reason efficiency value based on the age of the existing equipment (up over time.⁴²⁸ If age is unknown, use 12 years. <u>SEER2</u> * (1-0.01)^{Age} <u>SEER</u> * (1-1.44%)^{Age} 				
	If unknown, see table below				
issouri cities (St. Louis,	ynamics review PY2019. The recommended values are constructed based on we Cape Girardeau, Kansas City), weighted by partial year 2019 installations- ng, and Cooling Evaluation PY2018	eather conditions (heating d	egree days and cooling degree day	ys) in select	

<u>2025</u>MEEIA <u>4</u> 2019-21 Plan

Revision <u>8</u>7.0

 ⁴⁷² Ton = 12 kBu/hr.
 ⁴²⁸ Hinois TRM Version 12.0, https://www.ilsag.info/wp-content/uploads/IL-TRM Effective_010124_v12.0_Vol_3_Res_09222023_FINAL_clean.pdf, page 112_Justification for degradation factors can be found on page 14 of 'AIC HVAC Metering Study Memo FINAL 2_28_2018. docx'. Estimate efficiency as (Rated Efficiency * (1-0.01)/Equipment Age)Based on IL TRM Version 01L TRM Version for degradation factors on page 21 of 'AIC HVAC Metering Study Memo FINAL 2_28_2018'. Default of 12 years based on the remaining measure life of the equipment.

	Арре	endix I - TRM – Vol. 3: Residential Measures Formatted: Font: (Default) Arial, 12 pt
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	Existing Cooling System SEER2 _{exist} ⁴²⁹	Formatted: Keep with next
	Air Source Heat Pump7.26.91Central AC6.853	Formatted: Keep with next
	Room AC 6.3 ⁴³⁰	Formatted: Keep with next
	No existing cooling ⁴³¹ Let ' $1/SEER$ _exist' = 0	Formatted: Keep with next
	= Seasonal Energy Efficiency Ratio of baseline equipment (kBtu/kWl = 14 ⁴⁴² through 12/31/2023 and 15 (14.3 SEER2) beginning 1/1/2024 = 14 (13.4 SEER2) when replacing a CAC	
SEER _{2ee}	= SEER rating of new equipment (kBtu/kWh)	
	= Actual installed ⁴³⁵ = Equivalent Full Load Hours for cooling. See table below	
	Weather Basis (Ameren Missouri Average) EFLH _{cool} SF or MF 635 MFc (comprehensive envelope) 417	
ISR = In Serv	$vice Rate = 100\%^{436}$	Formatted: Font: 11 pt
~ .		Formatted: Point 11 pt
UMMER COINCIDENT I	PEAK DEMAND SAVINGS	Formatted: Norma
$\Delta kW = \Delta kWh_{Coo}$	$\frac{1}{1}$	
-		
Vhere:		
	 <u>Electric energy savings for cooling, calculated above</u> Summer peak coincidence demand (kW) to annual energy (kWh) fa 	and a second
	= Summer peak concretence demand (kw) to annual energy (kwn) ta = 0.0009474181	
$\frac{AkW}{AkW} = \frac{AkWh}{AkWh}$	h _{cooling} * CF	
$\frac{\text{Where:}}{\text{F}} = 0.0009474181}$		
JATURAL GAS SAVINGS J/A	8	
AC assumed to follow the sa 8.9% of 8.6 SEER CAC name eating and Cooling Program	ussumes degradation and is sourced from the Ameren Missouri Heating and Cooling I ume trend in degradation as the ASHP: 9.12 SEER nameplate to 7.2 (6.91 SEER2) op eplate gives an operational SEER of 6.8 (6.53 SEER2). ASHP existing efficiency ass Impact and Process Evaluation. Program Year 2015. CAC assumed to follow the sar	erations SEER represents degradation to 78.9% of nameplate. sumes degradation and is sourced from the Ameren Missouri me trend in degradation as the ASHP: 9.12 SEER nameplate to
2 operations SEER represent ves an operational SEER of (ts degradation to 78.9% of nameplate. 78.9% of 8.6 SEER CAC nameplate gives an 6 6.3.	operational SEER of 6.8, 78.9% of 8.0 SEER RAC nameplate
⁰ Estimated by converting the ased Model for Residential A pove footnote.	e EER assumption using the conversion equation; EER_base = (-0.02 * SEER_base ² , Air Conditioner and Heat Pump Energy Calculations," (Masters thesis) University of	Colorado at Boulder. Adjusted to account for degradation per
¹ If there is no existing coolir enefit.	ng in place but the incentive encourages installation of a new DMSHP with cooling, t	the added cooling load should be subtracted from any heating
² SEER to SEER2 conversion EER2. This is to meet the DC tetrics (e.g., both SEER or SE	n factor: SEER2 = SEER ** 96%. Conversion factor for SEER to SEER2 is used wh DE M1 CFR Standard beginning January 1, 2023. The efficiency levels of the existin EER2}-terms before applying formulas.	g, baseline, and efficient case must be expressed in the same
4 Based on minimum federal	Istandard effective 1/1/2015: <u>http://www.gpo.gov/fdsys/pkg/CFR-2012_title10_vol3/</u> Istandard effective 1/1/2023: 10 CFR 430.32(c)(5) uting is available, use the following conversion equation; EER_base = (-0.02 * SEER, Residential Air Conditioner and Heat Pump Energy Calculations. Masters Thesis, Un	
omponent-Based Model for I ⁴ Ameren Missouri HVAC E		iversity of Colorado at Boulder.
omponent-Based Model for I		iversity of Colorado at Boulder.

Appendix I - TRM – Vol. 3: Residential Measures

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WATER IMPACT DESCRIPTIONS AND CALCULATION $N\!/\!A$

Deemed O&M Cost Adjustment Calculation $N\!/\!A$

MEASURE CODE:

<u>2025 MEEIA <u>4 2019-21</u> Plan</u>

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Revision <u>8</u>7.0

Ameren Missouri	Appendix I - TRM – Vol. 3: Residential Meas	GUTES Formatted: Font: (Default) Arial, 12 pt
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3.4.5 Standard Programmable Thermostat		
5		
DESCRIPTION This measure characterizes the household energy savings from the installation of a n cooling energy consumption through temperature set-back during unoccupied or red		g and
Energy savings are applicable at the household level; installation of multiple program	nable thermostats per home does not accrue additional sav	ings.
If the home has a heat pump, a programmable thermostat specifically designed for he resistance heat systems.	at pumps should be used to minimize the use of backup e	ectric
This measure was developed to be applicable to the following program types: RF, and Savings will not be claimed for this measure for programs other than low income programs other than low income programs.		<u>rams.</u>
If applied to other program types, the measure savings should be verified.		Formatted: Space After: 0 pt
DEFINITION OF EFFICIENT EQUIPMENT The criteria for this measure are established by replacement of a manual-only te temperature setpoints according to a schedule without manual intervention.	mperature control with one that has the capability to	adjust
DEFINITION OF BASELINE EQUIPMENT For new thermostats the baseline is a non-programmable thermostat requiring manual	l intervention to change temperature set point.	
DEEMED LIFETIME OF EFFICIENT EQUIPMENT The expected equipment life of a programmable thermostat is assumed to be 10 year	.437	
DEEMED MEASURE COST Actual material and labor costs should be used if the implementation method allows. the new installation is assumed to be $$70.^{438}$	If unknown (e.g., through a retail program), the capital c	ost for
LOADSHAPE Cooling RES Heating RES		
Algorithm		
CALCULATION OF SAVINGS		
ELECTRIC ENERGY SAVINGS		
For central air conditioners and air source heat pumps:	· EE / 1 000 * 19D	Formatted: Space After: 6 pt
$\underline{\Delta kWh_{gool}} = EFLH_{gool} * Capacity_{\underline{Cooling}} * (1/SEER2) * SBdegrees * SF$	<u>EF / 1,000 * ISR</u>	Formatted: Subscript
		Formatted: Subscript
		Formatted: Subscript
⁴³⁷ Table 1, <u>Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measure https://energizect.com/sites/default/files/documents/Measure%20Life%20Report%202007.pdf; 'Measure HVAC Controls, Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measure%20Life%20Report%202007.pdf; page 1 savings to further refine measure life assumption. As this characterization depends heavily upon a large thermostats, the longer-term impacts should be assessed. ⁴³⁸ Market prices vary significantly in this category, generally increasing with thermostat capability and criteria are available on units readily available in the market for \$30. Labor is assumed to be one hour a second content of the market for \$30. Labor is assumed to be one hour a second content of the market for \$30. Labor is assumed to be one hour a second content of the market for \$30. Labor is assumed to be one hour a second content of the market for \$30. Labor is assumed to be one hour a second content of the market for \$30. Labor is assumed to be one hour a second content of the market for \$30. Labor is assumed to be one hour a second content of the market for \$30. Labor is assumed to be one hour a second content of the market for \$30. Labor is assumed to be one hour a second content of the market for \$30. Labor is assumed to be one hour a second content of the market for \$30. Labor is assumed to be one hour a second content of the market for \$30. Labor is assumed to be one hour a second content of the market for \$30. Labor is assumed to be assumed t</u>	e Life Report 2007.pdf, page 1-3. Jaures, GDS Associates, 2007. Future evaluation is strongly encouraged to inform the persistence scale but only 2-year study of the energy impacts of programmable sophistication. The basic functions required by this measure's eligib	
2025 MEEIA <u>4</u> 2019-21 Plan Revision <u>8</u> 7.0	Page	113

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		ES* Formatted: Font: (Default) Arial, 12 pt Formatted: Normal
$4kWh_{coot} = EFLH,$	cool * Capacity _{Looling} * (±) SEER) * SBdegrees * SF * EF /1000-	 Formatted: Check spelling and grammar Formatted: Indent: Left: 0", First line: 0", Space After
For air source heat p	umps there are additional heating savings:	6 pt
\kWh _{heat}	= EFLH _{heat} * Capacity _{Heating} * (1/HSPF2) * SBdegrees * SF * EF / 1,000 * ISR	Formatted: Check spelling and grammar
AkWh _{neat} =	= EFLH _{neat} * Capacity _{Heating} * {	
Where:		
EFLH _{cool}	= Equivalent full load hours of air conditioning ^{439} :	
	Weather Basis (Ameren Missouri EFLH _{cool}	
	Average) (Hours) SF or MF 869	
	MFc (comprehensive envelope) 632	
Canacitya	$_{ng}$ = Cooling capacity of system in BTU/hr (1 ton = 12,000 BTU/hr)	
CapacityCooli	= Use Actuals based upon units served	
SEER2	-= Seasonal Energy Efficiency Ratio of cooling system (kBtu/kWh)	
<u>SEEK</u>	= <u>Actual.</u> If unknown, use defaults provided below:	Formatted: Font: Not Italic
	Cooling System SEER Air Source Heat Pump 10 ⁴⁴⁰	
	Central AC 10 ⁴⁴¹	
HSPF <u>2</u>	= Heating Season Performance Factor of heating system (kBtu/kWh) <u>= Actual.</u> —If unknown, use defaults provided below: Existing Heating System HSPF2error Air Source Heat Pump 7.00 ⁴² Electric Resistance 3.41 ⁴⁴³	
$EFLH_{heat}$	= Equivalent full load hours of heating:44	
	Weather Basis (Ameren Missouri EFLH _{heat}	
	Average) CFL/heat	
	SF or MF 1496 MFc (comprehensive envelope) 510	
Capacity _{Heati}	ng= Heating capacity of system in BTU/hr (1 ton = 12,000 BTU/hr) _—= Use Actuals based upon units served	
	Ose Actuals based upon units served	
³⁹ Based on Full Load He http://www.energystar.go	our assumptions (for St Louis and Kansas City) taken from the ENERGY STAR [®] calculator o v/ia/business/bulk-purchasing/bpsavings-calc/Calc-CAC.xls) and reduced by 28.5% based on the evaluation results in Ameren Missouri' service	
	propriate EFLH of 869. The other weather basis values are calculated using the relative climate normals cooling degree day ratios (at 65F set point). n Year 2019 Annual EM&V Report Volume 2: Residential Portfolio Appendices, https://www.efis.psc.mo.gov/Document/Display/15876, page 30.	
erritory, suggesting an ap	on minimum federal standards between 1992 and 2006 — Ameren Missouri Community Saver Program Evaluation PY2018	
erritory, suggesting an ap Ameren Missouri Program 40 IL. TRM (V5) – based	gov/Document/Display/36053, page 26.	
erritory, suggesting an ap Ameren Missouri Program ⁴⁰ IL-TRM (V5) – based https://www.efis.psc.mo.p ⁴¹ IL-TRM – based on mi	inimum federal standards between 1992 and 2006—Ameren Missouri Community Saver Program Evaluation PY2018.	
erritory, suggesting an ap Ameren Missouri Program ⁴⁰ IL-TRM (V5) based- ittps://www.efis.psc.mo.g ⁴¹ IL-TRM - based on mi ⁴² IL-TRM (Based on mi	<u>gov/Document/Display/36053, page 26.</u> nimum federal standards between 1992 and 2006) – Ameren Missouri Community Saver Program Evaluation PY2018.	
erritory, suggesting an ap Ameren Missouri Prograt ⁴⁰ IL-TRM (V5) – based https://www.efis.psc.mo.g ⁴¹ IL-TRM – based on mi https://www.efis.psc.mo.g ⁴² IL-TRM (Based on mi ⁴³ Electric resistance has	<u>zov/Document/Display/36053, page 26</u> . nimum federal standards between 1992 and 2006) – Ameren Missouri Community Saver Program Evaluation PY2018. a COP of 1.0 which equals 1/0.293 – 3.41 HSPF.	
eritory, suggesting an ap Ameren Missouri Prograt ⁴⁰ IL TRM (V5) based- ttps://www.efis.psc.mo., ⁴¹ IL-TRM - based on mi ⁴² IL-TRM (Based on mi ⁴² IL-TRM (Based on mi ⁴³ Electric resistance has ⁴⁴ Evaluation - Opinion I	<u>gov/Document/Display/36053, page 26.</u> nimum federal standards between 1992 and 2006) – Ameren Missouri Community Saver Program Evaluation PY2018.	ct

		Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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	-= weighted sum of setback degrees to comfort temperature		
	-= SBdegrees Heating = 1.8 ⁴⁴⁵		
SF	= SBdegrees Cooling = 1.91 ⁴⁴⁶ = Savings factors from ENERGY STAR [®] calculator		
	= 3% / degree heat, 6% / degree cool		
	= Efficiency ratio from Cadmus metering study		
	= 13% heat ⁴⁴⁷		
100	$_{}=100\%$ cool ⁴⁴⁸		
ISR	= In-service rate = Actual, or if unknown, assume 100%.		
	- Actual, of It unknown, assume 100%.		
MMER COINCII	ENT PEAK DEMAND SAVINGS		
ΔkW	$= \Delta k Wh_{Cooling} * CF$		
ere:			
<u>AkWh_{Coolir}</u>	= Electric energy savings for cooling, calculated above		
CF	= 0.0009474181		
CF	= Summer peak coincidence demand (kW) to annual energy (k)	Wh) factor -	Formatted Table
	=0.0009474181		
	6FossilHeat * HeatingConusmption _{Gas} * HF * Heating _{Reduction} * Eff ₂₅	······································	Formatted: Subscript
		•	Formatted: Subscript
<u>∆Therms</u>	= %FossilHeat + HeatingConusmption _{Gas} + HF + Heating _{Reduction}	•	Formatted: Subscript Formatted: Subscript
	= %FossilHeat * HeatingConusmption _{Las} * HF * Heating _{re}	quetton * Eff _{ise} * PF	Formatted: Subscript
ATherms	= %FossilHeat + HeatingConusmption _{cas} + HF + Heating _{re} at = Percentage of heating savings assumed to b	auction * <i>Effisic</i> * <i>PE</i> e <u>n</u>Natural <u>g</u>Gas	Formatted: Subscript Formatted: Subscript
ATherms	= %FossilHeat + HeatingConusmption _{Gas} + HF + Heating _{Re} at = Percentage of heating savings assumed to b Heating fuel %Fos	quetton * Eff _{ise} * PF	Formatted: Subscript Formatted: Subscript
ATherms	= %FossilHeat + HeatingConusmption _{Gas} + HF + Heating _{Re} at = Percentage of heating savings assumed to b Heating fuel %Foss Electric 0%	auction * <i>Effisic</i> * <i>PE</i> e <u>n</u>Natural <u>g</u>Gas	Formatted: Subscript Formatted: Subscript
ATherms	= %FossilHeat + HeatingConusmption _{Gas} + HF + Heating _{Re} at = Percentage of heating savings assumed to b Heating fuel %Foss Electric 0% Natural Gas 100%	auction * <i>Effisic</i> * <i>PE</i> e <u>n</u>Natural <u>g</u>Gas	Formatted: Subscript Formatted: Subscript
ATherms	= %FossilHeat + HeatingConusmption _{Gas} + HF + Heating _{Re} at = Percentage of heating savings assumed to b Heating fuel %Foss Electric 0%	auction * <i>Effisic</i> * <i>PE</i> e <u>n</u>Natural <u>g</u>Gas	Formatted: Subscript Formatted: Subscript
<mark>∆Thorms</mark> ere: %FossilH€	= %FossilHeat + HeatingConusmption _{Gas} + HF + Heating _{Re} at = Percentage of heating savings assumed to b Heating fuel %Foss Electric 0% Natural Gas 100%	e <u>n</u> Natural <u>g</u> Gas silHeat	Formatted: Subscript Formatted: Subscript
<mark>∆Therms</mark> ere: %FossilH€	= %FossilHeat + HeatingConusmption _{Las} + HF + Heating _{ree} at = Percentage of heating savings assumed to b <u>Heating fuel</u> %Foss <u>Electric</u> 0% <u>Natural Gas</u> 100% Unknown 65% ⁴⁴⁹	e <u>n</u> Natural <u>g</u> Gas silHeat	Formatted: Subscript Formatted: Subscript
<mark>∆Therms</mark> ere: %FossilH€	= %FossilHeat + HeatingConusmption _{Las} + HF + Heating _{ree} at = Percentage of heating savings assumed to b <u>Heating fuel</u> %Foss <u>Electric</u> 0% <u>Natural Gas</u> 100% Unknown 65% ⁴⁴⁹	e <u>n</u> Natural <u>g</u> Gas silHeat	Formatted: Subscript Formatted: Subscript
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neren Missouri		Appendix I - TRM – Vol. 3	: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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	Weather Basis (City based upon)	Gas_Heating_ Consumption (Therms)		
	St Louis, MO	680		
Other variables as provided above.				
TER IMPACT DESCRIPTIONS AND CAL	CULATION			
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2 <u>5 MEEIA 4 2019-21 Plan</u>	Revision <u>8</u> 7.0		Page 116	

Ameren Missouri		Appendix I - TRM – Vol	. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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46 HVAC Tune-I	p (Central Air Conditioning or Air Source Heat Pu	ump)		
	p (Central All Conditioning of All Source Heat I	ump)		
of any problems found, an	measurement of refrigerant charge levels and airflow over ad post-treatment re-measurement. Tune-up activities incl	ude a general tune-up, refrigera	nt charge, indoor coil cleaning,	
-	These tune-up actions may be performed individually or a bed to be applicable to the following program type: RF.	as a packaged service with more	than one tune-up activity.	
	n types, the measure savings should be verified.			
DEFINITION OF EFFICIEN A tuned and commissione	TEQUIPMENT d residential central air conditioning unit or air source hea	t pump.		
DEFINITION OF BASELIN An existing residential cer	E EQUIPMENT ntral air conditioning unit or air source heat pump that has	required tuning to restore optim	al performance.	
DEEMED LIFETIME OF E The measure life is assum				
DEEMED MEASURE COST As a RF measure, actual of specific costs for varying	costs should be used. If unavailable, the measure cost show	uld be assumed to be \$175.452 T	The table below identifies more	
	Tune- up Service for HP or AC	Incremental Cost (\$)	+	Formatted Table
	General Tune-Up (no charge or coil clean)	\$70.00		
	Tune-up / refrigerant charge	\$81.00 \$63.00 \$175.00		
	Tune-up / Outdoor Coil (Condenser) Cleaning	\$31.00		
	· · · · · · · · · · · · · · · · · · ·			
LOADSHAPE	Tune-Up / Packaged Service	\$185 ⁴⁵³		
Cooling RES	Tune-Up / Packaged Service	\$185 ⁴⁵³		
Cooling RES	Tune-Up / Packaged Service	\$185 ⁴⁵³		Formatted: Subscript
Cooling RES Heating RES	Algorithm	\$185 ⁴⁵³		Formatted: Subscript
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$\frac{\Delta k W h_{ASHP}}{\Delta k W h_{CONTRALAC}} = \frac{1}{\Delta k W h_{ASHP}} =$ 151 Sourced from DEER Databa	$\frac{\text{Algorithm}}{\text{GS}}$ $((EFLH_{\text{cool}} * Capacity_{\text{cool}} * (1/SEER_{\text{test-in}} - 1/SEER_{\text{test-out}})$ $((EFLH_{\text{cool}} * Capacity_{\text{cool}} * (1/SEER_{\text{test-in}} - 1/SEER_{\text{test-out}})$ $((EFLH_{\text{cool}} * Capacity_{\text{cool}} * (1/SEER_{\text{test-in}} - 1/SEER_{\text{test-in}} - $) / 1,000)) / 1,000) + ((EFLH _{beat} * Capaci /SEER _{test-out})) / 1,000) SEER _{test-out})) / 1,000) + ((E	* FLH _{neat} * Capacity _{neat}	Formatted: Subscript Formatted: Subscript
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	Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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iere:		
EFLH _{cool}	= Equivalent full load hours of air conditioning	
Capacity _{cool}	= dependent on location: ⁴⁵⁴ = Cooling Capacity of Air Source Heat Pump (Btu/hr)	
Capacitycool	$= \text{Actual} \frac{(1 \text{ ton} = 12,000 \text{Btu/hr})}{(1 \text{ ton} = 12,000 \text{Btu/hr})}$	
SEER _{test-in}	= Seasonal Energy Efficiency Ratio of existing cooling system before tuning (kBtu/kWh)	
	= In most instances, test-in EER will be determined and noted prior to tuning. SEER rating can be estimated by using the following relationship: ⁴⁵⁵ EER = $(-0.02 * SEER^2) + (1.12 * SEER)$	
	When unknown, ⁴⁵⁶ assume SEER = 11.9	
SEER _{test-out}	 = Seasonal Energy Efficiency Ratio of existing cooling system after tuning (kBtu/kWh) = In most instances, test-out EER will be determined and noted after tuning. SEER rating can be estimated by using the 	
	= In most instances, test-out EEK will be determined and noted anet tuning. SEEK rating can be estimated by using the following relationship: ⁴⁵⁷ EER = $(-0.02 * \text{SEER}^2) + (1.12 * \text{SEER})$; if unknown, reference applicable assumed value in	
	table below,	Formatted: English (United States), Check spelling
EFLH _{heat} Capacity _{heat}	= Equivalent full load hours of heating: = Heating Capacity of Air Source Heat Pump (Btu/hr)	grammar
Capacityheat	= Heating Capacity of All Source Heat runnp (Bul/III) = Actual $\frac{(1 \text{ ton} = 12,000 \text{Btu/hr})}{(1 \text{ ton} = 12,000 \text{Btu/hr})}$	
HSPF _{test-in}	= Heating Seasonal Performance Factor of existing ASHP before tuning (kBtu/kWh)	
	= <u>Actual, or if unknown, Use actual HSPF rating where it is possible to measure or reasonably estimate. If not available,</u> assume HSPF = 6.3. ⁴⁵⁸	
HSPF _{test-out}	assume_HSFF = 0.5. =_Heating System Performance Factor of existing ASHP after tuning (kBtu/kWh)	
	= Actual, or if unknown, reference applicable assumed value in table below Use actual HSPF rating where it is possible to	
	measure or reasonably estimate.	
	Weather Basis (Ameren Missouri Average) EFLH _{cool} (Hours) EFLH _{heat} (Hours)	Formatted Table
	SF or MF 869 ⁴⁵⁹ 1496 ⁴⁶⁰ MFc (comprehensive envelope) 632 ⁴⁶¹ 510 ⁴⁶²	
en SEER test-in ar	Measure % Improvement SEER _{ietetat} (based on default 11.9 test-in value)	Formatted Table
en SEER test-in ar	Massura % Improvement SEERtest-out	Formatted Table
en SEER test-in ar	Massura % Improvement SEERtest-out	Formatted Table
	Measure % Improvement SEER _{test-out} (based on default 11.9 test-in value)	
Y <u>2019 Residential Ev</u> sas City) taken from d	Measure % Improvement SEERIest-out (based on default 11.9 test-in value) aluation Report Appendices, https://www.efis.psc.mo.gov/Document/Display/15876, page 35_Based on Full Load Hour assumptions (for St Louis and e ENERGY STAR* calculator	Formatted Table Field Code Changed
PY2019 Residential Ev sas City) taken from th ://www.energystar.go opriate EFL4 to 6 \$60.7	Measure % Improvement SEER _{test-out} (based on default 11.9 test-in value) aluation Report Appendices, https://www.efis.psc.mo.gov/Document/Display/15876, page 35_Based on Full Load Hour assumptions (for St Louis and the ENERGY STAR® calculator //advanteschulk_purchasing/sparings_calc/Calc_CAC_xls) and reduced by 28.5% based on the evaluation results in Ameren territory suggesting an The other weather basis values are calculated using the relative elimate normals cooling, degree day ratios (at 65F set point).	
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						Formatt	ed: Normal
Refrige	rant charge adjustment	22.0%28.4% ⁴⁶³	15.3				
Conder	user Cleaning Only	7.9% ⁴⁶⁴	12.8				
Indoor	coil cleaning	3.8% 465	12.4				
Genera	l tune-up	5.6% ⁴⁶⁶	12.6				
Packag	ed Service	13.6%467	13.8				
						Formatt	ed: Indent: Left: 0"
HSPF test-out values are unknow	wn, use the following	default test-out value	es based on the tune-up so	ervice(s) performed:			
	,		HSPF _{test-out}	l			
	Measure	(based on	default 6.3 test-in value)			Formatt	ed: Keep with next
	Refrigerant charge a		6.72			Formatt	ed Table
	Condenser Cleaning	0	6.42	1			
	Indoor coil cleaning		6.36	1			
	General tune-up		6.38				
	Packaged Service		7.29468				
				1			
IER COINCIDENT PEAK DEMAN	D SAVINGS						
$\Delta kW = \Delta kWh_{Cooling} * CF$							
<u>e:</u>							
$\Delta kWh_{Cooling}$ = Electric ener	ray covings for cooling	 aslaulated above 					
	rgy savings for cooling	g, calculated above					
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		g, calculated above					
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Ameren Missouri	Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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3.4.7 Blower Motor		
DESCRIPTION This measure describes savings from a brushless permanent magnet (BPM) commutated motor (ECM)) compared to a lower efficiency motor. Time of Sal this measure, as federal standards make ECM blower fan motors a requireme retrofitting an ECM motor into an existing furnace, or replacing an operational in of its life.	e and New Construction replacement scenarios no longer apply to ent for residential furnaces. Savings however are available from	
This measure characterizes the electric savings associated with the fan and the in the fan when operating in heating mode.	teractive negative therm savings due to a reduction in waste heat of	
Savings decrease sharply with static pressure so duct improvements, and clean, le the blower is used for heating, cooling as well as when it is used for continuous for continuous ventilation too. If the resident runs the ECM blower continuously motor that way, savings are near zero and possibly negative. This characterization in Wisconsin, which accounted for the effects of this behavioral impact.	ventilation, but only if the non-ECM motor would have been used because it is a more efficient motor and would not run a non-ECM	
Retrofitting an existing blower motor with a new ECM reduces the potential imp ECM blower motor because existing systems were not designed to capitalize an demand savings are limited to the efficiency gains from the motor itself.		
Note: as part of a Time of Sale measure, it is not appropriate to claim additiona ECM motors are now baseline for new furnaces and the SEER2/EER2 ratings of		
In an early replacement furnace situation, ECM fan heating savings can be claim claimed for the RUL of the CAC if an existing cooling unit is not replaced.	ed for the RUL of the existing furnace, and cooling savings can be	
If a new CAC unit is installed in a home where the existing furnace is not re- demonstrated that the new CAC motor will be used for the heating load.	placed, heating ECM savings should only be claimed if it can be	
This measure was developed to be applicable to the following program types: R	F, EREP	
If applied to other program types, the measure savings should be verified.		
A new furnace with a brushless permanent magnet (BPM) blower motor is inst measure characterizes only the electric savings associated with the fan and co furnace. Savings decrease sharply with static pressure so duct improvements, a improve when the blower is used for cooling as well and when it is used for conti- used for continuous ventilation too. If the resident runs the BPM blower continu BPM motor that way, savings are near zero and possibly negative. This characte savings in Wisconsin, which accounted for the effects of this behavioral impact.	uld be coupled with gas savings associated with a more efficient nd clean, low pressure drop filters can maximize savings. Savings nuous ventilation, but only if the non BPM motor would have been ously because it is a more efficient motor and would not run a non-	
This measure was developed to be applicable to the following program types: -T	OS, NC, and EREP.	
If applied to other program types, the measure savings should be verified.		
DEFINITION OF EFFICIENT EQUIPMENT A furnace with a brushless permanent magnet (BPM) blower motor, also known	by the trademark ECM, BLDC, and other names.	

DEFINITION OF BASELINE EQUIPMENT A furnace with a non-BPM blower motor. As part of the Code of Federal Regulations, energy conservation standards for covered residential furnace fans became effective on July 3, 2019 (10 CFR 430.32(y)). This code requirement effectively makes ECMs part of the baseline for New Construction (NC), Replace-on-Fail (ROF), Time-of-Replacement (TOS), and Early Replacement (EREP) scenarios.

2025 MEEIA 4 2019-21 Plan

Revision <u>8</u>7.0

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DEEMED LIFETIME OF EFFICIENT EQUIPMENT	
The expected measure life is assumed to be 6 years, which is the remaining life of existing furnaces The expected measure life is assumed to be 20 ears. ⁴⁶⁹	
eens, ~~	
DEEMED MEASURE COST	
The capital cost for this measure as a retrofit should be actual if known; if unknown, assume \$350.470 In cases of furnace early replacements, it is	Formatted: Normal
assumed the incremental cost of the ECM is \$0. The capital cost for this measure is assumed to be:	Formatted: Font: Bold
\$74.33 ⁴⁷⁴ Time of Sale	Formatted Table
\$475 ⁴⁷³ Early Replacement	
LOADSHAPE	
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ALCOLATION OF DAVINGS	
ELECTRIC ENERGY SAVINGS	
AkWh _{Heating Mode} = (1 - %_with_New_ASHP) * (400 kWh/year * HeatingEFLH / WisconsinHeatingEFLH) * HF * ISR	
$\frac{MWh_{\text{Heating Mode}}}{MWh_{\text{Cooling Mode}}} = (1 - \% \text{ with New} \text{ASHP}) * (400 \text{ kWh/year} * \text{HeatingEFLH} / \text{WisconsinHeatingEFLH}) * \text{HF} * \text{ISR}$ $\frac{MWh_{\text{Cooling Mode}}}{MWh_{\text{Cooling Mode}}} = (1 - \% \text{ with New} \text{Central} \text{Cooling}) * (70 \text{ kWh/year} * \text{CoolingEFLH} / \text{WisconsinCoolingEFLH}) * \text{HF} * \text{ISR}$	Formatted: Subscript
kWh _{auo} Ciculation = (25 kWh/year * CoolingEFLH / WisconsinCoolingEFLH + 2,960 kWh/year * RT% - 30 kWh/year * HF * ISR	Formatted: Subscript
\kWh _{Continues_Groutation} = (25 kWh/year * CoolingEFLH / WisconsinCoolingEFLH + 2,960 kWh/year * RT% - 30 kWh/year) * HF * ISR	Formatted: Subscript
kWb Hasting FELH	Formatted: Normal
$\frac{\Delta kWh_{\text{Heating Mode}} = (1 - \% \text{ with New ASHP}) \times (400 \frac{kWH}{\text{Vear}} \times \frac{Heating BFLH}{Wisconsin Heating EFLH}) * HF * ISR$	
(Wh Cooling FELH	
$\Delta kWh_{cooling mode} = (1 - \% with New Contral Cooling) \times (70 + Wisconsin Cooling ELH) * HF * ISR$	
$\Delta kWh_{auto Life utation} = \left(25 \frac{kWh}{year} \times \frac{Cooling EFLH}{Wisconsin Cooling EFLH} + 2960 \frac{kWh}{year} \times RT\% - 30 \frac{kWh}{year}\right) * HF * ISR$	
$\Delta kWh_{max} = (25 \frac{kWh}{2} \times \frac{CoolingEFLH}{2} + 2960 \times RT\% - 30 \frac{kWh}{2} \times RT\% - 30 kW$	
$\Delta kWh_{auto Life utation} = \left(25 \frac{kWh}{year} \times \frac{Cooling EFLH}{Wisconsin Cooling EFLH} + 2960 \frac{kWh}{year} \times RT\% - 30 \frac{kWh}{year}\right) * HF * ISR$	
$\Delta kWh_{subscriptions} = \left(25 \frac{kWh}{year} \times \frac{CoolingEFLH}{Visconsin CoolingEFLH} + 2960 \frac{kWh}{year} \times RT\% - 30 \frac{kWh}{year}\right) \times HF + ISR$ $\Delta kWh_{continous circulation} = \left(25 \frac{kWh}{year} \times \frac{CoolingEFLH}{Wisconsin CoolingEFLH} + 2960 \frac{kWh}{year} \times RT\% - 30 \frac{kWh}{year}\right) \times HF + ISR$	
$\Delta kWh_{subset circulation} = \left(25 \frac{kWh}{year} \times \frac{CoolingEFLH}{Wisconsin CoolingEFLH} + 2960 \frac{kWh}{year} \times RT\% - 30 \frac{kWh}{year}\right) * HF + ISR$ $\Delta kWh_{contineus circulation} = \left(25 \frac{kWh}{year} \times \frac{CoolingEFLH}{Wisconsin CoolingEFLH} + 2960 \frac{kWh}{year} \times RT\% - 30 \frac{kWh}{year}\right) * HF + ISR$ $\Delta kWh_{contineus circulation} = \left(25 \frac{kWh}{year} \times \frac{KWh}{Wisconsin CoolingEFLH} + 2960 \frac{kWh}{year} \times RT\% - 30 \frac{kWh}{year}\right) * HF + ISR$ Where:	
$\Delta kWh_{Auto-Lifecutation} = \left(25 \frac{kWh}{year} \times \frac{CoolingEFLH}{Wisconsin CoolingEFLH} + 2960 \frac{kWh}{year} \times RT\% - 30 \frac{kWh}{year}\right) * HF + ISR$ $\Delta kWh_{Lontinous-Lifecutation} = \left(25 \frac{kWh}{year} \times \frac{CoolingEFLH}{Wisconsin CoolingEFLH} + 2960 \frac{kWh}{year} \times RT\% - 30 \frac{kWh}{year}\right) * HF + ISR$ Where: $Parameter \qquad Value \qquad \checkmark$	Formatted Table
$\Delta kWh_{suto Circutation} = \left(25 \frac{kWh}{year} \times \frac{CoolingEFLH}{Wisconsin CoolingEFLH} + 2960 \frac{kWh}{year} \times RT\% - 30 \frac{kWh}{year}\right) + HF + ISR$ $\Delta kWh_{continous circutation} = \left(25 \frac{kWh}{year} \times \frac{CoolingEFLH}{Wisconsin CoolingEFLH} + 2960 \frac{kWh}{year} \times RT\% - 30 \frac{kWh}{year}\right) + HF + ISR$ Where: $\frac{Parameter}{Wisconsin Cooling Savings kWh/year} = \frac{Value}{70.00^{2/3}}$	Formatted Table
$\Delta kWh_{Auto-Lifecutation} = \left(25 \frac{kWh}{year} \times \frac{CoolingEFLH}{Wisconsin CoolingEFLH} + 2960 \frac{kWh}{year} \times RT\% - 30 \frac{kWh}{year}\right) * HF + ISR$ $\Delta kWh_{Lontinous-Lifecutation} = \left(25 \frac{kWh}{year} \times \frac{CoolingEFLH}{Wisconsin CoolingEFLH} + 2960 \frac{kWh}{year} \times RT\% - 30 \frac{kWh}{year}\right) * HF + ISR$ Where: $Parameter \qquad Value \qquad \checkmark$	
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$\Delta kWh_{auto-tircutation} = \left(25 \frac{kWh}{year} \times \frac{CoolingEFLH}{year} + 2960 \frac{kWh}{year} \times kW$	
$\Delta kWh_{Auto Chroutation} = \left(25 \frac{kWh}{year} \times \frac{Cooling EFLH}{Wisconsin Cooling EFLH} + 2960 \frac{kWh}{year} \times RT\% - 30 \frac{kWh}{year}\right) * HF + ISR$ $\Delta kWh_{continous circulation} = \left(25 \frac{kWh}{year} \times \frac{Cooling EFLH}{Wisconsin Cooling EFLH} + 2960 \frac{kWh}{year} \times RT\% - 30 \frac{kWh}{year}\right) * HF + ISR$ Where: $\frac{Parameter}{Wisconsin Cooling Savings kWh/year} = \frac{Value}{70.00^{973}}$ $Cooling Savings All Systems = 25.00^{474}}{Wisconsin Cooling EFLH} = 542.504^{75}}$	Formatted: Font: (Default) Arial
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$\frac{\Delta kWh_{auto Circutation}}{\Delta kWh_{auto Circutation}} = \left(25 \frac{kWh}{year} \times \frac{Cooling EFLH}{Wisconsin Cooling EFLH}}{\sqrt{kWh}} + 2960 \frac{kWh}{year} \times RT\% - 30 \frac{kWh}{year}}\right) + HF + ISR \frac{kWh}{year} \times \frac{RT\% - 30 \frac{kWh}{year}}{year} + HF + ISR$ $\Delta kWh_{continous circutation} = \left(25 \frac{kWh}{year} \times \frac{KWh}{Wisconsin Cooling EFLH}} + 2960 \frac{kWh}{year} \times RT\% - 30 \frac{kWh}{year}\right) + HF + ISR$ Where: $\frac{Parameter}{Visconsin Cooling Savings kWh/year} \frac{Value}{70.00^{473}} + 10000000000000000000000000000000000$	Formatted: Font: (Default) Arial Formatted: Font: (Default) Arial Formatted: Font: (Default) Arial Formatted: Font: 9 pt Formatted: Font: 9 pt Formatted: Font: 9 pt
$\frac{\Delta kWh_{suto CHCURATION}}{\Delta kWh_{suto CHCURATION}} = \left(25 \frac{kWh}{year} \times \frac{Gooling EFLH}{Wisconsin Cooling EFLH}}{2960} + 2960 \frac{kWh}{year} \times RT\% - 30 \frac{kWh}{year}\right) + HF + ISR}{\Delta kWh_{continous CHCURATION}} = \left(25 \frac{kWh}{year} \times \frac{Cooling EFLH}{Wisconsin Cooling EFLH}} + 2960 \frac{kWh}{year} \times RT\% - 30 \frac{kWh}{year}\right) + HF + ISR}{Where:}$ Where: $\frac{Parameter}{Visconsin Cooling Savings kWh/year} \frac{70.00473}{70.00473} \frac{1}{2000} \frac{1}{2$	Formatted: Font: (Default) Arial Formatted: Font: (Default) Arial Formatted: Font: (Default) Arial Formatted: Font: 9 pt Formatted: Font: 9 pt Formatted: Font: 9 pt Formatted: Font: 9 pt
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<u>meren Missouri</u>		Appendix I - TRM – Vol. 3: Residential Mea	SUICES Formatted: Font: (Default) Arial, 12 pt
			Formatted: Normal
	Parameter	Value	Formatted Table
	Wisconsin Circulation Savings kWh/year	2,960.00 ⁴⁷⁸	
	RT=Percent additional run time factor	8.81%479	
	Standby losses	30480	
	Saint Louis Heating EFLH	2,009.00 <u>481</u>	
	Saint Louis Cooling EFLH	1,215.00482	
	% with New Central Cooling % with New ASHP	82% ⁴⁸³ +016% ⁴⁸⁴	
		Actual, or if unknown,	
	ISR	assume 100% 485	
	HF	100% ⁴⁸⁶	
$\frac{\Delta kW = \Delta kW}{\Delta kWh}$ $\frac{\Delta kWh}{CF}$ CF	 Electric energy savings, as calculated above Summer peak coincidence demand (kW) to annual ene 0.0004660805 		Formatted: Indent: Left: 1", First line: 0.5"
ATURAL GAS SAV		rgy (kWh) factor	
AATURAL GAS SAV	- 0.0004660805	rgy (kWh) factor	
ATURAL GAS SAV Δtherms ⁴⁸⁷ =	- 0.0004660805 NGS		
A TURAL GAS SAV Δtherms ⁴⁸⁷ = Vhere: 0.03412	= 0.0004660805 NGS - Heating Savings * 0.03412 / AFUE = Converts kWh to therms = Efficiency of the Furnace		
Attural Gas Sav Atherms ⁴⁸⁷ = 0.03412 AFUE Jsing defaults: For new Furna	 -0.0004660805 NGS - Heating Savings * 0.03412 / AFUE = Converts kWh to therms = Efficiency of the Furnace = Actual. If unknown assume 95%⁴⁸⁸ if in new furnace or 		
Attural Gas Sav Atherms ⁴⁸⁷ = 0.03412 AFUE Jsing defaults: For new Furna	$= -0.0004660805$ NGS $= \text{Heating Savings * } 0.03412 / \text{AFUE}$ $= \text{Converts kWh to therms}$ $= \text{Efficiency of the Furnace}$ $= \text{Actual. If unknown assume } 95\%^{488} \text{ if in new furnace or}$ $\text{Ce} = -(430 * 0.03412) / 0.95$ $= -15.4 \text{ therms}$ $\text{Irnace} = -(430 * 0.03412) / 0.644$		Formatted: Font: 9 pt
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Atherms ⁴⁸⁷ = 0.03412 AFUE Using defaults: For new Furna For existing F	$= -0.0004660805$ NGS - Heating Savings * 0.03412 / AFUE $= \text{Converts kWh to therms}$ $= \text{Efficiency of the Furnace}$ $= \text{Actual. If unknown assume 95%}^{488} \text{ if in new furnace or}$ $\operatorname{ce} = -(430 * 0.03412) / 0.95$ $= -15.4 \text{ therms}$ $\operatorname{trnace} = -(430 * 0.03412) / 0.644$ $= -22.8 \text{ therms}$	r 64.4 AFUE% ⁴⁸⁹ if in existing furnace	Formatted: Font: 9 pt Formatted: Font: 9 pt
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Atturnal Gas Sav Atherms ⁴⁸⁷ = Uhere: 0.03412 AFUE Jsing defaults: For new Furna For existing F ⁹ Ameren Missouri HV ¹⁰ Jbid. ²⁰ Jhid. ³ Ameren Missouri HV ¹⁴ Jbid. ²¹ Jhid. ³ Ameren Missouri HV ¹⁵ Ameren Missouri HV ¹⁶ Household Factor (H ¹⁶ Household Factor (H ¹⁷ The blower fan is in ti ad due to reduced wast	-0.0004660805 NGS - Heating Savings * 0.03412 / AFUE = Converts kWh to therms = Efficiency of the Furnace = Actual. If unknown assume 95% ⁴⁸⁸ if in new furnace or Ce = - (430 * 0.03412) / 0.95 = - 15.4 therms urnace = - (430 * 0.03412) / 0.644 = - 22.8 therms AC Program Evaluation PY2019, page 39, https://www.efis.psc.mo.gov/ID AC Program Evaluation PY2019, https://www.efis.psc.mo.gov/Document AC Program Evaluation PY2020, https://www.efis.psc.mo.gov/Document D) is assumed to be 100%. 65% multifamily value is not applicable for this pla assumed to be 100%. 65% multifamily value is not applicable for this pla assumed to be 100%. 65% multifamily value is not applicable for this	C 64.4 AFUE% ⁴⁸⁹ if in existing furnace Document/Display/15876, Document/Display/15876, Document/Display/14208 #Display/15877, page 90, #Display/15831, page 53, s measure, as savings should be based upon pressure drop in the system. te conditioned space. Negative value since this measure will increase the arv 1, 2013.	Formatted: Font: 9 pt Formatted: Font: 9 pt Formatted: Font: 0 pt Formatted: Font: (Default) Arial, 10 pt

Appendix I - TRM – Vol. 3: Residential Measures

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WATER IMPACT DESCRIPTIONS AND CALCULATION N/A DEEMED O&M COST ADJUSTMENT CALCULATION N/A

MEASURE CODE:

<u>2025</u>MEEIA <u>4 2019-21</u> Plan

1

Revision <u>8</u>7.0

Ameren Missouri Appendix I - TRM – Vol. 3: Residential Measures	\sim	Formatted: Font: (Default) Arial, 12 pt
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3.4.8 Central Air Conditioner		
DESCRIPTION This measure characterizes:		
 TOS: The installation of a new residential sized (<= 65,000 Btu/hr) central air conditioning ducted split system meeting ENERGY STAR[®] efficiency standards presented below. This could relate to the replacement of an existing unit at the end of its useful life, or the installation of a new system in a new home. 		
2. EREP: For the early replacement baseline to apply, program participants or installation contractors must provide documentation asserting that the existing units operated when turned on—whether or not they provided cooling—and the existing unit brand name and model number must be documented; or, if the nameplate is not readable, a photograph of the unit in context and the nameplate specifically must be provided. Early Replacement determination will be defined by program requirements. All other conditions will be considered TOS. The baseline SEER2 of the existing unit is known and, the baseline SEER2 is the actual SEER2 value of the unit replaced. If the SEER2 of the existing unit is unknown, use assumptions in variable list below (SEER2_exist).		
This measure was developed to be applicable to the following program types: TOS, NC, and EREP.		
If applied to other program types, the measure savings should be verified.		
DEFINITION OF EFFICIENT EQUIPMENT In order for this characterization to apply, the efficient equipment is assumed to be a ducted split central air conditioning unit meeting the minimum ENERGY STAR [®] efficiency level standards ; 15 SEER and 12 EER . For reference, the minimum ENERGY STAR [®] version 6.1 efficiency level standards are provided below ⁴⁹⁰ .		Formatted: Font: Times New Roman
Split system central air conditioners – 15.2 SEER2 and 12.0 EER2		Formatted: Font: (Default) Times New Roman
• Single package central air conditioners – 15.2 SEER2 and 11.5 EER2		Formatted: Space Before: 6 pt
• Space constrained units – 13.4 SEER2 ⁴⁹¹		Formatted: Font: Times New Roman
The measure characterization recommends sourcing the efficiency specifications from the actually installed equipment. If those values are not		Formatted: Font: (Default) Times New Roman
known, the default equipment efficiency recommendations are conservatively based on ENERGY STAR® version 6.1 specifications		Formatted: Normal, Space After: 8 pt, Line spacing
DEFINITION OF BASELINE EQUIPMENT		Multiple 1.08 li
New federal standards affecting testing protocols for central air conditioners became effective January 1, 2023, but did not affect the standard efficiency of central air conditioners. The baseline for the TOS measure is based on the current federal standard efficiency level ⁹⁹² : 14 SEER (13.4 SEER2) and 11 EER (10.6 EER2).		Formatted: Font: Not Bold
Standard sized Split system air conditioners – 13.4 SEER2	<u> </u>	Formatted: Font: Times New Roman
Standard sized Single-package air conditioners – 13.4 SEER2		Formatted: Bulleted + Level: 1 + Aligned at: 0.25"
Space constrained air conditioners – 11.7 SEER2		Indent at: 0.5"
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⁴⁰⁰ ENERGY STAR Program Requirements Product Specification for Central Air Conditioner and Heat Pump Equipment, v6.1, effective January 1, 2023, https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Version%206.1%20Central%20Air%20Conditioner%20and%20Heat%20Pump%20Final%20Specification	Γ,	Formatted: Font: (Default) Times New Roman
%20%28Rev.%20January%20%202022%29.pdf; 'ENERGY STAR Version 6.1 Central Air Conditioner and Heat Pump Final Specification (Rev. January 2022).pdf are in	/	Formatted: Font: (Default) Times New Roman
terms of an updated metric, depicted as SEER2 and EER2. The updated test method as well as the updated ENERGY STAR specifications mimic the updated federal appliance standards. An equivalent stringency of these new standards for split system air conditioners are 16 SEER and 13 EER and for single-package air conditioners are 16 SEER and		Formatted: Font: (Default) Times New Roman
EER 12, as detailed in: Consortium for Energy Efficiency (CEE) Residential HVAC Specifications, Estimated Appendix M1 Equivalents, January 15 2021. 491, The ENERGY STAR specification does not provide an efficiency level for space constrained products but this is a proposed level for this product type that the marketplace has		Formatted: Font: (Default) Times New Roman
developed solutions to meet.		Formatted: Font: (Default) Times New Roman
⁴⁹² The 2023 federal standards (10 CFR 430.32(c)(5)) are in terms of an updated metric, depicted as SEER2 and manufacturers must certify their products meet the standard according to the new test procedure and new metrics. The updated test method as well as the updated energy conservation standards were negotiated under the appliance standards and rulemaking federal advisory committee (ASRAC) in accordance with the Federal Advisory Committee Act (FACA) and the negotiated rulemaking act. An equivalent		Formatted: Hyperlink, Font: (Default) Times New Roman, 11 pt
stringency of these new standards for split system air conditioners are 14 SEER and for single-package air conditioners are 14 SEER, as detailed in: Federal Code of Regulations, Energy Conservation Program: Energy Conservations Standards for residential Central Air Conditioners and Heat Pumps; Confirmation of effective date and compliance date for		Formatted: Font: (Default) Times New Roman
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Inder the new federal standards, the M1 testin	protocol was revised result	ing in a new SEER per	formance metric called SEER2 When	auantifying	romatica. Romai
nergy savings, the SEER2 metric should be u					
hould be used for the existing, baseline, and r	ew equipment. The following	g conversion formula c	an be used to convert between efficie	ency metrics:	
SEER2 = SEER \times 0.96					
$SEEK2 = SEEK \pm 0.90$					
he baseline for the early replacement measur	e is the efficiency of the exis	ting equipment for the	assumed remaining useful life of the	unit and the	Formatted: Normal, Justified
ew baseline as defined above493 for the remai					Tomatted. Normal, Justined
DEEMED LIFETIME OF EFFICIENT EQUIPME	NT				
The expected measure life is assumed to be 18					
emaining life of existing equipment is assum	-				
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DEEMED MEASURE COST	teta ana any tanàna amin'ny fisia	. CC		496	
ime of sale: The incremental capital cost for	Ffficiency	Incremental	ncremental costs are provided below		Formatted Table
	Level (SEER2)	Cost			Formatted Table
	<u>13.9</u>	\$111			
	14.4	\$230			
	<u>14.9</u> 15.4	<u>\$453</u> \$635			
	16.3	\$861			
	16.8	\$891			
	<u>17.3</u>	<u>\$921</u>			
	<u>19.2</u> 21.1	<u>\$1,006</u> \$1,120			
	22.4	<u>\$1,120</u> \$1,240			
	13.9	\$111			
	14.4	\$230			
	<u>14.9</u>	<u>\$453</u>			
	<u>15.4</u>	<u>\$635</u>			
arly replacement: The full install cost for this	measure is the actual cost of	f removing the existing	unit and installing the new one. If the	us is	
nknown, assume defaults below. ⁴⁹⁷	incusare is the detail cost of	removing the emisting			
	Efficiency	Full Retrofit		4	Formatted Table
	13.9	\$3,450			
	14.4	\$3,569			
	14.9	\$3,791			
	15.4	<u>\$3,973</u>			
	<u>16.3</u> 16.8	<u>\$4,200</u> \$4,229			
	10.0	04,227			
³ Baseline SEER and EER should be updated when new	minimum federal standards becor	ne effective.			
⁴ Measure Life Report, Residential and Commercial/In- ttps://energizect.com/sites/default/files/documents/Mea	lustrial Lighting and HVAC Measu	ires,	007 - 40 Marchard I for Damant Davidantial an		Formatted: Footnote
ommercial/Industrial Lighting and HVAC Measures, G					
1011 - 13.4 - 01	001 :fe0/ 00D ar	- 16		-	
ttp://www.etsavesenergy.org/files/Measure% he "lifespan" of a central air conditioner is about 15 to	201_HC% 20Keport% 202007.j 20 years (US DOE: http://www.ene	pur<u>.</u> rgysavers.gov/your_home/s	pace_heating_cooling/index.cfm/mytopic=1/	2440).	Formatted: Default Paragraph Font, Font: 11 pt
⁵ Assumed to be one third of effective useful life.	· · ·				
¹⁶ See 'CAC Costs 09.02.2024.xlsx'. ¹⁷ Ibid.					
1010.					
	Devision 07.0			Da. 105	
<u>025 </u> MEEIA <u>4 2019-21 Plan</u>	Revision <u>8</u> 7.0			Page 125	

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$\frac{1}{12} \frac{1}{12} \frac{1}{2} $	Ameren Missouri			Appendix I - TRM – Vol. 3: Reside	ntial Measures	Formatted: Font: (Default) Arial, 12 pt
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			21.1	\$4,458		
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<u>iiiiiiiiiiiiiiiiiiiiiiiii</u>		-				
15.4 33.071 samed deferred out fafter 6 varie) of replacing existing equipment with new baseline unit is assumed to be \$3.670.0% ⁴⁶ . This future cost should be \$3.600.0% for present value using 2.3% noninal societal discourt at four average (1/1/2014 – 1/231/2023) of the 10.9 years of the should be \$3.600.0% for present value using 2.3% noninal societal discourt at four average (1/1/2014 – 1/231/2023) of the 10.9 years of the should be \$3.600.0% for present value using 2.3% noninal societal discourt at four average (1/1/2014 – 1/231/2023) of the 10.9 years of the should be \$3.600.0% for present value using 2.5% noninal societal discourt at four average (1/1/2014 – 1/231/2023) of the 10.9 years of the should be \$3.600.0% for present value using the should be should		-				
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adv population of the following: income, means, the following: income, foll		The incremental cap	vital cost for this me	asure is dependent on efficiency. Assumed incremental	costs are	
Individual provides the full of the second of the second seco		ost for this measur	e is the actual cost o	f removing the existing unit and installing the new one	If this is	
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¹² These values are calculated in the deemed tables based on the unit size and SEER combination. ¹ Based on 3 to initial costs of a new baseline unit from ENERGY STAR ⁸ central AC calculator, \$2,857, and applying inflation rate of 2.0% theulator xlghtp://www.energystar.gov/fa/busines/bulk_purchasing/bpayvings_calc/Calc_CAC_xlg). While baselines are likely to shift in the future, there is currently no good dication of what the cost of a new baseline unit will be in 6 years. In the absence of this information, assuming a constant federal baseline cost is within the range of error for this escriptive measure.	⁸ Ibid.	0000004 1 1				
⁴⁴ Based on 3 ton initial cost estimate for a conventional unit from ENERGY STAR [®] central AC calculator, \$2,857, and applying inflation rate of 2.0% https://dn.mo.gov/sites/dnr/files/media/file/2017/01/energy star assumptions for central air conditioners. adjuators/adjuttry/www.energystar.gov/aia/business/bulk_purchasing/phagarings cale/Calc_CAC_xks). While baselines are likely to shift in the future, there is currently no good adjuators/adjuttry/www.energystar.gov/aia/business/bulk_purchasing/phagarings cale/Calc_CAC_xks). While baselines are likely to shift in the future, there is currently no good adjuators/adjuttry/www.energystar.gov/aia/business/bulk_purchasing/phagarings cale/Calc_CAC_xks). While baselines are likely to shift in the future, there is currently no good adjuators/adjuttry/www.energystar.gov/aia/business/bulk_purchasing/phagarings cale/Calc_CAC_xks). While baselines are likely to shift in the future, there is currently no good adjuators/adjuttry/www.energystar.gov/aia/business/bulk_purchasing/phagarings cale/Calc_CAC_xks). While baselines are likely to shift in the future, there is currently no good adjuttry/adjutt	²⁰ These values are calculated in the deemed	l tables based on the u				Formatted: Not Highlight
alculator xlghttp://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_cale/Cale_CAC_xls). While baselines are likely to shift in the future, there is currently no good adjustion of what the cost of a new baseline unit will be in 6 years. In the absence of this information, assuming a constant federal baseline cost is within the range of error for this rescriptive measure.	³⁴ Based on 3 ton initial cost estimate for a	conventional unit from	ENERGY STAR® cent	al AC calculator, \$2,857, and applying inflation rate of 2.0%		
rescriptive measure.	alculator.xlshttp://www.energystar.gov/ia/b	usiness/bulk_purchasi	ng/bpsavings_calc/Calc	CAC.xls). While baselines are likely to shift in the future, there is	currently no good	Field Code Changed
225 MEEIA 4 2010-21 Plan Revision 87.0 Page 126		unit will be in 6 years	. m me absence of this i	normation, assuming a constant reteral basenne cost is within the r	ange of error for this	
1025 MEELA 4 2019-21 Plan Revision 8Z 0 Page 106						
	2025 MEEIA <u>4 2019-21 P</u> lan	Revisi	on <mark>87</mark> .0		Page 126	

meren Missouri	Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
		Formatted: Normal
arly replacement:502		
	naining life of existing unit (1st 6 years):	
	$\frac{ \text{L}_{\text{cool}} * \text{Capacity} * (1/\text{SEER2}_{\text{exist}} - 1/\text{SEER2}_{\text{ee}})/(1,000) * \text{HF} * \text{ISR}}{(FLH_{\text{cool}} * \text{Capacity} * (1/\text{SEER}_{\text{exist}} - 1/(1,000)) * \text{HF} * \text{ISR}}$	Formatted: Body Text, Indent: Left: 0.5", Space After: 0 pt
	•	Formatted: Body Text, Space After: 0 pt
∆kWh for ren	naining measure life (next 12 years):	
<u>= ((F</u>	$LH_{cool} * Capacity * (1/SEER2_{base} - 1/SEER2_{ee})/1,000) * HF * ISR$	Formatted: Indent: Left: 0.5", First line: 0.5"
	4	Formatted: Indent: First line: 0"
	FLH _{cool} * Capacity * (1/SEER _{base} — 1/SEER _{ee}))/1,000) * HF * ISR	
Where:		
$FLH_{cool} = Fu$	l load cooling hours: ⁵⁰³	
	Weather Basis (Ameren EFLHcool	Formatted Table
	Missouri Average) (Hours) SF or MF 869	
	MFe (comprehensive envelope) 622 ⁵⁰⁴	
Constitut		
Capacity	= Size of new equipment in Btu/hr (note 1 ton = 12,000Btu/hr) = Actual installed, or if actual size unknown 33,600Btu/hr for single-family buildings ⁵⁰⁵	
SEER _{2base}	= Seasonal Energy Efficiency Ratio of baseline unit (kBtu/kWh) ⁵⁰⁶	
SEER2 _{exist}	= <u>14 or 13.4 SEER2 for standard sized units or 11.7 SEER2 for space constrained units</u> <u>13.4 SEER2⁵⁰⁷</u> = Seasonal Energy Efficiency Ratio of existing unit (kBtu/kWh)	
	= Use actual SEER2 rating where it is possible to measure or reasonably estimate. If using rated efficiencies, derate the	
	efficiency value based on the age of the existing equipment (up to a maximum of 30 years) to account for degradation over time. ⁵⁰⁸ If age is unknown, use 12 years Use actual SEER rating where it is possible to measure or reasonably	
	estimate. If using rated efficiencies, derate the efficiency value based on the age of the existing equipment (up to a	
	maximum of 30 years) to account for degradation over time. ⁵⁰⁹ If age is unknown, use 12 years. = SEER2 * (1-0.01) ^{Age} SEER * (1-1.44%) ^{Age}	
	If unknown, assume 8.940.0.510, which is already adjusted to account for age-related degradation.	Formatted: Not Highlight
SEER _{2ee}	————————————————————————————————————	
	provided to show how savings are determined during the initial phase of the measure (existing to efficient) and the remaining phase (new baseline to	
ljustment" input which v	screening tools used may either require a First Year savings (using the first equation) and then a "number of years to adjustment" and "savings rould be the (new base to efficient savings)/(existing to efficient savings).	
	ur assumptions (for St Louis and Kansas City) taken from the ENERGY STAR [®] calculator via/business/bulk_purchasing/bpsavings_calc/Calc_CAC.xls) and reduced by 28.5% based on the evaluation results in Ameren territory suggesting an	
propriate EFLH of 869.	The other weather basis values are calculated using the relative climate normals cooling degree day ratios (at 65F set point). Evaluation - Opinion	Formatted: Font: 9 pt
Evaluation Opinion I	ynamics review PY2019. The recommended values are constructed based on weather conditions (heating degree days and cooling degree days) in select	Field Code Changed
5 Actual unit size require	Cape Girardeau, Kansas City), weighted by partial year 2019 installations. d for multifamily building, no size assumption provided because the unit size and resulting savings can vary greatly depending on the number of units.	
	rsion factor: SEER2 = SEER 🐅 96%. Conversion factor for SEER to SEER2 is used when converting an existing system that is rated in SEER to DOE M1 CFR Standard beginning January 1, 2023. The efficiency levels of the existing, baseline, and efficient case must be expressed in SEER2 terms	
	The efficiency levels of the existing, baseline, and efficient case must be expressed in the same metrics (e.g., both SEER or both SEER2) before	
7 Based on minimum fee	eral standard effective 1/1/2023: 10 CFR 430.32(c)(5)	
	2.0, https://www.ilsag.info/wp-content/uploads/IL-TRM_Effective_010124_v12.0_Vol_3_Res_09222023_FINAL_clean.pdf, page 112. Justification for found on page 14 of 'AIC HVAC Metering Study Memo FINAL 2_28_2018.docx'. Estimate efficiency as (Rated Efficiency * (1-0.01)*Equipment	
ge). 9 Based on IL TRM V8.), which bases justification for degradation factors on page 21 of 'AIC HVAC Metering Study Memo FINAL 2-28-2018', Default of 12 years based on	
e remaining measure life		
1 Department of Energy	standard between 1992 and 2006. If utilities have specific evaluation results providing a more appropriate assumption for homes in a particular market or	
ographical area, then th	n mound de used.	
025 MEEIA 4 201	-21 Plan Revision 87.0 Page 127	
<u>720</u> WILLIA <u>4 201</u>	raye 127	

Ameren Missouri	Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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HF	 Actual installed or <u>14.515.2</u> if unknown. For Multifamily units, use a factor of 65% to convert residential single family to multifamily capacity. If actual capacity is used apply 100%. 	
ISR	= În service rate = <u>Actual, or if unknown, assume</u> 100% ⁵¹¹	
SUMMER COINCIDEN	T PEAK DEMAND SAVINGS	
$\Delta kW = \Delta kW h$	<u>1* CF</u>	
Where:		
ΔkWh CF	 = Electric energy savings, as calculated above = Summer peak coincidence demand (kW) to annual energy (kWh) factor 	
CF	<u>= 0.0009474181</u> ← <u>= 0.0009474181</u>	Formatted: Indent: Left: 1", First line: 0.5"
NATURAL GAS SAVIN N/A	igs	
WATER IMPACT DES N/A	CRIPTIONS AND CALCULATION	
DEEMED O&M COST N/A	ADJUSTMENT CALCULATION	
MEASURE CODE:		

⁵¹¹ Ameren Missouri HVAC Evaluation: PY2020, <u>https://www.efis.psc.mo.gov/Document/Display/13831, page 53</u>.

<u>2025 MEEIA 4 2019-21 Plan</u>

Revision <u>8</u>7.0

Ameren Missouri	Appendix I - TRM – Vol. 3: Resident	tial Measures Formatted: Font: (Default) Arial, 12 pt	
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2.4.0 Eilten Classing on P	amont and Dirty Eilten Alama		
3.4.9 Filter Cleaning or Replac	ement and Dirty Filter Alarms		
across the filter. As filters age, the pre	ating system is replaced prior to the end of its useful life with a new filter, resulting in a low ssure drop across them increases as filtered medium accumulates. Replacing filters before they gy by reducing the pressure drop required by filtration, subsequently reducing the load on the	y reach the point	
This measure was developed to be ap	plicable to the following program type: RET.		
If applied to other program types, the	measure savings should be verified.		
DEFINITION OF EFFICIENT EQUIPM A new filter offering a lower pressure	ENT drop across the filter medium compared to the existing filter.		
DEFINITION OF BASELINE EQUIPME A filter that is nearing the end of its e	NT ffective useful life, defined by having a pressure drop twice that of its original state.		
DEEMED LIFETIME OF EFFICIENT E The expected measure life is assumed	QUIPMENT to be 1 year ⁵¹² for a filter replacement and <u>5 years⁵¹³14 years</u> for a dirty filter alarm.		
	be used if known, since there is a wide range of filter types and costs. If unknown, ⁵¹⁴ the cos ost of a pleated filter is assumed to be \$15.66. If unknown, the cost of a dirty filter alarm is as		
LOADSHAPE HVAC RES			
Electric energy savings are calculate	Algorithm d by estimating the difference in power requirements to move air through the existing and ng hours of the blower during the heating season.	d new filter and	
Electric energy savings are calculate multiplying by the anticipated operati	d by estimating the difference in power requirements to move air through the existing and	1 new filter and	
multiplying by the anticipated operati ELECTRIC ENERGY SAVINGS ΔkWh = kWh pering	d by estimating the difference in power requirements to move air through the existing and ng hours of the blower during the heating season.	Formatted: Subscript	
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Electric energy savings are calculate multiplying by the anticipated operati ELECTRIC ENERGY SAVINGS <u>AkWh = kWh peating</u> <u>kWh peating</u> = %Heating	d by estimating the difference in power requirements to move air through the existing and ng hours of the blower during the heating season.	Formatted: Subscript	
Electric energy savings are calculate multiplying by the anticipated operati ELECTRIC ENERGY SAVINGS <u>AkWh = kWh peating</u> <u>kWh peating</u> = %Heating * <u>kWh pooling</u> = %AC * kW	d by estimating the difference in power requirements to move air through the existing and ng hours of the blower during the heating season. + <u>kWh cooling</u> * <u>kWymotry</u> * <u>EFLHpeat</u> * <u>EI</u> * (1 – Leakage) * <u>ISR</u> //gener_* <u>EFLHpeat</u> * <u>EI</u> * (1 – Leakage) * <u>ISR</u>	Formatted: Subscript Formatted: Subscript	
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Electric energy savings are calculate multiplying by the anticipated operati ELECTRIC ENERGY SAVINGS $\Delta kWh = kWh_{peating} = \% Heating 'kWh_{cooling} = \% AC * kW$ $\Delta kWh = kWh_{heatIng} + kWh_{cooling}$	d by estimating the difference in power requirements to move air through the existing and ng hours of the blower during the heating season. + <u>kWh_cooling</u> * <u>kW_{motor} * <u>EFLH_{keat} * EI * (1 - Leakage) * ISR</u> <u>approx</u> * <u>EFLH_{keat} * EI * (1 - Leakage) * ISR</u> ng + <u>kWmotor</u> * <u>EFLH_{keat} * EI + Utility Adjustment * ISR</u></u>	Formatted: Subscript Formatted: Subscript Formatted: Subscript Formatted: Subscript	
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Appendix I - TRM - Vol. 3: Residential Measures

Factor	Term	School Value
%Heating	Fraction of participants with electric heating	Actual95.65%515
%AC	Fraction of participants with central cooling	Actual95.65%516
-	Average motor full load electric demand (kW) - K-Kits	0.5 <u>517</u>
kW _{motor}	Average motor full load electric demand (kW) MFLI	0.43
	Average motor full load electric demand (kW) Other Programs	0.377 ⁵¹⁸
	Equivalent Full Load Hours (EFLH) Heating (hours/year) - SF or MF	1496 <u>519</u>
EFLH _{heat}	Equivalent Full Load Hours (EFLH) Heating (hours/year) MFc (comprehensive envelope)	510⁵²⁰
	Equivalent Full Load Hours (EFLH) Cooling (hours/year) - SF or MF	869 <u>521</u>
EFLH _{cool}	Equivalent Full Load Hours (EFLH) Cooling (hours/year) – MFc (comprehensive envelope)	632⁵²²
EI	Efficiency Improvement (%)	1 <u>0</u> 5% ⁵²³
	% Homes outside Service Territory Kits	28% ⁵²⁴
Leakage	% Homes outside Service Territory	<u>0</u> 28% ⁵²⁵
ISR	In Service Rate _ School Kits	Actual, or if unknown, assume 44% ⁵²⁶
ISK	In Service Rate – Appliance Recycling Program	Actual, or if unknown, assume 9% ⁵²⁷
	In Service Rate — MFIE Kits	Actual, or if unknown, assume 100% ⁵²⁸
	In Service Rate — MFMR and Single Family Income Eligible	Actual, or if unknown, assume 57.89% ⁵²⁹
	In Service Rate Other Programs	Actual

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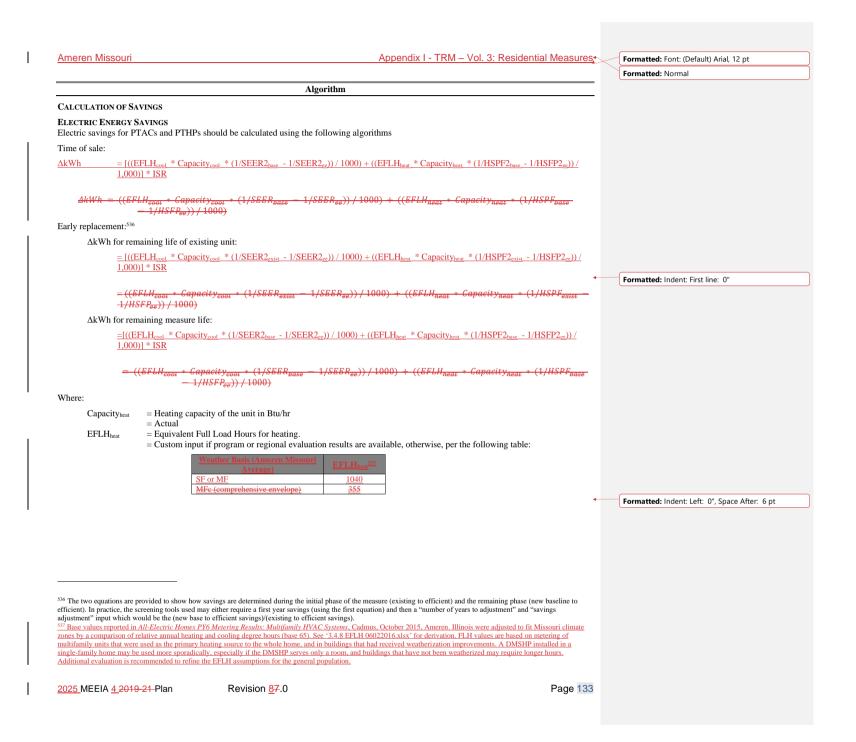
444 Ameren Missouri Energy Efficient Kits Evaluation: PY2018.		
⁵¹⁶ Ibid.		
517 Ameren Missouri EE Kits Evaluation PY2018, page 41, https://www.efis.psc.mo.gov/Document/Display/15870		Formatted: Font: 9 pt
*** Illinois TRM Version 12.0, https://www.ilsag.info/wp-content/uploads/IL_TRM_Effective_010124_v12.0_Vol_3_Res_09222023_FINAL_clean.pdf, page 232. Typical blower	\frown	
motor capacity for gas fumace is ¼ to ¾ HP. Midpoint is ½ HP. ½ HP * 0.746 (kW/hp) = 0.377kW.		Formatted: Font: 9 pt
⁵¹⁹ Ameren Missouri EE Kits Evaluation PY2018, page 41, https://www.efis.psc.mo.gov/Document/Display/15870.		Formatted: Font: 9 pt
³²⁰ Evaluation - Opinion Dynamics review PY2019. The recommended values are constructed based on weather conditions (heating degree days and cooling degree days) in select		Tomated. Tom. 5 pt
Missouri cities (St. Louis, Cape Girardeau, Kansas City), weighted by partial year 2019 installations.		
⁵²¹ Ameren Missouri EE Kits Evaluation PY2018, page 41, https://www.efis.psc.mo.gov/Document/Display/15870.		
322 Evaluation Opinion Dynamics review PY2019. The recommended values are constructed based on weather conditions (heating degree days and cooling degree days) in select		
Missouri cities (St. Louis, Cape Girardeau, Kansas City), weighted by partial year 2019 installations.		
⁵²³ Illinois TRM Version 12.0, https://www.ilsag.info/wp-content/uploads/IL-TRM Effective 010124 v12.0 Vol 3 Res 09222023 FINAL clean.pdf, page 233. Based on		
Energy.gov website; "Maintaining Your Air Conditioner", which states that replacing a dirty air filter with a clean one can lower total air conditioner energy consumption by 5-		
15%. See https://www.energy.gov/energysaver/maintaining-your-air-conditioner; 'Maintaining Your Air Conditioner _ Department of Energy.pdf'.		
³²⁴ Ameren Missouri Energy Efficient Kits Evaluation: PY2019, https://www.efis.psc.mo.gov/Document/Display/15876, page 77.		
323 Ameren Missouri Energy Efficient Kits Evaluation: PY2019, https://www.efis.psc.mo.gov/Document/Display/15876, page 77.		
⁵²⁶ Thid.		
327 Ameren Missouri Appliance Recycling Evaluation: PY2019_https://www.efis.psc.mo.gov/Document/Display/15876, page 95.		
⁵²⁸ Ameren Missouri EE Kits PY18 Program DataEvaluation, https://www.efis.psc.mo.gov/Document/Display/15870, page 41.		
⁴²⁰ Ameren Missouri Community Savers Evaluation PY2018, https://www.efis.psc.mo.gov/Document/Display/36053, page 27.		

2025 MEEIA 4 2019-21 Plan

Revision <u>8</u>7.0

Ameren Missouri		Appendix I - TRM -	Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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<u>AkWh</u>	= Electric energy savings, as calculated above			
CF	= Summer peak coincidence demand (kW) to annual energy (kW = 0.0004660805	Wh) factor		
AkWh	= <u>Energy Savings as calculated above</u>			Formatted: Indent: Left: 1", First line: 0.5"
CF	= 0.0004660805			
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2025 MEEIA <u>4</u> 201	-21 Plan Revision <u>8</u> 7.0		Page 13'	1

Ameren Missouri	Appendix	I - TRM – Vol. 3: Residential Mea	sures	Formatted: Font: (Default) Arial, 12 pt
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3 4 10 Packaged Terminal Air Condit	tioner (PTAC) and Packaged Terminal Heat Pur	nn (PTHP)		
DESCRIPTION	ioner († 1790) and Fackaged Terminal ficat ful	up (1 1111)		
A PTAC is a packaged terminal air condition terminal heat pump. A PTHP uses its computer terminal heat pump.	ner that cools and provides heat through an electric resis ressor year-round to heat or cool. In warm weather, it e er, it captures heat from outdoor air and pumps it into a	fficiently captures heat from inside a spa	ice and	
This measure was developed to be applicable	e to the following program types: TOS, NC, and EREP.			
This measure characterizes:				
1. TOS: the purchase and installation of	of a new efficient PTAC or PTHP.			
that the existing units operated when must be documented; or, if the nar providedthe early removal of an exis PTAC or PTHP unit, Savings are ca unit, and between new baseline unit	aseline to apply, program participants or installation con a turned on—whether or not they provided cooling—and meplate is not readable, a photograph of the unit in c sting PTAC or PTHP from service, prior to its natural e alculated between existing unit and efficient unit consur and efficient unit consumption for the remainder of the ample replacing a cooling only PTAC with a PTHP can	the existing unit brand name and model r ontext and the nameplate specifically n and of life, and replacement with a new eff nption during the remaining life of the e neasure life. The measure is only valid for	number nust be fficient existing	
If applied to other program types, the measu	re savings should be verified.			
DEFINITION OF EFFICIENT EQUIPMENT In order for this characterization to apply th	e efficient equipment is assumed to be PTACs or PTHP	s that exceed baseline efficiencies		
	te effectent equipment is assumed to be 1 fries of 1 fri	s that exceed baseline efficiencies.		
DEFINITION OF BASELINE EQUIPMENT TOS: the baseline condition is defined by the	e Code of Federal Regulations at 10 CFR 431.97(c), sec	tion §431.97.		
EREP: the baseline is the existing PTAC or remainder of the measure life.	PTHP for the assumed remaining useful life of the uni	t and the new baseline as defined above	for the	
DEEMED LIFETIME OF EFFICIENT EQUIPM The expected measure life is assumed to be				
Remaining life of existing equipment is assu	amed to be 5 years. ⁵³¹			
DEEMED MEASURE COST TOS: The incremental capital cost for this ea	quipment is estimated to be \$84/ton.532			
EREP: The measure cost is the full cost of re assume \$1,047 per ton. ⁵³³	emoving the existing unit and installing a new one. The a	ctual program cost should be used; if unl	known,	
should be discounted to present value using a	replacing existing equipment with new baseline unit is a a 2.31% nominal societal discount rate, based on the ten should be discounted to present value using the utilities	year average (1/1/2014 - 12/31/2023) of		
LOADSHAPE Cooling RES Heating RES				
https://energizect.com/sites/default/files/documents/M ⁵³¹ Standard assumption of one third of effective usefu ⁵²² DEER 2008. This assumes that baseline shift from ⁵³³ Based on DCEO – IL PHA Efficient Living Progra	IECC 2012 to IECC 2015 carries the same incremental costs. Value am data. he DCEO data and incorporating inflation rate of 1.91%.	7.pdf', page 1-4.		Formatted: Not Highlight
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HSPT2	Mark			Weather Basis	EFLH _{heat} ⁵³⁸	4	Formatted Table
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with the set of the set	result of the state of the			2.9 (0.026)	x Capacity/1000) x 3.41		
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HSPF2esting = Actual HSPF rating of existing equipment (kbtu/kwh). If unknown, assume: htSPF2esting = Actual HSPF rating of existing equipment (kbtu/kwh). If unknown, assume: important in the cooling capacity of the ductless heat pump unit in Btu/hr. ⁴¹ = Actual installed SEER2est = Actual installed ¹² SEER2est = Actual installed ¹² SEER2est = Second Energy Efficiency Ratio of SEER2 rating of the baseline unit (kBtu/kWh). When using the formulas in the table below, onvert the baseline EER to SEER2 using the EER conversion formula. ⁵⁴³ between the baseline in All Electric Interse of SEER2 rating of 140 - 0.300 * Capacity.est / 1000) Fract (Cooling mode) pTHP (Cooling mode) Standard Sized 140 - 0.300 * Capacity.est / 1000) pTHP (Cooling mode) Standard Sized 140 - 0.300 * Capacity.est / 1000) pTHP (Cooling mode) Standard Sized 140 - 0.300 * Capacity.est / 1000) pTHP (Cooling mode) Standard Sized 140 - 0.300 * Capacity.est / 1000) pTHP (Cooling mode) Standard Sized 140 - 0.300 * Capacity.est / 1000) pTHP (Cooling mode) Standard Sized 140 - 0.300 * Capacity.est / 1000) pTHP (Cooling mode) Standard Sized 140 - 0.300 * Capacity.est / 1000) pTHP (Cooling mode) Standard Sized 160	HSPF2_out = Actual HSPF raing of existing equipment (Athus Awh), If unknown, assume: LSPF2_out = Actual HSPF raing of existing equipment (Athus Awh), If unknown, assume: Deciri resistance heating (PTAC) 5.442%		PTHP (Heating mode)	Standard Sized (3	3.7 – (0.052 * Capacity _{heat} / 1,000)) * 3.41		
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	Image: Second In All Electric resistance heating (PTAC) 3.4125% Capacityow = the cooling capacity of the ductices heat pump unit in Btw/hr.*1 = Actual insulated = Actual insulated* SEER2_w					•	Formatted: Indent: First line: 0"
Existing Equipment Type HSPF8_met Electric resistance heating (PTAC) 3.412 ¹⁰ Stat2 ¹⁰ + the cooling capacity of the ductless heat pump unit in Btu/hr. ³⁴¹ - Actual installed	Existing Equipment Type 151272.min Electric resistance heating (PTAC) 3.412% State 5.44% Capacity at = the cooling capacity of the ductless heat pump unit in Btu/hr. ⁴¹ = Actual installed = Actual installed SEER2_we — — SEER rating of new equipment.(kbtu/kkh): = Actual installed* = SEER2_me = Seesonal Energy Efficiency Ratio-ofSEER2 using of the baseline unit (kBtu/kWh). When using the formulas in the table below, convert the baseline EER to SEER2_using the EER conversion formula. ⁵⁴³ SEER2_me = Seesonal Energy Efficiency Ratio-ofSEER2 using the EER conversion formula. ⁵⁴³ mainteent Expr Efficiency Ratio of See (2000) PTAC (Cooling mode) Standard Sized 14.0 – 0.300 * Capacity.get/1.000) PTAC (Cooling mode) Non-Standard Size* 10.9 – 0.213 * Capacity.get/1.000) PTHP (Cooling mode) Non-Standard Size* 10.8 – 0.213 * Capacity.get/1.000) PTHP (Cooling mode) Non-Standard Size* 10.8 – 0.213 * Capacity.get/1.000) PTHP (Cooling mode) Non-Standard Size* 10.8 – 0.213 * Capacity.get/1.000) PTHP (Cooling mode) Non-Standard Size* 10.8 – 0.213 * Capacity.get/1.000) PTHP (Cooling mode) Non-Standard Size* 10.	HSPF ₂ _{exist}	= Actual HSPF rating of exi	sting equipment (kbtu/kwh)	. If unknown, assume:	4	Formatted: Space After: 6 pt
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		se values reported in. by a comparison of re- amily units dhat were family home may be ional evaluation is ree circi resistance has a is is estimated based (average nameplate SI or = 12 kBtu/hr. te-that-if only an EEI R = (-0.02 * SERE).	table below, convert the base Equipment Type PTAC (Cooling mode) PTAC (Cooling mode) PTAP (Cooling mode) PTHP (Cooling mode) PTHP (Cooling mode) All Electric-Homes PY6 Metering Re- slative annual heating and cooling deg used as the primary heating source to used more spondically, especially if ommended to refine the EFLH assum used more spondically, especially if ommended to refine the EFLH assum COP of 1.0 which equals 1/0.293 = 3 on finding the average HSPP/SEER r EER rating of all early replacement que R2 rating is available, use the followin + (1.12 * SEER), EER, base = (1.12)	Unit Size Standard Sized Non-Standard Size* Standard Sized Non-Standard Size* Standard Sized Non-Standard Size* ults: Multifamily HVAC Systems, rece hours (base 65). See 3.4.8 EF the whole home, and in buildings the DMSHP serves only a room, a ptions for the general population. A1 HSPF. tio from the AHRI directory data nalifying equipment in Ameren PY ng conversion equation to estimate v(1.2544 - 0.08 = EER))/0From	Ederal Regulations Minimum Efficiency (EER) 14.0 - (0.300 * Capacity _{cool} /1,000) 10.9 - (0.213 * Capacity _{cool} /1,000) 14.0 - (0.300 * Capacity _{cool} /1,000) 14.0 - (0.300 * Capacity _{cool} /1,000) 14.0 - (0.300 * Capacity _{cool} /1,000) 14.0 - (0.213 * Capacity _{cool} /1,000) 10.8 - (0.213 * Capacity _{cool} /1,000) 10.8 - (0.213 * Capacity _{cool} /1,000) 10.8 - (0.213 * Capacity _{cool} /1,000) (using the least efficient models - SEER 12 and SEER (2003-PY2004. This estimation methodology appears t e SEER2: SEER = (1.12 + (1.2544 - 0.08 * EER) ⁰⁵ /0 m Wassmer, M. (2003), "A Component-Based Model f	 I on metering of ISHP installed in a re longer hours. 13) – 0.596 and applying o provide a result within 04. This is the observse 	Formatted: Superscript
	MEEIA 4 2019-21 Plan Bayision 87.0 Page 134	se values reported in- by a comparison of ra amily units that were family home may be onal evaluation is rec ctric resistance has a is is estimated based average nameplate SI factual HSPF. To n = 12 kBru/r. te that i ff only an EE $R = (-0.02 * SEER_{2}^{2})$. tioner and Heat Pump	table below, convert the base Equipment Type PTAC (Cooling mode) PTAC (Cooling mode) PTAP (Cooling mode) PTHP (Cooling mode) PTHP (Cooling mode) All Electric-Homes PY6 Metering Re- slative annual heating and cooling deg used as the primary heating source to used more spondically, especially if ommended to refine the EFLH assum used more spondically, especially if ommended to refine the EFLH assum COP of 1.0 which equals 1/0.293 = 3 on finding the average HSPP/SEER r EER rating of all early replacement que R2 rating is available, use the followin + (1.12 * SEER), EER, base = (1.12)	Unit Size Standard Sized Non-Standard Size* Standard Sized Non-Standard Size* Standard Sized Non-Standard Size* ults: Multifamily HVAC Systems, rece hours (base 65). See 3.4.8 EF the whole home, and in buildings the DMSHP serves only a room, a ptions for the general population. A1 HSPF. tio from the AHRI directory data nalifying equipment in Ameren PY ng conversion equation to estimate v(1.2544 - 0.08 = EER))/0From	Ederal Regulations Minimum Efficiency (EER) 14.0 - (0.300 * Capacity _{cool} /1,000) 10.9 - (0.213 * Capacity _{cool} /1,000) 14.0 - (0.300 * Capacity _{cool} /1,000) 14.0 - (0.300 * Capacity _{cool} /1,000) 14.0 - (0.300 * Capacity _{cool} /1,000) 14.0 - (0.213 * Capacity _{cool} /1,000) 10.8 - (0.213 * Capacity _{cool} /1,000) 10.8 - (0.213 * Capacity _{cool} /1,000) 10.8 - (0.213 * Capacity _{cool} /1,000) (using the least efficient models - SEER 12 and SEER (2003-PY2004. This estimation methodology appears t e SEER2: SEER = (1.12 + (1.2544 - 0.08 * EER) ⁰⁵ /0 m Wassmer, M. (2003), "A Component-Based Model f	 I on metering of ISHP installed in a re longer hours. 13) – 0.596 and applying o provide a result within 04. This is the observse 	Formatted: Superscript
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		Appendi	x I - TRM – Vol. 3: Residentia	Measures Formatted: Font: (Default) Arial, 12 pt
				Formatted: Normal
		EER _{bace} (manufacture date prior to 1/1/2017)	e EER _{baco}	
	Equipment Type	prior to 1/1/2017)	date on or after	
		12.0 (0.2	1/1/2017)	
	PTAC (Cooling mode) Standard Sized	13.8 – (0.3 x Capacity _{cool} /1000)	14.0 – (0.300 x Capacity _{cool} /1000)	Formatted: Font color: Auto
	PTAC (Cooling mode)		acity _{cool} /1000)	Formatted: Left
	Non-Standard Size PTHP (Cooling mode)	14.0 (0.200	1	Formatted: Font color: Auto
	Standard Sized	14.0 (0.300 x Caj	acity _{cool} 1000)	Formatted: Left
	PTHP (Cooling mode) Non-Standard Size	10.8 – (0.213 x Caj	xacity_{cool}/1000)	Formatted: Font color: Auto
<u>* Non-S</u>	Standard Size apply only to units with existin	g sleeves less than 16 inches	(406mm) in height and less than 42	inches (1067
mm) in	width.		-	Formatted: Font color: Auto
				Formatted: Left
				Formatted: Indent: Left: 1", First line:
SEER ₂ exist	= Actual SEER rating of existing equipment	-(kbtu/kwh). If unknown, ass	ime:	Formatted: Space After: 6 pt
	Existing Coo	oling System SEER2exist	44	
	PTHP	7.2 <u>6.91</u>		
	PTAC	6. <u>853</u>		
EFLH _{cool}	= Equivalent Full Load Hours for cooling.			
	= Custom input if program or regional evalu	ation results are available, oth	herwise, per the following table.545	
	Weather Basis (Amerer	1 Missouri		
	Average) Weather Basis	City based EFLH _{cool}		
	Average/vreather Dasis	(City Dased Ef Effcool		
	upon)			Formetted Table
	SF or MFSt Louis MFc (comprehensive enve	617		Formatted Table
ISR	<u>upon)</u> <u>SF or MFSt Louis</u>	617 lope) 449		
	= In-service rate. Actual, or if unknown, ass	617 lope) 449		Formatted Table Formatted: Space Before: 6 pt
MER COINCIDENT	SF or MFSt Louis MFe (comprehensive enve	617 lope) 449		
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IMER COINCIDENT e of sale: <u>AkW</u> =	= In-service rate. Actual, or if unknown, ass	617 lope) 449		
MER COINCIDENT e of sale: <u>AkW</u> =	In-service rate. Actual, or if unknown, ass	617 lope) 449		
MER COINCIDENT e of sale: <u>AkW =</u> re: AkWh =		617 lope) 449		
MER COINCIDENT e of sale: <u>AkW =</u> re: <u>AkWh</u>	= In-service rate. Actual, or if unknown, ass PEAK DEMAND SAVINGS - AkWheooning + CF	617 lope) 449		
MER COINCIDENT e of sale: <u>AkW =</u> re: AkWh =		617 lope) 449		
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IMER COINCIDENT e of sale: $\Delta kW =$ $\Delta kWh =$ $\Delta kWh =$ $\Delta kW = \Delta kWh_{C}$ re:	= In-service rate. Actual, or if unknown, ass PEAK DEMAND SAVINGS = AkWheooung + CF = Energy Savings as calculated above = 0.0009474181 soling * CF	617 (ope) 449 ume 100% ⁵⁴⁶		
IMER COINCIDENT e of sale: $\Delta kW =$ $\Delta kWh =$ $\Delta kWh =$ $\Delta kW = \Delta kWh_{C}$ re:		617 (ope) 449 ume 100% ⁵⁴⁶		
IMER COINCIDENT e of sale: $\Delta kW =$ $\Delta kWh =$ $\Delta kWh =$ $\Delta kW = \Delta kWh_{C}$ re:	= In-service rate. Actual, or if unknown, ass PEAK DEMAND SAVINGS = AkWheooung + CF = Energy Savings as calculated above = 0.0009474181 soling * CF	617 (ope) 449 ume 100% ⁵⁴⁶		
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IMER COINCIDENT e of sale: $\Delta kW =$ ΔkWh $\Delta kW = \Delta kWh_{coling}$ SHP existing efficiency	set of the second	dissouri Heating and Cooling Progr		Formatted: Space Before: 6 pt
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Appendix I - TRM – Vol. 3: Residential Measures

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NATURAL GAS ENERGY SAVINGS N/A

WATER IMPACT DESCRIPTIONS AND CALCULATION $N\!/\!A$

Deemed O&M Cost Adjustment Calculation $N\!/\!A$

MEASURE CODE:

<u>2025 MEEIA 4 2019-21 Plan</u>

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Revision <u>8</u>7.0

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<u>2025</u>MEEIA <u>4 2019-21</u> Plan

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<u>2025 MEEIA 4 2019-21 Plan</u>

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Revision <u>8</u>7.0

<u>meren Missouri</u>	Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
		Formatted: Normal
	$\Delta kWh = \frac{\left(FLH_{Roomac} * Btu/H * \left(\frac{1}{CEER_{base}} - \frac{1}{CEER_{ee}}\right)\right)}{1.000}$	Formatted: Normal
here:	2,000	
FLH _{RoomAC}	= Full Load Hours of room air conditioning unit:	
	Weather Basis (City based upon) Hours ⁵⁶⁰	
	St Louis, MO 860 for primary use and 556 for secondary use	
Btu/H	= Size of unit	
CEER _{base}	= Actual. If unknown assume 8,500 Btu/hr ⁵⁶¹ = Efficiency of baseline unit	
CLERobase	= For programs other than low-income programs, aAs provided in tables above	
CEERee	 = For low income programs, actual CEER of the existing unit; if unknown, assume 7.7⁵⁶² = Efficiency of ENERGY STAR[®] unit 	
	= Actual. If unknown assume minimum qualifying standard as provided in tables above	
ISR	= Actual, or if unknown, reference values in the table below dependent on program type	
	Program Type ISR TOS ⁵⁶³ 9797%	
	<u>SFIE⁵⁶⁴</u> <u>98%</u>	Formatted Table
MMER COINCIDE $\Delta kW = \Delta kW$	NT PEAK DEMAND SAVINGS √ <u>h * CF</u>	Formatted: Indent: Left: 0"
$\Delta kW = \Delta kW$	<u>'h * CF</u>	Formatted: Indent: Left: 0"
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$\frac{\Delta kW = \Delta kW}{\Delta kWh}$ $\frac{\Delta kWh}{CF}$ $\frac{\Delta kWh}{\Delta kWh}$	 <u>= Electric energy savings, as calculated above</u> <u>= Summer peak coincidence demand (kW) to annual energy (kWh) factor</u> <u>= 0.0009474181⁶⁶⁵</u> <u>= Summer Peak Coincidence Factor for measure</u> <u>= 0.0009474181⁵⁶⁶</u> 	
$\frac{\Delta kW = \Delta kW}{\Delta kWh}$ $\frac{\Delta kWh}{CF}$ $\frac{\Delta kWh}{CF}$ Atural Gas Savi A ater Impact De	 <u>= Electric energy savings, as calculated above</u> <u>= Summer peak coincidence demand (kW) to annual energy (kWh) factor</u> <u>= 0.0009474181⁶⁶⁵</u> <u>= Summer Peak Coincidence Factor for measure</u> <u>= 0.0009474181⁵⁶⁶</u> 	
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Appendix I - TRM – Vol. 3: Residential Measures

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DEEMED O&M COST ADJUSTMENT CALCULATION N/A Measure Code:

<u>2025</u> MEEIA <u>4 2019-21</u> Plan

Revision <u>8</u>7.0

Ameren Missouri Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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.4.12 Ground Source Heat Pump	
DESCRIPTION heat pump provides heating or cooling by moving heat between indoor and the ground.	
his measure characterizes:	
1. TOS: The installation of a new residential sized ground source heat pump. This could relate to the replacement of an existing unit at the end of its useful life, or the installation of a new system in a new home.	
2. EREP: The early removal of functioning electric heating and cooling systems from service, prior to its natural end of life, and replacement with a new high efficiency ground source heat pump unit. To qualify as early replacement, the existing unit must be operational when replaced. If the SEER of the existing unit is known ₂ and the baseline SEER is the actual SEER value of the unit replaced ₂ and if unknown use assumptions in the variable list below (SEER2 exist and HSPF2 exist). If the operational status of the existing unit is unknown, use TOS assumptions.	
'his measure was developed to be applicable to the following program types: TOS, NC, and EREP.	
f applied to other program types, the measure savings should be verified.	
DEFINITION OF EFFICIENT EQUIPMENT A new residential sized ground source heat pump with specifications to be determined by program.	
DEFINITION OF BASELINE EQUIPMENT The baseline for the TOS measure is federal standard efficiency level as of: 3.3 COP and 14.1 EER when replacing an existing ground source heat tump, 14.3 SEER2 and 7.58.2 HSPF2 when replacing an existing air source heat pump or existing ground source heat pump, and 13.4 SEER2 and .41 HSPF2 when replacing a central air conditioner and electric resistance heating.	
for the early replacement baseline to apply, program participants or installation contractors must provide documentation asserting that the existing	
nits operated when turned on—whether or not they provided cooling—and the existing unit brand name and model number must be documented; r, if the nameplate is not readable, a photograph of the unit in context and the nameplate specifically must be provided. The baseline for the early eplacement measure is the efficiency of the existing equipment for the assumed remaining useful life of the unit and the new baseline as defined bove for the remainder of the measure life.	
DEEMED LIFETIME OF EFFICIENT EQUIPMENT The expected measure life is assumed to be 2518 years. ⁵⁶⁷	
for early replacement, the remaining life of existing equipment is assumed to be 6 years for GSHP, ASHP and CAC and 2548 years for electric esistance.	
DEEMED MEASURE COST	
³ COS:New Construction and Time of Sale: The actual installed cost of the Ground Source Heat Pump should be used (default of \$3957 per ton), ⁵⁶⁸ ← ninus the assumed installation cost of the baseline equipment (\$6562 + \$600 per ton for ASHP ⁵⁶⁹ or \$2011 for a new baseline 80% AFUE furnace ⁵⁷⁰ nd \$3,338 for new baseline Central AC replacement ⁵⁷¹).	Formatted: Body Text
arly Replacement: The actual full installation cost of the Ground Source Heat Pump should be used (default of \$3957 per ton). he assumed deferred cost of replacing existing equipment with a new baseline unit is assumed to be \$7,527 + \$688 per ton for a new baseline Air ource Heat Pump, or \$2,296 for a new baseline 80% AFUE furnace and \$3,670 for new baseline Central AC replacement. ⁵⁷² This future cost	
hould be discounted to present value using a 2.31% nominal societal discount rate, based on the ten year average $(1/1/2014 - 12/31/2023)$ of the	Formatted: Font: (Default) Times New Roman, 9 p
0 year Treasury bond yield rates. 573	Formatted: Font: (Default) Times New Roman, 9 p
	Formatted: Font: (Default) Times New Roman, 9 p
⁷ Illinois TRM Version 12.0, https://www.ilsag.info/wp-content/uploads/IL-TRM Effective 010124 v12.0 Vol 3 Res 09222023 FINAL clean.pdf, p. 166. System life of	Formatted: Font: (Default) Times New Roman, 9 p
door components as per DOE estimate (see 'Geothermal Heat Pumps' Department of Energy.htm'). The ground loop has a much longer life, but the compressor and other sechanical components are the same as an ASHP.	Formatted: Font: 9 pt
⁸ Based on data provided in 'Results of HomE geothermal and air source heat pump rebate incentives documented by IL electric cooperatives'. ⁹ Full install ASHP costs are based upon data provided by Ameren. See 'ASHP Costs 06242022'.	Formatted: Font: (Default) Times New Roman
⁰ See 'Technical Standard Document APPENDIX E.pdf'.	Formatted: Font: (Default) Times New Roman
¹ See 'CAC Costs 09.02.2024.xlsx'.	Formatted: Font: 9 pt
³ 'Societal Discount Rate Calculation 08082024.xlsx'.	Formatted: Not Highlight

Ameren Missouri	A A	opendix I - TRM – Vol. 3: Residential Meas	SUITES Formatted: Font: (Default) Arial, 12 pt
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The incremental caj	pital cost for this measure is dependent on the efficiency and capacity (of the new unit. ⁵⁷⁴	
	Efficiency (EER)	Cost (including labor) per	Formatted Table
	GSHP EER 23 replace electric furnace / CAC		Formatted: Body Text, Left
	GSHP EER 23 Replace at Fail GSHP	- \$4,717 - \$3,200	Formatted: Body Text, Left
	Ophil EEK 25 Keplace at Pail Ophil	-93,200	Formatted: Body Text, Left
DED. The full inst	all cost for this measure is the actual cost of removing the existing un	t and installing the new one. If this is unknown a	Formatted: Body Text
	these costs are per ton of unit capacity): ⁵⁷⁵	it and installing the new one. If this is unknown, at	;sume
U.V.		Cost (including labor) per	
	Efficiency (EER)	measure	Formatted: Body Text, Left
	GSHP - EER 23 - replace electric furnace / CAC Early Replacement	- \$5,250	Formatted Table
	GSHP EER 23	\$4,859	Formatted: Body Text, Left
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			spacing: single, Tab stops: Not at 3.5"
Cooling RES Heating RES	Algorithm		
Heating RES	SAVINGS		spacing: single, Tab stops: Not at 3.5"
CALCULATION OF S	SAVINGS		
Leating RES	SAVINGS	t * Capacity _{heat} * (1/HSPF2 _{base} - 1/HSFP2 _c)/100	Spacing: single, Tab stops: Not at 3.5" Formatted: Level 6, Space Before: 10 pt, After: 0 Line spacing: Multiple 1.15 li, Tab stops: 3.5", Left
Leating RES CALCULATION OF S CLECTRIC ENERGY OS:	SAVINGS 'SAVINGS :FLH _{gool} * Capacity _{gool} * (1/EER2 _{pase} - 1/EER2 _{ce}) / 1000) + ((EFLH _{beel}	1 * Capacity _{heat} * (1/HSPF2 _{base} ~ 1/HSFP2 _{se})/ 100	Spacing: single, Tab stops: Not at 3.5" Formatted: Level 6, Space Before: 10 pt, After: 0 Line spacing: Multiple 1.15 li, Tab stops: 3.5", Left
Leating RES CALCULATION OF S LECTRIC ENERGY OS: kWh = [((E ISR	SAVINGS 'SAVINGS :FLH _{gool} * Capacity _{gool} * (1/EER2 _{pase} - 1/EER2 _{ce}) / 1000) + ((EFLH _{beel}	t * Capacity _{heat} * (1/HSPF2 _{base} - 1/HSFP2 _{ce}) / 100	spacing: single, Tab stops: Not at 3.5" Formatted: Level 6, Space Before: 10 pt, After: 0 Line spacing: Multiple 1.15 li, Tab stops: 3.5", Left Formatted: Indent: Left: 0", First line: 0"
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⁴⁷⁴ Cost based upon Ameren Missouri MEEIA 2016-18 TRM effective January 1, 2018.
 ⁴⁷⁵ Ibid.
 ⁵⁷⁶ The two equations are provided to show how savings are determined during the initial phase of the measure (existing to efficient) and the remaining phase (new baseline to efficient). In practice, the screening tools used may either require a first year savings (using the first equation) and then a "number of years to adjustment" and "savings adjustment" input which would be the (new base to efficient) savings)(existing to efficient savings).

<u>2025</u>MEEIA <u>4 2019-21</u> Plan

Revision <u>8</u>7.0

		Appendix I - TRM – Vol. 3: Residential Measure	Est Formatted: Font: (Default) Arial, 12 pt
			Formatted: Normal
		FLH _{heat} * Capacity _{heat} * (1/HSPF _{base}	
,	<i>ISFP_{ee})) / 1000)] ∗ ISR</i>		
nere:			
EFLH _{cool}	= Equivalent full load hours of air conditioning:577		Formatted: Space After: 6 pt
	Weather Basis (City based upon) St Louis, MO	EFLH _{cool} (Hours) 869	
	St Louis, MO	809	
Capacity _{cool}	= Cooling capacity of air source heat pump (Btu/hr)		
EER ₂ _{exist}	= Actual (1 ton = 12,000Btu/hr) = Seasonal Energy Efficiency Ratio of existing unit (kBt	u/kWh)	
	= Use actual SEER2578 rating where it is possible to mea	sure or reasonably estimate. If using rated efficiencies, derate th	<u>1e</u>
	efficiency value based on the age of the existing equipme over time. ⁵⁷⁹ If age is unknown, use 12 years.	ent (up to a maximum of 30 years) to account for degradation	
	= SEER2 * $(1-0.01)^{Age}$ = Seasonal Energy Efficiency Ra	tio of existing cooling system (kBtu/kWh)	
			Formatted: Indent: First line: 0"
		ow, which should not be further adjusted to account for age- possible to measure or reasonably estimate. If using rated	Formatted: Space After: 6 pt
	<u>U</u>	of the existing equipment (up to a maximum of 30 years) to	
	account for degradation over time.580 If age is unknown,	use 12 years.	
	= EER * (1-1.44%) ^{Age}		
	Existing Cooling System	SEER ² exist ⁵⁸¹	
	Air Source Heat Pump Ground Source Heat Pump	7.26.91 ⁵⁸² 13.4 ⁵⁸³	Formatted: Footnote
	Central AC	6.5 <u>3</u> 4	Reference,Footnote_Reference,o,fr,TT - Footnote Reference,FC,Style 9,Style 17,o + Times New Roman
	No central cooling ⁵⁸⁴	Let '1/SEER $\underline{2}_{exist}$ ' = 0	Font: Not Bold, Font color: Auto, Do not check spell
EER2 _{base}	= Seasonal Energy Efficiency Ratio of baseline Air Sour	ce Heat Pump (kBtu/kWh)	or grammar, Not Superscript/ Subscript
	= 14.3 if replacing air source heat pump or ground source	e heat pump; 13.4 if replacing central air conditioner ⁵⁸⁵	
EER_{2ee}^{2}	= Seasonal Energy Efficiency Ratio of efficient Air Sour = Actual	rce Heat Pump (kBtu/kWh)	
EFLH _{heat}	= Equivalent full load hours of heating		
	1		
	r assumptions (for St Louis and Kansas City) taken from the ENERGY		
p://www.energystar.gov/ ropriate EFLH of 869.T I	ia/business/bulk_purchasing/bpsavings_calc/Calc_CAC.xls) and reduc the other climate region values are calculated using the relative climate r	STAR [®] calculator ed by 28.5% based on the evaluation results in Ameren territory suggesting an formals cooling degree day ratios (at 65F set point). <u>PY2019 Evaluation Repo</u>	
p://www.energystar.gov/ ropriate EFLH of 869.TI s://www.efis.psc.mo.gov	ia/business/bulk_purchasing/bpsavings_cale/Cale_CAC.xls) and reduce the other climate region values are calculated using the relative climate r //Document/Display/15876, page 30.	ed by 28.5% based on the evaluation results in Ameren territory suggesting an normals cooling degree day ratios (at 65F set point). <u>PY2019 Evaluation Repo</u>	nt.
2://www.energystar.gov/ copriate EFLH of 869.Tl s://www.efis.psc.mo.go art load EER2 is paired <u>1_Effective_010124_v1</u>	ia/business/bulk purchasing/bpsavings cale/Cale CAC.xls) and reduc the other climate region values are calculated using the relative climate r //Document/Display/15876, page 30, with SEER2exist, consistent with the approach presented in section 3.4 2.0 Vol 3 Res 09222023 FINAL clean.pdf.p. 508.	ed by 28.5% based on the evaluation results in Ameren territory suggesting an normals cooling degree day ratios (at 65F set point). <u>PY2019 Evaluation Repo</u> .2, Illinois TRM Version 12.0, https://www.ilsag.info/wp-content/uploads/IL-	Int. Formatted: Font: (Default) Times New Roman, 9 pt
p://www.energystar.gov/ ropriate EFLH of 869.Tl s://www.efis.psc.mo.gov Part load EER2 is paired M Effective 010124 v1 bid., page 112. Justifica ciency * (1-0.01)^Equip	ia/business/bulk_purchasing/bpsavings_cale/Cale_CAC.xls) and reduce e other climate region values are calculated using the relative climate r //bocument/biplay/15876, page 30. with SEER2exist, consistent with the approach presented in section 3.4 2.0 Vol 3 Res (09222023 FINAL_clean.pdf.p. 508. tion for degradation factors can be found on page 14 of 'AIC HVAC M ment Age).	ed by 28.5% based on the evaluation results in Ameren territory suggesting an normals cooling degree day ratios (at 65F set point). PY2019 Evaluation Repo .2, Illinois 'TRM Version 12.0, https://www.ilsag.info/wp-content/uploads/IL- etering Study Memo FINAL 2_28_2018.docx'. Estimate efficiency as (Rated	Formatted: Font: (Default) Times New Roman, 9 pt Formatted: Footnote Reference: Footnote Reference.o.fr.TT - Footnote
p://www.energystar.gov. ropriate EFLH of 860.TI s://www.efis.psc.mo.gov art load EER2 is paired M Effective 010124 v1 bid., page 112. Justifica ciency * (1-0.01)^Equip Based on IL TRM V8.0,	ia/business/bulk_purchasing/bpsavings_cale/Cale_CAC:xls) and reduce a other climate region values are calculated using the relative climate r //Document/Display/15876, page 30, with SEER2exist, consistent with the approach presented in section 3.4 2.0. Vol. 3 Res. 09222023 FINAL_clean.pdf.ps.208. tion for degradation factors can be found on page 14 of 'AIC HVAC M ment Age), which bases justification for degradation factors on page 21 of 'AIC H'	ed by 28.5% based on the evaluation results in Ameren territory suggesting an normals cooling degree day ratios (at 65F set point). <u>PY2019 Evaluation Repo</u> .2, Illinois TRM Version 12.0, https://www.ilsag.info/wp-content/uploads/IL-	Formatted: Font: (Default) Times New Roman, 9 pt Formatted: Footnote Reference,Footnote Reference,o,fr,TT - Footnote Reference,FC,Style 9,Style 17,o + Times New Roman
p://www.energystar.gov. ropriate EFLH of 869.TI sv://www.eis.psc.mo.gov Part load EER2 is paired M Effective_010124_v1 Ibid, page 112. Justifica iciency * (1-0.01)*Equiji Based on IL_TRM V8.0, remaining measure life of SHP existing efficiency	ia/basiness/bulk_purchasing/bpsavings_cale/Cale_CAC.xls) and reduc the other climate region values are calculated using the relative climate r //bocument/biplay/15876, page 30. with SEER2exist, consistent with the approach presented in section 3.4 2.0 Vol 3 Res 09222023 FINAL_clean.pdf.p. 508. ion for degradation factors can be found on page 14 of 'AIC HVAC M ment Age), which bases justification for degradation factors on page 21 of 'AIC HV of the equipment.	ed by 28.5% based on the evaluation results in Ameren territory suggesting an normals cooling degree day ratios (at 65F set point). PY2019 Evaluation Repo .2, Illinois TRM Version 12.0, https://www.ilsag.info/wp-content/uploads/IL- etering Study Memo FINAL 2_28_2018.docx'. Estimate efficiency as (Rated VAC Metering Study Memo FINAL 2_28_2018'. Default of 12 years based of 12 and Cooling Program Impact and Process Evaluation: Program Year 2015.	Formatted: Font: (Default) Times New Roman, 9 pt Formatted: Footnote Reference,Footnote Reference,o,fr,TT - Footnote Reference,FC,Style 9,Style 17,o + Times New Romar Font: 9 pt
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p://www.energystar.gov. ropriate EFLH of 860.TI s://www.cfis.psc.mo.gov Part load EER2 is paired M Effective.010124_v1 lbid., page 112. Justifica- iciency * (1-0.01)*Equip Based on IL TRM V8.0, remaining measure life (ASHP existing efficiency C assumed to follow the 9% of 8.6 SEER CAC m aufacturers recommenda ASHP existing efficiency C assumed to follow the	industrieses/bulk_purchasing/bpsavings_cale/Cale_CAC:xls) and reduce the other climate region values are calculated using the relative climate r /Document/Display/15876, page 30, with SEER2exist, consistent with the approach presented in section 3.4 2.0 Vol. 3. Res 09222023 FINAL clean.pdf_p. 508. tion for degradation factors can be found on page 14 of 'AIC HVAC M ment Age), which bases justification for degradation factors on page 21 of 'AIC HV f the equipment. ransumes degradation and is sourced from the Ameren Missouri Heatin same trend in degradation as the ASHP 9.12 SEER nameplate to 7.2 (f meplate gives an operational SEER of 6.8 (6.53 SEER2)/meren Misso itons of 10 12 EER and 2.4 2.8 COP. Use of 12 EER and 2.8 COP. is c assumes degradation and is sourced from the Ameren Missouri Heatin same trend in degradation as the ASHP 9.12 SEER nameplate to 7.2 (f	ed by 28.5% based on the evaluation results in Ameren territory suggesting an normals cooling degree day ratios (at 65F set point). PY2019 Evaluation Report 2.1. Illinois TRM Version 12.0. https://www.ilsag.info/wp-content/uploads/IL- etering Study Memo FINAL 2_28_2018.docx'. Estimate efficiency as (Rated VAC Metering Study Memo FINAL 2_28_2018'. Default of 12 years based or or gand Cooling Program Impact and Process Evaluation: Program Year 2015, 5.91 SEER2) operations SEER represents degradation to 78.9% of nameplate. uri HVAC Program Evaluation PY2018. Operating would have the	Image: series of the series
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tp://www.energystar.gov. propriate EFLH of 860.TI ps://www.efis.psc.mo.gov Part load EER2 is paired M Effective 010124_v1 Ibid., page 112. Justifica Ticiency * (1-0.01)*Equip Based on IL.TRM V8.0, Cassumed to follow the 9% of 8.6 SEER CAC m nufacturers recommenda ASHP existing efficiency Cassumed to follow the 9% of 8.6 SEER CAC m Illinois TRM Version 12 If there is no central cool refit. Based on minimum fede	inDustness/bulk_purchasing/bpsavings_cale/Cale_CAC:xls) and redue are other climate region values are calculated using the relative climate r /Document/Display/15876, page 30, with SEER2exist, consistent with the approach presented in section 3.4 2.0. Vol 3. Res 09222023 FINAL clean.pdf ₄ p. 508. ion for degradation factors can be found on page 14 of 'AIC HVAC M ment Age). which bases justification for degradation factors on page 21 of 'AIC HV of the equipment. assume degradation and is sourced from the Ameren Missouri Heatin same trend in degradation as the ASHP-9.12 SEER nameplate to 7.2. (f meplate gives an operational SEER of 6.8 (6.53 SEER2)/Ameren Misso tions of 10 12 EER and 2.4.2.8 COP. Use of 12 EER and 2.8 COP, is et assumes degradation as is sourced from the Ameren Missouri Heatin same trend in degradation as the ASHP-9.12 SEER nameplate to 7.2. (f meplate gives an operational SEER of 6.8 (6.53 SEER2)/Ameren Misso tions of 10 12 EER and 2.4.2.8 COP. Use of 13 EER name 7.2 (f meplate gives an operational SEER of 6.8 (6.53 SEER2). Ameren Misso as the ASHP 9.12 SEER nameplate to 7.2. (f meplate gives an operational SEER of 6.8 (6.53 SEER2). O, https://www.ilsa.info/wp-content/upolas/IL_TRM_Effective_0101 ing in place but the incentive encourages installation of a new ASHP w ral-standard effective 1/1/2015;	ed by 28.5% based on the evaluation results in Ameren territory suggesting an normals cooling degree day ratios (at 65F set point). PY2019 Evaluation Report 2.1. Illinois TRM Version 12.0. https://www.ilsag.info/wp-content/uploads/IL- etering Study Memo FINAL 2_28_2018.docx'. Estimate efficiency as (Rated VAC Metering Study Memo FINAL 2_28_2018'. Default of 12 years based or ag and Cooling Program Impact and Process Evaluation: Program Year 2015. 501 SEER2) operations SEER represents degradation to 78.9% of nameplate. wri HVAC Program Impact and Process Evaluation: Program Year 2015. 5.91 SEER2) operations SEER represents degradation to 78.9% of nameplate. 5.91 SEER2) operations SEER represents degradation to 78.9% of nameplate. 124 v12.0 Vol 3 Res 09222023 FINAL clean.pdf, page 169.	Image: series of the series
p://www.energystar.gov. propriate EFLH of 860.TI so://www.efis.psc.mo.gov Part load EER2 is paired M Effective 010124_v1 Ibid., page 112. Justifica- liciency * (1-0.01)*Equip Based on IL TRM V8.0, remaining measure life (ASHP existing efficiency: C. assumed to follow the 9% of 8.6 SEER CAC m nufacturers recommenda ASHP existing efficiency: C. assumed to follow the 9% of 8.6 SEER CAC m Illinois TRM Version 12 If there is no central cool uefit. Based on minimum fede	industiness/hulk_purchasing/bpsavings_cale/Cale_CAC:xls) and redue are other climate region values are calculated using the relative climate r /Document/Display/15876, page 30, with SEER2exist, consistent with the approach presented in section 3.4 2.0. Vol. 3. Res. 09222023 FINAL_clean.pdf.p. 508, tion for degradation factors can be found on page 14 of 'AIC HVAC M ment Age), which bases justification for degradation factors on page 21 of 'AIC HV of the equipment- assume degradation and is sourced from the Ameren Missouri Heatin same trend in degradation as the ASHP: 9.12 SEER nameplate to 7.2 (f meplate gives an operational SEER of 6.8 (6.53 SEER2)Ameren Missouri assumes a degradation as the ASHP: 9.12 SEER nameplate to 7.2 (f meplate gives an operational SEER of 6.8 (6.53 SEER2). assumes a degradation as the ASHP: 9.12 SEER nameplate to 7.2 (f meplate to sa no perational SEER of 6.8 (6.53 SEER2). (a). https://www.ilsag.info/wp-content/uploads/IL-TRM_Effective_0101 ing in place but the incentive encourages installation of a new ASHP w	ed by 28.5% based on the evaluation results in Ameren territory suggesting an normals cooling degree day ratios (at 65F set point). PY2019 Evaluation Report 2.1. Illinois TRM Version 12.0. https://www.ilsag.info/wp-content/uploads/IL- etering Study Memo FINAL 2_28_2018.docx'. Estimate efficiency as (Rated VAC Metering Study Memo FINAL 2_28_2018'. Default of 12 years based or ag and Cooling Program Impact and Process Evaluation: Program Year 2015. 501 SEER2) operations SEER represents degradation to 78.9% of nameplate. wri HVAC Program Impact and Process Evaluation: Program Year 2015. 5.91 SEER2) operations SEER represents degradation to 78.9% of nameplate. 5.91 SEER2) operations SEER represents degradation to 78.9% of nameplate. 124 v12.0 Vol 3 Res 09222023 FINAL clean.pdf, page 169.	Image: series of the series

	Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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	= Dependent on location: ⁵⁸⁶	Formatted: Space After: 6 pt
	Weather Basis (City based EFLH _{heat}	
	upon) (Hours) St Louis, MO 1496	
Capacity _{heat}	= Heating Capacity of Air Source Heat Pump (Btu/hr)	
HSPF2 _{exist}	= Actual (1 ton = 12,000Btu/hr) = Heating System Performance Factor of existing heating system (kBtu/kWh)	
1151 I ⁻² exist	= Induing System renormance ratio of existing induing system (KDurkwin)	Formatted: Indent: Left: 0", First line: 0.5"
	 Use actual HSPF2 rating where it is possible to measure or reasonably estimate. If using rated efficiencies, derate the efficiency value based on the age of the existing equipment (up to a maximum of 30 years) to account for degradation over time.⁸⁸⁷ If age is unknown, use 12 years. HSPF2 * (1-0.01)^{Age} 	
	= Heating System Performance Factor of existing heating system (kBtu/kWh) = If rated efficiency is unknown, use defaults provided below, which should not be further adjusted to account for age-	Formatted: Indent: First line: 0"
	related degradation use actual HSPF rating where it is possible to measure or reasonably estimate. If not available use: 588	Formatted: Space After: 6 pt
	Existing Heating System HSPP2_exist	Formatted Table
	Air Source Heat Pump 5.44 ⁵⁸⁹ 4.91 Ground Source Heat Pump 7.5	
	Electric Resistance 3.41 ⁵⁹⁰	Formatted: Font: (Default) Times New Roman, Eng (United States), Check spelling and grammar
HSPF2 _{base}	= Heating System Performance Factor of baseline Air Source Heat Pump (kBtu/kWh)	Formatted: Font: (Default) Times New Roman
	= 7.58.2 if replacing air source heat pump or ground source heat pump; 3.41 if replacing electric resistance heating ⁵⁹⁴	
HSFP _{2ee}	= Heating System Performance Factor of efficient Air Source Heat Pump (kBtu/kWh)	
ISR	= <u>In-service rate. Actual, or if unknown, assume In Service Rate = 100%</u> ⁵⁹²	
DS:	NT PEAK DEMAND SAVINGS	
UMMER COINCIDEN DS: $\Delta kW = \Delta kW$ There:		
$\Delta kW = \Delta kW$		
$\Delta kW = \Delta kW$	<u>+ CF</u> = Electric energy savings, as calculated above = Summer peak coincidence demand (kW) to annual energy (kWh) factor	
$\Delta kW = \Delta kW$ $\Delta kW = \Delta kW$ ΔkWh	h * CF = Electric energy savings, as calculated above	Formatted: Indent: Left: 1", First line: 0.5"
DS: $\Delta kW = \Delta kWl$ here: ΔkWh CF		Formatted: Indent: Left: 1", First line: 0,5"
DS: $\frac{\Delta kW = \Delta kW}{\Delta kWh}$ $\frac{\Delta kWh}{CF}$ $\frac{\Delta kWh}{CF}$ ATURAL GAS SAVE	 <u>+ * CF</u> <u>= Electric energy savings, as calculated above</u> <u>= Summer peak coincidence demand (kW) to annual energy (kWh) factor</u> <u>= 0.0009474181</u> <u>= Energy Savings as calculated above</u> <u>= 0.0009474181</u> 	Formatted: Indent: Left: 1", First line: 0.5"
OS: $\Delta kW = \Delta kWl$ CF ΔkWh CF ΔkWh CF $Atural Gas Savi /A$ $Based on Full Load Ho$	h * CF = Electric energy savings, as calculated above = Summer peak coincidence demand (kW) to annual energy (kWh) factor = 0.0009474181 = Energy Savings as calculated above = 0.0009474181 WGS ur assumptions (for St Louis and Kansas City) taken from the ENERGY STAR®-calculator	Formatted: Indent: Left: 1", First line: 0.5"
OS: <u>AkW = AkWi</u> <u>CF</u> <u>AkWh</u> <u>CF</u> AtURAL GAS SAVII /A Based on Full Load Ho tp://www.energystar.go ta with a base temp ratic	h * CF = Electric energy savings, as calculated above = Summer peak coincidence demand (kW) to annual energy (kWh) factor = 0.0009474181 = Energy Savings as calculated above = 0.0009474181 WGS 	Formatted: Indent: Left: 1", First line: 0.5"
OS: $\Delta kW = \Delta kWl$ $here:$ ΔkWh CF CF Atural Gas Savir /A Based on Full Load Ho tp://www.energystar.go ta with a base temp rational to the second secon	h * CF = Electric energy savings, as calculated above = Summer peak coincidence demand (kW) to annual energy (kWh) factor = 0.0009474181 - Energy Savings as calculated above = 0.0009474181 NGS ur assumptions (for St Louis and Kansas City) taken from the ENERGY STAR® calculator via/business/bulk, purchasing/bpsavings_calc/Calc_CAC.xb). The other weather basis values are calculated using the relative climate normals HDD	Formatted: Indent: Left: 1", First line: 0.5"
OS: <u>ΔkW = ΔkW</u> <u>ΔkWh</u> <u>CF</u> <u>AkWh</u> CF ATURAL GAS SAVIE /A Based on Full Load Ho tp://www.energystar.go ta with a base temp ratie Illinois TRM Version 1 gradation factors can be <u>ip</u>).	h * CF = Electric energy savings, as calculated above = Summer peak coincidence demand (kW) to annual energy (kWh) factor = 0.0009474181 = Energy Savings as calculated above = -0.0009474181 NGS 	Formatted: Indent: Left: 1", First line: 0.5"
OS: <u>AkW = AkW</u> <u>CF</u> <u>AkWh</u> <u>CF</u> <u>AkWh</u> CF Atural Gas Savt <u>AkWh</u> CF Atural Gas Savt <u>AkWh</u> <u>CF</u> <u>Atural Gas Savt</u> <u>Atural G</u>	h * CF = Electric energy savings, as calculated above = Summer peak coincidence demand (kW) to annual energy (kWh) factor = 0.0009474181 = Energy Savings as calculated above = 0.0009474181 WGS 	Formatted: Indent: Left: 1", First line: 0.5"
OS: <u>AkW = AkW</u> <u>/here:</u> <u>AkWh</u> <u>CF</u> <u>AkWh</u> CF AtURAL GAS SAVI /A Based on Full Load Ho tp://www.energystar.go ta with a base temp ratic Illinois TRM Version 1 gradation factors can be re). Illinois TRM Version 1 'This is estimated based the average nameplate 5 % of actual HSPF.	h * CF = Electric energy savings, as calculated above = Summer peak coincidence demand (kW) to annual energy (kWh) factor = 0.0009474181 - Energy Savings as calculated above = 0.0009474181 NCS 	Formatted: Indent: Left: 1", First line: 0.5"
OS: $\Delta k W = \Delta k W$ $\Delta k W h = \Delta k W h$ <u>CF</u> $\Delta k W h$ <u>CF</u> $\Delta k W h$ <u>CF</u> ATURAL GAS SAVI (A) Based on Full Load Ho tp://www.energystar.go ta with a base temp ratio Illinois TRM Version 1 gradation factors can be go. Illinois TRM Version 1 This is estimated based the average nameplate 5 % of actual HSPF. Electric resistance has e- Based on minimum fed	h * CF = Electric energy savings, as calculated above = Summer peak coincidence demand (kW) to annual energy (kWh) factor = 0.0009474181 = Energy Savings as calculated above = 0.0009474181 WCS we assumptions (for St Louis and Kansas City) taken from the ENERGY STAR® calculator windusiness/bulk purchasing/bpavings-cale/Cale_CAC:xkb). The other weather basis values are calculated using the relative elimate normals HDD workfore; PY2019 Residential Evaluation Report, https://www.efis.psc.mo.gov/Document/Display/15876, page 30, 20, https://www.ilsag.info/wp-content/uploads/IL-TRM_Effective_010124_v12.0_Vol_3_Res_09222023_FINAL_clean.pdf, page 112, Justification for found on page 14 of 'AIC HVAC Metering Study Memo FINAL_2_28_2018.docx'. Estimate efficienty as (Rated Efficiency * (1-0.01)/Equipment 20, https://www.ilsag.info/wp-content/uploads/IL-TRM_Effective_010124_v12.0_Vol_3_Res_09222023_FINAL_clean.pdf, page 171. on finding the average HSBF/SEER ratio from the AHRI directory data (using the least efficient models _ SEER 12 and SEER 13) _ 0.596, and applying HER rating of all early-replacement qualifying equipment in Ameren PY2003-PY2004. This estimation methodology appears to provide a result within +COP of 1.0 which equals 10.293 = .3.41 HSPF. end standard effective 1.4/2015;	Formatted: Indent: Left: 1", First line: 0.5"
OS: <u>ΔkW = ΔkW</u> <u>ΔkWh</u> <u>CF</u> <u>ΔkWh</u> CF ΔkWh CF ΔkWh CF Atural Gas Save (A Based on Full Load Ho tp://www.energystar.go ta with a base temp ratic Illinois TRM Version 1 <u>This is estimated based</u> the average nameplate 5 %-of actual HSPF. 'Electric resistance has - Based on minimum fee p://www.energystarce.go	h * CF = Electric energy savings, as calculated above = Summer peak coincidence demand (kW) to annual energy (kWh) factor = 0.0009474181 = Energy Savings as calculated above = 0.0009474181 WGS 	Formatted: Indent: Left: 1", First line: 0.5"
OS: <u>ΔkW = ΔkW</u> <u>ΔkWh</u> <u>CF</u> <u>ΔkWh</u> CF ΔkWh CF ΔkWh CF Atural Gas Save (A Based on Full Load Ho tp://www.energystar.go ta with a base temp ratic Illinois TRM Version 1 <u>This is estimated based</u> the average nameplate 5 %-of actual HSPF. 'Electric resistance has - Based on minimum fee p://www.energystarce.go	h * CE = Electric energy savings, as calculated above = Summer peak coincidence demand (kW) to annual energy (kWh) factor = 0.0009474181 = Energy Savings as calculated above = 0.0009474181 WGS 	Formatted: Indent: Left: 1", First line: 0.5"

Appendix I - TRM – Vol. 3: Residential Measures

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WATER IMPACT DESCRIPTIONS AND CALCULATION N/A

DEEMED O&M COST ADJUSTMENT CALCULATION N/A

MEASURE CODE:

Ameren Missouri

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<u>2025 MEEIA <u>4 2019-21</u> Plan</u>

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Revision <u>8</u>7.0

Ameren Missouri	Appendix I - TRM – Vol. 3: Residential M	Casures Formatted: Font: (Default) Arial, 12 pt
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3.5 Lighting		
3.5.1 LED Screw Based O	mnidirectional Bulb	
and in-unit interior or exterior) program or efficiency kit), an u	ssumptions for LED screw-based omnidirectional (e.g., A-Type) lamps installed in a known location (i.e., n or, if the implementation strategy does not allow for the installation location to be known (e.g., an upstre nknown residential location. For upstream programs, utilities should develop an assumption of the Res relevant assumptions to each portion.	am retail
and 100W to be approximately lamps ended in 2012, followed b	m the Energy Independence and Security Act of 2007 (EISA) requires all general-purpose light bulbs betw 30% more energy efficient than standard incandescent bulbs. Production of 100W, standard efficacy incr by restrictions on 75W lamps in 2013 and 60W and 40W lamps in 2014. The baseline for this measure has escent or halogen) that meet the new standard.	indescent
making the baseline equivalent backstop provision had not bee decision by issuing a final rule	tions required that by January 1, 2020, all lamps meet efficiency criteria of at least 45 lumens per watt, o a current day CFL. In 2019, the Department of Energy issued a final determination and clarified that a) a triggered and therefore b) the efficiency standard would not change in 2020. In May 2022, DOE reve that expanded the General Service Lamp (GSL) and General Service Incandescent Lamp (GSIL) defini backstop provision with phased enforcement between January 2023 and July 2023, ⁵⁹³	the EISA ersed this
This measure was developed to	be applicable to the following program types: TOS, NC, and RF.	
If applied to other program type	s, the measure savings should be verified.	
	UIPMENT y, new lamps must be ENERGY STAR [®] labeled based upon the ENERGY STAR [®] specification v2.0 whic vw.energystar.gov/sites/default/files/Luminaires%20V2%200%20Final.pdf).⁵⁹⁴	h became
Qualification could also be base	d on the Design Light Consortium's qualified product list.595	
DEFINITION OF BASELINE EQU		
between 40 watts and 100 watts lamp standards apply; in 2013 t	ming from the Energy Independence and Security Act of 2007 (EISA) will require all general-purpose li to have ~30% increased efficiency, essentially phasing out standard incandescent technology. In 2012, the r5 w lamp standards will apply, followed by restrictions on the 60 w and 40 w lamps in 2014. Since ur after 2014, baseline equipment are the values after EISA. These are shown in the baseline table below.	he 100 w
lumens/watt or higher beginnir (GSILs), finding that this more Final rule for both the broadened it will use its enforcement discr	2) provision was included that would require replacement baseline lamps to meet an efficacy requirem g on 1/1/2020. In December 2019, DOE issued a final determination for General Service Incandescer stringent standard was not economically justified. However, in May 2022 DOE reversed this decision by I General Service Lamp definition as well as the implementation of the 45 lumen per watt backstop. DOE s etion to minimize impacts on the supply chain and effectively allow companies to continue the manufa rough the remainder of 2022, and allow retailers to continue selling them with limited enforcement until J	nt Lamps issuing a tated that cture and
No savings are claimed for non-	income qualified programs unless via direct install programs,	Formatted: Not Highlight
lighting as baseline and also as sale, manufacture, and import o reinstating the 45 lumen per wa lumens and above 3,300 lumens	can be shown that the LED is replacing working inefficient lighting should continue to use the existing i ume a measure life of 2 yearsStarting August 1, 2023, the EISA backstop provision became effective, lir f non-compliant lamps. Therefore, the baseline condition for this measure is a reflection of the 2022 DOE t backstop provisions for all GSL and GSILs between 310 and 3,300 lumens. All other lamps, i.e., those b , the baseline condition is a reflection of products available in the market and standards agreed upon in pro- cline condition for this measure is assumed to be an EISA-qualified halogen or CFL lamp.	siting the final rule elow 310
593 DOE 87 FR 27439 594 https://www.energystar.gov/sites/de 2016.pdf.	- fault/files/ENERGY%20STAR%20Lamps%20V2_0%20Revised%20AUG-2016.pdf <u>;</u> *ENERGY STAR Lamps_V2_0 Revised A	UG- Formatted: Font: 9 pt
⁵⁹⁵ <u>https://www.designlights.org/QPL.</u>		Formatted: Font: 9 pt
<u>2025 MEEIA 4 2019-21 Plan</u>	Revision <u>8</u> 7.0 Pa	age 146

					endix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt Formatted: Normal
virect Install programs where it can	he shown that	the LED is re-	nlacing worki	ng inefficient l	ighting should continue to use the existing inefficient	Formatted: Font: (Default) Times New Roman
ghting as baseline and also assume			practing works			Formatted: Body Text
DEEMED LIFETIME OF EFFICIENT I The measure life is assumed to be to The measure life is 19 years for reside	wo years for D				tions and eight years for income eligible populations attors, 596	
DEEMED MEASURE COST The deemed measures cost for a LEI) screw based (omnidirection	al bulb is \$1.4	15 per bulb ⁵⁹⁷		
OADSHAPE	s sere il susse i	, and the second second	ar o uro 15 φ 11	io per outor		Formatted: Indent: First line: 0"
ighting RES						Formatted: Normal
ighting BUS						Formatted: Font: Times New Roman
			Algorithm	1		Formatted: Font: Times New Roman
						Formatted: Font: Times New Roman
CALCULATION OF SAVINGS					/	Formatted: Font: Times New Roman
ELECTRIC ENERGY SAVINGS						Formatted: Font: Times New Roman
kWh = (Watt _{Base}	- Wattee) * IS	$\mathbf{D} * (1 + \mathbf{V} \mathbf{C})$	* Hours * V	VHE / 1 000	_//	Formatted: Font: Times New Roman
\mathbf{K} YV II = (VV allBase	- watt <u>ee</u>) ** 18	$\mathbf{x} + (1 - \mathbf{L}\mathbf{X}\mathbf{U})$	FIGUIS * V	<u>viii: / 1,000</u>	J.	Formatted: Font: Times New Roman
						Formatted: Font: Times New Roman
$kWh = \Delta kWh_{RES} + \Delta kWh_{RRES}$						Formatted: Font: Times New Roman
$kWh_{RES} = (Watt_{Base} - Watt_{EE})$	* %RES * IS	R * (1 - Lk)	(G) * Hour:	S _{RES} * WHF _{RES}	/1,000	Formatted: Font: Times New Roman
						Formatted: Font: Times New Roman
$kWh_{WRES} = (Watt_{Base} - Watt_{EE})$	+ (1 - % R I)	55) * ISR *	(1 - LKG)	* Hours _{wees} .*	- WHF _{NRES} /1,000	Formatted: Font: Times New Roman
Vhere:						Formatted: Font: Times New Roman
Watts _{Base} = Based on	lumens of LED	bulb installed	l. If lumens o	f LED bulb are	unknown, refer to table below.	Formatted: Font: Times New Roman
Watts _{EE} = Actual wa	ttage of LED p	ourchased / ins	talled - If unk	nown, use defa	ult provided below: ⁵⁹⁸	Formatted: Font: Times New Roman
						Formatted: Font: Times New Roman
	Minimum	Maximum		Baseline	<u>Delta</u>	Formatted: Font: Times New Roman
	Lumens	Lumens		(WattsBase)	Watts (WattsEE)	Formatted: Font: Times New Roman
					(WallSEE)	Formatted: Font: Times New Roman
	<u>310</u>	<u>399</u>	4.0	25	21.0	Formatted: Font: Times New Roman
	<u>400</u> 750.	749 <u>899</u>	<u>6.6</u> 9.6	<u>29</u> <u>43</u>	22.4	Formatted: Font: Times New Roman
	<u>900</u>	<u>1,399</u>	<u> </u>	53	39.9	Formatted: Font: Times New Roman
	1,400	1,999	16.0	72	56.0	Formatted: Font: Times New Roman
	<u>2,000</u>	<u>2,999</u>	21.8	<u>150</u>	128.2	Formatted: Font: Times New Roman
						Formatted: Font: Times New Roman
					<u>3 Res 09222023 FINAL clean.pdf, page 327Measure life is</u> ag hours. EULs of 19 years for residential and 6 years for non-	Formatted: Font: Times New Roman
esidential are based on average rated lifetim					s for residential settings and by 3,351 for non-residential	Formatted: Font: Times New Roman
ettings. 7 Illinois TRM Version 12.0, https://www.i	ilsag.info/wp-cont	ent/uploads/IL-Tl	RM Effective 0	10124 v12.0 Vol	_3_Res_09222023_FINAL_clean.pdf, page 329Based on IL	Formatted: Font: Times New Roman
RM V11.0, Section 5.5.8.					8/2015. For any lumen range where there is no ENERGY	Formatted: Font: Times New Roman
	is based upon the	ENERGY STAR	[©] minimum lum	inous efficacy (55	Lm/W for lamps with rated wattages less than 15W and 65	Formatted: Font: Times New Roman
	atts) for the mid-po		range. See calcu	lation at "cerified	light bulbs 2015 06 18.xlsx." These assumptions should be	
m/W for lamps with rated wattages ≥ 15 wa	he available produ	ct .				Formatted: Font: Limes New Roman
	he available produ	et .				Formatted: Font: Times New Roman

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	Minimum	Marian LED	Deseline	<u>Delta</u>			
	<u>Minimum</u> <u>Lumens</u>	Maximum Lumens (Wattaget)		Watts WattsEE)			Formatted: Font: Times New Roman
			<u></u>	<u>watisee</u>			
	<u>3,000</u>	<u>3,299</u> <u>28.9</u>	200	<u>171.1</u>			Formatted: Font: Times New Roman
%RES =	percentage of bulbs sold t	o residential customers	<u>.</u>			\square	Formatted: Font: Times New Roman
	100% for Online Store an			enown ⁵⁹⁹			Formatted: Font: Times New Roman
LKG =	laalsoon note (nuo enome hul	he installed outside Am					Formatted: Font: Times New Roman
	leakage rate (program bul Actual, or if unknown, ass		hereit witssourt's servi	ce alea)		•	Formatted: Font: Times New Roman
	Progra	m	Leakage	(1-Leakage)			Formatted: Indent: First line: 0", Space After: 6
	Efficiency Kit (Schoo		28%	72%		•	Formatted Table
	Efficiency Kit (MF) ⁶⁰ Appliance Recycling ⁶		0%	100%-			Formatted: Left
	Low Income ⁶⁰⁴	0.70	0%	100%		•	Formatted: Left
	MFMR ⁶⁰⁵		0%	100%		•//	Formatted: Left
ISR =	In <u>S</u> -Service Rate, the per	centage of units rebate	d that are actually in s	ervice. Actual, or if un	known, assume:		Formatted: Left
		D	Discounted In Serv	ice		Ì	Formatted: Left
	D	Program	Rate (ISR)				Formatted Table
	606	ct Install (MFLI) <u>MFIE</u>	98.2%				Formatted: Left
		ciency Kit (School) ⁶⁰⁷	92%			•	Formatted: Left
		and PAYSEfficiency MF) ⁶⁰⁸	100%				Formatted: Left
		liance Recycling ⁶⁰⁹	88%			•	Formatted: Left
		Income Kits As You Save ⁶¹⁰	90% 87%				Formatted: Left
							Formatted: Left
Hours =	Average hours of use per $= \Delta verage hours of$			com value or table belo ldings. Use custom val			Formatted: Indent: Left: 0.5"
10010-000		use per year for sures					Pormatted. Indent. Left. 0.5
		Program Residential	HOU Res 995.18611			•	Formatted Table
		Afficient Kits	995.18				
	Incor	ne Eligible RES	674.18 ⁶¹² 693.50 ⁶¹³				
		MFMR	095.50				

Ameren Missouri	Appendix I - TRM – Vol. 3: Residential Measures	 Formatted: Font: (Default) Arial, 12 pt
		Formatted: Normal
WHFe _{RES}	 Waste Heat Factor for energy to account for the impact from reducing waste heat from efficient lighting on electric cooling and heating loads in residential homes. 0.99 if unknown⁶¹⁴ 	
WHFe _{NRES}	——Wasse Heat Factor for energy to account for the impact from reducing waste heat from efficient lighting on electric cooling and heating loads in non-residential spaces.	
If unknown assume	1.1 or 0.97 for Income Eligible. ⁶⁵ ←	 Formatted: Indent: Left: 0", First line: 0"
WHFe _{Heat}	 = Waste Heat Factor for energy to account for electric heating increase from reducing waste heat from efficient lighting (if fossil fuel heating, see calculation of heating penalty in that section). = 1 - ((HF / ηHeat) * %ElecHeat). = If unknown assume 0.88⁶¹⁶ 	

⁶¹⁴ Ameren Missouri PY2014 Evaluation, <u>https://www.efis.psc.mo.gov/Document/Display/14194, page 45</u>, ⁶¹⁴ Ameren Missouri Community Savers Evaluation PY2018 workpapers. Weighted Avg. calculated from ADM workpapers. ⁶¹⁶ Calculated using defaults: 1-((0.53/1.57) * 0.35) = 0.88.

<u>2025</u>MEEIA <u>4 2019-21</u> Plan

Revision <u>8</u>7.0

				Appendix I -	<u> 1 RM – Vol. 3: R</u>	esidential Measures	\sim	Formatted: Font: (Default) Arial, 12 pt
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here:						•	(Formatted: Indent: Left: 0", First line: 0"
HF	= Heating F	actor or percentage of l				•	•(Formatted: Indent: Left: 0", First line: 0.5"
		= 53% ⁶¹⁷ f	or interior or unknown or unknown or unknown or unheated					
ηHea	at _{Electric} = Efficiency	in COP of Heating eq				•	·	Formatted: Indent: Left: 0"
	= Actual - In	f not available, use:618				•		Formatted: Indent: Left: 1"
				ηHeat				
	System Type	Age of Equipment	HSPF2 Estimate	(COP Estimate) (USDE2/2 412)80 85		•	(Formatted Table
	Heat Pump	Before 2006	5.8	1.44				
	(if age unknown	After 2006 - 2014	6.5	1.62				
	assume 2006-2014)	<u>2015 on</u>	7.0	1.74				
	Resistance Unknown ⁶¹⁹	N/A N/A	<u>N/A</u> N/A	<u>1.00</u> 1.28				
	Unkilowii	<u>11/A</u>			HODE E-thurst	ηHeat		
			System Type	Age of Equipment	HSPF Estimate	(COP Estimate)		
			Heat Pump	Before 2006 2006-2014	6.8 7 .7	2.00 2.26		
			from Fump	2015 and after	8.2	2.40		
			Resistance	N/A	N/A	1.00		
			Unknown	N/A	N/A	1.57⁶²⁰		
%Ele	ecHeat ————————————————————————————————————	ercentage of heating sa	vings assumed to b	e electric			·	Formatted: Indent: Left: 0"
							C	
			eating fuel	%ElectricHeat			-	
		Electric Natural		100% 0%		•		Formatted: Space After: 0 pt
							~ ~	
						•		Formatted: Space After: 0 pt
		Unknow		35% ⁶²¹				· · · · · · · · · · · · · · · · · · ·
WHE	Fe _{Cool} = Waste He	Unknow	n		waste heat from effic	eient lighting		Formatted: Space After: 0 pt
WHF	Fe _{Cool} = Waste He	Unknow	n account for cooling	35% ⁶²¹ g savings from reducing		ient lighting		Formatted: Space After: 0 pt Formatted: Space After: 0 pt
WHF	Fe _{Cool} = Waste He	Unknow at Factor for energy to	n	35% ⁶²¹ g savings from reducing		ient lighting		Formatted: Space After: 0 pt Formatted: Space After: 0 pt Formatted: Keep with next
WHF	Fe _{Cool} = Waste He	at Factor for energy to Building Building	n account for cooling Bulb Location with cooling without cooling or e:	35% ⁶²¹ g savings from reducing WHFecorr 1.12 ⁶²² xterior 1.0		ient lighting		Formatted: Space After: 0 pt Formatted: Space After: 0 pt Formatted: Keep with next Formatted: Keep with next
WHF	Fe _{Cool} = Waste He	Unknow at Factor for energy to Building	n account for cooling Bulb Location with cooling without cooling or e:	35% ⁶²¹ g savings from reducing WHFecor 1.12 ⁶²²		ient lighting		Formatted: Space After: 0 pt Formatted: Space After: 0 pt Formatted: Keep with next Formatted: Keep with next Formatted: Keep with next
WHF	Fe _{Cool} = Waste He	at Factor for energy to Building Building	n account for cooling Bulb Location with cooling without cooling or e:	35% ⁶²¹ g savings from reducing WHFecorr 1.12 ⁶²² xterior 1.0		ient lighting		Formatted: Space After: 0 pt Formatted: Space After: 0 pt Formatted: Keep with next Formatted: Keep with next
This means ti owa (Des Me These defaul	that heating loads increase by joines, Mason City, and Burli It system efficiencies are base	Unknow at Factor for energy to Building Building Unknown • 53% of the lighting savings angton). These results were ju ed on the applicable minimu	n account for cooling Bulb Location with cooling without cooling or e: 1 . This is based on the a un federal standards. In	35% ⁶²¹ g savings from reducing werage result from REMRate plicable to Missouri. 2006 and 2015, the federal st	modeling of several diffe	rent building configurations as adjusted. While one would		Formatted: Space After: 0 pt Formatted: Space After: 0 pt Formatted: Keep with next Formatted: Keep with next Formatted: Keep with next
This means the transformation of the avera a calculation a	that heating loads increase by loines, Mason City, and Burli It system efficiencies are bass age system efficiency to be hi assumes 35% Heat Pump and	4 Factor for energy to Building Building Unknown 53% of the lighting savings ington). These results were juicable minimu giber than this minimum, the 65% Resistance, which is b	n account for cooling Bulb Location with cooling or e: 1 . This is based on the a udged to be equally ap m federal standards. In likely degradation of heat from E	35% ⁶²¹ g savings from reducing WHPecor 1.12 ⁶²² xterior 1.0 1.11 ⁶²³ verage result from REMRate plicable to Missouri. 2006 and 2015, the federal sta efficiencies over time mean th energy Information Administra	modeling of several diffe undard for heat pumps wa at using the minimum sta	rent building configurations is adjusted. While one would ndard is appropriate. ergy Consumption Survey, +		Formatted: Space After: 0 pt Formatted: Space After: 0 pt Formatted: Keep with next Formatted: Keep with next Formatted: Keep with next Formatted: Keep with next
This means ti owa (Des Mo These defaul ect the avera calculation a calculation a	that heating loads increase by joines, Mason City, and Burli It system efficiencies are base age system efficiency to be hi assumes 35% Hear Pump and gov/consumption/residential	253% of the lighting savings ngton). These results were ji do n the applicable minimum igher than this minimum, the 65% Resistance, which is b 164% Resistance, which is b	n account for cooling Bulb Location with cooling without cooling or e: 1 . This is based on the a adaged to be equally api likely degradation of t ased upon data from E likely degradation of t ased upon data from E	35% ⁶²¹ g savings from reducing wHFecor 1.12 ⁶²² xterior 1.0 1.11 ⁶²³ verage result from REMRate bicable to Missouri. 2006 and 2015, the federal st efficiencies over time mean th nergy Information Administra ency of heat pump is based or	modeling of several diffe undard for heat pumps wa at using the minimum sta	rent building configurations is adjusted. While one would ndard is appropriate. ergy Consumption Survey, +		Formatted: Space After: 0 pt Formatted: Space After: 0 pt Formatted: Keep with next Formatted: Keep with next Formatted: Keep with next Formatted: Keep with next Formatted: Formatted: For
This means ti owa (Des Mo These defaul ect the avera alculation a s://www.eia o from 2006- alculation a dalculation a	that heating loads increase by loines, Mason City, and Burli It system efficiencies are bass age system efficiency to be hi assumes 35% Heat Pump and Lgov/consumption/residential -2014. Program or evaluation assumes 50% heat pump and	Unknow at Factor for energy to Building Building Building Unknown 53% of the lighting savings ngton). These results were j ed on the applicable minimu igher than this minimum, the fof5% Resistance, which is b /data/2009/hc/hc.69.28.is; 'the /data/2009/hc/hc.69.28.is; 'the /data/2009/hc/hc.69.28.is; 'the /data/2009/hc/hc.69.28.is; 'the /data/2009/hc/hc.69.28.is; 'the	n account for cooling Bulb Location with cooling or e: ' ' . This is based on the a udged to be equally ap m federal standards. In likely degradation of 6.9 xls', Average effici rove this assumption if was dupon data from Ear	35% ⁶²¹ g savings from reducing wHPecor 1.12 ⁶²² xterior 1.0 1.11 ⁶²³ verage result from REMRate blicable to Missouri. 2006 and 2015, the federal sta efficiencies over time mean th energy Information Administrati energy of heat pump is based or available, argy Information Administrati	modeling of several diffe andard for heat pumps wa at using the minimum sta tion, 2009 Residential Ene on, 2009 Residential Ene	rent building configurations is adjusted. While one would ndard is appropriate. ergy Consumption Survey, _x e units from before 2006 and rgy Consumption Survey,		Formatted: Space After: 0 pt Formatted: Space After: 0 pt Formatted: Keep with next Formatted: Keep with next Formatted: Keep with next Formatted: Keep with next Formatted: Forn: (Default) Times New Roma Formatted: Font: (Default) Times New Roma
This means ti owa (Des Mo These defaul calculation a s://www.eia 6 from 2006- Calculation a "HC6.9 Spa Vverage (def	that heating loads increase by loines, Mason City, and Burli It system efficiencies are bass age system efficiency to be hi assumes 35% Heat Pump and .gov/consumption/residentia .gov/consumption/res	Unknow at Factor for energy to Building Building Unknown 53% of the lighting savings ngton). These results were ji do nt he applicable minimu jigher than this minimum, the 165% Resistance, which is b Udata/2009/hchc6.9.4k; 'the 164m Subscriptione' (a pack and the subscriptione)	n account for cooling Bulb Location with cooling or e: 1 . This is based on the a udged to be equally ap m federal standards. In ikely degradation of ased upon data from E 60.9.18; Average effici ver this assumption if sed upon data from Em of heat pump is based o	35% ⁶²¹ g savings from reducing WHFecor 1.12 ⁶²² xterior 1.0 1.11 ⁶²³ verage result from REMRate plicable to Missouri. 2006 and 2015, the federal sta efficiencies over time mean th nergy Information Administrati available_ rgy Information 50% are units for available_ rgy Information 50% are units for piton Survey for Missouri. If	modeling of several diffe andard for heat pumps we at using the minimum sta tion, 2009 Residential Err on, 2009 Residential Ene on, 2009 Residential Ene	rent building configurations as adjusted. While one would ndard is appropriate. ergy Consumption Survey, - rgy Consumption Survey, -2006-2014.		Formatted: Space After: 0 pt Formatted: Space After: 0 pt Formatted: Keep with next Formatted: Font: (Default) Times New Roma Formatted: Font: (Default) Times New Roma Formatted: Font: (Default) Times New Roma
This means the towa (Des M These defaul eet the avera Calculation a <u>ss://www.cia</u> <u>calculation a</u> <u>calculation a</u> <u>calculatio</u>	that heating loads increase by loines, Mason City, and Burli It system efficiencies are base age system efficiency to be hi assumes 35% Heat Pump and sources 35% Heat Pump and sources 50% heat pump and en Heating in Midwest Regie fault) value of 35% electric sy a estimated at 1.12 (calculated veral different building config from standard assumption sed Model for Residential Ai 8COP), Results of the Iowa s estimated at 1.11 (calculated	Unknow at Factor for energy to Building Building Unknown 55% of the lighting savings ngton). These results were ji do nthe applicable minimu joer than this minimum, the 165% Resistance, which is b Jata should be used to imp 50% resistance, which is b anxls." Avenge efficiency of pack heating from 2009 Res particular market or geogra as 1 + (0.34 / 2.8), and it is gurations in Iowa (Des Moin of SEER 10.5 central AC ur r Conditioner and Heat Pum tudy are assumed to be appl as 1 + (0.34 / 0.34 / 2.8), at	n account for cooling Bulb Location with cooling without cooling or e: 1 . This is based on the a udged to be equally ap m federal standards. In ikely degradation of assed upon data from E ikely degradation of heat pump is based o fheat pump is based of dential Energy Consur bical area, then they si of dential standards. In of the based on coling load es, Mason City, and Bu it, converted to 9.5 EE De Energy Calculations, icable to Missouri. Thich is based on assum	35% 621 g savings from reducing y savings from reducing 1.12622 xterior 1.0 1.11623 verage result from REMRate plicable to Missouri. 2006 and 2015, the federal stic efficiencies over time mean th nergy Information Administration n assumption 50% are units finould be used. arguilable_ arguilable_	modeling of several diffe andard for heat pumps we at using the minimum sta tion, 2009 Residential Err on before 2006 and 50% utilities have specific ev- hting savings (average re assumption control and solve thing savings (average re assumes typical cooling s ER ² + (1.12 * SERR) (f Colorado at Boulder), co	rent building configurations as adjusted. While one would ndard is appropriate. ergy Consumption Survey, - consumption Survey, - 2006 2014. aluation results providing a sult from REMRate ystem operating efficiency of rom Wassmer, M. (2003); A inverted to COP = n 2009 Residential Energy		Formatted: Space After: 0 pt Formatted: Space After: 0 pt Formatted: Keep with next Formatted: Keep with next Formatted: Keep with next

Ameren Missouri	Appendix I - TRM – Vol. 3: Resi	idential Measures Formatted: Font: (Default) Arial, 12 pt
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SUMMER COINCIDEN	T PEAK DEMAND SAVINGS	
$\Delta kW = \Delta kW$) * CF	
Where:		
<u>AkWh</u>	= Electric energy savings, as calculated above.	
CF	= Summer peak coincidence demand (kW) to annual energy (kWh) factor = 0.0001492529 for Lighting RES (Residential)	
	$\frac{\Delta kW}{\Delta kW} = \Delta kWh * CF$	Enverstante Indents Lafe, 1" First line: 0" Space
When		Formatted: Indent: Left: 1", First line: 0", Space Before: 4 pt
AkWh	= Energy Savings as calculated above	Formatted: Normal, Indent: Left: 1"
CF	— Summer peak coincidence demand (kW) to annual energy (kWh) factor = 0.0001492529 for residential bulbs and 0.0001899635 for nonresidential bulbs	
NATURAL GAS SAVI		
0	atural Gas heated homes. ⁶²⁴	
∆Therms=	-((Watts_ <u>Base</u> – Watts <u>FE</u>) / 1,000 * ISR * Hours * HF * 0.03412) / ηHeat * %GasHeat	Formatted: Subscript
	$\frac{Watts_{Hase} - Watts_{EE} + ISR + Hours + HF + 0.03412}{1,000}$	Formatted: Subscript
	<u>ΔTherms = – + %GasHeat</u>	
Where:		
HF	= Heating Factor or percentage of light savings that must now be heated	
	$= 53\%^{625}$ for interior or unknown location	
0.02412	= 0% for exterior or unheated location	
0.03412	=Converts kWh to therms = Efficiency of heating system	
$\eta Heat_{Gas}$	= 21100000000000000000000000000000000000	
%GasHeat	= Percentage of heating savings assumed to be \underline{n} Autural \underline{g} as	
	Heating fuel%GasHeatElectric0%	
	Natural Gas 100%	
	Unknown 65% ⁶²⁷	
MEASURE CODE:		
VIEASURE CODE.		
²⁴ Negative value because	this is an increase in heating consumption due to the efficient lighting.	
	loads increase by 53% of the lighting savings. This is based on the average result from REMRate modeling of several different on City, and Burlington). Results of the Iowa study are judged to be equally applicable to Missouri.	building configurations
526 This has been estimated	assuming that natural gas central furnace heating is typical for Missouri residences (the predominant heating is gas furnace wit	
tomes (based on Energy I https://www.eia.gov/consu	formation Administration, 2009 Residential Energy Consumption Survey)). See reference "HC6.9 Space Heating in Midwest R mption/residential/data/2009/hc/hc6.9.xls; 'hc6.9.xls'. In 2000, 29% of furnaces purchased in Missouri were condensing (based	d on data from GAMA.
provided to Department of	Energy during the federal standard setting process for residential heating equipment - see Furnace Penetration.xls). Furnaces ter	nd to last up to 20 years,
	s ago provide a reasonable proxy for the current mix of furnaces in the state. Assuming typical efficiencies for condensing and n e heating system efficiency is estimated as follows: $((0.29*0.92) + (0.71*0.8))*(1-0.15) = 0.71_{\pi_a}$	non-condensing furnaces
and duct losses, the average		
²⁷ Average (default) value	of 65% gas space heating from 2009 Residential Energy Consumption Survey for Missouri. If utilities have specific evaluation	results providing a more
²⁷ Average (default) value		results providing a more
²⁷ Average (default) value	of 65% gas space heating from 2009 Residential Energy Consumption Survey for Missouri. If utilities have specific evaluation homes in a particular market or geographical area, then they should be used.	Page 151

America Miccouri	Appendix I. TDM	
Ameren Missouri	Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt Formatted: Normal
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3.5.2 LED Specialty Lamp		
residential and in-unit interior or exterior) or, if the implementation stra	orative, and globe lamps when the LED is installed in a known location (i.e., ategy does not allow for the installation location to be known (e.g., an upstream upstream programs, utilities should develop an assumption of the Residential ion.	
and 100W to be approximately 30% more energy efficient than stand	rity Act of 2007 (EISA) requires all general-purpose light bulbs between 40W dard incandescent bulbs. Production of 100W, standard efficacy incandescent and 60W and 40W lamps in 2014. The baseline for this measure has therefore standard.	
making the baseline equivalent to a current day CFL. In 2019, the De backstop provision had not been triggered and therefore b) the effici	0, all lamps meet efficiency criteria of at least 45 lumens per watt, in effect partment of Energy issued a final determination and clarified that a) the EISA iency standard would not change in 2020. In May 2022, DOE reversed this amp (GSL) and General Service Incandescent Lamp (GSIL) definitions and reement between January 2023 and July 2023. ⁶²⁸	
This measure was developed to be applicable to the following program	n types: TOS, NC, and RF.	
If applied to other program types, the measure savings should be verified	fied.	
DEFINITION OF EFFICIENT EQUIPMENT In order for this characterization to apply, new lamps must be ENERC became effective on $1/2/2017_{\pm}$ ⁶⁹ -Qualification could also be based	W STAR [®] labeled based upon the ENERGY STAR [®] specification v2.0 which don the Design Light Consortium's qualified product list. ⁶³⁰	Formatted: Font: Underline, Font color: Blue
Therefore, the baseline condition for this measure is a reflection of the	ective, limiting the sale, manufacture, and import of non-compliant lamps. te 2022 DOE final rule reinstating the 45 lumen per watt backstop provisions s, i.e., those below 310 lumens and above 3,300 lumens, the baseline condition d upon in practice.	
No savings are claimed for non-income qualified programs unless via	direct install programs.	
Direct Install programs where it can be shown that the LED is replac- lighting as baseline and also assume a measure life of 2 years.	ing working inefficient lighting should continue to use the existing inefficient	
	ing working inefficient lighting should continue to use the existing inefficient > August 1, 2023, the baseline condition for this measure is assumed to be an	
	ncome eligible populations and eight years for income eligible populations. ⁶³¹	
The measure life is 19 years for residential applications and 6 years for	n non residential applications.""	
	0V2_0%20Revised%20AUG-2016.pdf; 'ENERGY STAR Lamps V2_0 Revised AUG-	
6 years for non-residential are based on average rated lifetime for 2021 program mea	Effective 010124 v12.0 Vol 3 Res 09222023 FINAL clean.pdf. page 311, or lifetime hours to the estimated annual operating hours. EULs of 19 years for residential and sures (through 8/3/2021) divided by 995 hours for residential settings and by 3,351 for non-	
residential settings.		
2025 MEEIA <u>4 2019-21</u> Plan Revision <u>87</u> .0	Page 152	

DEEMED MEASURE CO						<u>M – Vol. 3: R</u>				
DEEMED MEASUDE CO									Formatted: Normal	
The deemed measures	cost for a specialty l	LED is \$1.66 per 1	amp. ⁶³³ In the case of c	lirect instal	I programs	or lighting incl	luded in efficient	kits, the		
teruar cost of the measu	are snourd de used.									
LOADSHAPE										
Lighting RES Lighting BUS										
Lighting DOS										
			Algorithm							
CALCULATION OF SAV	/INGS									
ELECTRIC ENERGY SA										
ELECTRIC ENERGY SA	AVINGS									
ΔkWh	= (Watt _{Base} - Watt	_{EE}) * ISR * (1 - L	KG) * Hours * WHF	/ 1,000						
									Formatted: Normal, Space Before: 0	ət
$\Delta kWh_{RES} = (Watt_{Base})$	- Watt_{er}) * %R	ES * ISR * (1 -	- LKG) * Hours _{ees} *	WHFprs /1	000					
					,000					
AkWh = (Watt)	- Watt $+$ (1	<u> </u>	2 + (1 - LKG) + Ho	urs + D	,	<u>IE/1.000</u>				
$\Delta kWh_{NRES} = (Watt_{sec})$	$\frac{1}{m} - Watt_{EE} + (1)$	<u>– %RES) * ISR</u>	<u>* (1 - LKG) * Ho</u>	urs _{nnes} + D	,	IF _{NRES} /1,000				
∆ <i>kWh_{NRES} = (Watt_{#e}</i> Where:	 Watt_{ee}) * (1	— %RES) * ISR	! * (1 − LKG) * Ho	urs _{nes} + D	,	IF_{rres}/1,000				
Where:		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	: * (1 – <i>LKG</i>) * Ho ED bulb installed. See		ays * WI	<i>IF_{nnes}/1,</i> 000				
Where: Watts _{Base}	= Based on bulb typ	pe and lumens of L		e tables belo	ays + WI ow.					
Where: Watts _{Base} Watts _{EE}	= Based on bulb typ = Actual wattage of	pe and lumens of LED purchased /	ED bulb installed. See installed - If unknown,	e tables belo use default	ow.	pelow: ⁶³⁴		•	Formatted: Indent: Left: 0", First line:	0"
Where: Watts _{Base} Watts _{EE}	= Based on bulb typ = Actual wattage of	pe and lumens of LED purchased /	ED bulb installed. See	e tables belo use default	ow.	pelow: ⁶³⁴	ine	•	Formatted: Indent: Left: 0", First line:	0"
Where: Watts _{Base} Watts _{EE}	= Based on bulb typ = Actual wattage of	pe and lumens of I f LED purchased / net Wattages throu wer Lumen Range	ED bulb installed. See installed - If unknown, gh July 31, 2023, assur Upper Lumen Range	e tables belo use default ning a EIS/ Wattstace	Days * WI Dw. t provided l A complian Wattser	below: ⁶³⁴ t halogen baseli Delta-Watts	ine	•	Formatted: Indent: Left: 0°, First line:	0"
Where: Watts _{Base} Watts _{EE}	= Based on bulb typ = Actual wattage of	pe and lumens of I f LED purchased / net Wattages throu wer Lumen Range 250	ED bulb installed. See installed - If unknown, ch July 31, 2023, assur Upper Lumen Range 349	e tables belo use default ning a EIS/ Watts _{Base} 25	ow. t provided l complian Wattsur 5.6	below: ⁶³⁴ thalogen baseli Delta-Watts 19.4	ine	•	Formatted: Indent: Left: 0°, First line:	0"
Where: Watts _{Base} Watts _{EE}	= Based on bulb ty = Actual wattage of Baseline and Efficien Rub Type Lo	pe and lumens of I f LED purchased / net Wattages throu wer Lumen Range	ED bulb installed. See installed - If unknown, gh July 31, 2023, assur Upper Lumen Range	e tables belo use default ning a EIS/ Wattstace	Days * WI Dw. t provided l A complian Wattser	below: ⁶³⁴ t halogen baseli Delta-Watts	ine	÷	Formatted: Indent: Left: 0°, First line:	0"
Where: Watts _{Base} Watts _{EE}	= Based on bulb typ = Actual wattage of	pe and lumens of I f LED purchased / net Wattages throu wer Lumen Range 250 350 400	ED bulb installed. Sec installed - If unknown, <u>ch July 31, 2023, assur</u> <u>Upper Lauren Range</u> <u>349</u> <u>399</u>	e tables belo use default ming a EIS/ Wattshow 25 35 40	ow. t provided l wattscz 5.6 6.3	below: ⁶³⁴ thalogen baseli Delta Watts 19:4 28:7 32:5	ine	÷	Formatted: Indent: Left: 0°, First line:	0"
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Where: Watts _{Base} Watts _{EE}	= Based on bulb ty = Actual wattage of Baseline and Efficient Bulb Type Lo	pe and lumens of L f LED purchased / net Wattages throu wer Lumen Range 250 350 400 600 750 1000 70 90 150 300 500 250	ED bulb installed. See installed - If unknown, <u>ch July 31, 2023, assur</u> <u>Upper Lumen Range</u> 349 399 599 749 999 1250 89 149 299 499 699 349	25 25 25 25 25 25 25 26 40 60 100 100 10 10 40 15 25 40 60 25 40 60 25 25 25 25 25 25 25 25 25 25	Rays WI www. provided I Complian Waitree 5.6 6.3 7.5 9.7 12.7 16.2 4.8 2.7 3.2 4.7 6.9 4.1	below: ⁶²⁴ thalogen baseli Delta Watts 19.4 28.7 32.5 50.3 62.3 62.3 83.8 8.2 12.3 21.8 35.3 53.1 20.9	ine	•	Formatted: Indent: Left: 0", First line:	0"
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<u>2025 MEEIA 4 2019-21 Plan</u>

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Revision <u>8</u>7.0

1	Bulb Type Lower Lum 110	en Range UI 0	oper Lumen 1 1300	Range Wa	HttsBase Watt 150 13.4	SEE Delta Watts 0 137.0	
Decorative Lamps – ENERC	TY STAR Minimum Lu	minous Effica	acv = 65 Lm/	W for all la	mps:		
				LED			
		Minimu	Maximu			Delta Watts	
	<u>Bulb Type</u>	<u>m</u> Lumens	<u>m</u> Lumens			(WattsE	
				<u>E)</u>		<u>E)</u>	
	Omni-Directional	1.100	<u>1,999</u>	<u>14.7</u>	<u>100</u>	<u>85.3</u>	
	3-Way	2,000	<u>2,700</u>	<u>22.6</u>	<u>150</u>	127.4	
	Globe	<u>310</u>	<u>349</u> 499	3.0	25	22	
	(medium and	<u>350</u>	<u>499</u> 574	<u>4.7</u> <u>5.7</u>	<u>40</u> <u>60</u>	<u>35.3</u> <u>54.3</u>	
	intermediate bases less than 750 lumens)	575	<u>649</u>	<u>6.5</u>	75	<u>68.5</u>	
		650	1,000	8.2	100	91.8	
	Globe	<u>310</u>	<u>349</u>	<u>3.5</u>	<u>25</u>	21.5	
	(candelabra bases less than 1050 lumens)	350	499	<u>4.4</u>	40	35.6	
	Decorative	<u>500</u> <u>310</u>	<u>574</u> <u>499</u>	<u>5.5</u> <u>4.3</u>	<u>60</u> <u>40</u>	<u>54.5</u> <u>35.7</u>	
	(Shapes B, BA, C,	210	422	<u></u>	40	<u></u>	
	CA, DC, F, G, medium and	500	800	5.8	60	54.2	
	intermediate bases less than 750 lumens)						
	Decorative	310	<u>499</u>	<u>4.2</u>	<u>40</u>	35.8	
	(Shapes B, BA, C, CA, DC, F, G,						
	candelabra bases less	<u>500</u>	<u>650</u>	<u>5.5</u>	<u>60</u>	54.5	
	than 1050 lumens)	310	499	6.5	40	33.5	
	Decorative (Shana ST)	500	999	8.8	60	51.2	
	(Shape ST)	1000	1500	<u>10.0</u>	<u>100</u>	90.0	
	Decorative (Shape S)	<u>310</u>	<u>340</u>	2.25	25	22.8	
			us Efficacy =	= 70Lm/W 1	for <90 CRI 1	amps and 61 Lm	/W for >=90CRI lamps.
Directional	R, BR, and ER lamp typ	Jes.					
				LED		Delta	
	Bulb Type	<u>Minimu</u> <u>m</u>	Maximu <u>m</u>	Wattag	Baseline (Watts _{Bas}	Watts	
	<u>buto rype</u>	Lumens	Lumens	\underline{C} (Watts _E	<u>e)</u>	(WattsE	
				<u>E)</u>		<u>E)</u>	
	Reflector lamp types	<u>400</u>	<u>649</u>	<u>7.0</u>	<u>50</u>	<u>43</u>	
	with medium screw bases (PAR20,	<u>650</u> 900	<u>899</u> 1,049	<u>10.7</u> 13.9	75 90	<u>64.3</u> 76.1	
	PAR30(S,L), PAR38,	1.050	<u>1,199</u>	<u>13.8</u>	<u>100</u>	86.2	
	<u>R40, etc.) w/ diameter</u> >2.25"	<u>1,200</u> <u>1,500</u>	<u>1,499</u> <u>1,999</u>	<u>15.9</u> <u>18.9</u>	<u>120</u> <u>150</u>	104.1 131.1	
	(*see exceptions below)	2,000	3,299	27.3	250	222.7	
	Delowy		1	1	ıI		
35 From pg 13 of the ENERGY ST	TAR Specification for lamps	v2.1					

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		Minimu	Maximu	LED Wattag	Baseline	Delta			_//	
	Bulb Type	m	m	<u>e</u>	(Watts _{Bas}	Watts				Formatted
		Lumens	Lumens	(Watts _E	<u>e)</u>	(WattsE E)				Formatted
				<u>E)</u>						Formatted
	Reflector lamp types with medium screw	<u>310</u>	<u>374</u>	<u>4.6</u>	35	30.4			/	Formatted
	bases (PAR16, R14,									Formatted
	<u>R16, etc.) w/ diameter</u> <2.25"	<u>375</u>	<u>600</u>	<u>6.4</u>	<u>50</u>	43.6			_/ /,	Formatted
	(*see exceptions below)									Formatted
	<u>detowy</u>	<u>650</u>	<u>949</u>	<u>9.3</u>	<u>65</u>	55.7	-			Formatted
	*BR30, BR40, or	<u>950</u> 1,100	<u>1,099</u> 1,399	<u>12.7</u> 14.4	75 85	<u>62.3</u> 70.6				Formatted
	<u>ER40</u>	1,400	1,600	16.6	100	83.4				Formatted
	*020	<u>1,601</u> 450	<u>1,800</u> 524	<u>22.2</u> 6.0	<u>120</u> 40	<u>97.8</u> 34.0				Formatted
	<u>*R20</u>	<u>525</u> 310	750 324	7.1 3.8	45	37.9			T	Formatted
	*MR16	<u>310</u> <u>325</u>	<u>324</u> <u>369</u>	<u>3.8</u> <u>4.8</u>	20.0 25.0	16.2 20.2				Formatted
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tool. ⁶³⁶ If CBCP a manufacturer's re	nd beam angle information ecommended baseline watta	are not avail ge equivalent	able or if the	equation b	elow returns	s a negative	value (or undefined	d), use the		Formatted
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tool 636 If CBCP a manufacturer's re WattsBase	and beam angle information ecommended baseline watta = $375.1 - 4.355(D)$ -	are not avail ge equivalent - (227,800 –	able or if the 	equation b	elow returns	s a negative	value (or undefined	d), use the		Formatted Formatted Formatted
tool, ⁶³⁶ If CBCP a manufacturer's re WattsBase Where:	nd beam angle information commended baseline watta = 375.1 - 4.355(D) - (BA^2)) - 16,720 * 1	are not avail ge equivalent - (227,800 – n(CBCP))^0	<u>able or if the</u> (937.9 * D) (5	equation b	elow returns	s a negative	value (or undefined	d), use the	•	Formatted Formatted Formatted
tool 636 If CBCP a manufacturer's re WattsBase	and beam angle information ecommended baseline watta = $375.1 - 4.355(D)$ -	are not avail ge equivalent - (227,800 – n(CBCP))^0	<u>able or if the</u> (937.9 * D) (5	equation b	elow returns	s a negative	value (or undefined	d), use the	•	Formatted Formatted Formatted Formatted Formatted Formatted Formatted
tool, ⁵³⁶ If CBCP a manufacturer's re WattsBase <u>Where:</u> D	nd beam angle information commended baseline watta = 375.1 - 4.355(D) - (BA^2)) - 16,720 * 1 = Bulb diameter (e.g	are not avail. ge equivalent - (227,800 – n(CBCP))^0. g. for PAR20	<u>able or if the</u> (937.9 * D) (5	equation b	elow returns	s a negative	value (or undefined	d), use the	•	Formatted Formatted Formatted Formatted Formatted
tool ₆ ⁶³⁶ If CBCP a manufacturer's re <u>WattsBase</u> <u>Where:</u> D BA CBCP	nd beam angle information commended baseline watta = 375.1 - 4.355(D) - (BA^2)) - 16,720 * 1 = Bulb diameter (e.g = Beam angle	are not avail. ge equivalent - (227,800 – n(CBCP))^0. g. for PAR20 le power	able or if the (937.9 * D) (55) (20) = 20)	<u>e equation b</u> - (0.9903 ²	* D^2) – (1,4	479 *BA) –	value (or undefined 	d), use the	•	Formatted Formatted Formatted Formatted Formatted Formatted Formatted
tool ₆ ³⁵⁰ If CBCP a manufacturer's re WattsBase Where: D BA CBCP	nd beam angle information commended baseline watta = 375.1 - 4.355(D) - (BA^2)) - 16,720 * 1 = Bulb diameter (e.g = Beam angle = Center beam cand	are not avail. ge equivalent - (227,800 – n(CBCP))^0. (, for PAR20 le power power power	able or if the (937.9 * D) (5 - 20) D = 20) N to the near	<u>e equation b</u> - (0.9903 ²	elow returns * D^2) – (1,- e established	479 *BA) –	value (or undefined 	d), use the		Formatted Formatted Formatted Formatted Formatted Formatted Formatted
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souri			Appe	endix I - TR	<u>M – Vol. 3:</u>	Residential Measures		Formatted: Font: (Default) Arial, 12 pt	
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Bull) I vne – – – – – – – – – – – – – – – – – – –	imum Maximum mens Lumens	LED Wattage (Watts _{EE})	<u>Baseline</u> - <u>(Watts_{Base})</u>	Delta Watts (WattsEE)			Formatted: Font: (Default) Times New R	loma
		399	<u>4.0</u>	25	21.0			Formatted: Font: (Default) Times New R	Roma
		100 749 750 899	<u>6.6</u> 9.6	29. 43.	22.4 33.4		$\neg \land$	Formatted	
CA > 749 lum	ens), Candelabra	000 1.399	13.1	53	39.9			Formatted	
Intermediate B	>1049 lumens), ase Lamps (>749	400 1,999	16.0	72	56.0			Formatted	
lur Efficienct Wattag	nens) res after August 1, 200	23, under the EISA bi	eketon prov	ision of 45 lu	monc/watt			Formatted	
ulb Type	Lower Lumen Range	Upper Lumen Ran	ge WattsBe	WattsEE	Delta Watts			Formatted	
	250	309	25	5.6	19.4			Formatted	
	310	399	7.9	6.3	1.6			Formatted	
Directional	400	599	44.4	7.5	3.6			Formatted	
Encetion	600	749	45	9.7	5.3			Formatted	
	750	999	19.4	12.7	6.7			Formatted	
	1000 70	1250 89	25 10	16.2 1.8	8.8 8.2			Formatted	
	70 90	149	+0 +5	1.8 2.7	8.2 12.3			Formatted	
Decorative		309	25	3.2	21.8			Formatted	
Decordarie	310	499	40	4.7	35.3			Formatted	
	500	699	60	6.9	53.1			Formatted	
	250	309	25	4.1	20.9			Formatted	
	310	499	9.0	5.9	3.1			Formatted	
Globe	500	574	11.9	7.6	4.3				
01000	575	649	13.6	13.6	0.0			Formatted	
	650	1099	19.4	17.5	1.9			Formatted	
	1100	1300	26.7	13.0	13.7			Formatted	
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	(program bulbs instal		Aissouri's ser	rvice area)				Formatted	
	unknown, assume 0%	638					$\langle \rangle$	Formatted	
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	ate, the percentage of	units rebated that are	actually in s	service. Actua	ul, or if unkno	vn, assume:	$\langle \rangle$	Formatted	
	ate, the percentage of	units rebated that are	actually in s	service. Actua	ıl, or if unkno	<u>vn, assume:</u>		Formatted	
	ate, the percentage of	units rebated that are	actually in s	service. Actua	ıl, or if unkno	<u>vn, assume:</u>			

Page 156

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2025_MEEIA <u>4_2019-21</u>-Plan

Revision <u>8</u>7.0

			Аррени	<u>ix I - TRM – Vol.</u>	5. Residential Measur		Formatted: Font: (Default) Arial, 12 pt
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			Discounted In Servic	<u>e</u>			
	Dir	rect Install (MFLI)MFIE	<u>98.2%</u>	-			
	<u>640</u>	IE and, PAYSEfficiency	100%	_			
		te and, PAYSETTCIEncy t(MF) ⁶⁴¹	100%				
	I		<u>90%</u>				
		w Income Kits v As You Save ⁶⁴²	87%				
⁶⁴³ Hours	= Average hours of use pe	r vear for bulbs in resider	ntial homes Custom	r if unknown accun	a 1 31/644 for exterior or	ort	
Tiours	if interior use table below.		intar nomes. Custom, o	<u>n ii ulikliowii assuli</u>	101 extendi, 01	<u>or</u> -	Formatted: Space After: 6 pt
		Program	HOU Res				
		Residential	<u>995.18645</u>				
		Efficient Kits ome Eligible RES	<u>995.18</u> 674.18 ⁶⁴⁶				
		MFMR	<u>693.50⁶⁴⁷</u>				
<u>WHFe</u>	<u>= Waste Heat Factor for e</u>	nergy to account for the in	mpact from reducing	waste heat from effic	cient lighting on electric	4	Formatted: Indent: Left: 0.5", Hanging: 1", Spa Before: 6 pt
	cooling and heating loads						· · ·
WHFe _{Heat}	$= 0.99 \text{ if unknown}^{648}$ = Waste Heat Factor for en	nergy to account for elect	ric heating increase fr	om reducing waste	neat from efficient lighting	ſif	
TT III CHeat	fossil fuel heating, see cal			on reducing waster	iea nom enterent ngittilig	111	
	$= 1 - ((HF / \eta Heat) * \% Ele$						
	= If unknown assume 0.88	3649				-	Formatted: Indent: Left: 1", First line: 0.5"
re :						+	Formatted: Indent: First line: 0"
HF	= Heating Factor or percer	ntage of light savings that	t must now be heated			-	Formatted: Indent: Left: 0", First line: 0"
							Formatted: Indent: Left: 0", First line: 0.5"
	$= 53\%^{650}$ for interior or un						Tormatted. Indent: Leit. 0, Thist line. 0.5
nHeat _{Electric}	= 0% for exterior or unhea	ated location					
ηHeat _{Electric}		ated location eating equipment				•	Formatted: Indent: Left: 0"
ηHeat _{Electric}	= 0% for exterior or unhea = Efficiency in COP of He	ated location eating equipment		nlleat		4	
ηHeat _{Electric}	= 0% for exterior or unhea = Efficiency in COP of He	ated location eating equipment	HSPF2 Estimate	<u>nHeat</u> (COP Estimate)		•	Formatted: Indent: Left: 0"
ηHeat _{Electric}	= 0% for exterior or unhea = Efficiency in COP of He = Actual - If not available, <u>System Type</u>	ated location eating equipment , use: ⁶³¹				•	Formatted: Indent: Left: 0"
ηHeat _{Electric}	= 0% for exterior or unhea = Efficiency in COP of He = Actual - If not available.	ated location eating equipment , use: ⁶⁵¹	HSPF2 Estimate 5.8 6.5	<u>uHeat</u> (<u>COP Estimate)</u> (<u>HSPF2/3.413)*0.85</u> <u>1.44</u> 1.62	-	•	Formatted: Indent: Left: 0"
ηHeat _{Electric}	= 0% for exterior or unhea = Efficiency in COP of He = Actual - If not available, <u>System Type</u> <u>Heat Pump</u> (if age unknown <u>assume 2006-2014)</u>	Age of Equipment Age of Equipment Before 2006 After 2006 - 2014 2015 on	<u>5.8</u> <u>6.5</u> <u>7.0</u>	(HSPF2/3.413)*0.85 <u>1.44</u> <u>1.62</u> <u>1.74</u>		•	Formatted: Indent: Left: 0"
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ηHeat _{Electric}	= 0% for exterior or unhea = Efficiency in COP of He = Actual - If not available, <u>System Type</u> <u>Heat Pump</u> (if age unknown <u>assume 2006-2014)</u>	Age of Equipment Age of Equipment Before 2006 After 2006 - 2014 2015 on	<u>5.8</u> <u>6.5</u> <u>7.0</u>	(HSPF2/3.413)*0.85 <u>1.44</u> <u>1.62</u> <u>1.74</u>		•	Formatted: Indent: Left: 0"
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eren Missouri			Арре	endix I - TRM – Vol.	3: Residential Measure	Formatted: Font: (Default) Arial, 12 pt
						Formatted: Normal
	Unknown ⁶⁵²	<u>N/A</u>	<u>N/A</u>	1.28		
%ElecHeat	= Percentage of heating	ng savings assumed to	be electric			Formatted: Indent: Left: 0"
		Heating fu	iel %ElectricHea	ıt		Formatted Table
		Electric	100%			
		Natural Gas Unknown	<u>0%</u> 35% ⁶⁵³			
WHE.	Wester Head Franker				e effetter i teleter	
WHFe _{Cool}	= waste Heat Factor 1	for energy to account	for cooling savings from r	educing waste neat from	n erncient lighting	
		Building with coo	Location	WHFe _{Cool} 1.12 ⁶⁵⁴		
		Building without o		<u>1.12</u>		
		<u>Unknown</u>		<u>1.11⁶⁵⁵</u>		
						Formatted: Indent: Left: 0.5", Hanging: 1"
%RES	= percentage of bulbs (tomers eam Lighting or 96% if un	lenovun 656		
ISR			bated that are actually in s		4	
Hours _{RES}	= Average hours of use		· · · · · · · · · · · · · · · · · · ·			
		wn assume 728657 for	interior or 1,314 for exteri	or, or 776 if location is	not known.	
Hours	= <u>3,351</u>			e 1		
WHFe _{Heat}		heating see calculati	or electric heating increase on of heating penalty in th		eat from efficient	
	If unknown assume 0.8	· · · · · · · · · · · · · · · · · · ·				
HF	= Heating Factor or pe	rcentage of light savi	ngs that must now be heat	ed		
	$= 53\%^{659}$ for interior of					
TT .	= 0% for exterior or un					
$\eta Heat_{Electric}$	= Efficiency in COP of = Actual - If not availa		la halow ⁶⁶⁰			
%ElecHeat	= Percentage of heatin					
WHFe _{Cool}			for cooling savings from re	educing waste heat from	efficient lighting	
culation assumes 35	% Heat Pump and 65% Resist	tance, which is based upon	data from Energy Information	Administration, 2009 Resider	ntial Energy Consumption Survey,	Formatted: Font: (Default) Times New Roman
/www.eia.gov/consu		hc/hc6.9.xls; 'hc6.9.xls' <u>,</u> A	verage efficiency of heat pump		50% are units from before 2006 an	
				Aissouri. If utilities have spec	cific evaluation results providing a	
appropriate assumption	on for homes in a particular m	narket or geographical area				Formatted: Font: (Default) Times New Roman
ing of several differe	nt building configurations in	Iowa (Des Moines, Mason	City, and Burlington)). The esti	imate also assumes typical co	ooling system operating efficiency of	Formatted: Font: (Default) Times New Roman
			ted to 9.5 EER using algorithm (Calculations. Masters Thesis, Ur		EER) (from Wassmer, M. (2003); A der), converted to COP =	<u>\</u>
3.412 = 2.8COP). Res	sults of the Iowa study are ass	umed to be applicable to M	<u>Aissouri.</u>			
	tt 1.11 (calculated as 1 + (0.91 https://www.eia.gov/consumption			nomes have central cooling (h	based on 2009 Residential Energy	
/www.eia.gov/consu	mption/residential/data/2015/	hc/php/hc7.9.php.				
	ing Evaluation: PY2022. 96% the PY2022 program.	is the weighted average for	or bulbs sold through the Online	Store and Upstream Program	ns based on evaluation results and	
neren Missouri Lighti	ing Impact and Process Evalu		Average daily HOU for efficie			
	for inside spaces. Unknown le ts: 1 ((0.53/1.57) * 0.35) = 0.8		e (by inventory) of all bulbs. Se	e 'MO Lamp Hours.xls' for o	calculations.	
	loads increase by 53% of the	lighting savings. This is b			al different building configurations	
culated using default						
leulated using default is means that heating ra (Des Moines, Masc ese default system eff	ficiencies are based on the app	plicable minimum federal	Judged to be equally applicable standards. In 2006 and 2015 the gradation of efficiencies over tir	federal standard for heat pun	nps was adjusted. While one would	£

					ol. 3: Residential Measu		Formatted: Font: (Default) Arial, 12 pt
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	Proo	ram		Discounted In Service Rate			Former And Table
	Tros	Program		Channer or Subgroup Service Kate (ISR)			Formatted Table
		-	Overall Program Averag				
	Retail (Time	o of Salo) ⁶⁶¹	Online Store - Reflecto Online Store - Specialty				
	Retail (1110	e or sale)	Upstream - Reflector	90.00%			
			Upstream Specialty	93.00%			
	Direct Instal Efficiency K	× /		<u>98.2%</u> 90%			
	Efficiency Kit (1			100%			
	Pay As Ye			87%			
	System Type	Age of	HSPF Estimate	nHeat (COP			
	of stem type	Equipment		Estimate)			
	Hoot Dumm	Before 2006 2006-2014	6.8 7 .7	2.00 2.26	_		
	Heat Pump	2006-2014 2015 and afte		2.26			
	Resistance	N/A	N/A	1.00	-		
	Unknown	N/A	N/A	1.57-665	-		
		· ·		·			
			Heating fu	el %ElectricHea	H-	4	Formatted Table
			Electric	100%			
			Natural Gas	0%			
			Unknown	35% 666			
		Rulh	Location	WHEecol			
			Location				
	1	Building with cooli	ng	1.12667		4	Formatted Table
		Building with cooli Building without co	V	$\frac{1.12^{667}}{1.0}$		4	Formatted Table
	1	V	V			4	Formatted Table
UMMER COINCIDENT	1	Building without co Unknown	V	1.0		4	Formatted Table
	r Peak Demand Sav	Building without co Unknown	V	1.0		4	Formatted Table
ummer Coincident <u>AkW = AkWh *</u>	r Peak Demand Sav	Building without co Unknown	V	1.0		4	Formatted Table
$\Delta kW = \Delta kWh^{\ast}$	r Peak Demand Sav	Building without co Unknown	V	1.0		4	Formatted Table
<u>ΔkW = ΔkWh *</u>	T PEAK DEMAND SAV * CF	Building without co Unknown INGS	oling or exterior	1.0		4	Formatted Table
$\frac{\Delta kW = \Delta kWh *}{here:}$ $\frac{\Delta kWh}{\Delta kWh}$	r Peak Demand Sav * CF = Electric energy savir	Building without co Unknown INGS ngs, as calculated	above.	+.0 +.11 ⁶⁶⁸		4	Formatted Table
$\Delta kW = \Delta kWh^{-8}$	r Peak Demand Sav * CF = Electric energy savin = Summer peak coinci	Building without ee Unknown INGS ngs, as calculated idence demand (k'	above. W) to annual energy (kW	+.0 +.11 ⁶⁶⁸		4	
$\frac{\Delta kW = \Delta kWh *}{here:}$ $\frac{\Delta kWh}{\Delta kWh}$	r Peak Demand Sav * CF = Electric energy savir	Building without ee Unknown INGS ngs, as calculated idence demand (k'	above. W) to annual energy (kW	+.0 +.11 ⁶⁶⁸		4	Formatted Table Formatted: Indent: Left: 1", First line: 0.5"
$\frac{\Delta kW = \Delta kWh^{*}}{here:}$ $\frac{\Delta kWh}{CF}$	r Peak Demand Sav * CF = Electric energy savin = Summer peak coinci	Building without ee Unknown INGS ngs, as calculated idence demand (k'	above. W) to annual energy (kW	+.0 +.11 ⁶⁶⁸		4	
$\frac{\Delta kW = \Delta kWh^{*}}{here:}$ $\frac{\Delta kWh}{CF}$	T PEAK DEMAND SAV T CF T Electric energy savir T Summer peak coinci T 0.0001492529 for Li T	Building without ee Unknown INGS ngs, as calculated idence demand (k'	above. W) to annual energy (kW	+.0 +.11 ⁶⁶⁸		•	
$\frac{\Delta kW = \Delta kWh^{8}}{\Delta kWh}$	T PEAK DEMAND SAV T CF T Electric energy savir T Summer peak coinci T 0.0001492529 for Li T	Building without ee Unknown INGS ngs, as calculated idence demand (k'	above. W) to annual energy (kW	+.0 +.11 ⁶⁶⁸		•	
$\frac{\Delta kW}{\Delta kWh} = \Delta kWh \frac{3}{\Delta kWh}$ $\frac{\Delta kWh}{CF}$ $\frac{\Delta kW}{\Delta kW} = \frac{1}{\Delta kW}$	T PEAK DEMAND SAV * CF = Electric energy savin = Summer peak coinci = 0.0001492529 for Li = AkWh + CF g Evaluation: PY2019. 3.989	Building without eo Unknown INGS ngs, as calculated idence demand (k' ighting RES (Resi	above, W) to annual energy (kW idential)	4.0 1.11 ⁶⁶⁸ h) factor	grams based on evaluation results		
$\frac{\Delta kW}{\Delta kWh} = \Delta kWh *$ There: $\frac{\Delta kWh}{CF}$ CF CF CF CF CF CF CF	T PEAK DEMAND SAV CF Electric energy savin Summer peak coinci 0.0001492529 for Li AkWh + CF Evaluation: PY2019.3.989 Is PY2019 program.	Building without ee Unknown INGS ngs, as calculated idence demand (k' ighting RES (Resi 6 is the weighted aver	above, W) to annual energy (kW idential)	4.0 1.11 ⁶⁶⁸ h) factor	grams based on evaluation results		
$\frac{\Delta kW}{\Delta kWh} = \Delta kWh *$ $\frac{\Delta kWh}{CF}$ $\frac{\Delta kWh}{\Delta kWr} =$ $\frac{\Delta kW}{\Delta kWr} =$ $\frac{\Delta kW}{\Delta kWr} =$	T PEAK DEMAND SAV CF Electric energy savin Summer peak coinci 0.0001492529 for Li AkWh + CF EValuation: PY2019, 3.989 Re PY2019 program. Mity Savers Program Evalua Kits Impact and Process Fi	Building without or Unknown INGS ngs, as calculated idence demand (k' ighting RES (Resi is the weighted aver tion: PY2018. valuation: Program Y	above. W) to annual energy (kW idential) age for bulbs sold through the	4.0 1.11 ⁶⁶⁸ h) factor	grams based on evaluation results		
<u>ΔkW = ΔkWh *</u> <u>ΔkWh</u> <u>CF</u> <u>ΔkWh</u> <u>ΔkW =</u> <u>ΔkW =</u> * Ameren Missouri Lighting distribution of bulbs in th Ameren Missouri Efficien Ameren Missouri Efficien	T PEAK DEMAND SAV T CF T Electric energy savir Summer peak coinci Output O	Building without co Unknown INGS ngs, as calculated idence demand (k' ighting RES (Resi is the weighted aver tion: PY2018. valuation: Program Y4	above. W) to annual energy (kW idential) age for bulbs sold through the ear 2018. mt Survey	H.0 H.14 ⁶⁶⁸ h) factor Online Store and Upstream Pre			
<u>ΔkW = ΔkWh *</u> <u>/here:</u> <u>ΔkWh</u> <u>CF</u> - <u>ΔkW-</u> - - - - - - - - - - - - -	T PEAK DEMAND SAV CF Electric energy savir Summer peak coinci Output	Building without co Unknown INGS ngs, as calculated idence demand (k' ighting RES (Resi is the weighted aver tion-PY2018- tion-PY2018- tion-PY2018- tion-PY2018- tion-PY2018- ge efficiency of heat	above. W) to annual energy (kW idential) age for bulbs sold through the ear 2018, mt Survey on data from Energy Informatii ump is based on assumption 5	H.0 H.1 H	antial Energy Consumption Survey and 50% 2006 2014.	+	
<u>ΔkW = ΔkWh *</u> <u>ΔkWh</u> <u>CF</u> <u>ΔkWh</u> <u>CF</u> <u>ΔkW =</u> * <u>ΔkW =</u> * <u>ΔkW =</u> * <u>ΔkW =</u> * <u>ΔkW =</u> * <u>ΔkW =</u> <u>ΔkW = <u>ΔkW =</u> <u>ΔkW = <u>ΔkW =</u> <u>ΔkW = <u>ΔkW =</u> <u>ΔkW =</u> <u></u></u></u></u>	F PEAK DEMAND SAV * CF = Electric energy savir = Summer peak coinci = 0.0001492529 for Li = ΔkWh + CF Gevaluation: PY2019, 3.989 to PY2019 program. mity Savers Program Evalua t Kits Impact and Process E You Save (PAYS [®]) Evaluati heat pump and 50% resistan Midwest Regionals:" Avera 155% electric space heating:	Building without ee Unknown INGS INGS (ighting RES (Resi ighting RES (Resi is the weighted aver tion: PY2018, valuation: Program Y, valuation: Program Y, ion: PY2022 Participa ree, which is based up ge efficiency of heat from 2009 Residentia	above, W) to annual energy (kW idential) age for bulbs sold through the ear 2018, ant Survey on data from Energy Informati pump is based on assumption 5	1.0 1.11 ⁶⁶⁸ (h) factor 60 Online Store and Upstream Presidence 2006 60% are units from before 2006 60m Missouri, Huiblites have s	ential Energy Consumption Surve	+	
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<u>AkW = ΔkWh *</u> <u>AkWh</u> <u>CF</u> <u>AkWh</u> <u>CF</u> <u>AkW+</u> <u>Akwr</u> = <u>Akwr</u> = <u>Akwr</u> = <u>Akwr</u> = <u>Ameren Missouri Efficien</u> <u>Ameren Missouri Efficient</u> <u>Ameren Missouri Efficient</u> <u>Amere</u>	Γ PEAK DEMAND SAV * CF = Electric energy savin = Summer peak coinci = 0.0001492529 for Li = ΔkWh * CF g Evaluation: PY2019.3.989 te PY2019 program. mity Saves: Program Evalua t Kits Impact and Process Er You Save (PAYS ⁵) Evaluati het pump and 50% resistan Midwest Regionals." Avera 15% electric space heating for homes in a particular mi H2 (calculated as 1 + (0.34) figurations in Iowa (Des Mic	Building without or Unknown INGS INGS ight in the second second second idence demand (k' ighting RES (Resi ighting RES (above, above, W) to annual energy (kW idential) age for bulbs sold through the ear 2018. nt Survey on data from Energy Informati pump is based on assumption 5 i Energy Consumption Survey area, then they should be used. oling loads decreasing by 34% d Burlington)). The estimate al Burlington). The estimate al	4.0 1.11 ⁶⁶⁸ h) factor on Administration, 2009 Resid 60% are units from before 2006 for Missouri. If utilities haves so of the lighting savings (average so assumes typical cooling syst 2× SEER?) + (1.12 * SEER)	ential Energy Consumption Surve and 50% 2006-2014. pecific evaluation results providin e result from REMRate modeling em operating efficiency of 2.8 CC rom Wassmer, M. (2003); A	π gα of	
<u>ΔkW = ΔkWh *</u> <u>/here:</u> <u>ΔkWh</u> <u>CF</u> <u>ΔkWh</u> <u>CF</u> <u>ΔkW-</u> * <u>Ameren Missouri Lighting</u> e distribution of bulbs in th <u>Ameren Missouri Commu</u> <u>Ameren Missouri Efficien</u> <u>Ameren Missouri Efficien</u> <u>Ameren Missouri Efficien</u> <u>Ameren Missouri Pay As</u> <u>Calculation assumes 50%</u> <u>e 'HCo.9 Space Heating in</u> <u>'Average (default) value of</u> ore appropriate assumption <u>'The value is estimated at</u> veral different building com tarting from standard assum paponen Based Model for R3:3412 = 2.8COP. Read	Γ PEAK DEMAND SAV * CF = Electric energy savin = Summer peak coinci = 0.0001492529 for Li = ΔkWh + CF gEvaluation: PY2019.3.989 te PY2019 program. To homes in a particular mi Hidrest Regionals." Averag for homes in a particular mi H2 (calculated as 1 + (0.34) for homes in a particular mi H2 (calculated as 1 + (0.54) for homes in a particular mi H2 (calculated as 1 + (0.54) For homes in a particular mi H2 (calculated as 1 + (0.54) For homes in a particular mi H2 (calculated as 1 + (0.54) For homes in Jowa (Des Me ption of SEER 10.5 central Residential Air Conditionet Residential	Building without or Unknown INGS INGS ings, as calculated idence demand (k' ighting RES (Resi ighting RES (Res) ighting	above, with the second	4.0 1.11 ⁶⁶⁶ h) factor Online Store and Upstream Procession of the store and Upstream Procession of the lighting savings (average of the lighting)))))))))))))	ntial Energy Consumption Surve and 50% 2006-2014, pecific evaluation results providin e result from REMRate modeling em operating efficiency of 2.8 CC rom Wassmer, M. (2003); A uilder), converted to COP=	π gα of	
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Ameren Missouri	Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
		Formatted: Normal
Where:		
AkWh	= Energy Savings as calculated above	
CF	= Summer peak coincidence demand (kW) to annual energy (kWh) factor	
	= 0.0001492529 for Lighting RES (Residential)	
	= 0.0001899635 for Lighting BUS (Business)	
NATURAL GAS SAVIN	GS	
	itural Gas heated home:s ⁶⁶⁹	
	Watto	
	$\frac{Watts_{gase} - Watts_{gee}}{1,000} + Watts_{gase} + ISR + Hours + HF + 0.03412}$	
	<u>ATherms =</u>	
∆Therms=	-((Watts_Base - Watts_EE) / 1,000 * ISR * Hours * HF * 0.03412) / nHeat * % GasHeat	
Where:		
HF	= Heating Factor or percentage of light savings that must be heated	
	= 53% ⁶⁷⁰ for interior or unknown location = 0% for exterior or unheated location	
0.03412	=Converts kWh to therms	
ηHeat _{Gas}	= Efficiency of heating system	
	=71% ⁶⁷¹	
%GasHeat	= Percentage of homes with gas heat	
	Heating fuel %GasHeat	
	Electric 0%	
	Gas 100%	
	Unknown 65% ⁶⁷²	
WATER IMPACT DES	CRIPTIONS AND CALCULATION	
N/A		
MEASURE CODE:		
(0 · · ·		
²⁰⁹ Negative value because ⁶⁷⁰ This means that heating	his is an increase in heating consumption due to the efficient lighting. loads increase by 53% of the lighting savings. This is based on the average result from REMRate modeling of several different building configurations	

⁶⁷¹ This has been estimated assuming that natural gas central furnace heating is typical for Missouri residences (the predominant heating is gas furnace with 48% of Missouri homes (based on Energy Information Administration, 2009 Residential Energy Consumption Survey)). See reference-<u>HC6.0 Space Heating in Midwest Region Als.⁶⁷²</u>, <u>https://www.ed.agov/consumption/residential/data2009/hc/hc6.9.3kj.⁶⁴</u>, <u>https://www.ed.agov/consumption/residential/data2009/hc/hc6.9.3kj.⁶⁴, <u>ht</u></u>

2025 MEEIA 4 2019-21 Plan

Revision <u>8</u>7.0

Ameren Missouri Appendix I - TRM – Vol. 3: Residentia	Measures Formatted: Font: (Default) Arial, 12 pt
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3.5.3 LED Nightlights	Formatted: Font: Bold
DESCRIPTION	
This measure describes savings from LED nightlights. This characterization assumes that the LED nightlight is installed in a residenti	al location.
This measure was developed to be applicable to the following program types: TOS, NC.	
<u>DEFINITION OF BASELINE EQUIPMENT</u> For this characterization to apply, the high-efficiency equipment must be a qualified LED nightlight.	
To this characterization to appry, the ingliferitelency equipment must be a quantical EED inglitight.	Formatted: Body Text
<u>DEFINITION OF BASELINE EQUIPMENT</u> The baseline condition is assumed to be an incandescent/halogen nightlight.	
DEEMED LIFETIME OF EFFICIENT EQUIPMENT The estimated useful life of the is estimated is 8 years. ⁶⁷³	
DEEMED MEASURE COST Where possible, the actual cost should be used and compared to the baseline cost. If the incremental cost is unknown, assume \$3.35. ⁶¹	4
LOADSHAPE	
Lighting RES	
A1	
Algorithm	
CALCULATION OF SAVINGS	
ELECTRIC ENERGY SAVINGS	
$\Delta kWh = ((WattsBase - WattsEE) / 1000) * ISR * (1-Leakage) * Hours * WHFe$	
Where:	
Wattsbase = Actual wattage if known, if unknown, assume 7W. ⁶⁷⁵	
$Watts_{EE}$ = Actual wattage of LED purchased / installed.	
ISR= In Service Rate or the percentage of nightlights rebated that get installedLeakage= Adjustment to account for the percentage of program bulbs that move out.	
= Actual, or if unknown, 0% for Online Store and 4% for Upstream Lighting or 3.98% if unknown 676	Formatted: Indent: Left: 1", First line: 0.5"
$\frac{\text{Hours}}{= 4.380^{677}} = 4.380^{677}$	
LKG = leakage rate (program bulbs installed outside Ameren Missouri's service area)	
$\frac{= \text{Actual, or if unknown, assume } 0\%^{678}}{\text{ISR}} = \text{In Service Rate, the percentage of units rebated that are actually in service. Actual, or if unknown, assume:}$	Formatted: Space After: 0 pt
	Formatted: Font: (Default) Times New Roman
	Formatted: Font: (Default) Times New Roman
	Formatted: Font: (Default) Times New Roman
⁶⁷³ Southern California Edison Company, "LED, Electroluminescent & Fluorescent Night Lights", Work Paper WPSCRELG0029 Rev. 1, February 2009, p. 2. and	Formatted: Font: (Default) Times New Roman
⁶⁷⁴ Average cost data provided in Stanley Mertz, "LED Nightlights Energy Efficiency Retail products programs", March 2018.	Formatted: Font: (Default) Times New Roman
⁶⁷⁵ Based on Stanley Mertz, "LED Nightlights Energy Efficiency Retail products programs", March 2018. ⁶⁷⁶ Ameren Missouri Lighting Evaluation: PY2019. 3.98% is the weighted average for bulbs sold through the Online Store and Upstream Programs based on evaluation.	tion results and Formatted: Font: (Default) Times New Roman
the distribution of bulbs in the PY19 program, https://www.efis.psc.mo.gov/Document/Display/15876, page 13. ⁶⁷⁷ Assumes nightlight is operating 12 hours per day, consistent with the 2016 Pennsylvania TRM.	Formatted: Font: (Default) Times New Roman
678 Assumed based on program delivery channels.	Formatted: Font: (Default) Times New Roman
<u>2025</u> MEEIA <u>4</u> 2019-21 Plan Revision <u>8</u> 7.0	Page 161

meren Missouri	Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
		Formatted: Normal
	Program Discounted In Service	
	Direct Install (MFLI)MFIE 98.2%	
	679	
	SFIE, PAYSEfficiency Kit 100%	
	Low Income Kits 90%	
	Pay As You Save ⁶⁸⁴ 87%	
WHFe	= Waste Heat Factor for energy to account for the impact from reducing waste heat from efficient lighting on electric	
	$\frac{\text{cooling and heating loads in residential homes.}}{= 0.99 \text{ if unknown}^{682}}$	
WHFe _{Heat}	= Waste Heat Factor for energy to account for electric heating increase from reducing waste heat from efficient lighting (if	
	fossil fuel heating, see calculation of heating penalty in that section).	
	$\frac{= 1 - ((HF / \eta Heat) * \% ElecHeat)}{= If unknown assume 0.88^{683}}$	
Vhere		
HF	= Heating Factor or percentage of light savings that must now be heated = 53% ⁶⁸⁴ for interior location	
nHeat _{Electric}	= Efficiency in COP of Heating equipment	
	= Actual - If not available, use: ⁶⁸⁵	
	ηlleat	
	System Type Age of Equipment HSPF2 Estimate (COP Estimate) - (HSPE7)3 413360 85 - (HSPE7)3 413360 85 - (HSPE7)3 413360 85	
	Heat Pump Before 2006 5.8 1.44	
	(if age unknown After 2006 - 2014 6.5 1.62	
	assume 2006-2014) 2015 on 7.0 1.74 Resistance N/A N/A 1.00	
	Unknown ⁶⁸⁶ N/A N/A 1.28	
0/ Electreat	= Percentage of heating savings assumed to be electric	
<u>%ElecHeat</u>	= Percentage of nearing savings assumed to be electric	
	Heating fuel %ElectricHeat	
	Electric 100% Natural Gas 0%	
	Unknown 35% ⁶⁸⁷	
WHFe _{Cool}	= Waste Heat Factor for energy to account for cooling savings from reducing waste heat from efficient lighting	
, Ameren Missouri Com	nunity Savers Evaluation: PY2018, . https://www.efis.psc.mo.gov/Document/Display/36053, page 17.	
Ameren Missouri Effici	ent Kits Impact and Process Evaluation: Program Year 2018, https://www.efis.psc.mo.gov/Document/Display/15870, page 38.	
² Ameren Missouri PY20	s You Save (PAYS[®]) Evaluation, https://www.efis.psc.mo.gov/Document/Display/17591, page 7. 14 Evaluation, https://www.efis.psc.mo.gov/Document/Display/14194, page 45.	
³ Calculated using default	is: 1-((0.53/1.57) * 0.35) = 0.88. loads increase by 53% of the lighting savings. This is based on the average result from REMRate modeling of several different building configurations	
Iowa (Des Moines, Mas	on City, and Burlington). These results were judged to be equally applicable to Missouri.	
spect the average system	ficiencies are based on the applicable minimum federal standards. In 2006 and 2015, the federal standard for heat pumps was adjusted. While one would efficiency to be higher than this minimum, the likely degradation of efficiencies over time mean that using the minimum standard is appropriate.	
6 Calculation assumes 35	% Heat Pump and 65% Resistance, which is based upon data from Energy Information Administration, 2009 Residential Energy Consumption Survey, z mption/residential/data/2009/hc/hc6.9.xls; 'hc6.9.xls', Average efficiency of heat pump is based on assumption that 50% are units from before 2006 and	
ttps://www.eia.gov/consii	infrontentienti auto 2007 internet 2000 auto 2000	
0% from 2006-2014. Prog	ram or evaluation used should be used to implore this assumption if a variable.	

Ameren Missouri Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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Bulb Location WHFe _{Cool}	Formatted: Keep with next
Building with cooling 1.12 ⁶⁸⁸ Building without cooling 1.0	Formatted: Keep with next
<u>Unknown</u> <u>1.11⁶⁸⁹</u>	Formatted: Keep with next
	Formatted: Keep with next
SUMMER COINCIDENT PEAK DEMAND SAVINGS	
$\Delta kW = \Delta kWh * CF$	
Where:	
ΔkWh = Electric energy savings, as calculated above.	
CF = Summer peak coincidence demand (kW) to annual energy (kWh) factor	
= 0.0001492529 for Lighting RES (Residential)	
NATURAL GAS SAVINGS	
Heating Penalty for Natural Gas heated homes: ⁶⁹⁰	
$\Delta Therms = -((Watts_Base - Watts_EE) / 1,000 * ISR * Hours * HF * 0.03412) / \eta Heat * % GasHeat$	
Where:	
HF = Heating Factor or percentage of light savings that must be heated = 53% ⁶⁹¹ for interior or unknown location	
= 0% for exterior or unheated location	
0.03412 =Converts kWh to therms	
$\frac{\eta \text{Heat}_{\text{Gas}}}{=71\%^{692}} = \frac{\text{Efficiency of heating system}}{=71\%^{692}}$	
<u>%GasHeat</u> = Percentage of homes with gas heat	
Heating fuel%GasHeatElectric0%Gas100%Unknown65% ⁶⁹³	
WATER IMPACT DESCRIPTIONS AND CALCULATION N/A	
MEASURE CODE:	
⁶⁸⁵ The value is estimated at 1.12 (calculated as 1 + (0.34/2.8)), and it is based on cooling loads decreasing by 34% of the lighting savings (average result from REMRate modeling of several different building configurations in Iowa (Des Moines, Mason City, and Burlington)). The estimate also assumes typical cooling system operating efficiency of 2.8 COP (starting from standard assumption of SEER 10.5 central AC unit, converted to 9.5 EER using algorithm (-0.02 * SEER ²) + (1.12 * SEER) (from Wassmer, M. (2003); A Component-Based Model for Residential Air Conditioner and Heat Pump Energy Calculations. Masters Thesis, University of Colorado at Boulder), converted to COP = EER/3.412 = 2.8COP). Results of the Iowa study are assumed to be applicable to Missouri. ⁶⁰⁰ The value is estimated at 1.11 (calculated as 1 + (0.91*(0.34/2.8)), which is based on assumption that 91% of homes have central cooling (based on 2009 Residential Energy).	
Consumption Survey, see, https://www.eia.gov/consumption/residential/data/2009/hc/hc/6.9.xls').	

Consumption Survey, see: https://www.eia.gov/consumption/residential/data/2009/hc/hc6.9.xls; 'hc6.9.xls'). ⁶⁰⁰ Negative value because this is an increase in heating consumption due to the efficient lighting. ⁶⁰¹ This means that heating loads increase by 53% of the lighting savings. This is based on the average result from REMRate modeling of several different building configurations ⁶⁰² This means that heating loads increase by 53% of the lighting savings. This is based on the average result from REMRate modeling of several different building configurations ⁶⁰² This means that heating loads increase by 53% of the lighting savings. This is based on the average result from REMRate modeling of several different building configurations ⁶⁰² This has been estimated assuming that natural gas central furnace heating is typical for Missouri residences (the predominant heating is gas furnace with 48% of Missouri homes (based on Energy Information Administration, 2009 Residential Energy Consumption Survey)). See reference : https://www.eia.gov/consumption/residential/data/2009/hc/hc6.9.xls; 'hc6.9.xls'. In 2000, 29% of furnaces purchased in Missouri were condensing (based on data from GAMA, provided to Department of Energy during the federal standard setting process for residential heating equipment - see Furnace Penetration.xls). Furnaces tend to last up to 20 years, so units purchased 15 years ago provide a reasonable proxy for the current mix of furnaces in the State. Assuming typical efficiencies for condensing and non-condensing furnaces and duct losses, the average heating system efficiency is estimated as follows: (0.29*0.92) + (0.1*0.8)* (1-0.15) = 0.71, ⁶⁰³ Average (default) value of 55% gas space heating from 2009 Residential Energy Consumption Survey for Missouri. If utilities have specific evaluation results providing a more appropriate assumption for homes in a particular market or geographical area, then they should be used.

2025 MEEIA <u>4 2019-21</u> Plan

Revision 87.0

Ameren Missouri Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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<u>Ultra-Efficient LED Lighting</u>	
DESCRIPTION This characterization provides savings assumptions for a variety of ultra efficient LED screw-based lamp types including omnidirectional and	
This characterization provides savings assumptions for a variety of ultra efficient LED serew based lamp types including omnidirectional and specialty (globe, decorative and downlights) types. This characterization assumes that the LED lamp is installed in a residential location.	
This measure was developed to be applicable to the following program types: TOS and KITS.	
DEFINITION OF EFFICIENT EQUIPMENT	
In order for this characterization to apply, new lamps must exceed efficiency specifications defined in the Standard-Efficiency LED Baseline Wattage	Formatted: Body Text, Left
Tables below. Consult the tables to find the maximum wattage that can be considered ultra efficient for each bulb type. Actual lamp wattages of the efficient equipment should be used to determine savings.	
DEFINITION OF BASELINE EQUIPMENT See "Standard Efficiency LED Baseline Wattage" tables below for specific baseline wattages by lamp type and lumen output.	
DEEMED LIFETIME OF EFFICIENT EQUIPMENT	
According to the ENERGY STAR Qualified Products list (accessed 6/16/2020), the average rated life for Omnidirectional lamps is approximately	
20,000 hours, 17,000 hours for decorative and 25,000 for directional lamps.	
DEEMED MEASURE COST The actual ultra efficient LED lamp cost should be used. For incremental cost, assume a baseline cost according to the following table ⁸⁹¹ :	
Standard LED	Formatted: Space After: 6 pt
Bulb Type Baseline Cost	
Omnidirectional \$2.70 Directional \$5.18	Formatted: Left
Decorative and Globe <u>\$3.40</u>	Formatted: Left
LOADSHAPE	Formatted: Left
Lighting RES	
Lighting BUS	
Algorithm	
CALCULATION OF SAVINGS	
ELECTRIC ENERGY SAVINGS	
AkWh = (Watt _{Face} Watt _{FEE})* ISR * (1 LKG) * Hours * WHF / 1,000	
Where	
Wattsnee =Input wattage of the existing or baseline system. Reference the "Standard Efficiency LED Baseline Wattage" table for	
default values. ⁶⁶⁵	
Watts _{EE} = Actual wattage of LED purchased / installed must be used.	
⁶⁴⁴ Illinois TRM Version 12.0, https://www.ilsag.info/wp-content/uploads/IL-TRM_Effective_010124_v12.0_Vol_3_Res_09222023_FINAL_clean.pdf, page 366. Baseline and LED lamp costs are based on field data collected by CLEAResult and provided by ComEd. See 'ComEd Pricing Projections 06302016.xlsx' for analysis. Given LED prices are	Formatted: Font: (Default) Times New Roman
expected to continue declining assumed costs should be reassessed on an annual basis and replaced with IL specific LED program information when available.	Formatted: Font: (Default) Times New Roman
Lamp Updates 2021 06-09.xslx' for details on Guidehouse lamp wattage calculations based on equivalent baseline wattage and LED wattage of available ENERGY STAR product.	
2025 MEEIA 4 2019-21 Plan Revision 87.0 Page 164	

neren Missouri			A	ppendix I - TRM – Vol. 3: Residential Mea	SUITES Formatted: Font: (Default) Arial, 12 pt
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	Standard-Efficiency LEI) Baseline V	Vattage Tabk	e: Omnidirectional	Formatted: Space After: 6 pt, Keep with next
	Minimum		<u>Standard</u> Baseline W		Formatted: Font: Times New Roman
	Lumens		(WattsBr		Formatted: Keep with next
	120	399	4.0		Formatted Table
	400	749	4.0 6.6		Formatted: Keep with next
	750	899	9.6		Formatted: Keep with next
	<u>900</u>	<u>1,399</u>	<u>13.1</u>		Formatted: Keep with next
	1,400 2,000	<u>1,999</u> 2,999	<u>16.0</u> 21.8		Formatted: Keep with next
	<u>3,000</u>	3,299	28.9		Formatted: Keep with next
					Formatted: Keep with next
	Standard-Efficiency LED	Baseline W	attage Table	: Decorative Lamps	Formatted: Keep with next
		Minimu	Maximu		Formatted: Centered, Indent: Left: 0", Space After
	Bulb Type	m	m	Standard LED Baseline Wattage (Watts _{Bare})	pt, Keep with next
		Lumens	<u>Lumens</u>	Huttinge (Huttingage)	Formatted: Font: (Default) Times New Roman
	Omni-Directional	1,100	1,999	<u>14.7</u>	Formatted: Font: (Default) Times New Roman
	3-Way	2,000	2,700	22.6	Formatted Table
		<u>310</u>	<u>349</u>	<u>3.0</u>	
	<u>Globe</u>	<u>350</u>	<u>499</u>	<u>4.7</u>	Formatted: Font: (Default) Times New Roman
	(medium and intermediate bases less than 750 lumens)	<u>500</u>	<u>574</u>	5.7	
	thun /30 lumens)	<u>575</u>	<u>649</u>	<u>6.5</u>	
		<u>650</u>	<u>1,000</u>	<u>8.2</u>	
	Globe	<u>310</u>	<u>349</u>	<u>3.5</u>	Formatted: Font: (Default) Times New Roman
	<u>(candelabra bases less than 1050</u>	<u>350</u>	<u>499</u>	<u>4.4</u>	
	lumens)	<u>500</u>	<u>574</u>	<u>5.5</u>	
	<u>Decorative</u>	<u>310</u>	<u>499</u>	<u>4.3</u>	Formatted: Font: (Default) Times New Roman
	(Shapes B, BA, C, CA, DC, F, G,	500	000	5.0	
	medium and intermediate bases less than 750 lumens)	<u>500</u>	<u>800</u>	<u>5.8</u>	
	Decorative	310	499	4.2	Former thanks (Default) Times New Demon
	(Shapes B, BA, C, CA, DC, F, G,	510		<u></u>	Formatted: Font: (Default) Times New Roman
	candelabra bases less than 1050	500	650	5.5	
	lumens)		000	<u></u>	
	Description	<u>310</u>	<u>499</u>	<u>6.5</u>	
	Decorative (Chora CT)	500	999	<u>8.8</u>	Formatted: Font: (Default) Times New Roman
	(<u>Shape ST)</u>	1000	1500	<u>10.0</u>	
	Decorative (Shape S)	310	340	2.25	Formatted: Font: (Default) Times New Roman

<u>2025</u>MEEIA <u>4 2019-21</u> Plan

1

Revision <u>8</u>7.0

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	Standard-Efficiency LED	Baseline Wa	ttage Table: Dir	ectional Lamps
	<u>Bulb Type</u>	Minimum Lumens	<u>Maximum</u> Lumens	Standard LED <u>Baseline Wattage</u> <u>(Watts_{Base})</u>
		<u>400</u>	<u>649</u>	<u>7.0</u>
	Reflector lamp types with medium	<u>650</u>	<u>899</u>	<u>10.7</u>
	screw bases (PAR20, PAR30(S,L),	<u>900</u> 1,050	<u>1,049</u>	<u>13.9</u> 13.8
	PAR38, R40, etc.) w/ diameter >2.25"	1,030 1,200	<u>1,199</u> 1,499	<u>15.9</u>
		1,200 1,500	1,122 1,999	18.9
		2,000	3,299	27.3
	Reflector lamp types with medium	310	374	4.6
	screw bases (PAR16, R14, R16, etc.) w/ diameter <2.25"	375	600	<u>6.4</u>
		<u>650</u>	<u>949</u>	<u>9.3</u>
		950	1,099	<u>12.7</u>
	BR30, BR40, or ER40	<u>1,100</u>	<u>1,399</u>	<u>14.4</u>
		<u>1,400</u>	<u>1,600</u>	<u>16.6</u>
		<u>1,601</u> 450	<u>1,800</u>	<u>22.2</u>
	<u>R20</u>	450 525	<u>524</u> 750	<u>6.0</u> 7.1
		310	324	3.8
	MR16	325	369	4.8
		370	400	4.9

Standard-Efficiency LED Baseline Wattage Table: Additional EISA non-exempt bulb types

Bulb Type	<u>Minimum</u> <u>Lumens</u>	<u>Maximum</u> <u>Lumens</u>	<u>Standard LED Baseline</u> <u>Wattage (Watts_{Base})</u>
Dimmable Twist, Globe	<u>310</u>	<u>399</u>	<u>4.0</u>
(less than 5" in diameter	<u>400</u>	749	<u>6.6</u>
and > 749 lumens),	750	899	9.6
candle (shapes B, BA,	900	1,399	<u>13.1</u>
<u>CA > 749 lumens).</u> <u>Candelabra Base Lamps</u> (>1049 lumens). <u>Intermediate Base</u> Lamps (>749 lumens)	1,400	1,999	16.0

LKG = leakage rate (program bulbs installed outside Ameren Missouri's service area) = Actual, or if unknown, assume 0%⁶⁰⁶

ISR = In Service Rate, the percentage of units rebated that are actually in service. Actual, or if unknown, assume:

⁶⁹⁶ Assumed based on program delivery channels.

2025 MEEIA <u>4 2019-21</u> Plan

Revision <u>8</u>7.0

Appendix I - TRM – Vol. 3: Residential Measures Formatted: Font: (Default) Arial, 12 pt

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meren Missouri			Appe	<u>endix I - TRM – Vol. (</u>	3: Residential Measure	ures	Formatted: Font: (Def	ault) Arial, 12 p
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			Discounted In Se	rvico				
			Rate (ISR)	T VICC				
	Di	rect Install (MFLI) 697	<u>98.2%</u>					
		ficiency Kit (MF) ⁶⁹⁸	100%					
		w Income Kits	90%					
	Par	y As You Save⁶⁹⁹	87%					
Hours	- Average hours of use pe	r year for bulbs in resid	lential homes. Custo	m, or if unknown assum	e 1,314 ⁷⁰⁰ for exterior, o	or or		
	if interior use table below.							
		Program	HOULE	loc				
		Residential	995.18	701				
		Efficient Kits	995.1	8				
	Inc	ome Eligible RES	<u>674.18</u>					
		MFMR	<u>693.50</u>	703				
WHFe	_ = Waste Heat Factor for e	nergy to account for the	impact from reduci	ng waste heat from effic	ient lighting on electric			
	cooling and heating loads							
	= 0.99 if unknown ⁷⁰⁴							
WHFe _{Heat}	= Waste Heat Factor for e	nergy to account for ele	etric heating increas	e from reducing waste h	eat from efficient lightir	ıg (if		
	fossil fuel heating, see cale		alty in that section).					
	<u>= 1 ((HF / ηHeat) * %El</u>							
	= If unknown assume 0.88	3 ⁷⁰⁵						
HF HF <u>nHeat_{Electric}</u>	= Heating Factor or percer = 53% ²⁰⁶ for interior or un = 0% for exterior or unher = Efficiency in COP of He	known location ated location eating equipment	nat must now be heat	ed				
HF	= 53% ⁷⁰⁶ for interior or un = 0% for exterior or unher	known location ated location eating equipment	nat must now be heat	<u>ed</u>	_			
HF	 = 53%⁷⁰⁶ for interior or un = 0% for exterior or unher = Efficiency in COP of Here 	known location ated location eating equipment	nat must now be heat	ed <u>nHeni</u> (<u>COP Estimate)</u> =(ISPE2A.11298.85	1			
HF	= 53% ³⁰⁶ for interior or un = 0% for exterior or unher = Efficiency in COP of He = Actual If not available <u>System Type</u>	known location ated location eating equipment , use:²⁰⁷		sHeat (COPEstimate)				
HF	 = 53%²⁰⁶ for interior or un = 0% for exterior or unher = Efficiency in COP of He = Actual If not available 	known location ated location eating equipment .use: ⁷⁰⁷ Age of Equipment	HSPF2 Estimate	<u>nHeat</u> (<u>COP Estimate</u>) ⇒(RNF223,413)=0.85	-			
HF	<u>= 53%²⁰⁶ for interior or un = 0% for exterior or unher = Efficiency in COP of He = Actual If not available System Type Heat Pump</u>	Accord Europeant	HSPF2 Extimate	<u>nHent</u> (<u>COP Estimate)</u> =(RSPF223,413)≠0.85 <u>1.44</u>	-			
HF	= 53% ²⁰⁶ for interior or un = 0% for exterior or unher = Efficiency in COP of He = Actual If not available System Type Heat Pump (if age unknown	known location ated location eating equipment , use: ²⁰² Age of Equipment Before 2006 After 2006 2014	HSPF2 Estimate	allest (<u>COP Estimate)</u> =(IISPF2/3.413)*0.85 <u>1.44</u> <u>1.62</u>	-			
HF	= 53% ²⁰⁶ for interior or un = 0% for exterior or unher = Efficiency in COP of He = Actual If not available System Type Heat Pump (if age unknown assume 2006-2014)	known location ated location eating equipment -use: ²⁰² Age of Equipment Before 2006 After 2006 2014 2015 on	HSPF2 Estimate 5.8 6.5 7.0	nHent (<u>COP Estimate)</u> =(HSPF23,413)=0.85 <u>1-444</u> <u>1-62</u> <u>1-74</u>				
HF	= 53% ²⁰⁶ for interior or un = 0% for exterior or unher = Efficiency in COP of He = Actual If not available <u>System Type</u> <u>Heat Pump</u> (if age unknown assume 2006-2014) <u>Resistance</u>	known location ated location eating equipment <u>Age of Equipment</u> Before 2006 <u>After 2006 - 2014</u> <u>2015 on</u> <u>N/A</u>	HSPF2-Estimate 5.8 6.5 7.0 N/A	<u>nHeat</u> (<u>COP Estimate</u>) =(HSPF2/3.413)=0.85 <u>1:44</u> <u>1:62</u> <u>1:74</u> <u>1:00</u>				
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%ElecHeat	= Percentage of heating	savings assumed to be e	ectric					
<u> //Licerreat</u>	- I elecinage of heating	savings assumed to be e		_				
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WHEecost		energy to account for co	oling savings from red	lucing waste heat fro	n efficient lighting			
<u>,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,</u>	Thaste Head Pactor 10.	energy to decount for et	ioning our rings from rec	storing waste near no	<u>n emeren nganng</u>			
		Building with cooling	tion <u>4</u>	/HFe _{Gool} 1.12 ⁷¹⁰				
		Building without cooling		<u>1.0</u>				
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IMMER COINCIDI	INT PEAK DEMAND SAVE	ICS						
$\Delta kW = \Delta kW$	<u>h*CF</u>							
here:								
<u>AkWh</u>	= Electric energy saving	s, as calculated above.						
CF		ence demand (kW) to an	nual energy (kWh) fac	tor				
	= 0.0001492529 for Lig	hting RES (Residential)						
here:								
HF	Heating Factor or per = 53% ⁷¹³ for interior or	centage of light savings t	hat must be heated					
	= 0% for exterior or unl	weated location						
0.03412	—=Converts kWh to there = Efficiency of heating							
<u>ŋHeat_{Gas}</u>	$\frac{-71\%^{714}}{-71\%^{714}}$	system						
%GasHeat	= Percentage of homes	with gas heat						
Average (default) valu	e of 35% electric space heating fi	om 2009 Residential Energy (Consumption Survey for Mi	ssouri. If utilities have spe	aific evaluation results pro	viding a		
re appropriate assumpt	ion for homes in a particular mar	ket or geographical area, then	hey should be used.					
deling of several differ	at 1.12 (calculated as 1 + (0.34 / ent building configurations in Io	va (Des Moines, Mason City,	and Burlington)). The estim	ate also assumes typical c	oling system operating ef	ficiency of		
	indard assumption of SEER 10.5 for Residential Air Conditioner ((<u>2003); A</u>		
R/3.412 = 2.8COP). R	esults of the Iowa study are assun at 1.11 (calculated as 1 + (0.91*)	ed to be applicable to Missou	÷			Energy		
nsumption Survey, see	https://www.eia.gov/consumptio	n/residential/data/2009/hc/hc6	9.xls; 'hc6.9.xls').	mes nave central cooffig	Dased on 2009 Residential	LINCIET		
This means that heatin	e this is an increase in heating con g loads increase by 53% of the lip	hting savings. This is based o	the average result from Rl	EMRate modeling of seve	al different building confi	gurations		
Des Moines, Mason Ci	ty, and Burlington, Iowa. Result: d assuming that natural gas centr	of the Iowa study were judge	1 to be equally applicable to) Missouri.				
mes (based on Energy l	information Administration, 2009	Residential Energy Consump	ion Survey)). See reference	2				
wided to Department o	f Energy during the federal stand	ard setting process for resident	ial heating equipment see	Furnace Penetration.xls).	Furnaces tend to last up to	20 years.		
	rs ago provide a reasonable proxy re heating system efficiency is es		s in the State. Assuming ty 2) + (0.71*0.8)) * (1-0.15) =		susing and non-condensing	<u>-iurnaces</u>		
d duct losses, the avera	ge neuting system enterency is es	<u>, , , , , , , , , , , , , , , , , , , </u>						
d duct losses, the avera		() =						
1 duct losses, the avera		evision <u>8</u> 7.0			Pa	ge 168		

neren Missouri		Appendix I - TRM – Vol. 3: Residential M	leasures.	Formatted: Font: (Default) Arial, 12 pt
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	Heating fuel %GasHeat			
	<u>lectric</u>			
	Jas <u>100%</u> Jnknown <u>65%⁷¹⁵</u>			
ATER IMPACT DESCRIPTIONS AND CALCU	LATION			
CASURE CODE:				
Average (default) value of 65% gas space heating fro ropriate assumption for homes in a particular market	m 2009 Residential Energy Consumption Survey or geographical area, then they should be used.	for Missouri. If utilities have specific evaluation results provi	ding a more	
-				

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Appendix I - TRM - Vol. 3: Residential Measures

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3.6 Motors

3.6.1 High Efficiency Pool Pumps

DESCRIPTION

Residential outdoor pool pumps can be single speed, two/multi-speed or variable speed. A federal standard (82 FR 5650) effective July 19, 2021 effectively requires pool pumps to be at least two speed.

Single speed pumps are often oversized, and run frequently at constant flow regardless of load. Single speed pool pumps require that the motor be sized for the task that requires the highest speed. As such, energy is wasted performing low speed tasks at high speed. Two-speed and variable speed pool pumps reduce speed when less flow is required, such as when filtering is needed but not cleaning, and have timers that encourage programming for fewer on hours. Variable speed pool pumps use advanced motor technologies to achieve efficiency ratings of 90% while the average single speed pump will have efficiency ratings between 30% and 70%.²¹⁴ This measure is the characterization of the purchasing and installing of a new ENERGY STAR variable speed residential pool pump motor in place of a new baseline pump meeting the federal standard for Time of Sale and New tion, or the early replace ent of a standard single speed motor of equivalent he

This measure was developed to be applicable to the following program types: TOS, NC, and RF.

If applied to other program types, the measure savings should be verified.

DEFINITION OF EFFICIENT EQUIPMENT

The high efficiency equipment is an ENERGY STAR[®] variable speed residential pool pump for in-ground pools.

DEFINITION OF BASELINE EQUIPMENT

For TOS and NC, the baseline equipment is a two speed residential pool pump meeting the Federal Standard, effective July 19, 2021 provided below:

Extra Small (hhp ≤ 0.13)	$WEF \ge 5.55$
Small (hhp > 0.13 and < 0.711)	WEF ≥ -1.30 x ln (hhp) + 2.90
Standard Size (hhp ≥ 0.711)	WEF ≥ 2.30 x ln (hhp) + 6.59

For early replacement, the baseline is the existing single speed residential pool pump.

DEEMED LIFETIME OF EFFICIENT FOURMENT

The estimated useful life for a two speed or variable speed pool pump is 10 years.717

DEEMED MEASURE COST

For TOS and NC, the incremental cost is estimated \$314 for a variable speed motor.718

For early replacement, the actual cost of the measure should be used; if actual is unknown, use \$549.719

LOADSHAPE

Pool Spa RES

214 U.S. DOE, 2012. Measure Guideline: Replacing Single-Speed Pool Pumps with Variable Speed Pumps for Energy Savings. Report No. DOE/GO-102012-3534.

ENERGY STAR[®] Pool Pump Calculator assumptions. ¹⁴⁷ Hinois TRW Version 12.0, https://www.ilsag.info/wp-content/uploads/IL-TRM_Effective_010124_v12.0_Vol_3_Res_09222023_FINAL_clean.pdf, page 408._ ENERGY STAR® Pool Pump Calculator, using the difference between the two speed pool pump and variable speed pool pump incremental costs.
²⁴⁹ ENERGY STAR® Pool Pump Calculator, estimated cost for a variable speed pool pump____

https://www.energystar.gov/productfinder/downloads/Pool-Pump_Calculator_2020.05.05_FINALx1sx (https://view.officeapps.live.com/op/view.aspx?src=https%3A%2P%2Fwww.energystar.gov%2Fproduc x&wdOrigin=BROWSELINK). -------oductfinder%2Fdownloads%2FPool_Pump_Calculator_2020.05.05_FINAL.xls

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Revision 87.0

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	Algorithm	
Cur our imposion Fa	<u> </u>	
CALCULATION OF EN	IERGY SAVINGS	
Electric Energy Saving	99 ⁷³⁹	
For TOS and NC:		
<u>AkWh</u>	= (Gallons * Turnovers * (1/(WEF _{ee} - 1/WEF _{ee}) * Days) / 1,000 * ISR	
For Early Replacemen	<u>#</u>	
AkWh	= (Gallons * Turnovers * (1/EF_{ected} - 1/WEF_{ect}) * Days) / 1,000 * ISR	
For TOS and NC:	$\Delta kWh = \left(Gallons * Turnovers * \left(\frac{1}{2} - \frac{1}{2} \right) * Days \right) / 1.000 * ISR$	
For Early Replacemen	$\left(\frac{WEF_{base}}{WEF_{ee}}\right)$	
	$\Delta kWh = \left(\frac{Gallons * Turnovers * \left(\frac{\pi}{EF_{exist}} - \frac{\pi}{WEF_{ee}}\right) * Days\right) / 1,000 * ISR$	
Where:		
Gallons	- Capacity of the pool. Use actual, or if unknown assume 22,000. ⁷²¹	
Turnovers	- Desired number of pool water turnovers per day	
WEF _{base}	—= 2 ⁷²³ —= Weighted Energy Factor of baseline pump (gal/Wh)	
WEF	= <u>Actual, or if unknown, assume 4</u> .6 ⁷²³ = Weighted Energy Factor of installed ENERGY STAR pump (gal/Wh)	
EF _{axiat}	<u>– Actual, or if unknown, assume 6.31²²⁴</u>	
	= Energy Factor of existing single speed pump (gal/Wh) = <u>Actual, or if unknown, assume 2.3725</u>	
Days	—= Days per year of operation —= 121.62 ⁷⁷⁶	
1,000 ISR	—= Conversion factor from Wh to kWh —= In Service Rate ²²⁷	
	- Actual, or if unknown 100% ⁷²⁸ for the Efficiency Products Program.	
²⁰ <u>Ibid.</u> The methodology f his has not been updated to	followed is consistent with the most recent version of the 2020 ENERGY STAR calculator (Pool_Pump_Calculator_2020.05.05_FINAL.xlsx), however o account for the new federal standard_https://www.energystar.gov/productfinder/downloads/Pool_Pump_Calculator_2020.05.05_FINAL.xlsx.	
²¹ <u>Ibid.</u> Consistent with ass attps://www.energystar.gov	sumption in the 2020 ENERGY STAR calculator (Pool_Pump_Calculator_2020.05.05_FINAL.xlsx), //productfinder/downloads/Pool_Pump_Calculator_2020.05.05_FINAL.xlsx,	
	TRM V10.0 assumption, which is based Based on applying the federal standard specifications to the average Curve C rated hydraulic horsepower	
24 Ibid. Consistent with IL	TAR Qualified Products List, accessed 3/31/2021. TRM V10.0 assumption, which is <u>B</u> based on applying the ENERGY STAR specifications to the average Curve C rated hydraulic horsepower (hhp)	
25 Ibid. Consistent with ass	Qualified Products List, accessed 3/31/2021. sumption in the 2020 ENERGY STAR calculator, assuming 1-5 HP pump ('Pool_Pump_Calculator_2020.05.05_FINAL.xlsx');	
²⁶ Ibid. Consistent with ass	//productFinder/downloads/Pool_Pump_Calculator_2020.05.05_FINAL.xlsx. sumption in the 2020 ENERGY STAR calculator (2000.05.05_FINAL.xlsx_), (a) b = 5 + (b) = 1 + (b) + (b) = 1 + (b) + (b) = 2020 + (b) + (b) + (b) = 2020 + (b) +	
¹²⁷ -Ameren Missouri Efficie	//productFinder/downloads/Pool_Pump_Calculator_2020.05.05_FINAL.xlsx. ent Products Evaluation PY2019 (Table 6-9)Ameren Missouri Efficient Products Evaluation: PY2019.	Formatted: Highlight
128 Ibid. Consistent with ass	w/Document/Display/15876_pnge_67_ sumption in the 2020_ENERGY_STAR_calculator, assuming_1.5 HP pump_('Pool_Pump_Calculator_2020.05.05_FINAL_xlsx'); useratorificational control from the provided of the pump_calculator_2020.05.05_FINAL_xlsx');	
ttps://www.energystar.gov	//productfinder/downloads/Pool_Pump_Calculator_2020.05.05_FINAL.xlsx_	
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Summer Coincide	NT PEAK DEMAND SAVINGS		Formatted: Heading 4
$\Delta kW = \Delta kW$	<u>h∗CF</u>		
Vhere:			
AkWh	= Electric energy savings, as calculated above.		
CF	= Summer peak coincidence demand (kW) to annual en	$\frac{\text{ergy (kWh) factor}\Delta kW = \Delta kWh * CF}{2}$	Formatted: Indent: First line: 0.5"
	= 0.0002354459Where:		Formatted: Indent: Left: 0", First line: 0.5"
41.3371			Formatted: Indent: Left: 1", First line: 0.5"
AkWh CF	 Energy Savings as calculated above Summer peak coincidence demand (kW) to annual end 0.0002354459 	rgy (kWh) factor	
Iatural Gas Savi ⊮A	NGS		
V ater Impact De ⊮A	SCRIPTIONS AND CALCULATION		
<mark>∂eemed O&M Cos</mark> ₩A	T Adjustment Calculation		
MEASURE CODE:			
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Ameren Missouri Appendix I - TRM – Vol. 3: Residentia	I Measures Formatted: Font: (Default) Arial, 12 pt
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<u>3.73.6</u> Building Shell	
3.7.1 Air Sealing	
DESCRIPTION Thermal shell air leaks are sealed through strategic use and location of air-tight materials. An estimate of savings is provided in two way recommended that leaks be detected and pre- and post-sealing leakage rates measured with the assistance of a blower-door by quali inspectors. ⁷²⁹ Where this occurs, an algorithm is provided to estimate the site-specific savings. Where test in/test out has not occurred, a deemedprescriptive savings assumption is provided.	ified/certified
This measure was developed to be applicable to the following program type: RF.	
If applied to other program types, the measure savings should be verified.	
DEFINITION OF EFFICIENT EQUIPMENT Air sealing materials and diagnostic testing should meet all eligibility program qualification criteria. The initial and final tested leakage be assessed in such a manner that the identified reductions can be properly discerned, particularly in situations wherein multiple build measures may be implemented simultaneously.	
DEFINITION OF BASELINE EQUIPMENT The existing air leakage should be determined through approved and appropriate test methods using a blower door. The baseline c building upon first inspection significantly affects the opportunity for cost-effective energy savings through air sealing.	condition of a
DEEMED LIFETIME OF EFFICIENT EQUIPMENT The expected measure life is assumed to be 2045 years. ⁷³⁰	
DEEMED MEASURE COST The actual capital cost for this measure should be used.	
LOADSHAPE Building Shell RES	
Algorithm	
CALCULATION OF SAVINGS	
¥	
CALCULATION OF SAVINGS ELECTRIC ENERGY SAVINGS	
CALCULATION OF SAVINGS ELECTRIC ENERGY SAVINGS Methodology 1: Test In / Test Out Approach ΔkWh = $\Delta kWh_{cooling} + \Delta kWh_{heating}$	Formatted: No underline
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CALCULATION OF SAVINGS ELECTRIC ENERGY SAVINGS Methodology 1: Test In / Test Out Approach ΔkWh = $\Delta kWh_{cooling} + \Delta kWh_{heating}$ ΔkWh = $\Delta kWh_{cooling} + \Delta kWh_{heating}$ If the home has central cooling, the electric energy saved in annual cooling due to the air sealing is: Where:	
O CALCULATION OF SAVINGS ELECTRIC ENERGY SAVINGS Methodology 1: Test In / Test Out Approach ΔkWh $\Delta kWh_{cooling} + \Delta kWh_{heating}$ $\Delta kWh = \Delta kWh_{cooling} + \Delta kWh_{heating}$ If the home has central cooling, the electric energy saved in annual cooling due to the air sealing is: Where: $\Delta kWh_{cooling} + \Delta kWh_{cooling} + \Delta kWh_{heating}$ If the home has central cooling, the electric energy saved in annual cooling due to the air sealing is: Where: $\Delta kWh_{cooling} + \Delta kWh_{cooling} - CFM50_{Poss}) / N_{cool}) * 60 * 24 * CDD * DUA * 0.018 * LM) / ((1.000 * \etaCool) = 16 central cooling, reduction in annual cooling requirement due to air sealing $	ol)) Formatted: Indent: Left: 0", First line: 0" Formatted: Indent: Left: 0", First line: 0", No
O CALCULATION OF SAVINGS ELECTRIC ENERGY SAVINGS Methodology 1: Test In / Test Out Approach ΔkWh $\Delta kWh_{cooling} + \Delta kWh_{heating}$ $\Delta kWh = \Delta kWh_{cooling} + \Delta kWh_{heating}$ If the home has central cooling, the electric energy saved in annual cooling due to the air sealing is: Where: $\Delta kWh_{cooling} + \Delta kWh_{cooling} + \Delta kWh_{heating}$ If the home has central cooling, the electric energy saved in annual cooling due to the air sealing is: Where: $\Delta kWh_{cooling} + \Delta kWh_{cooling} - CFM50_{Poss}) / N_{cool}) * 60 * 24 * CDD * DUA * 0.018 * LM) / ((1.000 * \etaCool) = 16 central cooling, reduction in annual cooling requirement due to air sealing $	ol)) Formatted: Indent: Left: 0", First line: 0" Formatted: Indent: Left: 0", First line: 0", No widow/orphan control Formatted: Indent: Hanging: 0.5", Widow/Orphan
C CALCULATION OF SAVINGS ELECTRIC ENERGY SAVINGS Methodology 1: Test In / Test Out Approach ΔkWh $\Delta kWh_{cooling} + \Delta kWh_{heating}$ $\Delta kWh = \Delta kWh_{cooling} + \Delta kWh_{heating}$ If the home has central cooling, the electric energy saved in annual cooling due to the air sealing is: Where: $\Delta kWh_{cooling} - ((CFM50p_{pc} - CFM50p_{oos}) / N_{cool}) * 60 * 24 * CDD * DUA * 0.018 * LM) / ((1.000 * \etaCool) = 16 central cooling, reduction in annual cooling requirement due to air sealing $	ol)) Formatted: Indent: Left: 0", First line: 0" Formatted: Indent: Left: 0", First line: 0", No widow/orphan control Formatted: Indent: Hanging: 0.5", Widow/Orphan control

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	$=\frac{\left(\frac{CFM50_{Pre}-CFM50_{Post}}{N_{coot}}\right)*60*24*CDD*DUA*0.018*LM}{(1000*nCool)}$		
CFM50 _{Pre}	= Infiltration at 50 Pascals as measured by blower door before air sealing = Actual ⁷³¹		
CFM50 _{Post}	 Infiltration at 50 Pascals as measured by blower door after air sealing Actual 		

1

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Revision <u>8</u>7.0

⁷³¹ Because the pre- and post-sealing blower door test will occur on different days, there is a potential for the wind and temperature conditions on the two days to affect the readings. There are methodologies to account for these effects. For wind – first, if possible, avoid testing in high wind, place blower door on downwind side, take a pre-test baseline house pressure reading, adjust house pressure readings by subtracting the baseline reading, and use the time averaging feature on the digital gauge, etc. Corrections for air density due to temperature swings can be accounted for with air density correction factors. Refer to the Energy Conservatory Blower Door Manual for more information.

		Formatted: Normal
N _{cool}	= Conversion factor from leakage at 50 Pascal to leakage at natural conditions	
	=Dependent on number of stories: ⁷³²	
	Weather Basis (City based upon) N_cool (by # of stories) 1 1.5 2 3	
	St Louis, MO 34.9 30.9 28.3 25.1	
60 * 24	= Converts cubic feet per minute to cubic feet per day	
CDD	= Cooling Degree Days: ⁷³³	
	Weather Basis (City based upon) CDD 65	
	St Louis, MO 1.646	
DUA	= Discretionary Use Adjustment (reflects the fact that people do not always operate their AC when conditions may call for	
	it)	
0.018	= 0.75 ⁷³⁴ = Specific heat capacity of air (Btu/ft ³ *°F)	
1000	= Specific near capacity of air $(Btu/ft^* F)$ = Converts Btu to kBtu	
ηCool	= Efficiency (SEER2) of air conditioning equipment (kBtu/kWh)	
10001	= Actual (where it is possible to measure or reasonably estimate) - if unknown, assume the	
	following: 735	
	Age of Equipment nCool Estimate	
	Before 2006 9.5	
	2006 - 2014 12.4 Central AC After 1/1/2015 12.4	
	Heat Pump After 1/1/2015 13.3	
	following: ²²⁶	
	Age of SEER	
	Equipment Estimate	
	Before 10 2006	
	2006- 43	
	2014	
	Central AC 13	
	After 1/1/2015	
	Heat Pump 14	
	After	
	1/1/2015	
LM	= Latent multiplier to account for latent cooling demand: ⁷³⁷	
732 N-factor is used to co	wert 50-pascal blower door air flows to natural air flows and is dependent on geographic location and # of stories. These were developed by applying the	

Sherman, 1986; page v-vi, Appendix page 7-9, <u>https://eta-publications.lhl.gov/sites/defaul/files/excgesis.of</u>, <u>proposed_ashrae_std_119.pdf</u>;
<u>texcgesis_of_proposed_ashrae_std_119.pdf</u>;
<u>texcgesis</u>

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Revision 87.0

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			Weath St Lou	er Basis (City based	upon)	LM 3.0			
i	If the home is bested a	uith alastnia hast		·	in an anna an an Air		in continue iou		
	If the nome is heated w	vith electric heat	(resistance or)	heat pump), the electri	ic energy saved in	n annual heating due to the ai	ir sealing is:		
	<u>AkWh_{HeatingElectricGas}</u> Ak	Wh_heating				$\frac{D * 0.018}{(\eta \text{Heat} * 3,412)}$	+	For	matted: Indent: Left: 0"
	= If electric heat (resist Where:	tance or heat pun	np), reduction	in annual electric heat	ing due to air sea	ling	•	For	matted: Indent: Left: 0", First line: 0"
									matted: Indent: Left: 0", Hanging: 0.5",
			1	CFM50 _{pre} – CFM5 <u>N-heat</u>	50_{POSE}) * 60 * 2	24 * <i>HDD</i> * 0.018		Wid	ow/Orphan control
				(i	9Heat * 3,412)				
I	<u>N_{heat}N_heat</u>	= Conv = Based on bui		from leakage at 50 Pas	scal to leakage at	natural conditions			
			Weather (City base		N_heat (by # o 1.5	of stories)	•	For	matted: Keep with next
		St	Louis, MO	24.	0 21.3	19.5 17.3	+	For	matted: Keep with next
•	HDD	= Heating Deg	ree Days						
			Weathe	r Basis (City based up	on)	HDD 65			
1		5	St Louis, MO			4_486			
	ηHeat	= Efficiency of = Actual - if no		n er to default table belo	ow: ⁷³⁹				
		System Type	Age of Equip	ment HSPF Estimate	ηHeat (Ε (Ε				
			Before 2006	6.8		1.7	_		
		Heat Pump	2006 - 2014 2015 and after	7.7 8.2		1.92 2.04	-		
		Resistance	N/A	N/A		4			
		Syster	<u>m Type</u>	Age of Equipment		<u>nHeat</u> (COP Estimate)	<u>م</u> ـــ	For	matted Table
		Heat Pump		Before 2006	5.8	<u>= (HSPF2/3.413)*0.85</u> 1.44			
		(if age unk	nown	After 2006 - 2014	6.5	<u>1.62</u>			
		assume 20		2015 on	<u>7.0</u> N/A	<u>1.74</u> 1.00			
		Resistance Unknown ⁷		N/A N/A	N/A N/A	1.28			
I	2/17					<u> </u>			
	3412	= Converts Btu	ı to kWh						
	738 N-factor is used to conve	ert 50-nascal blower	door air flows to	natural air flows and is den	endent on geographic	c location and # of stories. These w	ere developed by applying the		
i i	LBNL infiltration model (se Sherman, 1986; page v-vi, A	ee LBNL paper 2104 Appendix page 7-9).	0, Exegisis of Pro https://eta-publica	posed ASHRAE Standard ations.lbl.gov/sites/default/	119: Air Leakage Per files/exegesis of pro	rformance for Detached Single-Fan posed ashrae std 119.pdf) to the	nily Residential Buildings; reported wind speeds and		
	outdoor temperatures provid and calculation worksheets.	ded by the NRDC 30	year climate nor	nals. For more information	see Bruce Harley, C	LEAResult "Infiltration Factor Cal	lculations Methodology.doc"	_	
	739 These default system eff	iciencies are based o				standard for heat pumps was adjust that using the minimum standard is		For	matted: Font: (Default) Times New Roman
	distribution efficiency is the	en applied to account	for duct losses for	r heat pumps.		0		For	matted: Font: (Default) Times New Roman
	https://www.eia.gov/consun	nption/residential/da	ta/2009/hc/hc6.9.:	ds; 'hc6.9.xls', Average ef	ficiency of heat pum	Administration, 2009 Residential p is based on assumption that 50%	Energy Consumption Survey, 3 are units from before 2006 and	\sim $-$	matted: Font: (Default) Times New Roman
I	50% from 2006-2014. Prog	ram or evaluation da	ta should be used	to improve this assumption	if available			For	matted: Font: (Default) Times New Roman
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Deemed Ap	proach			
ingsPerU i				
zsPerUnit -	- Annual saving	s per square foot, dependent on heating / coolir	ng equipment ⁷⁴¹	
			0.1.	
		HVAC System	SavingsPerUnit (kWh/ft)	
	Manufactured	Central Air Conditioner	0.062	
	Multifamily	Central Air Conditioner	0.043	
	Single Family	Central Air Conditioner	0.050	
	Manufactured	Electric Furnace/Resistance Space Heat	0.413	
	Multifamily	Electric Furnace/Resistance Space Heat	0.285	
	Single Family	Electric Furnace/Resistance Space Heat	0.308	
	Manufactured	Air Source Heat Pump	0.391	
	Multifamily	Air Source Heat Pump	0.251	
	Single Family	Air Source Heat Pump	0.308	
	Manufactured	Air Source Heat Pump - Cooling	0.062	
	Multifamily	Air Source Heat Pump - Cooling	0.043	
	Single Family	Air Source Heat Pump - Cooling	0.050	
	Manufactured	Air Source Heat Pump – Heating	0.329	
	Multifamily	Air Source Heat Pump - Heating	0.208	
	Single Family	Air Source Heat Pump - Heating	0.257	

²⁴¹ The values in the table represent estimates of savings from a 15% improvement in air leakage. The values are half those provided by Cadmus for the Iowa Joint Assessment, based on building simulations performed. While 30% savings are certainly achievable, this represents a thorough job in both the attic and basements and could not be verified without testing. The conservative 15% estimate is more appropriate for a deemed estimate. These values should be re-evaluated if EM&V values provide support for a higher deemed estimate.

<u>2025 MEEIA <u>4</u> 2019-21 Plan</u>

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Revision <u>8</u>7.0

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If the building is fans will run less.	heated with a gas furnace, the	re will be some electric sav	ings in heating t	he building at	tributed to	air sealing since	the furnace		
Additional Fan sa	avings						4		atted: Space After: 8 pt, Line spacing: Multiple , Widow/Orphan control, Don't keep lines er
<u>∆kWh_{HeatingGas}</u> <u>Ak</u>	$\frac{\Delta Th}{\Delta Th}$	erms * F _e * 29.3 If gas <i>furne</i>	ace heat, kWh sa	wings for red	uction in fa	in run time	•	Forma	atted: Indent: Left: 0", First line: 0"
Where:	- ATherms * I	7 * 20 2							
Fe	= Furnace fan energy o	consumption as a percentag	e of annual fuel	consumption			•	Forma	atted: Indent: Left: 0", First line: 0.5"
29.3	$= 3.14\%^{742}$ $= kWh per therm$						+	Forma	atted: Indent: Left: 0", First line: 0.5"
Methodology 2: H	Prescriptive Infiltration Reduc	tion Measures ⁷⁴³							
Savings shall only	y be calculated via Methodolo	gy 2 if a blower door test is	s not conducted.						
A 1-33/1	(41.337)							Forma	atted: No underline
ΔkWh	$= (\Delta kWh_{cooling} + \Delta kW)$	<u>heating)</u>					•		atted: Indent: Left: 0", First line: 0", Line spacing e, No widow/orphan control
If the home has co	entral cooling, the electric ene	rgy saved in annual cooling	g due to the air s	ealing is:				Usingi	
$\Delta kWh_{cooling} = (\Delta k)$	$KWh_{cool_{gasket}} * n_{gasket} + \Delta kWh_{cool_{gasket}}$	$n_{sweep} * n_{sweep} + \Delta kWh_{cool}$	$_{ealing} * lf_{sealing} + \Delta$	kWh _{cool_wx} * 1	lf _{wx}) * AD.	J _{RxAirsealing}	+	Forma	atted: Indent: Left: 0", First line: 0"
If the home is hea	ated with electric heat (resistar	nce or heat pump), the elect	ric energy saved	l in annual hea	ating due to	o the air sealing is	:		
	= $(\Delta k W h_{heat_gasket} * n_{gasket} + \Delta k$				-				
<u>∆K W Nheatingelectric</u> =	= $(\Delta K W \Pi_{heat_gasket} ~ \Pi_{gasket} + \Delta K)$	W find the sweep $\sim n_{sweep} + \Delta K W f$	heat_sealing " IIsealin	$hg + \Delta K W n_{heat}$	_{wx} * II _{wx}) *	%ElectricHeat *	ADJ _{Rx} Airsealing	Forma	atted: Indent: Left: 0", First line: 0"
Where:	Norschause Caracteria i						+	Forma	atted: Indent: Left: 0", First line: 0"
ngasket nsweep	= Number of gaskets in = Number of sweeps in								
<u>lf_{sealing}</u>		ng, sealing, or polyethylene							
<u>lf_{wx}</u>	= Linear feet of windo	w weatherstripping or door	weatherstrippin	g					
		Savings	<u>AkWhheat/l</u>	<u>Unit</u>	ΔkWho	:ool/Unit			
	<u>Measure</u>	<u>Variable</u> <u>Ele</u> <u>Names</u> <u>Resi</u>	stance Heat Pump		<u>With</u> <u>Cooling</u>	Unknown Cooling			
	Outlet Gasket	$\frac{\Delta kWh_{cool \ gasket}}{\Delta kWh_{heat \ gasket}}$	<u>7.19</u> <u>3.59</u>	<u>5.9</u>	<u>1.63</u>	<u>1.07</u>			
	Door Sweep	$\frac{\Delta kWh_{cool_sweep}}{\Delta kWh_{heat_sweep}}$	<u>138.2</u> <u>69.1</u>	<u>114.0</u>	<u>6.39</u>	<u>4.22</u>			
742 E is not 6 -1	e AHRI certified ratings provided fo	reacidential furne hot 1	aaaanahluti 1	from a 11	on hos-1 -	the contificational to a first	r fuel energy (Tf		
in MMBtu/yr) and Ea	ae (kWh/yr). An average of a 300-rea 2% F _e . See "Furnace Fan Analysis.	cord sample (non-random) out of	1495 was 3.14%. T	This is, appropria	tely, ~50% g	reater than the ENER	GY STAR®		
743 Illinois TRM Vers	sion 12.0, https://www.ilsag.info/wp- on "Evaluation of the Weatherization	content/uploads/IL-TRM Effecti							
30, 2015, and adjuste	ed for relative HDD of Bridgeport/Ha dbook – Fundamentals, Chapter 26, 7	utford CT with the applicable we	ather data. Cooling	savings derived	using savings	assumptions pulled f	rom ASHRAE,		
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2025 MEEIA 42	2010-21 Plan	Revision <mark>87</mark> .0					Page 178		
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				Арр	endix I - 1	<u> RM – Vo</u>	. 3: Residen	tial Measure	3	Formatted: Font: (Default) Arial, 12 pt	
										Formatted: Normal	
	Caulking/Sealing/Polyethylene	$\Delta kWh_{cool\ sealing}$									
	Tape	$\Delta kWh_{heat sealing}$	<u>7.91</u>	<u>3.95</u>	<u>6.5</u>	<u>0.17</u>	<u>0.11</u>				
	Window or door weatherstripping	$\Delta kWh_{cool wx}$ $\Delta kWh_{heat wx}$	<u>9.19</u>	<u>4.59</u>	<u>7.6</u>	0.16	<u>0.11</u>				
	weddiotsaipping	ΔK W IIheat_wx								Remarked Indext Left: 01	
%ElectricHe	eat = Percentage of homes with	h electric heat								Formatted: Indent: Left: 0"	
	Heat Electric	ting fuel <u>%</u>	<u>6 ElectricH</u> 100%	eat							
	Natural Gas		0%								
	<u>Unknown</u>		<u>35%⁷⁴⁵</u>								
ADI	g = Adjustment for air sealing	a covinge to poor	t for proce	riptive esti-	nates overal	aiming age	nge746				
<u>ADJ_{RxAirsealin}</u>	g = Adjustment for air sealing= 80%	g savings to accoun	a for prese	uprive estin	nates overci	anning savi	ngs				
name Conversion											
UMMER COINCID	ENT PEAK DEMAND SAVINGS	,									
$\Delta kW = \Delta kW$	/ <u>h * CF</u>										
here:											
∆kWh	= Electric energy savings, a	a coloulated above									
CF	= Summer peak coincidence			rgy (kWh) f	factor 4kW	$= \Delta kWh$	* <u>CF</u>			Formatted: Indent: Left: 0". First line: 0.5"	
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AkWh	$= 0.0004660805^{747}$ Where:	4 . 4 . 4							•	Formatted: Indent: Left: 1", First line: 0.5", Space Arte	· ·
	= Energy Savings as calcula	ted above								After: 0 pt	ace
			nnual ener	$\alpha v (kWh) f$	actor					Alter. Upt	
CF	Summer peak coincidence = 0.0004660805 ⁷⁴⁸		nnual ener	gy (kWh) f	actor					Alter. opt	
CF	= Summer peak coincidence = 0.0004660805 ⁷⁴⁸		nnual ener	gy (kWh) f í	actor					Alter. o pr	
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CF ATURAL GAS SAV lethodology 1: Tes natural gas heating Therms	$= \frac{\text{Summer peak coincidence}}{= 0.0004660805^{248}}$ INGS t In / Test Out Approach 3: $= (((CFM50_{Pre} - CFM50_{Post}) - \frac{(CFM50_{Pres} - CFM50_{Post})}{N_{-}heat}$	<pre>> demand (kW) to a / N_{heat}) * 60 * 24 * 1 > + 60 * 24 * HD</pre>		118) / (nHer)				And. Upt	
CF ATURAL GAS SAV ethodology 1: Tes natural gas heating	$= \frac{\text{Summer peak coincidence}}{= 0.0004660805^{248}}$ INGS t In / Test Out Approach 3: $= (((CFM50_{Pre} - CFM50_{Post}) - \frac{(CFM50_{Pres} - CFM50_{Post})}{N_{-}heat}$	9 demand (kW) to a		118) / (nHer)				And. Upt	
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meren Missouri	Арре	ndix I - TRM – Vol. 3: Residential	Measures.	Formatted: Font: (Default) Arial, 12 pt
				Formatted: Normal
	Weather Basis N_heat (by # of s	tories)		
		2 3		
UDD		9.5 17.3		
HDD	= Heating Degree Days			
		0D 65 486		
ηHeat	= Efficiency of heating system			
	= Equipment efficiency * distribution efficiency = $Actual^{750}$ - if not available, use $71\%^{751}$			
	,			
Other factors	is defined above			
ethodology 2: Presc	iptive Infiltration Reduction Measures ⁷⁵²			
vings shall only be	alculated via Methodology 2 if a blower door test is not conducted.			
nservative Deemed	Approach			
he home is heated	vith electric heat (resistance or heat pump), the electric energy saved in a	nnual heating due to the air sealing is:		
herms	= $(\Delta \text{Therms}_{\text{easket}} * n_{\text{easket}} + \Delta \text{Therms}_{\text{sweep}} * n_{\text{sweep}} + \Delta \text{Therms}_{\text{sealing}} * 1f_{\text{seal}}$	$_{ng} + \Delta Therms_{wx} * lf_{wx} $ (1 – % Electric	Heat) *	Formatted: Indent: Left: 0", Hanging: 1.5"
	ADJ _{RxAirsealing}	<u> </u>		
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nere.				
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<u>ICIC.</u>	Savines			
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<u>leit.</u>	Measure Variable <u>A</u>	<u>Therms/Unit</u> 0.34		
<u>I.I.C.</u>	Measure Variable Names A Outlet Gasket Δ Therms _{gasket} Door Sweep Δ Therms _{weep}	<u> </u>	•	Formatted: Keep with next, Keep lines together
	Measure Variable Names Outlet Gasket Δ Therms _{gasket} Door Sweep Δ Therms _{weep} Caulking/Sealing/Polyethylene Tape Δ Therms _{sealing}	0.34 6.46 0.37	•	
<u>lut.</u>	Measure Variable Names A Outlet Gasket Δ Therms _{gasket} Door Sweep Δ Therms _{weep}	<u> </u>		Formatted: Keep with next, Keep lines together Formatted: Keep with next, Keep lines together
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	Measure Variable Names Outlet Gasket Δ Therms _{gasket} Door Sweep Δ Therms _{weep} Caulking/Sealing/Polyethylene Tape Δ Therms _{weep} Window or door weatherstripping Δ Therms _{wax}	0.34 6.46 0.37		Formatted: Keep with next, Keep lines together Formatted: Keep with next, Keep lines together Formatted: Keep with next, Keep lines together
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Other factors	Measure Variable Names Outlet Gasket △Therms _{gasket} Door Sweep △Therms _{weep} Caulking/Sealing/Polyethylene Tape △Therms _{ween} Window or door weatherstripping △Therms _{wx}	0.34 6.46 0.37		Formatted: Keep with next, Keep lines together Formatted: Keep with next, Keep lines together Formatted: Keep with next, Keep lines together
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Other factors. here: ldeally, the system effici imated via a visual insp p://www.bpi.org/files/p iidance on Estimating E ster testing. This has been estimated nes (based on Energy IT	Measure Variable Numes A Outlet Gasket ATherms _{gasket} Door Sweep Atherms seating Sweep Sweep Sweep Atherms seating Sweep	0.34 6.46 0.37 0.43 v state efficiency test. The distribution efficiency ce Institute- %200m%20Estimating%20Distribution%20Efficiency.pdf)- or by p redominant heating is gas furnace with 48% of 1 of furnaces purchased in Missouri were conden	ciency.pdf; erforming duct Missouri ing (based on	Formatted: Keep with next, Keep lines together Formatted: Keep with next, Keep lines together Formatted: Keep with next, Keep lines together
Other factors here: Ideally, the system effor imated via a visual insp tp://www.bpi.org/files/p iddance on Estimating I ster testing. This has been estimated nes (based on Energy Ir a from GANA, provide us to D 20 years, so units	Measure Variable Names A Outlet Gasket ATherms _{swatet} Door Sweep ATherms _{swatet} Door Sweep ATherms _{swatet} Caulking/Sealing/Polyethylene Tape ATherms _{swatet} Caulking/Sealing/Polyethylene Tape ATherms _{swatet} Caulking/Sealing/Polyethylene Tape ATherms _{swatet} window or door weatherstripping ATherms _{swatet} Caulking/Sealing/Polyethylene Tape ATherms _{watet} as defined above Atherms and by referring to a look up table such as that provided by the Building Performar (Polyethylene) Table BlueSheet.pdf (https://www.bpi.org/cms/docs/Guidance% 20m% 20Extimat Stasting Performars MirbuitonEfficiency.pdf https://www.bpi.org/cms/docs/Guidance% 20m% 20Extimat Stasting that natural gas central furnace heating is typical for Missouri residences (the portantion Administration, 2009 Residential Energy Consumption Survey). In 2000, 29% to Department of Energy during the federal standard setting process for residential heating in the current mix of furnaces in the	0.34 6.46 0.37 0.43 v state efficiency test. The distribution efficiency ce Institute- %200n%20Estimating%20Distribution%20Efficiency.pdf}- or by p redominant heating is gas furnace with 48% of I of furnaces purchased in Missouri were conden ng equipment - see Furnace Penetration.xls). Fu State. Assuming typical efficiencies for conden	ciency.pdf: rforming duct Aissouri ing (based on naces tend to	Formatted: Keep with next, Keep lines together Formatted: Keep with next, Keep lines together Formatted: Keep with next, Keep lines together
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			Appendix I - TRM		ivieasures.	Formatted: Font: (Default) Arial, 12 pt
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SavingsPerUnit =	Annual savings per square f	oot, dependent on heatin	g / cooling equipment7	3	•	Formatted: Space After: 6 pt
-			SavingsPerUnit			
	Building Type	HVAC System	(Therms/ft)			
	Manufactured	Gas Boiler	0.022			
	Multifamily	Gas Boiler	0.018			
	Single Family	Gas Boiler	0.016			
	Manufactured	Gas Furnace	0.017			
	Multifamily	Gas Furnace	0.012			
	Single Family	Gas Furnace	0.013			
SqFt =	Building square footage					
= Actual						Formatted: Indent: First line: 0"
ter Impact Descriptions and Cal	lculation					Formatted: Normal
A						Tomateu. Nomai
EMED O&M COST ADJUSTME						
A	NI CALCULATION					
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²⁴³ The values in the table represent estimates of savings from a 15% improvement in air leakage. The values are half those provided by Cadmus for the Iowa Joint Assessment, based on building simulations performed. While 30% savings are certainly achievable, this represents a thorough job in both the attic and basements and could not be verified without testing. The conservative 15% estimate is more appropriate for a deemed estimate. These values should be re-evaluated if EM&V values provide support for a higher deemed estimate.

<u>2025 MEEIA <u>4 2019-21</u> Plan</u>

Revision <u>8</u>7.0

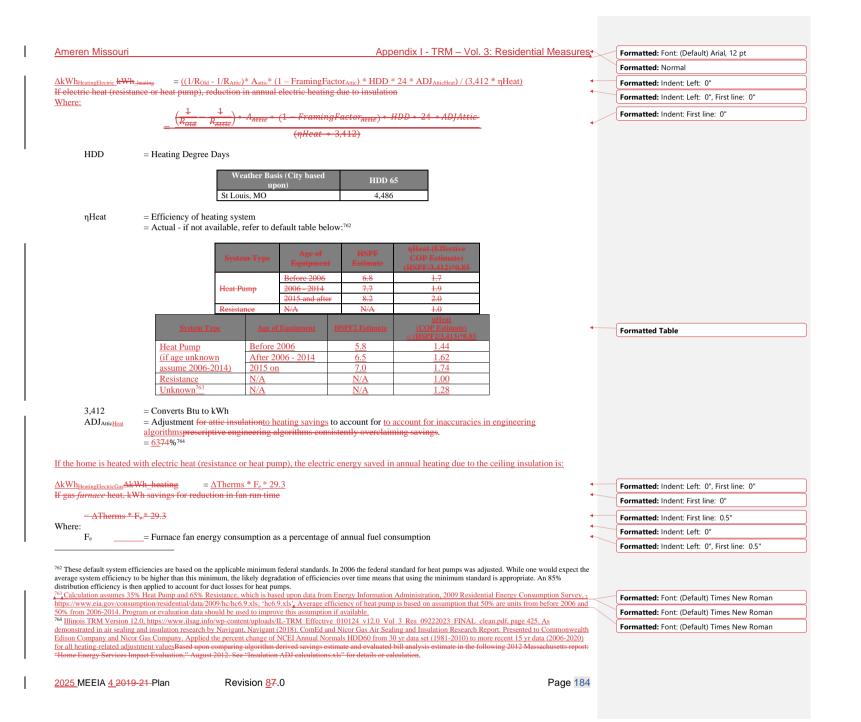
Ameren Missouri	Appendix I - TRM – Vol. 3: Re	sidential Measures Formatted: Font: (Default) Arial, 12 pt
		Formatted: Normal
3.7.2 Ceiling Insulation		
DESCRIPTION		
This measure describes savings from adding it	insulation to the attic/ceiling. This measure requires a member of the impleme asure surface areas. The efficiency of the heating and cooling equipment in th	
This measure was developed to be applicable	to the following program type: RF.	
If applied to other program types, the measure	e savings should be verified.	
DEFINITION OF EFFICIENT EQUIPMENT The requirements for participation in the prog	ram will be defined by the utilities.	
DEFINITION OF BASELINE EQUIPMENT The existing condition will be evaluated by in	plementation staff or a participating contractor.	
DEEMED LIFETIME OF EFFICIENT EQUIPME The expected measure life is assumed to be <u>30</u>		
DEEMED MEASURE COST The actual installed cost for this measure show	ıld be used in screening.	
LOADSHAPE Building Shell RES		
	Algorithm	
CALCULATION OF SAVINGS		
ELECTRIC ENERGY SAVINGS		
	$\Delta kWh = \Delta kWh_{eooting} + \Delta kWh_{heating}$	Formatted: Normal
$\Delta kWh = \Delta kWh_{\text{cooling}} + \Delta kW$		Formatted: Do not check spelling or grammar, Subscript
If the home has central cooling, the electric er Where	nergy saved in annual cooling due to the ceiling insulation is:	Formatted: Do not check spelling or grammar, Subscript
$\Delta kWh_{\text{-cooling}} = ((1/R_{\text{Old}} - 1/R_{\text{Attic}}))$	* Aattic* (1 – FramingFactorAttic) * CDD * 24 * DUA * ADJAtticCool) / (1,000 * r	Cool) Formatted: Indent: Left: 0", First line: 0"
Where	requirement due to institution	Formatted: Indent: Left: 0"
	$\left(\frac{1}{R_{ma}}-\frac{1}{R_{attic}}\right)*A_{attic}*(1-FramingFactor_{attic})*CDD*24*DU$	A
R _{Old} = R-value value of ex (Minimum of R-5 for	(1000 * 7Cool) c assembly including all layers between inside air and outside air (ft ² .°F.h/Btu) isting assembly and any existing insulation uninsulated assemblies ⁷⁵⁵)	-
A_{Attic} = Total area of insula		
recommended in Guidehouse 'EMV Group A, Deliveral https://pda.energydataweb.com/api/view/2518/CPUC%/ prepared for California Public Utilities Commission, Jul 2007	p-content/uploads/IL-TRM_Effective_010124_v12.0_Vol_3_Res_09222023_FINAL_clean.pdf ole 16 EUL_Research = Residential Insulation* (see 201nsulation%20EUL%2012nf%20Rep292021.pdf; 'CPUC Insulation EUL_Draft Rep te 2021_Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Meas extric, Exterior Wall Insulation, R-value for no insulation in walls, and NREL's Building Energy	ort 06292021.pdf). ures, GDS Associates,

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	i		Appendix I - TRI	I – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
					Formatted: Normal
FramingFac	ctorAttic= Adjustment to account	for area of framing			
CDD	= 7% ⁷⁵⁶ = Cooling Degree Days: ⁷⁵⁷				
CDD	= Cooning Degree Days:""				
	Wea	ther Basis (City based upon)	CDD 65		
	St Louis, 1	MO	1 <u>.</u> 646		
24	= Converts days to hours				
DUA		stment (reflects the fact that pe	cople do not always operate	their AC when conditions may call for	r
	it)			-	
1000	$= 0.75^{758}$				
1000 ηCool	= Converts Btu to kBtu = Seasonal energy efficien	cy ratio of cooling system (kE	Rtu/kWh)		
10001		ble to measure or reasonably e		ssume the following: 759	
	Det	Age of Equipment	<u>nCool Estimate</u>		
		fore 2006 06 - 2014	<u>9.5</u> 12.4		
		ntral AC After 1/1/2015	12.4		
		at Pump After 1/1/2015 known	<u>13.3</u> 12.4		
	following:760	KIIOWII	12.4		
	10110 // 1116.				
		Age of			
		Equipment Before	Estimat 10	e	
		2006	10		
		2006 -	13		
		2014 Central AC	43		
		after			
		1/1/2015			
		Heat Pump after	44		
		1/1/2015			
			nt for inaccuracies in engin	ering algorithms	
ADJ _{AtticCool}		avings to account for to accou	<u>0</u>	come argonamis.	
ADJ _{AtticCool}	= Adjustment to cooling sa = $114\%^{761}$	avings to account for to accou	g	tering argonanis.	Formatted: Indent: Left: 1.5", Hanging: 0.5"
	$= 114\%^{761}$	C C	, i i i i i i i i i i i i i i i i i i i	due to the ceiling insulation is:	
	$= 114\%^{761}$	C C	, i i i i i i i i i i i i i i i i i i i		Formatted: Indent: Left: 1.5", Hanging: 0.5" Formatted: Indent: Left: 0"
	$= 114\%^{761}$	C C	, i i i i i i i i i i i i i i i i i i i		
	$= 114\%^{761}$	C C	, i i i i i i i i i i i i i i i i i i i		
home is heater	$= 114\%^{761}$	or heat pump), the electric ene	ergy saved in annual heating	due to the ceiling insulation is:	
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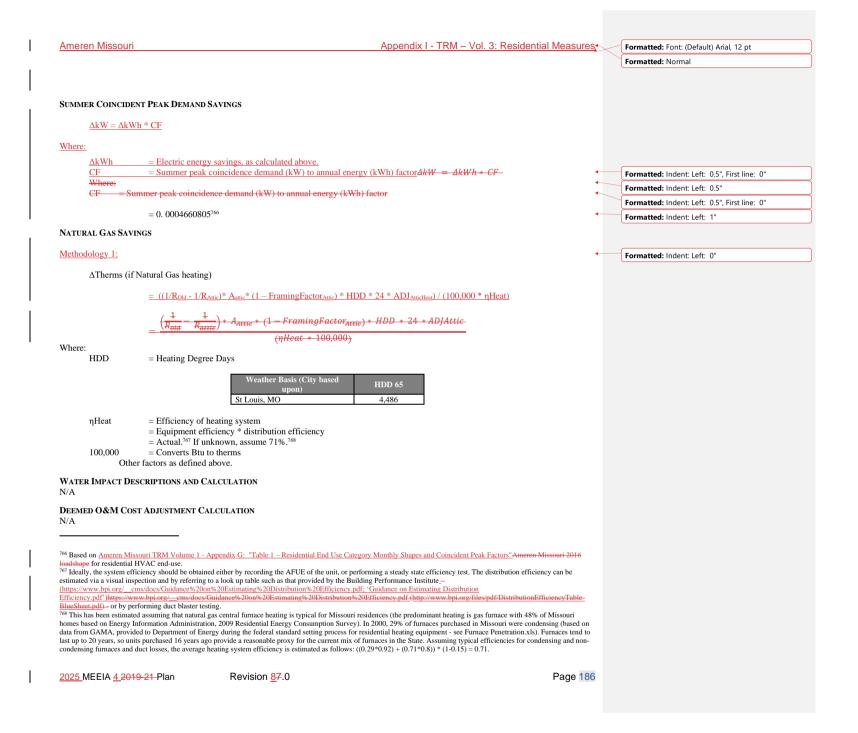
= 3.14% ⁷⁶⁵	pt
$= 3.14\%^{765}$	
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Revision <u>8</u>7.0

⁷⁶⁵ F_e is not one of the AHRI certified ratings provided for residential furnaces but can be reasonably estimated from a calculation based on the certified values for fuel energy (Ef in MMBtu/yr) and Eae (kWh/yr). An average of a 300 record sample (non-random) out of 1495 was 3.14%. This is, appropriately, ~50% greater than the ENERGY STAR[®] version 3 criteria for 2% F_e. See <u>""Furnace Fan Analysis.xlsx."</u> for reference.



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Ameren Missouri	Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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3.7.3 Duct Insulation		
DESCRIPTION		
	erforming duct insulation on the distribution system of homes with central cooling oned space can help with control and comfort, energy savings are largely limited to	
	outside the thermal envelope. Therefore, for this measure to be applicable, at least	
30% of ducts should be within unconditioned space (e.g., attic	with floor insulation, vented crawlspace, unheated garages. Basements should be	
considered conditioned space).		
This measure was developed to be applicable to the following pr	rogram type: RF.	
If applied to other program types, the measure savings should be	e verified.	
DEFINITION OF EFFICIENT EQUIPMENT		
The efficient condition is insulated duct work throughout the un-	conditioned space in the home.	
DEFINITION OF BASELINE EQUIPMENT		
The baseline condition is existing duct work with at least 30% o	f the ducts within the unconditioned space in the home.	
DEEMED LIFETIME OF EFFICIENT EQUIPMENT		
The expected measure life is assumed to be 20 years. ⁷⁶⁹		
DEEMED MEASURE COST		
The actual duct insulation measure cost should be used.		
LOADSHAPE		
HVAC RES		
	Algorithm	
CALCULATION OF SAVINGS		
ELECTRIC ENERGY SAVINGS		
	when cooling the home and energy saved when heating the home.	
A1-3371. A1-3371		
$\Delta kWh = \Delta kWh \ cooling + \Delta kWh \ heating$ $\Delta kWh = \Delta kWh \ cooling + \Delta kWh \ h_{Heating}$		
Zierrie Zierrie cooting / Zierrie nsating		
If the home has central cooling, the electric energy saved in annu-	ual cooling due to the added insulation is:	
0. 01		Formattad: Subscript
If <u>the home has</u> central cooling, the electric energy saved in annu $\Delta kWh_{Cooling} = (1/R_{existing} - 1/R_{pew}) * Area * EFLH_{cool}$		Formatted: Subscript
$\Delta k Wh_{\text{Cooling}} = (1/R_{\text{existing}} - 1/R_{\text{pew}}) * Area * EFLH_{\text{cool}}$ $\left(\frac{1}{R_{\text{existence}}} - \frac{1}{R_{\text{existence}}}\right) * Area * EFLH_{\text{cool}}$		Formatted: Subscript
0. 0.		Formatted: Subscript Formatted: Subscript
$\Delta kWh_{Cooling} = (1/R_{existing} - 1/R_{gew}) * Area * EFLH_{cool}$ $\Delta kWh_{Cooling} = \frac{\left(\frac{1}{R_{existing}} - \frac{1}{R_{new}}\right) * Area * EFLH_{cool}}{(1,000 * SEER)}$ Where:	$\frac{\Delta T_{AVG, cooling}}{\Delta T_{AVG, cooling}} / (1,000 * SEER2)$	Formatted: Subscript Formatted: Subscript Formatted: Subscript
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$\Delta k Wh_{Cooling} = (1/R_{existing} - 1/R_{pew}) * Area * EFLH_{cool}$ $\Delta k Wh_{Cooling} = \frac{(\frac{1}{R_{existing}} - \frac{1}{R_{Rew}}) * Area * EFLH_{cool}}{(1,000 * SEER)}$ Where: $R_{existing} = Duct heat loss coefficient with existin = Actual R_{new} = Duct heat loss coefficient with new in $ 769 Measure Life Report, Residential and Commercial/Industrial Lighting and Integr/energizect.com/sites/default/files/documents/Measure%20Life%20Rep	$\frac{* \Delta T_{AVG,cooling}) / (1,000 * SEER2)}{aot * \Delta T_{AVG,cooling}}$ g insulation ((hr- ⁰ F-ft ²)/Btu) sulation (hr- ⁰ F-ft ²)/Btu) +VAC Measures. ptt%202007.pdf; 'Measure Life Report 2007.pdf', page 1-3.	Formatted: Subscript Formatted: Subscript Formatted: Subscript
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$\Delta kWh_{cooling} = (1/R_{existing} - 1/R_{pew}) * Area * EFLH_{cool}$ $\Delta kWh_{cooling} = \frac{\left(\frac{1}{R_{existing}} - \frac{1}{R_{ngw}}\right) * Area + EFLH_{cool}}{(1,000 + SEER)}$ Where: $R_{existing} = Duct heat loss coefficient with existin = Actual R_{new} = Duct heat loss coefficient with new in $ 769 Measure Life Report. Residential and Commercial/Industrial Lighting and I https://energizect.com/sites/default/files/documents/Measure%20Life%20Rep	$\frac{* \Delta T_{AVG,cooling}) / (1,000 * SEER2)}{cor * \Delta T_{AVG,cooling}}$ g insulation ((hr- ⁰ F-ft ²)/Btu) sulation (hr- ⁰ F-ft ²)/Btu) <u>HVAC Measures.</u> https://doi.org/10.1007.pdf.*.page 1-3. AC Measures. GDS Associates. June 2007.	Formatted: Subscript Formatted: Subscript Formatted: Subscript Formatted: Subscript
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$\frac{\Delta kWh_{Cooling}}{\Delta kWh_{Cooling}} = (1/R_{existing} - 1/R_{gew}) * Area * EFLH_{cool} \\ \frac{1}{R_{existing}} - \frac{1}{R_{new}} * Area * EFLH_{cool} \\ \frac{1}{R_{existing}} = \frac{\left(\frac{1}{R_{existing}} - \frac{1}{R_{new}}\right) * Area * EFLH_{cool} \\ \frac{1}{(1,000 * SEER)} \\ Where: \\ R_{existing} = Duct heat loss coefficient with existin \\ = Actual \\ R_{new} = Duct heat loss coefficient with new in \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient with new in \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient with new in \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient with new in \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient with new in \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient with new in \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient with new in \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient with new in \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient with new in \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient with new in \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient with new in \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient with new in \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient with new in \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient with new in \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient with new in \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient heat counts \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient heat counts \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient heat counts \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient heat counts \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient heat counts \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient heat counts \\ \hline \\ \frac{1}{R_{new}} = Duct heat loss coefficient heat counts \\ \hline \\ \frac{1}{R_{new}} = Duct heat heat heat heat heat heat heat hea$	$\frac{* \Delta T_{AVG,cooling}) / (1,000 * SEER2)}{cor * \Delta T_{AVG,cooling}}$ g insulation ((hr- ⁰ F-ft ²)/Btu) sulation (hr- ⁰ F-ft ²)/Btu) <u>HVAC Measures.</u> https://doi.org/10.1007.pdf.*.page 1-3. AC Measures. GDS Associates. June 2007.	Formatted: Subscript Formatted: Subscript Formatted: Subscript Formatted: Subscript

meren Missouri		Appendix I	 TRM – Vol. 3: Residential Me 	asures Formatted: Font: (Default) Arial, 12 pt
				Formatted: Normal
Area EFLH _{cool}	= Actual _= Area of the duct surface exposed to the = Equivalent Full Load Cooling Hours:	unconditioned space that has been i	nsulated (ft ²)	
	Weather Basis (Ameren Mi Average) SF or MF <u>MFe (comprehensive envelope)</u>	EFLHcool (Hou 869 ⁷⁷⁰ 632⁷⁷¹	rs)	
$\Delta T_{AVG,cooling}$	= Average temperature difference (⁰ F) du supply air temperature ⁷⁷²			duct Formatted: Indent: Left: 0.5", Space After: 6 pt
	Weather Basis (City based upon St Louis, MO	$\begin{array}{c c} n) & OA_{AVG,cooling} [°F]^{773} & \Delta' \\ & 80.8 \end{array}$	Γ _{AVG,cooling} [°F] 20.8	
1,000 SEER <u>2</u> ruipment	= Converts Btu to kBtu = Seasonal Energy Efficiency Ratio of A	ir Conditioning equipment (kBtu/kV	<u>/h)Efficiency in SEER of air conditio</u>	ning
	= Actual - If not available, assume the fo	llowing: 774		Formatted: Font: 11 pt
	Age of Equi Before 2006 2006 - 2014 Central AC After 1 Heat Pump After 1			
	Equipment Type	Age of Equipment	SEER Estimate	
	Central AC	Before 2006 After	10 13	
_		2006 Before 2006	10	
	Heat Pump	2006- 2014	13	
		2015 on	14	
ttp://www.energystar.gov propriate EFLH of 869-7 valuation Report, http:/// * Evaluation - Opinion -D tissouri cities (St. Louis, * Leaving coil air temper: e environment it passes ti 3 National Solar Radiatio tp://rrede.trel.gov/solar/ 0 through August 15 th . Fo aded.	n Data Base 1991- 2005 Update: Typical Meteorolo <u>bl_data/nsrdb/1991 2005/tmy3/by_state_and_eity.ht</u> r cooling season, temperatures from 8AM to 8PM we ficiencies are based on the applicable minimum Fede	<u>AC.xis</u>) and reduced by 28.5% based on the relative climate normals cooling degree da 30. re constructed based on weather conditions of ar 2019 installations. d as an average temperature, recognizing the ogical Year 3 <u>https://doe2.com/Download/M</u> <u>mb</u> . Heating season defined as September 1' re used to establish average temperatures as ral Standards. In 2006 the Federal Standard.	y ratios (at 63F set point).PY2019 Residential heating degree days and cooling degree days) at some heat transfer occurs between the ductw (eather/TMY3/ 1 th through April 13 th , cooling season defined this is when cooling systems are expected to for Central AC was adjusted. While one woul	l Jin select work and as May be
tings have been converte	ncy to be higher than this minimum, the likely degrada d to SEER2 equivalents – since the new rating better ficiencies are based on the applicable minimum feder	reflects the actual efficiency of the units.		

<u>2025</u>MEEIA <u>4</u>2019-21 Plan

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Revision <u>8</u>7.0

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the home is heated v	with electric heat (resist	ance or heat pump), the electric	energy saved in annual heating due to th	e added insulation is:	
kWh _{HeatingElectric}	= (1/R _{existing} - 1/R _{new})	* Area * EFLH _{heat} * $\Delta T_{AVG,heatin}$	_{1g}) / (3,412 * COP)		
	× 1	1 、			
	$\frac{\pm}{R_{existing}}$	- + + Area * EFLH_{neat} * 	ΔT _{AVG,heating}		
$\Delta kWh_{Heating}$	Electric = Controlog	(3,412 * COP)			
here: EFLHheat	- Equivalant Full I o	ad Hasting Hours: 776			
ErLfilleat	= Equivalent Full Lo	au ricating riours."			
	Wea	ther Basis (Ameren Missouri	EFLHheat (Hours)		
	SF or MF	Average)	1,496		
	MFc (con	prehensive envelope)	509		
$\Delta T_{AVG,heating}$			ing season between outdoor air temperatu	are and assumed 115°F duct	
	supply temperature Weather B	asis (City based upon)	OA _{AVG,beating} [°F] ⁷⁷⁸ Δ T _{AVG,beating}	[°F]	
	St Louis, MO	usis (eng bused upon)	43.2 71.8		
3,412	= Converts Btu to kW				Formatted: Space Before: 6 pt
COP		of heating equipment			· · · ·
	= Actual - if not avai	lable, use:			
			nHeat		
	<u>System Type</u>	Age of Equipment I	HSPF2 Estimate (COP Estimate) = (HSPF2/3.413)*0.85	•	Formatted Table
	Heat Pump	Before 2006	<u>5.8</u> <u>1.44</u>	_	
	(if age unknown assume 2006-20)		<u>6.5</u> <u>1.62</u> 7.0 1.74	-	
	Resistance	<u>N/A</u>	<u>N/A</u> <u>1.00</u>		
	Unknown ⁷⁸⁰	<u>N/A</u>	<u>N/A</u> <u>1.28</u>		
		Age of HSPF	COP (Effective COP Estimate)		
	System Type	Equipment Estimat	e (HSPF/3.412)*0.85		
	Heat Pump	Before 2006 6.8 2006 - 2014 7.7	<u>1.7</u> <u>1.92</u>	_	
	Heat I ump	2015 on 8.2	2.04		
	Resistance	N/A N/A	4		
the building is heate irnace fans will run le		ere will be some electric saving	s in heating the building attributed to ext	ra insulation since the	Formatted: Indent: Left: 0"
mace rans will full fe					
			based on weather conditions (heating degree days	and cooling degree days) in select	
), weighted by partial year 2019 installa 15°F is used as an average temperature	ations. e, recognizing that some heat transfer occurs betwo	een the ductwork and the	
vironment it passes throu	gh.		https://doe2.com/Download/Weather/TMY3/		
p://rredc.nrel.gov/solar/o	ld_data/nsrdb/1991-2005/tm	y3/by_state_and_city.html . Heating se	eason defined as September 17 through April 13, c	ooling season defined as May 20	
rough August 15 For soo	ling season, temperatures fro iciencies are based on the ap	om 8AM to 8PM were used to establish plicable minimum federal standards. Ir	1 average temperatures as this is when cooling sys n 2006 the federal standard for heat pumps was ad	tems are expected to be loaded. justed. While one would expect the	Formatted: Font: (Default) Times New Roman
These default system eff	o be higher than this minimu	m, the likely degradation of efficiencie	es over time means that using the minimum standa		Formatted: Font: (Default) Times New Roman
² These default system eff erage system efficiency to	л арриец то ассоция 10Г ЦЦС	tance, which is based upon data from F	Energy Information Administration, 2009 Residen	tial Energy Consumption Survey.	Formatted: Font: (Default) Times New Roman
² These default system eff erage system efficiency to stribution efficiency is the Calculation assumes 35%	6 Heat Pump and 65% Resis	dance, which is based upon data from i			Formatted. Fort. (Default) Times New Roman
These default system effi- erage system efficiency to stribution efficiency is the Calculation assumes 359 tps://www.eia.gov/consur	6 Heat Pump and 65% Resis nption/residential/data/2009	hc/hc6.9.xls; 'hc6.9.xls', Average effic d be used to improve this assumption in	ciency of heat pump is based on assumption that 5	0% are units from before 2006 and	Formatted: Font: (Default) Times New Roman

Ameren Missour	i Appendix I - TRM – Vol. 3: Resider	ntial Measures	Formatted: Font: (Default) Arial, 12 pt
			Formatted: Normal
∆kWh _{HeatingGas}	$= \Delta \text{Therms} * \text{Fe} * 29.3$		Formatted: Subscript
AkWhHeat	ing_{cas} = (ΔTherms * Fe * 29.3)		Formatted: Indent: Left: 0"
Where: ∆Therms	= Therm savings as calculated in Natural Gas Savings		
Fe	= Furnace fan energy consumption as a percentage of annual fuel consumption		
20.2	$= 3.14\%^{781}$		
29.3	= Converts therms to kWh		
SUMMER COINCIDI	ENT PEAK DEMAND SAVINGS		
$\Delta kW = \Delta kV$	Vh _{Cooling} * CF		
Where:			
<u>AkWh_{Cooling}</u>	= Electric energy savings for cooling, calculated above		
CF	= Summer peak coincidence demand (kW) to annual energy (kWh) factor $\Delta kW = \Delta kWh * CF$	4	Formatted: Indent: First line: 0"
Where: AkWhCooli	ng = Electric energy savings for cooling, calculated above		Formatted: Indent: Left: 0.5"
	ummer peak coincidence demand (kW) to annual energy (kWh) factor		Formatted: Indent: Left: 0.5", First line: 0"
	= 0.0004660805	4	Formatted: Indent: Left: 1"
NATURAL GAS SAV			Formatica. Indent. Left. 1
<u>ATherms</u>	= $(1/R_{existing} - 1/R_{new}) * Area * EFLH_{heat} * \Delta T_{AVG,heating}) / (100,000 * \eta HeatGas)$		
$\left(\frac{1}{R_{max}}\right)$	$\frac{1}{2} - \frac{1}{R_{new}} + Area + EFLHheat + \Delta T_{AVG, heating}$		Formatted: Indent: Left: 0"
Δ Therms = $\frac{1}{2}$	(100,000 * ηHeat)		
Where: <u>nHeatGas</u> e	<u>uuals 71%⁷⁸² and a</u> All factors as defined above.	4	Formatted: Indent: Left: 0", First line: 0"
Water Impact D i N/A	ESCRIPTIONS AND CALCULATION		
Deemed O&M Co N/A	ST ADJUSTMENT CALCULATION		
MEASURE CODE:			
⁷⁸¹ F _e is not one of the A in MMBtu/yr) and Eae (version 3 criteria for 2%	HRI certified ratings provided for residential furnaces but can be reasonably estimated from a calculation based on the certified values $kWh/yr)$. An average of a 300-record sample (non-random) out of 1495 was 3.14%. This is, appropriately, ~50% greater than the ENI F_{e} .	for fuel energy (Ef ERGY STAR®	
⁸² This has been estimat nomes (based on Energy	ed assuming that natural gas central furnace heating is typical for Missouri residences (the predominant heating is gas furnace with 48 Information Administration, 2009 Residential Energy Consumption Survey). In 2000, 29% of furnaces purchased in Missouri were co	ondensing (based on	
data from GAMA, provi	ded to Department of Energy during the federal standard setting process for residential heating equipment - see Furnace Penetration.xl its purchased 16 years ago provide a reasonable proxy for the current mix of furnaces in the State. Assuming typical efficiencies for co	s). Furnaces tend to	
	duct losses, the average heating system efficiency is estimated as follows: $((0.29*0.92) + (0.71*0.8)) * (1-0.15) = 0.71$.		
2025 MEEIA <u>4 20</u>	19-21 Plan Revision 87.0	Page 191	
		. ~9~	

Ameren Missouri	Appendix I - TRM – Vol. 3: Residential N	easures,* Formatted: Font: (Default) Arial, 12 pt
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3.7.4 Floor Insulation		
DESCRIPTION Insulation is added to the floor above a vented crawl space that does no it is desirable to keep them within the conditioned space by insulating t space above from the space below the floor and is only acceptable wher in an environment resembling the outdoors. Even in the case of an emp the crawl space perimeter rather than the floor. Not only is there gener There is a "Foundation Sidewall Insulation" measure for perimeter sea unvented crawl space and should not be used in other situations.	he crawl space walls and ground. Insulating the floor separates the c n there is nothing underneath that could freeze or would operate less ty, unvented crawl space, it is still considered best practice to seal a ally less area to insulate this way, but there are also moisture contr	onditioned efficiently nd insulate ol benefits.
This measure was developed to be applicable to the following program	n type: RF.	
If applied to other program types, the measure savings should be verifi	ïed.	
DEFINITION OF EFFICIENT EQUIPMENT The requirements for participation in the program will be defined by t	he utilities.	
DEFINITION OF BASELINE EQUIPMENT The existing condition will be evaluated by implementation staff or a surrounding a crawl space.	participating contractor and is likely to be no insulation on any sur	ace
DEEMED LIFETIME OF EFFICIENT EQUIPMENT The expected measure life is assumed to be <u>3025</u> years. ⁷⁸³		
DEEMED MEASURE COST The actual installed cost for this measure should be used in screening.		
LOADSHAPE Building Shell RES		
A	lgorithm	
CALCULATION OF SAVINGS		
ELECTRIC ENERGY SAVINGS Where available, savings from shell insulation measures should be de engineering algorithms can be used with the inclusion of an adjustmen $\frac{\Delta kWh = -(\Delta kWh = c)}{\Delta kWh}$		following
$\Delta kWh = \Delta kWh_{cooling} + \Delta kWh_{heating}$		
If the home has central cooling, the electric energy saved in annual co	oling due to the floor insulation is:	
Where:		* (1
$\Delta kWh_cooling _= If central cooling, reduction in annual coolingFramingFactorFloor) * CDD * 24 * DUA * ADJFloorCool) / (1,000 * \etaCoo$	ng requirement due to insulation($(1/R_{old} - 1/(R_{added} + R_{old})) * Are$	
		Formatted: Subscript
$\frac{\text{Where:}}{(4 + 4)}$		Formatted: Subscript
$\frac{\left(\frac{1}{R_{OTA}} - \frac{1}{(R_{Added} + R_{OTA})}\right) * Area * (1)}{\left(\frac{1}{R_{Added}} + \frac{1}{(R_{OTA})}\right)}$	- Framing Factor) * CDD * 24 * DUA • nCool)	Formatted: Indent: First line: 0"
(1000 *	- ŋCool)	Formatted: Indent: First line: 0"
		Formatted: Font: 9 pt
783 Illinois TRM Version 12.0, https://www.ilsag.info/wp-content/uploads/IL-TRM E recommended in Guidehouse 'EMV Group A, Deliverable 16 EUL Research – Resid		Formatted: Font: 9 pt
https://pda.energydataweb.com/api/view/2518/CPUC%20Insulation%20EUL%20Dra	htt%20Report%2006292021.pdf; 'CPUC Insulation EUL Draft Report 06292021.	df) Formatted: Font: 9 pt
prepared for California Public Utilities Commission, June 2021 Measure Life Report, 2007.	Residential and Commercial/Industrial Lighting and HVAC Measures, GDS Ass	ciates, Formatted: Font: 9 pt
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	Appendix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
		Formatted: Normal
R_{Old}	= R-value value of floor before insulation, assuming $3/4$ " plywood subfloor and carpet with pad = Actual, I—if unknown, assume 3.5396^{784}	
R _{Added}	= R-value of additional spray foam, rigid foam, or cavity insulation.	
Area	= Total floor area to be insulated	
FramingFactor	r <u>Floor</u> Framing Factor — = Adjustment to account for area of framing = 12% ⁷⁸⁵	
24	= Converts hours to days	
CDD	= Cooling Degree Days	Formatted: Space After: 6 pt
	Weather Basis (City based upon) Unconditioned Space CDD 75 ⁷⁸⁶	
	St Louis, MO 762	
DUA	= Discretionary Use Adjustment (reflects the fact that people do not always operate their AC when conditions call for it). = 0.75^{787}	
1000	= Converts Btu to kBtu	
ηCool	= Seasonal energy efficiency ratio of cooling system (kBtu/kWh) = Actual (where it is possible to measure or reasonably estimate). If unknown, assume the following: 788780	Formetted Space After 6 at
		Formatted: Space After: 6 pt
	Age of Equipment nCool Estimate Before 2006 9.510	
	2006 - 2014 12.443	
	Central AC After 1/1/2015 <u>12.4</u> 13	
	Heat Pump After 1/1/2015 <u>13.3</u> 44	Formatted: Space Before: 6 pt
ADJ _{FloorCool}	= Adjustment to cooling savings to account for to account for inaccuracies in engineering algorithms.	Formatted: Space Before: 6 pt
	with electric heat (resistance or heat pump), the electric energy saved in annual heating due to the floor insulation is:	Formatted: Indent: Left: 0", First line: 0"
HeatingElectric AkW		
HeatingElectric AkW	$\frac{h_{\text{heating}}}{h_{\text{heating}}} = \text{If electric heat (resistance or heat pump), reduction in annual electric heating due to insulation((1/R_{\text{old}}))$	Formatted: Indent: Left: 0", First line: 0", Space
$\frac{M_{\text{HeatingElectric}}}{M_{\text{Added}} + R_{\text{Old}}} \times A$	$\frac{h_{\text{heating}}}{h_{\text{heating}}} = \text{If electric heat (resistance or heat pump), reduction in annual electric heating due to insulation((1/R_{\text{old}}))$	Formatted: Indent: Left: 0", First line: 0", Space Before: 6 pt Formatted: Space Before: 0 pt
$\frac{M_{\text{HeatingElectric}}}{M_{\text{Added}} + R_{\text{Old}}} \times A$	$\frac{h_{\text{heating}}}{h_{\text{heating}}} = \text{If electric heat (resistance or heat pump), reduction in annual electric heating due to insulation((1/R_{\text{old}}))$	Formatted: Indent: Left: 0", First line: 0", Space Before: 6 pt Formatted: Space Before: 0 pt Formatted: Indent: Left: 0", First line: 0", Space
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UteatingElectric_AkW: Added + Rold)) * A Where:	h_heating = If electric heat (resistance or heat pump), reduction in annual electric heating due to insulation((1/R_Old + Irea * (1 - FramingFactorFloor) * HDD * 24 * ADJ _{FloorHeat}) / (3,412 * ηHeat)	Formatted: Indent: Left: 0", First line: 0", Space Before: 6 pt Formatted: Space Before: 0 pt Formatted: Indent: Left: 0", First line: 0", Space
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	$\left(\frac{1}{p}\right)$	1		l – Framin	.g Factor) *	HDD * 24 * ADJ _{FLOOR}	F			
	$= \frac{1}{1} $	Added + R _{OL}		eat * 3,412	24		-			
HDD	= Heating Degr	ee Days:	Unite	* 3,711	-7			•	(Formatted: Space After: 6 pt
		7 (0)			Uncon	ditioned Space				
	Weather Basis	s Zone (City	y based upon)			DD 50 ⁷⁹¹				
	St Louis, MO					1,911				
ηHeat	= Efficiency of									
	= Actual if no	ot available,	refer to default ta	able below:	792					
						<u>nHeat</u>				
	System		Age of Equipm	ient HSF	PF2 Estimate			•		Formatted: Keep with next
	Heat Pump		Before 2006		<u>5.8</u>	<u>= (HSFF 2/3.413)*0.85</u> <u>1.44</u>		•		Formatted Table
	(if age unki		After 2006 - 20)14	<u>6.5</u>	<u>1.62</u>	_			Formatted: Keep with next
	assume 200 Resistance		<u>2015 on</u> N/A		<u>7.0</u> N/A	<u>1.74</u> 1.00	-		(Formattad Koon with pout
	Unknown ⁷⁹		<u>N/A</u>		<u>N/A</u>	1.00	-			Formatted: Keep with next
									ι	Formatted: Keep with next
	System Type	Age of E	Equipment		ηHeat		e)			
		Before 200)6	6.8		1.7				
	Heat Pump	2006 - 201		7.7		1.9				
	D. L.	2015 and a	ifter	8.2 N/A		2.0				
	Resistance	N/A		N/A		1.0				
			•	. .						
ADJ _{Floor_{Heat}}			vings to account i escriptive engine			acies in engineering alg	orithmsAdjustment	or floor		
	$= 6388\%^{794}$	count for pre	semptive engine	ering uigon		ining suvings.				
e home is heated	with electric heat (resistance of	r heat pump), the	e electric en	ergy saved in	annual heating due to th	ne floor insulation is:			
/h _{HeatingElectricGas}	= Δ Therms * F _e	e <u>* 29.3</u>								
ere: Othe	er factors as defined	labova								
			savings for reduc	tion in fan	run time					
	ng = n gas jurnace		U							
AkWh_heati	— – ΔTherms * F.									
	— – ΔTherms * F.		umption as a perc	entage of ar	nnual fuel con	sumption				

<u>2025</u>MEEIA <u>4</u>2019-21 Plan

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Revision <u>8</u>7.0

Ameren Missouri	Appendix I -	TRM – Vol. 3: Residential Measures Formatted: Font: (Default) Arial, 12 pt
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	= 3.14% ⁷⁹⁵	
29.3	= kWh per therm	
SUMMER COINCIDE	NT PEAK DEMAND SAVINGS	
$\Delta kW = \Delta kW$	ь * СЕ	
$\Delta K W = \Delta K W$		
Where:		
<u>AkWh</u>	= Electric energy savings, as calculated above.	
CF Where:	= Summer peak coincidence demand (kW) to annual energy (kWh) factor $\frac{4kW}{k}$	
	mmer peak coincidence demand (kW) to annual energy (kWh) factor	Formatted: Indent: Left: 0.5"
	0.0004660005796	Formatted: Indent: Left: 0.5", First line: 0"
	$= 0.\ 0004660805^{796}$	Formatted: Indent: Left: 1"
NATURAL GAS SAVI		
A merins (II	Natural Gas heating)	
	$= ((1/R_{Oid} - 1/(R_{Added} + R_{Oid})) * Area * (1 - FramingFactor_{Floor}) * HDD * 24 * (1 - FramingFactor_{Floor}) * HDD * 24 * (1 - FramingFactor_{Floor}) * HDD * 24 * (1 - FramingFactor_{Floor}) * (1 - Framin$	* ADJ _{FloorHeat}) / (100,000 * ηHeat)
(1 1) · · · · · · · · · · · · · · · · ·	
<u>_ t</u>	{ ola = (R_{naaca} + R_{ola}))* Area * (1 = Framing Factor) * HDD * 24 * Al	U Filor
Where	(ηHeat + 100,000)	
nHeat	= Efficiency of heating system	
i.	= Equipment efficiency * distribution efficiency	
100.000	= Actual ⁷⁹⁷ - If not available, use $71\%^{798}$	
100,000	= Converts Btu to therms Other factors as defined above.	
WATED IMDACT DE	SCRIPTIONS AND CALCULATION	
WATER IMPACT DE N/A	CRIP HONS AND CALCULATION	
DEEMED O&M COS	T ADJUSTMENT CALCULATION	
N/A	I ADJUSTMENT CALCULATION	
MEASURE CODE:		
WIEASURE CODE:		
¹⁹⁵ E ₂ is not one of the AF	RI certified ratings provided for residential furnaces but can be reasonably estimated from a calcula	tion based on the certified values for fuel energy (Ef
n MMBtu/yr) and Eae (k	Wh/yr). An average of a 300-record sample (non-random) out of 1495 was 3.14%. This is, appropr	
	&. See : Programmable Thermostats Furnace Fan Analysis.xlsx P for reference. Ouri TRM Volume 1 - Appendix G: "Table 1 – Residential End Use Category Monthly Shapes and	Coincident Peak Factors" Ameren Missouri 2016
oadshape for residential	uilding shell end-use.	
	ciency should be obtained either by recording the AFUE of the unit, or performing a steady state eff ection and by referring to a look up table such as that provided by the Building Performance Institut	
https://www.bpi.org/c	ns/docs/Guidance%20on%20Estimating%20Distribution%20Efficiency.pdf; 'Guidance on Estimati	ing Distribution Efficiency.pdf') -
by performing duct blaste		
⁷⁹⁸ This has been estimate	d assuming that natural gas central furnace heating is typical for Missouri residences (the predomina	ant heating is gas furnace with 48% of Missouri
	nformation Administration, 2009 Residential Energy Consumption Survey). In 2000, 29% of furnac ed to Department of Energy during the federal standard setting process for residential heating equip	
ast up to 20 years, so uni	s purchased 16 years ago provide a reasonable proxy for the current mix of furnaces in the State. As	ssuming typical efficiencies for condensing and non-
concensing furnaces and	buck losses, the average heating system efficiency is estimated as follows: $((0.29*0.92) + (0.71*0.8))$)* (1-0.13) = 0.71.
	Dat Dian Baylision 97.0	Dage 405
<u>2025 MEEIA <u>4</u> 201</u>	9-21 Plan Revision <u>8</u> 7.0	Page 195

Ameren Missouri	Appendix I - TRM – Vol. 3: Residential Measures	\sim	Formatted: Font: (Default) Arial, 12 pt
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3.7.5 Foundation Sidewall Insulation (Retired, effective 1/1/20	25) ⁷⁹⁹		
Description Insulation is added to a basement or crawl space. Insulation added above g ground insulation is adjusted with an approximation of the thermal resi reducing the degree days to reflect the smaller but non zero contribution insulation, as below grade has little temperature difference during the coo	stance of the ground. Insulation in unconditioned spaces is modeled by to heating and cooling load. Cooling savings only consider above grade		Formatted: Font color: Background 1
This measure was developed to be applicable to the following program ty			
If applied to other program types, the measure savings should be verified.			
Definition of Efficient Equipment The requirements for participation in the program will be defined by the u	tilities.		
Definition of Baseline Equipment The existing condition will be evaluated by implementation staff or a pinsulation.	participating contractor and is likely to be no basement wall or ceiling		
DEEMED LIFETIME OF EFFICIENT EQUIPMENT			
The expected measure life is assumed to be <u>30</u> 25 years. ⁸⁰⁰			
Deemed Measure Cost The actual installed cost for this measure should be used in screening.			
Loadshape Building Shell RES			
Algor	ithm		
Calculation of Savings			
the following engineering algorithms can be used with the inclusion of an	ined through a custom analysis. When that is not feasible for the program adjustment factor to de-rate the heating savings. soling + AkWh_heating}-		Formatted: Font color: Background 1, Check spelling
$\Delta kWh = \Delta kWh_{cooling} + \Delta kWh_{beasing}$			and grammar
If the home has central cooling, the electric energy saved in annual coolin	g due to the insulation is:		
$\frac{AkWh_{\text{conting}}}{(1,900 * \eta \text{Coll})} = \frac{((1/R_{\text{Old}AG} - 1/(R_{\text{Added}} + R_{\text{Old}AG})) * L_{\text{BWT}} * H_{\text{BW}}}{(1,900 * \eta \text{Cool})}$	$_{AG} \approx (1 - FramingFactor_{Basement}) \approx CDD \approx 24 \approx DUA \approx ADJ_{BasementCool})/2 = 4$		Formatted: Indent: Hanging: 1"
Where: <u>AkWh_cooling</u> = If central cooling, reduction in annual cooling requirem	ent due to Insulation		Formatted: Indent: Left: 0", Hanging: 0.5"
Where:	•		Formatted: Indent: Left: 0", First line: 0"
$= \frac{\left(\frac{1}{R_{ouasc}} - \frac{1}{\left(R_{Added} + R_{oldAG}\right)}\right) * L_{BWT} * H_{BWAG} * (1,000 * \eta Cool)}{(1,000 * \eta Cool)}$	(1 - FF) * CDD * 24 * DUA		
(1,000 * η€ool)			
²⁰⁰ -"Retire" indicates that the measure is not anticipated to be offered through an Ameren I	discours administered downed aids program during the particle of TDM -fffirm		
2. Retire indicates that the measure is not anticipated to be ordered infogure an America see Illinois TRM Version 12.0, https://www.ilsag.info/wp content/uploads/IL TRM Effect recommended in Guidehouse 'EMV Group A. Deliverable 16 EUL Research Residentia	ive 010124 v12.0 Vol 3 Res 09222023 FINAL clean.pdf, page 392. As		Formatted: Font color: Background 1
recommended in Judianause EAV Group A, Denvertator 10 EUL Research – Restauring https://pda.energydataweb.com/api/view/2518/CPU/K20Insulations/20EUL8-20Draft%2 prepared for California Public Utilities Commission, June 2021Measure Life Report, Resi 2007.	0Report%2006292021.pdf; 'CPUC Insulation EUL Draft Report 06292021.pdf').		
2025 MEEIA <u>4 2019-21 Plan</u> Revision <u>8</u> 7.0	Page 196		

meren Missouri			Apper	<u>Idix I - TRM –</u>	Vol. 3: Residential Measure	S.	Formatted: Font: (Default) Arial, 12 pt
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RAdded		itional spray foam, rigid foam, e					
Roldag-		of foundation wall above grade. own assume 1.0 ⁸⁰¹					
LRWT		ent Wall Total) of basement wa	Il around the entire ins	ulated perimeter	(ft)		
H _{BWAG}		ent Wall Above Grade) of insul					
FramingFacto		= Framing Factor, an adjustmen	to account for area of	framing when ca	vity insulation is used		
		um or external rigid foam ad cavity insulation ⁸⁰²					
24		-					
CDD							
	= Dependent whe	other basement is conditioned:			_	1	Formatted: Space After: 6 pt
	W (Cit	eather Basis Conditi	oned Space Une	conditioned Space			Formatted: Font color: Background 1
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DUA		Jse Adjustment (reflects the fac					Formatted. Form color. Background T
2011	-operate their AC	when conditions may call for i					
1.000	$=0.75^{805}$	1.00					
1,000 ηСоо1	- = Converts Btu to	ə kBtu y efficiency ratio of cooling sys	tem (kBtu/kWh)				
ησσοι		it is possible to measure or reas		known assume th	e <u>following: ⁸⁰⁶</u>	•	Formatted: Space After: 6 pt
		Age of Equipment	<u>nCool Estimat</u>	<u>e</u>			Formatted: Keep with next
		Before 2006 2006 - 2014	<u>9.5</u> 12.4			•	Formatted: Font color: Background 1
		Central AC After 1/1/2015	12.4				Formatted: Keep with next
		Heat Pump After 1/1/2015	13.3				Formatted: Font color: Background 1
	following: ⁸⁰⁷	Ane of		nCool		_//	Formatted: Keep with next
		Equipment	;	Estimate			Formatted: Font color: Background 1
		Before		10		//	
		2006 2006		13		$\langle \rangle \rangle$	Formatted: Keep with next
		2014				_//	Formatted: Font color: Background 1
		Central AC After		43		//	Formatted: Keep with next
		1/1/2015					Formatted: Font color: Background 1
		Heat Pump After		-14		\	Formatted: Font color: Background 1
		4/1/2015					Formatted: Font color: Background 1
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							Formatted: Font color: Background 1
ODMI Duildors Found	tion Handhook, aroust a	pace data from Table 5-5: Initial Effect	iva D values for Uninculate	d Foundation System	and Adjacent Soil 1001		Formatted: Font color: Background 1
p://www.ornl.gov/sci/ro	ofs+walls/foundation/OI	RNL_CON-295.pdf https://foundationl	nandbook.ornl.gov/handboo	k/.			
ASHRAE, 2001, "Char ctors.pdf", Table 7.1	acterization of Framing I	Factors for New Low-Rise Residential	Building Envelopes (904-F	<u> 2001 - ASHRA</u>	E - Characterization of Framing		Formatted: Font color: Background 1
National Climatic Data		1981-2010 climate normals with a bas					
The base temperature sl ns. Since unconditioned	nould be the outdoor tem basements are allowed	perature at which the desired indoor te to swing in temperature, are ground co	mperature stays constant, in upled, and are usually cool,	1 balance with heat le they have a bigger d	ss or gain to the outside and internal elta between the two (heating and		
		F for heating are used based on profestormals from NCDC are not available a		werage cooling degr	e days with 75F base temp are provide	ł	
This factor's source: En	ergy Center of Wisconsi	in, May 2008 metering study; "Central	Air Conditioning in Wisco				
nter of WI Central AC i mpilation of Recent Fie		is factor's source is: Energy Center of	Wisconsin, May 2008 mete	ring study; "Central .	Air Conditioning in Wisconsin, A		
These default system el	ficiencies are based on t	he applicable minimum Federal Stands	urds. In 2006 the Federal St	andard for Central A	was adjusted. While one would expect	£	
		s minimum, the likely degradation of e since the new rating better reflects the			m standard is appropriate. Note all		
These default system ef	ficiencies are based on the	he applicable minimum federal standar	ds. In 2006 the federal stan	dard for central AC v	vas adjusted. While one would expect the	e	
auge system efficiency	to be nigher than this mi	nimum, the likely degradation of effici	encies over time mean that	using the minimum (tanuard is appropriate.		
25 MEEIA 4 2019	21 Plan	Revision 87.0			Page 19	7	
					rage 1		

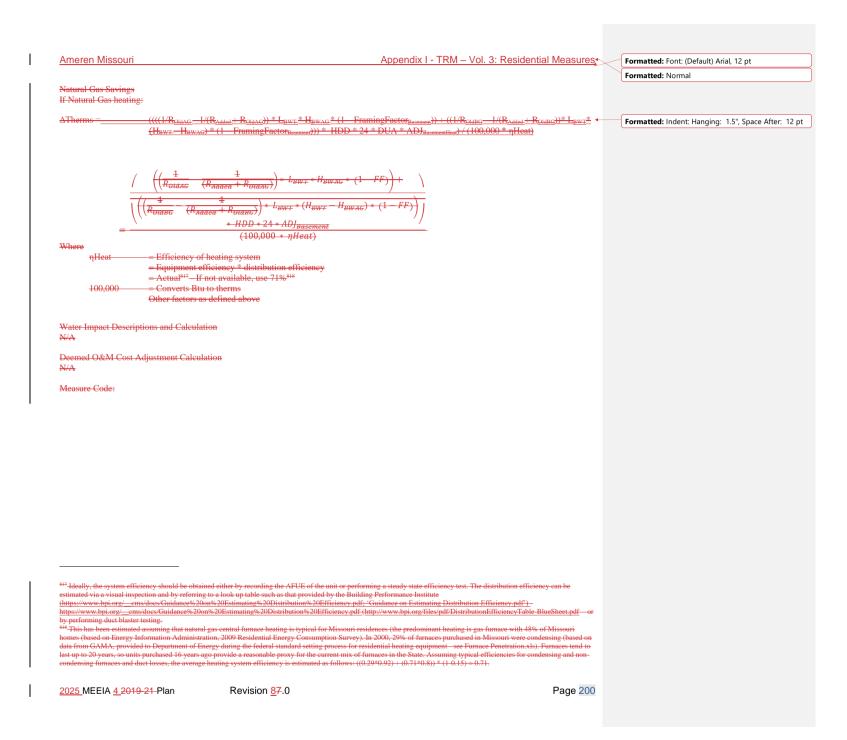
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ADJ _{Basemen}	$\frac{1}{1000} = Adjustment to coolin}{= 75\%^{808}}$	g savings t	o accoun	t for to (tecount f	or inacet	tracies in	enginee	ring alge	rithms.			
	≡ / 3% ***												
he home 18 heat	ed with electric heat (resistan	ce or heat j	oump), t l	ie electr	ic energy	saved 11	i annual l	ieating c	ue to the	e insulatio	on 18:		
Wh _{HeatingElectric}	<u>AkWh_heating = If ele</u>	etric heat (resistanc	e or hea	t pump),	reductio	n in annu	al electr	ic heatin	g due to	insulation <u>=</u>		Formatted: Indent: Hanging: 1.5"
	((((1/R _{OldAG} - 1/(R _{Added} (1 FramingFactor _{Bacan}	<u>+ R_{онаа})) :</u>					<u>ынва 1</u> (3,412 *		R _{okibe})) <u>* L_{BWT}*</u>	(H _{BWT} – H _{BWAG})	*	
	<u>(1 Frühingrüctor</u> <u>Basen</u>	tent	/// 21	DUM	Base	mentHeat 77	(3,112	- III ICULJ					
7 (1	<u> </u>	_) I	U	* (1	FE	Δ.							
<u> </u>	R oldAG (R _{Added} + R _{oldAC}	$\left(\frac{1}{2} \right)^{+} = \frac{1}{2} $	* П _{В₩7}	6* (1 -		- \							
$\frac{1}{1}$	+ +	- Low + (H	Huwar	* (1-)	F)							
(((Kon	авс (Клаава + Конавс)) <u>* HDD * 24 *</u>		DHT	bw no)	C C	<i>'</i>]]							
_		DUA * AL 2 * ŋHeat	J Baseme	nt									
	(3,11)	<u> qireu</u>	7										
ereL									4 - 000			•	Formatted: Indent: First line: 0"
Roube	= R value value of four = dependent on depth or			6	0								
	= Actual R value of wa							wan_ric	<i>.</i>).				
	For example, for an are	a that exter	ids 5 fee	t below	grade, an	R-value	of 7.46	would be	selected	l and add	ed to the existing		Formatted: Space After: 6 pt
	insulation R-value.												
	Below Grade R-value	Δ	1	2	2	4	5	6	7	Q	1		
	Earth R-value	2.44	4.50	6.30	8.40	10.44	12.66	14.49	+ 17.00	20.00			Formatted: Font color: Background 1
	(°F ft ² h/Btu)	2.44	4.50	0.50	0.40	10.44	12.00	14.49	17.00	20.00	-		Formatted: Font color: Background 1
	Average Earth R value (°F-ft2-h/Btu)	2.44	3.47	4.41	5.41	6.42	7.46	8.46	9.53	10.69			Formatted: Font color: Background 1
	Total BG R-value (earth +	2.14	4.47	5.41	6.41	7.42	9.46	0.46	10.52	11.60			Formatted: Font color: Background 1
	· · · · · · · · · · · · · · · · · · ·	3.44	4.47	5.41	6.41	7.42	8.46	9.46	10.53	11.69			Formatted: Font color: Background 1
H _{BWT}	Total BG R-value (earth + R-1.0 foundation) default = Total height of basen	nent wall (f		5.41	6.41	7.42	8.46	9.46	10.53	11.69]	-	Formatted: Font color: Background 1 Formatted: Font color: Background 1
H _{BWT}	Total BG R-value (earth + R 1.0 foundation) default = Total height of basen = Heating Degree Days	nent wall (f	it)				8.46	9.46	10.53	11.69]	•	
	Total BG R-value (earth + R 1.0 foundation) default = Total height of basen = Heating Degree Days	nent wall (f	it)				8.46	9.46	10.53	11.69]	•	Formatted: Font color: Background 1 Formatted: Indent: Left: 0", First line: 0.5"
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HDD	Total BG R-value (earth + R 1.0 foundation) default = Total height of basen = Heating Degree Days	ndent wall (f ndent on w Basis	it)				8.46	9.46	10.53		j	•	Formatted: Font color: Background 1 Formatted: Indent: Left: 0", First line: 0.5" Formatted: Indent: Left: 0", First line: 0", Space 6 pt
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<u>2025 MEEIA 4 2019-21 Plan</u>

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Revision <u>8</u>7.0

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	= Actual If not avai	ilable refer to default tabl	e helow: ⁸¹²				Formatted: Normal
				nHeat			
	System Typ	e <u>Age of Equipme</u>	ent <u>HSPF2 Estimate</u>	(<u>COP Estimate)</u> = (HSPF2/3.413)*0.85		•	Formatted: Keep with next
	Heat Pump	Before 2006	<u>5.8</u>	<u>1.44</u>		•	Formatted Table
	(if age unknown 2006-2014)	assume After 2006 - 2014 2015 on	<u>6.5</u> 7.0	<u>1.62</u> 1.74			Formatted: Font color: Background 1
	Resistance	2015 on N/A	<u>7.0</u> N/A	<u>1.74</u> 1.00		•	Formatted: Keep with next
	Unknown ⁸¹³	N/A	N/A	1.28		-	Formatted: Font color: Background 1
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	System Type	Age of Equipment	HSPF Estimate	Estimate)		\/	Formatted: Font color: Background 1
		P. 6 2006	6.9	(HSPF/3.412)*0.85	-	$\langle \rangle$	Formatted: Keep with next
	Heat Pump	Before 2006 2006 - 2014	6.8 7.7	<u>1.7</u> <u>1.9</u>	-		Formatted: Font color: Background 1
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	Resistance	N/A	N/A	1.0 1.0			
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the home is heat			alastria anargy sayed	in annual heating due to the ir	aulation is:		Formatted: Indent: Hanging: 1.5"
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Where:		Therms * F _c * 29.3 mption as a percentage of applicable minimum federal sta aum, the likely degradation of c act losses for heat pumps. <u>istance</u> , which is based upon d phoche6.9 xks ⁻ . he6.9 xks ⁻ . Av uld be used to improve this ass wp_content/uploads/H. TRM - I	² annual fuel consumpt o annual energy (kWh) andards. In 2006 the federal afficiencies over time mean ata from Energy Informatic argae efficiency of heat pur umption if available. Sifteetive 010124 v12.0 V more recent 15 vr data (20	tion -factor -standard for heat pumps was adjust s that using the minimum standard i m Administration_2009 Residential- np is based on assumption that 500 rol 2 Res 09222023 FINAL clean (bc 2020) for all heating related adir	s appropriate. An 85% [*] <u>Energy Consumption Survey</u> are units from before 2006 a <u>.pdf, page 397. Applied the</u> <u>ustment values</u> Based upon	<u>t</u>	
Vhere: 29.3 cummer Coincider <u>AkW = Ak</u> Vhere: CF " ² -These default syster verage system efficiency ¹⁰ /These default syster (0%) from 2006 2014. "Himois TRM Versis ercent change of NCI omparing algorithm d		Therms * F _c * 29.3 mption as a percentage of applicable minimum federal sta aum, the likely degradation of e uet losses for hear pumps- istance, which is based upon d 9/he/hc6/9.xk; 'hc6/9.xk;'A w uet losses for hear pumps- istance, which is based upon d 9/he/hc6/9.xk; 'hc6/9.xk;'A w uet losses of the prove this ass wp-content/uploade/II. TRM. I m 30 yr data set (1981 2010) to uated bill analysis estimate in	² annual fuel consumpt o annual energy (kWh) andards. In 2006 the federal afficiencies over time mean ata from Energy Informatic argae efficiency of heat pur umption if available. Sifteetive 010124 v12.0 V more recent 15 vr data (20	tion -factor -standard for heat pumps was adjust s that using the minimum standard i m Administration_2009 Residential up is based on assumption that 50% of J Res 09222023 FINAL clean	s appropriate. An 85% [*] <u>Energy Consumption Survey</u> are units from before 2006 a <u>.pdf, page 397. Applied the</u> <u>ustment values</u> Based upon	<u>t</u>	
Where:		Therms * F _c * 29.3 mption as a percentage of applicable minimum federal sta neidence demand (kW) to applicable minimum federal sta uum, the likely degradation of to use hoses for heat pumps- istance, which is based upon d bytherhe69.xls; 'he69.xls'. Ave did be used to improve this ass wp-content/uploads/1. TRM 1 a 30 vr data set (1981-2010) to duated bill analysis estimate in or details or calculation.	² annual fuel consumpt) annual energy (kWh) andards. In 2006 the federal officiencies over time mean ata from Energy. Informatic arge efficiency of heat pur umption if available: affective. 010124 v12.0 V more recent 15 vr data (22 the following 2012 Massac h be reasonably estimated 1	tion -factor -factor -standard for heat pumps was adjust a that using the minimum standard i m Administration, 2009. Residential mp is based on assumption that 50% (of 3 Res 0922023 FINAL clean for 3 Res 0922023 FINAL clean for 3 Res 0922023 FINAL clean -log - 2020; for all heating related adji shusetts report: "Home Energy Servi from a calculation based on the certifi	s appropriate. An 85% [*] <u>Energy Consumption Survey</u> are units from before 2006 a <u>updf. page 397. Applied the</u> <u>ustment values</u> Based upon iees Impact Evaluation, ²² fied values for fuel energy (F	ta nd	
Where:		Therms * F _c * 29.3 mption as a percentage of applicable minimum federal sta aum, the likely degradation of c net losses for heat pumps, istance, which is based upon d phorhe6.9 xks ⁻ . he6.9 xks ⁻ . Av uld be used to improve this ass wp_content/uploads/IL_TRM_I 9.0 crtata set (1981-2010) to thated bill analysis estimate in y details or calculation. Hor residential furnaces but can 3 receta sculutation.	² annual fuel consumpt • annual energy (kWh) andards. In 2006 the federal afficiencies over time mean ata from Energy Informatic argae efficiency of heat pur umption if available. Sifective 010124 v12.0 V more recent 15 yr data (20 the following 2012 Massae n be reasonably estimated 1 out of 1495 was 3.14%. Th Msc for reference.	tion -factor -standard for heat pumps was adjust s that using the minimum standard i m Administration_2009 Residential mp is based on assumption that 50% fol_3_Res_09222023_FINAL_clean 006-2020) for all heating related adju thusetts report. "Home Energy Servi	s appropriate. An 85% ¹ Energy Consumption Survey are units from before 2006 a <u>endf. page 397. Applied the</u> <u>istment values</u> Based upon ices Impact Evaluation, ²² fied values for fuel energy (Finan the ENERGY STAR®	ta nd	



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Appendix I - TRM - Vol. 3: Residential Measures

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3.7.6 Storm Windows

DESCRIPTION

Storm windows installed on either the interior or exterior of existing window assemblies can reduce both heating and eooling loads by reducing infiltration and solar heat gain and improving insulation properties. Glass options for storm windows can include traditional clear glazing as well as low emissivity (Low E) glazing. Low E glass is formed by adding an ultra thin layer of metal to clear glass. The metallie oxide (pyrolytic) coating is applied when the glass is in its molten state, and the coating becomes a permanent and extremely durable part of the glass. This coating is also known as "hard coat" Low E glass is designed to redirect heat back towards the source, effectively providing higher insulating properties and lower solar heat gain as compared to traditional clear glass. This characterization captures the savings associated with installing storm windows to an existing window assembly (retrofit).

This measure was developed to be applicable to the following program type: RF.-

If applied to other program types, the measure savings should be verified.

DEFINITION OF EFFICIENT EQUIPMENT

An interior or exterior storm window installed according to manufacturer specifications.

DEFINITION OF BASELINE EQUIPMENT The existing window assembly.

DEEMED LIFETIME OF EFFICIENT EQUIPMENT

20 years⁸¹⁹

DEEMED MEASURE COST

The actual capital cost for this measure should be used when available and include both material and labor costs. If unavailable, the cost for a lowe storm window can be assumed as \$7.85/ft² of window area (material cost) plus \$30 per window for installation expenses.³²²⁵⁷⁶ For clear glazing, cost can be assumed as \$6.72/ft² of window area (material cost) plus \$30 per window for installation expenses.³²²⁵⁷⁶

LOADSHAPE Building Shell RES

Algorithm

CALCULATION OF SAVINGS

The following reference tables show savings factors (kBtu/ft²) for both heating and cooling loads for each of the seven weather zones defined by the TRM.^{sti}. They are used with savings equations listed in the electric energy and gas savings sections to produce savings estimates. If storm windows are left installed year round, both heating and cooling savings may be claimed. If they are installed seasonally, only heating savings should be claimed. Savings are dependent on location, storm window location (interior or exterior), glazing type (clear or Low E) and existing window

⁴¹⁰ Task ET-WIN-PNNL-FY13-01_5.3: Database of Low-E Storm Window Energy Performance across U.S. Climate Zones. KA Cort and TD Culp, <u>'Culp ET Task 5-3_PNNL-22865. Final2.pdf'</u>, September 2013. Prepared for the U.S. Department of Energy by Pacific Northwest National Laboratory. PNNL-22864.
⁸²⁰ A comparison of Low-E to clear glazed storm windows available at large national retail outlets showed the average incremental cost for Low-E glazing to be \$1.13/ft². Installation costs are identical.

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<u>2025 MEEIA 4 2019-21 Plan</u>

Revision <u>8</u>7.0

				Дрр		<u>v v v. v. r.c</u>	esidential Measure	-	Formatted: Font: (Default) Arial, 12 pt
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t Louis, MO								•	Formatted: Space After: 6 pt
leating Savings Facto	rs (SavingsI	Factor _{heat}):						•	Formatted: Indent: First line: 0", Space After: 6 pt
				Base Window	Assembly				
		rings in kBtu/ft ²		DOUBLE PANE.	SINGLE PANE	DOUBLE PANE			
				DOUBLE	FIXED	FIXED			
		CLEAR EXTERIOR	HUNG 47.7	HUNG 13.3	48.5	12.3			
	Storm	CLEAR INTERIOR	49.8	15.5 17.9	49.0	14.2	-	•	Formatted Table
	Window Turne	LOW-E EXTERIOR	51.5	13.3	53.2	19.3			
	Type	LOW-E INTERIOR	57.7	20.3	55.9	47.5			
Cooling Savings Facto	rs (Savingsl	Factor				1	<u> </u>		Formatted: Space Before: 6 pt
ooning burnings rubu	io (ou ingoi	<u></u>		Dogo Window	Accombly		1		Pormatteu. space belore. o pr
		-	SINGLE	DOUBLE	- Assembly				
		'ings in kBtu/ft²	PANE,	PANE,	SINGLE PANE,	DOUBLE PANE,			
				DOUBLE HUNG	FIXED	FIXED			
		CLEAR EXTERIOR	23.0	10.5	22.5	9.6			
	Storm Window	CLEAR INTERIOR	23.9	10.7	24.4	9.8		•	Formatted Table
	Type	LOW-E EXTERIOR	29.5	15.4	29.3	9.3	_		
		LOW-E INTERIOR	28.8	14.2	29.0	13.4			
AkWh	<u> </u>	$\frac{+\Delta kWh_{heating}}{}$							
Vhere:									
AkWh _{cooling}		windows are left installe	0	oling season and th	he home has ce	ntral cooling, th	e reduction in annual		
	cooning re	equirement due to air seal	mg						
	<u> </u>	gsFactor _{cool} *A / ηCool							
	$\frac{\Sigma_{coot}}{2}$	<u>-</u> .						•	Formatted: Indent: First line: 0"
	<u>- ηθοσ</u>								
$\frac{\Sigma_{cool}}{A}$		factor for cooling, as tal pare footage) of storm v		a					
ηCool		ev (SEER2) of Air Cond							
	= Actual (where it is possible to m	easure or reason	ably estimate) If	`unknown, assu	me the followin	ng: ⁸²²		
		Age	of Equipment	nCool Estin	nate				
		Before 2000		<u>9.5</u>					
		2006 - 2014 Central AC	After 1/1/2015	<u>12.4</u> 12.4					
			After 1/1/2015	<u>12.4</u> <u>13.3</u>					
	ficiencies are b	ased on the applicable minimu	um Federal Standary	s In 2006 the Eederal	Standard for Cont	ral AC was adjusted	d While one would expect		
22 These default system of	uc o	and a set the applicable infinition			on that using the m	inimum standard is	appropriate Note all		
²² These default system efficien	cy to be higher	than this minimum, the likely ivalents since the new ratin				minum standaru is	appropriate. Note an		

				appointer i terre voi.	3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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	following: ⁸²³	Age of		SEER		
		Equipmen	ŧ	Estimate		
		Before 2006		-10		
		2006 -		13		
		2014 Central AC	+	13		
		After				
		<u>1/1/2015</u> Heat Pump				
		After				
		1/1/2015				
AkWh _{heating}		ce or heat pump), redu	etion in annual e	electric heating due to air sea	ling	
-						
	$= \Sigma SavingsFactor_{heat} * A /$	η Heat * 3.412				
		-	<u>Σ_{heat} * Α</u>			
-			ηHeat * 3.4	12		
Σ _{heat} ηHeat	— Savings factor for heating — Efficiency of heating sy	8,				
quien		refer to default table b	elow: ⁸²⁴ -			
	<u>System Type</u>	Age of Equipment	HSPF2 Estim		•	Formatted: Keep with next
	Heat Pump	Before 2006	5.8	<u>= (HSPF2/3.413)*0.85</u> <u>1.44</u>		Formatted Table
	(if age unknown	After 2006 - 2014	<u>5.8</u> 6.5	<u>1.44</u> <u>1.62</u>	-	Formatted: Keep with next
	assume 2006-2014)	2015 on	<u>7.0</u>	<u>1.74</u>		
	Resistance Unknown ⁸²⁵	N/A N/A	N/A N/A	<u>1.00</u> 1.28	-	Formatted: Keep with next
			HSPF H	Ieat (Effective		Formatted: Keep with next
	Syste Type	m <u>Age of</u> Equipment	Estimate C	OP-Estimate)		
	T J P	Before 2006	6.8	SPF/3.412)*0.85		
	Heat Pun		7.7	1.92		
	D. L.	2015 and after	8.2 N/A	2.04		
	Resistar	nee N/A	N/A	+		
3.412	= Converts kBtu to kWh					
MMED COINCIDENT	PEAK DEMAND SAVINGS					
CONCIDENT	LAR DEMAND DATENDS					
$\Delta kW = \Delta kWh_{c}$	tooling * CF					
ere:						
<u></u>						
hasa dafault austarr -ff	aionaios ara basad on tha ¹¹ 1	ala minimum fadaral -+	eds. In 2006 the f-d	anal standard for control AC	ljusted. While one would expect the	
age system efficiency to	be higher than this minimum, the	e likely degradation of effic	iencies over time m	ean that using the minimum standa	rd is appropriate.	
The second second second second second				eral standard for heat pumps was a eans that using the minimum stand	djusted. While one would expect the ard is appropriate. An 85%	
		es for heat pumps.		-		
age system efficiency to ibution efficiency is the	rapplied to account for duct loss					
age system efficiency to ibution efficiency is the Calculation assumes 35%	Heat Pump and 65% Resistance	, which is based upon data f 6.9.xls; 'hc6.9.xls'. Average	rom Energy Inform e efficiency of heat	pump is based on assumption that	50% are units from before 2006 and	Formatted: Font: (Default) Times New Roman

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$\Delta kWh_{Cooling} = Electric energy$	y savings for cooling, calculated above		
	coincidence demand (kW) to annual energy (kWh) factor 4kW	$= \Delta kWh * CF \qquad \bullet$	Formatted: Indent: Left: 0", First line: 0.5"
Where:			
$\frac{\Delta kWh_cooling}{\Delta kWh_cooling} = As calculated$			
CF = Summer System Peak = 0, 000466080	Coincidence Factor for Cooling		
ATURAL CAS SAVINGS	,		
Natural Gas heating:			
Therms – Σ _{heat} *Α / ηΗα	at * 100	+	Formatted: Indent: Left: 0"
$\Sigma_{next} * A$			
$\frac{Therms}{\eta Heat + 100}$			
/here:			
	neating system		
	iciency * distribution efficiency		
= Actual ^{or -} II 1 100 = Converts kBtt	ot available, use 71% ⁸²⁸		
Other factors as defined above			
VATER IMPACT DESCRIPTIONS AND C	ALCULATION		
ATEX INFACT DESCRIPTIONS AND C	ALCOLATION		
EEMED O&M COST ADJUSTMENT C.	LCULATION		
∕/ A			
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	Appendix G: "Table 1 Residential End Use Category Monthly Shapes and C	oincident Peak Factors" Ameren Missouri 2016	
adshape for residential building shell end use.	ed either by recording the AFUE of the unit or performing a steady state effici	ancy test. The distribution efficiency can be	
	to a look up table such as that provided by the Building Performance Institute	ency test. The distribution enterency can be	
ttps://www.bpi.org/cms/docs/Guidance%200	1%20Estimating%20Distribution%20Efficiency.pdf; 'Guidance on Estimating		
tps://www.bpi.org/cms/docs/Guidance%20or / performing_duct_blaster_testing.	%20Estimating%20Distribution%20Efficiency.pdf (<u>http://www.bpi.org/files/</u>	odf/DistributionEfficiencyTable_BlueSheet.pdf or	
	gas central furnace heating is typical for Missouri residences (the predominant	heating is gas furnace with 48% of Missouri	
omes (based on Energy Information Administra	ion, 2009 Residential Energy Consumption Survey). In 2000, 29% of furnaces	purchased in Missouri were condensing (based on	
	rgy during the federal standard setting process for residential heating equipme o provide a reasonable proxy for the current mix of furnaces in the State. Assu		
	to provide a reasonable proxy for the current finx of furnaces in the state. Assonation and the state. Assonation and the state of the		
	· · · · · · · · · · · · · · · · · · ·		
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3.7.7 Kneewall and Sillbox Insulation	entry contraction of the second secon		
Description This measure describes savings from adding i areas). This measure requires a member of th efficiency of the heating and cooling equipm This measure was developed to be applicable If applied to other program types, the measur Definition of Efficient Equipment The requirements for participation in the pro- Definition of Baseline Equipment	nsulation (for example, blown cellulose, spray foam) to wall eavities (this inc e implementation staff evaluating the pre- and post-project R-values and to r ent in the home should also be evaluated if possible. > to the following program type: RF * savings should be verified. gram will be defined by the utilities. mplementation staff or a participating contractor and is likely to be empty w	neasure surface areas. The	Formatted: Font color: Background 1
Deemed Measure Cost The actual installed cost for this measure sho Loadshape Building Shell RES	uld be used in screening.		
	Algorithm		
Calculation of Savings			
Electric Energy Savings			
<u>AkWh = AkWh_{eooling} + AkWh_{beoling}</u>	<u>AkWh = AkWh_{cooling} + AkWh_{neating}.</u>		
If the home has central cooling, the electric e	nergy saved in annual cooling due to the wall insulation is:		
AkWh _{enoling} Where AkWh _{enoling} = If central cooling, reduction FramingFactorwall * CDD * 24 * DUA * AD	o n in annual cooling requirement due to insulation<u>= ((1/R_{OLI} 1/R_{VAII})* Aw</u> J<u>wallCool) / (1,000 * ŋCool)</u>	<u>an* (1</u> ←	Formatted: Indent: Left: 0", First line: 0"
Where:		4	Formatted: Indent: Left: 0", First line: 0"
R _{old} = R value v	$= \frac{\left(\frac{1}{R_{out}} - \frac{1}{R_{watt}}\right) * A_{watt} * \left(1 - FramingFactor_{1}\right)}{\left(1,000 + \eta Cool\right)}$ value of new wall assembly including all layers between inside air and outs alue of existing assembly and any existing insulation (h ² .°F.h/Btu) of R-5 for uninsulated assemblies ⁸⁴⁴)	wau) * CDD * 24 * DUA	
⁸²⁹ "Retire" indicates that the measure is not anticipated ⁸³⁰ Illinois TRM Version 12.0. https://www.ilsag.info/u	1 to be offered through an Ameren Missouri administered demand side program during the p vp-content/uploads/IL TRM_Effective_010124_v12.0_Vol_3_Res_09222023_FINAL_clean	eriod of TRM effectiveness.	Formatted: Font color: Background 1
recommended in Guidehouse 'EMV- Group A, Deliver, https://pda.energydataweb.com/api/view/2518/CPUC% prepared for California Public Utilities Commission, Ju 2007.	(proment/uploads) TRAN_Interview_010129 (12.0 V013) Key_0222023 (Phyte_clean ble 16 EUL Research - Residential Insulation (see (20Insulation%20EUL%20Draft%20Report%2006292021.pdf: CPUC Insulation EUL Draft me 2021Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC M lectric, Exterior Wall Insulation, R-value for no insulation in-walls, and NREL's Building En	Report 06292021.pdf [*]). Ieasures, GDS Associates,	
<u>2025 MEEIA 4.2019-21 Plan</u>	Revision <u>8</u> 7.0	Page 205	

en Missouri		Appendix	I - TRM – Vol. 3: Residential	
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Awall .	$\frac{1}{1} = \text{Net area of insulated wall (ft}^2)$			
FramingFactor _{wall}	—= Adjustment to account for area of framination of the second	ng		
CDD	— = Cooling Degree Days: ⁸³³			
	Weather Basis (City based up St Louis, MO	2000) CDD 65		Formettade Font color: Poekeround 1
		-10.10		Formatted: Font color: Background 1
24				Formatted: Font color: Background 1
DUA	 Biscretionary Use Adjustment (reflects) may call for it) 	the fact that people do not	always operate their AC when con	ditions
	$= 0.75^{834}$			
1,000				
ηCool	— = Seasonal Energy Efficiency Ratio of coordinate of coordinate of coordinate of the season of t) ilf unknown, assume the follow	Formatted: Indent: First line: 0.5"
		fredsondory estimate <u>/</u>	, <u>-</u> 11_ unitio (11, ussuite the <u>-010 (1</u>	Formatted. Indent. First line. 0.5
	Age of Equipment	ηCool Estimate 9,5		
	<u>Before 2006</u> 2006 - 2014	<u>9.5</u> <u>12.4</u>		Formatted: Font color: Background 1
	Central AC After 1/1/2015	<u>12.4</u>		Formatted: Font color: Background 1
	<u>Heat Pump After 1/1/2015</u> following: ⁸³⁶	<u>13.3</u>		Formatted: Font color: Background 1
	tonowing.			Formatted: Font color: Background 1
			ŋCool Fetiwata	Formatted: Font color: Background 1
	Before		Lestimate 10	Formatted: Font color: Background 1
	2006			
	2006 - 2014		13	Formatted: Font color: Background 1
	Central AC		13	Formatted: Font color: Background 1
	after <u>1/1/2015</u>			
	Heat Pump		-14	Formatted: Font color: Background 1
	after 1/1/2015			
	1/1/2015			Formatted: Font color: Background 1
ADJ _{WallCool}	= Adjustment for wall insulation to account	nt for prescriptive enginee	ring algorithms consistently overcl	
	$\frac{\text{savings}}{= 63\%^{837}}$			
				
ome is heated with ele	ectric heat (resistance or heat pump), the election	ric energy saved in annual	heating due to the wall insulation i	<u>8:</u>
A.F. 2001. "Characterizat	on of Framing Factors for New Low Rise Residential B	uilding Envelopes (904-RP)." "	2001 ASHRAE - Characterization of Fran	ning Factors
Low Rise Residential Bui	ding Envelopes.pdf', Table 7.1.			
nal Climatic Data Center, (factor's source: Energy Cei	alculated from 1981-2010 climate normals with a base (ter of Wisconsin, May 2008 metering study; "Central A	emperature of 65°F. ir Conditioning in Wisconsin, /	Compilation of Recent Field Research," *	Energy Formatted: Font color: Background 1
	8.pdf', p. 31 This factor's source is: Energy Center of W			
e default system efficiencie	s are based on the applicable minimum Federal Standard			
ge system efficiency to be	higher than this minimum, the likely degradation of effi R2 equivalents since the new rating better reflects the	ciencies over time mean that us		
default system efficiencie	s are based on the applicable minimum federal standard	s. In 2006 the federal standard f		ild expect the
	ver than this minimum, the likely degradation of efficient ://www.ilsag.info/wp-content/uploads/IL-TRM_Effecti			÷
	ng evaluation by Opinion Dynamics, see Memo "Resul	ts for AIC PY6 HPwES Billing	Analysis" ('Memo on Ameren HPwES Bil	ling Analysis
	wuary 20, 2015. Applied the percent change of NCEI As adjustment values.	anual Normais CDD65 from 30	yr data set (1981-2010) to more recent 15	yr data

ren Missour	1		A	<u>ppendix I - TRM – Vol. 3: F</u>		Formatted: Font: (Default) Arial, 12 pt
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HeatingElectric	kWh _{heati}	mg = If elect FramingFactorwan) * HD		eat pump), reduction in annual el	leetric heating due to	
HOR <u>((1/K_{Old}</u>	$\frac{1/K_{\text{Wall}}}{M_{\text{Wall}}} + \frac{1}{M_{\text{Wall}}} + \frac{1}{M_{\text{Wall}}}$	FramingFactor _{wall}) * HD	D = 24 = ADJ WallHeat / (.)	3,412 ~ ηHeat)		
):					•	Formatted: Indent: Left: 0", First line: 0"
			$\frac{1}{R_{wall}} + \frac{1}{R_{wall}} + A_{wall} +$	(1 – FramingFactor _{Wall}) *	HDD * 24 * ADJWall	Formatted: Space After: 6 pt
			nu wui	(ηHeat * 3,412)		
HDD	= Heatir	ng Degree Days: ⁸³⁸				
		Weather Ba	asis (City based	D 65		
		et Louis MO	i pon)	186		
		St Louis, MO	4.2	180		Formatted: Font color: Background 1
ηHeat		ency of heating system				Formatted: Font color: Background 1
	= Actua	ıl - If not available, refer t	3 default table below: ⁸³⁹			
				<u>nHent</u>		
	System	<u>Type</u> <u>Age of Equi</u>	pment HSPF2 Estimat	te (<u>COP Estimate)</u> = (HSPF2/3.413)*0.85		Formatted Table
	Heat Pump	Before 2006	<u>5.8</u> 2014 6.5	<u>1.44</u> <u>1.62</u>		Formatted: Font color: Background 1
	<u>(if age unkno</u> <u>2006-2014)</u>	<u>After 2006 - 2</u> 2015 - on	<u>2014</u> <u>6.5</u> <u>7.0</u>	<u>1.62</u> <u>1.74</u>		
	Resistance	N/A	N/A	1.00		Formatted: Font color: Background 1
	Unknown ⁸⁴⁰	<u>N/A</u>	HSPF 7H	1.28 eat (Effective COP Estimate)		Formatted: Font color: Background 1
	System Type	Age of Equipment	Estimate			Formatted: Font color: Background 1
		Before 2006	6.8	1.7		
	Heat Pump	2006 2014	7.7	1.9		Formatted: Font color: Background 1
	Resistance	2015 and after N/A	8.2 N/A	2.0 1.0	-	Formatted: Font color: Packground 1
						Formatted: Font color: Background 1 Formatted: Font color: Background 1
3412 ADJ _{WallHeat} -		erts Btu to kWh	to account for prescripti	ve engineering algorithms consi-	stently overclaiming	Formatted. Fort color. Background T
	savings		······		8	
	= 63% ⁸⁴	#				
home is heate	d with electric heat (r	resistance or heat pump),	the electric energy saved	l in annual heating due to the wa	all insulation is:	
Heating Electric Gas-	ALWh.	- If gas t	furnaca beet kWh servin	as for reduction in fan run time	_	
HeatingElectricGas	= ATher	$\frac{-11}{\text{gas}}$ rms * F _e * 29.3	andee near, k wir saving	55 for reduction in full full time		Formatted: Indent: First line: 0"
* F	= Furna	ce fan energy consumptio	m as a percentage of anr	ual fuel consumption	•	Formatted: Indent: Left: 0", First line: 0"
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onal Climatia Da				istent with the findings of Belzer and C	ort, Pacific Northwest	
	Statistical Analysis of Hi	storical State Level Residential the applicable minimum Feder	Energy Consumption Trends al Standards. In 2006 the fede	;," 2004. stal standard for heat pumps was adjuste	ed. While one would expect	Formattad Font color: Pool/ground 1
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Appendix I - TRM - Vol. 3: Residential Measures

3.7.5 Cool Roof

DESCRIPTION

Cool (high albedo) roofing materials reduce the overall heat load on a home by reflecting more of the incident solar radiation, thus decreasing the $\sqrt{}$ total heat energy absorbed into the building system. This reduction in heat load provides space cooling energy savings during the cooling season but can increase heating energy use during the winter. Therefore, cool roofs are most beneficial in warmer climates and may not be recommended for homes where the primary heat source is electric resistance.

This measure is only applicable to existing buildings constructed before 2016 that have not undergone roof improvements since 2016.

This measure was developed to be applicable to the following program types: RF, DI. If applied to other program types, the measure savings should be verified.

DEFINITION OF EFFICIENT EQUIPMENT

The efficient condition is cool (high albedo) asphalt shingleroofing material. Although, the ENERGY STAR cool roof rating was discontinued, the minimum thresholds are listed for the required minimum solar reflectance and thermal emittance by the roof slope. The <u>Cool Roof Rating Council</u> provides ratings at https://coolroofs.org/directory/roof.at 0.30⁹⁴⁷.

	Solar Reflectance I Year,	Solar Reflectance 5 Year,		
Low slope/≤2:12 pitch	≥0.65	≥0.5	≥0.75	
Steep slope/>2:12 pitch	≥0.25	≥0.15	≥0.75	
		-		

DEFINITION OF BASELINE EQUIPMENT

The baseline condition is assumed to be an conventional asphalt shingle roof of albedo 0.142. All residential buildings with asphalt shingles and metal roofing products are. For other existing roofing materials, the reflectance and emittance values can be sourced, with savings determined by the calculators built by the Oak Ridge National Laboratory for low slope⁸⁴⁸ and steep slope⁸⁴⁹ roofs.

<u>Steep slopes, typically 5:12, with a roof area to footprint area ratio of 13/12 (~1.08).</u>

DEEMED LIFETIME OF EFFICIENT EQUIPMENT

The expected measure life is assumed to be 15 years.850

DEEMED MEASURE COST

The actual implementation cost for applying cool (high albedo) roof should be used.

LOADSHAPE Building Shell RES

Algorithm

CALCULATION OF SAVINGS

Mid-America Regional Council (MARC), in partnership with Lawrence Berkeley National Laboratory (LBNL), commissioned Leidos to study building energy consumption. The study area was a nine-county region identified by MARC. A whole-building energy modeling tool was used to evaluate urban heat island (UHI) countermeasure strategies for several common residential building categories based on models developed by the U.S. Department of Energy (DOE). Residential buildings were adapted to the Kansas City region to model changes in building energy consumption.

 ⁸⁴² Heat Island Mitigation Assessment and Policy Development for the Kansas City Region, LBNL, https://www.marc.org/sites/default/files/2022-05/Head/shandMitigationAssessmentandPolicy.pdf.; 'HeatIslandMitigationAssessmentandPolicy.pdf.;
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	Post-1980	1980-1999		25%	•	Formatted	
	IECC 2006	2000-2009		<u>13%</u>		Formatted	
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	1980-1999		<u>73.9</u>	<u>58.1</u>		Formatted	
	2000-2009		<u>33.3</u>	<u>24.9</u>		Formatted	
	2010-2015		23.9	<u>19.5</u>		Formatted	
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bid. BID	ri TRM Volume 1 - Appendix G	"Table 1 - Residential End Use Category	w Monthly Shapes and Coi	incident Peak Factors" Ameren M	lissouri 2016	Formatted	

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Residential New Construction	
ESCRIPTION	
his protocol documents the energy savings attributed to improvements in the construction of residential buildings compared to the basel	
uilding that is minimally compliant with specified code requirements. It applies to attached or detached single family homes and mul	<u>ltifamily</u>
esidential buildings with individual meters, residential grade HVAC and water heating equipment, and fewer than 4 stories.	
VEFINITION OF EFFICIENT EQUIPMENT	
fficient equipment refers to all components and systems in the residential new construction that meet or exceed the energy efficiency stand	
y RESNET accordited software or Passive House accreditation software. This includes high-performance insulation, windows, HVAC syste	ems, and
ppliances designed to reduce energy consumption.	
EFINITION OF BASELINE EQUIPMENT	
aseline equipment represents the minimum code compliant components and systems in residential new construction based on the curre	
dopted International Energy Conservation Code (IECC) 2015 standards. This includes standard insulation, windows, HVAC systems, and ap	ppliances
s defined by the IECC for energy modeling comparison.	
Deemed Lifetime of Efficient Equipment	
he expected measure life is assumed to be 15 years.	
NETWED MEASURE COST	
internet coor	
-OADSHAPE	
<u>Cooling RES</u> <u>Aiscellaneous RES (applicable to non-cooling savings)</u>	
Insectateous RES (appreade to non-coording savings)	
Algorithm	
CALCULATION OF SAVINGS Energy and peak demand savings for Residential New Construction programs will be calculated by comparing outputs of energy models of the	the oc
mergy and pear demand savings for Kendeman two considerion programs with occurate or comparing outputs of energy models of a serience unit or building to a minimally code compliant baseline unit or building. The characteristics of the baseline unit or building thermal	
velope and/or system characteristics shall be based on the current state adopted International Energy Conservation Code (IECC) 2015.	••••••••••••••••••••••••••••••••••••••
Indeled energy and peak demand savings shall be produced by a RESNET accredited software program ⁸⁵⁶ or the Passive House accreditation	
oftware packages (Passive House Planning Package ⁸⁵⁷ and WUFI Passive ⁸⁵⁸), though both Passive House tools require the user to separately the code baseline reference design to calculate energy and demand savings.	y model
the code observe reference design to calculate energy and demand savings.	
or multifamily buildings, savings may be calculated by modeling the building's individual units using any approved software. Savings may	r also be
alculated for the entire building using Passive House accreditation software, or under RESNET multifamily sampling protocols.869	
aseline insulation and fenestration requirements by component for buildings less than 4 stories (equivalent U-factors) ⁸⁶⁰ ;	
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*International-Code Council, Inc. (2015). 2015 International Energy Conservation Code. Retrieved from International-Code Council: trau/code actions/search/actional/Code Council:	Formatted: Font: Times New Roman, 9 pt
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- http://www.passivenousedcademy.com/index.php/shop_us ⁸ http://www.phius.org/software resources/wufi passive and other modeling tools/wufi passive 3-0	Formatted: Font: 9 pt
² -At the time of publication, RESNET standards for multifamily inspection and sampling were still under development, though they are expected to be adopted before this	
kes effect. See tp://conference2018.resnet.us/data/energymeetings/presentations/How%20Standards%20are%20Evolving%20to%20Better%20Address%20Multifamily%20Ratings%20.	.pdf
^a 2015 International Energy Conservation Code Table R402.1.4 Equivalent U Factors presents the R Value requirements of Table R402.1.2 in an equivalent U Factor form	
sers may choose to follow Table R402.1.2 instead. 2015 IECC supersedes this table in case of discrepancy. Additional requirements per §R402 of 2015 IECC must be foll	

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Revision <u>8</u>7.0

meren Missouri			Appendix I - TRM – Vol. 3: Resi	dential Measures	Formatted: Font: (Default) Arial, 12 pt
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	<u>P.</u>		IECC Climate	4	Formatted Table
			Zone 4A		Tornatted Table
	Fenestration U-Facto Skylight U-Factor	E	0.35 0.55		
	Ceiling U-Factor		0.026		
	Frame Wall U-Factor		0.06		
	Mass Wall U-Factor		0.098		
	Floor		<u>0.047</u>		
	Basement Wall		<u>0.059</u>		
	Slab		<u>10, 2 ft</u>		
	Crawl Space Wall		0.065		
vidential new constru	ction baseline building values for	ar building loss then 4 stories.			
sidential new constru	etton basenne bunding values i	<i>n</i> bunding less than 4 stories.			
	Data Point		<u>Value</u>		
	Air Infiltration Rate	5.0 ACH for the whole house 861			
	Duct Leakage	4 CFM ₂₅ (4 cubic feet per minut space when tested at 25 pascals)	te per 100 square feet of conditioned		
	Duct Insulation	where ≥3" in diameter and a min All other ducts not located comp	shall be insulated to a minimum of R-8 nimum of R-6 where <3 [™] in diameter. pletely inside the building thermal minimum of R-6 where ≥3 [™] in diameter <3 [™] in diameter. ⁸⁶³		
	Duct Location	50% in conditioned space, 50%			
	Mechanical Ventilation		ilation system with efficiency of 2.8 by Table M1507.3.3(1) of 2015 IRC ⁸⁶⁴		
	Lighting	1			
	Appliances	Use baseline values as defined in appliance.	n applicable TRM measure for each		
	Thermostat Setback	Maintain zone temperature down	n to 55 °F (13 °C) or up to 85 °F (29 °C)		
	Temperature Set Points	Heating: 70°F; Cooling: 78°F	5 -		
	ASHP, GSHP, PTHP Heating and Cooling Efficiency	See New Construction values in system.	applicable TRM measure for each		
	Electric Water Heating	See volume and load dependent	values in TRM section 3.3.4.		
	VINGS calculated from the software out walified unit/building (kWh/yr)	put using the following algorith			
$Wh = (kWh base_{co})$	<u>oling kW eecooling) + (kWh ba</u>	30 noncooling- <u>KW-00</u> noncooling)			
				/	Formatted: Font: Times New Roman, 9 pt
2015 International Energy	Conservation Code §R401-R404. http	s://codes.iccsafe.org/content/IECC201	5/chapter 4 re residential energy efficiency	/ /	Formatted: Font: Times New Roman, 9 pt
Ibid. I bid.					Formatted: Font: Times New Roman, 9 pt
2015 International Resider	ntial Code, Table M1507.3.3(1): Conti	uous Whole House Mechanical Venti	ilation System Airflow Rate Requirements.		Formatted: Font: Times New Roman, 9 pt
	ent/IRC2015/chapter 15 exhaust syste Conservation Code §R401 R404. http		5/chapter 4 re residential energy efficiency		Formatted: Font: Times New Roman, 9 pt
Ibid.					Formatted: Font: Times New Roman, 9 pt

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here:				
	— — Modeled annual cooling electric energy use of ba		Formatted: Indent: First line: 0.5"	
kW_ee	= Modeled annual cooling electric energy use of as			
kWh basenonecooling				
<u>kW-ee_{noncooling}</u>	<u> </u>	<u>of as-built home</u>	Formatted: Indent: First line: 0.5", Line spa	acing:
			Multiple 1.15 li	
MMER COINCIDENT PE	AK DEMAND SAVINGS			
$\Delta kW = \Delta kWh_{Coolin}$	<u>* CF</u>			
here:				
<u>AkWh_{Cooling} = 1</u>	<u>Electric energy savings for cooling, calculated above</u> Summer peak coincidence demand (kW) to annual energy (i	WID Contain		
).0009474181	<u>kwn) factor</u>		
ATURAL GAS SAVINGS	· · · · · · · · · · · · · · · · · · ·			
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	TIONS AND CALCULATION			
ATER IMPACT DESCRIP A	HONS AND CALCULATION			
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Revision <u>8</u>7.0

		Appendix I - TRM – Vol. 3: Re		Formatted: Font: (Default) Arial, 12 pt
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8 Miscellaneous				
	1 PP // 1/1/2027\%/			
8.1 Home Energy Report (Retired	1, effective 1/1/2025) ³⁰¹			
Description	ergy use reports to participating resident	ial electric or gas customers in order to cha	nga customers' energy	Formatted: Font color: Background 1
se behavior. Energy savings are evaluate	d by ex-post billing analysis comparing	g consumption before and after (or with	and without) program	
		age regression analysis and randomized the sponsorship of the US Department of		
alculation of savings achieved by the prog			Energy J. As such,	
		custom calculations, estimates of program		
		nated, or ex ante, values are based on pro r, or taken from actual savings values from		
elivered by other program administrators.		r, or taken from actual savings values from	comparative programs	
IER Program Estimated (Ex Ante) Saving	s Values			
Utility Program	Year Gross Electric Energ	y Savings Gross Demand Savings		
Cunty Frogram	(kWh/home			
	$\frac{1}{2}$ $\frac{140.37^{*}}{112.29}$	0.065422 0.052337		
Ameren Missouri Home Energy Report	3 89.83	0.041870		Formatted: Font color: Background 1
	4 71.87 5 57.49	0.033496 0.026797		
A Demand savings are calculated as the product of	de la companya de la companya de la companya de la 1937. Comp			
D				Formatted: Font color: Background 1
^B Value is based on the Ameren Missouri Home Er Program Adjusted Net Annual Savings / Number o	nergy Report Evaluation PY2021. First year annu			Formatted: Font color: Background 1
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Deemed O&M Cost Adjustment Calculation N/A		
Measure Code:		

<u>2025</u>MEEIA <u>4 2019-21</u> Plan

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Revision <u>8</u>7.0

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3.93.7 Residential Demand Response		
3.9.1 <u>Residential Demand Response Baseline Analysis</u> Approach		
DESCRIPTION		
For residential demand response measures, the energy and demand impace nterval data. The baseline for measuring impacts will be established by cree usage patterns and weather conditions. This control group will be used to est esponse event.	ating a control group of non-participant customers with similar energy	
The analysis will include weather normalization to ensure that the baseline eduction will be calculated as the difference between the weather-normalize		
f AMI data is not available for all participants, results will be extrapolated t	o represent the broader participant population.	

Revision <u>8</u>7.0

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Residential demand response: For dema				Formatted: Font:
participants will be randomly partition a signal to initiate activity on the therm signal (control group). Demand impacts impacts will be estimated from compari consumption for each event day. Howev dispatched), other quasi experimental d	ostat (treatment group), while s will be estimated from the av ing the 24 hours of the control ver, if it is not practical or plau	the other group of partici erage of the hours over all group for each event day t isible to use this approach	pants would not receive this event periods. Energy savings to the 24 hours of actual kWh	Formatted: Heading 3
3.9.2 Demand Response Advanced Th	ermostat			
DESCRIPTION This measure characterizes the demand savin response (DR) program. It also characterizes overall usage. Savings impacts will be evalue with and without program intervention.	the energy savings resulting from l	load shaping strategies employ	ed during non-peak hours to reduce	Formatted: Body Text
The evaluation approach includes establishing energy usage patterns and weather conditions impacts will be determined by comparing the characterizes the energy and demand savings (controls customer energy loads and also red impacts are evaluated by ex-post analysis con may be available through advanced thermost specific energy usage regression analysis and demand and energy savings achieved by the p Given that actual monitored field data is neer year evaluation results are used for program p	s. The analysis involves weather n te treatment group's energy used to for an advanced thermostat enrolled uces energy usage by utilizing a to mparing demand and consumption ats' 2-way communication ability. randomized controlled trial (RCT) regram for the year are treated as a ded as ex post inputs for these custanning and goal setting at the beginaring at the beginaring at the beginaring at the setting at the beginaring at the setting at the beginaring	ormalization to ensure accurat tring DR events to the weathe lin the Residential Demand Re- continuous load shaping strate with and without program int The program will require Med- experimental designs, among custom protocol. tom calculations, estimates of iming of the program cycles.	te baseline estimations. The savings er-normalized baseline This measure esponse (DR) Program. The program yey during non peak hours. Savings ervention, utilizing field data which &V methods that include customer- others. As such, calculation of both program savings based on previous	
As advanced thermostats evolve, some models however, will only attribute savings to the in influence in activating or enhancing the th optimization will not be attributed to the progr energy savings. The program differentiates influence to operate optional optimization, an optimization baseline or no optimization routi	cremental impact of "program-driv ermostat's optimization features. am As advanced thermostats mature between thermostats with "progran ad without "program-driven optimiz	ven optimization"—those savin Energy savings that result fr , some models include embedd m-driven optimization," whiel	ngs achieved through the program's rom default or non-program-driven ed optimization routines that achieve h achieve savings through program	
Due to the custom nature of the evaluation, available each year, with previous year results				
Demand Respon	nse Smart Thermostat Deemed Sav	ings Estimates for 2019-21 Pla	anning -	Formatted: Centered
Utility Program	Gross Electric Savings (Annual) (kWh/thermostat)	Gross Demand Savings (Event) (kW/thermostat)	-	Formatted Table
Demand Response Advanced Thermostat with Program- Driven Optimization	97.49 ⁸⁷⁰	0.94⁸⁷¹		
⁸⁷⁰ Average energy savings per device based on Ameren Response Portfolio Report, Table <u>20, https://www.efis.p</u> AMI Data Pathways. ⁸⁷¹ Average demand impact per device based on Ameren Response Portfolio Report, <u>Table 187, Residential DR I Program: Resource Capability Impacts for the per accou DR Program: Resource Capability Impacts for the numl impacts and number of accounts. 2025 MEEIA <u>4</u> 2019-21-Plan</u>	ssc.mo.gov/Document/Display/7866771927 n Missouri PY202 <u>3</u> 2 evaluation. See Amerr Program: Event Day Energy Savings by De mt kW impacts and number of accounts, ht	2. Comparison of Savings from Emer en Missouri Program Year 202 <u>3</u> 2 An vice Manufacturer for the number of itps://www.efis.psc.mo.gov/Documen	son Optimization Using Telemetry and nual EM&V Report, Volume 4: Demand devices and Table 143. Residential DR u <u>rDisplay/786677</u> Table 13. Residential	

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Appendix I - TRM - Vol. 3: Residential Measures

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Demand Response Advanced			
Thermostat without Program-	0.00	0.94 ⁸⁷²	
Driven Optimization			

This measure was developed to be applicable to the following program type: -DR.

DEFINITION OF EFFICIENT CASE

The efficient case is a customer who participates in the DR program, where the thermostat is under the control of the program. In this case, energy consumption is directly influenced by program-driven strategies, including load shaping during non-peak hours and demand reduction during peak periods The efficient case is a customer who participated in the DR program.

DEFINITION OF BASELINE CASE

The baseline case is a customer who is not participating in the DR program and whose thermostat operates independently of program-driven strategies. The baseline for measuring impacts will be established by creating a control group of non-participant customers with similar energy usage patterns and weather conditions. This control group will be used to estimate what energy usage would have been in the absence of a demand response event. The analysis will include weather normalization to ensure that the baseline reflects the weather conditions experienced during the event. If AMI data is not available for all participants, results will be extrapolated to represent the broader participant oppulation The baseline case is a customer who is not participating in the DR program and who has installed a thermostat with default enabled capability—or the capability to automatically—establish a schedule of temperature set points according to driving device inputs above and beyond basic time and temperature data of conventional programmable thermostats. This category of products and services is broad and rapidly advancing with regard to their capability, usability, and sophistication, but at a minimum the baseline customer must have installed a thermostat capable of two way communication and exceed the typical performance of manual and conventional programmable thermostats through the automatic or default capabilities described above.

DEEMED LIFETIME OF PROGRAM SAVINGS The expected measure life is assumed to be 1 year.

DEEMED MEASURE COST

It is assumed that program-controlled changes in residential settings are accomplished without homeowner investment in new equipment. Therefore, without evidence to the contrary, measure costs in such residential programs focused on program controlled changes in customer behavior may be defined as \$0.

LOADSHAPE

HVAC RES (for optimization routines that save energy during the cooling and heating seasons) Cooling RES (for optimization routines that save energy only during the cooling season) Heating RES (for optimization routines that save energy only during the heating season)

WATER IMPACT DESCRIPTIONS AND CALCULATION $N\!/\!A$

DEEMED O&M COST ADJUSTMENT CALCULATION $N\!/\!A$

3.9.3 Demand Response Water Heater Switch

DESCRIPTION

This measure characterizes the demand savings achieved by controlling residential water heater loads during peak periods through a demand response (DR) program. Savings impacts will be evaluated using ex-post analysis, primarily leveraging AMI interval data to compare energy consumption during peak periods with and without program intervention.

The evaluation approach includes establishing a control group through propensity score matching with non-participant customers who have similar energy usage patterns and weather conditions. The analysis involves weather normalization to ensure accurate baseline estimations. The demand savings impacts will be determined by comparing the treatment group's energy use during DR events to the weather-normalized baseline.

872 Ibid.

<u>2025 MEEIA 4 2019-21 Plan</u>

Revision <u>8</u>7.0

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between neuron neuron of the calculation, excise denand as using constantion will be based on the proof for calculations and data available end the view encisies. The result of the calculation encourse denand as using constantion of the subsequence excise. Description of the calculation encourse denands are single collations. There is a calculation of the calculation of the DB program, where the state heater is under the control of the program. In this case, denand is a direct in the DB program in the DB program and whose water beater operates independently, of program-adverse area is a castomer of boo profile operation denong or good of non-privilent control is an operative for the same in the DB program and whose water beater operates independently of program-adverse area is a castomer of the same of a domand is calculated to excise a domand is a calculated by cercal as calculated would have been in the domand or a domand is calculated to excise a domand is a calculated by cercal as calculated would have been in the domand or a domand is calculated to excise a domand is a calculated by cercal as calculated by cercal as calculated by cercal as calculated by cercal as calculated as a domand or a domand would have been in the domand or a domand is calculated to excise a domand is a submet of the same base of a domand is calculated as a domand or a doman	Ameren Missouri	Append	lix I - TRM – Vol. 3: Residential Measures	Formatted: Font: (Default) Arial, 12 pt
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In the function was not an extragation in the DR program, where the water heater is under the control of the program. In this case, demand reduction is interpretending in the DR program, where the water heater operator is protocol of the program. The second reduction is the program of the DR program				
In the function was not an extragation in the DR program, where the water heater is under the control of the program. In this case, demand reduction is interpretending in the DR program, where the water heater operator is protocol of the program. The second reduction is the program of the DR program	DEFINITION OF REFICIENT CASE			
In basin case is a customer who is not participating in the DA Porgram and whose water heater operators independently of program-driving register is a water basin is provided to expressent the base customer with indire entropy of the second	The efficient case is a customer who partici		ler the control of the program. In this case, demand	
In basin case is a customer who is not participating in the DA Porgram and whose water heater operators independently of program-driving register is a water basin is provided to expressent the base customer with indire entropy of the second	DEFINITION OF BASELINE CASE			
in the number of the formations. This control aroups will be used to existing the three whether controls experienced during the events. A is a vacable for all participants: usel the extendeated to represent the basedor participant population. If the proceeding of the same the test is a summed to be a low of the same test is a low of the same test is a low of the same test is a low of the same test is a low of the same test is a low of the same test is a low of the same test is a low of the same test is a low of the same test. The same test is a low of the same test is a low of the same test is a low of the same test is a low of the same test is a low of the same test is a low of the same test is a low of the same test is a low of the same test is a low of the same test is a low of the same test is a low of the same test is a low of the same test. The same test is a low of the same test is a low of the same test is a low of the same test. The same test is a low of the same test is a low of the same test is a low of the same test. The same test is a low of the same test is a low of the	The baseline case is a customer who is no			
In the final basis will include weather normalization to ensure that the baseline reflects the weather conditions experienced during the events. If AM Lans considuable for a final baseline to the booster participant population. EVEN EVEN EVEN EVEN The mean lans constrained to be larse. Demonstrained constrained to be larse. Demonstrained constrained to be average				
ENCIDENTIAL OF PROGRAM SAVINGS The subscription of the same data is a subscription of the same data is a subscription of the water heater switch is \$199.00. ENCIDENT PROGRAM SAVINGS MARE MARE <	event. The analysis will include weather n	ormalization to ensure that the baseline reflects the w	eather conditions experienced during the event. If	
The expected measure life is assumed to be 1 year. Presented to water heater switch is \$149.00. LOUSHAPE NA WATER DEPART DESCRIPTIONS AND CALCULATION NA DEPARTD O&M COST ADJUSTMENT CALCULATION NA	AMI data is not available for all participant	ts, results will be extrapolated to represent the broader	participant population.	
The incremental cost of the water heater switch is \$149.00. Localizate NA A A A A A A A A A A A A A A A A A				
LANSING MA MA DEMED DESCRIPTIONS AND CALCULATION NA DEMED DEMIC DESCRIPTIONS AND CALCULATION NA DEMED DEMIC DESCRIPTIONS AND CALCULATION NA DEMIC DESCRIPTIONS AND CALCULATIONS NA DEMIC DESCRIPTIONS NA DEMIC DESCRIPTIONS NA	DEEMED MEASURE COST			
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WATER IMPACT DESCRIPTIONS AND CALCULATION NA DEPARED O&M Cost AddUSTMENT CALCULATION NA				
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Ameren Missouri	Appendix I - TRM – Vol. 3: Residential Measures*	Formatted: Font: (Default) Arial, 12 pt
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3.9.4 Demand Response Electric Vehicle Charger		
Description	•	Formatted: Heading 3
	ed by controlling residential electric vehicle (EV) charger loads during m. Savings impacts will be evaluated using ex-post analysis, primarily	
leveraging AMI interval data to compare energy consu	mption during peak periods with and without program intervention.	
	al group through propensity score matching with non-participant weather conditions. The analysis involves weather normalization to	
ensure accurate baseline estimations. The demand savi	ngs impacts will be determined by comparing the treatment group's	
energy use during DR events to the weather-normalize	d baseline.	
	nand savings calculations will be based on the specific conditions and forming program planning and goal setting for subsequent cycles.	
This measure was developed to be applicable to the fol	lowing program type: DR.	
Definition of Efficient Case		
	DR program, where the EV charger is under the control of the Increed by program driven strategies during peak periods.	
· · · · · · · · · · · · · · · · · · ·	nieneed by program-arriven strategies during peak periods.	
Definition of Baseline Case		
	g in the DR program and whose EV charger operates independently of impacts will be established by creating a control group of non-	
	ns and weather conditions. This control group will be used to estimate and response event. The analysis will include weather normalization to	
ensure that the baseline reflects the weather conditions	experienced during the event. If AMI data is not available for all	
participants, results will be extrapolated to represent t	he broader participant population.	
Deemed Lifetime of Program Savings		
The expected measure life is assumed to be 1 year.		
Deemed Measure-Cost		
Since customers do not need to invest in new equipmer deemed measure cost is \$0.	It or incur additional expenses to participate in the program, the	
Loadshape		
<u>N/A</u>		
Water Impact Descriptions and Calculation		
N/A		
Deemed O&M Cost Adjustment Calculation		
<u>N/A</u>		

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3.9.5 Behavioral Demand Response	l'omateu. roma
Description	Formatted: Heading 3
This measure characterizes the demand savings achieved through a behavioral demand response (DR) program, where	
participating customers are notified of peak energy use events and encouraged to reduce their energy consumption during	
these periods. Customers self-manage their energy use in response to notifications, which may be delivered via email, text	
message, or other communication channels. The program relies on customer action to achieve load reduction during DR events.	
Savings impacts will be evaluated using ex-post analysis, primarily leveraging AMI interval data to compare energy	
eonomption during peak periods with and without program participation. The effectiveness of customer actions in response	
to DR notifications will be assessed to determine the overall demand savings.	
The evaluation approach includes establishing a control group through propensity score matching with non-participant	
eustomers who have similar energy usage patterns and weather conditions. The analysis involves weather normalization to	
ensure accurate baseline estimations. Demand savings impacts will be determined by comparing the energy use of participants during DR events to the weather normalized baseline derived from the control group.	
Due to the custom nature of the evaluation, ex-post demand savings calculations will be based on the specific conditions and data available each year, with previous year results informing program planning and goal setting for subsequent cycles.	
This measure was developed to be applicable to the following program type: DR.	
Definition of Efficient Case	
The efficient case is a customer who receives notification of behavioral DR program peak energy use events. In this case,	
demand reduction is directly influenced by the customer's actions in response to program-driven notifications.	
Definition of Baseline Case	
The baseline case is a customer who does not receive notification of behavioral DR program peak energy use events. The	
baseline for measuring impacts will be established by creating a control group of non-participant customers with similar	
energy usage patterns and weather conditions. This control group will be used to estimate what demand would have been in the absence of a behavioral DR event notification. The analysis will include weather normalization to ensure that the baseline	
reflects the weather conditions experienced during the event. If AMI data is not available for all participants, results will be	
extrapolated to represent the broader participant population.	
Deemed Lifetime of Program Savings	
The expected measure life is assumed to be 1 year.	
Deemed Measure Cost	
Since customers do not need to invest in new equipment or incur additional expenses to participate in the program, the deemed measure cost is \$0.	
Loadshape	
N/A	
Water Impact Descriptions and Calculation	
Deemed O&M Cost Adjustment Calculation	
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