Opinion **Dynamics**

Ameren Missouri Program Year 2022

Volume 2: Residential Portfolio Appendices

June 9, 2023

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Appendix A.   Detailed Prescriptive Impact Analysis Methodology

The evaluation team estimated gross energy and demand savings for measures installed through residential and residential income eligible programs using prescriptive algorithms included in Version 6.0 of Ameren Missouri's technical reference manual (TRM) Appendix I and Appendix F. Where available, our team used parameters included in tracking data collected by the implementation teams of each program and, where unavailable, deemed parameters included in the TRM. Table 1 below includes references to the appropriate Missouri TRM appendix and section for each unique measure type offered through Ameren Missouri's suite of residential programs.[1]

Table 1. Missouri TRM Appendix Reference Table

Measure Name	HVAC	REP	MFMR	PAYS Tier 1	MFIE	SFIE	Community Lighting
Refrigerator Replacement						Appendix F Income Eligible Appendix I 3.1.1	
Advanced Power Strips Tier 1		Appendix F EE Kits Appendix I 3.2.1		Appendix F Income Eligible Appendix I 3.2.1 A			
Advanced Power Strips Tier 2		Appendix F REP Appendix I 3.2.2			Appendix F Income Eligible Appendix I 3.2.2	Appendix F Income Eligible Appendix I 3.2.2	
Low-Flow Faucet Aerator				Appendix F Income Eligible Appendix I 3.3.1 A	Appendix F Income Eligible Appendix I 3.3.1	Appendix F Income Eligible and EE Kits Appendix I 3.3.1	
Low-Flow Showerhead				Appendix F Income Eligible Appendix I 3.3.2 A	Appendix F Income Eligible Appendix I 3.3.2	Appendix F Income Eligible and EE Kits Appendix I 3.3.2	
Water Heater Tank Wrap				Appendix F Income Eligible Appendix I 3.3.3 A			
Heat Pump Water Heater		Appendix F REP Appendix I 3.3.4	Appendix F Efficient Products Appendix I 3.3.4				

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[1] Note that the evaluation team estimated ex post impacts for Tier 4 Pay As You Save (PAYS) Program measures using building energy modeling software and, as such, we reference our approach separately in Appendix C of this evaluation report.

Measure Name	HVAC	REP	MFMR	PAYS Tier 1	MFIE	SFIE	Community Lighting
Water Heater Pipe Insulation				Appendix F Income Eligible Appendix I 3.3.5 A		Appendix F Income Eligible and EE Kits Appendix I 3.3.5	
Advanced Thermostat	Appendix F HVAC Appendix I 3.4.1 A	Appendix F REP Appendix I 3.4.1	Appendix F Efficient Products Appendix I 3.4.1		Appendix F Income Eligible Appendix I 3.4.1	Appendix F Income Eligible Appendix I 3.4.1	
Air Source Heat Pumps	Appendix F HVAC Appendix I 3.4.2 B		Appendix F HVAC Appendix I 3.4.2		Appendix F HVAC Appendix I 3.4.2	Appendix F HVAC Appendix I 3.4.2	
Duct sealing						Appendix F Income Eligible Appendix I 3.4.3	
Ductless Minisplit	Appendix F HVAC Appendix I 3.4.4 B						
Programmable Thermostat					Appendix F Income Eligible Appendix I 3.4.5	Appendix F Income Eligible Appendix I 3.4.5	
HVAC tune up			Appendix F MFMR Appendix I 3.4.6		Appendix F Income Eligible Appendix I 3.4.6	Appendix F Income Eligible Appendix I 3.4.6	
Electronically Commutated Motor			Appendix F HVAC Appendix I 3.4.7		Appendix F Income Eligible Appendix I 3.4.7	Appendix F Income Eligible Appendix I 3.4.7	
Central Air Conditioner	Appendix F HVAC Appendix I 3.4.8 B		Appendix F HVAC Appendix I 3.4.8		Appendix F HVAC Appendix I 3.4.8	Appendix F HVAC Appendix I 3.4.8	
Dirty Filter Alarm			Appendix F MFMR Appendix I 3.4.9		Appendix F Income Eligible Appendix I 3.4.9	Appendix F Income Eligible and EE Kits Appendix I 3.4.9	
Room Air Conditioner						Appendix F Income Eligible Appendix I 3.4.11	
Ground Source Heat Pump	Appendix F HVAC						

Measure Name	HVAC	REP	MFMR	PAYS Tier 1	MFIE	SFIE	Community Lighting
	Appendix I 3.4.12 [B]						
Residential Lighting			Appendix F MFMR Appendix I 3.5.1 and 3.5.2	Appendix F Lighting Appendix I 3.5.1 and 3.5.2 [A]	Appendix F Income Eligible Appendix I 3.5.1 and 3.5.2	Appendix F Income Eligible and EE Kits Appendix I 3.5.1 and 3.5.2	Appendix F Lighting and Income Eligible Appendix I 3.5.1 and 3.5.2
Business Lighting			Appendix F MFMR and BUS Appendix I 3.5.1 and 3.5.2 Appendix H 2.6.6		Appendix F Income Eligible and BUS 3.5.1 and 3.5.2 Appendix H 2.6.4 and 2.6.7		
Air Sealing					Appendix F Income Eligible Appendix I 3.7.1	Appendix F Income Eligible Appendix I 3.7.1	
Ceiling Insulation					Appendix F Income Eligible Appendix I 3.7.2	Appendix F Income Eligible Appendix I 3.7.2	
Motor Replacement			Appendix H 2.8.1				
VFD on Chilled Water Pump			Appendix H 2.8.5				
Window replacements			MO TRM 2017 2.12.1 [C]		MO TRM 2017 2.12.1 [C]		

[A] The evaluation team applied in-service rates (ISR) developed from a participant survey that are different than those in the Ameren Missouri TRM.

[B] The evaluation team applied an early replacement ratio factor developed from a participant survey to account for inconsistencies in program tracking data.

[C] The evaluation team applied algorithms and assumptions from the Missouri Technical Reference Manual – 2017 – Volume 2: Commercial and Industrial Measures (dated March 31, 2017) Section 2.12.1 – Windows pp.27–284. Note that the evaluation team used the statewide TRM (last updated in 2017) as the Ameren Missouri TRM appendices referenced elsewhere in this evaluation do not contain a window replacement measure.

Appendix B.   Heating Ventilation and Cooling (HVAC)

Early Replacement Methodology

The PY2022 evaluation used an operational/functional definition of early replacement (ER), based on a combination of program-tracking data and participant survey responses. The ER battery in the HVAC participant survey included two key questions:

- Was the unit working/did it run when turned on and, if so, did it meet the participant's cooling/heating needs?
- Was repair offered by the contractor and, if so, was it a feasible option for the participant?

The purpose of this approach was to arrive at a more rigorous determination of whether the unit is operational/functional than the current ex ante definition, which only considers if the unit turns on.

Sampled participants with a new central air conditioner or heat pump who replaced a central heating and/or cooling system were asked the ER survey questions. Systems identified as not turning on in the program-tracking data were considered replacement on failure (ROF), irrespective of survey responses.

Early Replacement Survey Questions

ER1.   Which of the following **best** describes the operating condition of the old [UNIT] that you replaced? (*please select one*)

1.   Unit ran when turned on and provided sufficient [heating/cooling] for my space
2.   Unit ran when turned on but *did not* provide sufficient [heating/cooling] for my space (it worked but not well)
3.   Unit did not run when turned on / it was not working
98.   Unsure

ER2.   Did your contractor provide you with an option to repair your old [UNIT]?
1.   Yes
2.   No
98.   Unsure

[ASK IF ER2=1]
ER2a. Why did you not accept the option to repair your old [UNIT]?
1.   Repair cost was too high to make feasible, so I/we did not consider repairing the unit
2.   Repairs were a feasible option, but I/we decided to replace the [UNIT] instead
3.   Other, please specify: [OPEN END]
98.   Unsure

Unit Age

If "unsure" was selected for either ER2 or ER2a, we used the age of the unit in the tracking data to make the ER/ROF determination. We compared the age of the respondents' unit with the mean age of all units, which was 20.4 years based on the PY2022 program-tracking data. If the age of the respondent's unit was less than or equal to the mean age, we considered the unit to be ER; if the age of the respondent's unit was greater than the mean age, we considered the unit to be ROF.

Scoring Algorithm

The table below shows the combination of tracking data and survey responses used to classify units as ROF or ER.

Tracking data	Tracking data	ER1	ER2	ER2a	Tracking data	Classification
Type	Function	Operating Condition	Repair Option	Reason for not Repairing	Age	
NC or Addition						TOS
Existing or remodel	Does not turn on					ROF
	Turns on	1. Unit ran when turned on and provided sufficient heating/cooling for my space			All	ER
		2. Unit ran when turned on but did not provide sufficient heating/cooling for my space (it worked but not well) 98. Unsure	1. Yes	1. Repair cost was too high for an old [UNIT] / not worth it	All	ROF
				2. Repairs were a feasible option but I/we decided to replace the [UNIT] instead	All	ER
				0. Other, specify	<=PY22 mean age	TBD
					>PY22 mean age	TBD
				98. Unsure	<=PY22 mean age	ER
					>PY22 mean age	ROF
			2. No		All	ROF
			98. Unsure		<=PY22 mean age	ER
					>PY22 mean age	ROF
		3. Unit did not run when turned on / it was not working	1. Yes	1. Repair cost was too high for an old [UNIT] / not worth it	All	ROF
				2. Repairs were a feasible option but I/we decided to replace the [UNIT] instead	All	ER
				0. Other, specify	<=PY22 mean age	TBD
					>PY22 mean age	TBD
				98. Unsure	All	ROF
			2. No		All	ROF
			98. Unsure		All	ROF

TOS
ER
ROF
TBD

Demographics Results

The evaluation team asked participants to provide information about their household characteristics. Respondents could opt out of all demographic questions. Table 2 provides the demographic results from the participant survey.

Table 2. HVAC Participant Survey Demographics

Characteristic	Downstream (Percent of Participants)	Midstream (Percent of Participants)
Age	(n= 601)	(n= 95)
Under 25	0.2%	0.0%
26–44	17%	19%
45–64	39%	38%
65+	44%	43%

Characteristic	Downstream (Percent of Participants)	Midstream (Percent of Participants)
Homeownership	**(n= 772)**	**(n= 113)**
Own	99.6%	100%
Rent	0.4%	0.0%
Education	**(n= 702)**	**(n= 107)**
High School or less	9%	6%
Some College	19%	13%
College Graduate	28%	34%
Technical / Trade School Program or Associates Degree	11%	11%
Graduate or Professional Degree, EG, JD, MBA, Md, PhD	34%	36%
Income	**(n= 519)**	**(n= 84)**
Less than $50,000	18%	4%
$50,000 to less than $100,000	38%	37%
$100,000 to less than $150,000	24%	30%
Greater than $150,000	20%	30%
Housing Type	**(n= 771)**	**(n= 112)**
Single Family Detached Home	88%	95%
Single Family Attached Home Such as a Townhouse or Row House	6%	4%
Apartment or Condominium	6%	2%
Mobile Home	0.1%	0%
Gender	**(n=682)**	**(n=100)**
Female	51%	41%
Male	48%	59%
Non-Binary	0.4%	0.0%
Race / Ethnicity	**(n= 658)**	**(n= 99)**
White or Caucasian	92%	96%
Black or African American	5%	3%
Asian	2%	1%
American Indian or Alaskan Native	0.5%	0.0%
Pacific Islander	0.2%	0.0%

Appendix C.   Pay As You Save (PAYS)

The following section presents details of our PY2022 impact evaluation for the PAYS Program, along with demographic information from surveys of participants and non-participants completed through this evaluation.

Detailed Impact Results

In the remainder of this section, we provide additional detailed results of key components of our impact evaluation for Tier 1 and 4 PAYS measures, including:

■ Development of survey-based in-service rates (ISRs) for application to both Tier 1 and 4 measures;

■ Application of deemed parameters to estimate ex post savings for Tier 1 measures; and

■ Detailed results of our energy model review for a sample of Tier 4 projects, including descriptions of updates that the evaluation team made to the energy model for each project included in our sample.

Survey-Based ISR Development

Survey-based ISRs range from 65% to 100% for Tier 1 measures and from 95% to 100% for Tier 4 measures, as shown in Table 3 below. Participants confirmed receipt of at least 90% of program-tracked units for each measure category but indicated somewhat lower installation rates for several Tier 1 measure categories (72% for low-flow showerheads, 76% for advanced power strips, 82% for faucet aerators, 91% for LED lighting). We combined results across insulation and sealing measures (attic insulation, air sealing, and duct dealing), because they shared very similar response patterns and had small individual base sizes. ISRs for each measure category reflect relative precision ranging from 1% to 6% at 90% confidence. For water heater wrap and water heater pipe wrap, ISRs are deemed at 100% given observed uncertainty among survey respondents and the likelihood that customers may not be aware of its installation.[2]

Table 3. PAYS Survey-Based ISRs by Channel and Measure Category

Channel	Measure Category	Ex Ante ISR[a]	Respondents	Quantity	% Received	% Installed	Ex Post ISR
Tier 1 Direct Install	Standard LED Lighting	88.6%	144	914	95.4%	91.2%	87.0%
	Advanced Power Strips	95.0%	305	324	97.8%	75.9%	74.3%
	Low-Flow Showerheads	94.0%	37	40	90.0%	72.2%	65.0%
	Faucet Aerators	95.0%	44	77	98.7%	81.9%	80.9%
	Water Heater/Pipe Wrap [b]	96.0%	N/A	N/A	100.0%	100.0%	100.0%
Tier 4 Retrofit	HVAC	100%	30	30	100.0%	100.0%	100.0%
	Smart Thermostats		21	22	100.0%	95.5%	95.5%

[2] Of the 57 survey respondents who, based on program-tracking data, received water heater/pipe wrap, eight could not recall receiving the measure and 10 indicated they had not received it. Given the high degree of uncertainty and the likelihood that a contractor may install these materials without the customer noticing or remembering, we opted not to rely on customer-reported ISR information for this measure category and apply a deemed value of 100% instead. Note that TRM ISRs for water heater wrap and pipe wrap range from 96% to 100%. The contribution of these measures to total ex ante program savings is 0.6%, meaning that this assumption will have negligible effects on overall program performance.

Channel	Measure Category	Ex Ante ISR[a]	Respondents	Quantity	% Received	% Installed	Ex Post ISR
	Insulation and Sealing		47	47	97.9%	N/A	97.9%
	Specialty LED Lighting		7	51	100.0%	90.2%	90.2%

[a] ISRs used to estimate ex ante savings for Tier 1 measures are embedded in the per-unit savings estimates included in version 5.0 of Appendix F of the Ameren MO TRM. For Tier 4 measures, ex ante calculations assumed an ISR of 100%.

[b] Water heater and pipe wrap ISR does not rely on survey responses. We assume 100% ISR for these measures.

Among participants with units not installed at the time of the survey, many reported placing them in storage (94% for LED lighting, 80% for showerheads, 66% for advanced power strips, and 40% for faucet aerators). Some participants also indicated that they had removed the units (50% for faucet aerators, 6% for LEDs, 5% for advanced power strips). The majority of those who removed initially installed equipment indicated it was because the unit broke or was nonfunctional (100% for LEDs, 60% for faucet aerators, 75% for advanced power strips).

Deemed Savings Analysis for Tier 1 Measures

Table 4 summarizes per-unit ex ante and ex post energy and demand savings for Tier 1 measures along with associated gross realization rates. Realization rates for these measures ranged from 58.1% for low-flow showerheads to 100.0% for water heater wrap. For low-flow showerheads, aerators, and water heater pipe wrap, ex post savings rely on TRM-recommended electric domestic water heating fuel type assumptions applied based on available information from program-tracking data. For all measure categories, ex post savings reflect survey-based ISRs presented in the previous section. For measure categories that do not rely on water heater fuel type assumptions, differences between ex ante and ex post savings are solely attributable to application of ISR assumptions established as part of this evaluation. [3]

Table 4. PAYS Tier 1 Per-Unit Savings

Measure Category	Energy Savings			Demand Savings		
	Ex Ante (kWh)	RR	Ex Post (kWh)	Ex Ante (kW)	RR	Ex Post (kW)
Standard LED Lighting	32.51	98.2%	31.92	0.0050	98.2%	0.0050
Advanced Power Strips	29.45	78.2%	23.03	0.0034	78.2%	0.0026
Low-Flow Showerheads	194.72	58.1%	113.10	0.0173	58.1%	0.0100
Faucet Aerators- Bath	35.17	74.0%	26.02	0.0031	74.0%	0.0023
Faucet Aerators- Kitchen	111.03	75.7%	84.07	0.0099	75.7%	0.0075
Water Heater Wrap	100.55	100.0%	100.55	0.0089	100.0%	0.0089
Water Heater Pipe Wrap	4.64	90.3%	4.19	0.0004	90.3%	0.0004

[3] LED lighting ex ante and ex post savings use a halogen baseline. Future changes to lighting baseline assumptions are expected to dramatically reduce per-unit savings associated with LED lighting.

Energy Model Analysis for Tier 4 Retrofit Measures

Our Tier 4 energy model analysis consisted of a desk review of project documentation and a thorough review of modeling files for 20 sampled projects representing 17% of total Tier 4 projects and 18% of total ex ante energy savings associated with Tier 4 measures. For all 20 sampled projects, we were able to replicate ex ante savings for Tier 4 measures using the OptiMiser modeling software employed by the implementation team. We then updated model specifications to align with available project details and developed realization rates for each project. For 15 of the 20 projects included in the energy model analysis, we established realization rates (RRs), exclusive of ISR, ranging from 90% to 109%. For another four projects, these RRs ranged from 69% to 83%, and one project had a much lower RR of 32%.

Table 5 summarizes the key drivers of differences between ex ante and ex post savings for the sampled projects. More detail is provided following the table.

Table 5. PAYS Tier 4 Energy Model Review Findings (Exclusive of ISR)

Project ID	Ex Ante kWh Savings	Ex Post kWh Savings	RR	Key Drivers of Differences
ODC001	6,896	6,725	97.5%	Updated weather station reference. Updated baseline heating capacity based on info from nameplate.
ODC002	8,851	8,320	94.0%	Updated weather station reference. Updated lighting measure info/per-unit savings. Updated billing data finding discrepancy in usage data- ex ante consumption values are 2-5% higher than ex post.
ODC003	1,671	1,322	79.1%	Updated blower door test results. Updated lighting measure info/per-unit savings. Updated billing data (usage discrepancy found in one month).
ODC004	6,938	6,867	99.0%	Updated weather station reference.
ODC005	12,970	12,222	94.2%	Updated weather station reference. Updated lighting measure info/per-unit savings. Updated billing data (usage discrepancy found in one month).
ODC006	14,443	14,383	99.6%	Updated lighting measure info/per-unit savings. Updated billing data (usage discrepancy found in one month).
ODC007	11,009	10,610	96.4%	Updated weather station reference. Updated heat pump heating capacity based on info from nameplate data field. Updated billing data (usage discrepancy found in one month).
ODC008	10,927	3,543	32.4%	Updated HSPF for existing heating equipment type. Updated weather station reference. Updated lighting measure info/per-unit savings.
ODC009	2,980	3,203	107.5%	Updated weather station reference. Updated lighting measure info/per-unit savings.
ODC010	5,941	5,696	95.9%	Updated weather station reference. Updated lighting measure info/per-unit savings.
ODC011	982	679	69.1%	Updated lighting measure info/per-unit savings.
ODC012	3,046	3,129	102.7%	Updated weather station reference. Updated baseline heating capacity based on info from nameplate. Updated billing data (usage discrepancy found in one month). Updated lighting measure info/per-unit savings
ODC013	489	489	100.0%	N/A

Project ID	Ex Ante kWh Savings	Ex Post kWh Savings	RR	Key Drivers of Differences
ODC014	8,313	6,500	78.2%	Updated weather station reference. Updated lighting measure info/per-unit savings. Since no evidence was provided for the baseline R-value, calibration range was adjusted to be between R-4 and R-12; R-12 is a minimum threshold of insulation if batts were installed. The model calibrated baseline to an R-8, which is more reasonable compared to ex ante assumption (R-4).
ODC015	8,492	8,336	98.2%	Updated lighting measure info/per-unit savings.
ODC016	900	978	108.7%	Updated weather station reference. Updated billing data (usage discrepancy found in one month).
ODC017	8,935	8,769	98.1%	Updated lighting measure info/per-unit savings.
ODC018	11,888	11,436	96.2%	Updated billing data (usage discrepancy found in one month). Updated baseline heating capacity. Updated HSPF for the installed unit based on info from nameplate.
ODC019	7,162	6,533	91.2%	Updated weather station reference. Updated lighting measure info/per-unit savings. Updated conditioned area. Updated attic insulation area. Updated baseline R-value based on the program-tracking data.
ODC020	564	468	83.0%	Updated weather station reference. Updated lighting measure info/per-unit savings. Updated billing data (usage discrepancy found in one month).
Overall	133,397	120,208	90.1%	N/A

Inconsistencies between energy model specifications and available documentation or data for a small number of projects included in our energy model analysis accounted for the vast majority of differences between ex ante and ex post savings. For project ODC008, we updated equipment specifications based on available project documentation (pre-installation photos), changing the existing heating equipment from an electric resistance furnace to an air-source heat pump, which reduced savings dramatically and represented the primary driver of the project's 32% realization rate. For project ODC014, we updated baseline assumptions for attic insulation R-values, allowing a calibration range of R-4 to R-12 in the absence of project-specific data or documentation, which reduced savings substantially and represented the primary driver of the project's 78% realization rate. These two projects represented the majority of the negative differences between ex ante and ex post savings across the 20 projects included in our energy model analysis.

We also identified three common issues with energy model assumptions which had somewhat smaller effects on savings across many projects. First, energy models often used climatological assumptions from unreliable or unverifiable sources. Second, these models included oversimplified specialty LED lighting savings assumptions. Lastly, the models did not always fully integrate accurate, customer-specific billing data into model calibrations. While these findings did not have significant implications for overall ex post gross savings, we note them here because of their frequency and potential impact on future program savings.

We updated weather assumptions for 13 of the 20 projects to use industry-standard weather stations.[4] We also updated LED lighting savings assumptions for 13 of the 20 projects. In these cases, the energy model included generalized assumptions regarding LED baselines and installed wattages and often included Tier 1 standard LEDs. Ex post savings for Tier 4 specialty lighting instead used Missouri TRM Appendix F deemed per-unit savings assumptions, which we applied to quantities included in supplemental program-tracking data.

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[4] Weather stations associated with Typical Meteorological Year version 3 (TMY3) datasets (e.g., St. Louis International Airport for projects in the St. Louis area).

For nine of the 20 projects, we found inconsistency between the electric usage data used to calibrate energy models and billing data provided by Ameren Missouri. In these cases, we revised the models to use billing data received from Ameren Missouri.

Project documentation provided by the implementation team to inform the energy model review included invoices and pre- and post-HVAC installation verification photos for 18 out of 20 projects. However, their documentation did not include several explicitly requested items, including verification or additional detail regarding: (1) duct sealing and attic insulation materials, measurements, and photos, and (2) blower door test results and CFM reduction values. Consistently collecting and tracking these types of project details would add significant value not only in terms of supporting verification efforts but also for quality control purposes and to help ensure a positive customer experience.

Application of Evaluation Results

This section summarizes gross impact results for the PY2022 PAYS Program by measure category. For Tier 1 measures, RRs reflect the difference between ex ante and ex post per-unit savings that rely on appropriate TRM-recommended per-unit savings and survey-based ISRs developed as part of the current evaluation for each Tier 1 measure category. For Tier 4 measures, the RR reflects a savings-weighted average of results from our modeling review of 20 sampled projects, as well as developed as part of the current evaluation for each Tier 4 measure category. Table 6 presents ex ante savings by channel and measure category along with the RRs for Tier 1 and Tier 4 measures and survey-based ISRs used to calculate ex post savings.

Table 6. PAYS Annual First Year Gross Impacts by Channel and Measure Category

Channel	Measure Category	Energy Savings			Demand Savings		
		Ex Ante (MWh	RR	Ex Post (MWh)	Ex Ante (MW)	RR	Ex Post (MW)
Tier 1 Direct Install	Standard LED Lighting	90	98.2%	88	0.014	98.2%	0.014
	Advanced Power Strip	33	78.2%	26	0.004	78.2%	0.003
	Low-Flow Showerhead	34	58.1%	20	0.003	58.1%	0.002
	Bathroom Faucet Aerator	10	74.0%	8	0.001	74.0%	0.001
	Kitchen Faucet Aerator	8	75.7%	6	0.001	75.7%	0.001
	Water Heater Wrap	1	100.0%	1	<0.001	100.0%	<0.001
	Water Heater Pipe Wrap	5	90.3%	4	<0.001	90.3%	<0.001
	Tier 1 Subtotal	*180*	*84.4%*	*152*	*0.023*	*87.7%*	*0.020*
Tier 4 Retrofit	HVAC	643	90.1%	579	0.300	90.1%	0.270
	Smart Thermostat	62	86.1%	53	0.029	86.1%	0.025
	Attic Insulation	58	88.2%	51	0.027	88.2%	0.024
	Air Sealing	48	88.2%	43	0.023	88.2%	0.020
	Duct Sealing	13	88.2%	12	0.006	88.2%	0.005
	Specialty LED Lighting	10	81.3%	8	0.001	81.3%	0.001

Channel	Measure Category	Energy Savings			Demand Savings		
		Ex Ante (MWh	RR	Ex Post (MWh)	Ex Ante (MW)	RR	Ex Post (MW)
	Tier 1 Measures A	1	N/A	N/A	<0.001	N/A	N/A
	Tier 4 Subtotal	*835*	*89.3%*	*746*	*0.386*	*89.5%*	*0.345*
	Total	**1,016**	**88.5%**	**899**	**0.409**	**89.4%**	**0.365**

A Tier 1 measures included in Tier 4 tracking data were excluded to avoid double counting of associated savings.

Note: Individual values may not sum to totals due to rounding.

Survey Demographics

The evaluation team asked participant survey respondents to provide information about their household characteristics. Respondents could opt out of all demographic questions. Table 7 provides the demographics results from the participant survey.

Table 7. PAYS Participant Survey Demographics

Characteristic	Percent of Respondents
Age (n=338)	
25 or under	1%
26–44	39%
45–64	39%
65+	21%
Education (n=374)	
High School or less	11%
Technical / Trade School Program or Associates Degree	13%
Some College	20%
College Graduate	28%
Graduate or Professional Degree, EG, JD, MBA, Md, PhD	28%
Income (n=305)	
Less than $50,000	26%
$50,000 to less than $100,000	41%
$100,000 to less than $150,000	18%
Greater than $150,000	15%
Housing Type (n=390)	
Single Family Detached Home	91%
Single Family Attached Home Such as a Townhouse or Row House	5%
Apartment or Condominium	3%
Mobile Home	2%
Persons in Household (n=371)	
1 - 2	53%
3 - 4	35%
5 - 6	10%
7+	2%

Characteristic	Percent of Respondents
Time at Residence (n=388)	
Less than one year	4%
One to three years	24%
Four to 10 years	31%
11 to 20 years	20%
More than 20 years	20%

The evaluation team asked non-participant survey respondents to provide information about their household characteristics. Respondents could opt out of all demographic questions. Table 8 provides the demographics results from the non-participant survey.

Table 8. PAYS Non-Participant Survey Demographics

Characteristic	Percent of Respondents
Age (n=224)	
25 or under	2%
26–44	46%
45–64	36%
65+	16%
Education (n=236)	
High School or less	14%
Technical / Trade School Program or Associates Degree	13%
Some College	17%
College Graduate	29%
Graduate or Professional Degree, EG, JD, MBA, Md, PhD	27%
Income (n=212)	
Less than $50,000	31%
$50,000 to less than $100,000	33%
$100,000 to less than $150,000	19%
Greater than $150,000	16%
Housing Type (n=244)	
Single Family Detached Home	86%
Single Family Attached Home Such as a Townhouse or Row House	4%
Apartment or Condominium	6%
Mobile Home	4%
Persons in Household (n=236)	
1 - 2	47%
3 - 4	36%
5 - 6	15%
7+	2%
Time at Residence (n=243)	
Less than one year	5%
One to three years	25%

Characteristic	Percent of Respondents
Four to 10 years	33%
11 to 20 years	22%
More than 20 years	15%

Appendix D.   Data Collection Instruments

In this Appendix, the evaluation team presents data collection instruments for all primary data collection activities that contributed to the development of gross program savings. In Table 9, we provide data collection instruments for the HVAC and PAYS Programs, along with the tasks and gross impact component that each instrument contributed to.

Table 9. Residential Program Evaluation Data Collection Instruments

Program	Task	NTGR Component	File
HVAC Program	Participant survey	▪ Early Retirement Rates ▪ In-Service Rates	PY2022 Ameren Missouri_HVAC_Part
PAYS Program	Participant Survey	▪ In-Service Rates	PY2022 Ameren Missouri_PAYS_Partic

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