BizSavers Program Evaluation Report

Volume II of II

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Prepared For:

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1. Introduction

This report is the divided into two volumes presenting the results of the impact, process, and cost effectiveness evaluations of the BizSavers Custom, Standard, Energy Management System (EMS) Pilot, New Construction, Retro-Commissioning, and Small Business Direct Install (SBDI) programs. Volume II contains appendices presenting detailed information regarding evaluation methodologies, data collection instruments, and evaluation results. Volume II is organized as follows:

- Appendix 2 presents site-level gross impact evaluation reports for each site in which measurement and verification of energy savings was performed.
- Appendix 3 presents detailed information regarding the sampling plans that facilitated estimation of energy savings.
- Appendix 4 presents detailed information regarding the results of the gross impact evaluation, including a discussion of high impact measures (HIM).
- Appendix 0 contains the staff and implementer interview guide.
- Appendix 6 contains the online participant survey instrument.
- Appendix 7 presents the non-participant survey instrument.
- Appendix 8 presents the lighting trade ally interview guide.
- Appendix 9 presents non-participant spillover methodology.
- Appendix 10 presents the heating and cooling interaction factors used in assessment of ex post energy savings of lighting measures in conditioned spaces.
- Appendix 11 presents detailed information pertaining to the cost effectiveness evaluation.
- Appendix 12 contains a glossary of terms used in the evaluation report.

See report Volume I for narrative and summary information pertaining to the evaluation methods and results.

2. Site-Level Estimation of Ex Post Gross Savings

This appendix presents site-level gross impact evaluation reports for each site in which measurement and verification of energy savings was performed. A table of contents is shown below listing the site reports presented in this appendix. In this table, site-level reports are listed in order of site ID.

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Site ID 6001

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed twelve photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/12/18 and 6/06/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh RR*
100107-Lighting-Linear Tube LED Fixture Replac T5 HO Fixture	1169	Lighting	Custom	111	111	360	168	5,686	1.07	216,876	129,618	60%
100213-Lighting-Non Linear LED Fixt Replac CFL Fixture				36	36	46	14	2,716	1.11	4,499	3,460	77%
				36	36	46	14	5,106	1.11	4,499	6,505	145%
				20	20	44	22	2,480	1.11	1,789	1,207	67%
100107-Lighting-Linear Tube LED Fixture Replac T5 HO Fixture				1	1	240	112	5,235	1.11	970	741	76%
305402-Lighting-Linear ft LED (<=5.5 W/ft) Replac T8 32W Linear ft	3025		Standard	50	50	32	14	4,298	1.11	3,082	4,279	139%
				30	30	32	14	2,152	1.07	2,311	1,244	54%
				10	10	25	9	2,716	1.11	548	481	88%
100107-Lighting-Linear Tube LED Fixture Replac T5 HO Fixture	1169	Exterior Lighting	Custom	10	10	360	168	4,247	1.00	-	8,155	
		Lighting		16	16	120	56	5,235	1.11	-	5,929	
				34	34	240	112	5,235	1.11	-	25,199	
Total										234,574	186,817	80%

The annual lighting hours of operation verified during the M&V site visit (ranging from 2,152 – 5,686) are fewer than the annual hours of operation used to calculate ex ante savings (ranging from 3,200 – 7,085).

The quantity of the first line item in the table above (111) verified during the M&V site visit is less than the ex ante savings quantity (149). The following paragraph provides details on the discrepancy.

The ex post savings analysis added the ninth, tenth, and eleventh line items in the table above. The ninth line item was added due to the end use being exterior instead of interior. The tenth and eleventh line items were found to be two-lamp and four-lamp fixtures instead of six-lamp fixtures.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned office in St. Louis, was applied to the ex post lighting energy savings. In addition, a factor of 1.00 was applied to

the exterior installations as well as the shipping warehouse and mezzanine. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[1]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 80%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and overestimated installed quantity of the first measure.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	5,941	6,003	101%	1.14
Custom	Lighting	228,633	172,659	76%	32.80
Custom	Exterior Lighting		8,155		0.05
Total		234,574	186,817	80%	33.99

[1] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6003

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules which use photo cells.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixture Replacing Metal Halide Fixture	1169	Exterior Lighting	Custom	16	8	455	137	4,308	1.00	27,086	26,641	98%
				8	4	455	171	4,308	1.00	12,947	12,735	98%
				4	4	455	41	4,308	1.00	7,253	7,134	98%
				4	2	455	137	4,308	1.00	6,771	6,660	98%
				3	3	455	41	4,308	1.00	5,440	5,351	98%
Total										59,497	58,521	98%

The annual lighting hours of operation for the line items in the above table using photo cells (4,308[2]) are less than the hours of operation used to calculate ex ante savings (4,380).

A heating and cooling interactive factor of 1.00, applicable to an exterior installation was applied to the ex post lighting energy savings which corresponds with the ex ante estimate for interactive effects

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[3]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	59,497	58,521	98%	0.33
Total		59,497	58,521	98%	0.33

[2] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[3] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6004

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules with the use of photo cells.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixture Replacing Metal Halide Fixture	1169	Exterior Lighting	Custom	20	6	455	171	4,308	1.00	35,364	34,783	98%
Total										35,364	34,783	98%

The annual lighting hours of operation for the line item in the above table using photo cells (4,308[4]) are less than the hours of operation used to calculate ex ante savings (4,380).

A heating and cooling interactive factor of 1.00, applicable to an exterior installation was applied to the ex post lighting energy savings which corresponds with the ex ante savings estimate for interactive effects.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[5]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	35,364	34,783	98%	0.20
Total		35,364	34,783	98%	0.20

[4] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[5] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6005

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules and use of photo cells.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixture Replacing Metal Halide Fixture	1169	Exterior Lighting	Custom	16	16	215	29	4,308	1.00	13,035	12,821	98%
				4	2	455	281	4,308	1.00	5,510	5,420	98%
				4	2	455	281	4,308	1.00	5,510	5,420	98%
				2	1	455	281	4,308	1.00	2,755	2,710	98%
				2	1	455	281	4,308	1.00	2,755	2,710	98%
				3	3	215	29	4,308	1.00	2,444	2,404	98%
Total										32,009	31,483	98%

The annual lighting hours of operation for the line items in the above table using photo cells (4,308[6]) are less than the hours of operation used to calculate ex ante savings (4,380).

A heating and cooling interactive factor of 1.00, applicable to an exterior installation was applied to the ex post lighting energy savings and corresponds with the ex ante savings estimate for interactive factors.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[7]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

[6] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[7] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	32,009	31,483	98%	0.18
Total		32,009	31,483	98%	0.18

Site ID 6006

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules with photo cell usage.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixture Replacing Metal Halide Fixture	1169	Exterior Lighting	Custom	16	7	455	171	4,308	1.00	26,644	26,206	98%
				2	2	455	87	4,308	1.00	3,224	3,171	98%
				1	1	455	87	4,308	1.00	1,612	1,585	98%
Total										31,480	30,962	98%

The annual lighting hours of operation for the line items in the above table using photo cells (4,308[8]) are less than the hours of operation used to calculate ex ante savings (4,380).

A heating and cooling interactive factor of 1.00, applicable to an exterior installation was applied to the ex post lighting energy savings and corresponds with the ex ante energy savings estimate interactive factors.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[9]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	31,480	30,962	98%	0.17
Total		31,480	30,962	98%	0.17

[8] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[9] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6007

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules with photo cell usage.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixture Replacing Metal Halide Fixture	1169	Exterior Lighting	Custom	17	9	455	230	4,308	1.00	24,813	24,405	98%
Total										24,813	24,405	98%

The annual lighting hours of operation for the line item in the above table using photo cells (4,308[10]) are less than the hours of operation used to calculate ex ante savings (4,380).

A heating and cooling interactive factor of 1.00, was applied to the ex post lighting energy savings and corresponds with the ex ante savings estimate interactive factor.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[11]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	24,813	24,405	98%	0.14
Total		24,813	24,405	98%	0.14

[10] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[11] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6008

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules with photo cell usage.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixture Replacing Metal Halide Fixture	1169	Exterior Lighting	Custom	3	3	295	87	4,308	1.00	2,733	2,688	98%
				5	5	128	37	4,308	1.00	1,993	1,960	98%
Total										4,726	4,648	98%

The annual lighting hours of operation for the line items in the above table using photo cells (4,308[12]) are less than the hours of operation used to calculate ex ante savings (4,380).

A heating and cooling interactive factor of 1.00, applicable to an exterior installation was applied to the ex post lighting energy savings and corresponds to the ex ante savings estimate interactive factor.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[13]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	4,726	4,648	98%	0.03
Total		4,726	4,648	98%	0.03

[12] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[13] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6011

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/02/18 and 5/21/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025	Lighting	Standard	113	113	59	26	6,197	1.11	17,476	25,596	146%
				36	36	112	52	6,151	1.11	10,123	14,716	145%
				17	17	32	13	5,742	1.11	1,514	2,054	136%
Total										29,113	42,366	146%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (4,380). The ex ante estimated hours did not take into account the actual posted store hours nor the hours employees are present.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned retail in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[14]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 146%. The ex ante energy savings estimate was premised on

[14] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	17,476	25,596	146%	4.86
Total		17,476	25,596	146%	4.86

Site ID 6012

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/02/18 and 5/21/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp FixtReplac T8 Lamp or Fixture	3025	Lighting	Standard	103	103	59	25	6,620	1.11	17,780	25,677	144%
				28	28	114	50	6,087	1.11	9,098	12,081	133%
				8	8	32	13	2,276	1.11	773	384	50%
Total										27,651	38,141	138%

The annual lighting hours of operation verified during the M&V site visit for the third line item in the table above (2,276) are fewer than the annual hours of operation used to calculate ex ante savings (4,745). These lamps were placed within the restrooms and breakroom where the lighting was turned off when the area not in use. For the first and second line items above the annual operating hours (6,620 and 6,087, respectively) are greater than the ex ante saving hours (4,745). The ex ante hours did not represent the posted hours and did not include employee stocking hours.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned retail in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[15]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 138%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for the majority of the project and underestimated heating and cooling interactive effects.

[15] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	27,651	38,141	138%	7.25
Total		27,651	38,141	138%	7.25

Site ID 6013

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/03/18 and 5/23/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025	Lighting	Standard	258	258	32	17	3,332	1.09	13,574	14,103	104%
Total										13,574	14,103	104%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (3,278).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned light industrial in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[16]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 104%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	13,574	14,103	104%	2.68
Total		13,574	14,103	104%	2.68

[16] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6014

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/03/18 and 5/23/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025	Lighting	Standard	155	155	32	14	2,845	1.09	8,155	8,682	106%
Total										8,155	8,682	106%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours were fewer than those used to develop the ex ante energy savings estimates (3,278).

The efficient wattage above (14W) verified during the M&V site visit is less than the ex ante savings wattage (17W). The vendor only delivered the lower wattage to the facility.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned light manufacturing in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[17]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 106%. The ex ante energy savings estimate was premised on usage of a higher wattage lamp and underestimated heating and cooling interactive effects.

[17] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	8,155	8,682	106%	1.65
Total		8,155	8,682	106%	1.65

Site ID 6016

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/02/18 and 5/23/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025	Lighting	Standard	19	19	114	68	3,078	1.11	2,918	2,975	102%
Total										2,918	2,975	102%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours were fewer than those used to develop the ex ante energy savings estimates (3,120).

A heating and cooling interactive factor of 1.12, applicable to a gas heated, air conditioned office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[18]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 102%. The ex ante energy savings estimate was premised on underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	2,918	2,975	102%	0.57
Total		2,918	2,975	102%	0.57

[18] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6017

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/01/18 and 5/21/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	Standard	45	45	210	43	4,582	0.90	29,270	30,883	106%
				30	30	164	68	5,888	0.96	11,217	16,320	145%
Total										40,487	47,202	117%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (3,640).

A heating and cooling interactive factor of 1.01, applicable to an electric heated, air conditioned retail in St. Louis, was applied to the ex post lighting energy savings for the sales floor. In addition, a factor of 0.90, applicable to an electric heated only retail facility was applied to the shop and storage areas. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[19]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 117%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	40,487	47,202	117%	8.97
Total		40,487	47,202	117%	8.97

[19] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6018

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/01/18 and 5/21/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	Standard	63	63	164	68	5,338	0.94	23,555	30,242	128%
Total										23,555	30,242	128%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (3,640). Twenty-seven percent of the lamps were continuously in use (8,760).

A heating and cooling interactive factor of 1.01, applicable to an electric heated, air conditioned small retail in St. Louis, was applied to the ex post lighting energy savings for the sales areas. In addition, a factor of 0.90 was applied to the shop and parts storage areas where there was no cooling but electric heating. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[20]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 128%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours.

[20] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	23,555	30,242	128%	5.74
Total		23,555	30,242	128%	5.74

Site ID 6019

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/01/18 and 5/21/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025	Lighting	Standard	400	400	32	17	4,498	1.02	23,369	27,654	118%
Total										23,369	27,654	118%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (3,640).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small retail in St. Louis, was applied to the ex post lighting energy savings for the sales floor. In addition, a factor of 1.00 was applied to the shop and parts storage areas due to no cooling. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[21]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 118%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	23,369	27,654	118%	5.25
Total		23,369	27,654	118%	5.25

[21] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6020

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/01/18 and 5/21/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp Fixtu Replac T8 Lamp Fixt	3025	Lighting	Standard	70	70	114	80	4,663	1.03	10,859	11,440	105%
306142-Lighting-LED Lamp Fixt Replac T12 Lamp Fixt	3026			7	7	138	86	4,213	1.00	1,661	1,534	92%
Total										12,520	12,974	104%

The annual lighting hours of operation verified during the M&V site visit for the first line item in the table above (4,663) are greater than the annual hours of operation used to calculate ex ante savings (4,264), while the hours for the second line item are fewer (4,213).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small retail in St. Louis, was applied to the ex post lighting energy savings for the sales floor. In addition, a factor of 1.00 was applied to the shop and parts storage areas due to not cooling. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[22]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 104%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for 91% of the project.

[22] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	12,520	12,974	104%	2.46
Total		12,520	12,974	104%	2.46

Site ID 6021

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules with photo cell usage.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixture Replacing Metal Halide Fixture	1169	Exterior Lighting	Custom	10	10	215	34	4,308	1.00	7,911	7,781	98%
Total										7,911	7,781	98%

The annual lighting hours of operation for the line item in the above table using photo cells (4,308[23]) are less than the hours of operation used to calculate ex ante savings (4,380).

A heating and cooling interactive factor of 1.00, applicable to an exterior installation was applied to the ex post lighting energy savings and corresponds with the ex ante savings estimate interactive factor.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[24]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	7,911	7,781	98%	0.04
Total		7,911	7,781	98%	0.04

[23] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[24] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6022

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules with the use of photo cells.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixture Replacing Metal Halide Fixture	1169	Exterior Lighting	Custom	10	10	215	34	4,308	1.00	7,911	7,781	98%
Total										7,911	7,781	98%

The annual lighting hours of operation for the line item in the above table using photo cells (4,308[25]) are less than the hours of operation used to calculate ex ante savings (4,380).

A heating and cooling interactive factor of 1.00, applicable to an exterior installation was applied to the ex post lighting energy savings and corresponds with the ex ante interactive factor.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[26]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	7,911	7,781	98%	0.04
Total		7,911	7,781	98%	0.04

[25] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[26] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6023

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules with the use of photo cells.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixture Replacing Metal Halide Fixture	1169	Exterior Lighting	Custom	10	10	215	34	4,308	1.00	7,911	7,781	98%
Total										7,911	7,781	98%

The annual lighting hours of operation for the line item in the above table using photo cells (4,308[27]) are less than the hours of operation used to calculate ex ante savings (4,380).

A heating and cooling interactive factor of 1.00, applicable to an exterior installation was applied to the ex post lighting energy savings and corresponds with the ex ante savings estimate interactive factor.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[28]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	7,911	7,781	98%	0.04
Total		7,911	7,781	98%	0.04

[27] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[28] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6024

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules with photo cell usage.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixture Replacing Metal Halide Fixture	1169	Exterior Lighting	Custom	10	10	215	34	4,308	1.00	7,911	7,781	98%
Total										7,911	7,781	98%

The annual lighting hours of operation for the line item in the table above using photo cells (4,308[29]) are less than the hours of operation used to calculate ex ante savings (4,380).

A heating and cooling interactive factor of 1.00, applicable to an exterior installation was applied to the ex post lighting energy savings and corresponds with the ex ante savings estimate interactive factor.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[30]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	7,911	7,781	98%	0.04
Total		7,911	7,781	98%	0.04

[29] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[30] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6026

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed one photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 4/26/18 and 5/21/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Fixt Replac T12 Lamp Fixt	3026	Lighting	SBDI	17	17	164	45	4,417	1.10	8,329	9,819	118%
				10	10	164	45	4,476	1.10	4,900	5,853	119%
306143-Lighting-LED Lamp Fixt Replac T8 Lamp Fixt	3025			5	5	114	45	4,476	1.10	1,420	1,697	120%
				4	4	114	30	4,476	1.10	1,384	1,653	119%
306142-Lighting-LED Lamp Fixt Replac T12 Lamp Fixt	3026			2	2	164	30	4,332	1.10	1,103	1,276	116%
				1	1	164	30	4,332	1.10	552	638	116%
				1	1	138	30	4,332	1.10	445	514	116%
Total										18,133	21,450	118%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (3,848).

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air conditioned restaurant in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[31]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 118%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

[31] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	18,133	21,450	118%	4.07
Total		18,133	21,450	118%	4.07

Site ID 6029

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed one photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 4/26/18 and 5/21/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T12 <=40 Watt Linear ft	3026	Lighting	Standard	38	76	60	15	3,153	1.11	3,659	3,981	109%
Total										3,659	3,981	109%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (3,000).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small retail in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[32]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 109%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	3,659	3,981	109%	0.76
Total		3,659	3,981	109%	0.76

[32] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6030

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/04/18 and 5/23/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025	Lighting	Standard	83	83	32	18	2,902	1.11	3,233	3,730	115%
200909-Lighting-LED <=14 Watt Lamp Replacing Halogen BR/R 45-66 Watt Lamp or Fixture	3007			20	20	50	8	1,719	1.11	2,337	1,597	68%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T12 <=40 Watt Linear ft	3026			2	4	96	15	8,760	1.11	1,469	1,279	87%
Total										7,039	6,606	94%

The annual lighting hours of operation verified during the M&V site visit for the first and third line items in the table above (2,902 and 8,760, respectively) are greater than the annual hours of operation used to calculate ex ante savings (2,600), while the second line item above is fewer (1,719).

The base and efficient quantities of the third line item in the table above (2 and 4, respectively) verified during the M&V site visit is less than the ex ante savings quantities (8 and 16, respectively). The facility decided to discontinue the retrofitting and leave the existing installed with the extra lamps as replacements.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office in St. Louis, was applied to the ex post lighting energy savings. In addition, for measures installed in

the warehouse a factor of 1.00 was applied due to no cooling in the area. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[33]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 94%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for two measures and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	7,039	6,606	94%	1.25
Total		7,039	6,606	94%	1.25

[33] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6031

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed one photo-sensor logger to monitor lighting operation. The photo-sensor logger collected data between 4/26/18 and 5/21/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T12 <=40 Watt Linear ft	3026	Lighting	Standard	52	104	80	15	3,102	1.00	12,185	8,066	66%
Total										12,185	8,066	66%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours are fewer than those used to develop the ex ante energy savings estimates (4,380). The site is operational 8 a.m. to 5 p.m. Monday through Friday.

A heating and cooling interactive factor of 1.00, applicable to a gas heated, uncooled warehouse in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[34]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 66%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	12,185	8,066	66%	1.53
Total		12,185	8,066	66%	1.53

[34] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6060

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules with photo cell usage.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixture Replacing Metal Halide Fixture	1169	Exterior Lighting	Custom	117	117	455	200	4,308	1.00	130,677	128,532	98%
Total										130,677	128,532	98%

The annual lighting hours of operation for the line item in the above table using photo cells (4,308[35]) are less than the hours of operation used to calculate ex ante savings (4,380).

A heating and cooling interactive factor of 1.00, applicable to an exterior installation was applied to the ex post lighting energy savings and corresponds with the ex ante savings estimate interactive factor.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[36]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	130,677	128,532	98%	0.72
Total		130,677	128,532	98%	0.72

[35] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[36] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6073

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules with photo cell usage.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixture Replacing Metal Halide Fixture	1169	Exterior Lighting	Custom	14	14	1,080	285	4,308	1.00	48,749	47,949	98%
				2	2	1,080	285	4,308	1.00	6,964	6,850	98%
				4	4	295	78	4,308	1.00	3,802	3,739	98%
Total										59,515	58,538	98%

The annual lighting hours of operation for the line items in the above table using photo cells (4,308[37]) are less than the hours of operation used to calculate ex ante savings (4,380).

A heating and cooling interactive factor of 1.00, applicable to an exterior installation was applied to the ex post lighting energy savings and corresponds with the ex ante savings estimate interactive factor.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[38]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	59,515	58,538	98%	0.33
Total		59,515	58,538	98%	0.33

[37] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[38] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 5642

Data Collection

The participant received EMS Program incentives from Ameren Missouri.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered mechanical schedules and HVAC equipment nameplate information.

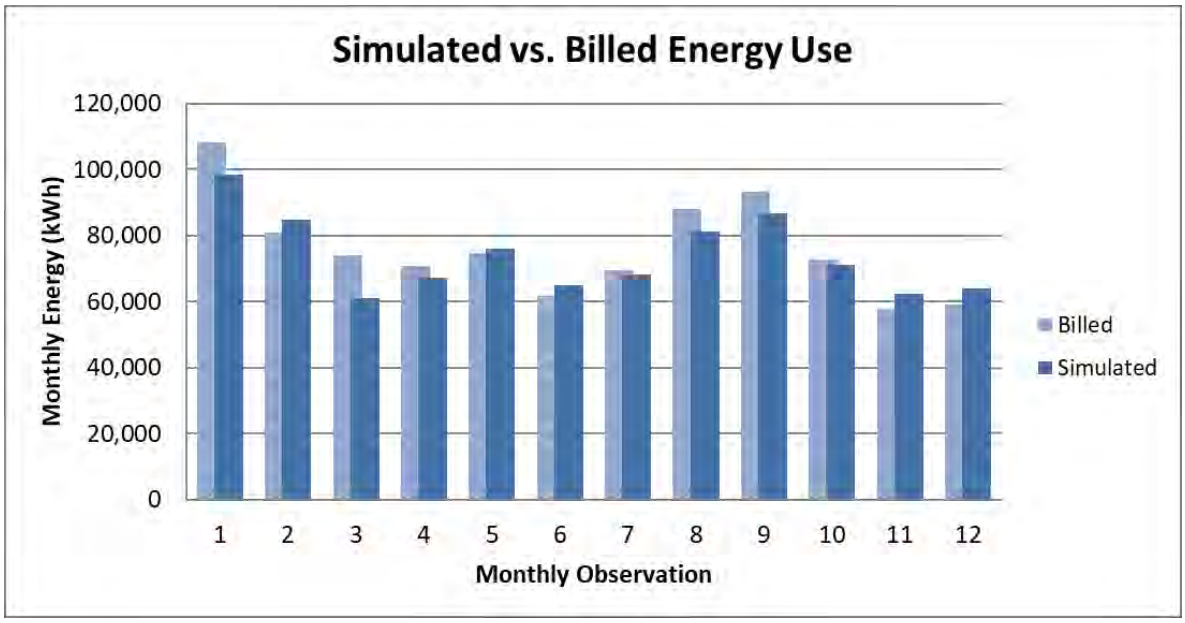
Analysis Results

EMS Controls Savings Calculations

Energy savings for the installed measures were calculated using IPMVP Option D: Calibrated Simulation. ADM compiled an eQuest model of the as-built facility using the details and construction documents collected during the on-site M&V visit and from the project documentation.

Upon completion of the initial model, a custom weather file was created using NOAA weather data for the region. Using this weather file and the utility provided billing data for the facility, ADM ensured that the model's energy load shape matched that of the bills. The results of this calibration effort can be seen below:

Monthly kWh Calibration



Upon completion of the calibration for the as-built eQuest model, the impacts of the installed measures were removed using parametric runs. Once the parametric runs were defined, the as-built model and parametric runs were simulated using TMY3 weather data. The total realized energy savings are the differences between the baseline and as-built models' energy usages, and the total site-level energy savings by end use can be seen in the following table:

Typical Year Energy Usage (kWh) by End Use

End-Use	*Baseline*	*As-Built*	*kWh Savings*
Lighting	386,402	386,402	0
Misc. Equipment	136,627	136,627	0
Heating	210,680	131,678	79,002
Cooling	179,330	158,491	20,839
Heat Rejection	0	0	0
Auxiliary (pumps)	13,210	3,555	9,654
Vent Fans	67,147	38,160	28,987
Domestic Hot Water	0	0	0
Ext. Lighting	31,864	31,864	0
Total	1,025,259	886,777	138,482

Measure level savings are shown in the following table:

Custom and EMS Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
117920 – EMS Controls – Cooling	1169	Cooling	EMS Pilot	16,978	20,839	123%
118220 – EMS Controls – HVAC	1169	HVAC	EMS Pilot	113,619	117,649	104%
Total				130,597	138,482	106%

There were significant differences in the ex ante and ex post analyses for the EMS controls, with a realization rate of 106%. The ex ante analysis used rules of thumb, assumed HVAC loads, and assumed energy savings factors. ADM was provided the ex ante calculations, but the savings values didn't match the incentivized numbers exactly. ADM created eQuest models of the entire facility and calibrated the models to actual billing data. This method accounts for interactive effects and building and HVAC system operations better than the ex ante calculations.

Verified annual savings for the EMS Pilot Program incentives are 138,482 kWh, resulting in a realization rate of 106%. The site-level verified energy savings are 138,482 kWh, resulting in a realization rate of 106%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	16,978	20,839	123%	18.98
	HVAC	113,619	117,649	104%	52.23
Total		130,597	138,482	106%	71.21

Site ID 6002

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed eight photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/22/18 and 6/11/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	62	62	138	44	2,509	1.00	17,511	14,624	84%
				40	40	138	44	2,307	1.00	11,297	8,675	77%
				29	29	164	44	1,664	1.11	10,456	6,403	61%
				24	24	164	44	3,399	1.11	8,653	10,827	125%
				11	11	164	44	1,765	1.11	3,966	2,577	65%
				11	11	138	44	1,981	1.00	3,107	2,048	66%
				8	8	164	44	1,669	1.00	2,885	1,603	56%
Total										57,875	46,756	81%

The annual lighting hours of operation verified during the M&V site visit for the fourth line item in the table above (3,399) are greater than the annual hours of operation used to calculate ex ante savings (2,808), while the remaining line items are fewer (ranging from 1,664 – 2,509). The measures were installed in multiple locations and multiple buildings with varying usage.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned office in St. Louis, was applied to the ex post lighting energy savings. In addition, a factor of 1.00 was applied to all uncooled warehouse locations. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[39]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 81%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 87% of the project and overestimated heating and cooling interactive effects for 65% of the project.

[39] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	57,875	46,756	81%	8.88
Total		57,875	46,756	81%	8.88

Site ID 6009

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/03/18 and 5/23/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025	Lighting	Standard	117	117	114	50	6,631	1.11	40,829	54,997	135%
				14	14	59	25	5,370	1.11	2,595	2,831	109%
Total										43,424	57,829	133%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (5,096).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small retail in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[40]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 133%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	43,424	57,829	133%	10.99
Total		43,424	57,829	133%	10.99

[40] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6010

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/03/18 and 5/23/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025	Lighting	Standard	94	94	59	25	5,423	1.11	17,426	19,198	110%
				33	33	114	50	7,659	1.11	11,516	17,915	156%
				10	10	32	13	3,709	1.11	1,037	781	75%
Total										29,979	37,893	126%

The annual lighting hours of operation verified during the M&V site visit for the first and second line items in the table above (5,423 and 7,659, respectively) are greater than the annual hours of operation used to calculate ex ante savings (5,096), while the third line item is fewer (3,709).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small retail in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[41]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 126%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for 97% of the project and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	29,979	37,893	126%	7.20
Total		29,979	37,893	126%	7.20

[41] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6015

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/02/18 and 6/20/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025	Lighting	Standard	35	35	114	68	5,488	1.11	5,375	9,773	182%
				1	1	32	14	2,748	1.11	50	55	109%
Total										5,425	9,828	181%

The annual lighting hours of operation verified during the M&V site visit for the second item (2,748) is fewer than the annual hours of operation used to calculate ex ante savings (3,120). The remaining line item has hours of operation greater than the hours of operation used to calculate ex ante savings.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07 for all measures.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[42]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 181%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for the first line item and underestimated heating and cooling interactive effects for the project. Forty-nine percent of the first measure has continuous usage which was not accounted for when determining the ex ante hours.

[42] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	5,425	9,828	181%	1.87
Total		5,425	9,828	181%	1.87

Site ID 6033

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/26/18 and 6/18/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
305233-Lighting-85-225 Watt Lamp or Fixture Replacing Interior HID 301-500 Watt Lamp or Fixture	3005-1	Lighting	Standard	19	19	400	146	3,109	1.09	21,688	16,414	76%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025			160	160	32	14	2,397	1.11	8,012	7,635	95%
Total										29,700	24,049	81%

Primary data were used to develop estimates of annual lighting operating hours for the ex post savings analysis. The annual lighting hours of operation verified during the M&V site visit (2,453 and 3,109) are fewer than the annual hours of operation used to calculate ex ante savings (2,600 and 4,200).

Heating and cooling interactive factors of 1.09 and 1.11, applicable to gas heated, air-conditioned light manufacturing and small office spaces in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[43]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 81%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

[43] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Program	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	29,700	24,049	81%	4.57
Total		29,700	24,049	81%	4.57

Site ID 6038

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 6/07/18 and 6/27/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	29	29	138	44	2,193	1.09	8,179	6,546	80%
				20	20	164	46	2,735	1.09	7,080	7,068	100%
Total										15,259	13,613	89%

The annual lighting hours of operation verified during the M&V site visit (2,193 and 2,735) are fewer than the annual hours of operation used to calculate ex ante savings (2,804).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned large office facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[44]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 89%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	15,259	13,613	89%	2.59
Total		15,259	13,613	89%	2.59

[44] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6046

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025	Lighting	Standard	3,246	3,246	25	17	8,760	1.00	235,282	228,032	97%
Total										235,282	228,032	97%

The annual lighting hours of operation verified during the M&V site visit (8,760) are greater than the annual hours of operation used to calculate ex ante savings (8,712). The lighting runs continuously, 24/7.

A heating and cooling interactive factor of 1.00, applicable to an unconditioned industrial facility in St. Louis, was applied to the ex post lighting energy savings. In addition, a factor of 1.09 was applied to 3% of the installed measure for an industrial area that was heated and cooled. The ex ante savings estimate accounted for a heating and cooling factor of 1.04.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[45]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 97%. The ex ante energy savings estimate was premised on overestimated heating and cooling interactive effects.

[45] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	235,282	228,032	97%	43.32
Total		235,282	228,032	97%	43.32

Site ID 6047

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixture Replacing Metal Halide Fixture	1169	Lighting	Custom	75	75	295	60	8,760	1.09	160,571	154,395	96%
Total										160,571	154,395	96%

The annual lighting hours of operation verified during the M&V site visit (8,760) correspond with the annual hours of operation used to calculate ex ante savings.

A heating and cooling interactive factor of 1.00, applicable to a non-conditioned facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.04.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[46]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 96%. The ex ante energy savings estimate was premised on overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Lighting	160,571	154,395	96%	29.33
Total		160,571	154,395	96%	29.33

[46] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6048

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules and the use of photo cells.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100211-Lighting-Non Linear LED Fixture Replacing High Pressure Sodium Fixture	1169	Exterior Lighting	Custom	150	150	188	45	4,310	1.00	93,951	92,454	98%
Total										93,951	92,454	98%

The annual lighting hours of operation for the line items in the above table using photo cells (4,310[47]) are less than the hours of operation used to calculate ex ante savings (4,380).

A heating and cooling interactive factor of 1.00, applicable for an exterior installation, was applied to the ex post lighting energy savings which corresponds with the ex ante savings estimate.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[48]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%. The ex ante energy savings estimate was premised on overestimated annual hours of use.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	93,951	92,454	98%	0.52
Total		93,951	92,454	98%	0.52

[47] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[48] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6049

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/05/18 and 5/28/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100204-Lighting-Non Linear LED Fixture Replacing T8 Fixture	1169	Lighting	Custom	990	990	59	34	6,245	1.10	153,281	170,583	111%
				42	42	59	19	4,436	1.10	10,405	8,224	79%
Total										163,686	178,806	109%

The annual lighting hours of operation verified during the M&V site visit for the first line item in the table above (6,245) are greater than the annual hours of operation used to calculate ex ante savings (5,788). Thirty percent of this measure runs continuously. The second measure has annual lighting hours of operation (4,436) that are fewer than the ex ante savings estimate (5,788). Sixty percent of this measure was located within the Café which has fewer hours than the remainder of the store.

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air conditioned large retail in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[49]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 109%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for 96% of the project and overestimated heating and cooling interactive effects.

[49] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Lighting	163,686	178,806	109%	33.97
Total		163,686	178,806	109%	33.97

Site ID 6050

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/24/18 and 6/13/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100104-Lighting-Linear Tube LED Fixture Replacing T8 Fixture	1169	Lighting	Custom	1,002	1,002	59	34	6,517	1.02	155,139	165,942	107%
				29	29	59	34	6,549	1.02	4,490	4,826	107%
Total										159,629	170,768	107%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (5,788). Thirty percent of the installed lamps run continuously.

A heating and cooling interactive factor of 1.02, applicable to a electric heated, air conditioned large retail in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[50]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 107%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Lighting	159,629	170,768	107%	32.44
Total		159,629	170,768	107%	32.44

[50] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6052

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/26/18 and 6/18/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100104-Lighting-Linear Tube LED Fixture Replacing T8 Fixture	1169	Lighting	Custom	1,051	1,051	59	34	6,674	1.02	162,725	178,270	110%
				43	43	59	34	6,058	1.02	6,658	6,620	99%
Total										169,383	184,891	109%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (5,788). Twenty-nine percent of the installed lamps run continuously.

A heating and cooling interactive factor of 1.02, applicable to a electric heated, air conditioned small retail in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[51]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 109%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Lighting	169,383	184,891	109%	35.12
Total		169,383	184,891	109%	35.12

[51] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6054

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed six photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/10/18 and 5/30/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100107-Lighting-Linear Tube LED Fixture Replac T5 HO Fixture	1169	Lighting	Custom	44	44	360	150	5,328	1.01	55,366	49,812	90%
305402-Lighting-Linear ft LED (<=5.5 W/ft) Replac T8 32W Linear ft	3025		Standard	130	130	32	10	3,636	1.01	17,137	10,523	61%
Total										72,503	60,334	83%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours are fewer than those used to develop the ex ante energy savings estimates (5,600).

A heating and cooling interactive factor of 1.01, applicable to an electric heated, air conditioned office and industrial facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[52]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 83%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and overestimated heating and cooling interactive effects.

[52] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	17,137	10,523	61%	2.00
Custom	Lighting	55,366	49,812	90%	9.46
Total		72,503	60,334	83%	11.46

Site ID 6055

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/30/18 and 6/18/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T12 <=40 Watt Linear	3026	Lighting	Standard	1,400	2,800	60	17	4,663	1.10	153,922	187,303	122%
Total										153,922	187,303	122%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (3,952). Eighteen percent of the installed measure ran continuously.

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air conditioned large retail in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[53]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 122%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	153,922	187,303	122%	35.58
Total		153,922	187,303	122%	35.58

[53] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6056

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/12/18 and 6/06/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100104-Lighting-Linear Tube LED Fixture Replacing T8 Fixture	1169	Lighting	Custom	152	152	128	44	3,487	1.11	51,505	49,239	96%
				20	20	56	26	1,663	1.11	2,420	1,104	46%
Total										53,925	50,342	93%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours are fewer than those used to develop the ex ante energy savings estimates (3,770). The measures were installed in multiple locations with varying usage.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[54]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 93%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

[54] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Lighting	53,925	50,342	93%	9.56
Total		53,925	50,342	93%	9.56

Site ID 6059

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules and the use of photo cells.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixture Replacing Metal Halide Fixture	1169	Exterior Lighting	Custom	32	30	1,080	400	4,308	1.00	98,813	97,190	98%
				6	6	455	150	4,308	1.00	8,015	7,884	98%
				1	1	1,080	150	4,308	1.00	4,073	4,007	98%
Total										110,901	109,081	98%

The annual lighting hours of operation using photo cells (4,308[55]) are less than the hours of operation used to calculate the ex ante energy savings (4,380).

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[56]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	110,901	109,081	98%	0.61
Total		110,901	109,081	98%	0.61

[55] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[56] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6061

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/09/18 and 5/29/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100204-Lighting-Non Linear LED Fixt ReplacT8 Fixt	1169	Lighting	Custom	33	33	72	30	4,699	1.10	6,377	7,188	113%
				11	11	96	50	4,699	1.10	2,328	2,624	113%
305233-Lighting-85-225W Lamp or Fixt Replacing Interior HID 301-500 Watt Lamp Fixture	3005-1		Standard	32	32	400	105	4,699	1.10	43,433	48,951	113%
305402-Lighting-Linear ft LED (<=5.5 Wa/ft) Replac T8 32WLinearft	3025			200	200	32	12	4,699	1.10	18,404	20,744	113%
201316-Lighting-LEDor Electroluminescent Replac Incand Exit Sign	793			25	25	18	2	8,760	1.10	3,749	3,867	103%
Total										74,291	83,374	112%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours for the first four-line items in the table above exceeded those used to develop the ex ante energy savings estimates (4,300). The fifth line item corresponds with the ex ante savings estimate (8,760).

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air-conditioned retail in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[57]

[57] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 112%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	65,586	73,562	112%	13.97
Custom		8,705	9,811	113%	1.86
Total		74,291	83,374	112%	15.84

Site ID 6062

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/24/18 and 6/13/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100210-Lighting-Non Linear LED Fixt Replac M V Fixture	1169	Exterior Lighting	Custom	6	6	455	164	4,308	1.00	7,647	7,522	98%
305233-Lighting-85-225 W Lamp Fixt Replac Interior HID 301-500 Watt Lamp Fixture	3005-1	Lighting	Standard	72	72	455	164	4,282	1.11	97,387	99,361	102%
				18	18	455	164	4,024	1.11	24,347	23,342	96%
				10	10	455	164	4,018	1.11	13,526	12,951	96%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replac T12 <40W Linear ft	3026			80	80	32	13	4,361	1.11	7,065	7,342	104%
305233-Lighting-85-225 W Lamp Fixt Replac Interior HID 301-500 Watt Lamp Fixture	3005-1			4	4	455	164	4,308	1.00	5,410	5,015	93%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replac T12 <40W Linear ft	3026			60	60	32	13	4,638	1.11	5,299	5,857	111%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 WLinear ft	3025			12	24	96	13	4,018	1.11	3,904	3,738	96%
201111-Lighting-LED <=11 W Lamp ReplaHaloge 28-52WLamp	3011			20	20	43	9	4,018	1.11	3,068	3,026	99%
305233Lightn-85-225WLamp Fixt Replac	3005-1			1	1	455	164	4,024	1.11	1,353	1,297	96%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
Interior HID 301-500 W Lamp Fixture												
201111-Lighting-LED <=11 W Lamp Replacing Halogen A 28-52W Lamp	3011			8	8	43	9	4,018	1.11	1,227	1,211	99%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replac T12 <40W Linear ft	3026			6	6	40	13	4,018	1.11	753	721	96%
				4	4	40	13	4,169	1.11	502	499	99%
				2	2	40	13	1,408	1.11	251	84	34%
				2	2	40	13	1,408	1.11	251	84	34%
201111-Lighting-LED <=11 Watt Lamp Replac Halogen A 28-52W Lamp	3011			1	1	43	9	103	1.11	153	4	3%
Total										172,143	172,053	100%

The annual lighting hours of operation for the first and sixth line items in the above table using photo cells (4,308[58]) are less than the hours of operation used to calculate ex ante savings (4,380 and 4,344, respectively). For the fifth and seventh line item the lighting hours of operation verified during the M&V site visit (4,361 and 4,638, respectively) are greater than the annual hours of operation used to calculate ex ante savings (4,344). The remaining line items have hours of operation (ranging from 103 to 4,282) which are fewer than the annual hours used to calculate ex ante savings (4,344).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned retail in St. Louis, was applied to the ex post lighting energy savings for all interior locations. The ex ante savings estimate accounted for a heating and cooling factor of 1.07. For the first line item in the table above the measure was installed exterior and corresponds with the ex ante savings calculation (1.00). The sixth line item was installed within a location that was not conditioned and received a factor of 1.00.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[59]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 100%.

[58] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[59] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	164,496	164,531	100%	31.25
Custom	Exterior Lighting	7,647	7,522	98%	0.04
Total		172,143	172,053	100%	31.30

Site ID 6063

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, photo-cell usage, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/11/18 and 5/30/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixt Replac M Ha Fixture	1169	Exterior Lighting	Custom	2	2	215	38	4,308	1.00	1,551	1,525	98%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025	Lighting	Standard	273	273	32	13	5,194	1.11	24,110	29,838	124%
				100	100	32	13	5,002	1.11	8,831	10,526	119%
				60	60	32	13	5,431	1.11	4,183	6,857	164%
				40	40	32	13	4,843	1.11	3,533	4,077	115%
				36	36	32	13	6,153	1.11	3,179	4,662	147%
				8	8	32	13	4,804	1.11	707	809	114%
				4	4	32	13	155	1.11	353	13	4%
				4	4	32	13	1,993	1.11	353	168	48%
				4	4	32	13	103	1.11	353	9	2%
				4	4	32	13	4,843	1.11	353	408	115%
				2	2	32	13	1,387	1.11	177	58	33%
				2	2	32	13	1,387	1.11	177	58	33%
Total										47,860	59,006	123%

The annual lighting hours of operation for the first line item in the above table using photo cells (4,308[60]) are less than the hours of operation used to calculate ex ante savings (4,380). For the second through seventh and eleventh line items in the table above the lighting hours of operation verified during the M&V site visit (ranging from 4,804 to 5,431) are greater than the annual hours of operation used to calculate ex ante savings (4,344). The remaining line items have annual hours (ranging from 103 to 1,993) are fewer than the ex ante hours of operation (4,344).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned retail in St. Louis, was applied to the ex post lighting energy savings for all interior installations. The ex ante savings

[60] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

estimate accounted for a heating and cooling factor of 1.07. A factor of 1.00 was applied to the first line item in the table above due to the measure being installed exterior and corresponds with the factor from the ex ante savings estimate.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[61]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 123%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for 97% of the project and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	46,309	57,481	124%	10.92
Custom	Exterior Lighting	1,551	1,525	98%	0.01
Total		47,860	59,006	123%	10.93

[61] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6064

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, photo-cell usage, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/09/18 and 5/28/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting - NonLinearLED Fixt Replacing MH Fixture	1169	Exterior Lighting	Custom	6	6	1,080	280	4,308	1.00	21,024	20,679	98%
305402-Lighting-Linear ftLED (<=5.5 W/ft) Replac T8 32W Linear ft	3025	Lighting	Standard	162	162	28	13	4,821	1.11	11,295	12,975	115%
				80	80	28	13	4,550	1.11	5,578	6,048	108%
				66	66	28	17	5,240	1.11	3,375	4,213	125%
				9	9	28	13	4,481	1.11	627	670	107%
				3	3	28	13	2,166	1.11	209	108	52%
				3	3	28	13	2,166	1.11	209	108	52%
Total										42,317	44,801	106%

The annual lighting hours of operation for the first line item in the above table using photo cells (4,308[62]) are less than the hours of operation used to calculate ex ante savings (4,380). For the second through the fifth line items above the annual lighting hours of operation verified during the M&V site visit (ranging from 4,481 to 5,240) are greater than the annual hours of operation used to calculate ex ante savings (4,344). The remaining line items were installed within restrooms with fewer hours of usage (2,166).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned retail in St. Louis, was applied to the ex post lighting energy savings for all interior installations. The ex ante savings estimate accounted for a heating and cooling factor of 1.07. The first line item in the above table was installed exterior and received a factor of 1.00 which corresponds with the ex ante savings estimate.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[63]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 106%. The ex ante energy savings estimate was premised on

[62] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[63] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

underestimated annual lighting operating hours for 96% of the project and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	21,293	24,122	113%	4.58
Custom	Exterior Lighting	21,024	20,679	98%	0.12
Total		42,317	44,801	106%	4.70

Site ID 6066

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed seven photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/12/18 and 6/06/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025	Lighting	Standard	2,210	2,210	32	14	6,543	1.09	372,866	284,990	76%
				52	52	32	12	8,557	1.09	9,748	9,744	100%
				25	25	17	8	8,760	1.09	2,109	2,158	102%
Total										384,723	296,892	77%

The annual lighting hours of operation verified during the M&V site visit for the first and second line items in the table above (6,543 and 8,557, respectively) are fewer than the annual hours of operation used to calculate ex ante savings (8,760). These measures were installed in multiple locations with varying usage. The third line item corresponds with the ex ante savings estimate for annual hours.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned large office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[64]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 77%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	384,723	296,892	77%	56.40
Total		384,723	296,892	77%	56.40

[64] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6070

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/08/18 and 5/28/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
100201-Lighting-Non Linear LED Fixture Replacing T12 Fixture	1169	Lighting	Custom	4	4	82	30	4,185	1.09	1,950	953	49%
201111-Lighting-LED <=11 Watt Lamp Replacing Halogen A 28-52 Watt Lamp	3011		Standard	16	16	43	10	4,297	1.09	4,799	2,484	52%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T12 <=40 Watt Linear ft	3026			32	32	17	8	4,297	1.09	2,699	1,355	50%
Total										9,448	4,792	51%

The annual lighting hours of operation verified during the M&V site visit (4,185 and 4,297) are fewer than the annual hours of operation used to calculate ex ante savings (8,760).

An adjusted base wattage of 43W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned large office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[65]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 51%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	7,498	3,839	51%	0.73
Custom		1,950	953	49%	0.18
Total		9,448	4,792	51%	0.91

[65] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6071

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed one photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/8/18 and 5/28/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306140-Lighting-LED Lamp Replacing Interior HID Lamp	3004-1	Lighting	Standard	28	28	210	54	3,814	1.09	40,942	18,241	45%
Total										40,942	18,241	45%

The annual lighting hours of operation verified during the M&V site visit (3,814) are fewer than the annual hours of operation used to calculate ex ante savings (8,760).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned large office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[66]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 45%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	40,942	18,241	45%	3.47
Total		40,942	18,241	45%	3.47

[66] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6072

Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri. During the M&V visit, ADM staff verified equipment installation and the post-retrofit connected loads. The ADM staff also determined the lighting operating schedule by interviewing facility personnel.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
201317-Lighting-LED Replacing CFL Exit Sign	8001	Misc.	Standard	10	10	13	2	8,760	1.00	1,031	964	93%
301132-Lighting-LED 7-20 W Lamp Replacing Halogen A 53-70 W Lamp	3009			29	29	72	9	8,760	1.00	16,581	16,005	97%
201111-Lighting-LED <=11 W Lamp Replacing Halogen A 28-52 W Lamp	3011			58	58	30	6	8,760	1.00	13,047	12,194	93%
305401-Lighting-Linear ft LED (<=5.5 Wa/ft) Replac T12 <=40 Watt Linear ft	3026			8	8	34	15	8,760	1.00	1,425	1,332	93%
305402-Lighting-Linear ft LED (<=5.5 W/ft) Replacing T8 32 Watt Linear ft	3025			4	4	32	15	8,760	1.00	637	596	94%
100204-Lighting-Non Linear LED Fixture Replacing T8 Fixture	1169		Custom	3	3	88	56	8,760	1.00	841	841	100%
100212-Lighting-Non Linear LED Fixt Replacing Incand/Halo Lamp Fixture				58	58	21	6	8,760	1.00	7,875	7,875	100%
305013-Lighting-<=80 Watt Lamp Replacing Exterior 24/7 HID 100-175 Watt Lamp	3006-1		Standard	36	36	175	56	8,760	1.00	37,528	37,528	100%
				2	2	150	40	8,760	1.00	1,927	1,927	100%
				12	12	100	45	8,760	1.00	5,782	5,782	100%
				45	45	175	56	8,760	1.00	46,910	46,910	100%
				46	46	175	56	8,760	1.00	47,952	47,952	100%
100101-Lighting-Linear Tube LED Fixture Replacing T12 Fixture	1169		Custom	3	1	164	60	8,760	1.00	3,784	3,784	100%
100212-Lighting-Non Linear LED Fixt Replacing Incand/Halo Lamp Fixture				4	4	20	2	8,760	1.00	660	617	93%
100208-Lighting-Non Linear LED Fixture Replacing M H Fixture				53	24	295	80	8,760	1.00	120,143	120,143	100%
100212-Lighting-Non Linear LED Fixt Replacing Incand/Halo Lamp Fixture				29	29	18	9	8,760	1.00	2,159	2,159	100%
				1	1	96	56	8,760	1.00	350	350	100%
Total										308,632	306,958	99%

The annual lighting hours of operation verified during the M&V site visit (8,760) corresponds with the annual hours of operation used to calculate ex ante savings.

A heating and cooling interactive factor of 1.00, applicable to non-climate-controlled parking garages, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a

heating and cooling factor of 1.07 for the first five line items in the table above and fourteenth line item. For the remaining measures the ex ante used a factor of 1.00.

Line items one through five and fourteen in the table above had an end use of lighting. All measures were installed in an exterior parking garage with a 24/7 operating schedule resulting in a miscellaneous end use category.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[67]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 99%.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Miscellaneous	172,820	171,188	99%	23.61
Custom		135,812	135,770	100%	18.73
Total		308,632	306,958	99%	42.34

[67] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6074

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed seven photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 05/31/18 and 06/20/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025	Lighting	Standard	520	520	32	14	1,663	1.14	25,038	17,701	71%
305802-Lighting-Delamping Replacing T8 32 Watt	3084			260	-	32	-	1,663	1.14	22,256	15,734	71%
200909-Lighting-LED <=14 Watt Lamp Replacing Halogen BR/R 45-66 Watt Lamp	3007			27	27	65	9	123	1.14	3,236	212	7%
Total										50,530	33,647	67%

The annual lighting hours of operation verified during the M&V site visit (123 and 1,663) are fewer than the annual hours of operation used to calculate ex ante savings (2,500).

A heating and cooling interactive factor of 1.1, applicable to a gas heated, air conditioned assembly in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[68]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 67%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and overestimated heating and cooling interactive effects.

[68] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	50,530	33,647	67%	6.39
Total		50,530	33,647	67%	6.39

Site ID 6075

Data Collection

The participant received Custom and Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 06/07/18 and 06/27/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
100204-Lighting-Non Linear LED Fixture Replacing T8 Fixture	1169	Lighting	Custom	30	30	124	60	3,829	1.00	8,957	7,352	82%
306036-Lighting-Linear ft LED (<=7.5 Watts/ft) Replacing T5 HO Lamp	3089		Standard	288	288	54	24	4,099	1.00	40,307	37,416	88%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025			75	75	32	15	4,762	1.00	5,948	6,071	102%
Total										55,212	48,839	88%

The annual lighting hours of operation verified during the M&V site visit for the first and second line item in the table above (3,829 and 4,099, respectively) is fewer than the annual hours of operation used to calculate ex ante savings (4,360), while the third line item is greater (4,762).

A heating and cooling interactive factor of 1.00, applicable to a gas heated light manufacturing facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[69]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 88%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for eighty-one percent of the installed lamps and an overestimation of heating and cooling interactive effects.

[69] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	46,255	41,487	90%	7.88
Custom		8,957	*7,352*	82%	1.40
Total		55,212	*48,839*	88%	9.28

Site ID 6076

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation and the post-retrofit connected loads. ADM staff additionally verified annual facility lighting hours through interviews with facility personnel and the installation of three photo-sensor loggers that collected data between 5/31/18 and 6/20/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025	Lighting	Standard	280	280	25	11	5,686	1.11	22,901	24,687	108%
				96	96	25	11	5,759	1.11	7,852	8,573	109%
				2	2	14	11	1,372	1.11	199	9	5%
Total										30,952	33,269	107%

The annual hours of operation verified during the M&V site visit for the first and second line items in the table above (5,686 and 5,759, respectively) are greater than the annual hours of operation used to calculate ex ante savings (5,460). The third line item above had fewer hours of operation (1,372) due to the installation within restrooms where the lighting was routinely turned off when unoccupied.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned retail in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[70]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 107%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for 99% of the project and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Program	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	30,952	33,269	107%	6.32
Total		30,952	33,269	107%	6.32

[70] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6080

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixture Replacing Metal Halide Fixture	1169	Exterior Lighting	Custom	55	55	1,080	300	4,308	1.00	187,902	184,817	98%
100211-Lighting-Non Linear LED Fixture Replacing High Pressure Sodium Fixture				25	25	188	70	4,842	1.00	12,921	14,285	111%
100208-Lighting-Non Linear LED Fixture Replacing Metal Halide Fixture				12	12	295	70	4,679	1.00	11,826	12,633	107%
				8	8	455	150	4,308	1.00	10,687	10,512	98%
Total										223,336	222,247	100%

The annual lighting hours of operation for the fixtures using photo cells (4,308[71]) are less than the hours of operation used to calculate ex ante savings (4,380). Twelve percent of the quantity in the second line item, and eight percent of the quantity in the third line item had annual lighting hours of operation of 8,760.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[72]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 100%.

[71] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[72] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	223,336	222,247	100%	1.25
Total		223,336	222,247	100%	1.25

Site ID 6081

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 06/08/18 and 06/27/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixt Replacing MH Fixt	1169	Lighting	Custom	24	29	455	133	4,938	1.01	44,211	35,097	79%
100201-Lighting-Non Linear LED Fixt Replac T12 Fixture				81	50	138	90	4,574	1.01	41,801	30,740	74%
100208-Lighting-Non Linear LED Fixt Replac M H Fixture				12	24	455	90	4,047	1.01	20,656	13,440	65%
				9	12	455	133	4,021	1.01	15,642	10,114	65%
100201-Lighting-Non Linear LED Fixt Replac T12 Fixture				6	3	138	75	2,458	1.01	3,774	1,492	40%
100204-Lighting-Non Linear LED Fixt Replac T8 Fixture				4	3	175	133	4,021	1.01	1,884	1,218	65%
				2	1	175	133	4,938	1.01	1,358	1,078	79%
Total										129,326	93,179	72%

The annual lighting hours of operation verified during the M&V site visit (ranging from 2,458 to 4,938) are fewer than the annual hours of operation used to calculate ex ante savings (5,850).

A heating and cooling interactive factor of 1.01, applicable to an electric heated, air conditioned light manufacturing facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[73]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 72%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and overestimated heating and cooling interactive effects.

[73] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Custom	Lighting	129,326	93,179	72%	17.70
Total		129,326	93,179	72%	17.70

Site ID 6082

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
100201-Lighting-Non Linear LED Fixture Replacing T12 Fixture	1169	Lighting	Custom	37	37	164	44	8,760	1.11	41,617	43,079	104%
				1	1	82	32	8,760	1.11	469	485	103%
100209-Lighting-Non Linear LED Fixture Replacing Pulse Start Metal Halide Fixture		Exterior Lighting		24	24	350	96	4,308	1.00	26,700	26,262	98%
100208-Lighting-Non Linear LED Fixture Replacing Metal Halide Fixture				3	3	1,080	215	4,308	1.00	11,366	11,179	98%
				8	8	295	42	4,308	1.00	8,865	8,720	98%
Total										89,017	89,726	101%

The annual lighting hours of operation for the last three line items above with fixtures using photo cells (4,308[74]) are less than the hours of operation used to calculate ex ante savings (4,380).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings for the first two line items in the table above. The ex ante savings estimate accounted for a heating and cooling factor of 1.07. The last three items were exterior installations where the ex post applied a 1.00 factor matching the ex ante savings estimate factor.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[75]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 101%.

[74] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[75] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Custom	Lighting	42,086	43,565	104%	8.28
	Exterior Lighting	46,931	46,161	98%	0.26
Total		89,017	89,726	101%	8.53

Site ID 6084

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 05/09/18 and 05/28/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
305233-Lighting-85-225 Watt Lamp Replacing Interior HID 301-500 Watt Lamp	3005-1	Lighting	Standard	279	279	400	146	6,255	1.00	434,335	443,241	102%
Total										434,335	443,241	102%

The annual lighting hours of operation verified during the M&V site visit (6,255) are greater than the annual hours of operation used to calculate ex ante savings (5,728).

A heating and cooling interactive factor of 1.00, applicable to a gas heated, unconditioned light manufacturing facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[76]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 102%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	434,335	443,241	102%	84.20
Total		434,335	443,241	102%	84.20

[76] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6085

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 05/23/18 and 06/11/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
100213-Lighting-Non Linear LED Fixture Replacing CFL Fixture	1169	Lighting	Custom	100	100	46	14	8,760	1.11	29,994	31,012	103%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025	Lighting	Standard	260	260	32	14	5,273	1.11	43,867	27,300	62%
Total										73,861	58,312	79%

The annual lighting hours of operation verified during the M&V site visit for the second line item (5,273) are fewer than the annual hours of operation used to calculate ex ante savings (8,760).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned hotel in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[77]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 79%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for the second line item and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	43,867	27,300	62%	5.19
Custom		29,994	31,012	103%	5.89
Total		73,861	58,312	79%	11.08

[77] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6105

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 06/13/18 and 07/02/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	Standard	110	110	84	36	6,769	1.10	30,677	39,444	129%
306143-Lighting-LED Lamp Replacing T8 Lamp	3025			7	7	28	18	6,674	1.10	407	516	127%
Total										31,084	39,959	129%

The annual lighting hours of operation verified during the M&V site visit (ranging from 6,674 – 6,769) are greater than the annual hours of operation used to calculate ex ante savings (5,430). Forty-five percent of the lamps had continuous usage.

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air conditioned large single-story retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[78]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 129%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

[78] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	31,084	39,959	129%	7.59
Total		31,084	39,959	129%	7.59

Site ID 6106

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 06/15/18 and 07/09/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp Replacing T8 Lamp	3025	Lighting	Standard	114	114	114	36	6,556	1.10	44,775	64,338	144%
				3	3	59	18	5,532	1.10	620	751	121%
Total										45,395	65,089	143%

The annual lighting hours of operation verified during the M&V site visit (ranging from 5,532 – 6,556) are greater than the annual hours of operation used to calculate ex ante savings (4,706). Twenty-six percent of the lamps had continuous usage.

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air conditioned large single-story retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[79]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 143%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	45,395	65,089	143%	12.36
Total		45,395	65,089	143%	12.36

[79] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6107

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 06/20/18 and 07/09/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp Replacing T8 Lamp	3025	Lighting	Standard	114	114	114	36	6,709	1.10	72,510	65,840	91%
				12	12	59	18	4,119	1.10	2,858	2,237	78%
Total										75,368	68,077	90%

The annual lighting hours of operation verified during the M&V site visit for the first line item above (6,709) is greater than the annual hours of operation used to calculate ex ante savings (5,430). The second line item has fewer hours of operation (4,119).

The quantity of the first line item in the table above verified during an initial and secondary site visit (114) is fewer than the quantity used to calculate ex ante savings (180). The managers had no idea if or when the other fixtures would be retrofitted, and no additional lamps were found in storage.

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air conditioned large single-story retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[80]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 90%. The ex ante energy savings estimate was premised on all measures being installed and underestimated annual lighting operating hours for the second line item.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	75,368	68,077	90%	12.93
Total		75,368	68,077	90%	12.93

[80] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6108

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 06/22/18 and 07/16/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp Replacing T8 Lamp	3025	Lighting	Standard	155	155	114	36	6,612	1.10	64,216	88,217	137%
				5	5	59	18	4,881	1.10	1,088	1,104	101%
				2	2	114	36	7,320	1.10	829	1,260	152%
Total										66,133	90,582	137%

The annual lighting hours of operation verified during the M&V site visit for the first and third line items in the table above (6,612 and 7,320, respectively) are greater than the annual hours of operation used to calculate ex ante savings (4,964). The second line item above has fewer hours of operation (4,881).

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air conditioned large single-story retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[81]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 137%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for 97% of the installed measures and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	66,133	90,582	137%	17.20
Total		66,133	*90,582*	137%	17.20

[81] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6109

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 06/20/18 and 07/09/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	Standard	116	116	82	36	5,461	1.10	26,275	32,156	122%
306143-Lighting-LED Lamp Replacing T8 Lamp	3025			3	3	32	18	6,093	1.10	207	282	136%
Total										26,482	32,439	122%

The annual lighting hours of operation verified during the M&V site visit (ranging from 5,461 – 6,093) are greater than the annual hours of operation used to calculate ex ante savings (4,602).

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air conditioned large single-story retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[82]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 122%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	26,482	32,439	122%	6.16
Total		26,482	32,439	122%	6.16

[82] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6115

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 06/21/18 and 07/16/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	Standard	7	7	164	72	5,324	1.01	2,481	3,449	139%
Total										2,481	3,449	139%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (3,600). The ex ante did not represent the facilities posted hours of operation.

A heating and cooling interactive factor of 1.01, applicable to an electric heated, air conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[83]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 139%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	2,481	3,449	139%	0.66
Total		2,481	3,449	139%	0.66

[83] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6116

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 06/21/18 and 07/15/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	Standard	9	9	164	72	4,315	1.11	3,898	3,957	113%
				2	2	82	36	4,214			429	
Total										3,898	4,386	113%

The annual lighting hours of operation verified during the M&V site visit (ranging from 4,214 - 4,315) are greater than the annual hours of operation used to calculate ex ante savings (3,600). The ex ante hours did not represent the posted store hours.

The M&V site visit verified the quantity of nine 4' 4L fixtures and two 4' 2L fixtures. The ex ante had a total of eleven 4' 4L fixtures.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[84]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 113%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	3,898	4,386	113%	0.83
Total		3,898	4,386	113%	0.83

[84] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6117

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 06/21/18 and 07/16/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	Standard	22	22	164	72	4,376	1.01	7,797	8,911	114%
				8	8	138	72	2,107	1.01	3,143	1,119	36%
				2	2	164	36	212	1.01	987	55	6%
Total										11,927	10,084	85%

The annual lighting hours of operation verified during the M&V site visit for the first line item in the table above (4,376) is greater than the annual hours of operation used to calculate ex ante savings (3,600). The second and third line items were in the basement with fewer annual hours of usage (2,107 and 212, respectively).

The efficient wattage verified during the M&V site visit for the second line item in the table above (72W) is greater than the ex ante savings estimate (36W). The client had installed 2 lamps in each fixture instead of 1 lamp as claimed in the application.

A heating and cooling interactive factor of 1.01, applicable to an electric heated, air conditioned small retail in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[85]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 85%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for 21% of the lamps, underestimated installed quantity for the second measure, and overestimated heating and cooling interactive effects.

[85] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	11,927	10,084	85%	1.92
Total		11,927	10,084	85%	1.92

Site ID 6124

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 06/14/18 and 07/11/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306140-Lighting-LED Lamp Replacing Interior HID Lamp	3004-1	Lighting	Standard	15	15	460	222	8,760	1.00	33,462	31,273	93%
				15	15	460	222	6,389	1.00	12,224	22,807	187%
				15	15	460	222	8,619	1.00	12,224	30,769	252%
Total										57,910	84,849	147%

The annual lighting hours of operation verified during the M&V site visit for the second and third line items in the table above (6,389 and 8,619, respectively) are greater than the annual hours of operation used to calculate ex ante savings (3,200). The first line item corresponds with the ex ante hours.

A heating and cooling interactive factor of 1.00, applicable to an unconditioned site was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[86]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 147%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for 2/3 of the measures and overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	57,910	84,849	147%	16.12
Total		57,910	84,849	147%	16.12

[86] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6135

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed eight photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 06/30/18 and 07/25/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025	Lighting	SBDI	26	26	88	34	2,821	1.15	4,063	4,547	112%
				8	8	32	9	2,146	1.15	532	453	85%
				13	13	59	28	3,196	1.15	1,166	1,478	127%
				4	4	32	17	2,146	1.15	173	148	85%
				8	8	46	12	2,146	1.15	786	670	85%
306140-Lighting-LED Lamp or Fixture Replacing Interior HID Lamp or Fixture	3004-1			10	10	129	15	2,515	1.15	3,298	3,291	100%
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025			2	2	56	30	518	1.15	151	31	20%
301037-Lighting-LED <=20 Watt Lamp or Fixture Replacing Halogen A >=40 Watt Lamp or Fixture	3011			6	6	43	9	789	1.15	573	185	32%
200808-Lighting-LED <=13 Watt Lamp Replacing Halogen MR-16 35-50 Watt Lamp or Fixture	3012			8	8	50	7	2,498	1.15	996	986	99%
Total										11,738	11,790	100%

The annual lighting hours of operation verified during the M&V site visit for the first and third line items in the table above (2,821 and 3,196, respectively) are greater than the annual hours of operation used to calculate ex ante savings (2,704). The remaining line items have hours of use fewer (ranging from 151 – 2,515).

An adjusted base wattage of 43W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

A heating and cooling interactive factor of 1.15, applicable to a electric heated, air conditioned large office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[87]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 100%.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	11,738	11,790	100%	2.24
Total		11,738	11,790	100%	*2.24*

[87] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6136

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed nine photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 6/29/18 and 7/25/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp Replacing T8 Lamp	3025	Lighting	SBDI	40	40	114	34	3,142	1.15	9,259	11,540	125%
				10	10	114	23	5,234	1.15	2,633	5,468	208%
				5	5	32	18	2,038	1.15	203	164	81%
				3	3	56	24	1,694	1.15	277	187	67%
				24	24	114	56	2,898	1.15	4,027	4,630	115%
301039-Lighting-LED <=20 Watt Lamp Replacing Halogen PAR Lamp	3008			11	11	67	13	2,884	1.15	1,639	1,948	119%
306143-Lighting-LED Lamp Replacing T8 Lamp	3025			59	59	59	28	2,125	1.15	5,292	4,461	84%
301037-Lighting-LED <=20 Watt Lamp Replacing Halogen A >=40 Watt Lamp	3011			4	4	53	9	1,098	1.15	504	222	44%
Total										23,834	28,619	120%

The annual lighting hours of operation verified during the M&V site visit for the first, second, fifth, and sixth line items in the table above (ranging from 2,884 – 5,234) are greater than the annual hours of operation used to calculate ex ante savings (2,704). The remaining lines have annual hours fewer (ranging from 1,098 – 2,125).

An adjusted base wattage of 53W was used for the eighth line item in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 75W incandescent lamp. The ex ante base wattage of 52.5W was computed within the application by factoring 70% of a 75W incandescent lamp.

The efficient wattage of the sixth line item in the table above (13W) verified during the M&V site visit is fewer than the ex ante savings estimate wattage (15W).

A heating and cooling interactive factor of 1.15, applicable to an electric heated, air conditioned large office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[88]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 120%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for 54% of the measures, overestimated efficient wattage for one measure, and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	23,834	28,619	120%	5.44
Total		23,834	28,619	120%	5.44

[88] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6137

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed eight photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 06/30/18 and 07/25/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp Replacing T8 Lamp	3025	Lighting	SBDI	14	14	59	17	4,240	1.15	1,701	2,862	166%
				4	4	32	9	4,240	1.15	266	448	166%
				3	3	56	30	3,254	1.15	226	291	129%
				17	17	59	28	1,975	1.15	1,525	1,195	78%
				39	39	88	34	2,543	1.15	6,093	6,148	101%
306140-Lighting-LED Lamp Replacing Interior HID Lamp	3004-1			5	5	129	15	2,933	1.15	1,649	1,919	116%
306143-Lighting-LED Lamp Replacing T8 Lamp	3025			6	6	114	34	5,747	1.15	1,389	3,166	228%
301037-Lighting-LED <=20 Watt Lamp Replacing Halogen A >=40 Watt Lamp	3011			6	6	43	9	4,146	1.15	573	971	169%
200808-Lighting-LED <=13 Watt Lamp Replacing Halogen MR-16 35-50 Watt Lamp	3012			6	6	50	7	-	1.15	746	-	0%
Total										14,168	17,000	120%

The annual lighting hours of operation verified during the M&V site visit for the fourth and fifth line item in the table above (1,975 and 2,543, respectively) are fewer than the annual hours of operation used to calculate ex ante savings (2,704). The remaining line items (1-3 and 6-8) have greater hours of operation (ranging from 2,933 – 5,747).

The ninth line item in the table above was installed within a track fixture with no electricity connected. Therefore, there are no hours of use since the lamps do not operate.

An adjusted base wattage of 43W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

A heating and cooling interactive factor of 1.15, applicable to a n electric heated, air conditioned large office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[89]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 120%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for 40% of the measures and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	14,168	17,000	120%	3.23
Total		14,168	17,000	120%	3.23

[89] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6146

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 06/30/18 and 07/25/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replac T12 Lamp	3026	Lighting	SBDI	14	14	82	34	2,080	1.00	1,869	1,399	75%
				34	34	174	86	2,463	1.00	8,325	7,390	89%
				3	3	82	28	1,947	1.00	452	315	70%
301037-LightingLED <20W Lamp Replac HalogenA>40W La	3011			1	-	72	-	-	1.00	163	-	0%
306142-Lighting-LED Lamp Replac T12 Lamp	3026			18	18	174	86	1,644	1.00	4,406	2,604	59%
Total										15,215	11,708	77%

The annual lighting hours of operation verified during the M&V site visit (ranging from 1,644 to 2,463) are fewer than the annual hours of operation used to calculate ex ante savings (2,600).

The M&V site visit discovered that the fourth line item in the table above was not retrofitted. On a return visit the lamp was still an incandescent lamp. Therefore, the efficient quantity, hours of use, kWh savings, and realization rate are zero.

A heating and cooling interactive factor of 1.01, applicable to an electric heated, air conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings for the lobby area. All other locations were unconditioned with a 1.00 factor applied. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[90]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 77%. The ex ante energy savings estimate was premised on

[90] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

overestimated annual lighting operating hours, all measures installed, and overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	15,215	11,708	77%	2.22
Total		15,215	11,708	77%	2.22

Site ID 6147

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/03/18 and 7/30/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED LampReplac T12 Lamp	3026	Lighting	SBDI	16	16	82	28	796	1.00	2,403	688	29%
301037-Lighting-LED <=20 t Lamp Replacing HalogenA >40W Lamp	3011			2	2	43	9	207	1.11	183	16	9%
306142-Lighting-LED LampReplac T12 Lamp	3026			4	4	82	28	1,626	1.05	601	370	62%
				40	40	174	86	1,194	1.04	9,793	4,369	45%
Total										12,980	5,443	42%

The annual lighting hours of operation verified during the M&V site visit (ranging from 207 – 1.626) are fewer than the annual hours of operation used to calculate ex ante savings (2,600). The site has many windows, so the client stated they do not use their lighting often.

An adjusted base wattage of 43W was used for the second line item in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office in St. Louis, was applied to the ex post lighting energy savings for the office areas. The remaining locations were unconditioned and received a factor of 1.00. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[91]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 42%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and overestimated heating and cooling interactive effects.

[91] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	12,980	5,443	42%	1.03
Total		12,980	5,443	42%	1.03

Site ID 6148

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/03/18 and 07/30/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	3	3	82	28	740	1.00	309	120	39%
				2	2	164	28	1,910	1.00	519	520	100%
				22	22	174	86	1,742	1.00	3,698	3,372	91%
Total										4,526	4,011	89%

The annual lighting hours of operation verified during the M&V site visit for the second line item in the table above (1,910) are greater than the annual hours of operation used to calculate ex ante savings (1,785). The first and third line items had fewer annual hours of operation (740 and 1,742, respectively). The installed location for the first measure has infrequent usage.

A heating and cooling interactive factor of 1.00, applicable to a gas heated, non-air-conditioned facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[92]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 89%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 93% of the measures and overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	4,526	4,011	89%	0.76
Total		4,526	4,011	89%	0.76

[92] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6149

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed seven photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 06/28/18 and 07/23/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	30	30	138	86	2,292	1.00	4,663	3,576	77%
				1	1	276	86	1,620	1.00	568	308	54%
				2	2	82	36	2,457	1.00	275	226	82%
301037-Lighting-LED Lamp Replacing Halogen A Lamp	3011			17	17	43	10	1,338	1.09	1,626	816	50%
306142-Lighting-LED Lamp Replacing T12 Lamp	3026			3	3	227	86	9	1.00	453	4	1%
Total										7,585	4,930	65%

The annual lighting hours of operation verified during the M&V site visit (ranging from 9 – 2,457) are fewer than the annual hours of operation used to calculate ex ante savings (2,794).

An adjusted base wattage of 43W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned small office in St. Louis, was applied to the ex post lighting energy savings for all office locations. A factor of 1.00 was applied to the shop areas since they were unconditioned. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[93]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 65%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours overestimated heating and cooling interactive effects.

[93] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	7,585	4,930	65%	0.94
Total		7,585	4,930	65%	0.94

Site ID 6155

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
100211-Lighting-Non Linear LED Fixture Replacing High Pressure Sodium Fixture	1169	Exterior Lighting	Custom	99	99	465	74	4,790	1.00	169,632	185,505	109%
Total										169,632	185,505	109%

The annual lighting hours of operation verified during the M&V site visit (4,790) are greater than the annual hours of operation used to calculate ex ante savings (4,380). A timer controlled 78% of the measure while 22% were controlled through photo cells[94].

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[95]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 109%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	169,632	185,505	109%	1.04
Total		169,632	185,505	100%	1.04

[94] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[95] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6171

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	37	37	82	34	8,760	1.01	16,647	15,651	94%
				17	17	120	17	8,760	1.18	16,412	18,038	110%
Total										33,059	33,689	102%

The annual lighting hours of operation verified during the M&V site visit (8,760) correspond with the annual hours of operation used to calculate ex ante savings.

A heating and cooling interactive factor of 1.01, applicable to an electric heated, air conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings for sales floor locations. A factor of 1.18 was applied to the walk-in cooler doors since the area is refrigerated. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[96]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 102%. The ex ante energy savings estimate was premised on underestimated heating and cooling interactive effects for 69% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	33,059	33,689	102%	6.40
Total		33,059	33,689	102%	6.40

[96] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6172

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/04/18 and 07/30/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	39	39	138	44	2,732	1.00	12,239	10,015	82%
Total										12,239	10,015	82%

The annual lighting hours of operation verified during the M&V site visit (2,732) are fewer than the annual hours of operation used to calculate ex ante savings (3,120).

A heating and cooling interactive factor of 1.00, applicable to a unconditioned facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[97]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 82%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	12,239	10,015	82%	1.90
Total		12,239	10,015	82%	1.90

[97] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6188

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed one photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/03/18 and 07/30/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306135-Lighting-LED Lamp Replacing T5 Lamp	3088	Lighting	SBDI	6	6	240	100	1,810	1.00	1,869	1,520	81%
306143-Lighting-LED Lamp Replacing T8 Lamp	3025			1	1	114	34	1,810	1.00	178	145	81%
Total										2,047	1,665	81%

The annual lighting hours of operation verified during the M&V site visit (1,810) are fewer than the annual hours of operation used to calculate ex ante savings (2,080).

A heating and cooling interactive factor of 1.00, applicable to an unconditioned facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[98]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 81%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	2,047	1,665	81%	0.32
Total		2,047	1,665	81%	0.32

[98] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6191

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/14/18 and 08/08/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	6	6	164	48	2,225	1.11	387	1,713	443%
				16	16	138	44	67	1.00	837	100	12%
Total										1,224	1,813	148%

The annual lighting hours of operation verified during the M&V site visit for the first line item in the table above (2,225) are greater than the annual hours of operation used to calculate ex ante savings (520). This measure was installed within the office area with posted hours of 8 a.m. to 4:30 p.m. Monday through Friday. The second line item above had fewer verified hours (67) than the ex ante estimated hours. This measure was placed within infrequently used storage closets.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office in St. Louis, was applied to the ex post lighting energy savings for the office measures. The storage measures were unconditioned, so a 1.00 factor applied. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[99]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 148%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and underestimated heating and cooling interactive effects for half of the installed measures.

[99] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	1,224	1,813	148%	0.34
Total		1,224	1,813	148%	0.34

Site ID 6192

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/14/18 and 08/08/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	15	15	164	30	1,908	1.11	5,256	4,247	81%
				2	2	82	15	25	1.11	351	4	1%
Total										5,607	4,250	76%

The annual lighting hours of operation verified during the M&V site visit (25 and1,908) are fewer than the annual hours of operation used to calculate ex ante savings (2,444). The second line item in the table above was located in a back room where the lighting is not utilized often. The ex ante hours were found to also be greater than the posted store hours (2,020).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[100]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 76%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	5,607	4,250	76%	0.81
Total		5,607	4,250	76%	0.81

[100] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6025

Data Collection

The participant received EMS Program incentives from Ameren Missouri.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation and school schedules. ADM also collected information on building construction and HVAC equipment nameplates that were necessary for energy modeling purposes.

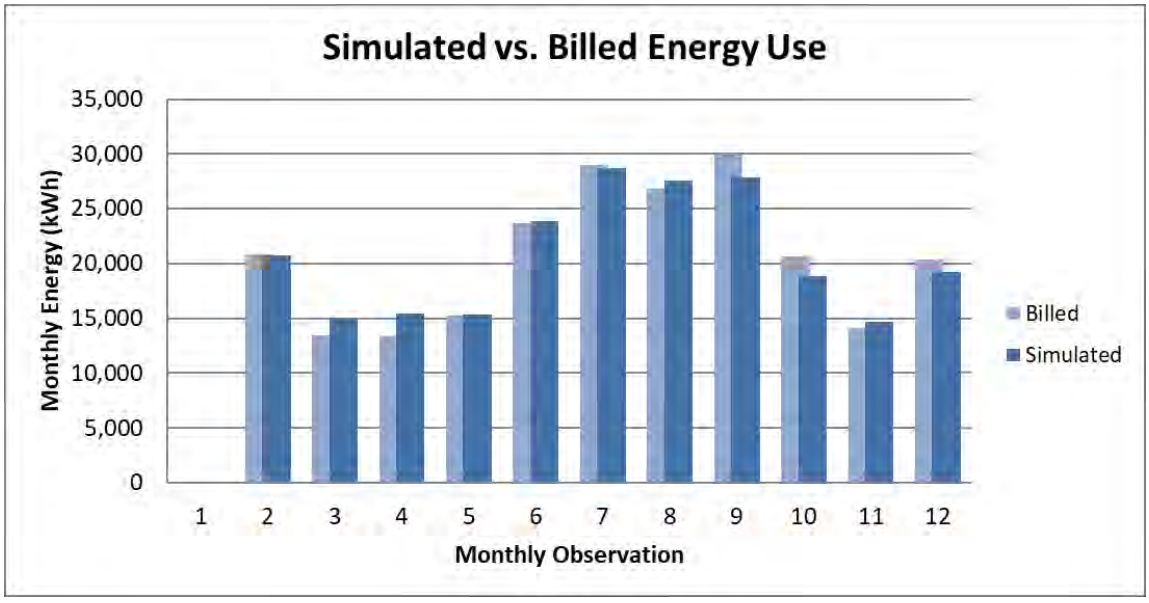
Analysis Results

EMS Controls Savings Calculations

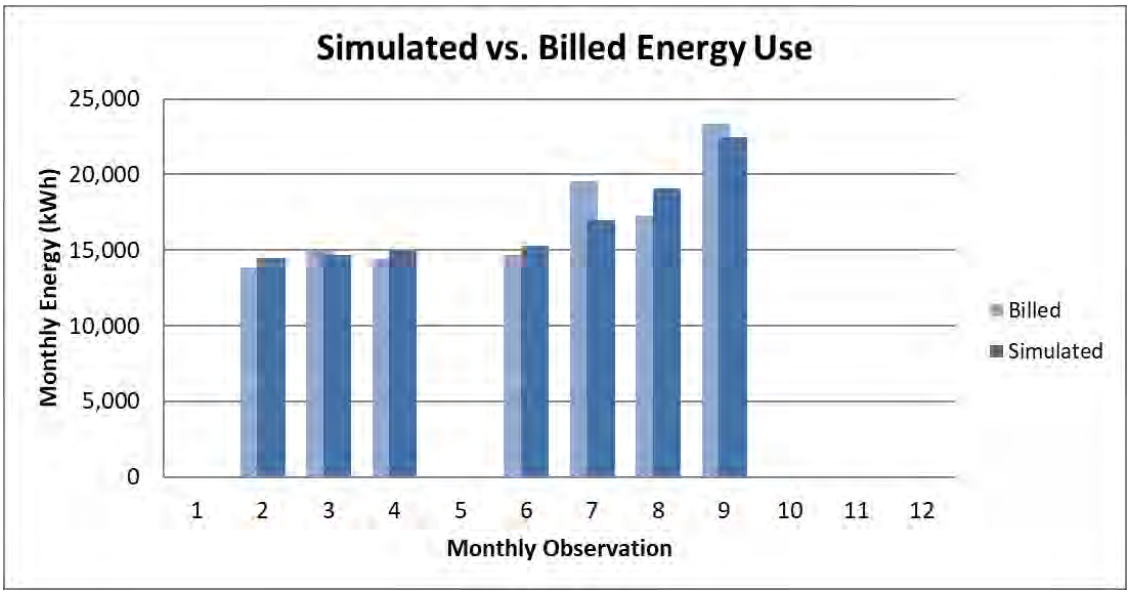
Energy savings for the installed measures were calculated using IPMVP Option D: Calibrated Simulation. ADM compiled two eQuest models for each project using the details and construction documents collected during the on-site M&V visit and from the project documentation. For project 1, ADM first modeled the baseline building. For project 2, ADM modeled the as-built building first.

Upon completion of the initial models, custom weather files were created using 2016 & 2018 NOAA weather data for the region. Using this weather file and the utility provided billing data for the building, ADM ensured that the models' energy load shapes matched that of the bills. ADM performed baseline calibration for Project 1 due lack of enough post data and as-built calibration for Project 2 because there was a utility meter change at the same time as the project. The results of this calibration effort can be seen below:

Project 1 – 2016 Monthly kWh Calibration



Project 2 – 2018 Monthly kWh Calibration



Upon calibrations of the eQuest models, the impacts of the installed measures were added through the uses of parametric runs. Once the parametric runs were defined, the initial models and parametric runs were simulated using TMY3 weather data. The total realized energy savings are the differences between the baseline and as-built models' energy usages, and the total site-level energy savings by end use can be seen in the following tables:

Project 1 – Typical Year Energy Usage (kWh) by End Use

End-Use	*Baseline*	*As-Built*	*kWh Savings*
Lighting	87,286	87,286	0
Miscellaneous Equipment	29,452	29,452	0
Heating	38,124	38,124	0
Supplemental Heating	0	0	0
Cooling	62,131	46,321	15,810
Heat Rejection	0	0	0
Pumps	876	876	0
Fans	37,043	23,176	13,866
Domestic Hot Water	0	0	0
Exterior Lighting	0	0	0
Total	254,911	225,235	29,676

Project 1 – Typical Year Energy Usage (kWh) by End Use

End-Use	*Baseline*	*As-Built*	*kWh Savings*
Lighting	87,286	87,286	0
Miscellaneous Equipment	29,452	29,452	0
Heating	38,124	38,124	0
Supplemental Heating	0	0	0
Cooling	62,131	46,321	15,810
Heat Rejection	0	0	0
Pumps	876	876	0
Fans	37,043	23,176	13,866
Domestic Hot Water	0	0	0
Exterior Lighting	0	0	0
Total	254,911	225,235	29,676

Measure level savings are shown in the following table:

EMS Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
117920 - Controls – Cooling	1169	Cooling	EMS	27,702	15,810	57%
118220 - Controls – HVAC	1169	HVAC	EMS	6,925	13,866	200%
117920 - Controls – Cooling	1169	Cooling	EMS	21,071	8,216	39%
118220 - Controls – HVAC	1169	HVAC	EMS	5,268	13,442	255%
Total				60,966	51,335	84%

There were significant differences in the ex ante and ex post analysis methodologies for the EMS controls. The ex ante analysis used bin calculations with assumed loads, hours of operation, and savings distributions (80% cooling and 20% ventilation). The ex post energy simulations resulted in less cooling savings and more ventilation (HVAC) savings. ADM created eQuest models of the two relevant buildings and calibrated the models to actual billing data. This method accounts for interactive effects and building and HVAC system operations better than the ex ante calculations.

The site-level verified energy savings are 51,335 kWh, resulting in a site-level realization rate of 84%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	27,702	15,810	57%	7.48
	HVAC	6,925	13,866	200%	5.97
	Cooling	21,071	8,216	39%	14.40
	HVAC	5,268	13,442	255%	6.16
Total		60,966	51,334	84%	27.85

Site ID 6039

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed eight photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/26/18 and 6/18/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
305801-Lighting-Delamping Replacing T12 <=40 Watt	3084	Lighting	Standard	80	-	40	-	1,443	1.14	10,272	5,252	51%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replac T12 <=40 Watt Linear ft	3026			80	80	40	14	1,443	1.14	6,677	3,414	51%
				50	50	40	14	3,043	1.14	4,173	4,501	108%
				40	40	40	14	429	1.14	3,338	507	15%
305801-Lighting-Delamping Replacing T12 <=40 Watt	3084			20	-	40	-	429	1.14	2,568	390	15%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replac T12 <=40 Watt Linear ft	3026			30	30	40	14	2,910	1.14	2,504	2,582	103%
201111-Lighting-LED <=11 Watt Lamp Replacing Halogen A 28-52 Watt Lamp	3011			20	20	43	10	1,181	1.14	2,087	900	43%
305801-Lighting-Delamping Replacing T12 <=40 Watt	3084			15	-	40	-	2,910	1.14	1,926	1,986	103%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replac T12 <=40 Watt Linear ft	3026			12	12	40	12	2,268	1.14	1,079	867	80%
				10	10	40	13	970	1.14	867	298	34%
Total										35,491	20,698	58%

Primary data were used to develop estimates of annual lighting operating hours, except in locations with 24/7 lighting. For all facility areas monitored, except the third line item in the table above, the estimated annual operating hours were fewer than those used to develop the ex ante energy savings estimates (3,000). The fourth and fifth line items in the table above have particularly low annual hours of operation compared to those used to develop the ex ante energy savings estimate due to lighting being installed in classroom locations with low usage.

An adjusted base wattage of 43W was used in the ex post savings analysis for the seventh line item in the table above to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

A heating and cooling interactive factor of 1.14, applicable to a gas heated, air conditioned assembly facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[101]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 58%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	35,491	20,698	58%	3.93
Total		35,491	20,698	58%	3.93

[101] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6040

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 05/04/18 and 05/23/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	66	66	138	44	5,331	1.00	16,570	33,072	200%
				50	50	138	44	4,708	1.00	12,552	22,128	176%
				6	6	164	44	2,647	1.00	1,923	1,906	99%
				1	1	83	44	4,284	1.00	104	167	161%
Total										31,149	57,273	184%

The annual lighting hours of operation verified during the M&V site visit (ranging from 2,647 and 5,331) are greater than the annual hours of operation used to calculate ex ante savings (2,496).

A heating and cooling interactive factor of 1.00 was applied to the ex post lighting energy savings. All measures were installed in unconditioned spaces. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[102]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 184%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	31,149	57,273	184%	10.88
Total		31,149	57,273	184%	10.88

[102] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6041

Data Collection

The participant received SBDI and Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed fourteen photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/9/2018 and 10/10/2018

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
301037-Lighting-LED <=20 W Lamp Replacing Halogen A >=40 Watt Lamp	3011	Lighting	SBDI	26	26	43	9	1,138	0.99	463	1,001	216%
301039-Lighting-LED <=20 W Lamp Replacing Halogen PAR Lamp	3008			4	4	53	11	767	0.98	90	127	141%
306143-Lighting-LED Lamp Replacing T8 Lamp	3025		Standard	100	100	114	30	1,581	0.98	17,473	13,054	75%
306142-Lighting-LED Lamp Replac T12 Lamp	3026			26	26	164	30	1,751	0.98	7,247	5,995	83%
306143-Lighting-LED Lamp Replacing T8 Lamp	3025			10	10	221	102	1,985	0.98	2,475	2,322	94%
306142-Lighting-LED Lamp Replac T12 Lamp	3026			16	16	82	30	1,492	0.98	1,731	1,220	71%
306143-Lighting-LED Lamp Replacing T8 Lamp	3025			2	2	88	30	1,985	0.98	241	226	94%
306142-Lighting-LED Lamp Replac T12 Lamp	3026			1	1	82	36	1,985	0.98	95	90	94%
Total										29,815	24,036	81%

The annual lighting hours of operation verified during the M&V site visit for the first, second, fifth, seventh, and eighth line items in the table above (ranging from 767 to 1,985) are greater than the annual hours of operation used to calculate ex ante savings (ranging from 504 to 1,944). The hours for the third, fourth, and sixth line items above are fewer than used to calculate ex ante savings (1,944).

The ex ante savings estimate used an adjusted base wattage of 42W for the first item in the above table and 52.5W for the second line item by multiplying the provided wattage by 70%. Adjusted base wattages of 43W and 53W, respectively, were used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for 60W and 75W incandescent lamps.

A heating and cooling interactive factor of 1.29, applicable to a medium temperature walk-in cooler, was applied to the ex post lighting energy savings for a portion of the first line item. A factor of 0.98,

applicable to an electrically heated, air conditioned education based facility in Jefferson City, Missouri, was applied to the ex post lighting energy savings for the remaining line items. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[103]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 81%. The ex ante energy savings estimate was premised upon overestimated hours of operation for 75% of the installed lamps and overestimated heating and cooling interactive effects for the entire project.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	29,262	22,909	78%	4.35
SBDI		553	1,128	204%	0.21
Total		29,815	24,036	81%	4.57

[103] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6053

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
100208-Lighting-Non Linear LED Fixture Replacing Metal Halide Fixture	1169	Exterior Lighting	Custom	8	8	455	81	2,120	1.00	7,181	6,344	88%
				8	8	455	81	2,120	1.00	7,181	6,344	88%
				8	8	455	81	2,120	1.00	7,181	6,344	88%
				8	8	455	81	4,308	1.00	13,105	12,888	98%
				8	8	455	81	2,120	1.00	7,181	6,344	88%
				8	8	455	81	2,120	1.00	7,181	6,344	88%
				8	8	455	81	4,308	1.00	13,105	12,888	98%
				8	8	455	81	2,120	1.00	7,181	6,344	88%
				8	8	455	81	2,120	1.00	7,181	6,344	88%
				8	8	455	81	2,120	1.00	7,181	6,344	88%
				8	8	455	81	2,120	1.00	7,181	6,344	88%
				8	8	455	81	2,120	1.00	7,181	6,344	88%
				8	8	455	81	2,120	1.00	7,181	6,344	88%
				8	8	455	81	2,120	1.00	7,181	6,344	88%
				8	8	455	81	2,120	1.00	7,181	6,344	88%
				8	8	455	81	2,120	1.00	7,181	6,344	88%
				8	8	455	81	2,120	1.00	7,181	6,344	88%
				8	8	455	81	2,120	1.00	7,181	6,344	88%
				6	6	455	81	2,120	1.00	5,386	4,758	88%
				8	8	455	81	2,120	1.00	7,181	6,344	88%
				8	8	455	81	2,120	1.00	7,181	6,344	88%
				16	16	455	81	2,120	1.00	14,362	12,687	88%
				24	24	455	81	2,120	1.00	21,542	19,031	88%
				16	16	455	81	2,120	1.00	14,362	12,687	88%
Total										211,120	189,125	90%

The annual lighting hours of operation for the fourth and seventh line items in the above table using photo cells (4,308[104]) are less than the hours of operation used to calculate ex ante savings (4,380). The annual lighting hours of operation for the remaining line items (2,120) are less than the hours of operation used to calculate ex ante savings (2,400). These lights are turned on by photocells and are turned off at midnight.

No heating and cooling interactive effects were considered due to all lighting being installed in exterior locations. The ex ante savings estimate did not account for a heating and cooling factor.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[105]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 90%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	196,758	176,438	90%	0.99
Total		196,758	176,438	90%	0.99

[104] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[105] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6058

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed nine photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 6/16/18 and 7/11/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100207-Lighting-Non Linear LED Fixt Replac T5 HO Fixt	1169	Lighting	Custom	199	199	240	118	8,760	1.00	227,563	213,573	94%
100204-Lighting-Non Linear LED Fixt Replac T8 Fixture				484	484	88	31	2,440	1.01	140,511	68,238	49%
100207-Lighting-Non Linear LED Fixt Replac T5 HO Fixt				656	656	240	135	8,742	1.00	645,626	604,664	94%
100204-Lighting-Non Linear LED Fixt Replac T8 Fixture				109	109	175	135	8,760	1.00	40,867	38,355	94%
100201-Lighting-Non Linear LED Fixt Replac T12 Fixture				2	2	82	45	5,641	1.02	694	424	61%
				11	11	82	22	1,356	1.02	3,362	910	27%
100208-Lighting-Non Linear LED Fixt Replac M H Fixture				12	12	215	27	3,306	1.02	11,490	7,578	66%
100211-Lighting-Non Linear LED Fixt Replac HPS Fixture		Exterior Lighting		13	13	465	76	4,308	1.00	22,150	21,785	98%
				25	25	465	128	4,308	1.00	36,902	36,293	98%
				24	24	465	128	4,308	1.00	35,425	34,842	98%
100208-Lighting-Non Linear LED Fixt Replac M H Fixture		Lighting		14	14	215	21	4,308	1.00	22,093	11,700	53%
100101-LightingLinear Tube LED				23	23	138	44	8,760	1.00	11,011	19,019	173%
				21	21	164	45	8,530	1.00	12,728	21,407	168%
				189	189	138	44	7,580	1.01	90,486	135,558	150%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
Fixt Replac T12 Fixture												
100208-Lighting-Non Linear LED Fixt Replac M H Fixture				12	12	215	21	3,306	1.02	-	7,820	-
Total										1,300,908	1,222,166	94%

Primary data were used to develop estimates of annual lighting operating hours for interior locations where operation was not 24/7. For all facility areas monitored, the estimated annual operating hours were fewer than those used to develop the ex ante energy savings estimates (4,760). This is primarily due to the fact that (227) lamps were installed in unused office space. During the site visit, ADM staff verified that this space would not be occupied for the next year.

The annual lighting hours of operation for the eight through tenth line items in the above table using photo cells (4,308[106]) are less than the hours of operation used to calculate ex ante savings (4,380).

A heating and cooling interactive factor of 1.02, applicable to an electrically heated, air conditioned office in Jefferson City, was applied to the ex post lighting energy savings regarding lighting installed in office areas. A heating and cooling interactive factor of 1.004, applicable to an electrically heated, air conditioned manufacturing facility in Jefferson City, was applied to the ex post lighting energy savings regarding lighting installed in manufacturing and storage locations. The ex ante savings estimate accounted for a heating and cooling factor of 1.07. Heating and cooling interactive effects were not accounted for regarding lighting installed in the exterior.

During the site visit, ADM staff noted that 12 of 26 fixtures referenced in the twelfth line item in the table above was installed in the facility interior. These 12 fixtures are accounted for in the last line item. The ex post savings analysis applied the “external lighting” end use category for the twelfth line item and the “lighting” end use category for the final line item.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[107]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 94%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and overestimated heating and cooling interactive effects.

[106] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[107] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Lighting	1,184,338	1,117,546	94%	212.29
	Exterior Lighting	116,570	104,620	90%	0.59
Total		1,300,908	1,222,166	94%	212.88

Site ID 6077

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. ADM staff verified the annual lighting operating hours through interviews with facility personnel regarding lighting operating schedules as the installation of three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/31/18 and 6/20/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replac T8 32 W Linear ft	3025	Lighting	Standard	104	208	50	10	5,178	1.11	17,012	17,309	102%
				44	88	50	10	5,194	1.11	7,198	7,346	102%
				2	2	28	10	4,264	1.11	199	165	83%
Total										24,409	24,821	102%

The annual lighting hours of operation verified during the M&V site visit, using photocells, (ranging from 4,264 to 5,194) are fewer than the annual hours of operation used to calculate ex ante savings (5,460).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned small retail in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[108]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 102%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

[108] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	24,409	24,821	102%	4.72
Total		24,409	24,821	102%	4.72

Site ID 6131

Data Collection

The participant received New Construction lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed one photo-sensor loggers to monitor lighting operation. The photo-sensor logger collected data between 6/01/18 and 8/01/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
406123-Lighting-New Construction Lighting Power Density (LPD)	3000	Lighting	New Construction	48	48	405	136	2,206	1.00	30,179	28,450	94%
Total										30,179	28,450	94%

The lighting energy use of the installed lighting equipment is compared with the estimated lighting energy use associated with the applicable new construction baseline (ASHAE 90.1 2010) to determine realized lighting energy savings. The facility constructed in Calloway County which allows for 1.11 lighting watts/SF. The code compliant baseline lighting wattage for this project was 19,425 watts (1.11 watts/SF*17,500SF).

The annual lighting hours of operation verified during the M&V site visit (2,206) are fewer than the annual hours of operation used to calculate ex ante savings (2,340).

A heating and cooling interactive factor of 1.00, applicable to an unconditioned space was applied to the ex post lighting energy savings. The ex ante savings estimate also did not account for heating and cooling interactive effects.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[109]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 94%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

[109] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
New Construction	Lighting	30,179	28,450	94%	5.40
Total		30,179	28,450	94%	5.40

Site ID 6134

Data Collection

The participant received New Construction lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules. The timer hours were provided.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
406123-Lighting-New Construction Lighting Power Density (LPD)	3000	Lighting	New Construction	856	856	44	10	3,546	1.00	104,114	104,106	100%
Total										104,114	104,106	100%

The lighting energy use of the installed lighting equipment is compared with the estimated lighting energy use associated with the applicable new construction baseline (ASHAE 90.1 2007) to determine realized lighting energy savings. The garage facility constructed in St. Louis County was subject to the 2009 IECC code in effect during the building design, which allows for 0.3 lighting watts/SF. The code compliant baseline lighting wattage for this project was 38,028 watts (0.3 watts/SF*126,760SF).

The annual lighting hours of operation verified during the M&V site visit (3,546) equal the annual hours of operation used to calculate ex ante savings. The measures are operated by a timer.

A heating and cooling interactive factor of 1.00, applicable to an unconditioned space was applied to the ex post lighting energy savings. The ex ante savings estimate also did not use a heating and cooling factor.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[110]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 100%.

[110] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
New Construction	Miscellaneous	104,114	104,106	100%	14.36
Total		104,114	104,106	100%	14.36

Site ID 6143

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed eight photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 08/25/18 and 09/17/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	10	10	164	48	1,916	1.11	2,905	2,458	85%
				3	3	82	24	1,978	1.00	1,017	344	34%
				18	18	164	48	2,579	1.11	5,228	5,955	114%
				1	1	138	44	1,978	1.00	235	186	79%
				20	20	164	48	4,450	1.10	5,809	11,308	195%
				3	3	138	44	3,247	1.00	706	916	130%
306140-Lighting-LED Lamp Replac Interior HID Lamp	3004-1			4	4	460	122	3,158	1.00	3,385	4,269	126%
306142-Lighting-LED Lamp Replac T12 Lamp	3026			2	2	82	24	3,247	1.00	291	377	129%
Total										19,576	25,812	132%

The annual lighting hours of operation verified during the M&V site visit for the first, second, and fourth line items in the table above (1,916, 1,978, 1,978, respectively) are fewer than the annual hours of operation used to calculate ex ante savings (2,340). The verified hours for the remaining line items (ranging from 2,579 and 4,450) are greater than ex ante hours.

The quantity of the second line item in the first table above (3) verified during the M&V site visit is less than the ex ante savings quantity (7). The remaining lamps were in storage.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office in St. Louis, was applied to the ex post lighting energy savings. A factor of 1.00 was used in unconditioned warehouse spaces. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[111]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 132%. The ex ante energy savings estimate was premised on

[111] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	19,576	25,812	132%	4.90
Total		19,576	25,812	132%	4.90

Site ID 6153

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/12/18 and 08/06/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixt Replac M Ha Fixture	1169	Lighting	Custom	140	92	1,080	600	3,167	1.14	313,707	345,887	110%
				28	20	1,080	190	3,167	1.14	86,400	95,263	110%
Total										400,107	441,150	110%

The annual lighting hours of operation verified during the M&V site visit (3,167) are greater than the annual hours of operation used to calculate ex ante savings (3,054).

A heating and cooling interactive factor of 1.14, applicable to a gas heated, air conditioned assembly facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[112]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 110%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Custom	Lighting	400,107	441,150	110%	83.80
Total		400,107	441,150	110%	83.80

[112] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6167

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 08/21/18 and 10/02/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replac T12 Lamp	3026	Lighting	SBDI	41	41	164	30	2,285	1.10	16,049	13,777	86%
				2	2	164	30	1,266	1.10	392	373	95%
Total										16,441	14,149	86%

The annual lighting hours of operation verified during the M&V site visit (2,285 and 1,266) are fewer than the annual hours of operation used to calculate ex ante savings (2,730 and 1,365).

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air conditioned small retail in Kirksville, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[113]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 86%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	16,441	14,149	86%	2.69
Total		16,441	14,149	86%	2.69

[113] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6169

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 08/23/18 and 09/26/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	54	54	164	30	1,628	1.09	22,609	12,887	57%
				26	26	164	30	2,464	1.09	10,885	9,391	86%
				4	4	164	30	2,464	1.09	5,025	1,445	29%
				1	1	164	60	2,331	1.09	325	265	82%
Total										38,844	23,988	62%

The annual lighting hours of operation verified during the M&V site visit (ranging from 1,628 - 2,464) are fewer than the annual hours of operation used to calculate ex ante savings (ranging from 2,920 – 8,760).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned small office in Kirksville, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[114]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 62%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	38,844	23,988	62%	4.56
Total		38,844	23,988	62%	4.56

[114] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6173

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed six photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/07/18 and 08/01/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp Replac T8 Lamp	3025	Lighting	SBDI	26	26	114	30	739	1.11	3,505	1,784	51%
306142-Lighting-LED Lamp Replac T12 Lamp	3026			11	11	82	15	715	1.11	1,182	582	49%
301037-Lighting-LED <=20W Lamp Replac Halogen A >=40 WLamp	3011			17	17	53	11	2,062	1.11	1,132	1,627	144%
306143-Lighting-LED Lamp Replac T8 Lamp	3025			5	5	59	30	2,121	1.11	233	340	146%
300938-Lighting-LED <=14W Lamp Replacing Halogen BR/R Lamp	3007			3	3	50	7	1,642	1.11	207	234	113%
				2	2	65	11	252	1.11	173	30	17%
301037-Lighting-LED <=20W Lamp Replacing HalogenA >=40W Lamp	3011			2	2	46	9	2,440	1.11	117	197	168%
Total										6,549	4,794	73%

The annual lighting hours of operation verified during the M&V site visit for the first, second, and sixth line items in the table above (739, 715, and 252, respectively) are fewer than the annual hours of operation used to calculate ex ante savings (1,500). The remaining line items have verified hours of operation (ranging from 1,642 to 2,440) are greater than ex ante hours of operation.

An adjusted base wattage of 53W and 45.5W was used for the third and seventh line items in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 75W and 65W incandescent lamp. The ex ante base wattage of 52.5W ad 45.5W was computed within the application by factoring 70% of a 75W and 65W incandescent lamp.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office in Cape Girardeau, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[115]

[115] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 73%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 61% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	6,549	4,794	73%	0.91
Total		6,549	4,794	73%	0.91

Site ID 6174

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/07/18 and 08/01/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306140-Lighting-LED Lamp Replacing Interior HID Lamp	3004-1	Lighting	SBDI	7	7	460	115	3,388	0.90	6,852	7,403	108%
306143-Lighting-LED Lamp Replac T8 Lamp	3025			13	13	114	30	3,306	1.02	3,099	3,669	118%
306142-Lighting-LED LampReplac T12Lamp	3026			5	5	227	54	1,133	0.90	2,455	887	36%
306143-Lighting-LED Lamp Replac T8 Lamp or Fixture	3025			2	2	59	18	1,479	0.96	233	117	50%
Total										12,639	12,076	96%

The annual lighting hours of operation verified during the M&V site visit for the third and fourth line items in the table above (1,133 and 1,479, respectively) are fewer than the annual hours of operation used to calculate ex ante savings (2,652). The first and second line items have annual lighting hours of operation that are greater (3,388 and 3,306, respectively).

A heating and cooling interactive factor of 1.02, applicable to an electric heated, air conditioned small office in Cape Girardeau, was applied to the ex post lighting energy savings for office locations. A factor of 0.90 was applied to unconditioned shop spaces. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[116]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 96%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 26% of the installed measures and overestimated heating and cooling interactive effects.

[116] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	12,639	12,076	96%	2.29
Total		12,639	12,076	96%	2.29

Site ID 6176

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/07/18 and 08/01/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	30	30	138	30	3,019	1.11	10,978	10,834	99%
				10	10	164	30	2,643	1.11	3,585	3,922	109%
				5	5	138	60	2,643	1.11	1,043	1,142	109%
301037-Lighting-LED <=20W LampRepla Halogen A >40WLamp	3011			6	6	43	11	2,666	1.11	829	567	68%
306142-LightingLED LampRepla T12 Lamp	3026	Exterior Lighting		8	8	138	30	4,310	1.00	-	3,722	-
Total										16,435	20,187	123%

The annual lighting hours of operation verified during the M&V site visit (ranging from 2,643 and 4,310[117]) are greater than the annual hours of operation used to calculate ex ante savings (2,500).

An adjusted base wattage of 43W was used for the fourth line item in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

The quantity of the fourth line item in the table above (6) verified during the M&V site visit is less than the ex ante savings quantity (10). In addition, 8 of the 38 ex ante measures in the first line item were installed as exterior lighting (shown in the fifth line item).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small retail in Cape Girardeau, was applied to the ex post lighting energy savings for interior spaces. The exterior

[117] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

spaces were not heated or conditioned and received a factor of 1.00. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[118]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 123%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	16,435	16,464	100%	3.13
	Exterior Lighting	-	3,722	-	0.02
Total		16,435	20,187	123%	3.15

[118] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6181

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed one photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/07/18 and 08/05/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306140-Lighting-LED Lamp Replacing Interior HID Lamp	3004-1	Lighting	SBDI	16	16	460	100	471	1.14	6,163	3,501	57%
Total										6,163	3,501	57%

The annual lighting hours of operation verified during the M&V site visit (533) are fewer than the annual hours of operation used to calculate ex ante savings (1,000).

A heating and cooling interactive factor of 1.14, applicable to a gas heated, air conditioned community assembly facility in Cape Girardeau, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[119]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 57%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	6,163	3,501	57%	0.67
Total		6,163	3,501	57%	0.67

[119] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6182

Data Collection

The participant received SBDI lighting and miscellaneous incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed six photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/06/18 and 08/01/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replac T12 Lamp	3026	Lighting	SBDI	30	30	164	60	3,832	1.11	29,004	13,211	46%
301037-Lighting-LED <=20 Watt Lamp Replac Halogen A >=40 W Lamp	3011			1	1	43	8	171	1.11	48	7	14%
306141-Lighting-LED Lamp Replac Exterior 24/7 HID Lamp	3004-2	Misc.		1	1	205	38	4,310	1.00	1,451	720	50%
301037-Lighting-LED <=20 Watt Lamp Replac Halogen A >=40 W Lamp	3011	Lighting		6	6	43	6	1,555	1.11	611	381	62%
306142-Lighting-LED Lamp Replac T12 Lamp	3026			5	5	227	60	3,432	1.00	2,203	2,866	130%
Total										33,317	17,184	52%

The annual lighting hours of operation verified during the M&V site visit for the first four line items in the table above (3,832, 171, 4,310, and 1,556, respectively) are fewer than the hours of operation used to calculate ex ante savings (8,688, 1,320, 8,688, and 2,642, respectively. The fifth line item has annual hours (3,532) which is greater than the ex ante estimate hours (2,466).

An adjusted base wattage of 43W was used for the second and fourth line items in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office in Cape Girardeau, was applied to the ex post lighting energy savings. A factor of 1.00 was used in

unconditioned shop area and exterior spaces. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[120] The third line item in the table above operates on a photo-cell with an end use of exterior lighting while the ex ante savings had an end use of miscellaneous implying 24/7 usage.

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 52%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 88% of the installed measures and underestimated heating and cooling interactive effects for 98% of the project.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	31,866	16,464	52%	3.13
	Exterior Lighting	1,451	720	50%	0.04
Total		33,317	17,184	52%	3.13

[120] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6184

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/06/18 and 08/01/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixtu Replac T12 Lamp or Fixture	3026	Lighting	SBDI	4	4	164	60	3,600	1.11	3,590	1,655	46%
				4	4	82	30	3,314	1.00	1,794	689	38%
306141-Lighting-LED Lamp Fixt Replac Garage or Exterior 24/7 HID Lamp Fixt	3004-2	Ext Lighting		4	4	205	38	4,310	1.00	5,803	2,879	50%
306140-Lighting-LED Lamp Fixt Replac Interior HID Lamp Fixt	3004-1	Lighting		18	18	295	93	4,236	1.00	31,373	15,400	49%
306142-Lighting-LED Lamp Fixt Replacing T12 Lamp or Fixture	3026			7	7	227	60	3,969	1.00	10,087	4,640	46%
301037-Lighting-LED <=20WLamp or Fixt Replacing HalogenA >=40W Lamp or Fixture	3011			1	1	72	11	1,258	1.00	129	77	60%
Total										52,776	25,341	48%

The annual lighting hours of operation verified during the M&V site visit (3,600, 3,314, 4,310[121], 4,236, 3,969, and 1,258, respectively) are fewer than the annual hours of operation used to calculate ex ante savings (for the first five line items 8,064 and 2,040 for the sixth line item).

An adjusted base wattage of 72W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 100W incandescent lamp for the sixth line item above. The ex ante base wattage of 70W was computed within the application by factoring 70% of a 100W incandescent lamp.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office in Cape Girardeau, was applied to the ex post lighting energy savings for the office area. A factor of

[121] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php

1.00 was applied to the shop and exterior measures since they were unconditioned. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[122]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 48%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours. The estimate was also premised on overestimated heating and cooling interactive effects for 89% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	46,973	22,461	48%	4.27
	Exterior Lighting	5,803	2,879	50%	0.02
Total		52,776	25,341	48%	4.28

[122] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6187

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/12/18 and 08/06/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp Replac T8 Lamp	3025	Lighting	SBDI	24	24	114	44	3,567	1.01	4,511	6,063	134%
306142-Lighting-LED Lamp Replac T12 Lamp	3026			10	10	164	56	2,855	1.01	2,900	3,120	108%
306143-Lighting-LED Lamp Replac T8 Lamp	3025			2	2	59	22	1,146	1.01	199	86	43%
Total										7,610	9,269	122%

The annual lighting hours of operation verified during the M&V site visit for the first two line items in the above table (3,567 and 2,855, respectively) are greater than the annual hours of operation used to calculate ex ante savings (2,510). The third line item has fewer hours (1,146) and was installed within restrooms.

A heating and cooling interactive factor of 1.01, applicable to an electric heated, air conditioned small office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[123]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 122%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for 94% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	7,610	9,269	122%	1.76
Total		7,610	9,269	122%	1.76

[123] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6189

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/14/18 and 08/08/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	11	11	164	48	1,433	1.11	498	2,022	406%
				11	11	138	44	185	1.00	403	191	47%
Total										901	2,213	246%

The annual lighting hours of operation verified during the M&V site visit for the first line item (1,433) are greater than the annual hours of operation used to calculate ex ante savings (364). The second line item has fewer hours of operation (185) and were located in storage rooms.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office in St. Louis, was applied to the ex post lighting energy savings. A factor of 1.00 was used in unconditioned storage areas of the facility. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[124]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 246%. The ex ante energy savings estimate for 50% of the measures were premised on underestimated annual lighting operating hours and overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	901	2,213	246%	0.42
Total		901	2,213	246%	0.42

[124] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6190

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/27/18 and 8/27/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	11	11	164	48	2,462	1.11	3,194	3,474	109%
				8	8	138	44	2,513	1.00	1,882	1,890	100%
Total										5,076	5,364	106%

The annual lighting hours of operation verified during the M&V site visit for the first and second line item in the table above (2,462 and 2,513, respectively) are greater than the annual hours of operation used to calculate ex ante savings (2,340).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office in St. Louis, was applied to the ex post lighting energy savings of the first line item in the above table. A factor of 1.00 was used in the unconditioned storage areas pertaining to the second line item. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[125]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 106%. The ex ante energy savings estimate was premised upon underestimated annual lighting operating hours and underestimated heating and cooling interactive effects for the first line item.

[125] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	5,076	5,364	106%	1.02
Total		5,076	5,364	106%	1.02

Site ID 6194

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/17/18 and 08/13/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	83	83	138	86	2,899	1.09	12,718	13,682	108%
				1	1	164	60	439	1.10	111	50	45%
				6	6	82	30	2,033	1.10	334	700	210%
Total										13,163	14,433	110%

The annual lighting hours of operation verified during the M&V site visit for the first and third line items in the table above (2,899 and 2,033, respectively) are greater than the hours of operation used to calculate ex ante savings (2,754 and 1,000, respectively). The second line item had hours of operation (439) fewer than the ex ante hours estimate (1,000).

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air-conditioned large retail facility in St. Louis, was applied to the ex post lighting energy savings. A factor of 1.00 was used for 9.6% of the measures in the first line item, as they were unconditioned spaces. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[126]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 110%. The ex ante energy savings estimate on 99% of the installed measures were premised on underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	13,163	13,350	14,433	110%
Total		13,163	13,350	14,433	110%

[126] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6196

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/17/18 and 08/13/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	6	6	82	22	2,236	1.00	1,082	805	74%
				24	24	138	44	2,236	1.00	6,778	5,045	74%
Total										7,860	5,850	74%

The annual lighting hours of operation verified during the M&V site visit (2,236) are fewer than the annual hours of operation used to calculate ex ante savings (2,808).

A heating and cooling interactive factor of 1.00, applicable to a non-conditioned space was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[127]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 74%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	7,860	5,850	74%	1.11
Total		7,860	5,850	74%	1.11

[127] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6199

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/19/18 and 08/15/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp Replacing T8 Lamp	3025	Lighting	SBDI	3	3	56	30	920	1.11	118	80	67%
				34	34	114	34	1,434	1.11	4,086	4,319	106%
Total										4,204	4,399	105%

The annual lighting hours of operation verified during the M&V site visit for the first line item in the table above (920) are fewer than the annual hours of operation used to calculate ex ante savings (1,404). While the second line item has slightly greater hours of operation (1,434).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small retail in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[128]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 105%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for 92% of the installed measures and underestimated heating and cooling interactive effects for the project.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	4,204	4,399	105%	0.84
Total		4,204	4,399	105%	0.84

[128] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6201

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed seven photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/21/18 and 08/20/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replac T12 Lamp	3026	Lighting	SBDI	29	29	138	44	820	1.10	3,033	2,462	81%
306143-Lighting-LED Lamp Replac T8 Lamp	3025			58	58	114	44	1,657	1.12	4,518	7,522	166%
Total										7,551	9,983	132%

The annual lighting hours of operation verified during the M&V site visit for the second line item (1,657) are greater than the annual hours of operation used to calculate ex ante savings (1,040). The first line item has fewer hours of operation (820).

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air conditioned fast food restaurant in St. Louis, was applied to the ex post lighting energy savings. A factor of 1.00 was given to measures installed in unconditioned spaces. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[129]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 132%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for 67% of the installed measures and underestimated heating and cooling interactive effects for 95% of the measures.

[129] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	7,551	9,983	132%	1.90
Total		7,551	9,983	132%	1.90

Site ID 6203

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/13/18 and 08/06/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replaci T12 Lamp	3026	Lighting	SBDI	41	41	164	40	2,645	1.09	9,792	14,725	150%
301037-Lighting-LED <=20W Lamp Replac Halogen A >=40 Watt Lamp	3011			7	7	43	9	2,746	1.09	445	716	161%
300938-Lighting-LED <=14W Lamp Replac Halogen BR/R Lamp	3007			15	15	75	8	3,951	1.09	1,936	4,348	225%
306142-Lighting-LED Lamp Replac T12 Lamp	3026			1	1	82	30	2,746	1.09	101	156	155%
201316-Lighting-LED Replacing Incand Exit Sign	793			7	7	40	4	8,760	1.09	2,362	2,417	102%
306142-Lighting-LED Lamp Replac T12 Lamp	3026			2	2	82	14	2,073	1.09	146	309	211%
Total										14,782	22,671	153%

The annual lighting hours of operation verified during the M&V site visit for the fifth line item in the table above (8,760) corresponds with the ex ante savings hours of operation. The remaining measures had hours of operation (ranging from 2,073 to 3,951) which were greater than the annual hours of operation used to calculate ex ante savings (1,800 for the first four lines and 1,000 for the sixth line item).

An adjusted base wattage of 43W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[130]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 153%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	14,782	22,671	153%	4.31
Total		14,782	22,671	153%	4.31

[130] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6204

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/19/18 and 08/15/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	7	7	82	22	2,217	1.11	819	1,030	126%
				30	30	138	44	2,432	1.07	5,492	7,366	134%
				24	24	164	44	3,184	1.11	5,609	10,142	181%
Total										11,920	18,538	156%

The annual lighting hours of operation verified during the M&V site visit (ranging from 2,217 and 3,184) are greater than the annual hours of operation used to calculate ex ante savings (1,820).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned small office in St. Louis, was applied to the ex post lighting energy savings for the office and work areas. A factor of 1.00 was given to 30% of the measures in the second line item, because the measures are installed in unconditioned spaces. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[131]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 156%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for the project and underestimated heating and cooling interactive effects for 51% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	11,920	18,538	156%	3.52
Total		11,920	18,538	156%	3.52

[131] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6206

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/14/18 and 08/08/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	14	14	138	44	1,203	1.00	760	1,583	208%
Total										760	1,583	208%

The annual lighting hours of operation verified during the M&V site visit (1,203) are greater than the annual hours of operation used to calculate ex ante savings (540).

A heating and cooling interactive factor of 1.00, applicable to a gas heated, unconditioned storage facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[132]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 208%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	760	1,583	208%	0.30
Total		760	1,583	208%	0.30

[132] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6208

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/14/18 and 08/08/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025	Lighting	SBDI	104	104	32	17	2,506	1.11	4,219	4,323	102%
Total										4,219	4,323	102%

The annual lighting hours of operation verified during the M&V site visit (2,506) are fewer than the annual hours of operation used to calculate ex ante savings (2,528).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[133]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 102%.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	4,219	4,323	102%	0.82
Total		4,219	4,323	102%	0.82

[133] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6209

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/18/18 and 8/13/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	2	2	82	22	5,567	1.00	200	668	334%
				6	6	164	44	1,647	1.04	1,202	1,227	102%
				13	13	138	44	2,374	1.00	2,040	2,901	142%
Total										3,442	4,797	139%

The annual lighting hours of operation verified during the M&V site visit (ranging from 1,647 and 5,567) are greater than the annual hours of operation used to calculate ex ante savings (1,560).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office in St. Louis, was applied to the ex post lighting energy savings for a third of the second line item in the above table. The remaining measures were installed within unconditioned spaces and a factor of 1.00 was used. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[134]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 139%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	3,442	4,797	139%	0.91
Total		3,442	4,797	139%	0.91

[134] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6211

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/17/18 and 08/13/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp Replac T8 Lamp	3025	Lighting	SBDI	60	60	59	22	4,693	1.10	5,559	11,497	207%
306140-Lighting-LED Lamp Replac Interior HID Lamp	3004-1			4	4	210	60	3,996	1.10	1,502	2,646	176%
306143-Lighting-LED Lamp Replacing T8 Lamp	3025			6	6	114	44	3,158	1.10	1,052	1,464	139%
				1	1	32	22	3,994	1.10	26	44	170%
Total										8,139	15,651	192%

The annual lighting hours of operation verified during the M&V site visit (ranging from 3,158 and 4,693) are greater than the annual hours of operation used to calculate ex ante savings (2,340).

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air conditioned small retail in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[135]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 192%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	8,139	15,651	192%	2.97
Total		8,139	15,651	192%	2.97

[135] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6224

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/19/18 and 08/16/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replac T12 Lamp	3026	Lighting	SBDI	8	8	138	44	2,300	1.04	1,882	1,799	96%
306143-Lighting-LED Lamp Replac T8 Lamp	3025			9	9	59	24	2,731	1.00	790	860	109%
306142-Lighting-LED Lamp Replac T12 Lamp	3026			2	2	82	24	2,489	1.11	291	319	110%
Total										2,963	2,978	101%

The annual lighting hours of operation verified during the M&V site visit for the first line item (2,300) are fewer than the annual hours of operation used to calculate ex ante savings (2,340). The second and third line item has greater hours of operation (2,731 and 2,489, respectively).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office in St. Louis, was applied to the ex post lighting energy savings for the interior office space. A factor of 1.00 was used for unconditioned spaces. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[136]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 101%.

[136] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	2,963	2,978	101%	0.57
Total		2,963	2,978	101%	0.57

Site ID 6226

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/20/18 and 08/15/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp Replac T8 Lamp	3025	Lighting	SBDI	10	10	114	44	2,406	1.00	1,753	1,684	96%
306142-Lighting-LED Lamp Replac T12 Lamp	3026			4	4	164	44	2,348	1.05	1,202	1,187	99%
				2	2	82	24	1,471	1.00	291	171	59%
Total										3,246	3,042	94%

The annual lighting hours of operation verified during the M&V site visit for the first two line items in the table above (2,406 and 2,348, respectively) are greater than the annual hours of operation used to calculate ex ante savings (2,340). The third line item has fewer hours of operation (1,471) and was installed in a storage area.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office in St. Louis, was applied to the ex post lighting energy savings for the office space. A factor of 1.00 was used for unconditioned spaces. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[137]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 94%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for the third measure above and overestimated heating and cooling interactive effects for the majority of the project.

[137] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	3,246	3,042	94%	0.58
Total		3,246	3,042	94%	0.58

Site ID 6227

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/28/2018 and 8/27/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	2	2	122	54	1,130	1.10	515	170	33%
				1	1	122	54	1,130	1.10	258	85	33%
				22	22	122	36	1,640	1.10	7,172	3,424	48%
				5	5	122	36	4,233	1.10	1,288	2,009	156%
				33	33	164	36	3,970	1.10	16,014	18,504	116%
				15	15	122	36	3,970	1.10	4,891	5,651	116%
				3	3	164	36	4,233	1.10	1,455	1,794	123%
				2	2	82	30	3,970	1.10	394	456	116%
				2	2	82	30	1,130	1.10	394	130	33%
Total										32,381	32,222	100%

The annual lighting hours of operation verified during the M&V site visit for the first, second, third, and ninth line items in the above table (1,130, 1,130, 1,640, and 1,130, respectively) are fewer than the annual hours of operation used to calculate ex ante savings (3,543). The verified hours for the fourth through eighth line items (ranging from 3,970 to 4,233) are greater than those used to calculate ex ante savings (3,543).

The efficient wattage of the fourth line item in the above table (36) verified during the M&V site visit is less than the efficient wattage used to calculate ex ante savings (54). Two lamps had been installed per fixture, instead of three lamps per fixture as stated in the application.

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air conditioned large retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[138]

[138] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 100%.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	32,381	32,222	100%	6.12
Total		32,381	32,222	100%	6.12

Site ID 6229

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed one photo-sensor logger to monitor lighting operation. The photo-sensor logger collected data between 7/24/18 and 8/20/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	24	24	138	44	6,746	1.11	13,180	16,856	128%
Total										13,180	16,856	128%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (5,460). The ex ante savings estimate did not account for (8) lamps that were determined to be operational 24/7.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[139]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 128%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	13,180	16,856	128%	3.20
Total		13,180	16,856	128%	3.20

[139] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6230

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed one photo-sensor logger to monitor lighting operation. The photo-sensor logger collected data between 7/24/18 and 8/20/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025	Lighting	SBDI	32	32	114	64	5,835	1.11	8,101	10,340	128%
Total										8,101	10,340	128%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (4,732). The ex ante savings estimate did not account for (8) lamps that were determined to be operational 24/7.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[140]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 128%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and heating and cooling interactive effects.

[140] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	8,101	10,340	128%	1.96
Total		8,101	10,340	128%	1.96

Site ID 6231

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed one photo-sensor logger to monitor lighting operation. The photo-sensor logger collected data between 7/21/18 and 8/20/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	16	16	138	44	3,650	1.00	3,766	5,490	146%
Total										3,766	5,490	146%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (2,340). The ex ante savings estimate did not account for (2) lamps that were determined to operate 24/7.

No heating and cooling interactive effects were accounted for due to gas heating, no cooling in the shop. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[141]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 146%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	3,766	5,490	146%	1.04
Total		3,766	5,490	146%	1.04

[141] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6239

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed one photo-sensor logger to monitor lighting operation. The photo-sensor logger collected data between 7/26/18 and 8/22/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Fixt Replac T12 Lamp Fixt	3026	Lighting	SBDI	13	13	138	44	3,282	1.11	4,488	4,441	99%
306143-Lighting-LED Lamp Fixt Replac T8 Lamp Fixt	3025			3	3	59	22	6,934	1.11	407	852	209%
Total										4,895	5,294	108%

The annual lighting hours of operation verified during the M&V site visit for the first line item in the table above (3,282) are fewer than the annual hours of operation used to calculate ex ante savings (3,432). The hours for the second line item (6,934) are greater due to the ex ante savings estimate not accounting for (2) lamps that were determined to operate 24/7.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[142]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 108%. The ex ante energy savings estimate did not account for lighting that operates 24/7, and underestimated heating and cooling interactive effects.

[142] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	4,895	5,294	108%	1.01
Total		4,895	5,294	108%	1.01

Site ID 6240

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/28/18 and 8/27/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Fixt Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	68	68	164	46	2,757	1.11	19,318	24,468	127%
201316-Lighting-LEDElectroluminescent Replac Incand Exit Sign	793			2	2	30	3	8,760	1.11	505	523	104%
301037-Lighting-LED<=20WLamp Fixt Replacing HalogenA >=40 W Lamp Fixture	3011			9	9	43	9	1,818	1.11	715	615	86%
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026			3	3	56	18	845	1.11	462	107	23%
				1	1	138	46	60	1.11	221	6	3%
				4	4	82	23	60	1.11	568	16	3%
Total										21,789	25,735	118%

The annual lighting hours of operation verified during the M&V site visit for the first two line items in the above table (2,757 and 8,760, respectively) are greater than the annual hours of operation used to calculate ex ante savings (2,250 and 8,736, respectively). The verified hours for the remaining line items (ranging from 60 – 1,818) are fewer than those used to calculate ex ante savings (2,250).

The ex ante savings estimate used an adjusted base wattage of 42W for the third line item in the above by multiplying the provided wattage by 70%. An adjusted base wattage of 43W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp.

The baseline wattage verified during the M&V site visit and used for the ex post savings for the fourth line item in the above table (56W) was less than the wattage used to calculate ex ante savings (82W). The baseline lamps were 2' T12s and not 2' U-tube lamps.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[143]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 118%. The ex ante savings estimate was premised upon underestimated annual lighting operating hours for the first two line items in the above table and underestimated heating and cooling interactive factor for the project.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	21,789	25,735	118%	4.89
Total		21,789	25,735	118%	4.89

[143] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6241

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/28/2018 and 8/27/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp Fixture Replacing T8 Lamp or Fixture	3025	Lighting	SBDI	27	27	114	46	2,261	1.11	4,420	4,592	104%
301037-Lighting-LED <=20 W Lamp or Fixture Replacing Halogen A >=40 Watt Lamp Fixture	3011			9	9	43	9	1,392	1.11	715	471	66%
201316-Lighting-LED or Electroluminescent Replac Incand Exit Sign	793			3	3	30	3	8,760	1.11	757	785	104%
Total										5,892	5,848	99%

The annual lighting hours of operation verified during the M&V site visit for the first and third line items in the above table (2,261 and 8,760, respectively) are greater than the annual hours of operation used to calculate ex ante savings (2,250 and 8,736, respectively). The verified hours for the second line item (1,392) are fewer than those used to calculate ex ante savings (2,250).

The ex ante savings estimate used an adjusted base wattage of 42W for the second line item in the above table by multiplying the provided wattage by 70%. An adjusted base wattage of 43W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling interactive factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[144]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 99%.

[144] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	5,892	5,848	99%	1.11
Total		5,892	5,848	99%	1.11

Site ID 6245

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/26/18 and 8/22/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp Replac T8 Lamp	3025	Lighting	SBDI	20	20	114	68	5,626	1.07	5,414	5,532	102%
301037-Lighting-LED <=20W Lamp Replac HalogenA >=40WLamp	3011			4	4	43	9	121	1.05	311	17	6%
306143-Lighting-LED Lamp Replac T8 Lamp	3025			10	10	114	34	2,299	1.11	1,883	2,034	108%
Total										7,608	7,584	100%

The annual lighting hours of operation verified during the M&V site visit for the first and third line items in the table above (5,626 and 2,299, respectively) are greater than the annual hours of operation used to calculate ex ante savings (5,500 and 2,200, respectively). The annual hours of operation for the second line item (121) are fewer than the ex antes savings estimate (2,200) and were installed in areas with little usage.

An adjusted base wattage of 43W was used in the ex post savings analysis for the second line item to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office in St. Louis, was applied to the ex post lighting energy savings. A factor of 1.00 was applied to unconditioned spaces where measures from both the first and second line items were installed. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[145]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 100%.

[145] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	7,608	7,584	100%	1.44
Total		7,608	7,584	100%	1.44

Site ID 6246

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/26/18 and 8/22/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	38	38	164	40	2,434	1.11	11,092	12,683	114%
Total										11,092	12,683	114%

The annual lighting hours of operation verified during the M&V site visit (2,434) are greater than the annual hours of operation used to calculate ex ante savings (2,200).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[146]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 114%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	11,092	12,683	114%	2.41
Total		11,092	12,683	114%	2.41

[146] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6247

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/27/18 and 8/27/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp Replacing T8 Lamp	3025	Lighting	SBDI	8	8	114	40	2,252	1.11	1,564	1,477	94%
306142-Lighting-LED Lamp Replacing T12 Lamp	3026			48	48	138	44	2,252	1.11	11,920	11,255	94%
Total										13,484	12,732	94%

The annual lighting hours of operation verified during the M&V site visit (2,252) are fewer than the annual hours of operation used to calculate ex ante savings (2,469).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[147]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 94%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	13,484	12,732	94%	2.42
Total		13,484	12,732	94%	2.42

[147] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6249

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed nine photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/31/18 and 8/29/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Fixture Replac T12 Lamp Fixture	3026	Lighting	SBDI	3	3	82	34	194	1.14	7	32	455%
301037-Lighting-LED <=20 W Lamp Fixt Replac Halogen A >=40 Watt Lamp Fixture	3011			23	23	43	15	1,050	1.14	797	713	90%
306142-Lighting-LED Lamp Fixture Replac T12 Lamp Fixture	3026			4	4	164	68	980	1.14	493	395	80%
				3	3	82	36.23	1,634	1.14	339	255	75%
				1	1	164	68	1,549	1.14	226	169	75%
301039-Lighting-LED <=20 Watt Lamp Fixture Replacing Halogen PAR Lamp Fixture	3008			20	20	150	20	358	1.14	1,000	1,059	106%
301037-Lighting-LED <=20 Watt Lamp Fixture Replac Halog A>=40 Watt Lamp Fixture	3011			10	10	43	15	761	1.14	347	218	63%
301039-Lighting-LED <=20 Watt Lamp Fixture Replacing Halogen PAR Lamp Fixture	3008			2	2	29	7	358	1.14	24	18	75%
				19	19	72	16	946	1.14	1,317	1,052	80%
301037-Lighting-LED <=20 Watt	3011			8	8	43	6.5	1,676	1.14	277	557	201%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
Lamp Fixture Replacing Halogen A >=40 Watt Lamp Fixture				10	10	29	9	358	1.14	111	81	73%
Total										4,938	4,550	92%

The annual lighting hours of operation verified during the M&V site visit for the first and tenth line items in the table above (194 and 1,676, respectively) are greater than the annual hours of operation used to calculate ex ante savings (50 and 1,200, respectively). The annual hours for the remaining line items (ranging from 358 – 1,634) were fewer than the ex ante savings estimate hours (ranging from 550 - 2,200).

An adjusted base wattage of 43W was used in the ex post savings analysis for the second, seventh and tenth line items in the table above to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp. An adjusted base wattage of 29W was used in the ex post savings analysis for the eighth and eleventh line items to meet the EISA 2007 standard lumen equivalent for a 40W incandescent lamp. The ex ante base wattage of 28W was computed within the application by factoring 70% of a 40W incandescent lamp. An adjusted base wattage of 72W was used in the ex post savings analysis for the ninth line item to meet the EISA 2007 standard lumen equivalent for a 100W incandescent lamp. The ex ante base wattage of 70W was computed within the application by factoring 70% of a 100W incandescent lamp.

The ex ante savings estimate referenced a base wattage of 105W regarding the sixth line item in the table above by factoring 70% of 150W incandescent lamp. No adjustment was made in the ex post savings due to 150W incandescent lamps not qualifying for EISA 2007 adjustments.

During the M&V visit, ADM determined that 36.23W LED strip lighting fixtures were installed regarding the fourth line item in the table above. The ex ante savings estimate references 34W 4’ 2L LED fixtures. ADM also determined that 6.5W LED A-line lamps were installed regarding the tenth line item. The ex ante savings estimate references 15W LED A-line lamps. The 15W lamps were not compatible according to facility personnel.

A heating and cooling interactive factor of 1.14, applicable to a gas heated, air conditioned assembly facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[148]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 92%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 89% of the installed measures.

[148] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	4,938	4,550	92%	0.86
Total		4,938	4,550	92%	0.86

Site ID 6251

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/2/2018 and 9/12/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	5	5	82	34	3,205	1.11	385	851	221%
306140-Lighting-LED Lamp or Fixture Replacing Interior HID Lamp or Fixture	3004-1			1	1	1,080	68	3,313	1.00	541	3,353	620%
				10	10	1,080	162	3,313	1.00	9,823	30,412	310%
				3	3	1,080	46	3,313	1.00	2,656	10,277	387%
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026			1	1	227	86	3,257	1.11	227	508	224%
301037-Lighting-LED <=20 Watt Lamp Fixt Replacing Halogen A >=40 W Lamp or Fixt	3011			6	6	53	9	224	1.11	140	65	47%
Total										13,772	45,466	330%

The annual lighting hours of operation verified during the M&V site visit for the sixth line item in the above table (224) are fewer than the annual hours of operation used to calculate ex ante savings (500). This measure was installed within restrooms. The verified hours for the first through fifth line items (ranging from 3,205 to 3,313) are greater than those used to calculate ex ante savings (1,500, 500, 1,000, 800, and 1,500, respectively). The hours used to calculate ex ante savings are fewer than the facility's posted annual hours of operation (3,458).

The ex ante savings estimate used an adjusted base wattage of 52.5W for the sixth line item in the above table by multiplying the provided wattage by 70%. An adjusted base wattage of 53W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 75W incandescent lamp.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office in St. Louis, was applied to the ex post lighting energy savings of the first, fifth, and sixth line items in

the above table. A factor of 1.00, applicable to a gas heated, non-air conditioned facility in St. Louis, was applied to the ex post savings of the remaining three line items. The ex ante savings estimate accounted for a heating and cooling interactive factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[149]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 330%. The ex ante energy savings estimate was premised upon underestimated annual operating hours for first five line items in the above table.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	13,772	45,466	330%	8.64
Total		13,772	45,466	330%	8.64

[149] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6253

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/02/18 and 9/12/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp Fixt Replac T8 Lamp Fixt	3025	Lighting	SBDI	4	4	59	22	203	1.11	444	33	7%
306142-Lighting-LED Lamp Fixt Replac T12 Lamp Fixt	3026			2	2	138	44	203	1.11	564	42	7%
306143-Lighting-LED Lamp Fixt Replac T8 Lamp Fixt	3025			29	29	114	23	1,657	1.11	7,830	4,838	62%
Total										8,838	4,913	56%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours were fewer than those used to develop the ex ante energy savings estimates (2,804). The first and second line items in the table above were installed in a low usage basement location.

During the M&V visit, ADM determined the fixture referenced in the third line item in the table above contained (2) 11.5W lamps, giving a fixture wattage of 23W. The ex ante savings estimate referenced a fixture wattage of 24W.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[150]

[150] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 56%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	8,838	4,913	56%	0.93
Total		8,838	4,913	56%	0.93

Site ID 6271

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed ten photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 9/20/2018 and 10/15/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp ReplacT8Lamp	3025	Lighting	SBDI	39	39	114	34	2,172	1.01	8,853	6,857	77%
306140-Lighting-LED Lamp Replac Interior HID Lamp	3004-1			27	27	460	100	5,540	1.00	40,978	53,848	131%
306143-Lighting-LED Lamp ReplacT8Lamp	3025			1	1	88	30	2,281	1.01	165	134	81%
306142-Lighting-LED LampRepla T12Lamp	3026			9	9	164	34	2,238	1.01	3,320	2,649	80%
306140-Lighting-LED Lamp Replac Int HID	3004-1			6	6	460	54	832	1.00	10,270	2,027	20%
306143-Lighting-LED Lamp ReplacT8Lamp	3025			18	18	88	36	2,199	1.01	2,656	2,083	78%
300938-Lighting-LED <=14W Lamp Replac Halogen BR/R Lamp	3007			6	6	65	8	2,281	1.01	970	789	81%
306143-Lighting-LED Lamp ReplacT8Lamp	3025			6	6	56	30	12	1.01	443	2	0%
301037-Lighting-LED <=20W Lamp Replac HalogenA >40WLamp	3011			8	8	43	9	1,679	1.01	749	462	62%
Total										68,404	68,851	101%

The annual lighting hours of operation verified during the M&V site visit for the second line item in the above table (5,540) are greater than the annual hours of operation used to calculate ex ante savings (3,940). The verified hours for the remaining line items (ranging from 12 – 2,281) are fewer than those used to calculate ex ante savings (ranging from 2,652 – 3,940).

The ex ante savings estimate used an adjusted base wattage of 42W for the ninth line item in the above table by multiplying the provided wattage by 70%. An adjusted base wattage of 43W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp.

A heating and cooling interactive factor of 1.01, applicable to an electrically heated, air conditioned small office in St. Louis, was applied to the ex post savings. The warehouse areas were not conditioned and a actor of 1.00 was applied to the ex post savings analysis. The ex ante savings estimate accounted for a heating and cooling interactive factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[151]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 101%.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	68,404	68,851	101%	13.08
Total		68,404	68,851	101%	13.08

[151] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6274

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/30/2018 and 10/1/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	23	23	164	29	653	1.11	14,286	2,244	16%
				4	4	82	36	2,057	1.11	847	419	49%
				3	3	82	29	3,022	1.11	732	531	73%
				22	22	164	49	2,756	1.11	11,641	7,711	66%
Total										27,506	10,905	40%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours were fewer those used to develop the ex ante energy savings estimates (4,300). Ambient sunlight provides sufficient lighting and during the M&V site visit employees were unaware of the light switch locations because they never need lighting turned on.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small office in St. Louis, was applied to the ex post energy savings of the four line items in the above table. The ex ante savings estimate accounted for a heating and cooling interactive factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[152]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 40%. The ex ante energy savings estimate was premised upon overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	27,506	10,905	40%	2.07
Total		27,506	10,905	40%	2.07

[152] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6275

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/23/18 and 9/17/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	3	3	82	22	4,715	1.11	982	940	96%
				42	42	138	44	4,717	1.11	21,527	20,626	96%
Total										22,509	21,566	96%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours were fewer than those used to develop the ex ante energy savings estimates (5,096).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[153]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 96%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

[153] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	22,509	21,566	96%	4.10
Total		22,509	21,566	96%	4.10

Site ID 6276

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 9/12/18 and 10/01/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	1	1	138	44	1,914	1.10	221	197	89%
				29	29	276	86	1,957	1.10	12,971	11,821	91%
				21	21	138	43	3,550	1.10	4,696	7,763	165%
Total										17,888	19,781	111%

The annual lighting hours of operation verified during the M&V site visit for the first and second line items in the table above (1,914 and 1,957, respectively) are fewer than the annual hours of operation used to calculate ex ante savings (2,200). The third line item hours (3,550) are greater than the same ex ante hours estimate due to a portion of the installed measures operating 24/7.

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air conditioned storage facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The ex ante building type claimed grocery and convenience. However, the site was a conditioned storage space for antique cars. The client also has the space next door which would have been grocery and convenience but was not part of this project.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[154]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 111%.

[154] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	17,888	19,781	111%	3.76
Total		17,888	19,781	111%	3.76

Site ID 6288

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 9/20/2018 and 10/15/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025	Lighting	SBDI	38	38	56	30	2,212	1.11	2,426	2,417	100%
Total										2,426	2,417	100%

The annual lighting hours of operation verified during the M&V site visit shown in the above table (2,212) are fewer than the annual hours of operation used to calculate ex ante savings (2,295).

A heating and cooling interactive factor of 1.11, applicable to an gas heated, air conditioned small office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling interactive factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[155]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 100%.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	2,426	2,417	100%	0.46
Total		2,426	2,417	100%	0.46

[155] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6293

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 10/02/18 and 10/24/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	Standard	19	19	164	36	4,045	1.01	9,369	9,896	106%
Total										9,369	9,896	106%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (3,600).

A heating and cooling interactive factor of 1.01, applicable to an electrically heated, air conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[156]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 106%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	End Use Category	kWh Savings			Gross Ex Post kW Reduction
		Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross Realization Rate	
Standard	Lighting	9,369	9,896	106%	1.88
Total		9,369	9,896	106%	1.88

[156] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6294

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed one photo-sensor logger to monitor lighting operation. The photo-sensor logger collected data between 10/02/18 and 10/24/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	Standard	7	7	164	36	3,582	1.01	3,452	3,229	94%
Total										3,452	3,229	94%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours were fewer than those used to develop the ex ante energy savings estimates (3,600).

A heating and cooling interactive factor of 1.01, applicable to an electrically heated, air conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[157]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 94%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	3,452	3,229	94%	0.61
Total		3,452	3,229	94%	0.61

[157] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6295

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 10/03/18 and 10/22/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	Standard	11	11	164	36	3,561	1.01	5,423	5,044	93%
Total										5,423	5,044	93%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours were fewer than those used to develop the ex ante energy savings estimates (3,600).

A heating and cooling interactive factor of 1.01, applicable to an electrically heated, air conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[158]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 93%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	End Use Category	kWh Savings			Gross Ex Post kW Reduction
		Ex Ante kWh Savings	Ex Post Gross kWh Saving	Gross Realization Rate	
Standard	Lighting	5,423	5,044	93%	0.96
Total		5,423	5,044	93%	0.96

[158] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6296

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 10/10/18 and 10/29/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	Standard	2	2	164	36	3,153	1.01	987	812	82%
				2	2	82	18	3,153	1.01	492	406	82%
Total										1,479	1,218	82%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours were fewer than those used to develop the ex ante energy savings estimates (3,600).

A heating and cooling interactive factor of 1.01, applicable to an electrically heated, air conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[159]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 82%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	End Use Category	kWh Savings			Gross Ex Post kW Reduction
		Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross Realization Rate	
Standard	Lighting	1,479	1,218	82%	0.23
Total		1,479	1,218	82%	0.23

[159] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6297

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 10/02/18 and 10/24/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	Standard	27	27	164	36	3,655	1.01	13,313	12,706	95%
Total										13,313	12,706	95%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (3,600).

A heating and cooling interactive factor of 1.01, applicable to an electrically heated, air conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[160]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 95%. The ex ante energy savings estimate was premised on overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	13,313	12,706	95%	2.41
Total		13,313	12,706	95%	2.41

[160] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6298

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 10/09/18 and 10/29/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	Standard	31	31	164	36	3,165	1.01	6,369	12,633	198%
				1	1	82	18	14	1.01	103	1	1%
Total										6,472	12,634	195%

The annual lighting hours of operation verified during the M&V site visit for the first line item in the table above (3,165) are greater than the annual hours of operation used to calculate ex ante savings (1,500). The ex ante hours do not represent the posted store hours. The verified annual hours for second line item above has are fewer (14) than the ex ante. The ex ante energy savings estimate did not account for lighting installed in low usage area.

A heating and cooling interactive factor of 1.01, applicable to an electrically heated, air conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[161]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 195%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	End Use Category	kWh Savings			Gross Ex Post kW Reduction
		Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross Realization Rate	
Standard	Lighting	6,472	12,634	195%	2.40
Total		6,472	12,634	195%	2.40

[161] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6299

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 10/09/18 and 10/29/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	Standard	1	1	82	30	4,189	1.11	271	241	89%
200808-Lighting-LED <=13 Watt Lamp Replacing Halogen MR-16 35-50 Watt Lamp or Fixture	3012			4	4	50	7	4,070	1.11	895	775	87%
301039-Lighting-LED <=20 Watt Lamp or Fixture Replacing Halogen PAR Lamp or Fixture	3008			3	3	43	10	4,070	1.11	936	446	99%
				3	3	43	7.7	4,070	1.11		477	
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025			13	13	114	56	3,809	1.11	4,223	3,181	75%
Total										6,325	5,122	81%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours were fewer than those used to develop the ex ante energy savings estimates (4,860).

During the M&V visit, ADM staff determined that three 10W and three 7.7W LEDs were installed in place of six 12W LEDs as shown in the application. This is reflected in the third and fourth line items in the table above.

An adjusted base wattage of 43W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

The quantity of the fifth line item in the table above (13) verified during the M&V site visit is less than the ex ante savings quantity (14).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[162]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 81%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and incorrectly referenced efficient lighting.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	6,325	5,122	81%	0.97
Total		6,325	5,122	81%	0.97

[162] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6300

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 10/10/18 and 10/29/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
301037-Lighting-LED <=20 Watt Lamp or Fixture Replacing Halogen A >=40 Watt Lamp or Fixture	3011	Lighting	Standard	4	4	72	9	4,762	1.11	1,904	1,329	70%
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025			17	17	114	56	4,762	1.11	5,429	5,200	96%
200808-Lighting-LED <=13 Watt Lamp Replacing Halogen MR-16 35-50 Watt Lamp or Fixture	3012			6	6	50	7	4,762	1.11	1,342	1,361	101%
Total										8,675	7,890	91%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours were fewer than those used to develop the ex ante energy savings estimates (4,860).

An adjusted base wattage of 72W was used in the ex post savings analysis for the first line item in the table above to meet the EISA 2007 standard lumen equivalent for a 100W incandescent lamp. The ex ante base wattage of 70W was computed within the application by factoring 70% of a 100W incandescent lamp.

The quantities of the first and second line items in the table above (4 and 17, respectively) verified during the M&V site visit is less than the ex ante savings quantity (6 and 18, respectively).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[163]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 91%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and overestimated installation quantities.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	8,675	7,890	91%	1.50
Total		8,675	7,890	91%	1.50

[163] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6301

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 10/09/18 and 10/29/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025	Lighting	Standard	23	23	114	56	3,664	1.11	7,239	5,414	75%
Total										7,239	5,414	75%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours were fewer than those used to develop the ex ante energy savings estimates (4,860).

The quantity in the table above (23) verified during the M&V site visit is less than the ex ante savings quantity (24).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[164]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 75%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and overestimated installation quantity.

[164] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	7,239	5,414	75%	1.03
Total		7,239	5,414	75%	1.03

Site ID 6317

Data Collection

The participant received Custom and Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed seven photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 11/1/2018 and 12/5/2018

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306140-Lighting-LED Lamp Fixt Replac Interior HID Lamp Fixt	3004-1	Lighting	Standard	9	9	240	150	2,479	1.11	9,591	2,224	23%
100201-Lighting-Non Linear LED Fixture Replacing T12 Fixture	1169		Custom	17	4	56	31	3,849	1.10	2,847	3,517	124%
100204-Lighting-Non Linear LED Fixture Replacing T8 Fixture				10	2	59	154	5,833	1.10	969	1,815	187%
100201-Lighting-Non Linear LED Fixture Replacing T12 Fixture				36	18	164	31	3,849	1.10	18,379	22,710	124%
				88	35	138	31	3,849	1.10	38,020	46,980	124%
				6	1	82	154	2,907	1.10	1,162	1,084	93%
				8	3	82	31	3,849	1.10	1,936	2,392	124%
100208-Lighting-Non Linear LED Replac MH Fixt				2	1	215	154	2,907	1.10	949	885	93%
100201-Lighting-Non Linear LED Fixture Replacing T12 Fixture				31	14	138	154	4,258	1.10	7,295	9,972	137%
				31	16	138	154	3,638	1.10	6,236	7,284	117%
				27	16	164	41	3,874	1.10	12,980	16,142	124%
				25	8	82	41	3,638	1.10	5,926	6,922	117%
				43	8	48	41	1,290	1.10	5,975	2,475	41%
				8	1	28	41	1,290	1.10	630	261	41%
				10	2	46	41	2,907	1.10	1,301	1,214	93%
100208-Lighting-Non Linear LED Fixture Replacing M H Fixture				157	81	455	154	3,966	1.10	202,703	258,074	127%
100201-Lighting-Non Linear LED Fixture Replacing T12 Fixture				49	10	138	154	3,943	1.10	17,953	22,724	127%
100208-Lighting-Non Linear LED Fixture Replacing M H Fixture				21	6	215	154	3,975	1.10	12,346	15,754	128%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
Total										347,198	422,431	122%

The annual lighting hours of operation verified during the M&V site visit for the first, sixth, eighth, thirteenth, fourteenth- and fifteenth-line items in the above table (2,479, 2,907, 2,907, 1,290, 1,290, and 2,907, respectively) are fewer than the annual hours of operation used to calculate ex ante savings (3,213). The verified hours for the remaining line items (ranging from 3,638 to 5,833) are greater than those used to calculate ex ante savings (3,213).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small retail in St. Louis, was applied to the ex post lighting energy savings of the first line item in the above table. A factor of 1.10, applicable to a gas heated, air conditioned large retail in St. Louis, was applied to the ex post energy savings of the remaining line items. The ex ante savings estimate accounted for a heating and cooling interactive factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.165

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 122%. The ex ante energy savings estimate was premised upon underestimated annual lighting operating hours for 91% of the installed measures and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	End Use Category	kWh Savings			Gross Ex Post kW Reduction
		Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross Realization Rate	
Standard	Lighting	9,591	2,224	23%	0.42
Custom		337,607	420,206	124%	79.82
Total		347,198	422,431	122%	80.25

[165] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6329

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixt Replac M H Fixture	1169	Exterior Lighting	Custom	5	5	1,080	360	4,308	1.00	15,768	15,509	98%
100213-Lighting-Non Linear LED Fixt Replac CFL Fixture		Lighting		40	40	42	23	8,760	1.03	7,124	6,882	97%
100216-Lighting-Non Linear LED Fixt Replac Inefficient Light Fixture		Exterior Lighting		13	13	145	36	4,308	1.00	6,206	6,105	98%
100202-Lighting-Non Linear LED Fixt Replac T12 HO Fixt				14	14	207	72	4,308	1.00	8,278	8,142	98%
100213-Lighting-Non Linear LED Fixt Replac CFL Fixture				-	-	29	11	8,760	1.03	2,025	-	0%
				9	9	29	14	4,308	1.00	1,265	582	46%
100216-Lighting-Non Linear LED Fixt Replac Inefficient Light Fixture				1	1	66	24	4,308	1.00	184	181	98%
Total										40,850	37,400	92%

The annual lighting hours of operation for the first, third, fourth, sixth, and seventh line items in the above table using photo cells (4,308[166]) are less than the hours of operation used to calculate ex ante savings (4,380). The remaining line items were found to be operational 24/7, as shown in the application.

[166] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

The lamps referenced in the fifth line item in the table above were not found to be installed during the M&V visit. ADM staff found (9) lamps in a storage location, the remaining (3) were not located.

A heating and cooling interactive factor of 1.03, applicable to an electrically heated, air conditioned restaurant facility in St. Louis, was applied to the ex post lighting energy savings for lighting installed in an interior location. No heating or cooling interactive effects were accounted for regarding lighting installed in exterior locations. The ex ante savings estimate accounted for a heating and cooling factor of 1.07 for interior locations and did not account for heating and cooling effects for exterior locations.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[167] The ex ante savings estimate incorrectly applied the "Lighting" end use category to the sixth line item in the table above. These lamps were installed in an exterior location and the "Exterior Lighting" end use category was applied in this analysis.

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 92%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for the exterior installations and overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Lighting	9,149	6,882	75%	1.31
	Exterior Lighting	31,701	30,518	96%	0.17
Total		40,850	37,400	92%	1.48

[167] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6330

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100203-Lighting-Non Linear LED Fixture Replacing T12 VHO Fixture	1169	Exterior Lighting	Custom	43	43	390	86	4,308	1.00	57,255	56,315	98%
100201-Lighting-Non Linear LED Fixture Replacing T12 Fixture				16	16	200	60	4,308	1.00	9,811	9,650	98%
				11	11	145	72	4,308	1.00	3,517	3,459	98%
Total										70,583	69,425	98%

The annual lighting hours of operation for the line items in the above table using photo cells (4,308[168]) are less than the hours of operation used to calculate ex ante savings (4,380).

No heating or cooling interactive effects were accounted for due to lighting being installed in an exterior location. The ex ante savings estimate did not account for heating and cooling interactive factors.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[169]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

[168] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[169] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	70,583	69,425	98%	0.39
Total		70,583	69,425	98%	0.39

Site ID 6333

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 11/20/2018 and 12/10/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025	Lighting	Standard	20	20	88	60	6,561	1.10	5,297	4,037	76%
				1	1	88	60	6,317	1.10	218	194	89%
				18	18	88	60	6,294	1.10	3,927	3,485	89%
301037-Lighting-LED <=20 Watt Lamp or Fixture Replacing Halogen A >=40 Watt Lamp or Fixture	3011			4	4	43	9	6,131	1.10	206	916	445%
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026			2	2	82	46	5,304	1.15	561	439	78%
Total										10,209	9,073	89%

The annual lighting hours of operation verified during the M&V site visit for the fourth line item in the above table (6,116) are greater than the annual hours of operation used to calculate ex ante savings (1,456). The installation took place within the dining room and restrooms. The verified hours for the remaining line items (6,545, 6,299, 6,282, and 5,304, respectively), are fewer than those used to calculate ex ante savings (7,280).

The baseline and efficient wattages of the first line item in the above table (88W and 60W, respectively), are less than the wattages used to calculate ex ante savings (114W and 80W, respectively). The ex ante calculations claimed four-lamp fixtures, while three-lamp fixtures were verified during the M&V site visit as the baseline and efficient fixtures.

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air conditioned fast-food restaurant in St. Louis, was applied to the ex post lighting energy savings of the first four line items in

the above table. A factor of 1.15, applicable to a low temperature freezer space, was applied to the ex post savings of the last line item. The ex ante savings estimate accounted for a heating and cooling interactive factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[170]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 89%. The ex ante energy savings estimate was premised upon overestimated annual lighting hours of operation for 91% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	10,209	9,073	89%	1.72
Total		10,209	9,073	89%	1.72

[170] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6334

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 11/20/2018 and 12/10/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025	Lighting	Standard	42	42	88	51	6,283	1.10	12,105	10,754	89%
301039-Lighting-LED <=20 Watt Lamp or Fixture Replacing Halogen PAR Lamp or Fixture	3008			4	4	65	12	6,116	1.10	1,652	1,425	86%
Total										13,757	12,178	89%

The annual lighting hours of operation verified during the M&V site visit for the line items in the above table (6,283 and 6,031, respectively) are fewer than the annual hours of operation used to calculate ex ante savings (7,280).

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air conditioned fast-food restaurant in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling interactive factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[171]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 89%. The ex ante energy savings estimate was premised upon overestimated annual lighting operating hours.

[171] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	13,757	12,178	89%	2.31
Total		13,757	12,178	89%	2.31

Site ID 6335

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 11/20/2018 and 12/10/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp Fixt Replac T8 Lamp Fixt	3025	Lighting	Standard	46	46	88	60	5,594	1.10	10,032	7,918	79%
306135-Lighting-LED Lamp Fixt Replac T5 Lamp Fixt	3088			2	2	117	54	8,216	1.29	982	1,335	136%
306143-Lighting-LED Lamp Fixt Replac T8 Lamp Fixt	3025			2	2	59	40	1,428	1.15	296	62	21%
Total										11,310	9,316	82%

The annual lighting hours of operation verified during the M&V site visit for the second line item in the above table (8,173) are greater than the annual hours of operation used to calculate ex ante savings (7,280). The verified hours for the first and third line items (5,567 and 1,422, respectively), are fewer than those used to calculate ex ante savings (7,280).

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air conditioned fast-food restaurant in St. Louis, was applied to the ex post lighting energy savings for the first line item. A factor of 1.29, applicable to a medium temperature refrigerated space, was applied to the ex post savings of the second line item. A factor of 1.15, suited for a low temperature freezer space, was applied to the ex post savings of the third line item. The ex ante savings estimate accounted for a heating and cooling interactive factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[172]

[172] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 82%. The ex ante energy savings estimate was premised upon overestimated annual lighting operating hours for the first and third line items in the above table.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	11,310	9,316	82%	1.77
Total		11,310	9,316	82%	1.77

Site ID 6032

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation and the post-retrofit connected loads. Additionally, ADM staff verified lighting operating schedules, by interviewing facility personnel and installing seven photo-sensor loggers. The photo-sensor loggers collected data between 6/16/18 and 7/11/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Fixture Replacing T12 Lamp Fixture	3026	Lighting	SBDI	62	62	88	30	1,514	1.15	6,926	6,274	91%
306142-Lighting-LED Lamp Fixture Replacing T12 Lamp Fixture	3026			21	21	88	30	2,061	1.15	2,346	2,893	123%
301037-Lighting-LED <=20 Watt Lamp oFixture Replacing HalogenA 40W Lamp Fixture	3011			24	24	53	9	1,398	1.15	1,676	1,701	102%
306142-Lighting-LED Lamp Fixture Replacing T12 Lamp Fixture	3026			2	2	175	30	2,879	1.15	621	962	155%
Total										11,568	11,830	102%

The annual lighting hours of operation verified during the M&V site visit for the first and third lines in the table above (1,514 and 1,398, respectively) are fewer than the annual hours of operation used to calculate ex ante savings (1,800 and 1,500, respectively). For the second and fourth line items the post annual hours of use (2,061 and 2,879, respectively) are greater than the ex ante hours (1,800 and 2,000).

A heating and cooling interactive factor of 1.15, applicable to a gas heated, air-conditioned facilities for assembly in Jefferson City, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[173]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 102%. The ex ante energy savings estimate was premised on slightly overestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	11,568	11,830	102%	2.25
Total		11,568	11,830	102%	2.25

[173] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6034

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation and the post-retrofit connected loads. ADM staff also verified annual lighting operating hours by interviewing facility personnel regarding lighting operating schedules and installing two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 6/12/18 and 7/11/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Fixt Replacing T12 Lamp Fixture	3026	Lighting	SBDI	17	17	227	43	2,910	1.11	5,368	10,143	189%
300938-Lighting-LED <=14 Watt Lamp Fixture ReplacHalo BR/R Lamp Fixture	3007			8	8	65	11	1,692	1.11	742	815	110%
301039-Lighting-LED <=20 Watt Lamp or Fixture ReplacHalogPAR Lamp or Fixture	3008			4	4	70	11	1,692	1.11	405	445	110%
306142-Lighting-LED Lamp Fixt Replacing T12 Lamp or Fixture	3026			2	2	164	30	186	1.11	58	56	96%
301037-Lighting-LED <=20 Watt Lamp or Fixture Replac Halogen A >=40 Watt Lamp or Fixture	3011			5	5	43	10	36	1.11	8	7	83%
Total										6,581	11,465	174%

The annual lighting hours of operation verified during the M&V site visit for the first three line items in the table above (2,910, 1,692, and 1,692, respectively) are greater than the annual hours of operation used to calculate ex ante savings (1,604). The ex ante did not take into consideration continuous use fixtures. The annual hours for the last two line items (186 and 36, respectively) are fewer than the ex ante hours (200 and 50, respectively).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned small retail in Jefferson City, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[174]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 174%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for 81% of the project and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	6,581	11,465	174%	2.18
Total		6,581	11,465	174%	2,18

[174] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6035

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation and the post-retrofit connected loads. ADM staff also verified annual lighting operating hours by interviewing facility personnel regarding the lighting operating schedule and installing two photo-sensor loggers to monitor lighting operations. The photo-sensor loggers collected data between 6/12/18 and 7/11/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Fixt Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	22	22	138	43	3,638	1.11	5,591	8,470	151%
				8	8	164	30	2,131	1.11	2,868	2,545	89%
				3	3	82	15	2,131	1.11	537	477	89%
301037-Lighting-LED <=20 W Lamp Fixture Replac Halogen A >=40W Lamp or Fixture	3011			3	3	43	9	1,541	1.11	264	178	67%
Total										9,260	11,670	126%

The annual lighting hours of operation verified during the M&V site visit for the first line item in the table above (3,638) are greater than the annual hours of operation used to calculate ex ante savings (2,500), while the remaining line items had fewer annual hours (ranging from 1,541 – 2,131). The ex ante did not take into consideration the continuous use fixtures for the first measure.

The efficient lighting wattage of the fourth line item in the above table has been verified as 8.5W, rather than 9W as reported in the final application.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned small retail in Jefferson City, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[175]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 126%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for 61% of the installed measures and underestimated heating and cooling interactive effects.

[175] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	9,262	11,670	126%	2.22
Total		9,262	11,670	126%	2.22

Site ID 6036

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation and the post-retrofit connected loads. ADM staff also determined the lighting operating schedule through interviews with facility personnel regarding lighting operating schedules and installation of three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 6/12/18 and 7/11/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Fixt Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	6	6	164	30	357	1.00	430	287	67%
301037-Lighting-LED <=20 Watt Lamp or Fixture ReplacHalo A 40W Lamp or Fixture	3011			6	6	43	11	39	1.00	4	8	188%
				5	5	53	15	42	1.00	3	8	266%
				5	5	43	9	42	1.00	3	7	242%
Total										440	309	70%

The annual lighting hours of operation verified during the M&V site visit for the first line item in the table above (357) are fewer than the annual hours of operation used to calculate ex ante savings (500). The annual hours for the remaining line items (ranging from 39 – 42) are greater than the ex ante hours (20).

The fourth line item's efficient wattage verified through project invoices and at the M&V site visit is 8.5W, rather than 9W as stated in the final application.

A heating and cooling interactive factor of 1.00, applicable to an unconditioned space in Jefferson City, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07. The space does have cooling capabilities, but they do not utilize it.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[176]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 70%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 27% of the installed measures and overestimated heating and cooling interactive effects.

[176] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	440	309	70%	0.06
Total		440	309	70%	0.06

Site ID 6037

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation and the post-retrofit connected loads. ADM staff also verified the annual lighting operating schedule through interviews with on-site personnel and the installation of two photo-sensor loggers. The photo-sensor loggers collected data between 6/12/18 and 7/11/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	6	6	82	15	3,136	1.11	582	1,405	241%
				4	4	138	43	3,136	1.11	551	1,328	241%
Total										1,133	2,733	241%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours (3,136) exceeded those used to develop the ex ante energy savings estimates (1,354). The ex ante savings estimate did not incorporate that half of the lighting remains on overnight nor did it represent the posted store hours.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned small retail in Jefferson City, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[177]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 241%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

[177] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	1,132	2,733	241%	0.52
Total		1,132	2,733	241%	0.52

Site ID 6042

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed fifteen photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/18/2018 and 9/20/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	30	30	175	30	1,020	1.09	9,309	4,858	52%
				30	30	175	30	955	1.09	9,309	4,550	49%
				30	30	175	30	3,104	1.09	9,309	14,782	159%
				30	30	175	30	583	1.09	9,309	2,776	30%
				29	29	175	30	614	1.09	8,999	2,828	31%
				29	29	175	30	1,357	1.09	8,999	6,245	69%
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp Fixture	3025			40	40	131	28	2,694	1.09	8,817	12,149	138%
306142-Lighting-LED Lamp Fixt Replacing T12 Lamp Fixture	3026			26	26	175	30	475	1.09	8,068	1,959	24%
				18	18	175	30	399	1.09	5,585	1,141	20%
				20	20	175	45	4,715	1.09	5,564	13,421	241%
301037-Lighting-LED 20 WLamp or Fixture Replac Halogen A 40 W Lamp or Fixture	3011			55	55	53	9	3,873	1.09	5,120	10,261	200%
300938-Lighting-LED <=14 Watt Lamp or Fixture Replac Halogen BR/R Lamp Fixt	3007			35	35	65	8	3,178	1.09	4,269	6,941	163%
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp Fixture	3025			19	19	100	28	1,227	1.09	2,928	1,838	63%
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp Fixt	3026			5	5	135	30	399	1.09	1,124	230	20%
				5	5	135	30	399	1.09	1,124	230	20%
				8	8	88	24	2,918	1.09	1,096	1,636	149%
306140-Lighting-LED Lamp or Fixt Replac Interior HID Lamp Fixt	3004-1			5	5	465	80			1,030		0%
301039-Lighting-LED<=20W Lamp Fixture Replacing	3008			6	6	63	11	3,939	1.09	1,002	1,345	134%

Halogen PAR Lamp or Fixture												
306140-Lighting-LED Lamp or Fixture Replacing Interior HID Lamp or Fixture	3004-1			4	4	465	80			824		0%
200808-Lighting-LED <=13 Watt Lamp Replacing HalogMR-16 35-50W Lamp Fixt	3012			5	5	50	7	3,939	1.09	690	927	134%
300938-Lighting-LED <=14 Watt Lamp or Fixture Replac Halogen BR/R Lamp Fixt	3007			6	6	50	7	3,939	1.09	552	1,112	202%
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp Fixture	3025			6	6	64	24	3,939	1.09	514	1,035	201%
301039-Lighting-LED <=20 Watt Lamp or Fixture Replac Halogen PAR Lamp Fixt	3008			3	3	53	8	3,821	1.09	286	565	197%
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp Fixt	3026			2	2	88	24	3,821	1.09	274	535	195%
				2	2	88	30	3,704	1.09	248	470	190%
300938-Lighting-LED <=14 Watt Lamp or Fixture Replac Halogen BR/R Lamp Fixt	3007			2	2	65	8	208	1.09	244	26	11%
Total										104,593	91,861	88%

The annual lighting hours of operation for the first, second, fourth through sixth, eighth, ninth, thirteenth through fifteenth, and twenty-sixth line items in the table above (ranging from 208 to 1,357) are fewer than the annual hours of operation used to calculate ex ante savings (2,000). The verified hours for the remaining line items (ranging from 2,694 to 4,715) are greater than those used to calculate ex ante savings (3,000 for the eighteenth line item, 2,000 for the remaining line items).

During the M&V site visit the client specified that the fixtures for line items seventeen and nineteen had not been utilized in over a decade. It was confirmed that the information had been relayed to the installation team, but the lamps were updated nonetheless.

The ex ante savings estimate used adjusted base wattages of 52.5W for the eleventh and twenty-third line items, and 63W for the eighteenth line item in the above table by multiplying the provided wattages by 70%. An adjusted base wattage of 53W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 75W incandescent lamp.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned education based facility in Jefferson City, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[178]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 88%. The ex ante energy savings estimate was premised upon overestimated annual hours of operation for 52% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	104,593	91,861	88%	17.45
Total		104,593	91,861	88%	17.45

[178] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6043

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules and all areas had continuous usage.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306140-Lighting-LED Lamp Fixt Replac Interior HID Lamp Fixt	3004-1	Lighting	Standard	11	11	295	54	8,760	1.07	24,848	24,963	100%
306143-Lighting-LED Lamp Fixt Replac T8 Lamp Fixt	3025			50	50	114	68	8,760	1.07	21,558	21,658	100%
				50	50	59	34	8,760	1.07	11,717	11,771	100%
				89	89	88	51	8,760	1.07	30,866	31,008	100%
Total										88,989	89,400	100%

The annual lighting hours of operation verified during the M&V site visit (8,760) correspond with the annual hours of operation used to calculate ex ante savings.

A heating and cooling interactive factor of 1.07, applicable to a gas heated, air conditioned hospital in Cape Girardeau, was applied to the ex post lighting energy savings and corresponds with the ex ante savings estimate.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[179]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 100%.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	88,989	89,400	100%	16.98
Total		88,989	89,400	100%	16.98

[179] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6044

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed six photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/05/18 and 5/28/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
015271-LightingNew Efficient Lighting Fixt Replac Exist Inefficient Lighting Fixt	1169	Custom	Lighting	407	763	127	23	5,356	1.09	149,218	196,603	132%
Total										149,218	196,603	132%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours (5,356) exceeded those used to develop the ex ante energy savings estimates (4,500).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned education facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate did not account for heating and cooling interactive factors.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[180]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 132%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Lighting	149,218	196,603	132%	37.35
Total		149,218	196,603	132%	37.35

[180] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6045

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed eight photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/24/18 and 6/13/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
101116-Lighting-New Eff Light Fixture Replac Exist Inefficient Lighting Fixt	1169	Lighting	Custom	496	505	72	31	4,456	1.09	103,077	97,402	94%
Total										103,077	97,402	94%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours (4,456) were fewer than those used to develop the ex ante energy savings estimates (4,500).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned education facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate did not account for heating and cooling interactive factors.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[181]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 94%. The ex ante energy savings estimate was premised on underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Lighting	103,077	97,402	94%	18.50
Total		103,077	97,402	94%	18.50

[181] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6051

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/23/2018 and 6/11/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100104-Lighting-Linear Tube LED Fixture Replacing T8 Fixture	1169	Lighting	Custom	1,084	1,084	59	34	6,515	1.02	167,835	179,477	107%
				238	238	59	34	6,531	1.02	36,849	39,502	107%
Total										204,684	218,979	107%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (5,788). The annual hours used to calculate ex ante energy savings did not represent the posted store hours (6,152).

A heating and cooling interactive factor of 1.02, applicable to an electrically heated, air-conditioned large retail in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[182]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 107%. The ex ante energy savings estimate was premised upon underestimated annual hours of operation.

[182] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Lighting	204,684	218,979	107%	41.60
Total		204,684	218,979	107%	41.60

Site ID 6057

Data Collection

The participant received Standard and Custom lighting incentives.

During the M&V visit, ADM staff verified equipment installation, baseline and the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed sixteen photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/22/18 and 6/11/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixture Replac M H Fixture	1169	Exterior Lighting	Custom	4	4	455	128	4,308	1.00	5,729	5,635	98%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replac T12 <=40W Linear ft	3026	Lighting	Standard	1,474	1,474	40	15	2,282	1.09	157,876	92,077	58%
305801-Lighting-Delamping ReplaT12<=40W	3084			132	132	40	-	4,818	1.09	22,621	27,854	123%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replac T12 <=40 W Linear ft	3026			132	132	40	15	4,818	1.09	14,138	17,409	123%
201010-Lighting-LED <=20 Watt Lamp Replacing HalogenPAR 48 -90WLamp Fixt	3008	Misc.		14	14	65	18	8,760	1.00	5,764	5,764	100%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T12 <=40 W Linear ft	3026	Lighting		40	40	40	15	1,752	1.09	4,284	1,918	45%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025			56	56	32	15	3,985	1.09	4,079	4,153	102%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T12 <=40 W Linear ft	3026			6	6	40	18	1,939	1.09	566	280	50%
				4	4	20	9	2,851	1.09	189	137	73%
Total										215,246	155,228	72%

Lighting Controls Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Quantity*	*Controlled Wattage*	*Baseline Hours*	*Efficient Hours*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
201718-Lighting-Dual Technology Occupancy Sensor Controlling Lighting Circuit >150 Watts	3016	Lighting	Standard	55	150	2,614	1,978	1.09	31,350	5,743	18%
				1	150	2,851	2,529	1.09	570	53	9%
Total									31,920	5,796	18%

The annual lighting hours of operation verified during the M&V site visit for the fifth line item in the table above (8,760) corresponds the annual hours of operation used to calculate ex ante savings. The hours of operation for the first line items in the above table using photo cells (4,308[183]) are less than the hours of operation used to calculate ex ante savings (4,380). The hours of operation for the third- and fourth-line items (4,818) are greater than the ex ante hours (4,004). The remaining measures have hours of operation (ranging from 1,939 to 3,985) which are fewer than the ex ante savings estimate (4,004). The interior ex ante was based on 11 hour days/ seven days a week.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned office in St. Louis was applied to the ex post lighting energy savings for the interior installations. The ex ante savings estimate accounted for heating and cooling interactive factor of 1.07. For the exterior measures the ex post and ex ante used a factor of 1.00.

During the M&V site visit, the baseline behavior for controlling lighting was determined by survey questions per usage area. The survey indicated some efficient behavior with turning off lighting during the workday and at the end of the workday.

The peak coincident kW reduction was determined by applying the corresponding end use kW factor to the kWh savings.[184]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall realization rate is 65%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and a larger impact from the occupancy sensors.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	235,103	149,572	64%	28.41
	Miscellaneous	5,764	5,764	100%	0.80
Custom	Exterior Lighting	5,729	5,635	98%	0.03
Total		246,596	160,971	65%	29.24

[183] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[184] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6065

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed eleven photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 05/11/18 and 5/30/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
100204-Lighting-Non Linear LED Fixture Replacing T8 Fixture	1169	Lighting	Custom	620	620	88	16	5,918	1.09	278,182	289,269	104%
				96	96	88	16	3,087	1.09	43,073	23,361	54%
				74	74	88	16	4,786	1.09	33,202	27,921	84%
				52	52	88	16	5,469	1.09	23,331	22,417	96%
				21	21	88	16	5,478	1.09	9,422	9,069	96%
				20	20	88	16	1,212	1.09	8,974	1,911	21%
				30	30	56	10	5,478	1.09	8,600	8,277	96%
				41	41	88	16	1,212	1.09	8,212	3,917	48%
				41	41	88	16	1,281	1.09	8,212	4,141	50%
				28	28	56	10	5,461	1.09	8,026	7,702	96%
				39	39	88	16	1,212	1.09	7,812	3,726	48%
				25	25	56	10	5,461	1.09	7,166	6,877	96%
				28	28	88	16	1,430	1.09	5,609	3,157	56%
				8	8	88	16	8,760	1.09	5,399	5,525	102%
				20	20	88	16	5,471	1.09	4,006	8,627	215%
				12	12	56	10	5,461	1.09	3,440	3,301	96%
				4	4	88	16	8,760	1.09	2,699	2,762	102%
				14	14	26	10	8,760	1.09	2,100	2,148	102%
				19	19	26	10	5,469	1.09	1,894	1,820	96%
				5	5	56	10	5,461	1.09	1,433	1,375	96%
				4	4	56	10	5,478	1.09	1,147	1,104	96%
				7	7	56	10	2,577	1.09	896	909	101%
				2	2	56	10	8,760	1.09	862	882	102%
				5	5	56	10	7,268	1.09	640	1,830	286%
				2	2	56	10	5,478	1.09	573	552	96%
				1	1	56	10	5,478	1.09	287	276	96%
100213-Lighting-Non Linear LED Fixture Replac CFL Fixture				1	1	26	12	5,478	1.09	87	84	97%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
100212-Lighting-Non Linear LED Fixture Replac Incand/Halogen Lamp Fixture		Exterior Lighting		6	6	43	12	4,308	1.09	788	801	102%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025	Lighting	Standard	66	66	96	30	3,899	1.09	27,145	18,596	69%
201316-Lighting-LEDElectroluminescent Replac Incand Exit Sign	793			40	40	35	4	8,760	1.09	11,623	11,893	102%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025			40	40	32	13	5,478	1.09	4,736	4,558	96%
				16	16	32	13	8,760	1.09	2,849	2,916	102%
				10	10	32	13	5,461	1.09	1,184	1,136	96%
				4	4	32	13	8,760	1.09	712	729	102%
				12	12	32	13	402	1.09	634	100	16%
				8	8	32	13	38	1.09	423	6	1%
				2	2	32	13	8,760	1.09	356	364	102%
				26	26	32	13	38	1.09	275	21	7%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T12 <=40 W Linear ft	3026			-	-	-	-			262		0%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025			13	13	32	13	110	1.09	137	30	22%
				12	12	32	13	19	1.09	127	5	4%
				2	2	32	13	7,268	1.09	106	302	285%
				2	2	32	13	19	1.09	21	1	4%
				-	-	-	-			10		0%
Total										526,672	484,398	92%

The annual lighting hours of operation verified during the M&V site visit for the twenty-eighth line item in the above table using photo cells (4,308[185]) are less than the hours of operation used to calculate ex ante savings (4,380). The ex post hours of operation for the fourteenth, seventeenth, eighteenth, twenty-third, thirtieth, thirty-second, thirty-fourth, and thirty-seventh line items (8,760) correspond with the ex ante savings estimate hours. The annual hours of operation for the first, fifteenth, twenty-fourth, and forty-second line items (ranging from 5,471 to 7,268) are greater than the ex ante hours (ranging from 2,600 to 5,478). The remaining measures have annual hours of use (ranging from 19 to 5,478) which are fewer than the ex ante hours (ranging from 520 to 5,824).

An adjusted base wattage of 43W was used for the twenty-eighth line item in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

[185] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

The quantity of the thirty-ninth- and forty-fourth-line items in the table above (0) verified during the M&V site visit is less than the ex ante savings quantity (0).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned large office in St. Louis, was applied to the ex post lighting energy savings. A factor of 1.00 was used for unconditioned spaces. The ex ante savings estimate accounted for a heating and cooling factor of 1.07, and a factor of 1.00 for unconditioned spaces.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[186]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 92%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 50% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	50,600	40,658	80%	7.72
Custom	Lighting	475,284	442,939	93%	84.14
	Exterior Lighting	788	801	102%	0.00
Total		526,672	484,398	92%	91.87

[186] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6068

Data Collection

The participant received Standard & Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed ten photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/25/2018 and 7/02/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
201316-Lighting-LED/ Electroluminescent Replacing IncanExitSign	793	Lighting	Standard	20	20	20	5	8,760	1.11	2,812	2,907	103%
305802-LightDelamp ReplaT8 32W	3084			447	-	32	-	2,427	1.11	51,360	38,389	75%
305402-LightingLinear ft LED (<=5.5 Watts/ftReplac T8 32Watt Linear ft	3025			606	606	32	17	2,510	1.11	40,928	25,238	62%
100210-Lighting-Non Linear LED Fixt Replac MV	1169	Exterior Lighting	Custom	5	5	455	120	4,308	1.00	7,337	7,215	98%
100208-Lighting-Non Linear LED Fixt ReplacMH				43	43	295	55	4,308	1.00	45,202	44,456	98%
100211-Lighting-Non Linear LED Fix ReplacHPS				25	25	188	30	4,308	1.00	17,301	17,015	98%
100210-Lighting-Non Linear LED Fixt Replac MV				7	7	205	60	4,308	1.00	4,446	4,372	98%
301132-Lighting-LED 7-20 W Lamp ReplaHalogen A53-70WLamp	3009	Lighting	Standard	48	48	53	11	8,760	1.11	6,394	19,532	305%
200909-Lighting-LED <=14W Lamp ReplaHalogen BR/R 45-66W Lamp or Fixt	3007			36	36	75	11	8,760	1.11	9,861	22,322	226%
201111-Lighting-LED <=11 Watt	3011			13	13	43	9	1,141	1.11	5,085	558	11%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
Lamp Replac Halogen A 28-52 Watt Lamp												
Total										190,726	182,005	95%

The annual lighting hours of operation verified during the M&V site visit for the fourth through seventh line items in the above table using photo cells (4,308[187]) are less than the hours of operation used to calculate ex ante savings (4,380). The second, third, and tenth line items have hours of operation (ranging from 1,141 – 2,510) which are fewer than the ex ante hours (3,000). The remaining line items have constant usage (8,760) with the first line item corresponding with the ex ante estimate hours and the eighth and ninth lines being greater (3,000).

The ex ante savings estimate used adjusted base wattages of 52.5W and 42W for the eighth and tenth line items in the above table, respectively, by multiplying the provided wattages by 70%. Adjusted base wattages of 53W and 43W were used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for 75W and 60W incandescent lamps.

The quantities for the second, third, ninth, and tenth line items in the above table (447, 606, 36, and 13, respectively) verified during the M&V site visit are less than the ex ante savings quantities (500, 850, 48, and 48, respectively).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned office in St. Louis, was applied to the ex post lighting energy savings. A factor of 1.00 was applied to exterior measures. The ex ante savings estimate accounted for a heating and cooling factor of 1.07 for interior measures, and a factor of 1.00 for exterior measures.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[188]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 95%. The ex ante energy savings estimate was premised upon overestimated annual hours of operation for 92% of the measures in the above table.

Site-Level Energy Savings

Incentive	End Use Category	kWh Savings			Gross Ex Post kW Reduction
		Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross Realization Rate	
Standard	Lighting	116,440	108,946	94%	20.70
Custom	Exterior Lighting	74,286	73,059	98%	0.41
Total		190,726	182,005	95%	21.11

[187] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[188] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6069

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed nine photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 6/07/18 and 6/27/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100204-Lighting-Non Linear LED Fixture Replacing T8 Fixture	1169	Lighting	Custom	401	401	88	30	5,527	1.15	144,936	147,560	102%
				88	88	88	30	4,039	1.15	14,199	23,662	167%
				39	39	88	30	2,755	1.15	14,096	7,153	51%
				76	76	88	30	1,897	1.15	12,263	9,597	78%
100213-Lighting-Non Linear LED Fixt Replac CFL Fixture				70	70	52	24	4,966	1.15	12,214	11,172	91%
				47	47	52	24	5,105	1.15	8,201	7,711	94%
				55	55	52	24	3,126	1.15	4,284	5,525	129%
100204-Lighting-Non Linear LED Fixture Replacing T8 Fixture				19	19	56	22	5,109	1.15	4,026	3,789	94%
				20	20	88	30	2,256	1.15	3,227	3,005	93%
				7	7	56	10	5,083	1.15	2,007	1,879	94%
100213-Lighting-Non Linear LED Fixture Replacing CFL Fixture				16	16	52	24	2,256	1.15	1,246	1,160	93%
100204-Lighting-Non Linear LED Fixt Replac T8 Fixture				1	1	88	30	2,242	1.15	544	149	27%
100213-Lighting-Non Linear LED Fixt Replac CFL Fixture				6	6	52	24	5,109	1.15	467	985	211%
				10	5	26	24	2,524	1.15	389	406	104%
100204-Lighting-Non Linear LED Fixt Replac T8 Fixture				1	1	56	10	2,242	1.15	128	118	92%
100208-Lighting-Non Linear LED Fixt Replac M H Fixture		Exterior Lighting		25	25	800	169	4,308	1.00	68,905	67,959	99%
				5	5	100	45	4,308	1.00	1,824	1,185	65%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
305402-Lighting-Linear ft LED 5.5W/ft Replacing T8 32 W Linear ft	3025	Lighting	Standard	666	666	32	13	5,718	1.15	78,856	83,054	105%
				228	228	25	13	5,865	1.15	17,050	18,418	108%
				42	42	32	13	5,043	1.15	4,973	4,620	93%
				30	30	32	13	8,760	1.15	3,552	5,732	161%
				20	20	32	13	5,109	1.15	2,368	2,228	94%
200808-Lighting-LED <=13 Watt Lamp Replac Halogen MR-16 35-50 Watt Lamp Fixture	3012			22	22	35	7	2,256	1.15	1,714	1,596	93%
201111-Lighting-LED <=11 Watt Lamp Replaci Halogen A 28-52W Lamp	3011			16	16	35	7	2,256	1.15	499	1,160	233%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025			2	2	25	16	150	1.15	112	3	3%
				8	8	32	13	150	1.15	85	26	31%
				6	6	32	13	70	1.15	63	9	15%
				6	6	32	13	70	1.15	63	9	15%
				4	4	32	13	70	1.15	42	6	15%
				1	1	25	16	2,242	1.15	5	17	434%
Total										402,338	409,894	102%

The annual lighting hours of operation verified during the M&V site visit for the second, seventh, thirteenth, eighteenth, twentieth, twenty-second, and twenty-eighth line items in the table above (4,039, 3,126, 5,109, 5,865, 8,760, 2,256, and 2,242, respectively) are greater than the annual hours of operation used to calculate ex ante savings (ranging from 1,040 – 5,824). The remaining line items had hours (ranging from 70 – 4,966) which were fewer than the ex ante hours (ranging from 520 – 8,760).

The efficient wattage of the seventeenth line item in the first table above (45W) verified during the M&V site visit is greater than the ex ante savings quantity (17).

A heating and cooling interactive factor of 1.15, applicable to an electrically heated, air conditioned large office in St. Louis, was applied to the ex post lighting energy savings for all interior measures. A factor of 1.00 was applied for the exterior measures. The ex ante savings estimate accounted for a heating and cooling factor of 1.07 for the interior and 1.00 for the exterior.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[189]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 102%. The ex ante energy savings estimate was premised on varying annual lighting operating hours and underestimated heating and cooling interactive effects.

[189] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	109,382	116,878	107%	22.20
Custom		222,227	223,872	101%	42.53
	Exterior Lighting	70,729	69,143	98%	0.39
Total		402,338	409,894	102%	65.12

Site ID 6078

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed 10 photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/19/18 and 10/10/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixt Replac M Ha Fixture	1169	Exterior Lighting	Custom	24	24	1,080	200	4,308	1.00	92,506	90,986	98%
				20	20	1,080	300	4,308	1.00	68,328	67,206	98%
306140-Lighting-LED Lamp or Fixt Replacing Interior HID Lamp or Fixt	3004-1	Lighting	Standard	15	15	460	150	3,191	1.10	16,996	16,378	96%
100208-Lighting-Non Linear LED Fixt Replac M H Fixture	1169	Exterior Lighting	Custom	10	10	455	150	4,308	1.00	13,359	13,140	98%
306142-Lighting-LED Lamp or Fixt Replac T12 Lamp Fixt	3026	Lighting	Standard	55	55	82	36	3,981	1.10	9,602	11,116	116%
100208-Lighting-Non Linear LED Fixt Replac M H Fixture	1169	Exterior Lighting	Custom	2	2	1,080	200	4,308	1.00	7,709	7,582	98%
306143-Lighting-LED Lamp or Fixt Replacing T8 Lamp or Fixture	3025	Lighting	Standard	39	39	88	54	2,531	1.10	5,032	3,704	74%
				38	38	88	54	3,191	1.10	4,904	4,551	93%
				18	18	175	108	2,947	1.10	4,577	3,922	86%
				18	18	175	108	2,947	1.10	4,577	3,922	86%
306142-Lighting-LED Lamp or Fixt Replac T12 Lamp Fixt	3026			36	36	48	18	3,568	1.10	4,099	4,252	104%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
100208-Lighting-Non Linear LED Fixt Replac M H Fixture	1169	Exterior Lighting	Custom	3	3	455	150	4,308	1.00	4,008	3,942	98%
306135-Lighting-LED Lamp or Fixt Replac T5 Lamp Fixture	3088	Lighting	Standard	8	8	240	109	4,047	1.10	3,977	4,681	118%
301039-Lighting-LED <=20 Watt Lamp or Fixt ReplacHalog PAR Lamp or Fixture	3008			16	16	72	14	3,191	1.10	3,275	3,268	100%
306143-Lighting-LED Lamp or Fixt Replac T8 Lamp Fixt	3025			16	16	114	72	2,947	1.10	2,551	2,185	86%
100202-Lighting-Non Linear LED Fixt Replac T12HO Fixt	1169		Custom	4	2	227	109	2,321	1.10	1,733	1,767	102%
306143-Lighting-LED Lamp or Fixt Replaci T8 Lamp Fixt	3025		Standard	6	6	175	109	5,555	1.10	1,502	2,428	162%
306135-Lighting-LED Lamp or Fixt Replac T5 Lamp Fixt	3088			3	3	240	109	2,321	1.10	1,492	1,007	67%
306143-Lighting-LED Lamp or Fixt Replac T8 Lamp Fixt	3025			11	11	88	54	3,191	1.10	1,419	1,317	93%
306142-Lighting-LED Lamp or Fixt Replaci T12 Lamp Fixt	3026			6	6	82	36	3,568	1.10	1,048	1,087	104%
306143-Lighting-LED Lamp or Fixt Replac T8 Lamp Fixt	3025			9	9	59	36	3,981	1.10	785	910	116%
306142-Lighting-LED Lamp or Fixt Replac T12 Lamp Fixt	3026			3	3	82	36	3,981	1.10	524	606	116%
306143-Lighting-LED Lamp or Fixt Replac T8 Lamp Fixt	3025			2	2	175	109	3,981	1.10	501	580	116%
				3	3	114	72	3,568	1.10	478	496	104%
				3	3	114	72	3,568	1.10	478	496	104%
				5	5	59	36	3,981	1.10	437	505	116%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
306142-Lighting-LED Lamp or Fixt Replac T12 Lamp Fixt	3026			2	2	82	36	3,981	1.10	350	404	115%
306143-Lighting-LED Lamp or Fixt Replac T8 Lamp Fixt	3025			4	4	59	36	3,568	1.10	349	362	104%
				2	2	114	72	4,047	1.10	319	375	118%
				2	2	114	72	2,531	1.10	319	235	74%
				3	3	59	36	4,047	1.10	262	308	118%
				2	2	88	54	3,191	1.10	258	240	93%
306142-Lighting-LED Lamp or Fixt Replacing T12 Lamp or Fixture	3026			1	1	82	36	3,191	1.10	174	162	93%
306143-Lighting-LED Lamp or Fixt Replac T8 Lamp Fixt	3025			1	1	114	72	3,981	1.10	159	185	116%
				1	1	114	72	5,555	1.10	159	257	162%
				2	2	56	36	3,191	1.10	152	141	93%
				2	2	59	44	2,947	1.10	114	98	86%
306142-Lighting-LED Lamp or Fixt Replac T12 Lamp Fixt	3026			1	1	48	18	2,531	1.10	113	84	74%
Total										258,625	254,883	99%

The annual lighting hours of operation for the first, second, fourth, sixth, and twelfth line items in the above table using photo cells (4,308[190]) are less than the hours of operation used to calculate ex ante savings (4,380). These measures were exterior installations.

The annual lighting hours of operation verified during the M&V site visit for the fifth, eleventh, thirteenth, seventeenth, twentieth through the twenty-ninth, thirty-first, thirty-fourth, and thirty-fifth lines in the table above (3,547) are fewer than the annual hours of operation used to calculate ex ante savings (ranging from 3568 – 5,555). The remaining line items above (ranging from 2,347 – 3,547) are greater than the ex ante savings estimate (ranging from 2,321 – 3,191).

An adjusted base wattage of 72W was used in the ex post savings analysis for the fourteenth line item in the table above to meet the EISA 2007 standard lumen equivalent for a 100W incandescent lamp. The ex ante base wattage of 70W was computed within the application by factoring 70% of a 100W incandescent lamp.

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air-conditioned large retail in St. Louis, was applied to the ex post lighting energy savings for all interior installations. The ex ante savings estimate accounted for a heating and cooling factor of 1.07. For the exterior measure installations, a factor of 1.00 was used in both the ex ante and ex post analysis.

[190] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[191]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 99%.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	70,982	70,261	99%	13.35
Custom		1,733	1,767	102%	0.34
	Exterior Lighting	185,910	182,855	98%	1.03
Total		258,625	254,883	99%	14.71

[191] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6079

Data Collection

The participant received Standard and Custom lighting incentives.

During the M&V visit, ADM staff verified equipment installation, baseline and the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed twelve photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 5/08/2018 and 5/28/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
100204-Lighting Non Linear LED Fixt Replac T8	1169	Lighting	Custom	202	202	85	24	2,007	1.09	43,311	26,981	62%
100213-Lighting-Non Linear LED Fixt Replac CFL Fixt				58	58	35	8	2,866	1.09	7,023	4,896	70%
100204-Lighting-Non Linear LED Fixt Replac T8 Fixt				15	15	62	17	2,528	1.09	2,373	1,861	78%
100208-Lighting-Non Linear LED Fixt Replacing Metal Halide Fixture		Exterior Lighting		5	5	215	24	4,308	1.00	4,183	4,114	98%
				2	2	455	160	4,308	1.00	2,584	2,542	98%
				2	2	455	280	4,308	1.00	1,533	1,508	98%
				1	1	295	56	4,308	1.00	1,047	1,030	98%
305233-Lighting-85-225 W Lamp Fixture Replac Interior HID 301-500 Watt Lamp Fixt	3005-1	Lighting	Standard	20	20	455	110	5,206	1.09	24,253	39,186	162%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replac T8 32WLinear ft	3025			28	28	32	11	4,516	1.09	2,067	2,897	140%
				22	22	32	11	2,309	1.09	1,624	1,164	72%
				20	20	32	11	2,124	1.09	1,476	973	66%
305802-Lighting-Delamp ReplacT8 32 W	3084			10	-	32	-	2,124	1.09	1,125	741	66%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replac T8 32WLinear ft	3025			10	10	32	11	1,811	1.09	738	415	56%
305802-Lighting-Delamp ReplacT8 32W	3084			6	-	32	-	1,601	1.09	675	335	50%
305402-Lighting-Linear ft LED 5.5 W/ft Replac T8 32WLinear ft	3025			8	8	32	15	1,182	1.09	478	175	37%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
305802-Lighting-Delamp ReplacT8 32 W	3084			4	-	32	-	1,182	1.09	450	165	37%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replac T8 32WLinear ft	3025			6	6	32	15	1,601	1.09	358	178	50%
201111-Lighting-LED <=11 W Lamp Replac Halogen A 28-52 WLamp	3011	Ext Lighting		2	2	43	9	4,308	1.00	232	293	126%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replac T8 32WLinear ft	3025			2	2	30	10	1,182	1.09	141	52	37%
301132-Lighting-LED 7-20 Watt Lamp Replac Halogen A 53-70W Lamp	3009	Lighting		1	1	53	13	1,811	1.09	139	79	57%
100213-Lighting-Non Linear LED Fixt Replac CFL Fixt	1169	Ext Lighting	Custom	16	16	35	8	4,308	1.00	-	1,861	
Total										95,810	91,445	95%

Lighting Controls Savings Calculations

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Quantity	Controlled Wattage	Baseline Hours	Efficient Hours	Heating Cooling Interaction Factor	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
301818-Lighting-Fixture Mounted Occupancy Sensor Controlling >50 and <=200 Watts Replacing No Controls	3077	Lighting	Standard	-	-	-	-	-	6,000	0	0%
Total									6,000	0	0%

The annual lighting hours of operation verified during the M&V site visit for the fourth through seventh line items in the first table above using photo cells (4,308[192]) are less than the annual hours of operation used to calculate ex ante savings (4,380). In addition, the eighteenth- and twenty-first-line items used photo cells (4,308) and the hours are greater than the hours used to for ex ante savings (3,285), as the measures had been installed in exterior locations instead of interior as stated in the application. The eighth and ninth line items in the first table above (5,206 and 4,516, respectively) are greater than the hours used to calculate savings (3,285), while the verified hours for remaining line items (ranging from 1,182 to 2,866) are fewer.

The ex ante savings estimate used an adjusted base wattage for the eighteenth- and twentieth-line items in the first able above (42W and 52.5W, respectively) by multiplying the provided wattage by

[192] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

70%. An adjusted base wattage of 43W and 53W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W and 75W incandescent lamp.

The quantity of the second line item in the first table above (58) is less than the ex ante savings quantity (74). The quantity of 16 lamps were installed in exterior fixtures and are displayed in the twenty-first line item of the first table.

The quantity of occupancy sensors verified during the M&V site visit shown in the second table above (0) is less than the ex ante savings quantity (20)

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned education facility in St. Louis, was applied to the ex post lighting energy savings. A factor of 1.00 was applied to the exterior measures. The ex ante savings estimate accounted for a heating and cooling factor of 1.07 for interior measures, and a factor of 1.00 for exterior measures.

The peak coincident kW reduction was determined by applying the corresponding end use kW factor to the kWh savings.[193] The end use of Exterior Lighting was verified during the M&V site visit for the eighteenth- and twenty-first line items in the first table. Both measures stated Lighting end use in the application.

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall realization rate is 90%. The ex ante savings estimate was premised upon a completed installation and overestimated annual hours of operation for 85% of the measures in the first table above.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	39,524	46,360	117%	8.81
Custom		52,707	33,738	64%	6.41
	Exterior Lighting	9,347	11,054	118%	0.06
Total		101,578	91,152	90%	15.28

[193] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6083

Data Collection

The participant received Standard lighting incentives.

During the M&V visit, ADM staff verified equipment installation, baseline and the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed six photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 6/09/2018 and 7/04/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
305801-LightingDelamp Replacing T12 <=40 Watt	3084	Lighting	Standard	438	-	110	-	2,735	1.09	163,937	143,706	88%
305401Lighting-Linear ft LED (<=5.5 Watts/ft) Replac T12 <=40 W Linear ft	3026			342	684	110	19	3,101	1.09	83,786	83,284	99%
				24	24	40	15	3,183	1.09	2,042	2,082	102%
Total										249,765	229,073	92%

Lighting Controls Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Quantity*	*Controlled Wattage*	*Baseline Hours*	*Efficient Hours*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
301818-Lighting-Fixt Mnt Occ Sensor Controlling >50 <200 Replac No Control	3077	Lighting	Standard	40	111	2,574	1,788	1.09	12,000	3,809	32%
201618-Lighting-Single Techn Occ Sensor Controlling Light Circuit >120 W	3079			2	180	3,183	2,870	1.09	920	123	13%
Total									12,920	3,931	30%

The annual lighting hours of operation verified during the M&V site visit for the third line item in the first table above (3,183) is greater than the annual hours of operation used to calculate ex ante savings (3,180), while the verified hours for the remaining line items (ranging from 2,735 to 3,101) are fewer.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned light manufacturing facility in Cape Girardeau was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling interactive factor of 1.07.

During the M&V site visit, the baseline behavior for controlling lighting was determined by survey questions per usage area. The survey indicated no efficient behavior with turning off lighting during the workday but considerably efficient behavior at the end of the workday.

The peak coincident kW reduction was determined by applying the corresponding end use kW factor to the kWh savings.[194]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall realization rate is 89%. The ex ante energy savings estimate was premised upon overestimated annual hours of operation for 97% of the measures in the first table above and expectation of greater impact from the occupancy sensors.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	262,685	233,004	89%	45.97
Total		262,685	233,004	89%	45.97

[194] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6086

Data Collection

The participant received New Construction incentives from Ameren Missouri.

During the M&V visit, ADM staff verified the new construction measures, equipment installation, the post-retrofit connected loads, interviewed facility personnel regarding lighting and equipment operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 4/13/18 and 6/25/18.

Analysis Results

Lighting Savings Calculations

Measure Name/ ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
406123-Lighting-New Construction Lighting Power Density (LPD)	3000	Lighting	New Construction	3,242	3,242	51	27	2,318	0.94	175,391	176,234	100%
				158	158	144	62	8,760	1.00	113,293	113,293	100%
Total										288,684	289,527	100%

The lighting energy use of the installed lighting equipment is compared with the estimated lighting energy use associated with the applicable new construction baseline (ASHAE 90.1 2007) to determine realized lighting energy savings. The facility constructed in St. Louis County had three space types which allowed for 0.70 lighting watts/SF, 0.30 lighting watts/SF, and 0.70 lighting watts/SF. The code compliant baseline lighting wattages for this project were 36,423 watts (0.70watts/SF*52,033SF), 22,705 watts (0.30watts/SF*75,682SF), and 128,222 watts (0.70watts/SF*183,174SF).

The average annual lighting hours of operation verified during the M&V site visit for the interior common areas (8,414) were greater than the annual hours used to calculate ex ante savings (7,800). The ex post savings analysis used the Ameren TRM hours for the residential lighting measures (694) which were fewer than the ex ante estimated hours (728). All garage measure hours (8,760) were consistent with the ex ante garage hours.

A heating and cooling interactive factor of 0.94, applicable to an electric heated, air-conditioned multi-family facility in St. Louis, was applied to the ex post lighting energy savings for all interior spaces while a factor of 1.00 was applied to the garage measures. The ex ante savings estimate did not account for heating and cooling interactive effects.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[195]

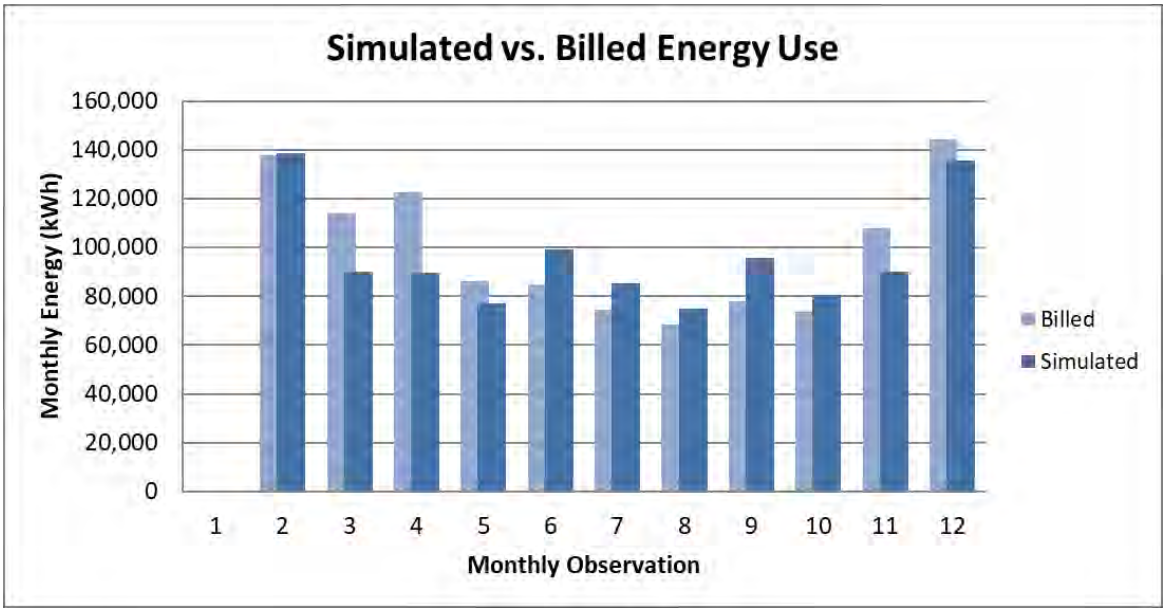
[195] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Whole Building Savings Calculations

Energy savings for the above code whole building measures were calculated using IPMVP Option D: Calibrated Simulation. ADM compiled an eQuest model of the as-built facility using the details and construction documents collected during the on-site M&V visit and from the project documentation.

Upon completion of the initial model, a custom weather file was created using NOAA weather data for the region. Using this weather file and the utility provided billing data for the facility, ADM ensured that the model's energy load shape matched that of the bills. The results of this calibration effort can be seen below:

Monthly kWh Calibration



Upon completion of the calibration for the as-built eQuest model, the impacts of the installed measures were removed using parametric runs. Once the parametric runs were defined, the as-built model and parametric runs were simulated using TMY3 weather data. The total realized energy savings are the differences between the baseline and as-built models' energy usages, and the total site-level energy savings by end use can be seen in the following table:

Typical Year Energy Usage (kWh) by End Use

End-Use	*Baseline*	*As-Built*	*kWh Savings*
Lighting	277,128	277,128	0
Misc. Equipment	148,214	148,214	0
Heating	768,598	359,408	409,189
Cooling	118,891	213,605	-94,714
Heat Rejection	0	0	0
Auxiliary (pumps)	16,103	15,871	232
Vent Fans	44,085	47,153	-3,068
Domestic Hot Water	163,433	162,869	564
Ext. Lighting	3	3	0
Total	1,536,454	1,224,250	312,204

Packaged RTUs Savings Calculations

Energy savings for the packaged rooftop units (RTUs) were calculated using the calibrated model. The baseline model was created by changing the baseline to be in compliance with the Energy Cost Budget Method in ASHRAE 90.1-2007. The largest difference is changing the HVAC system type to packaged variable air volume (PVAV) with parallel fan powered boxes. The total realized energy savings are the differences between the ASHRAE baseline and as-built models' energy usages, and the total site-level energy savings by end use can be seen in the following table:

Typical Year Energy Usage (kWh) by End Use

End-Use	*Baseline*	*As-Built*	*kWh Savings*
Lighting	277,128	277,128	0
Misc. Equipment	148,214	148,214	0
Heating	402,874	359,408	43,465
Cooling	231,580	213,605	17,975
Heat Rejection	0	0	0
Auxiliary (pumps)	15,508	15,871	-362
Vent Fans	52,334	47,153	5,182
Domestic Hot Water	163,030	162,869	161
Ext. Lighting	3	3	0
Total	1,290,671	1,224,250	66,421

Measure level savings are shown in the following table:

New Construction Measure Level Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
426325 – Whole Building – Shell	3000	Building Shell	New Construction	337,974	312,204	92%
112721 – Packaged RTU – HVAC	1169	HVAC	New Construction	65,411	66,421	102%
Total				403,385	378,625	94%

There were significant differences in the ex ante and ex post analysis results for the whole building and HVAC measures, with a 94% realization rate. The ex ante analysis utilizes an uncalibrated energy model of the site. ADM was provided the model; however, the model was run using proprietary software, so ADM created a new model for the ex post analysis. The ex post model was calibrated to actual billing and weather data. The ex ante model was created during the design phase and it significantly over estimated occupancy schedules and loads. However, since most of the savings are weather related, the ex ante savings estimates did not vary significantly. ADM also applied a different end use category for the packaged RTUs. ADM used HVAC end use instead of cooling because a majority of the savings were not from cooling.

The site-level verified energy savings are 692,069 kWh, resulting in a realization rate of 97%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
New Construction	Lighting	175,391	176,234	100%	33.48
	Miscellaneous	113,293	113,293	100%	15.63
	Building Shell	337,974	312,204	92%	138.61
	HVAC	65,411	66,421	102%	29.49
Total		692,069	668,152	97%	217.21

Site ID 6089

Data Collection

The participant received New Construction incentives from Ameren Missouri for constructing an office space that exceeds the minimum building code. The facility is a three-story office located in St. Louis that is open from 8:30 am to 4:30 pm. Savings are associated with installing twelve air conditioning units with a higher efficiency rating than required by code and installing lighting measures.

During the M&V visit, ADM staff verified the new construction measures, equipment installation, post-retrofit connected loads, and interviewed facility personnel regarding lighting and equipment operating schedules.

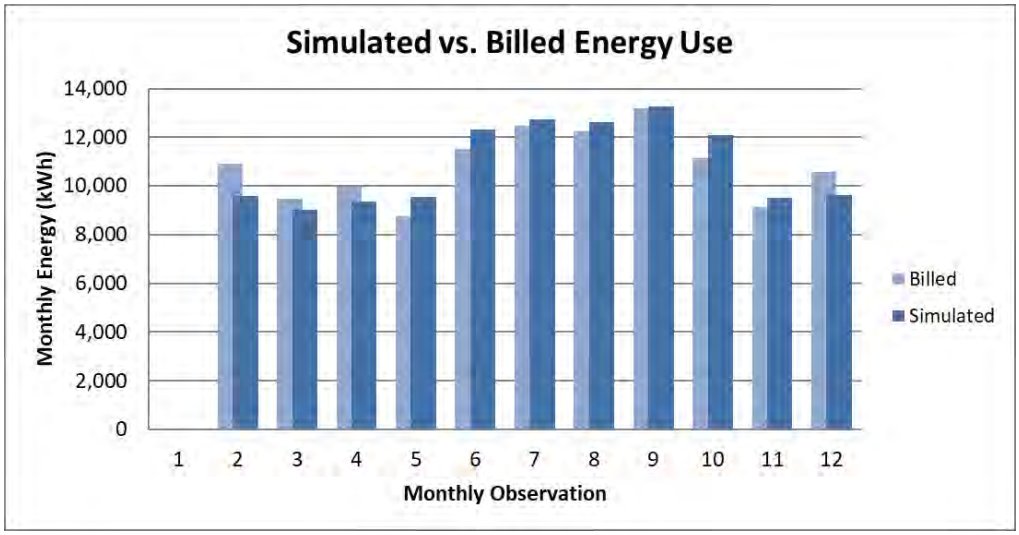
Analysis Results

Whole Building Savings Calculations

Energy savings for the high efficiency air conditioning units were calculated using IPMVP Option D: Calibrated Simulation. ADM reviewed, adjusted, and calibrated an eQuest model of the as-built facility using the construction documents, application details, and photographs taken during the on-site M&V visit.

Upon completion of the initial model, a custom weather file was created using NOAA weather data for the region. Using this weather file and the utility provided billing data for the facility, ADM ensured that the model's energy load shape matched that of the bills. The results of this calibration effort can be seen below:

Monthly kWh Calibration



Upon completion of the calibration for the as-built eQuest model, the impacts of the installed measures were removed using parametric runs. Once the parametric runs were defined, the as-built model and parametric runs were simulated using TMY3 weather data. The total realized energy savings are the differences between the baseline and as-built models' energy usages, and the total site-level energy savings by end use can be seen in the following table:

Typical Year Energy Usage (kWh) by End Use

End-Use	*Baseline*	*As-Built*	*kWh Savings*
Lighting	17,036	17,036	0
Misc. Equipment	56,418	56,418	0
Heating	1,571	1,310	261
Cooling	26,684	20,740	5,944
Auxiliary (pumps)	3,019	3,017	2
Vent Fans	20,285	20,285	0
Heat Pump Supp	1,623	1,800	-177
Domestic Hot Water	4,253	4,253	0
Total	130,889	124,860	6,029

Measure level savings are shown in the following table:

New Construction Measure Level Savings

Measure Name/ID	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
High Efficiency AC	Cooling	New Construction	7,050	6,029	86%
Total			7,050	6,029	86%

There were some differences in the ex ante and ex post analysis results for the HVAC measure, with an 86% realization rate. The ex ante analysis utilizes an energy model of the site but did not show any calibration efforts. ADM reviewed and adjusted the provided energy model and calibrated the model to actual billing and weather data. Changes to the energy model were made based on the building documentation, application information, site visit notes, and to calibrate the model. The largest change to the energy model was adding a second HVAC type and separating the stairwells into different zones conditioned by heat pumps with the remaining office space conditioned by an air conditioner with gas heating. The ex ante analysis used heat pumps for the whole facility, removed all the electric heating, and then added electric heating to the space cooling usage to account for the heat pumps in the stairwells. The following table details the changes made to the energy model and the reasons for changing the values.

Energy Model Changes

Label	*Ex Ante*	*Ex Post*	*Reasoning*
Weather File	TMY2	TMY3	Using TMY3 weather file since it is a more recent file.
Roof Insulation	R-26 batt	R-21 batt	Rigid insulation stated in the building documentation
Wall Insulation	R-13 batt	R-21 batt	Insulation stated in the building documentation
Saturday Schedule	8 am – 1 pm	9 am – noon	Based on site visit photo of the ecobee thermostat
Sunday Schedule	Off	9 am – noon	Based on site visit photo of the ecobee thermostat
Weekday Schedule	7 am – 5 pm	8 am – 6 pm	Based on site visit photo of the ecobee thermostat
Space Heating	Heat Pump	Gas Furnace	Site used gas for space heating every except the stairwells
HVAC system 2	None	Heat pump	The stairwells have heat pumps instead of gas heating
Cooling Occ Setpoint	76	73	Based on site visit photo of the ecobee thermostat
Plug Load (all spaces)	1 W/sf	Default	Model adjusted the plug load to 1 watt per square foot regardless of the space type and typical plug loads
Plug Load (office)	1 W/sf	1.6 W/sf	Increased the plug load in the office space to better calibrate the energy model to the actual billing data

The site-level verified energy savings are 6,029 kWh, resulting in a realization rate of 86%.

Lighting Retrofit Savings Calculations

Measure Name/ ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
406123-Lighting-NC Lighting Power Density (LPD)	3000	Lighting	New Construction	265	265	70	26	2,480	1.11	33,090	32,069	97%
Total										33,090	32,069	97%

The lighting energy use of the installed lighting equipment is compared with the estimated lighting energy use associated with the applicable new construction baseline (ASHAE 90.1 2007) to determine realized lighting energy savings. The office facility constructed in St. Louis was subject to the 2009 IBC code in effect during the building design, which allows for 1.0 lighting watts/SF. The code compliant baseline lighting wattage for this project was 18,600 watts (1.0 watts/SF*18,600SF).

Primary data were used to develop estimates of annual lighting operating hours. For all facility area schedules, the estimated annual operating hours (2,480) were fewer than those used to develop the ex ante energy savings estimates (2,830).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate did not account for heating and cooling interactive effects.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[196]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 95%. The ex ante lighting energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
New Construction	Lighting	33,090	32,069	97%	6.09
	HVAC	7,050	6,029	86%	5.49
Total		40,140	38,098	95%	11.58

[196] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6090

Data Collection

The participant received EMS Program incentives from Ameren Missouri.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered HVAC equipment nameplate information.

Analysis Results

EMS Controls Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A monthly pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against monthly billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Cooling degree days (CDD) were calculated for each billing period and used with a pre/post binary flag variable in an electric usage regression resulting in an R^2 of 0.982 and adjusted R^2 of 0.980. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh_{monthly} = 180.3 \times CDD - 54.18 \times CDD\_Post + 694.4$$

Where:

kWh_{montly} = Monthly kWh Consumption
CDD = Cooling Degree Days for the Month with a Base Temperature of 56.5°F
CDD_Post = Pre/Post-Retrofit Binary Flag multiplied by CDD

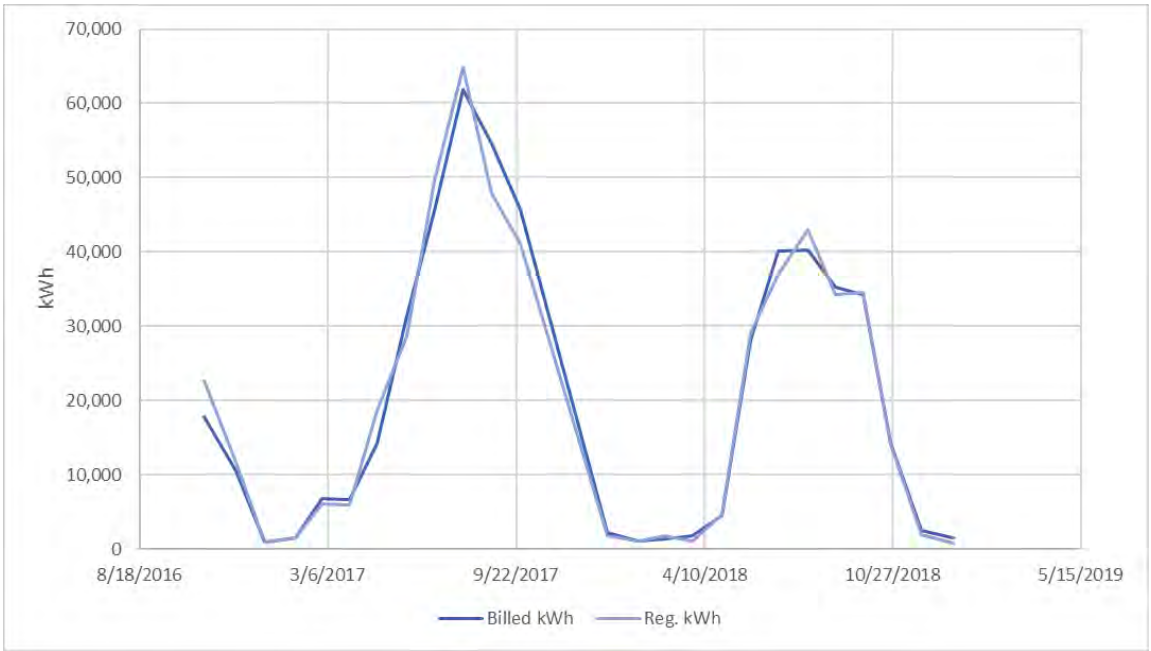
The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	*T Stat*
Intercept	0.868
CDD	31.6
CDD_Post	-8.59

Electric energy usage values were calculated on a monthly basis using the derived regression equation. The following plot compares the monthly billed kWh to the regressed kWh:

Billed vs. Regressed Monthly kWh



Annual kWh savings for the installed measures were determined by using typical year (TMY3) weather data and the derived equation to calculate monthly pre/post energy consumption of the site. Each month was summed for a year to obtain annual energy savings. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility, and can be seen in the following table:

Monthly kWh Savings

Month	*CDD*	*kWh*		
		Baseline	*As-Built*	*Savings*
Jan	2	1,074	960	114
Feb	5	1,642	1,358	285
Mar	40	7,988	5,796	2,192
Apr	72	13,617	9,733	3,883
May	120	22,350	15,842	6,508
Jun	260	47,521	33,448	14,072
Jul	321	58,638	41,225	17,413
Aug	278	50,819	35,756	15,064
Sep	177	32,555	22,980	9,575
Oct	48	9,341	6,742	2,598
Nov	16	3,630	2,748	882
Dec	1	837	794	43
Total		250,013	177,383	72,630

The total billing regression energy savings were used to determine measure level savings. Measure level savings are shown in the following table:

Custom and EMS Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
117920 Controls – Cooling	1169	Cooling	EMS	39,596	32,942	83%
118120 Controls – Heating	1169	Heating	EMS	47,839	0	0%
118220 Controls – Ventilation	1169	HVAC	EMS	47,704	39,688	83%
Total				135,139	72,630	54%

There were substantial differences in the ex ante and ex post analysis methodologies for the EMS controls, with a realization rate of 54%. The ex ante analysis used assumed lighting and equipment loads to determine an assumed HVAC load from annual billing data. The assumed HVAC load was used to derive energy savings by multiplying assumed energy savings factors for the EMS control measures. Sources for the assumed energy savings factors could not be obtained. The ex ante analysis also assumed heating savings, but the site does not have electric heating. These assumptions created significant uncertainty with the ex ante savings estimates. ADM used a billing regression with a great fit (R Square = 0.982) to determine realized energy savings. This method better accounts for actual site HVAC energy usage than the ex ante calculations.

Verified annual savings for the EMS Program incentives are 72,630 kWh, resulting in a realization rate of 54%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below:

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	39,596	32,942	83%	30.00
	Heating	47,839	0	0%	0.00
	HVAC	47,704	39,688	83%	17.62
Total		135,139	72,630	54%	47.62

Site ID 6092

Data Collection

The participant received Retro-Commissioning (RCx) and Custom Program incentives from Ameren Missouri.

During the M&V visit, ADM staff verified the optimization of building automation system (BAS) and interviewed site personnel regarding equipment operation. Data from the BAS were collected where possible. ADM also gathered site occupancy schedules, lighting information, and HVAC equipment nameplate data.

Analysis Results

BAS Optimization Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A monthly pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against monthly billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Cooling and heating degree days (CDD & HDD) were calculated for each billing period and used with a pre/post binary flag and school days variables in an electric usage regression resulting in an R^2 of 0.950 and adjusted R^2 of 0.940. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh_{monthly} = 114.1 \times CDD + 92.16\,HDD - 11{,}128 \times Pre\_Post + 777.1 \times School\_Days + 7{,}640$$

Where:

kWh_{monthly} = Monthly kWh Consumption
CDD = Cooling Degree Days for the Month with a Base Temperature of 55.94°F
HDD = Heating Degree Days for the Month with a Base Temperature of 60.08°F
Pre_Post = Pre/Post-Retrofit Binary Flag
School_Days = Number of School Days for the Month

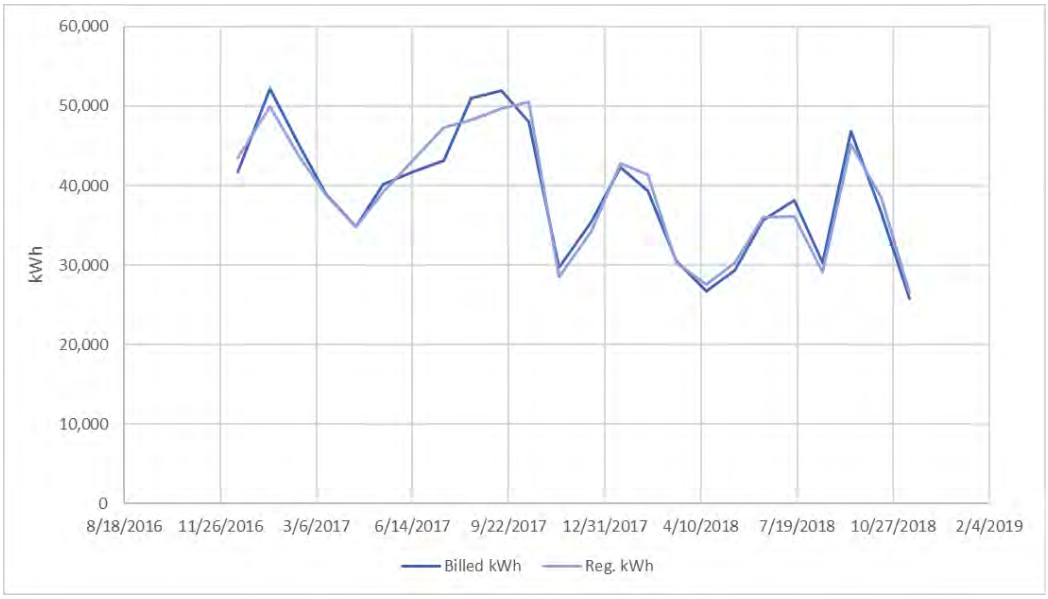
The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	*T Stat*
Intercept	2.70
School_Days	9.50
Pre_Post	-13.9
CDD	14.0
HDD	13.1

Electric energy usage values were calculated on a monthly basis using the derived regression equation. The following plot compares the monthly billed kWh to the regressed kWh:

Billed vs. Regressed Monthly kWh



Annual kWh savings for the installed measures were determined by using typical year (TMY3) weather data and the derived equation to calculate monthly pre/post energy consumption of the site. Each month was summed for a year to obtain annual energy savings. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility, and can be seen in the following table:

Monthly kWh Savings

Month	*CDD*	*HDD*	*kWh*		
			Baseline	*As-Built*	*Savings*
Jan	2	385	51,906	40,778	11,128
Feb	6	284	50,768	39,640	11,128
Mar	43	155	40,830	29,702	11,128
Apr	76	77	35,795	24,667	11,128
May	127	28	40,286	29,159	11,128
Jun	269	1	45,432	34,304	11,128
Jul	332	0	45,471	34,343	11,128
Aug	288	0	46,705	35,578	11,128
Sep	185	6	44,858	33,730	11,128
Oct	51	88	38,715	27,587	11,128
Nov	18	194	42,264	31,136	11,128
Dec	1	355	56,012	44,884	11,128

Month	CDD	HDD	kWh		
			Baseline	As-Built	Savings
Total			539,042	405,508	133,534

The total billing regression energy savings were used to determine measure level savings. Another project, Project 2, was also completed at this site during the evaluated timeline but was not sampled. The expected savings for Project 2 are 58,821 kWh. Those savings were subtracted from the total billing regression savings to obtain the total site-level energy savings (133,534 – 58,821 = 74,713 kWh). ADM also performed lighting controls savings calculations in order to allocate measure level savings more accurately.

Lighting Controls Savings Calculations

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Quantity	Controlled Wattage	Annual Hours of Operation	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
424220-Miscellanous-Efficient Equipment Replacing Existing Inefficient Equipment or Early Replacement	1169	Lighting	Custom	15	432	2,790	2,070	1.09	4,665	4,703	101%
Total									4,665	4,703	101%

The energy savings for the lighting controls were subtracted from the site-level billing regression savings and the remaining billing regression savings were allocated between the HVAC and cooling optimization measures similar to the ex ante analysis. Measure level savings are shown in the following table:

Custom and RCx Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
116620 Optimization – HVAC	1169	HVAC	RCx	32,450	50,914	157%
115920 Optimization – Cooling	1169	Cooling	RCx	12,171	19,096	157%
424220 Controls – Lighting	1169	Lighting	Custom	4,665	4,703	101%
Total				49,286	74,713	152%

There were substantial differences in the ex ante and ex post analysis methodologies for the RCx measures, with a realization rate of 152%. The ex ante analysis for the HVAC optimization measures used bin analyses with assumed occupancy schedules, fan speeds, and HVAC loads. All these assumptions created significant uncertainty with the ex ante savings estimates. The ex ante analysis did not use any site-specific trending or utility data. ADM used a billing regression with a good fit (R Square = 0.950) to determine realized energy savings. This method better accounts for actual site HVAC energy usage than the ex ante calculations.

This billing analysis is further justified by the billing analysis for Site 6093, which is a very similar project. Both Site 6092 and Site 6093 are identical facilities and implemented the same measures, thus the

savings for each facility should be similar. The billing regression savings for Site 6093 are within 1,000 kWh of the billing regression savings for this site, indicating the billing regression savings for this site are reasonable.

Verified annual savings for the RCx Program incentives are 69,986 kWh, resulting in a realization rate of 157%. Verified annual savings for the Custom Program incentives are 4,703 kWh, resulting in a realization rate of 101%. The verified annual site-level energy savings are 74,713 kWh, resulting in a 152% realization rate.

A table showing the energy savings achieved by the measures evaluated for this site is shown below:

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Retro-Commissioning	HVAC	32,450	50,914	157%	22.60
	Cooling	12,171	19,096	157%	17.39
Custom	Lighting	4,665	4,703	101%	0.89
Total		49,286	74,713	152%	40.89

Site ID 6093

Data Collection

The participant received Retro-Commissioning (RCx) Program incentives from Ameren Missouri.

During the M&V visit, ADM staff verified the optimization of building automation system (BAS) and interviewed site personnel regarding equipment operation. Data from the BAS were collected where possible. ADM also gathered site occupancy schedules and HVAC equipment nameplate data.

Analysis Results

BAS Optimization Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A monthly pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against monthly billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Cooling and heating degree days (CDD & HDD) were calculated for each billing period and used with a pre/post binary flag and school days variables in an electric usage regression resulting in an R^2 of 0.965 and adjusted R^2 of 0.958. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh_{monthly} = 197.6 \times CDD + 121.4\, HDD - 11{,}045 \times Pre\_Post + 1{,}591 \times School\_Days - 23{,}352$$

Where:

$kWh_{monthly}$ = Monthly kWh Consumption
CDD = Cooling Degree Days for the Month with a Base Temperature of 55°F
HDD = Heating Degree Days for the Month with a Base Temperature of 73°F
Pre_Post = Pre/Post-Retrofit Binary Flag
School_Days = Number of School Days for the Month

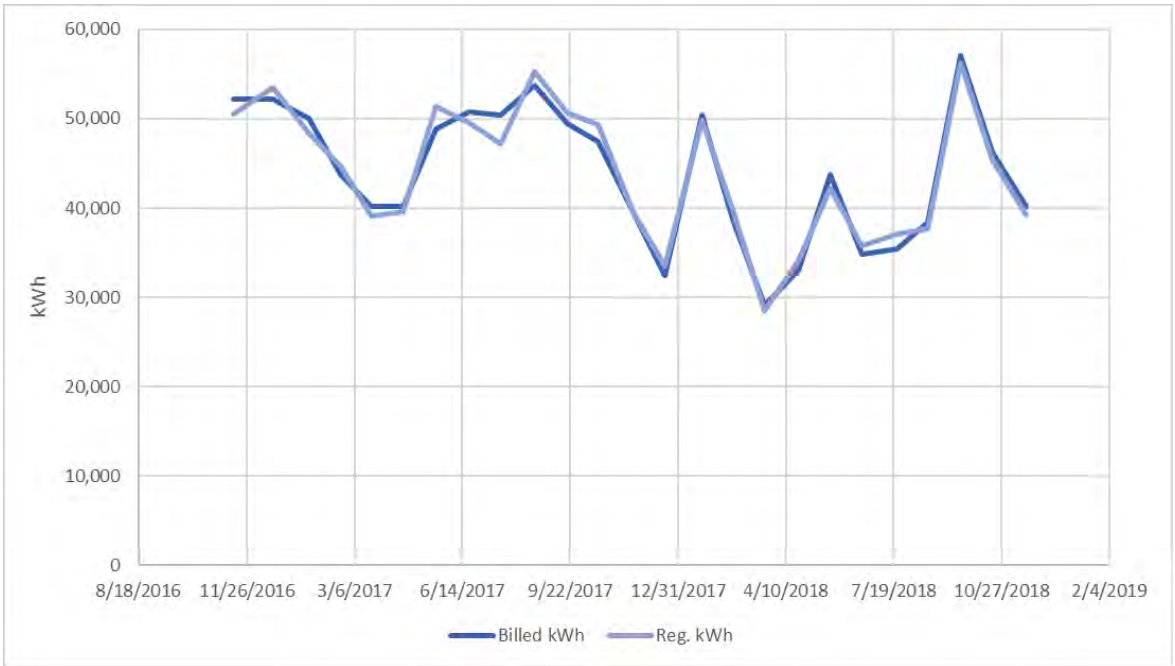
The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	*T Stat*
Intercept	-6.13
School_Days	17.1
Pre_Post	-17.0
CDD	19.0
HDD	17.2

Electric energy usage values were calculated on a monthly basis using the derived regression equation. The following plot compares the monthly billed kWh to the regressed kWh:

Billed vs. Regressed Monthly kWh



Annual kWh savings for the installed measures were determined by using typical year (TMY3) weather data and the derived equation to calculate monthly pre/post energy consumption of the site. Each month was summed for a year to obtain annual energy savings. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility, and can be seen in the following table:

Monthly kWh Savings

Month	*CDD*	*HDD*	*kWh*		
			Baseline	*As-Built*	*Savings*
Jan	3	447	55,429	44,384	11,045
Feb	7	350	50,771	39,726	11,045
Mar	48	240	42,306	31,261	11,045
Apr	84	158	41,037	29,993	11,045
May	139	98	47,897	36,852	11,045
Jun	286	19	51,425	40,380	11,045
Jul	350	6	46,608	35,563	11,045
Aug	306	11	51,093	40,048	11,045
Sep	200	50	46,050	35,005	11,045
Oct	58	182	35,668	24,623	11,045
Nov	20	279	51,124	40,079	11,045
Dec	1	423	58,462	47,417	11,045

Month	CDD	HDD	kWh		
			Baseline	As-Built	Savings
Total			577,869	445,330	132,539

The total billing regression energy savings were used to determine measure level savings. Another project, Project 2, was also completed at this site during the evaluated timeline but was not sampled. The expected lighting savings for Project 2 are 68,311 kWh. Those savings were subtracted from the total billing regression savings to obtain the total site-level energy savings (132,539 – 68,311 = 64,228 kWh). The remaining billing regression savings were allocated between the HVAC and cooling optimization measures like the ex ante analysis. Measure level savings are shown in the following table:

RCx Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
116620 Optimization – HVAC	1169	HVAC	RCx	45,430	42,548	94%
115920 Optimization – Cooling	1169	Cooling	RCx	23,149	21,680	94%
Total				68,579	64,228	94%

There were significant differences in the ex ante and ex post analysis methodologies for the RCx measures, with a realization rate of 94%. The ex ante analysis for the HVAC optimization measures used bin analyses with assumed occupancy schedules, fan speeds, and HVAC loads. All these assumptions created significant uncertainty with the ex ante savings estimates. The ex ante analysis didn't use any site-specific trending or utility data. ADM used a billing regression with a good fit (R Square = 0.965) to determine realized energy savings. This method better accounts for actual site HVAC energy usage than the ex ante calculations.

Verified annual savings for the RCx Program incentives are 64,228 kWh, resulting in a realization rate of 94%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below:

Site-Level Energy Savings

Incentive	End Use Category	kWh Savings			Gross Ex Post kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Retro-Commissioning	HVAC	45,430	42,548	94%	18.89
	Cooling	23,149	21,680	94%	19.74
Total		68,579	64,228	94%	38.63

Site ID 6094

Data Collection

The participant received New Construction and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified the new construction measures, equipment installation, the post-retrofit thermostat setpoints and schedules, building floor plan, and interviewed facility personnel regarding site operation schedules. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
100208-Ltg.-Non Linear LED Fixture Replacing M H Fixture	1169	Exterior Lighting	Custom	12	12	455	113	4,308	1.00	17,976	17,680	98%
				10	10	455	225	4,308	1.00	10,074	9,908	98%
406123-Ltg-NC Ltg Power Density (LPD)	3000	Lighting	New Construc-tion	445	445	1,108	252	3,386	1.05	1,584,690	1,528,595	96%
Total										1,612,740	1,556,184	96%

The lighting energy use of the installed lighting equipment is compared with the estimated lighting energy use associated with the applicable new construction baseline (ASHAE 90.1 2007) to determine realized lighting energy savings. The manufacturing facility constructed in St. Louis County was subject to the IBC 2009 code in effect during the building design. The facility had three distinct areas which the code allows for 1.0, 1.3, and 1.4 lighting watts/SF. The code compliant baseline lighting wattages for this project was 12,000 watts (1.0 watts/SF*12,000SF), 478,400 watts (1.3 watts/SF*368,000SF), and 2,800 watts (1.4 watts/SF*2000SF).

The annual lighting hours of operation for the first two line items in the above table using photo cells (4,308[197]) are less than the hours of operation used to calculate ex ante savings (4,380). The remaining line item has hours of use (3,386) which are also fewer than the ex ante hours (4,160). This is due to the ex ante interior hours not considering the office areas with fewer working hours than the manufacturing areas.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned office in St. Louis, was applied to the ex post lighting energy savings for the office areas and a factor of 1.00 for the unconditioned manufacturing areas. The ex ante savings estimate did not account for heating and cooling interactive effects.

[197] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[198]

Cooling Savings Calculations

A calibrated model was used to attempt to calculate energy savings for the packaged rooftop units (RTUs). However, due to the site not operating at full capacity, the energy model outputs could not be adequately calibrated to billing data. Energy savings were calculated with TMY3 data using parametric runs in eQuest to isolate the savings for the installed RTUs based on above-code efficiencies and economizer settings. The modeled energy savings were then compared to the ex ante calculations based on the initial assumptions. The total site-level energy savings by end use can be seen in the following table:

Typical Year Energy Usage (kWh) by End Use

End-Use	*Baseline*	*As-Built*	*kWh Savings*
Lighting	360,153	360,153	0
Misc. Equipment	338,766	338,766	0
Heating	0	0	0
Cooling	33,570	30,281	3,289
Heat Rejection	0	0	0
Auxiliary (pumps)	871	876	-5
Vent Fans	37,394	37,393	1
Total	770,754	767,469	3,285

Measure level savings are shown in the following table:

New Construction Measure Level Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
112721 – Packaged RTU – HVAC	1169	Cooling	New Construction	7,870	3,285	42%
Total				7,870	3,285	42%

There were significant differences in the ex ante and ex post analysis results for the HVAC measures, with a 42% realization rate. The ex ante analysis used a bin calculation based on outside air temperatures and assumed thermostat setpoint and setback temperatures to determine calculation parameters. Ex ante analysis also calculated the occupied and unoccupied hours for each temperature bin though these calculations could not be verified. Further, a linear equation using the design outside

[198] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

air temperature (OAT), setback temperature, and design indoor air temperature (IAT) was used to calculate the HVAC tonnage at each temperature bin. The RTU baseline and as-built efficiencies were then averaged, and these efficiencies were used along with the HVAC tonnage and hours at each temperature bin to calculate baseline and as-built HVAC energy usage.

In contrast, ex post analysis created an eQuest energy model using the detailed building floor plan; assigning each relevant thermal zone to its respective HVAC unit. The input parameters such as unit efficiency, equipment power density, lighting power density, occupancy levels, schedules, and default building constructions were modified to represent the office and warehouse operation parameters discovered during the site visit. This resulted in HVAC loads for each zone that were consistent with the designed RTU capacities. However, once parametric runs were performed and the as-built efficiencies and economizer energy savings were included, ex post analysis showed 3,285 kWh of energy savings. This value is considerably lower than expected energy savings.

The ex ante calculations assumed the design IAT would be 75 degrees Fahrenheit and that the setback temperature was 80 degrees Fahrenheit. These setpoint parameters were then used to calculate an adjustment factor for HVAC loading when the office was unoccupied. This resulted in an unoccupied adjustment factor of 73.7%. When the design temperatures were modified to reflect the as-built conditions of a 69 degree setpoint and 85 degree setback, the ex ante equation resulted in an adjustment factor of approximately 36%. This adjustment factor is quite unrealistic and indicates the adjustment factor calculations were inaccurate since an unoccupied space would likely not reduce cooling loads by that large of a margin.

Additionally, the ex ante calculations assumed that there would be a linear relationship between cooling load and OAT at any temperature above 50 degrees. This resulted in ex ante air conditioning operation of 5,441 hours; whereas, ex post model outputs indicated that there were only 3,403 hours with a cooling load. In contrast, the model outputs indicated that there were 1,643 hours with the temperature over 50 degrees and no cooling load. This is expected, since building insulation and thermal mass lessen the immediate effects of OAT changes on changes in cooling loads. Consequently, the ex ante methodology of calculating cooling overestimated HVAC operation. This overestimation is further justified by the Missouri Technical Reference Manual, which lists equivalent full load hours (EFLHs) for air conditioning equipment in small offices at 1,159 hours.

For comparison, the energy model outputs were used to calculate the total occupied and unoccupied hours for each temperature bin during which there was a cooling load, and the adjustment factor for unoccupied versus occupied loads (~71.7%). These values were then input to the ex ante calculator and this showed only 2,862 kWh of savings. This further justifies that the ex ante operation hour and HVAC load assumptions overestimated savings.

The site-level verified energy savings are 3,285 kWh, resulting in a realization rate of 42%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 96%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for the exterior and office area measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	28,050	27,588	98%	0.15
New Construction	Lighting	1,584,690	1,528,595	96%	290.38
	Cooling	7,870	3,285	42%	2.99
Total		1,620,610	1,559,468	96%	293.52

Site ID 6095

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed six photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 6/01/18 and 9/27/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100204-Lighting-Non LinearLED Fixt Replacing T8 Fixture	1169	Lighting	Custom	2,049	2,049	114	38	4,142	1.09	868,781	704,358	81%
				123	123	56	31	4,385	1.09	17,155	14,726	86%
305402-LightingLinear ft LED (<=5.5 Watts/ft) Replac T8 32W Linearft	3025		Standard	16	16	86	40	2,775	1.09	4,106	2,231	54%
				8	8	65	30	2,775	1.09	1,562	849	54%
Total										891,604	722,163	81%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours (ranging from 2,775 – 4,385) are fewer than those used to develop the ex ante energy savings estimates (5,214).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned large office in Jefferson City, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[199]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 81%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

[199] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	5,668	3,079	54%	0.58
Custom		885,936	719,084	81%	136.60
Total		891,604	722,163	81%	137.18

Site ID 6096

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed nineteen photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/30/2018 and 10/08/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
305402-LightingLinear LED<=5.5W/ft Replac T8 32WLinear ft	3025	Lighting	Standard	600	600	32	18	2,601	1.09	55,771	23,804	43%
306143-Lighting-LED Lamp Fixt Replac T8 Lamp Fixt				410	410	59	40	3,942	1.09	25,006	33,451	134%
306135-Lighting-LED Lamp Fixt Replac T5 Lamp Fixt	3088			85	85	117	50	4,628	1.09	18,281	28,710	157%
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025			150	150	59	40	4,628	1.09	9,149	14,368	157%
				18	18	124	86	1,787	1.09	2,196	1,331	61%
				15	15	56	38	4,756	1.09	867	1,399	161%
				10	10	56	38	1,787	1.09	578	350	61%
				1	1	32	20	1,787	1.09	39	23	60%
				380	380	59	40	7,026	1.09	23,176	55,262	238%
				221	221	59	40	5,152	1.09	13,479	23,565	175%
300938-Lighting-LED <=14 Watt Lamp Fixt Replacing HalogenBRR Lamp Fixt	3007			30	30	65	8	4,628	1.09	5,489	8,621	157%
301039-Lighting-LED <=20W Lamp Fixt Replac HalogenPAR Lamp Fixt	3008			20	20	85	17	5,016	1.09	4,366	7,431	170%
306143-Lighting-LED Lamp Fixt Replac T8 Lamp Fixt	3025			15	15	124	86	1,370	1.09	1,830	850	46%
				320	320	68	40	1,104	1.09	28,762	10,778	37%

300938-Lighting-LED <=14W Lamp Fixt Replac HalogenBRR Lamp Fixt	3007			120	120	75	8	3,246	1.09	25,808	28,427	110%
				75	75	40	7	3,833	1.09	7,945	10,335	130%
306140-Lighting-LED Lamp Fixt Replacing Interior HID Lamp Fixt	3004-1			10	10	93	12	4,756	1.09	2,600	4,196	161%
306143-Lighting-LED Lamp Fixture Replacing T8 Lamp or Fixture	3025			500	500	59	40	2,834	1.09	30,495	29,329	96%
				500	500	59	40	2,965	1.09	30,495	30,683	101%
				50	50	68	40	2,965	1.09	4,494	4,522	101%
				35	35	25	11	2,601	1.09	1,573	1,389	88%
				30	30	27	11	2,601	1.09	1,541	1,360	88%
Total										293,940	320,184	109%

The annual lighting hours of operation verified during the M&V site visit for the second through fourth, sixth, ninth through twelfth, and fifteenth through seventeenth line items in the above table (ranging from 3,246 to 7,026) are greater than the annual hours of operation used to calculate ex ante savings (3,000). The ex ante savings estimate did not account for the 24/7 fixtures throughout the facility. The verified hours for the remaining line items (ranging from 1,787 to 2,965) are fewer than those used to calculate ex ante savings (6,205 for the first line item, 3,000 for the remaining line items).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned education based facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[200]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 109%. The ex ante savings estimate was premised upon underestimated annual hours of operation for 58% of the measures in the table above. And underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	293,940	320,184	109%	60.82
Total		293,940	320,184	109%	60.82

[200] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6098

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed six photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/21/2018 and 9/24/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
305502-Lighting-Linear ft T8 25 Watt (<=7 Watts/ft) Replacing T8 32 Watt Linear ft	3022	Lighting	Standard	1,800	1,800	32	25	3,327	1.08	47,187	45,278	96%
Total										47,187	45,278	96%

The annual lighting hours of operation verified during the M&V site visit for the measure in the above table (3,327) are fewer than the annual hours of operation used to calculate ex ante savings (3,500). The installation occurred within 76 education-based buildings and one administrative building in the St. Louis area.

A heating and cooling interactive factor of 1.08, applicable to a gas heated, air conditioned education facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[201]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 96%. The ex ante energy savings estimate was premised upon overestimated annual hours of operation.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	47,187	45,278	96%	8.60
Total		47,187	45,278	96%	8.60

[201] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6102

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/21/2018 and 9/24/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
301037-Lighting-LED <=20 Watt Lamp or Fixture Replacing Halogen A >=40 Watt Lamp or Fixture	3011	Lighting	Standard	88	88	43	10	6,856	1.09	5,544	21,719	392%
Total										5,544	21,719	392%

The annual lighting hours of operation verified during the M&V site visit for the measure in the above table (6,856) are greater than the annual hours of operation used to calculate ex ante savings (1,840). The data collection recorded several periods of 24/7 continuous usage.

The ex ante savings estimate used an adjusted base wattage of 42W for the line item in the above table by multiplying the provided wattage by 70%. An adjusted base wattage of 43W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned education facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[202]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 392%. The ex ante energy savings estimate was premised upon underestimated annual hours of operation.

[202] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	5,544	21,719	392%	4.13
Total		5,544	21,719	392%	4.13

Site ID 6113

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 6/23/2018 and 7/18/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
305402LightLinear ft LED (<=5.5 W/ft) Replac T8 32W Linear ft	3025	Lighting	Standard	30	30	32	17	5,006	1.09	2,408	2,466	102%
				20	20	88	51	5,006	1.09	3,167	4,056	128%
306142-Lighting-LED LampFixture Replac T12 LampFixture	3026			10	10	82	32	4,276	1.09	2,140	2,341	109%
				20	20	82	32	4,276	1.09	4,280	4,681	109%
306143-Lighting-LED LampFixture Replac T8 LampFixture	3025			30	30	59	34	4,118	1.09	3,210	3,382	105%
306142-Lighting-LED LampFixture Replac T12 LampFixture	3026			20	20	82	32	3,317	1.09	3,745	3,632	97%
				13	13	122	51	3,368	1.09	3,456	3,404	98%
306143-Lighting-LED LampFixture Replac T8 LampFixture	3025			102	102	114	68	3,317	1.09	17,572	17,041	97%
				15	15	56	32	3,361	1.09	1,348	1,325	98%
306142-Lighting-LED LampFixture Replac T12 LampFixture	3026			30	30	72	32	3,317	1.09	4,494	4,358	97%
306143-Lighting-LED LampFixture Replac T8 LampFixture	3025			30	30	59	28	3,317	1.09	3,483	3,378	97%
Total										49,303	50,064	102%

The annual lighting hours of operation verified during the M&V site visit for the first five-line items in the above table (ranging from 4,118 to 5,006) are greater than the annual hours of operation used to calculate ex ante savings (ranging from 4,000 to 5,000). The remaining line items have hours (ranging from 3,317 to 3,368) fewer than those used to calculate ex ante savings (3,500).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned large office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[203]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 102%. The ex ante energy savings estimate was premised upon underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	49,303	50,064	102%	9.51
Total		49,303	50,064	102%	9.51

[203] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6114

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 06/23/18 and 07/18/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Fixture Replacing T12 Lamp Fixture	3026	Lighting	Standard	20	20	82	32	8,760	1.09	4,280	9,591	224%
306143-Lighting-LED Lamp Fixture Replacing T8 Lamp Fixture	3025			30	30	59	34	4,082	1.09	3,210	3,352	104%
				20	20	88	51	4,152	1.09	3,167	3,364	106%
306142-Lighting-LED Lamp Fixture Replacing T12 Lamp Fixture	3026			10	10	82	32	8,760	1.09	2,140	4,796	224%
306143-Lighting-LED Lamp Fixture Replacing T8 Lamp Fixture	3025			45	45	114	34	3,450	1.09	13,482	13,598	101%
				15	15	114	56	3,450	1.09	3,258	3,286	101%
306142-Lighting-LED Lamp Fixture Replacing T12 Lamp Fixture	3026			30	30	72	30	3,450	1.09	4,719	4,759	101%
Total										34,256	42,747	125%

The annual lighting hours of operation verified during the M&V site visit for the fifth through seventh line items in the table above (3,450) are fewer than the annual hours of operation used to calculate ex ante savings (3,500). The remaining line items have hours (ranging from 4,082 to 8,760) greater than those used to calculate ex ante savings (4,000). The ex ante savings estimate did not account for the installation of the first and fourth measures in public areas with continuous usage.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned large office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[204]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 125%. The ex ante energy savings estimate was premised upon underestimated annual lighting operating hours for 47% of the installed measures, and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	34,256	42,747	125%	8.12
Total		34,256	42,747	125%	8.12

[204] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6118

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation and the post-retrofit connected loads. ADM staff also determined annual lighting operating schedules through interviews with on-site personnel and the installation of five photo-sensor loggers. The photo-sensor loggers collected data between 6/23/18 and 7/18/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixt	3026	Lighting	SBDI	11	11	164	34	8,049	1.09	3,060	12,602	412%
300938-Lighting-LED <=14 Watt Lamp or Fixture ReplacHalogBRR Lamp or Fixt	3007			21	21	65	11	7,890	1.09	2,427	9,797	404%
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixt	3026			1	1	164	34	7,888	1.09	609	1,123	184%
				31	31	164	34	2,019	1.09	8,970	8,910	99%
Total										15,066	32,431	215%

The annual lighting hours of operation verified during the M&V site visit for the first three line items in the table above (8.049, 7,890, and 7,888, respectively) are greater than the annual hours of operation used to calculate ex ante savings (2,000, 2,000, and 4,380, respectively). These measures were located within common hallways and stairs of the building where the ex ante did not take into consideration the near continuous usage for those types of installations. The fourth line item in the table above has annual hours (2,019) which are fewer than the ex ante hours estimation (2,080) and was located within a tenant space.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[205]

[205] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 215%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for 51% of the project and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	15,066	32,431	215%	6.16
Total		15,066	32,431	215%	6.16

Site ID 6119

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation and the post-retrofit connected loads. ADM staff also determined the annual lighting operation schedules through interviews with on-site personnel and the installation of 6 photo-sensor loggers. The photo-sensor loggers collected data between 6/23/18 and 7/18/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	35	35	164	56	1,461	1.11	14,965	6,109	41%
				1	1	138	86	353	1.11	207	20	10%
Total										15,172	6,129	40%

The annual lighting hours of operation verified during the M&V site visit (1,461 and 353, respectively) are fewer than the annual hours of operation used to calculate ex ante savings (3,700). The measures were installed in various usage locations. In addition, the ex ante hours are considerably higher than the posted operating hours of the facility.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned small office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[206]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 40%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	15,172	6,129	40%	1.16
Total		15,172	6,129	40%	1.16

[206] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6122

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed eleven photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 6/26/2018 and 12/17/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
201010-Lighting-LED <=20 W Lamp Replac Haloge PAR 48-90 W Lamp Fixture	3008	Lighting	Standard	20	20	90	16	711	1.14	3,959	1,198	30%
				4	4	90	14	711	1.14	819	248	30%
201111-Lighting-LED <=11 W Lamp Replac Haloge A28-52W Lamp	3011			26	26	43	10	711	1.14	2,712	705	26%
200909-Lighti-LED <=14Lamp Replac Haloge BR/R 45-66 W Lamp Fixture	3007			4	4	65	9	711	1.14	240	181	76%
201010-Lighting-LED <=20 W Lamp Replac Haloge PAR 48-90 W Lamp Fixture	3008			2	2	53	16	711	1.14	79	60	76%
306142-Lighting-LED Lamp Fixture Replacing T12 Lamp Fixture	3026			50	50	164	34	1,433	1.14	17,388	10,597	61%
301039-Lighting-LED <=20 W Lamp Fixture Replac Haloge PAR Lamp Fixt	3008			6	6	90	12	1,132	1.14	1,252	602	48%
300938-Lighting-LED <=14 W Lamp Fixture Replac Haloge BR/RLamp Fixt	3007			6	6	65	9	711	1.14	899	272	30%
306142-Lighting-LED Lamp Fixture Replacing T12 Lamp Fixture	3026			140	140	164	34	598	1.14	58,422	12,388	21%

100201-Lighting-Non Linear LED Fixture Replaci T12 Fixture	1169		Custom	9	9	82	33	8,760	1.14	4,100	4,358	106%
				50	50	82	33	1,083	1.14	9,490	2,994	32%
305401-Lighting-Linear ft LED (<=5.5 Wa/ft) Replac T12 <40W Lin ft	3026		Standard	20	20	40	14	1,083	1.14	1,981	641	32%
Total										101,341	34,244	34%

The annual hours of operation verified during the M&V site visit for the tenth line item in the above table (8,760) are consistent with the annual hours of operation used to calculate ex ante savings. The verified hours for the remaining line items (ranging from 598 to 1,433) are fewer than those used to calculate ex ante savings (ranging from 1,000 to 3,650). The hours used to calculate ex ante savings do not reflect the actual hours of use within the installed locations.

The ex ante savings estimate used an adjusted base wattage of 42W for the third line item in the above table by multiplying the provided wattage by 70%. An adjusted base wattage of 43W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp.

A heating and cooling interactive factor of 1.14, applicable to a gas heated, air conditioned assembly facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[207]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 34%. The ex ante energy savings estimate was premised upon overestimated annual hours of operation within the actual installed locations.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	87,751	26,892	31%	5.11
Custom		13,590	7,353	54%	1.40
Total		101,341	34,244	34%	6.51

[207] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6123

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp/ Fixture ReplacingT12 Lamp/ Fixture	3026	Lighting	Standard	21	21	164	36	7,648	1.03	25,194	21,221	84%
				19	19	164	36	8,760	1.03	22,796	21,993	96%
				10	10	164	36	8,760	1.03	11,997	11,575	96%
				6	6	82	15	747	1.03	3,768	310	8%
Total										63,755	55,100	86%

The annual lighting hours of operation verified during the M&V site visit for the first and fourth line items in the table above (7,648 and 747, respectively) are fewer than the annual hours of operation used to calculate ex ante savings (8,760). The ex post and ex ante hours for the remaining line items correspond (8,760).

A heating and cooling interactive factor of 1.03, applicable to an electrically heated, air-conditioned assembly in Cape Girardeau, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[208]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 86%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 48% of the installed measures and overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	63,755	55,100	86%	10.47
Total		63,755	55,100	86%	10.47

[208] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6125

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 06/25/18 and 07/24/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
305402-Light-Linearft LED (5.5W/ft) Replac T8 32W Linear ft	3025	Lighting	Standard	30	30	59	35	3,774	1.09	3,082	2,975	97%
305013Light<=80W Lamp Fixture Repl Garage Ext 24/7 HID LampFixture	3006-1	Misc.		3	3	175	60	8,760	1.00	3,022	3,022	100%
				5	5	175	60	8,760	1.00	5,037	5,037	100%
301132-Lighting-LED 7-20W Lamp ReplacHalog 5370WLamp	3009	Lighting		12	12	72	11	5,714	1.09	2,651	4,580	173%
				12	12	72	16	3,715	1.09	2,427	2,733	113%
306143-Lighting-LED LampFixture Replac T8 LampFixture	3025			10	10	117	52	2,846	1.09	2,097	2,025	97%
		Misc.		10	10	124	82	8,760	1.00	1,798	3,679	205%
306140-Lighting-LED LampFixture Replac Interi HIDLampFixt	3004-1	Exterior Lighting		8	8	185	60	4,000	1.00	4,280	4,000	93%
306143-Lighting-LED LampFixture Replac T8 LampFixture	3025	Lighting		18	18	124	82	2,846	1.09	3,236	2,356	73%
				30	30	59	28	2,846	1.09	3,980	2,898	73%
306141-Lighting-LED LampFixture RepGarExtr 24/7 HID LampFixt	3004-2	Misc.		24	24	185	60	8,760	1.00	26,280	26,280	100%
306142-Lighting-LED LampFixture Replac T12 LampFixture	3026	Lighting		11	11	82	28	2,846	1.09	2,225	1,851	83%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
306143-Lighting-LED LampFixture Replaci T8 LampFixture	3025			310	310	32	14	3,715	1.09	20,897	22,698	109%
				25	25	124	82	5,696	1.09	3,932	6,549	167%
				64	64	59	30	2,846	1.09	6,882	5,783	84%
				85	85	114	56	2,846	1.09	18,463	15,362	83%
Total										110,289	111,828	101%

The annual lighting hours of operation verified during the M&V site visit for the second, third, eighth, and eleventh line items (ranging from 4,000 to 8,760) are consistent with the annual hours of operation used to calculate ex ante savings. The verified hours for the fourth, fifth, seventh, thirteenth, and fourteenth line items (ranging from 3,715 to 8,760) are greater than those used to calculate ex ante savings (ranging from 3,500 to 4,000). The remaining line items have hours (ranging from 2,846 to 3,774) fewer than those used to calculate ex ante savings (ranging from 3,500 to 4,000).

An adjusted base wattage of 72W was used in the ex post savings analysis for the fourth- and fifth-line items in the above table to meet the EISA 2007 standard lumen equivalent for a 100W incandescent lamp. The ex ante base wattage of 70W was computed within the application by factoring 70% of a 100W incandescent lamp.

During the M&V site visit the client confirmed that the sixth line item above was retrofitted with 4 lamps per fixture and not 3 lamps. The area needed a higher lumen output.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned large office facility in St. Louis, was applied to the ex post lighting energy savings for all interior measures. The ex ante savings estimate accounted for a heating and cooling factor of 1.07. The exterior measures had a 1.00 factor applied.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[209] The seventh- and eighth-line items above were confirmed to have a miscellaneous and exterior lighting end use, respectively, and not an interior end use.

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 101%.

Site-Level Energy Savings

Incentive	End Use Category	kWh Savings			Gross Ex Post kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Standard	Lighting	69,872	69,809	100%	13.26
	Exterior Lighting	4,280	4,000	93%	0.02
	Miscellaneous	36,137	38,018	105%	5.24
Total		110,289	111,828	101%	18.53

[209] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6126

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed eleven photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 6/13/2018 and 7/24/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306135-Lighting-LED Fixt Replacing T5 Fixture	3088	Lighting	Standard	223	223	240	112	8,130	1.09	267,548	253,346	95%
				42	42	240	137	7,305	1.09	40,549	34,353	85%
306143-Lighting-LED Fixt Replacing T8 Fixture	3025			73	73	88	32	7,322	1.09	38,318	32,742	85%
306142-Lighting-LED Fixt Replacing T12 Fixture	3026			20	20	164	32	8,585	1.09	24,746	24,791	100%
306143-Lighting-LED Fixt Replacing. T8 Fixture	3025			44	44	88	32	7,649	1.09	23,096	20,617	89%
306135-Lighting-LED Fixt Replacing. T5 Fixture	3088			18	18	240	112	1,519	1.09	21,596	3,827	18%
306143-Lighting-LED Fixt Replacing T8 Fixture	3025			20	20	114	32	6,577	1.09	15,373	11,799	77%
306135-Lighting-LED Fixt Replacing. T5 Fixture	3088			5	5	360	112	4,127	1.09	11,622	5,597	48%
300938-Lighting-LED <=14 Watt Fixt Replac Halogen BR/R Fixture	3007			-	-	-	-	-	-	2,100	-	0%
306142-Lighting-LED Fixt Replacing T12 Fixture	3026			2	2	122	32	8,709	1.09	1,686	1,715	102%
306143-Lighting-LED Fixt Replacing T8 Fixture	3025			4	4	32	19	7,233	1.09	487	411	84%
Total										447,121	389,198	87%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours (ranging from 1,519 to 8,709) were fewer than those used to develop the ex ante energy savings estimates (4,380 for the ninth line item, and 8,760 for the remaining line items).

The quantity of the ninth line item in the table above (0) verified during the M&V site visit is less than the ex ante savings quantity (8). The client claimed that there were no fixtures compatible with this measure within the facility and no extra lamps were in storage.

A heating and cooling interactive factor of 1.00 was applied to the ex post lighting energy savings of the unconditioned areas of the facility. A factor of 1.09, applicable to a gas heated, air-conditioned lighting manufacturing facility in St. Louis, was applied to the ex post savings of the rest of the facility. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[210]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 87%. The ex ante energy savings estimate was premised upon a completed installation and overestimated annual hours of operation.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	447,121	389,198	87%	73.93
Total		447,121	389,198	87%	73.93

[210] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6127

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules with all areas having continuous usage.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
305233-Lighting-85-225 Watt Lamp Fixture Replacing Interior HID 301-500 Watt Lamp Fixture	3005-1	Lighting	Standard	146	146	400	146	8,760	1.00	347,596	324,856	93%
306140-Lighting-LED Lamp Fixture Replacing Interior HID Lamp Fixture	3004-1			13	13	1,080	300	8,760	1.00	95,044	88,826	93%
Total										442,640	413,682	93%

The annual lighting hours of operation verified during the M&V site visit (8,760) corresponds with the annual hours of operation used to calculate ex ante savings.

A heating and cooling interactive factor of 1.00, applicable to a unconditioned facility, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[211]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 93%. The ex ante energy savings estimate was premised on overestimated heating and cooling interactive effects.

[211] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	442,640	413,682	93%	78.58
Total		442,640	413,682	93%	78.58

Site ID 6130

Data Collection

The participant received New Construction and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed fifteen photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 6/28/18 and 7/25/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
406123-Lighting-New Cons. Lighting Power Density(LPD)	3000	Lighting	New Construction	295	295	328	34	1,312	1.14	243,040	128,786	53%
100208-Lighting-Non Linear LED Fixture Replacing MH Fixture	1169	Exterior Lighting	Custom	26	26	1,080	200	4,308	1.00	100,214	98,567	98%
Total										343,254	227,353	66%

The lighting energy use of the installed interior lighting equipment is compared with the estimated lighting energy use associated with the applicable new construction baseline (ASHAE 90.1 2001) to determine realized lighting energy savings. The church facility constructed in the City of Bridgeton was subject to the IBC 2003 code in effect during the building design, which allows for 2.2 lighting watts/SF. The code compliant baseline lighting wattage for this project was 96,800 watts (2.2 watts/SF*44000SF).

The annual lighting hours of operation for the second line item in the above table using photo cells (4,308[212]) are less than the hours of operation used to calculate ex ante savings (4,380). Primary data were used to develop estimates of annual lighting operating hours for the new construction interior measures. For all facility areas monitored, the estimated annual operating hours (ranging from 1,279 – 1,355) were fewer than those used to develop the ex ante energy savings estimates (2,800).

A heating and cooling interactive factor of 1.14, applicable to a gas heated, air-conditioned assembly in St. Louis, was applied to the ex post lighting energy savings for the interior measures and a factor of 1.00 for the exterior unconditioned space. The ex ante savings estimate did not account for heating and cooling interactive effects.

[212] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[213]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 66%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	100,214	98,567	98%	0.55
New Construction	Lighting	243,040	128,786	53%	24.46
Total		343,254	227,353	66%	25.02

[213] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6144

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed six photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/25/2018 and 9/17/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306140-Lighting-LED Lamp or Fixt Replacing Interior HID Lamp or Fixt	3004-1	Lighting	Standard	10	10	460	110	2,256	1.00	8,763	7,898	90%
306143-Lighting-LED Lamp or Fixt Replacing T8 Lamp or Fixture	3025			96	96	114	44	2,506	1.02	16,826	17,156	102%
Total										25,589	25,054	98%

The annual lighting hours of operation verified during the M&V site visit for the first line item in the above table (2,256) are fewer than the annual hours of operation used to calculate ex ante savings (2,340), while the hours the second line item (2,506) are greater.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned small office in St. Louis, was applied to the ex post lighting energy savings of the office portion of the second line item in the above table. A factor of 1.00 was applied to the ex post savings for the remaining unconditioned measures. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[214]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%. The ex ante savings estimate was premised upon overestimated heating and cooling interactive effects for 84% of the measures in the above table.

[214] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	25,589	25,054	98%	4.76
Total		25,589	25,054	98%	4.76

Site ID 6154

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed six photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/23/18 and 9/26/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100107-Lighting-Linear Tube LED Fixture Replacing T5 HO Fixture	1169	Lighting	Custom	201	201	360	168	5,403	1.09	247,761	228,077	92%
				135	135	117	56	5,410	1.09	52,869	48,736	92%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025		Standard	696	696	60	43	5,405	1.09	75,961	69,951	92%
				620	620	32	14	1,763	1.09	35,824	21,526	60%
Total										412,415	368,289	89%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours were fewer than those used to develop the ex ante energy savings estimates (ranging from 3,000 to 6,000).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned industrial facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[215]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 89%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

[215] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	111,785	91,476	82%	17.38
Custom		300,630	276,813	92%	52.58
Total		412,415	368,289	89%	69.96

Site ID 6163

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/23/18 and 9/26/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T12 <=40W Linear ft	3026	Lighting	SBDI	423	423	40	18	2,613	1.09	24,894	26,400	106%
				82	82	96	43	2,763	1.09	11,626	13,044	112%
200909-Lighting-LED <=14 W Lamp Replac Halogen BR/R 45-66 W Lamp or Fixture	3007			45	45	65	8	2,639	1.09	7,624	7,350	96%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T12 <=40W Linear ft	3026			22	22	96	43	2,613	1.09	3,119	3,308	106%
305802-Lighting-Delamping Replac T8 32 W	3084			32	32	32	-	2,613	1.09	2,740	2,905	106%
200909-Lighting-LED <=14 Watt Lamp Replacing Halogen BR/R 45-66 Watt Lamp or Fixture	3007			-	-	-	-			1,868		
305233-Lighting-85-225 Watt Lamp or Fixture Replacing Interior HID 301-500 Watt Lamp or Fixture	3005-1			-	-	-	-			1,327		
200808-Lighting-LED <=13 Watt Lamp Replacing Halogen MR-16 35-50 Watt Lamp or Fixture	3012			9	9	35	7	2,934	1.09	1,198	802	67%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft)	3025			32	32	32	18	2,613	1.09	1,198	1,271	106%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
Replacing T8 32 Watt Linear ft												
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T12 <=40W Linear ft	3026			10	10	40	15	2,934	1.09	669	796	119%
301132-Lighting-LED 7-20 Watt Lamp Replacing Halogen A 53-70 Watt Lamp	3009			-	-	-	-			196		
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T12 <=40W Linear ft	3026			3	3	40	18	2,620	1.09	177	189	107%
201111-Lighting-LED <=11 Watt Lamp Replacing Halogen A 28-52 Watt Lamp	3011			1	1	43	9	1,003	1.09	35	37	107%
Total										56,671	56,102	99%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (ranging from 1,000 – 2,500).

An adjusted base wattage was used for the eighth, eleventh, and thirteenth line items in the table above (35W, 72W, and 43W, respectively) to meet the EISA 2007 standard lumen equivalent for an incandescent lamp (50W, 100W, and 60W, respectively). The ex ante base wattage was computed within the application by factoring 70% of an incandescent lamp.

The quantities of the third, sixth, seventh, eighth, and eleventh line items in the table above (45, 0, 0, 9, and 0) verified during the M&V site visit is less than the ex ante savings quantities (50, 11, 2, 16, and 3, respectively).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned light manufacturing in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[216]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 99%. Although several measures were not installed the high realization rate was due to the ex ante savings estimate being premised on underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

[216] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	56,671	56,102	99%	10.66
Total		56,671	56,102	99%	10.66

Site ID 6164

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/23/18 and 9/26/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	10	10	175	46	2,378	1.00	3,313	3,067	93%
301037-Lighting-LED <=20 Watt Lamp or Fixture Replacing Halogen A >=40 Watt Lamp or Fixture	3011			22	22	72	9	2,367	1.01	3,002	3,312	110%
				-	-	-	-	-	-	3,002	-	0%
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026			16	16	88	23	3,116	1.07	2,226	3,458	155%
				4	4	207	86	2,378	1.00	2,072	1,151	56%
				1	1	207	43	2,378	1.00	1,404	390	28%
				1	1	175	23	2,378	1.00	325	361	111%
Total										15,344	11,740	77%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (2,000). The ex ante estimate did not consider the posted store hours nor the 24/7 lighting.

An adjusted base wattage of 72W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 100W incandescent lamp. The ex ante base wattage of 70W was computed within the application by factoring 70% of a 100W incandescent lamp.

The quantities of the first, second, third, fifth, and sixth line items in the first table above (10, 22, 0, 4, and 1, respectively) verified during the M&V site visit is less than the ex ante savings quantity (12, 23, 23, 8, and 4, respectively). The ex post analysis contends that the same measure was placed on two

of the applications in regard to the second and third line items above causing one to have a quantity of zero.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small retail in St. Louis, was applied to the ex post lighting energy savings for the retail areas while a factor of 1.00 was applied to the unconditioned shop areas. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[217]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 77%. The ex ante energy savings estimate was premised on overestimated installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	15,344	11,740	77%	2.23
Total		15,344	11,740	77%	2.23

[217] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6166

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/30/18 and 10/01/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp Fixt	3026	Lighting	SBDI	64	64	164	23	923	1.14	12,070	9,478	79%
301037-Lighting-LED <=20 Watt Lamp or Fixture Replac Halogen A >=40 Watt Lamp or Fixture	3011			88	88	53	9	917	1.14	6,144	4,038	66%
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp Fixt	3026			12	12	82	23	957	1.14	947	771	81%
301039-Lighting-LED <=20 Watt Lamp or Fixture Replacing Halogen PAR Lamp or Fixture	3008			12	12	53	11	936	1.14	799	537	67%
300938-Lighting-LED <=14 Watt Lamp or Fixture Replacing Halogen BR/R Lamp or Fixture	3007			3	3	65	8	705	1.14	549	137	25%
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp Fixt	3026			6	6	56	9	957	1.14	377	307	81%
301039-Lighting-LED <=20 Watt Lamp or Fixture Replacing Halogen PAR Lamp or Fixture	3008			3	3	67	15	936	1.14	247	164	67%
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp Fixt	3026			-	-					246		0%

306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp Fixt	3026			2	2	74	24	957	1.14	134	109	81%
306142-Lighting-LED Lamp Fixt Replacing T12 Lamp or Fixture	3026			-	-					54		0%
Total										21,567	15,541	72%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours (ranging from 705 – 957) were fewer than those used to develop the ex ante energy savings estimates (ranging from 1,250 – 1,500).

An adjusted base wattage of 53W was used in the ex post savings analysis for the second and fourth line items in the table above to meet the EISA 2007 standard lumen equivalent for a 75W incandescent lamp. The ex ante base wattage of 52.5W was computed within the application by factoring 70% of a 75W incandescent lamp.

The quantity of the fifth line item in the first table above (3) verified during the M&V site visit is less than the ex ante savings quantity (6). In addition, the quantities for the eighth and tenth measures (0) were less than the ex ante quantities (1 and 1, respectively). There were no 8' fixtures in the facility.

A heating and cooling interactive factor of 1.14, applicable to a gas heated, air-conditioned assembly facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[218]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 72%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and overestimated installed measures for three line items.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	21,567	15,541	72%	2.95
Total		21,567	15,541	72%	2.95

[218] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6168

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/30/18 and 9/27/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixt Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	37	37	175	23	879	1.14	9,027	5,626	62%
				51	51	88	11	879	1.14	6,302	3,928	62%
301037-Lighting-LED <=20 Lamp or Fixture Replac HalogenA =40 W Lamp or Fixture	3011			47	47	53	9	880	1.14	3,281	2,070	63%
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026			23	23	88	23	879	1.14	2,399	1,496	62%
301039-Lighting-LED <=20 W Lamp or Fixt Replacing Halogen PAR Lamp or Fixture	3008			-	-	-	-			1,011	-	0%
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026			4	4	175	34	879	1.14	905	564	62%
300938-Lighting-LED <=14 W Lamp or Fixture Replac Halogen BR/R Lamp or Fixture	3007			8	8	65	11	455	1.14	732	224	31%
200808-Lighting-LED <=13 W Lamp Replacing Halogen MR-16 35-50 Watt Lamp or Fixture	3012			3	3	50	7	1,287	1.14	207	189	91%
Total										23,864	14,097	59%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours (ranging from 455 – 1,287) were fewer than those used to develop the ex ante energy savings estimates (1,500).

An adjusted base wattage of 53W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 75W incandescent lamp. The ex ante base wattage of 52.5W was computed within the application by factoring 70% of a 60W incandescent lamp.

The quantity of the fifth line item in the table above (0) verified during the M&V site visit is less than the ex ante savings quantity (10). The client confirmed that they had replaced those prior to the trade ally visiting.

The efficient wattage for the seventh line item in the table above (11W) was confirmed during the M&V site visit and is greater than the ex ante wattage (8W).

A heating and cooling interactive factor of 1.14, applicable to a gas heated, air conditioned assembly facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[219]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 59%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours, underestimated efficient wattage for one measure, and overestimated installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	23,864	14,097	59%	2.68
Total		23,864	14,097	59%	2.68

[219] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6178

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed one photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 3/20/18 and 4/23/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixt Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	13	13	164	30	2,611	1.11	5,332	5,038	94%
				4	4	82	30	2,611	1.11	637	602	94%
				1	1	56	20	2,611	1.11	110	104	95%
Total										6,079	5,744	94%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours (2,611) were fewer than those used to develop the ex ante energy savings estimates (2,860).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air conditioned small retail in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[220]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 94%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	6,079	5,744	94%	1.09
Total		6,079	5,744	94%	1.09

[220] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6179

Data Collection

The participant received EMS Program incentives from Ameren Missouri.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered HVAC equipment nameplate information.

Analysis Results

EMS Controls Savings Calculations

Energy savings for the EMS controls were calculated using prototypical energy simulation. ADM used a DEER prototypical eQuest model of a school. The model's HVAC system was auto-sized during a sizing run with local weather data. Using project documents and the details collected during the on-site M&V visit, heating, cooling, and fan schedules were created for the baseline and as-built models. ADM ran parametric simulations to determine the prototypical annual energy usage of the model with EMS schedule changes. The realized energy savings are the differences between the parametric simulations' energy usages, and the energy savings by end use can be seen in the following table:

Prototypical Annual Energy Usage (kWh) by End Use

End Use	*Baseline*	*As-Built*	*kWh Savings*
Lighting	134,598	134,598	0
Misc. Equipment	98,754	98,754	0
Heating	0	0	0
Cooling	78,107	71,648	6,459
Heat Rejection	0	0	0
Auxiliary (pumps)	2,238	2,238	0
Vent fan	61,096	60,042	1,054
Total	374,793	367,280	7,513

The prototypical annual energy savings were normalized to HVAC cooling tonnage. This was done by dividing the prototypical energy savings by the prototypical model's HVAC cooling tonnage. The normalized 87.76 kWh/ton savings were multiplied by the actual site HVAC tonnage.

The following table presents information on prototypical and actual equipment and expected and realized energy savings for the EMS controls installed at the site:

EMS Controls Savings

Program	Measure	HVAC Tonnage		EMS Controls Savings		Realized kWh Savings
		Prototypical	Actual	Prototypical kWh	Normalized kWh/ton	
EMS	Temp. Set-backs	85.6	598	7,513	87.76	52,478
Total						52,748

Measure level savings are shown in the following table:

Custom and EMS Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
17920 Controls – Cooling	1169	Cooling	EMS	60,498	52,478	87%
Total				60,498	52,478	87%

There were significant differences in the ex ante and ex post analyses for the EMS controls, with a realization rate of 87%. The ex ante analysis that was provided does not match the expected savings. The provided ex ante analysis uses assumed schedules and setbacks, HVAC equipment runtimes, and collected HVAC nameplate data. ADM used eQuest prototypical simulation to calculate energy savings. The simulations account for the equipment runtime better than the ex ante. The ex post analysis also used different cooling and fan schedules based on post verification. The ex ante analysis assumed that the baseline controls did not have cooling set-backs. ADM determined that the existing thermostats were programmable, so ADM accounted for some baseline cooling set-backs resulting in less realized savings.

Verified annual savings for the EMS Program incentives are 52,478 kWh, resulting in a realization rate of 87%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	End Use Category	kWh Savings			Gross Ex Post kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
EMS	Cooling	60,498	52,478	87%	47.79
Total		60,498	52,478	87%	47.79

Site ID 6180

Data Collection

The participant received EMS Program incentives from Ameren Missouri for installing a new energy management system (EMS) to control HVAC schedules.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered mechanical schedules and HVAC equipment nameplate information.

Analysis Results

EMS Controls Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A monthly pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against monthly billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Cooling and heating degree days (CDD & HDD) were calculated for each billing period and used with a pre/post binary flag variable in an electric usage regression resulting in an R^2 of 0.965 and adjusted R^2 of 0.957. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh_{monthly} = 39.5 \times CDD + 83.8 \times HDD - 3{,}370 \times Pre\_Post + 83.8 \times HDD\_Post + 19{,}730$$

Where:

$kWh_{monthly}$	= Monthly kWh Consumption
CDD	= Cooling Degree Days for the Month with a Base Temperature of 64°F
HDD	= Heating Degree Days for the Month with a Base Temperature of 47°F
Pre_Post	= Pre/Post-Retrofit Binary Flag
HDD_Post	= HDD multiplied by Pre_Post

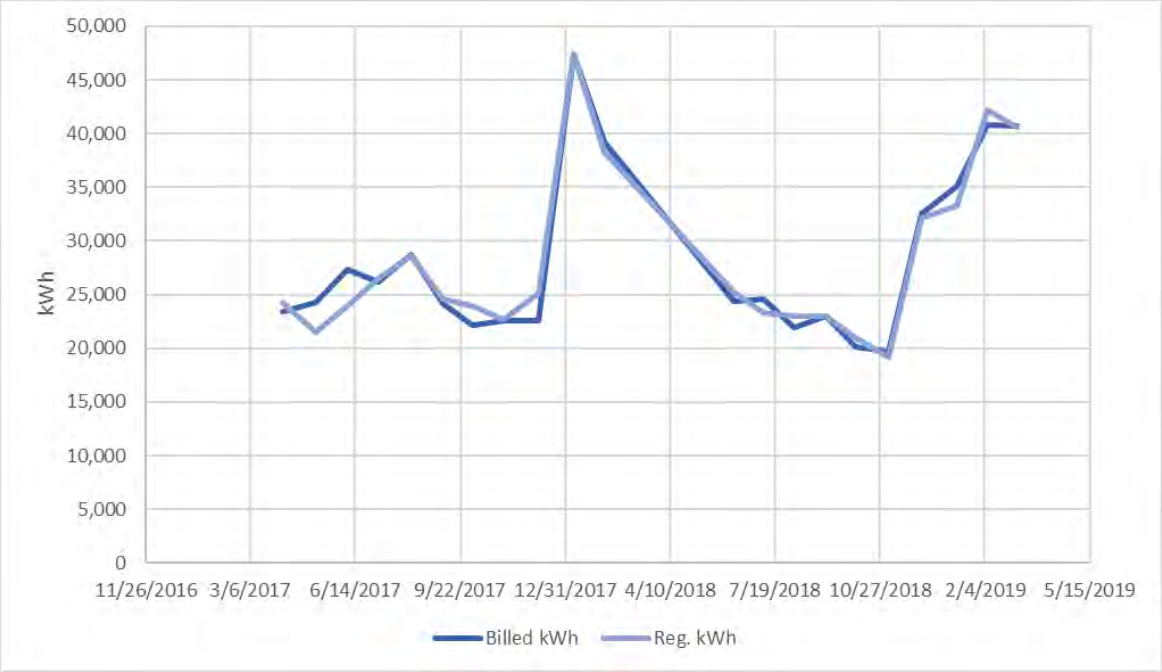
The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	*T Stat*
Intercept	25.1
Pre_Post	-3.77
CDD	6.23
HDD	16.0
HDD_Post	2.56

Electric energy usage values were calculated on a monthly basis using the derived regression equation. The following plot compares the monthly billed kWh to the regressed kWh:

Billed vs. Regressed Monthly kWh



Annual kWh savings for the installed measures were determined by using typical year (TMY3) weather data and the derived equation to calculate monthly pre/post energy consumption of the site. Each month was summed for a year to obtain annual energy savings. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility, and can be seen in the following table:

Monthly kWh Savings

Month	*CDD*	*HDD*	*kWh*		
			Baseline	*As-Built*	*Savings*
Jan	0	297	28,710	30,576	-1,867
Feb	0	197	24,898	24,992	-94
Mar	14	66	24,226	22,025	2,200
Apr	28	18	21,562	18,500	3,062
May	45	2	23,980	20,652	3,329
Jun	146	0	26,467	23,097	3,370
Jul	193	0	28,570	25,200	3,370
Aug	156	0	24,550	21,180	3,370
Sep	81	0	23,998	20,628	3,370
Oct	15	18	22,723	19,672	3,050
Nov	3	93	25,067	23,327	1,740

Month	CDD	HDD	kWh		
			Baseline	As-Built	Savings
Dec	0	252	47,409	48,468	-1,059
Total			322,161	298,318	23,842

Total billing regression energy savings were allocated to cooling and HVAC measures in the same ratios as the ex ante analysis.

Measure level savings are shown in the following table:

EMS Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
117920 HVAC Optimization – Cooling	1169	Cooling	EMS	1,865	1,526	82%
118229 HVAC Optimization – HVAC	1169	HVAC	EMS	27,276	22,317	82%
Total				29,141	23,842	82%

There were significant differences in the ex ante and ex post analysis methodologies for the EMS measures, with a realization rate of 82%. The ex ante analysis used bin analysis with assumed occupancy schedules, fan speeds, and HVAC loads. All these assumptions created significant uncertainty with the ex ante savings estimates. The ex ante analysis did not use any site-specific trending or utility data. ADM used a billing regression with a good fit (R Square = 0.965) to determine realized energy savings. This method better accounts for actual site HVAC energy usage than the ex ante calculations. The ex post analysis also realized slightly negative heating savings. The ex ante analysis does not account for heating energy usage.

The verified annual site-level energy savings are 23,842 kWh, resulting in an 82% realization rate.

A table showing the energy savings achieved by the measures evaluated for this site is shown below:

Site-Level Energy Savings

Incentive	End Use Category	kWh Savings			Gross Ex Post kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
EMS	Cooling	1,865	1,526	82%	1.39
	HVAC	27,276	22,317	82%	9.91
Total		29,141	23,842	82%	11.30

Site ID 6183

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/06/18 and 08/01/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replac T12 Lamp	3026	Lighting	SBDI	18	18	227	60	1,952	1.09	6,433	6,400	99%
306141-Lighting-LED Lamp Replac Exter24/7HIDLamp	3004-2	Ext. Lighting		1	1	205	38	4,310	1.00	1,463	720	49%
306142-Lighting-LED Lamp Replaci T12 Lamp	3026	Lighting		4	4	82	30	855	1.09	445	194	44%
				8	8	164	60	855	1.09	1,780	776	44%
306141-Lighting-LED Lamp Replac Exter24/7HIDLamp	3004-2	Ext. Lighting		2	2	295	42	4,310	1.00	4,432	2,181	49%
306142-Lighting-LED Lamp Replac T12 Lamp	3026	Lighting		3	3	82	30	1,827	1.09	334	311	93%
Total										14,887	10,581	71%

The annual lighting hours of operation verified during the M&V site visit for the first, third, fourth, and sixth non-exterior line items in the table above (ranging from 855 and1,952) are fewer than the annual hours of operation used to calculate ex ante savings (2,000). For the exterior measures in the second and fifth line items above the annual lighting hours of operation using photo cells (4,310[221]) are less than the hours of operation used to calculate ex ante savings used for exterior lighting (8,760).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned light manufacturing facility in Cape Girardeau, was applied to the ex post lighting energy savings for the interior installations. A factor of 1.00 was applied to exterior spaces. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

[221] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[222] The second and fifth measures in the table above were incorrectly labeled as miscellaneous on the application where the ex post end use applied exterior lighting.

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 71%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	8,992	7,680	85%	1.46
	Exterior Lighting	5,895	2,901	49%	0.02
Total		14,887	10,581	71%	1.48

[222] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6186

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/12/18 and 08/06/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	18	18	138	86	1,858	1.11	1,941	1,926	99%
301037-Lighting-LED <=20 Watt Lamp Replacing Halogen A >=40 Watt Lamp	3011			4	4	43	11	365	1.11	258	52	20%
306142-Lighting-LED Lamp Replacing T12 Lamp	3026			1	1	82	36	1,890	1.11	95	96	101%
				2	2	138	86	1,890	1.11	215	218	101%
Total										2,509	2,292	91%

The annual lighting hours of operation verified during the M&V site visit (ranging from 365 and 1,890) are fewer than the annual hours of operation used to calculate ex ante savings (1,939).

An adjusted base wattage of 43W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp for the second line item in the table above. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[223]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 91%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

[223] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	2,509	2,292	91%	0.44
Total		2,509	2,292	91%	0.44

Site ID 6193

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed six photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/19/2018 and 8/29/2018

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixt Replacing T8 Lamp or Fixture	3025	Lighting	SBDI	29	29	114	44	506	1.14	5,083	1,168	23%
				9	9	59	24	393	1.14	790	141	18%
Total										5,873	1,309	22%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours (ranging from 393 – 506) were fewer than those used to develop the ex ante energy savings estimates (2,340). It appears the ex ante savings were based on an often-used office space and did not account for infrequently used areas.

A heating and cooling interactive factor of 1.14, applicable to a gas heated, air-conditioned assembly facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[224]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 22%. The ex ante energy savings estimate was premised upon overestimated annual hours of use.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	5,873	1,309	24%	0.25
Total		5,873	1,309	22%	0.25

[224] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6195

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/25/2018 and 8/22/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixt Replacing T12 Lamp or Fixt	3026	Lighting	SBDI	20	20	164	44	1,346	1.11	9,142	3,572	39%
Total										9,142	3,572	39%

The annual lighting hours of operation verified during the M&V site visit for the line item in the above table (1,346) were fewer than the annual hours of operation used to calculate ex ante savings (3,560). Most of the measures were installed in unoccupied suites during the initial installation. The suites were unoccupied during two EMV site visits and the client has no prospects for leasing the spaces. The ex ante hours do not represent typical office hours nor the actual site usage.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[225]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 39%. The ex ante energy savings estimate was premised upon overestimated annual hours of operation.

[225] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	9,142	3,572	39%	0.68
Total		9,142	3,572	39%	0.68

Site ID 6197

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/19/2018 and 9/19/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp/ Fixt Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	52	52	164	44	1,012	1.09	13,888	6,892	50%
				5	5	82	24	2,129	1.09	645	673	104%
				7	7	48	12	2,129	1.09	561	585	104%
Total										15,094	8,151	54%

The annual lighting hours of operation verified during the M&V site visit for the first line item (1,012) are fewer than the annual hours of operation used to calculate ex ante savings (2,080), while the verified hours for the remaining line items (2,129) are greater.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned education facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[226]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 54%. The ex ante energy savings estimate was premised upon overestimated annual hours of operation for 81% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	15,094	8,151	54%	1.55
Total		15,094	8,151	54%	1.55

[226] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6198

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/19/2018 and 9/19/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	25	25	164	44	767	1.14	7,511	2,616	35%
				76	76	82	24	1,059	1.14	11,037	5,310	48%
Total										18,548	7,926	43%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours (ranging from 767 to 1,059) were fewer than those used to develop the ex ante energy savings estimates (2,340). The measures were installed in less frequently used areas of the facility.

A heating and cooling interactive factor of 1.14, applicable to a gas heated, air-conditioned assembly facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[227]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 43%. The ex ante energy savings estimate was premised upon overestimated annual hours of operation.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	18,548	7,926	43%	1.51
Total		18,548	7,926	43%	1.51

[227] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6200

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/21/2018 and 8/31/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306140-Lighting-LED Lamp or Fixture Replacing Interior HID Lamp or Fixture	3004-1	Lighting	SBDI	29	29	460	110	2,115	1.09	34,319	23,417	68%
Total										34,319	23,417	68%

Primary data were used to develop estimates of annual lighting operating hours. For the facility area monitored, the estimated annual operating hours were fewer than those used to develop the ex ante energy savings estimates (3,160).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned education based facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling interactive factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[228]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 68%. The ex ante energy savings estimate was premised upon overestimated annual hours of operation.

[228] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	34,319	23,417	68%	4.45
Total		34,319	23,417	68%	4.45

Site ID 6202

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed eight photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/25/18 and 08/22/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	22	22	138	44	1,246	1.14	4,603	2,932	64%
				12	12	164	44	1,279	1.14	3,205	2,096	65%
				69	69	82	24	986	1.14	8,908	4,488	50%
Total										16,716	9,515	57%

The annual lighting hours of operation verified during the M&V site visit (ranging from 986 and 1,279) are fewer than the annual hours of operation used to calculate ex ante savings (2,080).

A heating and cooling interactive factor of 1.14, applicable to a gas heated, air-conditioned community assembly facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[229]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 57%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	16,716	9,515	57%	1.81
Total		16,716	9,515	57%	1.81

[229] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6205

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/19/18 and 08/29/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Fixture Replacing T12 Fixture	3026	Lighting	SBDI	15	15	138	44	1,255	1.11	4,237	1,957	46%
Total										8,474	3,914	46%

The annual lighting hours of operation verified during the M&V site visit (1,255) are fewer than the annual hours of operation used to calculate ex ante savings (2,808).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned small office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[230]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 46%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	4,237	1,957	46%	0.37
Total		4,237	1,957	46%	0.37

[230] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6210

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed six photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/17/18 and 08/13/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	182	182	138	86	3,616	1.10	30,744	37,770	123%
				20	20	138	86	1,521	1.10	3,378	1,746	52%
				30	30	138	86	3,935	1.00	5,068	6,139	121%
Total										39,190	45,655	116%

The annual lighting hours of operation verified during the M&V site visit for the second line item above (1,521) are fewer than the annual hours of operation used to calculate ex ante savings (3,036). The hours of operation for the first and third line items (3,616 and 3,935) are greater than ex ante hours.

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air-conditioned large single-story retail facility in St. Louis, was applied to the ex post lighting energy savings. A factor of 1.00 was applied to unconditioned storage spaces. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[231]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 116%. The ex ante energy savings estimate were premised on underestimated annual lighting operating hours and underestimated heating and cooling interactive effects for 91% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	39,190	45,655	116%	8.67
Total		39,190	45,655	116%	8.67

[231] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6212

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/20/2018 and 8/15/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
200808-Lighting-LED <=13 Watt Lamp Replacing Halogen MR-16 35-50 Watt Lamp Fixt	3012	Lighting	SBDI	8	8	50	7	3,461	1.01	1,327	1,198	90%
				7	7	50	7	3,455	1.01	1,161	1,046	90%
301037-Lighting-LED <=20 Watt Fixt Replacing Halogen A >=40 Watt Fixt	3011			6	6	43	9	3,461	1.01	764	710	93%
301039-Lighting-LED <=20 Watt Fixture Replacing Halogen PAR Lamp	3008			30	30	65	12	4,520	1.01	6,135	7,231	118%
300938-Lighting-LED <=14 Watt Lamp or Fixture Replacing Halogen BR/R Lamp or Fixture	3007			21	21	65	9	4,465	1.01	4,537	5,283	116%
				6	6	65	9	1,942	1.01	1,296	657	51%
				2	2	65	9	3,371	1.01	432	380	88%
				-	-	65	9	-	-	864	-	-
				-	-	75	9	-	-	255	-	-
301037-Lighting-LED <=20 Watt Fixt Replacing Halogen A >=40 Watt Fixt	3011			1	1	43	9	3,371	1.01	128	115	90%
301039-Lighting-LED <=20 Watt Lamp Fixture Replacing Halogen PAR Lamp or Fixture	3008			6	6	90	16	3,461	1.01	1,713	1,546	90%
Total										18,612	18,165	98%

The annual lighting hours of operation verified during the M&V site visit for the fourth and fifth line items in the above table (4,520 and 4,465, respectively) are greater than the annual hours used to calculate ex ante savings (3,606). The verified hours for the remaining line items (ranging from 1,942 to 3,461) are fewer than those used to calculate ex ante savings (3,606).

The quantities of the eighth and ninth line items in the above table (0) verified during the M&V site visit are less than the ex ante savings quantities (4 and 1, respectively). The baseline lamps for these line items were reinstalled at the site contact's request.

A heating and cooling interactive factor of 1.01, applicable to an electrically heated, air-conditioned small retail in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[232]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%. The ex ante energy savings estimate was premised upon a completed installation and overestimated heating and cooling interactive factors.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	18,612	18,165	98%	3.45
Total		18,612	18,165	98%	3.45

[232] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6213

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/21/18 and 08/20/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
305013-Lighting-<=80 Watt Lamp Replacing Garage 24/7 HID 100-175 Watt Lamp	3006-1	Exterior Lighting	Standard	140	140	175	50	4,250	1.00	153,300	74,371	49%
				14	14	175	24	4,308	1.00	18,519	9,107	49%
305005-Lighting-<=80 Watt Lamp Replacing Interior HID 100-175 Watt Lamp				328	328	175	50	4,269	1.00	359,160	175,011	49%
Total										530,979	258,489	49%

The annual lighting hours of operation verified during the M&V site visit (ranging from 4,250 and 4,308[233]) are fewer than the annual hours of operation used to calculate ex ante savings (8,760). No measures had continuous usage.

A heating and cooling interactive factor of 1.00, applicable to an unconditioned space was applied to the ex post lighting energy savings which corresponds to the ex ante savings estimate factor.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[234]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 49%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

[233] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[234] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Exterior Lighting	530,979	258,489	49%	1.45
Total		530,979	258,489	49%	1.45

Site ID 6217

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/26/18 and 10/24/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306135-Lighting-LED Lamp or Fixture Replacing T5 Lamp or Fixture	3088	Lighting	Standard	533	533	360	168	7,080	0.91	735,837	660,254	90%
				24	24	468	224	6,822	0.91	42,107	36,408	86%
				11	11	577	280	7,335	0.91	23,491	21,838	93%
Total										801,435	718,499	90%

The annual lighting hours of operation verified during the M&V site visit for the line items in the table above (6,822, 7,080, and 7,335) are greater than the annual hours of operation used to calculate ex ante savings (6,720).

A heating and cooling interactive factor of 0.91, applicable to an electric heated, unconditioned light manufacturing facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[235]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 90%. The ex ante energy savings estimate was premised on overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	801,435	718,499	90%	136.49
Total		801,435	718,499	90%	136.49

[235] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6218

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed seven photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 6/29/18 and 10/04/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100201-Lighting-Non Linear LED Fixture Replac T12 Fixture	1169	Lighting	Custom	1	1	82	32	3,734	1.00	215	187	87%
				14	14	164	36	2,882	1.11	6,299	5,711	91%
100204-Lighting-Non Linear LED Fixture Replac T8 Fixture				38	38	114	36	2,882	1.11	10,418	9,447	91%
100208-Lighting-Non Linear LED Fixture Replac M H Fixture		Exterior Lighting		7	7	455	220	4,308	1.00	7,205	7,087	98%
				7	7	128	20	4,308	1.00	3,311	3,257	98%
100212-Lighting-Non Linear LED Fixture Replac Incan/Halogen Lamp Fixture				2	2	56	17	4,308	1.00	342	336	98%
305233-Lighting-85-225 Watt Lamp Fixture Replac Interior HID 301-500 Watt Lamp Fixture	3005-1	Lighting	Standard	96	96	460	150	3,734	1.00	278,946	111,130	40%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T12 <=40 Watt Linear ft	3026			84	84	60	43	3,734	1.00	6,055	5,332	88%
				6	6	75	43	3,850	1.00	814	739	91%
				4	4	110	43	3,850	1.00	1,136	1,032	91%
				4	4	60	43	3,850	1.00	288	262	91%
				8	8	40	18	3,850	1.00	746	678	91%
				260	260	40	18	3,734	1.00	24,255	21,360	88%
				1	1	40	18	3,850	1.00	93	85	91%
305402-Lighting-Linear ft LED (<=5.5	3025			522	522	32	17	3,734	1.00	33,202	29,239	88%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
Watts/ft) Replac T8 32WLinearft												
Total										373,325	195,880	52%

The annual lighting hours of operation verified during the M&V site visit for the second, fourth, and fifth line items in the above table using photo cells (4,308[236]) are less than the hours of operation used to calculate ex ante savings (ranging from 4,380-8,760). The remaining measures had annual operating hours (ranging from 2,882 – 3,850) which were fewer than the ex ante savings estimate hours (ranging from 3,285 – 8,760).

A heating and cooling interactive factor of 1.00 was applied to the exterior measures and corresponds with the ex ante factor. For the interior office space, a factor of 1.11, applicable to a gas heated, air-conditioned office in St. Louis, was applied to the ex post lighting energy savings. While a factor of 1.00 was used for the measures that were installed in the unconditioned warehouse spaces. The ex ante savings estimate accounted for a heating and cooling factor of 1.07 for both the office and warehouse locations.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[237]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 52%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	End Use Category	kWh Savings			Gross Ex Post kW Reduction
		Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross Realization Rate	
Standard	Lighting	345,535	169,856	49%	32.27
Custom	Lighting	16,932	15,345	91%	2.91
	Exterior Lighting	10,858	10,680	98%	0.06
Total		373,325	195,880	52%	35.24

[236] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[237] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6221

Data Collection

The participant received New Construction Program incentives from Ameren Missouri.

During the M&V visit, ADM staff verified the implemented above code new construction measures. Field staff also collected specifics about the construction of the facility, occupancy rates, internal loads, HVAC equipment, and HVAC operation. ADM also acquired the ex ante Trane Trace energy models used for energy savings estimates. Facility personnel were interviewed regarding lighting operating schedules and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/30/18 and 10/24/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
406123-Lighting-NC Lighting Power Density(LPD)	3000	Lighting	New Construction	4,546	4,546	14	12	5,981	1.14	56,722	53,283	94%
Total										56,722	53,283	94%

The lighting energy use of the installed lighting equipment is compared with the estimated lighting energy use associated with the applicable new construction baseline (ASHAE 90.1 2007) to determine realized lighting energy savings. The retirement facility constructed in St. Louis County allows for 0.61 lighting watts/SF. The code compliant baseline lighting wattage for this project which had two spaces was 37,401 watts (0.61 watts/SF*61,313SF) and 25,009 watts (0.61 watts/ SF*40,998SF).

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours (5,981) was fewer than those used to develop the ex ante energy savings estimates (7,261).

A heating and cooling interactive factor of 1.14, applicable to a gas heated, nursing home facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate did not account for heating and cooling interactive effects.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[238]

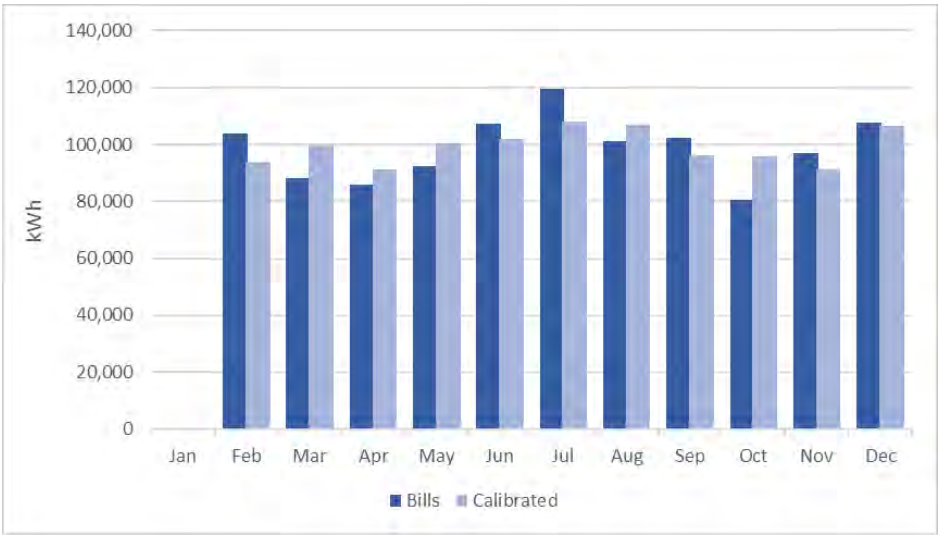
New Construction Savings Calculations

Energy savings for the implemented above code new construction measures were calculated using IPMVP Option D, Calibrated Simulation. This was completed using Trane Trace 700 energy simulation. ADM was provided the Trane Trace archived model used to estimate ex ante energy savings. ADM

[238] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

reviewed the baseline model's inputs and adjusted the model based on information collected during the on-site visit. The model was then run using weather data for the St. Louis region to ensure that the model was properly calibrated to the billed energy consumption of the facility. The results of the calibration effort can be seen in the following plot:

Trane Trace Model Calibration



The new facility addition was added to an existing electric utility meter for an existing facility, thus ADM performed a billing regression analysis to determine the usage of only the new facility. A monthly pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against monthly billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the new facility addition.

Cooling and Heating degree days (CDD, HDD) were calculated for each billing period and used with a pre/post binary flag variable in an electric usage regression resulting in an R^2 of 0.997 and adjusted R^2 of 0.997. The pre/post binary flag variable represents when the new facility addition was completed and a resulting increase in energy usage was observed on the electric utility meter. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post facility addition configurations:

$$kWh_{monthly} = 303 \times CDD + 309 \times CDD\_Post + 227 \times HDD + 201 \times HDD\_Post + 37{,}606 \times Pre\_Post + 41{,}835$$

Where:

kWh_{montly}	= Monthly kWh Consumption
CDD	= Cooling Degree Days for the Month with a Base Temperature of 60.3°F
HDD	= Heating Degree Days for the Month with a Base Temperature of 67.4°F
Pre_Post	= Pre/Post Facility Addition Binary Flag
CDD_Post	= Pre/Post Facility Addition Binary Flag multiplied by CDD
HDD_Post	= Pre/Post Facility Addition Binary Flag multiplied by HDD

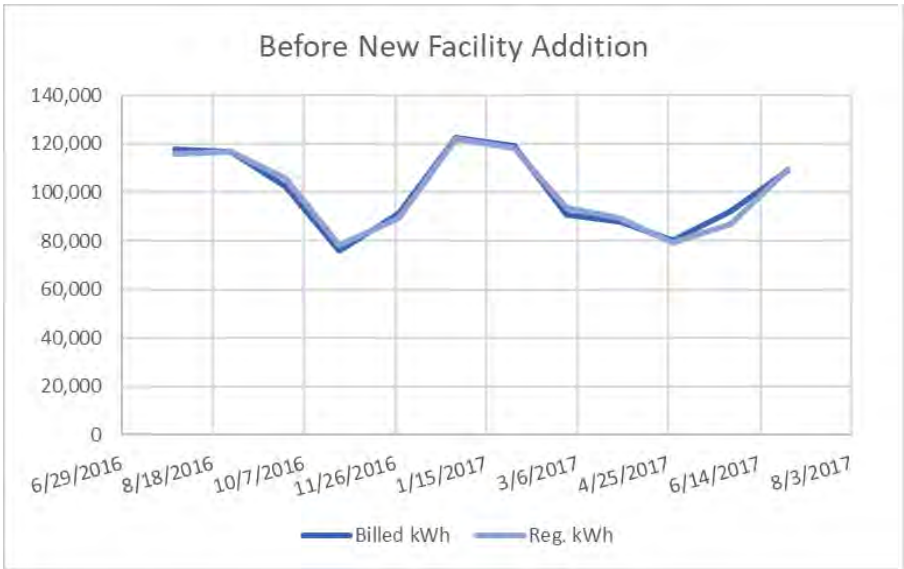
The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

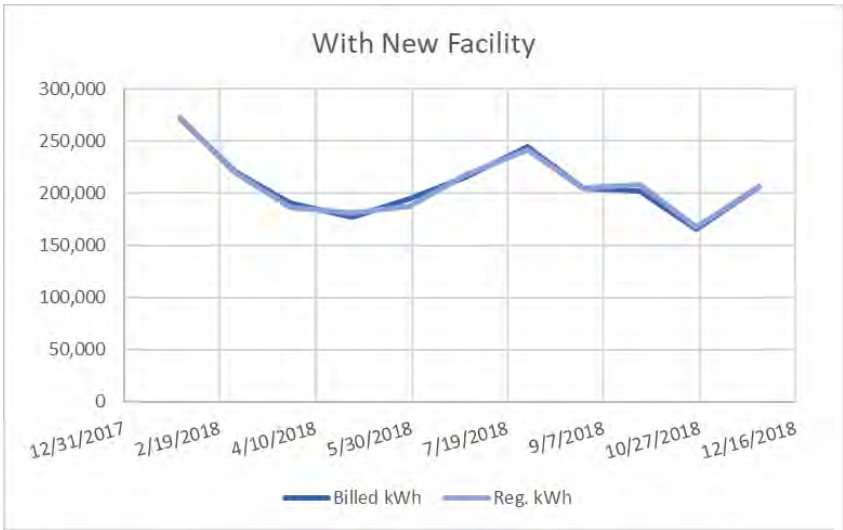
Variable	*T Stat*
Intercept	10.5
Pre_Post	5.86
CDD	14.8
HDD	14.4
CDD_Post	9.69
HDD_Post	8.88

Electric energy usage values were calculated on a monthly basis using the derived regression equation. The following plots compares the monthly billed kWh to the regressed kWh before and after the new facility addition:

Billed vs. Regressed Monthly kWh



Billed vs. Regressed Monthly kWh



For the calibration, the new facility energy usage was determined using only the pre/post variables because they represent the added load from the facility addition. Thus, the new facility's month energy usage was calculated using the following equation:

$$Facility\ Addition\ kWh_{monthly} = 309 \times CDD\_Post + 201 \times HDD\_Post + 37{,}606 \times Pre\_Post$$

Where:

Facility Addition kWh$_{monthly}$ = Monthly kWh Consumption of the facility addition
Pre_Post = Pre/Post Facility Addition Binary Flag
CDD_Post = Pre/Post Facility Addition Binary Flag multiplied by CDD
HDD_Post = Pre/Post Facility Addition Binary Flag multiplied by HDD

Upon the calibration of the as-built model using the facility addition regressed billing data, an alternative model run was utilized in Trane Trace to determine the impacts of the above code measures on energy consumption. The two models were run using typical weather for the region to determine the typical annual savings for the project. The annual savings are the difference between the annual consumption of the baseline and as-built models. The energy savings results from the model are presented in the following table:

New Construction Energy Savings

Month	*TMY3 Savings*		
	Baseline	*As-Built*	*Savings*
January	99,523	111,646	-12,123
February	90,736	94,103	-3,367
March	105,940	95,430	10,510
April	117,578	94,862	22,716
May	135,416	101,241	34,175
June	153,744	106,339	47,405
July	161,048	110,049	50,999

Month	*TMY3 Savings*		
	Baseline	*As-Built*	*Savings*
August	160,073	111,707	48,366
September	139,369	98,746	40,623
October	118,783	98,779	20,004
November	98,947	93,818	5,129
December	98,424	105,471	-7,047
Total	1,479,581	1,222,191	257,390

Measure level savings are shown in the following table:

New Construction Savings

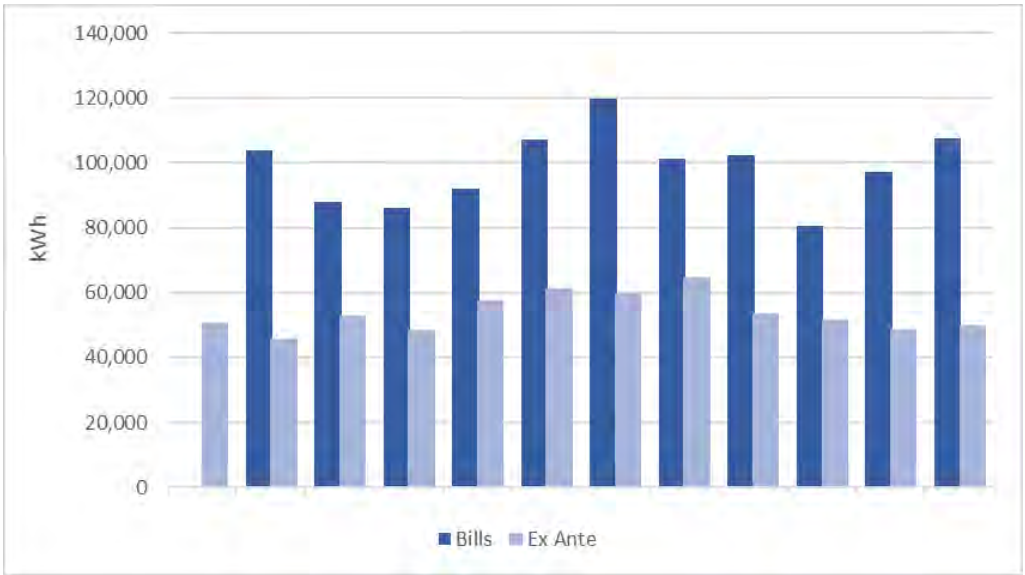
Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
115921 – VRF	1169	Cooling	New Construction	128,107	124,881	97%
113321 – VFDs	1169	HVAC	New Construction	62,818	80,601	128%
426325 – Whole Building	3000	Bld. Shell	New Construction	40,455	51,908	128%
Total				231,380	257,390	111%

Verified annual savings for implementation of the New Construction measures are 257,390 kWh, resulting in a site-level realization rate of 111%. The differences in realized savings can be attributed to the calibration of the provided Trane Trace model. The calibration adjustments to the model included: adjusting lighting and occupancy schedules, internal loads, and modifying heating and cooling equipment, schedules, and set-points.

ADM adjusted the as-built heating and cooling schedules for model calibration based on information collected on site. The ex post model calibration resulted in less savings for the one end use category and more savings in two end use categories. The cooling savings decreased because schedules were reduced during non-summer months. The fan and envelope savings increased because ADM increased lighting and occupancy schedules, which increased the amount of heat in the spaces, which then required less heating and fan energy usage.

The ex ante model used assumed thermostat set-points, equipment loads, and lighting and occupancy schedules. As a result, the model's calibration was significantly different than the billed energy usage and can be seen in the following figure:

Monthly Energy Usage of Ex Ante Model vs. Utility Bills



A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 108%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
New Construction	Lighting	56,722	53,283	94%	10.12
	Cooling	128,107	124,881	97%	113.73
	HVAC	62,818	80,601	128%	35.79
	Building Shell	40,455	51,908	128%	23.05
Total		288,102	310,673	108%	182.69

Site ID 6225

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 07/20/18 and 08/15/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp Replacing T8 Lamp	3025	Lighting	SBDI	76	76	59	22	2,490	1.00	7,042	7,002	99%
306142-Lighting-LED Lamp Replacing T12 Lamp	3026			2	2	82	24	1,752	1.00	291	203	70%
Total										7,333	7,205	98%

The annual lighting hours of operation verified during the M&V site visit for the first line item in the table above (2,490) are greater than the annual hours of operation used to calculate ex ante savings (2,340), while the second line item has fewer hours of operation (1,752).

A heating and cooling interactive factor of 1.00, applicable to a gas heated, unconditioned storage facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[239]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	7,333	7,205	98%	1.37
Total		7,333	7,205	98%	1.37

[239] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6228

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed six photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/19/2018 and 8/15/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixt Replacing T8 Lamp or Fixture	3025	Lighting	SBDI	2	2	59	22	2,797	1.00	185	207	112%
				51	51	114	44	2,543	1.08	8,939	9,778	109%
				18	18	175	66	1,930	1.00	4,912	3,786	77%
Total										14,036	13,771	98%

The annual lighting hours of operation verified during the M&V site visit for the first two line items in the above table (2,797 and 2,543, respectively) are greater than the annual hours of operation used to calculate ex ante savings (2,340), while the hours for the third line item (1,930) are fewer.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned small office in St. Louis, was applied to the ex post lighting energy savings of the office portion of the second line item in the above table. A factor of 1.00 was applied to the ex post savings for the remaining unconditioned measures. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[240]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	14,036	13,771	98%	2.62
Total		14,036	13,771	98%	2.62

[240] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6233

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed eleven photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/31/18 and 8/29/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
021808-306142-Lighting-LED Lamp or Fixt Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	97	97	164	51	2,523	0.98	43,104	27,169	63%
				28	28	122	51	2,551	0.98	7,430	4,981	67%
021808-201316-Lighting-LED Electroluminescent Replacing Incandescent Exit Sign	793			5	5	40	4	8,760	0.98	2,700	1,549	57%
021808-301037-Lighting-LED <=20 Watt Lamp or Fixt Replacing Halogen A >=40 Watt Lamp or Fixt	3011			26	26	53	9	2,643	0.98	3,752	2,970	79%
021808-300938-Lighting-LED <=14 Watt Lamp or Fixt Replacing Halogen BR/R Lamp or Fixture	3007			6	6	75	8	4,013	0.98	2,666	1,585	59%
Total										59,652	38,253	64%

The annual lighting hours of operation for the fifth line item in the table above was verified during the M&V site visit to operate 24/7, which is consistent with the ex ante savings estimate hours (8,760). The lighting hours of for the fifth line item in the table above (4,013) are greater than the annual hours of operation used to calculate ex ante savings (3,100), while the remaining lighting hours (ranging from 2,523 – 2,643) were fewer than the ex ante.

An adjusted base wattage of 53W was used in the ex post savings analysis regarding the sixth line item in the table above to meet the EISA 2007 standard lumen equivalent for a 75W incandescent lamp. The ex ante base wattage of 52.5W was computed within the application by factoring 70% of a 60W incandescent lamp.

The efficient wattages for the fixtures referenced in the second line item in the table above verified during the M&V site visit (51W) is greater than the efficient wattage referenced for the ex ante savings estimate (42W). The 17W LEDs referenced in the first line item was used instead of 14W LED lamps.

The quantities of the first, third, and fifth line items in the table above (97, 5 and 6, respectively) verified during the M&V site visit is less than the ex ante savings quantity (115, 8 and 12, respectively).

A heating and cooling interactive factor of 0.98, applicable to an electrically heated, air-conditioned education facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[241]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 64%. The ex ante savings estimate was premised on overestimated annual operating hours for 93% of the project, overestimated installed quantities, and overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	59,652	38,253	64%	7.27
Total		59,652	38,253	64%	7.27

[241] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6234

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 12/21/2018 and 1/23/2019.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
301037-Lighting-LED <=20 Watt Lamp or Fixt Replacing Halogen A >=40 Watt Lamp or Fixt	3011	Lighting	SBDI	125	125	43	13	1,155	1.09	10,015	4,724	47%
Total										10,015	4,724	47%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours (1,155) were fewer than those used to develop the ex ante energy savings estimates (2,340).

The ex ante savings estimate used an adjusted base wattage of 42W by multiplying the provided wattage by 70%. An adjusted base wattage of 43W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp.

The efficient wattage verified during the M&V site visit (13) is greater than the efficient wattage used to calculate ex ante savings (10).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned education-based facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[242]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 47%. The ex ante energy savings estimate was premised upon overestimated annual lighting operating hours.

[242] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	10,015	4,724	47%	0.90
Total		10,015	4,724	47%	0.90

Site ID 6235

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/24/18 and 8/20/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realizati on Rate*
306142-Lighting-LED Lamp or Fixt Replacing T12 Lamp Fixture	3026	Lighting	SBDI	12	12	122	30	2,773	1.11	3,317	3,391	102%
301037-Lighting-LED <=20W Lamp or Fixt Replac HalogenA 40W Lamp or Fixt	3011			12	12	43	9	2,773	1.11	1,190	1,253	105%
306142-Lighting-LED Lamp or Fixt Replacing T12 Lamp Fixture	3026			1	1	164	30	2,773	1.11	403	412	102%
300938-Lighting-LED <=14 Watt Lamp or Fixt Replacing Halogen BR/R Lamp Fixture	3007			2	2	65	11	2,731	1.11	324	327	101%
				5	5	65	8	2,773	1.11	857	875	102%
306142-Lighting-LED Lamp or Fixt Replacing T12 Lamp Fixture	3026			1	1	164	60	2,731	1.11	314	315	100%
Total										6,405	6,572	103%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours were fewer than those used to develop the ex ante energy savings estimates (2,808).

An adjusted base wattage of 43W was used in the ex post savings analysis regarding the second line item in the table above to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[243]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 103%. The ex ante energy savings estimate was premised on underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	6,405	6,572	103%	1.25
Total		6,405	6,572	103%	1.25

[243] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6236

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 08/01/18 and 08/29/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T12 <=40 Watt Linear ft	3026	Lighting	SBDI	72	72	84	43	2,615	0.91	7,555	7,011	93%
				21	21	41	14	3,422	0.91	1,452	1,762	121%
Total										9,007	8,773	97%

Lighting Controls Savings Calculations

Measure Name/ ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Quantity*	*Controlled Wattage*	*Baseline Hours*	*Efficient Hours*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
Controls	3080	Lighting	SBDI	1	75	348	224	1.01	125	9	7%
Total									125	9	7%

The annual lighting hours of operation verified during the M&V site visit shown in the first table above (2,615 and 3,422, respectively) are greater than the annual hours of operation used to calculate ex ante savings (2,392).

A heating and cooling interactive factor of 0.91, applicable to an electric heated, unconditioned storage facility in St. Louis, was applied to the ex post lighting energy savings. A factor of 1.01 was used for conditioned spaces. The ex ante savings estimate accounted for a heating and cooling interactive factor of 1.07.

During the M&V site visit, the baseline behavior for controlling lighting was determined by survey questions per usage area. The survey indicated highly efficient behavior with turning off lighting during the workday and at the end of the workday.

The peak coincident kW reduction was determined by applying the corresponding end use kW factor to the kWh savings.[244]

[244] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall realization rate is 96%. The ex ante savings estimate was premised upon overestimated heating and cooling interactive effects and greater impact with the occupancy sensor.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	9,132	8,783	96%	1.67
Total		9,132	8,783	96%	1.67

Site ID 6237

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/01/18 and 8/29/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
301132-Lighting-LED 7-20 W Lamp Replac Halog A53-70WLamp	3009	Lighting	SBDI	7	7	53	9	1,384	1.01	779	429	55%
200909-Lighting-LED <=14 W Lamp Replac Halog BR/R 45-66 W Lamp or Fixt	3007			5	5	75	8	2,279	1.01	857	768	90%
305401-LightiLinearlED <=5.5 Wa/ft Replacing T12 <=40W Linear	3026			81	81	41	14	2,057	1.01	5,597	4,527	81%
Total										7,233	5,723	79%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours were fewer those used to develop the ex ante energy savings estimates (2,392).

An adjusted base wattage of 53W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 75W incandescent lamp for the first line item in the table above. The ex ante base wattage of 52.5W was computed within the application by factoring 70% of a 75W incandescent lamp.

A heating and cooling interactive factor of 1.01, applicable to an electrically heated, air-conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[245]

[245] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 79%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	7,233	5,723	79%	1.09
Total		7,233	5,723	79%	1.09

Site ID 6238

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/01/18 and 8/29/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Fixture Replacing T12 Fixture	3026	Lighting	SBDI	26	26	84	34	1,598	1.06	2,852	2,196	77%
				7	7	82	17	674	1.11	998	339	34%
Total										3,850	2,535	66%

The annual lighting hours of operation verified during the M&V site visit for the items in the table above (1,598 and 674) are less than the annual hours of operation used to calculate ex ante savings (2,050).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned small office in St. Louis, was applied to the ex post lighting energy savings. A factor of 1.00 was applied to unconditioned spaces. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[246]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 66%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	3,850	2,535	66%	0.48
Total		3,850	2,535	66%	0.48

[246] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6242

Data Collection

The participant received Standard and SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/24/18 and 8/20/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED LampFixture Replac T12 LampFixture	3026	Lighting	SBDI	3	3	164	60	2,868	1.11	566	990	175%
				4	4	164	72	1,816	1.11	1,858	739	40%
				2	2	82	30	2,334	1.11	378	268	71%
301037Lighti LED <=20 W LampFixture ReplacHalog A >=40 Watt LampFixture	3011		Standard	1	1	43	10	2,868	1.11	116	105	90%
306142-Lighting-LED LampFixture Replac T12 LampFixture	3026			5	5	164	60	2,868	1.11	1,886	1,649	87%
				1	1	82	30	2,868	1.11	188	165	88%
				1	1	82	30	2,868	1.11	188	165	88%
Total										5,180	4,081	79%

The annual lighting hours of operation verified during the M&V site visit (ranging from 1,816 and 2,868) are fewer than the annual hours of operation used to calculate ex ante savings (3,390).

The baseline wattage of the first line item in the table above (164W) verified during the M&V site visit is greater than the ex ante baseline wattage (82W). The efficient wattage of the first and second line items in the above table (60W and 72W, respectively) verified during the M&V site visit are greater than the ex ante efficient wattage (30W and 36W, respectively). Both the baseline and efficient measures were 4 lamp fixtures.

An adjusted base wattage of 43W was used in the ex post savings analysis for the fourth line item in the above table to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

A heating and cooling interactive factor of 1.11, applicable to an electric heated, air conditioned small office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[247]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 79%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	2,378	2,084	88%	0.40
SBDI		2,802	1,997	71%	0.38
Total		5,180	4,081	79%	0.78

[247] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6243

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed six photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/31/18 and 8/29/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306135-Lighting-LED Lamp Replacing T5 Lamp	3088	Lighting	SBDI	98	98	117	50	2,375	1.09	19,706	17,073	87%
201316-Lighting-LED Replacing Incandescent Exit Sign	793			9	9	30	3	8,760	1.09	2,271	2,331	103%
306142-Lighting-LED Lamp Replacing T12 Lamp	3026			4	4	82	23	20	1.09	708	5	1%
Total										22,685	19,408	86%

The annual lighting hours of operation verified during the M&V site visit for the second line item in the table above (8,760) are greater than the annual hours of operation used to calculate ex ante savings (8,736). The remaining measures had hours of operation (2,375 and 20) which were fewer than the annual hours of operation used to calculate ex ante savings (2,805).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned large office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[248]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 86%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 92% of the installed measures.

[248] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	22,685	19,408	86%	3.69
Total		22,685	19,408	86%	3.69

Site ID 6244

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed one photo-sensor logger to monitor lighting operation. The photo-sensor logger collected data between 7/31/18 and 8/29/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	25	25	156	86	701	1.09	5,253	1,344	26%
201316-Lighting-LED Replacing Incandescent Exit Sign	793			2	2	30	4	8,760	1.09	486	499	103%
Total										5,739	1,843	32%

The annual lighting hours of operation verified during the M&V site visit for the first line item (701) are fewer than the annual hours of operation used to calculate ex ante savings (2,805). The area is infrequently used. The remaining measure, exit signage, has annual hours of operation (8,760) that are greater than ex ante hours (8,736).

A heating and cooling interactive factor of 1.09, applicable to a heated, air-conditioned large office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[249]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 32%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

[249] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	5,739	1,843	32%	0.35
Total		5,739	1,843	32%	0.35

Site ID 6250

Data Collection

The participant received Retro-Commissioning (RCx) incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation and post-implementation connected loads, interviewed facility personnel regarding equipment operation. ADM also reviewed of the provided documentation and data.

The customer repaired 108 leaks in the compressed air system, totaling 114.32 cfm, as follows:

Leak Repair Log

TAG	LOCATION	SIZE
620	Sulf-DRS LUL 3	S
621	Sulf-DRS LUL 3	M
622	Sulf-DRS LUL 3	M
623	Caustic Head Tank	S
624	"A" Degasser	M
625	Sulf- Sulfer Burner Valve	M
626	South Primary Pit	M
627	Salt Receiver	M
628	Dike#4 between(421/424)	M
629	Dike#5 520-2 skid	L
630	Dike#4 between(413/412)	L
631	Liq Tank Farm -Tank #6	S
632	Liq Tank Farm- Fatty Acid Tank	S
633	Ethonol Outloading	M
634	Bld 2 behind tank L5A	M
635	Bld 2 Soda Ash Tank	S
636	Bld 2 Mezzanine gate	S
637	Bld 2 Manifold #2	M
638	Bld 2 Manifold #2	L
639	Bld 2 Manifold #3	L
640	Bld 2 Manifold #3	L
641	Bld 2 Manifold #4	M
642	Bld 3 Tank Farm	L
643	Bld 3 Salt Silo (gvd flour)	M
644	Bld 3 LvL 131	L

TAG	LOCATION	SIZE
645	Bld 3 LvL 134	S
650	R6TTC02 Valve	S
651	R6 Labels	L
652	R5 plugger west	L
653	R5 plugger east	L
654	L1A Rejector	M
655	L1A Drop Packer	M
656	L1B Accum #1	L
657	L1A Bottle Combiner	S
658	VRC - North "T"	S
659	L5A Air Line Under Rejector	S
660	South Case Erector Under South End	S
661	North Case Erector	S
662	Van Pak air line 3/8 going to dispenser	S
663	Post 7D8 air line	S
664	Post 7F10	M
665	Gardner Denver #4	S
666	Bld 6 near 6F1	S
667	L5B FC	S
668	L5B FC	S
669	L5B FC	S
670	L5B FC	S
671	L5B FC	S
672	L5B FC	S
673	L5B FC	S
674	L5B FC	S
679	L5B FC	S
675	L5B FC	S
676	L5B FC	S
678	L5B FC	S
680	5BC VRC Area	S
681	5BC VRC Area	S
682	5BC OHC - FC VRC AREA	S
683	5BC OHC - FC VRC AREA	S

TAG	LOCATION	SIZE
684	5BC OHC - FC VRC AREA	S
685	5BC OHC - FC VRC AREA	S
686	5BC OHC - FC VRC AREA	S
687	5BC OHC - FC VRC AREA	S
688	5BC OHC - FC VRC AREA	S
689	5BC OHC - FC VRC AREA	S
690	5BC OHC - FC VRC AREA	S
691	5BC OHC - FC VRC AREA	S
692	5BC OHC - FC VRC AREA	S
693	5BC OHC - FC VRC AREA	S
694	5BC OHC - FC VRC AREA	S
695	R5 OHC FC Bldg 7	S
696	R5 OHC FC Bldg 7	S
697	L1B FCC	S
698	Renuzit Inside Horseshoe R6	S
699	Renuzit Inside Horseshoe R6	S
700	In Horseshoe by Yellow Post Has to be Down	S
701	R6 Main	S
702	R6 Main	S
703	R6 Main	S
704	R6 Multipack	S
705	R6 Main	S
706	R6 Main	S
708	OSBB L1A East at Break Beam	S
709	Bldg 8 Silver Air Supply to Graham	S
710	Overhead Conveyor	S
711	Overhead Conveyor	S
712	Overhead Conveyor	S
713	Overhead Conveyor	S
714	Overhead Conveyor	S
715	Overhead Conveyor	S
716	Overhead Conveyor	S
717	Overhead Conveyor	S
718	Overhead Conveyor	S

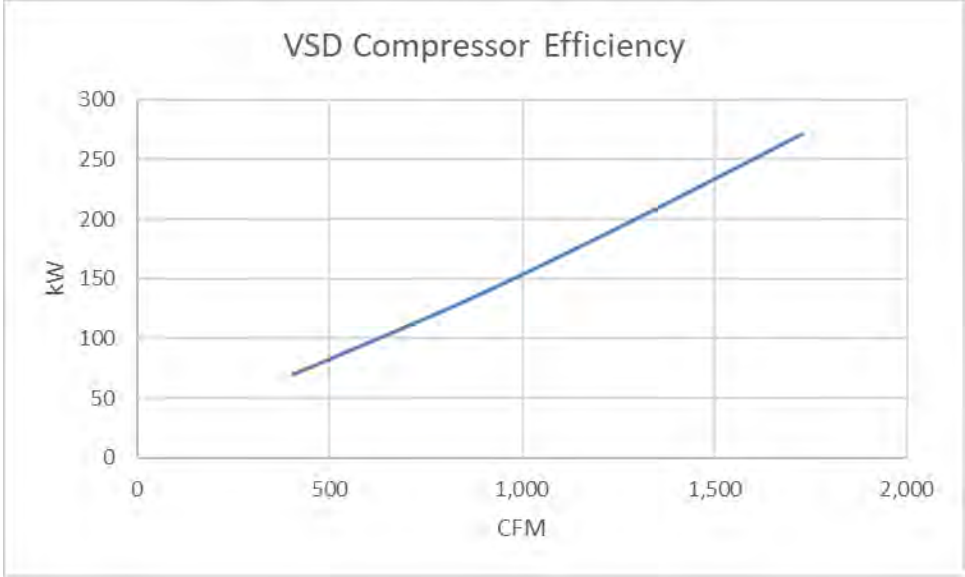
TAG	LOCATION	SIZE
719	Overhead Conveyor	S
720	Overhead Conveyor	S
721	Overhead Conveyor	S
722	Overhead Conveyor	S
723	Overhead Conveyor	S
724	Overhead Conveyor	S
725	Overhead Conveyor	S
726	Overhead Conveyor	S
727	Overhead Conveyor	S
728	Overhead Conveyor	S
729	Overhead Conveyor	S
730	Overhead Conveyor	S
731	Overhead Conveyor	S
732	Overhead Conveyor	S
733	Overhead Conveyor	S

Correcting these leaks reduced the load on the compressors, resulting in less energy consumption. ADM reviewed all project documentation, including the “Compressed Air Study” provided by the contractor, and obtained the baseline monitoring data referenced in the study. The monitoring data totaled seven days in 12 second intervals. Variables monitored that were used for the analysis included current (amperage) for each of the two compressors. One 250 horsepower Gardner Denver fixed speed compressor and one 150 horsepower Gardner Denver VSD compressor operated during the monitoring period.

Analysis Results

Compressed Air Leak Repair Savings Calculations

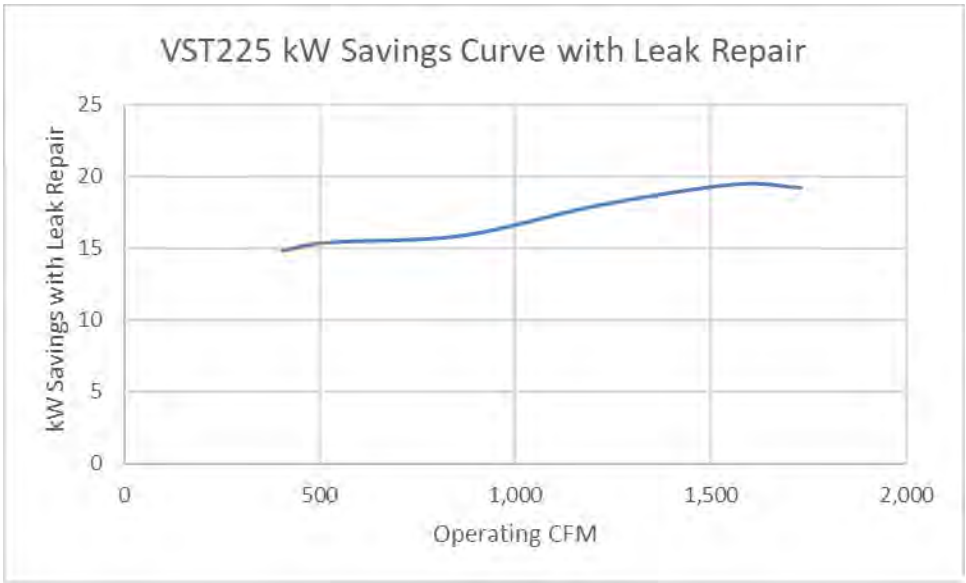
ADM estimated energy savings using the facility’s compressed air load profile derived from baseline monitoring data. The 250 horsepower fixed speed air compressor runs full load while the 150 horsepower VSD runs trim. Thus, the savings result from reduced load on only the 150 horsepower VSD compressor. The kW at each monitoring point was determined using the load (CFM) values and a CAGI air compressor curve. Using the full load compressor power and flow, the following compressor efficiency curve of kW vs cfm was used to calculate the baseline compressor power:



The compressor efficiency curve was used to calculate the new load (kW) values for decreasing the post implementation load by the 114.32 cfm in leaks repaired. This “new” load profile represented the decreased demand as a result of repaired leaks.

Energy savings were calculated by taking the difference in energy requirements of baseline and post-RCx compressed air systems, at each monitoring point, summing over the monitoring period, and scaling to an annual basis. This method assumes the monitoring period represented a typical demand profile at the facility.

The site-level realization rate is 59%. The CFM reduction is relatively small, so the savings are fairly consistent regardless of operating CFM. The savings are relatively independent of operating CFM (or CFM frequency profile) because the VSD compressor curve is nearly linear. The relative kW change between any two CFM values is nearly equivalent as seen below:



The 59% realization rate is due to the ex ante analysis applying the full CFM reduction to both air compressors, when the CFM reduction should only affect the trim compressor. If the ex ante analysis

had calculated energy savings for only the VSD compressor's CFM reduction, the realization rate would be 101%

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
RCx	Compressed Air	257,449	152,184	59%	20.99
Total		257,449	152,184	59%	20.99

Site ID 6252

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed eight photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/2/2018 and 9/12/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	58	58	164	44	452	1.14	15,490	3,580	23%
				11	11	82	24	19	1.14	1,420	14	1%
				4	4	138	44	438	1.14	837	187	22%
301037-Lighting-LED =20W Fixt ReplacHalog A >40W Lamp Fixt	3011			-	-	-	-	-	-	6,766	-	0%
306142-Lighting-LED Lamp Fixt Replacing T12 Lamp or Fixture	3026			1	1	48	12	435	1.14	80	18	22%
Total										24,593	3,799	15%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours (ranging from 19 – 452) were fewer than those used to develop the ex ante energy savings estimates (2,080). The facility's usage was not considered when determining the ex ante hours.

The quantity of the fourth line item in the table above (0) verified during the M&V site visit is less than the ex ante savings quantity (95). Two sealed fifty-count cases of 9W LED dimmable A-Line lamps were found in a storage room during the site level inspection.

A heating and cooling interactive factor of 1.14, applicable to a gas heated, air-conditioned assembly facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[250]

[250] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 15%. The ex ante savings estimate was premised upon a completed installation and overestimated annual hours of operation.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	24,593	3,799	15%	0.72
Total		24,593	3,799	15%	0.72

Site ID 6255

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed seven photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/7/2018 and 9/12/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	4	4	164	40	3,582	1.14	1,762	2,021	115%
				7	7	138	86	1,181	1.14	1,293	489	38%
				2	2	164	40	2,821	1.14	881	796	90%
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025			2	2	59	40	2,927	1.14	135	127	94%
				2	2	59	40	2,927	1.14	135	127	94%
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026			4	4	138	86	4,021	1.14	739	951	129%
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025			2	2	59	40	3,582	1.14	135	155	115%
				7	7	124	70	3,538	1.14	5,059	1,521	30%
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026			3	3	46	11	5,708	1.14	372	682	183%
				1	1	48	15	5,708	1.14	117	214	183%
Total										10,628	7,083	67%

The annual lighting hours of operation verified during the M&V site visit for the second through fifth line items in the above table (1,181, 2,821, 2,927, and 2,927, respectively) are fewer than the annual hours of operation used to calculate ex ante savings (3,320). While the verified hours for the remaining line items (ranging from 3,582 – 5,708) are greater than those used to calculate ex ante savings (3,320).

The quantity of the eighth line item in the table above (7) verified during the M&V site visit is less than the ex ante savings quantity (8). The remaining fixture was not retrofitted to LED.

The baseline wattage of the eighth line item in the table above (124) verified during the M&V site visit is less the wattage used to calculate the ex ante savings (248). The application describes the baseline fixtures as four-lamp, however the baseline fixtures were confirmed as two-lamp during the site visit.

A heating and cooling interactive factor of 1.14, applicable to an electrically heated, air-conditioned assembly in St. Louis, was applied to the ex post lighting energy savings of the third line item in the above table. The ex ante savings estimate accounted for a heating and cooling interactive factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[251]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 67%. The ex ante energy savings estimate was premised upon overestimated annual lighting operating hours for 44% of the measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	10,629	7,083	67%	1.35
Total		10,629	7,083	67%	1.35

[251] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6256

Data Collection

The participant received SBDI lighting incentives.

During the M&V visit, ADM staff verified equipment installation, baseline and the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed twelve photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/10/2018 and 9/12/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replac T8 Lamp or Fixture	3025	Lighting	SBDI	106	106	114	48	2,067	1.09	16,468	15,779	96%
301037-Lighting-LED <=20 Watt Lamp or Fixture Replac Halogen A >=40 W Lamp Fixt	3011			-	-	-	-	-	-	12	-	0%
306143-Lighting-LED Lamp Fixture Replacing T8 Lamp or Fixture	3025			2	2	56	30	3,091	1.09	122	175	144%
				4	4	88	40	2,950	1.09	452	618	137%
				7	7	59	24	1,953	1.09	577	522	90%
				1	1	46	24	85	1.09	1	2	205%
Total										17,632	17,096	97%

Lighting Controls Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Quantity*	*Controlled Wattage*	*Baseline Hours*	*Efficient Hours*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
201618-Lighting-Single Technology Occupancy Sensor Controlling Lighting Circuit >120 Watts	3079	Lighting	SBDI	16	44.75	2,290	1,337	1.09	7,360	745	10%
Total									7,360	745	10%

The annual lighting hours of operation verified during the M&V site visit for the first and fifth line items in the first table above (2,067 and 1,953, respectively) are fewer than the annual hours of operation used to calculate ex ante savings (2,200). The verified hours for the remaining line items (ranging from 85 to 1,953) are exceeded those used to calculate ex ante savings (ranging from 50 to 2,200).

During the M&V site visit, the baseline behavior for controlling lighting was determined by survey questions per usage area. The survey indicated some efficient behavior with turning off lighting during the workday, and highly efficient behavior at the end of the workday.

The controlled wattage of the occupancy sensors verified during the M&V site visit shown in the second table above (45) is less than the controlled wattage used for ex ante savings (144). There were no fixtures within the facility that matched this controlled wattage of 144W.

The quantity of the second line item in the first table above verified during the M&V site visit (0) is less than the quantity used to calculate ex ante savings (4). The client was aware of the uninstalled measures.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned education based facility in St. Louis applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling interactive factor of 1.07.

The peak coincident kW reduction was determined by applying the corresponding end use kW factor to the kWh savings.[252]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall realization rate is 71%. The ex ante energy savings estimate was premised upon the newly installed occupancy sensors controlling wattages 322% higher than what was verified during the M&V site visit.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	24,992	17,841	71%	3.39
Total		24,992	17,841	71%	3.39

[252] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6257

Data Collection

The participant received New Construction lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/12/18 and 8/15/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
406123-Lighting-New Const. Lighting Power Density(LPD)	3000	Lighting	New Construction	954	954	122	69	1,165	1.09	75,378	69,902	93%
Total										75,378	69,902	93%

The lighting energy use of the installed lighting equipment is compared with the estimated lighting energy use associated with the applicable new construction baseline (ASHAE 90.1 2007) to determine realized lighting energy savings. The manufacturing facility constructed in St. Louis County was subject to the 2009 IECC code in effect during the building design, which allows for 1.2 lighting watts/SF. The code compliant baseline lighting wattage for this project was 116,400 watts (1.2 watts/SF*97,000SF).

The annual lighting hours of operation verified during the M&V site visit (1,165) are fewer than the annual hours of operation used to calculate ex ante savings (1,500).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned elementary school in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate did not account for heating and cooling interactive effects.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[253]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 93%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

[253] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
New Construction	Lighting	75,378	69,902	93%	13.28
Total		75,378	69,902	93%	13.28

Site ID 6258

Data Collection

The participant received New Construction lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/14/18 and 8/17/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
406123-Lighting-New Const. Lighting Power Density (LPD)	3000	Lighting	New Construction	367	367	136	61	154	1.00	4,700	4,854	103%
Total										4,700	4,854	103%

The lighting energy use of the installed lighting equipment is compared with the estimated lighting energy use associated with the applicable new construction baseline (ASHAE 90.1 2007) to determine realized lighting energy savings. The warehouse facility constructed in St. Louis City allows for 0.80 lighting watts/SF. The ex ante code compliant baseline lighting wattage for this project was 74,656 watts (0.8 watts/SF*74,656SF). The ex post analysis used a space by space method since the storage units only receive spillover lighting within them where the lumens per square foot does not meet the standard. The ex post baseline wattage for this project was 49,766 watts (0.8 watts/SF*62,207SF).

The annual lighting hours of operation verified during the M&V site visit (154) are greater than the annual hours of operation used to calculate ex ante savings (90).

A heating and cooling interactive factor of 1.00, applicable to an unconditioned space in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate did not account for heating and cooling interactive effects.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[254]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 103%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours.

[254] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
New Construction	Lighting	4,700	4,854	103%	0.92
Total		4,700	4,854	103%	0.92

Site ID 6259

Data Collection

The participant received Standard and Custom lighting incentives.

During the M&V visit, ADM staff verified equipment installation, baseline and the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed thirteen photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/18/18 and 10/23/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
100212-Lighting-Non Linear LED Fixture Replacing Incand/Halogen Lamp Fixture	1169	Lighting	Custom	5	5	90	13	1,264	1.09	860	530	62%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025		Standard	6	6	17	9	1,264	1.09	107	66	62%
				1	1	32	9	1,264	1.09	47	32	67%
				154	154	32	18	1,264	1.09	4,817	2,970	62%
				60	60	32	18	1,264	1.09	1,876	1,157	62%
				9	9	32	14	1,264	1.09	362	223	62%
305802-Lighting-Delamping Replacing T8 32 Watt	3084			1	1	32	-	1,264	1.09	36	22	61%
				77	77	32	-	1,264	1.09	5,505	3,394	62%
				30	30	32	-	1,264	1.09	2,145	1,322	62%
				3	3	32	-	1,264	1.09	214	132	62%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025			8	8	32	14	1,264	1.09	595	198	33%
100210-Lighting-Non Linear LED Fixture Replacing M V Fixture	1169	Exterior Lighting	Custom	3	3	205	40	2,375	1.09	2,168	1,281	59%
100208-Lighting-Non Linear LED Fixture Replacing M Ha Fixture				8	8	455	124	4,308	1.00	11,598	11,407	98%
100216-Lighting-Non Linear LED Fixture Replacing Exist Inefficient Lighting Fixture				2	2	185	23	4,308	1.00	1,419	1,396	98%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025		Standard	2	2	32	14	4,308	1.00	315	155	49%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
100208-Lighting-Non Linear LED Fixture Replacing Metal Halide Fixture	1169		Custom	11	11	295	62	4,308	1.00	11,226	11,041	98%
				1	1	295	62	4,308	1.00	1,021	1,004	98%
				38	38	455	124	4,308	1.00	55,092	54,182	98%
				14	14	455	124	4,308	1.00	20,297	19,962	98%
				2	2	295	62	4,308	1.00	2,041	2,007	98%
				9	9	128	36	4,308	1.00	3,627	3,567	98%
100211-Lighting-Non Linear LED Fixture Replacing H P S Fixture				7	7	138	27	4,308	1.00	3,403	3,347	98%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025	Lighting	Standard	16	16	32	14	7,578	1.09	1,190	2,378	200%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T12 <=40 WattLinear ft	3026			6	6	40	14	7,578	1.09	1,462	1,288	88%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025			20	20	32	18	3,215	1.09	1,157	981	85%
305802-Lighting-Delamping Replac T8 32W	3084			10	10	32	-	3,215	1.09	1,323	1,121	85%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025			4	4	32	18	8,760	1.09	525	534	102%
305802-Lighting-Delamping Replac T8 32 W	3084			2	2	32	-	8,760	1.09	600	611	102%
100208-Lighting-Non Linear LED Fixture Replacing M H Fixture	1169		Custom	5	5	455	150	1,625	1.00	3,407	2,478	73%
100216-Lighting-Non Linear LED Fixture Replacing Existing Ineffic Lighting Fixture				1	1	56	24	1,625	1.00	71	52	73%
100104-Lighting-Linear Tube LED Fixture Replacing T8 Fixture				3	3	124	85	1,625	1.00	261	190	73%
100102-Lighting-Linear Tube LED Fixture Replacing T12 HO Fixture				1	1	227	85	1,625	1.00	317	231	73%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T12 <=40 W Linear ft	3026		Standard	1	1	40	14	1,625	1.00	87	42	49%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft)	3025			33	33	32	14	1,625	1.00	1,990	965	48%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
Replacing T8 32 Watt Linear ft												
305802-Lighting-Delamping Replac T8 32 W	3084			11	11	32	-	1,625	1.00	1,180	572	48%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025			4	4	32	14	1,625	1.00	161	117	73%
				4	4	32	14	1,625	1.00	161	117	73%
				15	15	32	14	1,625	1.00	604	439	73%
305802-Lighting-Delamping Replac T8 32 W	3084			5	5	32	-	1,625	1.00	357	260	73%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025			8	8	32	18	1,753	1.09	120	214	178%
305802-Lighting-Delamping Replac T8 32 W	3084			4	4	32	-	1,753	1.09	137	245	178%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025			22	22	32	18	1,753	1.09	1,032	588	57%
				16	16	32	14	1,753	1.09	965	550	57%
305802-Lighting-Delamping Replac T8 32 W	3084			11	11	32	-	1,753	1.09	1,180	672	57%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025			28	28	32	14	1,375	1.09	2,083	755	36%
				4	4	32	14	1,375	1.09	78	108	138%
305802-Lighting-Delamping Replacing T8 32 Watt	3084			2	2	32	-	1,375	1.09	68	96	141%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025			4	4	32	14	1,375	1.09	81	108	133%
305802-Lighting-Delamping Replac T8 32 W	3084			2	2	32	-	1,375	1.09	71	96	135%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025			4	4	32	14	1,375	1.09	92	108	117%
				10	10	32	14	1,375	1.09	231	270	117%
Total										149,762	135,578	91%

Lighting Controls Savings Calculations

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Quantity	Heating Cooling Interaction Factor	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
Controls	1169	Lighting	Custom	1	1.09	473	473	1.00
Total						473	473	1.00

The annual lighting hours of operation verified during the M&V site visit for the thirteenth through twenty-second line items in the first table above using photo cells (4,308[255]) are less than the hours of operation used to calculate ex ante savings (4,380). The lighting hours for the twenty-third, twenty-fourth, fortieth, forty-first, and forty-sixth through fifty-first line items (ranging from 1,375 to 7,578) are greater than the annual hours of operation used to calculate ex ante savings (ranging from 1,000 to 3,863). The ex post and ex ante correspond for twenty-seventh- and twenty-eighth-line items (8,760). The remaining line items have annual hours of operation (ranging from 1,264 to 3,215) which are fewer than the ex ante savings estimate (ranging from 2,088 to 3,863).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned university in St. Louis, was applied to the ex post lighting energy savings for all interior measures. The ex ante savings estimate accounted for a heating and cooling factor of 1.07. A factor of 1.00 was applied to all exterior and unconditioned locations which corresponds with the ex ante savings estimate.

The peak coincident kW reduction was determined by applying the corresponding end use kW factor to the kWh savings.[256]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall realization rate is 91%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 91% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	32,639	22,751	70%	4.32
	Exterior Lighting	315	155	49%	0.00
Custom	Lighting	5,389	3,954	73%	0.75
	Exterior Lighting	111,892	109,192	98%	0.61
Total		150,235	136,051	91%	5.69

[255] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[256] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6260

Data Collection

The participant received New Construction incentives from Ameren Missouri.

During the M&V visit, ADM staff verified the new construction measures, equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules. The new construction project also included: whole building measures: above code HVAC equipment, wall and roof insulation, and high efficiency windows and guestroom energy management (GREM) HVAC controls.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
406123-Lighting-New Construction Lighting Power Density(LPD)	3000	Lighting	New Construction	1,173	1,173	46	25	3,954	1.09	93,974	91,012	97%
Total										93,974	91,012	97%

The lighting energy use of the installed lighting equipment is compared with the estimated lighting energy use associated with the applicable new construction baseline (ASHAE 90.1 2007) to determine realized lighting energy savings. The manufacturing facility constructed in Adair County was subject to the 2009 IBC code in effect during the building design, which allows for 1.0 lighting watts/SF. The code compliant baseline lighting wattage for this project was 54,103 watts (1.0 watts/SF*54,103SF).

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (3,754). Measures within guestrooms (1,145[257]) comprised 58%, measures with continuous usage (8,760) represented 33%, and the remaining measures (4,380) were 8%.

A heating and cooling interactive factor of 1.09, applicable to a electric heated, air conditioned hotel in Kirksville, was applied to the ex post lighting energy savings. The ex ante savings estimate did not account for heating and cooling interactive effects. The ex ante energy savings estimate was also premised on overestimated annual lighting operating hours within the guestrooms.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[258]

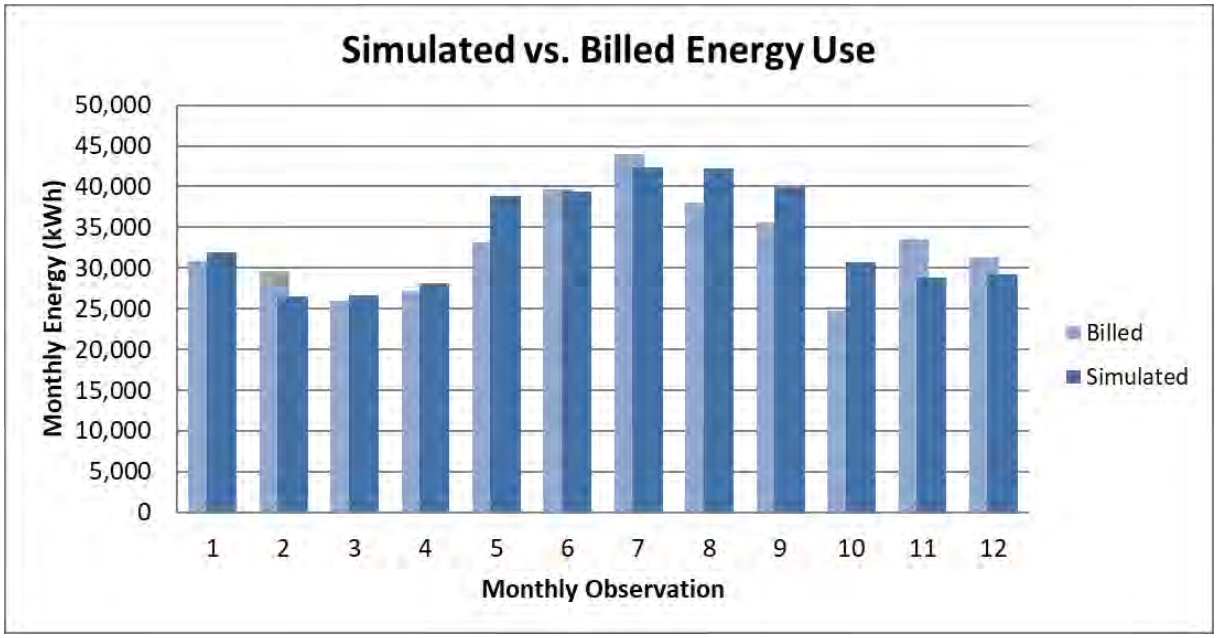
[258] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Whole Building and GREM Savings Calculations

Energy savings for the above code whole building and GREM measures were calculated using IPMVP Option D: Calibrated Simulation. ADM compiled an eQuest model of the as-built facility using the details and construction documents collected during the on-site M&V visit and from the project documentation.

Upon completion of the initial model, a custom weather file was created using NOAA weather data for the region. Using this weather file and the utility provided billing data for the facility, ADM ensured that the model's energy load shape matched that of the bills. The results of this calibration effort can be seen below:

Monthly kWh Calibration



Upon completion of the calibration for the as-built eQuest model, the impacts of the installed measures were removed using parametric runs. Once the parametric runs were defined, the as-built model and parametric runs were simulated using TMY3 weather data. The total realized energy savings are the differences between the baseline and as-built models' energy usages, and the total site-level energy savings and HVAC controls savings by end use can be seen in the following tables:

Whole Building Energy Usage (kWh) by End Use

End-Use	*Baseline*	*As-Built*	*kWh Savings*
Lighting	118,601	118,601	0
Misc. Equipment	71,431	71,431	0
Heating	129,829	70,791	59,038
Cooling	143,230	66,802	76,428
Heat Rejection	0	0	0
Pumps	0	0	0
Fans	97,840	75,924	21,916
Domestic HW	0	0	0
Suppl. Heat	15,518	0	15,518
Total	576,450	403,549	172,901

HVAC Controls (GREM) Energy Usage (kWh) Usage by End Use

End-Use	*Baseline*	*As-Built*	*kWh Savings*
Lighting	118,601	118,601	0
Misc. Equipment	71,431	71,431	0
Heating	82,821	70,791	12,030
Cooling	134,945	66,802	68,142
Heat Rejection	0	0	0
Pumps	0	0	0
Fans	80,238	75,924	4,314
Domestic HW	0	0	0
Suppl. Heat	3,272	0	3,272
Total	491,308	403,549	87,759

Measure level savings are shown in the following table:

HVAC and Building Shell Measure Level Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
191521 – Whole Building – Shell	1169	Building Shell	New Construction	12,283	16,097	131%
112721 – Above Code – HVAC	1169	HVAC	New Construction	59,656	69,044	116%
113221 – HVAC Controls – HVAC	1169	HVAC	New Construction	113,788	87,759	77%
191521– Whole Building – Shell	1169	Building Shell	New Construction	12,283	0	0%
Total				198,010	172,901	87%

There were significant differences in the ex ante and ex post analysis results for the whole building and HVAC measures, with an 87% realization rate. The ex ante analysis utilizes an uncalibrated energy model of the site for the whole building and above code HVAC measures. ADM was provided the model; however, only the baseline model was provided, so ADM created new parametric runs for the as-built model in the ex post analysis. The final as-built parametric run was calibrated to actual billing and weather data. The ex ante model was created during the design phase, and it significantly overestimated occupancy schedules and loads. The ex ante model also assumed more conservative heating and cooling temperature setpoints than those found during the M&V site visit. These differences resulted in more realized savings for the building shell and above code HVAC measures. The building shell measure was incentivized twice, but ADM feels that this was an oversight because the ex ante model's outputs only shows energy savings of 12,283 kWh; therefore, the second shell measures realizes 0 kWh savings.

For the HVAC controls (GREM), ADM used the calibrated eQuest model to determine realized savings. The ex ante analysis relies on assumed HVAC loads and energy savings results from another building. The building referenced in the ex ante analysis used more than 10% more energy annually and claimed a 44% runtime reduction for the guestroom HVAC. The calibrated simulation resulted in a 29% reduction in HVAC usage. From the M&V visit, ADM found that the amount of time spent in the setback mode was between 10% – 32%. This justifies the ex post calibrated model more than the ex ante assumption.

The site-level verified energy savings are 263,913 kWh, resulting in a realization rate of 90%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
New Construction	Lighting	93,974	91,012	97%	17.29
	Building Shell	12,283	16,097	131%	7.15
	HVAC	59,656	69,044	116%	30.65
	HVAC	113,788	87,759	77%	38.96
	Building Shell	12,283	0	0%	0
Total		291,984	263,913	90%	94.05

Site ID 6261

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 7/24/18 and 8/27/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
200102-Lighting-Linear LED Lamp <=22 W Lamp Replac T8 32W Lamp	3025	Lighting	Standard	220	220	32	12	2,362	1.09	13,728	11,367	83%
				430	430	32	12	6,239	1.00	75,336	53,658	71%
				220	220	32	12	2,311	1.00	38,544	10,167	26%
306143-Lighting-LED Lamp/ Fixture Replacing T8 Lamp/ Fixture				150	150	114	52	5,512	1.09	31,047	56,076	181%
Total										158,655	131,268	83%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours (ranging from 2,311 to 6,239) were fewer than those used to develop the ex ante energy savings estimates (ranging from 3,120 to 8,760). The measures were installed in multiple usage locations within the facility.

A heating and cooling interactive factor of 1.09 (applicable to a gas heated, air-conditioned manufacturing facility in St. Louis) and a factor of 1.00 (applicable to an unconditioned space) was applied to the ex post lighting energy savings. The ex ante savings estimate did not account for heating and cooling interactive factors for the first three-line items in the table above but used a factor of 1.07 for the fourth line item.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[259]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 83%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

[259] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	158,655	131,268	83%	24.94
Total		158,655	131,268	83%	24.94

Site ID 6262

Data Collection

The participant received New Construction Program incentives from Ameren Missouri for installing above standard baseline HVAC systems and lighting measures.

During the M&V visit, ADM staff verified the implemented above HVAC standard new construction measures. Field staff also collected specifics about the construction of the facility, occupancy rates, internal loads, HVAC equipment, and HVAC operation. ADM also acquired the ex ante Trane Trace energy models used for energy savings estimates. There were two lighting photo-sensor loggers installed to monitor lighting operation. The photo-sensor loggers collected data between 8/07/18 and 10/15/18.

Analysis Results

New Construction Savings Calculations

Energy savings for the implemented above code new construction measures were calculated using IPMVP Option D, Calibrated Simulation. This was completed using Trane Trace 700 energy simulation. ADM was provided the Trane Trace archived model used to estimate ex ante energy savings. ADM reviewed the as-built model's inputs and adjusted the model based on information collected during the on-site visit. The model was then run using weather data for the St. Louis region to ensure that the model was properly calibrated to the billed energy consumption of the facility. The results of the calibration effort can be seen in the following plot:

Trane Trace Model Calibration

Upon the calibration of the as-built model using billing data, an alternative model run was utilized in Trane Trace to determine the energy impacts of the HVAC measures above ASHRAE 90.1-2007 Appendix G. The two models were run using typical weather (TMY3) for the region to determine the typical annual savings for the project. The annual savings are the difference between the annual

consumption of the baseline and as-built models. The energy savings results from the model are presented in the following table:

New Construction Energy Savings

Month	*TMY3 Savings*		
	Baseline	*As-Built*	*Savings*
January	55,288	51,329	3,959
February	50,655	46,688	3,967
March	73,454	61,630	11,824
April	74,151	59,041	15,110
May	79,909	57,129	22,780
June	106,356	67,994	38,362
July	107,534	67,609	39,925
August	114,932	72,555	42,377
September	97,003	70,678	26,325
October	76,606	62,010	14,596
November	60,735	53,201	7,534
December	53,491	49,227	4,264
Total	950,114	719,091	231,022

Measure level savings are shown in the following table:

New Construction Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
113321 – HVAC	1169	HVAC	New Construction	25,091	14,169	56%
112421 – Cooling	1169	Cooling	New Construction	239,990	216,853	90%
Total				265,081	231,022	87%

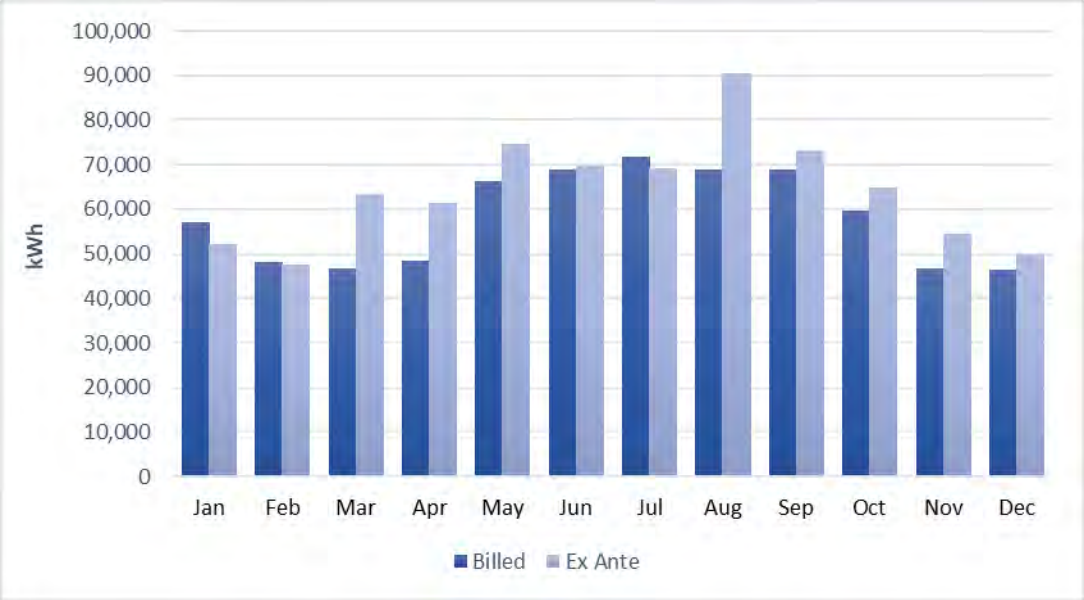
Verified annual savings for implementation of the New Construction measures are 231,022 kWh, resulting in a site-level realization rate of 87%. The differences in realized savings can be attributed to calibration of the provided Trane Trace model. The calibration adjustments to the model included: adjusting lighting, equipment, and occupancy schedules, internal loads, and modifying baseline heating and cooling equipment.

The ex post model calibration resulted in less savings for both end use categories. The cooling savings decreased because schedules were further reduced during school breaks which decreased the cooling

load. The HVAC savings decreased because ADM changed the quantity of the baseline packaged VAV systems to be the same as the number of as-built air handlers. This allows for less fan energy usage in the baseline compared the ex ante model only using two packaged VAV systems with larger fans.

The ex ante model used assumed equipment loads, and lighting and occupancy schedules. As a result, the model's calibration was slightly off and can be seen in the following figure:

Monthly Energy Usage of Ex Ante Model vs. Utility Bills



Lighting Retrofit Savings Calculations

Measure Name/ ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
406123-LightingNew Construction Lighting Power Density(LPD)	3000	Lighting	New Construction	1,116	1,116	109	85	1,929	1.09	75,295	54,866	73%
Total										75,295	54,866	73%

The lighting energy use of the installed lighting equipment is compared with the estimated lighting energy use associated with the applicable new construction baseline (ASHAE 90.1 2007) to determine realized lighting energy savings. The education facility constructed in Warren County allows for 1.2 lighting watts/SF. The code compliant baseline lighting wattage for this project was 121,241 watts (1.2 watts/SF*101,034SF).

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours (1,929) were fewer than those used to develop the ex ante energy savings estimates (5,788).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned elementary school in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate did not account for heating and cooling interactive effects.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[260]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 84%. The ex ante energy lighting savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
New Construction	Lighting	75,295	54,866	73%	10.42
	HVAC	25,091	14,169	56%	6.29
	Cooling	239,990	216,853	90%	197.48
Total		340,376	285,888	84%	214.19

[260] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6263

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed ten photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/29/2018 and 9/24/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	Standard	105	105	164	26	3,584	1.07	83,723	55,685	67%
				80	80	82	24	2,843	1.07	26,810	14,142	53%
				100	100	164	26	2,345	1.07	79,736	34,702	44%
				150	150	82	24	2,664	1.07	50,269	24,852	49%
				150	150	164	26	2,610	1.07	119,605	57,924	48%
				26	26	122	23	8,760	1.07	14,873	24,176	163%
				60	60	82	24	5,023	1.07	32,619	18,743	57%
				20	20	164	26	2,700	1.07	15,947	7,991	50%
				10	10	122	23	8,760	1.07	5,720	9,298	163%
				152	152	82	24	2,831	1.07	51,504	26,758	52%
				220	220	164	26	2,831	1.07	177,370	92,148	52%
				45	45	164	26	8,760	1.07	58,208	58,326	100%
				33	33	72	24	8,760	1.07	14,847	14,877	100%
				46	46	82	32	8,760	1.07	21,558	21,602	100%
				23	23	164	32	8,760	1.07	28,458	28,515	100%
				10	10	72	24	8,760	1.07	4,499	4,508	100%
				30	30	122	23	8,760	1.07	27,839	27,895	100%
				40	40	72	24	8,760	1.07	17,996	18,033	100%
306143-LightigLED Lamp Fixt Replac T8 Lamp Fixt	3025			188	188	114	26	8,760	1.07	155,070	155,386	100%
306142-LightngLED Lamp Fixt ReplaT12 Lamp Fixt	3026			52	52	72	24	8,760	1.07	23,396	23,443	100%
				36	36	82	32	8,760	1.07	16,872	16,906	100%
				41	41	111	26	8,760	1.07	32,666	32,732	100%
306143-LightngLED Lamp Fixt Replac T8 Lamp Fixt	3025			7	7	56	24	8,760	1.07	2,099	2,104	100%
Total										1,061,684	770,746	73%

The annual lighting hours of operation verified during the M&V site visit for the twelfth through twenty-third line items in the above table are consistent with the annual hours of operation used to calculate ex ante savings (8,760). The hours for the sixth and ninth line items (8,760) are greater than those used to calculate ex ante savings (5,400). The hours for the remaining line items (ranging from 2,345 - 5,023) are fewer than the hours used for ex ante savings (ranging from 5,400 – 5,460). The ex ante hours of 5,400 represent 15 hours per day, 7 days per week, which does not reflect the actual hours of use within the facility.

A heating and cooling interactive factor of 1.07, applicable to a gas heated, air conditioned hospital in St. Louis, was applied to the ex post lighting energy savings and corresponds with the ex ante savings estimate.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[261]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 73%. The ex ante energy savings estimate was premised upon overestimated annual hours of operation for 64% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	1,061,684	770,746	73%	146.41
Total		1,061,684	770,746	73%	146.41

[261] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6264

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed ten photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 09/14/18 and 10/03/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Fixture Replacing T8 Fixture	3025	Lighting	Standard	153	153	114	76	3,900	1.04	31,451	23,404	74%
				25	25	114	76	3,515	0.93	4,493	3,113	69%
306135-Lighting-LED Fixture Replacing T5 Fixture	3088			122	122	240	160	3,515	0.93	96,859	31,856	33%
306142-Lighting-LED Fixture Replacing T12 Fixture	3026			55	55	56	34	3,213	0.93	5,723	3,625	63%
306135-Lighting-LED Fixture Replacing T5 Fixture	3088			5	5	117	56	3,699	1.06	1,442	1,198	83%
				10	10	240	112	3,515	0.93	6,054	4,195	69%
306143-Lighting-LED Fixture Replacing T8 Fixture	3025			65	65	88	60	3,681	1.15	8,607	7,690	89%
				10	10	59	32	3,535	1.15	1,278	1,096	86%
				6	6	114	80	3,073	1.00	3,973	630	16%
301037-Lighting-LED Fixture Replacing Halogen A Fixture	3011			5	5	43	9	2,190	1.15	642	427	67%
300938-Lighting-LED Fixture Replacing Halogen BR/R Fixture	3007			26	26	65	9	2,718	1.15	6,543	4,542	69%
306143-Lighting-LED Fixture Replacing T8 Fixture	3025			17	17	114	56	2,525	1.15	6,777	2,858	42%
306142-Lighting-LED Fixture Replacing T12 Fixture	3026			7	7	82	34	1,521	0.93	2,804	477	17%
Total										176,646	85,110	48%

The annual lighting hours of operation verified during the M&V site visit for the line items in the table above (ranging from1,521 - 3,900) are less than the annual hours of operation used to calculate ex ante savings (3,640 and 4,420).

An adjusted base wattage of 43W was used for the tenth line item in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

The quantity of the first, third, ninth, eleventh, twelfth, and thirteenth line items in the table above (153, 122, 6, 26, 17, and 7, respectively) verified during the M&V site visit is less than the ex ante savings quantity (175, 160, 30, 30, and 15). The remaining lamps were located within storage areas and the client stated they were to be used as replacements.

A heating and cooling interactive factor of 1.15, applicable to an electric heated, air-conditioned large office in St. Louis, was applied to the ex post lighting energy savings. A factor of 0.93 was used for unconditioned spaces. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[262]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 48%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	176,646	85,110	48%	16.17
Total		176,646	85,110	48%	16.17

[262] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6265

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed thirteen photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 9/11/2018 and 10/01/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025	Lighting	Standard	18	18	25	9	1,963	1.09	2,568	619	24%
				180	180	32	13	4,725	1.09	10,978	17,693	161%
				1,608	1,608	32	14	3,468	1.09	92,910	109,891	118%
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture				26	26	88	51	2,423	1.09	3,603	2,552	71%
				1	1	59	34	2,187	1.09	94	60	64%
				-	-	-	-	-	-	861	-	0%
				60	60	59	28	2,798	1.09	5,971	5,699	95%
Total										116,985	136,514	117%

The annual lighting hours of operation verified during the M&V site visit for the second- and third-line items in the above table (4,725 and 3,468, respectively) are greater than the annual hours of operation used to calculate ex ante savings (3,000). The remaining line items have hours (ranging from 1,963 - 2,798) fewer than those used to calculate ex ante savings (ranging from 3,000 - 3,500). The ex ante savings estimate did not account for the 24/7/365 areas of the facility.

The quantity of the first line item in the table above (18) verified during the M&V site visit is less than the quantity used to calculate ex ante savings (50). The verified quantity of the sixth line item (0) is less than the quantity used to calculate ex ante savings (10), as there were no efficient retrofit fixtures for this line item.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned large office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[263]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 117%. The ex ante energy savings estimate was premised upon underestimated annual lighting operating hours for 94% of the fixtures in the above table and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	116,985	136,514	117%	25.93
Total		116,985	136,514	117%	25.93

[263] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6268

Data Collection

The participant received Standard lighting incentives.

During the M&V visit, ADM staff verified equipment installation, baseline and the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 1/14/2019 and 1/31/2019.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306140-Lighting-LED Lamp or Fixture Replacing Interior HID Lamp or Fixture	3004-1	Lighting	Standard	250	250	460	135	2,140	1.00	220,821	173,836	79%
Total										220,821	173,836	79%

Lighting Controls Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Quantity*	*Controlled Wattage*	*Baseline Hours*	*Efficient Hours*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
301818-Lighting-Fixture Mounted Occupancy Sensor Controlling >50 and <=200 Watts Replacing No Controls	3077	Lighting	Standard	250	460	2,140	1,196	1.00	75,000	108,490	145%
Total									75,000	108,490	145%

The annual lighting hours of operation verified during the M&V site visit shown in the first table above (2,140) are fewer than the annual hours of operation used to calculate ex ante savings (2,540).

A heating and cooling interactive factor of 1.00, applicable to an unconditioned space in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling interactive factor of 1.07.

During the M&V site visit, the baseline behavior for controlling lighting was determined by survey questions per usage area. The survey indicated some efficient behavior with turning off lighting during the workday but at always at the end of the workday.

The peak coincident kW reduction was determined by applying the corresponding end use kW factor to the kWh savings.[264]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall realization rate is 95%. The ex ante savings estimate was premised upon overestimated annual hours of use.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	295,821	282,326	95%	53.63
Total		295,821	282,326	95%	53.63

[264] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6270

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed ten photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 08/31/18 and 9/26/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Fixture Replacing T12 Fix	3026	Lighting	SBDI	173	173	175	28	2,739	1.09	87,866	76,270	87%
301037-Lighting-LED <=20 Watt Fixture Replacing Halogen A >=40 Watt Fixture	3011			10	10	53	13	1,925	1.09	1,283	843	66%
306142-Lighting-LED Fixture Replacing T12 Fix	3026			83	83	88	30	2,438	1.09	16,392	12,848	78%
301037-Lighting-LED <=20 Watt Fixture Replacing Halogen A >=40 Watt Fixture	3011			10	10	43	9	1,528	1.09	1,072	569	53%
306142-Lighting-LED Fixture Replacing T12 Fix	3026			8	8	88	28	2,183	1.09	1,559	1,147	74%
300938-Lighting-LED <=14 Watt Fixture Replacing Halogen BR/R Fixture	3007			12	12	65	9	1,813	1.09	2,183	1,334	61%
306142-Lighting-LED Fixture Replacing T12 Fix	3026			-	-	-	-	-	-	338	-	0%
Total										110,693	93,011	84%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours (ranging from 0 – 2,739) were fewer than those used to develop the ex ante energy savings estimates (3,036).

The ex ante savings estimate used an adjusted base wattage of 52.5W for the second line item in the above table and 42W for the fourth line item by multiplying the provided wattage by 70%. An adjusted base wattage of 53W and 43W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 75W and 60W incandescent lamp.

The quantity of the first, third, and seventh line items in the table above (173, 83, and 0, respectively) verified during the M&V site visit are less than the ex ante savings quantity (175, 87, and 2, respectively).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned large office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[265]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 84%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and overestimated installed measures for 3 line items.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	110,693	93,011	84%	17.67
Total		110,693	93,011	84%	17.67

[265] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6272

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 8/16/18 and 10/17/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025	Lighting	Standard	200	200	56	30	4,022	1.09	23,146	22,901	99%
				800	800	88	34	4,022	1.09	192,292	190,251	99%
Total										215,438	213,152	99%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours were fewer than those used to develop the ex ante energy savings estimates (4,160).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned large office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[266]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 99%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	215,438	213,152	99%	40.49
Total		215,438	213,152	99%	40.49

[266] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6277

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed one photo-sensor logger to monitor lighting operation. The photo-sensor logger collected data between 9/12/2018 and 10/1/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	18	18	82	22	8,760	1.10	4,326	10,369	240%
Total										4,326	10,369	240%

The annual lighting hours of operation verified during the M&V site visit for the measure in the above table (8,760) are greater than the annual hours of operation used to calculate ex ante savings (3,744). The ex ante hours did not represent continuous usage of the measures.

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air conditioned storage facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[267]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 240%. The ex ante energy savings estimate was premised upon underestimated annual hours of operation.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	4,326	10,369	240%	1.97
Total		4,326	10,369	240%	1.97

[267] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6278

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed nine photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 9/1/2018 and 9/26/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp/ Fixt Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	-	-	82	22	-	-	314	-	-
301037-Lighting-LED <=20 Watt Lamp/ Fixt Replacing Halogen A >=40 Watt Lamp/ Fixt	3011			45	45	43	10	1,678	1.14	3,766	2,835	75%
306142-Lighting-LED Lamp/ Fixt Replacing T12 Lamp or Fixture	3026			16	16	164	48	2,509	1.14	4,854	5,296	109%
				70	70	82	24	1,312	1.14	10,618	6,058	57%
				20	20	164	44	293	1.14	6,276	799	13%
Total										25,828	14,988	58%

The annual lighting hours of operation verified during the M&V site visit for the third line item in the above table (2,509) are greater than the annual hours of operation used to calculate ex ante savings (2,444). The verified hours for the remaining line items (ranging from 293 to 1,678) are fewer than those used to calculate ex ante savings (2,444). The ex ante hours did not account for less frequently used areas of the facility.

The ex ante savings estimate used an adjusted base wattage of 42W for the second line item in the above table by multiplying the provided wattage by 70%. An adjusted base wattage of 43W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp.

The quantity of the first line item in the table above (0) verified during the M&V site visit is less than the ex ante savings quantity (2).

A heating and cooling interactive factor of 1.14, applicable to a gas heated, air-conditioned assembly facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[268]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 58%. The ex ante savings estimate was premised upon a completed installation and overestimated annual hours of operation for 89% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	25,828	14,988	58%	2.85
Total		25,828	14,988	58%	2.85

[268] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6279

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 9/19/2018 and 10/8/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixt Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	26	26	82	30	552	1.14	4,513	848	19%
Total										4,513	848	19%

The annual lighting hours of operation verified during the M&V site visit (552) are fewer than the annual hours of operation used to calculate ex ante savings (3,120). The ex ante hours closely represent 8.5 hours per day/ seven days per week which does not represent the installed measure locations usage.

A heating and cooling interactive factor of 1.14, applicable to a gas heated, air-conditioned assembly facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling interactive factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[269]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 19%. The ex ante energy savings estimate was premised upon overestimated annual hours of use.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	4,513	848	19%	0.16
Total		4,513	848	19%	0.16

[269] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6280

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 9/13/18 and 10/03/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp	3026	Lighting	SBDI	1	1	164	30	2,445	1.11	418	363	87%
				4	4	164	60	2,445	1.11	1,296	1,126	87%
				7	7	164	60	2,445	1.11	2,268	1,971	87%
300938-Lighting-LED <=14 Watt Lamp or Fixture Replacing Halogen BR/R Lamp	3007			17	17	65	8	2,445	1.11	3,019	2,624	87%
Total										7,001	6,084	87%

The annual lighting hours of operation verified during the M&V site visit (2,445) are fewer than the annual hours of operation used to calculate ex ante savings (2,912).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned small retail in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[270]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 87%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	7,001	6,084	87%	1.16
Total		7,001	6,084	87%	1.16

[270] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6281

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 9/20/18 and 10/15/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Replacing T12 Lamp	3026	Lighting	SBDI	4	4	164	60	2,551	1.01	926	1,068	115%
301039-Lighting-LED <=20 Watt Lamp Replacing Halogen PAR Lamp	3008			4	4	70	15	2,551	1.01	489	565	115%
301037-Lighting-LED <=20 Watt Lamp Replacing Halogen A >=40 Watt Lamp	3011			4	4	43	9	282	1.01	28	39	138%
306142-Lighting-LED Lamp Replacing T12 Lamp	3026			7	7	82	30	2,551	1.01	810	934	115%
301037-Lighting-LED <=20 Watt Lamp Replacing Halogen A >=40 Watt Lamp	3011			2	2	43	9	1,352	1.01	147	92	63%
Total										2,400	2,698	112%

The annual lighting hours of operation verified during the M&V site visit for the first, second, and fourth line items in the table above (2,551) are greater than the annual hours of operation used to calculate ex ante savings (2,080), while the fifth line item has fewer hours of operation (1,352). The third line item has greater hours of operation (282) than ex ante hours (200).

An adjusted base wattage of 43W was used for the third and fifth line item in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

A heating and cooling interactive factor of 1.01, applicable to an electric heated, air-conditioned small retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[271]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 112%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for 90% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	2,400	2,698	112%	0.51
Total		2,400	2,698	112%	0.51

[271] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6282

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 09/25/18 and 10/17/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
100204-Lighting-Non Linear LED Fixture Replacing T8 Fixture	1169	Lighting	Custom	800	400	124	90	6,116	1.09	385,727	422,821	110%
Total										385,727	422,821	110%

Lighting Controls Savings Calculations

Measure Name/ ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Quantity*	*Controlled Wattage*	*Baseline Hours*	*Efficient Hours*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
301818-Lighting-Fixture Mounted Occupancy Sensor Controlling >50 and <=200 Watts Replacing No Controls	3077	Lighting	Standard	400	124	6,116	5,582	1.09	120,000	28,959	24%
Total									120,000	28,959	24%

The annual lighting hours of operation verified during the M&V site visit shown in the first table above (6,116) are greater than the annual hours of operation used to calculate ex ante savings (5,704).

During the M&V site visit, the baseline behavior for controlling lighting was determined by survey questions per usage area. The survey indicated moderately efficient behavior with turning off lighting during the workday but at the end of the workday.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned light manufacturing facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling interactive factor of 1.07.

The peak coincident kW reduction was determined by applying the corresponding end use kW factor to the kWh savings.[272]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall realization rate is 89%. The ex ante savings estimate was premised upon greater impact of the occupancy sensors.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	120,000	28,959	24%	5.50
Custom		385,727	422,821	110%	80.32
Total		505,727	451,780	89%	85.82

[272] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6284

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed nine photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 09/13/18 and 10/03/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
200808-Lighting -LED <=13 Watt Lamp Replacing Halogen MR-16 35-50 Watt Fixt	3012	Lighting	Standard	2	2	50	7	4,196	1.14	460	410	89%
305402-Lighting -Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025			50	50	25	10	8,760	1.14	7,030	7,473	106%
				4	4	25	10	8,760	1.14	562	598	106%
				11	11	25	10	8,760	1.14	1,547	1,644	106%
				2	2	25	10	8,760	1.14	281	299	106%
306036-Lighting -Linear ft LED (<=7.5 Watts/ft) Replacing T5 HO Lamp	3089			44	44	50	24	1,362	1.14	5,361	1,772	33%
305402-Lighting -Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	3025			50	50	25	10	8,760	1.14	7,030	7,473	106%
				140	140	25	10	8,760	1.14	19,684	20,925	106%
				10	10	25	10	8,760	1.14	1,406	1,495	106%
101113-Lighting -New Efficient Lighting Fixture Replacing CFL Fixture	1169		Custom	12	12	52	21	8,760	1.14	3,487	3,707	106%
				35	35	28	15	8,760	1.14	3,033	4,708	155%
				83	83	26	15	8,760	1.14	8,947	9,511	106%
100208-Lighting -Non Linear LED Fixture Replacing Metal Halide Fixture				13	6	95	26	8,760	1.14	10,114	10,752	106%
101113-Lighting -New Efficient Lighting Fixture Replacing CFL Fixture				5	5	42	21	8,760	1.14	984	1,046	106%
				112	112	28	15	6,927	1.14	14,172	11,913	84%
				41	41	28	15	4,196	1.14	2,961	2,642	89%
101108-Lighting -New Efficient Lighting Fixture Replacing Metal Halide Fixture				12	12	48	17	1,643	1.14	1,743	695	40%
				16	16	26	11	8,760	1.14	2,250	2,391	106%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
101113-Lighting -New Efficient Lighting Fixture Replacing CFL Fixture				6	6	42	29	4,196	1.14	433	387	89%
				7	7	42	29	8,760	1.14	607	942	155%
100204-Lighting -Non Linear LED Fixt Replacing T8 Fixture				19	19	43	17	8,760	1.14	4,630	4,922	106%
101113-Lighting -New Efficient Lighting Fixture Replacing CFL Fixture				1	1	42	29	8,760	1.14	127	135	106%
100204-Lighting-Non Linear LED Fixture Replacing T8 Fixture				2	2	43	17	8,760	1.14	278	518	186%
				13	13	43	17	4,035	1.14	1,848	1,551	84%
				6	6	43	17	8,760	1.14	1,462	1,554	106%
				49	49	43	17	8,760	1.14	11,941	12,695	106%
				8	8	43	21	8,760	1.14	1,650	1,754	106%
				12	12	43	17	626	1.14	1,462	222	15%
				1	1	43	17	1,081	1.14	142	32	23%
				35	35	43	17	5,091	1.14	4,869	5,269	108%
				55	55	43	17	8,760	1.14	13,404	14,249	106%
				23	23	63	21	8,760	1.14	9,055	9,626	106%
				3	3	43	17	8,760	1.14	731	777	106%
				15	15	58	25	4,173	1.14	2,608	2,314	89%
				9	9	58	25	8,760	1.14	2,742	2,915	106%
				163	163	58	38	8,760	1.14	29,793	31,672	106%
100207-Lighting -Non Linear LED Fixture Replacing T5 HO Fixture				18	18	120	33	8,760	1.14	7,339	15,604	213%
				2	2	120	33	8,760	1.18	931	1,793	193%
				30	30	120	33	8,760	1.14	24,464	26,007	106%
				58	58	167	69	1,427	1.14	53,277	9,226	17%
				5	5	186	69	4,196	1.14	2,510	2,799	112%
Total										267,355	236,420	88%

The annual lighting hours of operation verified during the M&V site visit for the first, sixth, fifteenth, sixteenth, seventeenth, nineteenth, twenty-fourth, twenty-eighth, twenty-ninth, thirty-fourth, and fortieth line items in the table above (4,196, 1,362, 6,927, 4,196, 1,643, 4,196, 4,035, 626, 1,081, 5,000, 4,173, 1,427, respectively) are less than the annual hours of operation used to calculate ex ante savings (ranging from 4,000 – 8,760), while the remaining line items have equal or greater hours of operation (ranging from 4,196 – 8,760).

A heating and cooling interactive factor of 1.14, applicable to a gas heated, air-conditioned community assembly facility in St. Louis, was applied to the ex post lighting energy savings. A factor of 1.18 was applied to refrigerated spaces. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[273]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 88%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 27% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	43,361	42,090	97%	8.00
Custom		223,994	194,330	87%	36.92
Total		267,355	236,420	88%	44.91

[273] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6285

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed eight photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 9/26/2018 and 10/17/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025	Lighting	Standard	1,100	1,100	114	56	3,714	1.15	212,990	271,958	128%
Total										212,990	271,958	128%

The annual lighting hours of operation verified during the M&V site visit (3,714) are greater than the annual hours of operation used to calculate ex ante savings (3,120).

A heating and cooling interactive factor of 1.15, applicable to an electrically heated, air-conditioned large office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling interactive factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[274]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 128%. The ex ante energy savings estimate was premised upon underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	212,990	271,958	128%	51.66
Total		212,990	271,958	128%	51.66

[274] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6286

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed six photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 9/27/18 and 10/22/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025	Lighting	Standard	339	339	114	66	6,496	1.10	116,585	115,852	99%
				85	85	59	33	6,418	1.14	15,834	16,146	102%
				353	353	114	66	6,394	1.10	121,399	118,738	98%
Total										253,818	250,735	99%

Primary data were used to develop estimates of annual lighting operating hours. For all areas monitored, the estimated annual operating hours were fewer than those used to develop the ex ante energy savings estimates (6,696).

A heating and cooling interactive factor of 1.10, applicable to a gas heated, air-conditioned warehouse facility in St. Louis, was applied to the ex post lighting energy savings for the first and third line items in the table above. A factor of 1.14, applicable to a walk-in refrigerated space, was applied to the ex post lighting energy savings for the second line item in the table above. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[275]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 99%.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	253,818	250,735	99%	47.63
Total		253,818	250,735	99%	47.63

[275] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6287

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 9/21/2018 and 10/17/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306140-Lighting-LED Lamp or Fixt Replacing Interior HID Lamp or Fixt	3004-1	Lighting	Standard	48	48	460	115	3,310	1.14	84,769	62,357	74%
				12	12	460	115	3,234	1.14	19,349	15,228	79%
Total										104,118	77,585	75%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours were fewer than those used to develop the ex ante energy savings estimates (4,784 for the first line item, 4,368 for the second).

A heating and cooling interactive factor of 1.14, applicable to a gas heated, air-conditioned assembly facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[276]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 75%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

[276] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	104,118	77,585	75%	14.74
Total		104,118	77,585	75%	14.74

Site ID 6289

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed eleven photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 9/12/2018 and 10/1/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	9	9	164	36	2,434	1.14	2,134	3,190	149%
				5	5	82	36	603	1.14	426	158	37%
				13	13	164	36	757	1.14	3,082	1,432	46%
				6	6	164	36	525	1.14	1,422	459	32%
				22	22	48	18	1,221	1.14	1,223	917	75%
				6	6	164	36	525	1.14	1,422	459	32%
				4	4	82	36	1,003	1.14	341	210	62%
				8	8	164	36	1,863	1.14	1,896	2,170	114%
				5	5	164	36	503	1.14	1,184	366	31%
				2	2	82	36	205	1.14	170	21	13%
				10	10	82	30	414	1.14	963	245	25%
				7	7	164	36	1,885	1.14	1,660	1,921	116%
306140-Lighting-LED Lamp or Fixture Replacing Interior HID Lamp or Fixture	3004-1			3	3	460	100	1,314	1.14	2,001	1,614	81%
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026			1	1	82	36	205	1.14	86	11	12%
				28	28	164	36	1,109	1.14	6,638	4,519	68%
				4	4	82	36	205	1.14	341	43	13%
Total										24,989	17,734	71%

The annual lighting hours of operation verified during the M&V site visit for the first, eight, and twelfth line items in the above table (2,434, 1,863, and 1,885, respectively) are greater than the annual hours of operation used to calculate ex ante savings (1,731), while the remaining line items (ranging from 205 to 1,221) are fewer.

A heating and cooling interactive factor of 1.14, applicable to a gas heated, air-conditioned assembly facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling interactive factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[277]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 71%. The ex ante energy savings estimate was premised upon overestimated annual lighting operating hours for 82% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	24,989	17,734	71%	3.37
Total		24,989	17,734	71%	3.37

[277] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6290

Data Collection

The participant received EMS and Custom Program incentives from Ameren Missouri.

During the M&V visit, ADM staff verified the installation of EMS controls and a new 70 ton rooftop unit (RTU) and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered HVAC equipment nameplate information.

Analysis Results

EMS Controls and RTU Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A monthly pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against monthly billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Heating and cooling degree days (HDD & CDD) were calculated for each billing period and used with a pre/post binary flag variable in an electric usage regression resulting in an R^2 of 0.974 and adjusted R^2 of 0.971. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh_{monthly} = 87.711 \times HDD + 48.498 \times CDD - 19{,}371 \times Pre\_Post + 34{,}551$$

Where:

kWh_{montly} = Monthly kWh Consumption
HDD = Heating Degree Days for the Month with a base temperature of 55ºF
CDD = Cooling Degree Days for the Month with a base temperature of 55ºF
Pre_Post = Pre/Post-Retrofit Binary Flag

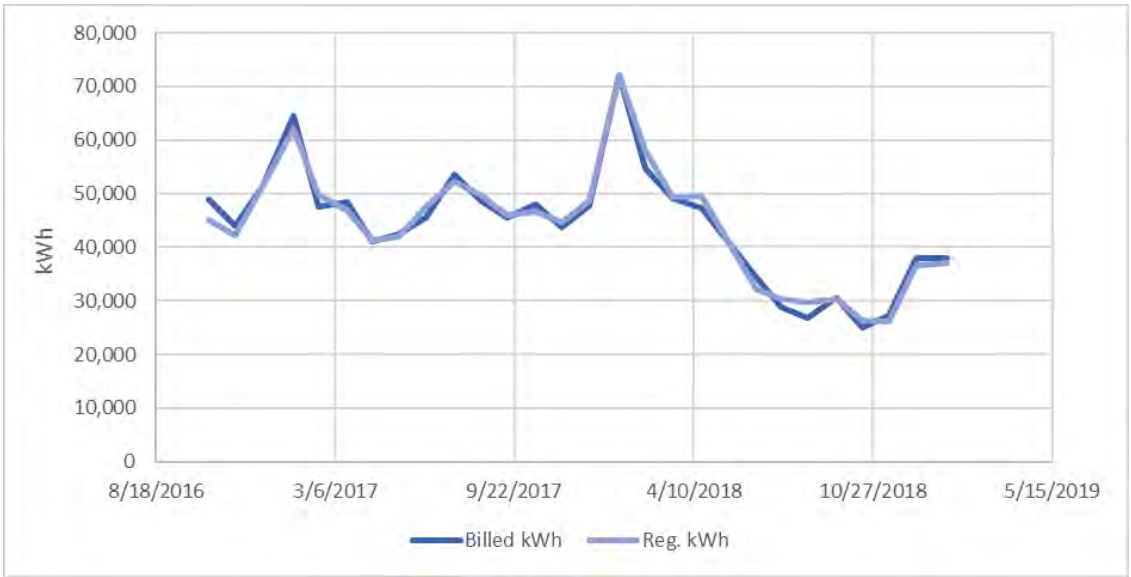
The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	*T Stat*
Intercept	30.6
HDD	-23.5
CDD	10.3
Pre_Post	17.0

Electric energy usage values were calculated using the derived regression equation and summed on a monthly basis. The following plot compares the monthly billed kWh to the regressed kWh:

Billed vs. Regressed Monthly kWh



Annual kWh savings for the installed measures were determined by using the derived equation to calculate monthly pre/post energy consumption of the facility and summing each month for a year. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility and can be seen in the following table:

Monthly kWh Savings

Month	*HDD*	*CDD*	*kWh*		
			Baseline	*As-Built*	*Savings*
Jan	426	2	71,992	52,622	19,371
Feb	264	5	57,970	38,599	19,371
Mar	159	15	49,234	29,863	19,371
Apr	160	22	49,657	30,286	19,371
May	16	155	43,526	24,156	19,371
Jun	0	351	51,552	32,181	19,371
Jul	0	316	49,867	30,497	19,371
Aug	0	300	49,078	29,707	19,371
Sep	0	313	49,743	30,372	19,371
Oct	12	211	45,790	26,420	19,371
Nov	115	17	45,481	26,111	19,371
Dec	242	3	55,894	36,524	19,371
Total			619,785	387,336	232,449

The total billing regression energy savings were used to calculate measure level savings. Since the RTU needed replacement and was beyond is its useful life, ADM had to determine how to remove the additional savings over the existing equipment from the billing regression. ADM used section 2.7.15

Single-Package and Split System in the 2017 Missouri Statewide Technical Reference Manual to determine how to allocate and remove savings for the RTU from the billing regression. The following shows how the savings over the existing equipment and code were determined:

$$\Delta kWH = (kBtu/hr) * [(1/IEER_{base}) - (1/IEER_{ee})] * EFLH$$

Where:

kBtu/hr = Capacity of the cooling equipment actually installed in kBtu per hour
IEER$_{base}$ = Integrated Energy Efficiency Ratio of the baseline equipment and code
IEER$_{ee}$ = Integrated Energy Efficiency Ratio of the energy efficient equipment
EFLH = Equivalent Full Load Hours for cooling

RTU Savings Allocation

Allocation	*IEER*$_{base}$	*IEER*$_{ee}$	*EFLH*	*kBtu*/hr	*kWh Savings*
Over Existing	9.45	16.7	3,265	822	123,295
Above Code	11	16.7			40,019

Measure level savings are shown in the following table:

Custom and EMS Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
117920 –Controls – Cooling	1169	Cooling	EMS	20,947	20,740	99%
118120 –Controls – Heating	1169	Heating	EMS	12,127	12,007	99%
118120 –Controls – Ventilation	1169	HVAC	EMS	77,172	76,408	99%
112720 – HVAC – RTU Replacement	1169	HVAC	Custom	42,656	40,019	94%
Total				152,902	149,174	98%

There were significant differences in the ex ante and ex post analysis methodologies for the EMS controls, with a realization rate of 99%. The ex ante analysis used assumed schedules and setbacks, engineering equations, and a 365-day profile to derive energy savings. ADM used a billing regression to determine realized energy savings. This method accounts for actual facility energy usage as opposed to relying on assumed variables. The difference in ex ante and ex post kWh savings for the Custom RTU replacement are due to slight differences in calculation methodologies. ADM references the 2017 Missouri Statewide Technical Reference Manual for equations and variables while the ex ante analysis uses engineering equations with assumptions that are not fully sourced or justified. Lastly, the end use category for the RTU replacement was corrected to cooling instead of HVAC.

Verified annual savings for the EMS Program incentives are 109,155 kWh, resulting in a realization rate of 99%. Verified annual savings for the Custom Program incentives are 40,019 kWh, resulting in a realization rate of 94%. The site-level verified energy savings are 149,174 kWh, resulting in a realization rate of 98%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	20,947	20,740	99%	18.89
	Heating	12,127	12,007	99%	0.00
	HVAC	77,172	76,408	99%	33.92
Custom	Cooling	42,656	40,019	94%	36.44
Total		152,902	149,174	98%	89.26

Site ID 6291

Data Collection

The participant received EMS Program incentives from Ameren Missouri for installing an Electronic Management System (EMS) to control and schedule the whole facility. The facility is a single-story religious building located in St. Louis consisting of office spaces, classrooms, multipurpose room and a sanctuary. The office is open from 7:00 am to 5:00 pm, Monday through Friday and the sanctuary and multipurpose rooms are open Saturdays from 7:00 am to 5:00 pm. The building is separated into distinct HVAC zones based on occupancy and space scheduling. The facility has three rooftop air conditioning units with electric resistance heating for most of the spaces and gas heating for the sanctuary and multipurpose room along with variable air volume dampers with reheat. Savings are associated with the EMS controls optimizing the start time to condition the facility before opening and implementing demand control ventilation (DCV) and a supply air temperature reset.

During the M&V visit, ADM staff verified the new construction measures, equipment installation, the post-retrofit connected loads, and interviewed facility personnel regarding lighting and equipment operating schedules.

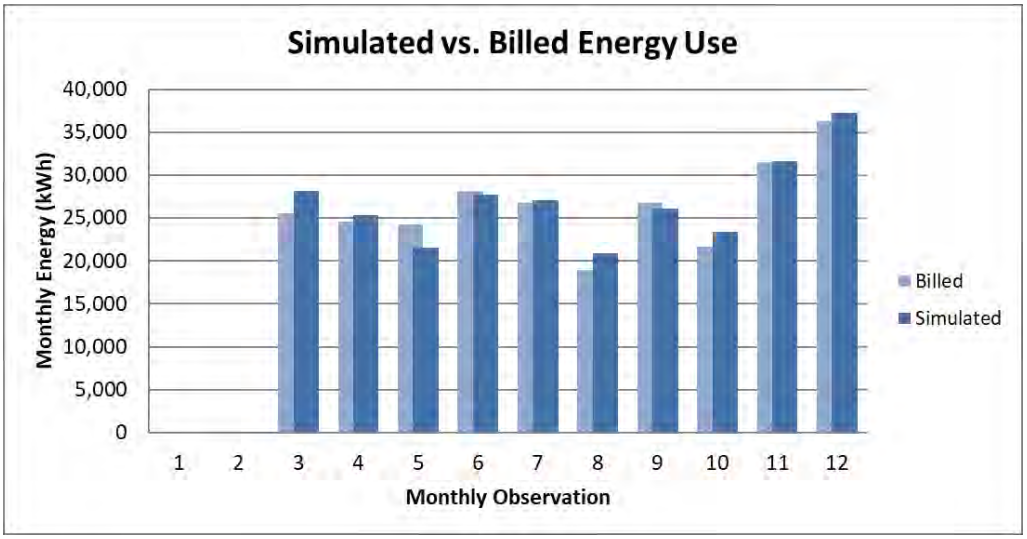
Analysis Results

EMS Savings Calculations

Energy savings for the EMS were calculated using IPMVP Option D: Calibrated Simulation. ADM created and calibrated an eQuest model of the as-built facility using the documentation provided, application details, and photographs taken during the on-site M&V visit.

Upon completion of the initial model, a custom weather file was created using NOAA weather data for the region. Using this weather file and the utility provided billing data for the facility, ADM ensured that the model's energy load shape matched that of the bills. The results of this calibration effort can be seen below. January and February were excluded from the calibration because of an unrelated air conditioning retrofit that caused abnormally high energy usage:

Monthly kWh Calibration



Upon completion of the calibration of the as-built eQuest model, the impacts of the installed measures were removed using parametric runs. Once the parametric runs were defined, the as-built model and parametric runs were simulated using TMY3 weather data. The total realized energy savings are the differences between the baseline and as-built models' energy usages, and the total site-level energy savings by end use can be seen in the following table:

Typical Year Energy Usage (kWh) by End Use

End-Use	*Baseline*	*As-Built*	*kWh Savings*
Lighting	112,033	112,033	-
Misc. Equipment	23,313	23,313	-
Heating	146,368	76,793	69,575
Cooling	72,684	40,419	32,265
Heat Rejection	-	-	-
Auxiliary (pumps)	413	418	-5
Vent Fans	17,655	8,510	9,145
Domestic Hot Water	-	-	-
Ext. Lighting	8,760	8,760	-
Total	381,227	270,246	110,980

Measure level savings are shown in the following table:

New Construction Measure Level Savings

Measure Name/ID	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
117920	Cooling	EMS	16,681	32,265	193%
118120	Heating		57,383	69,575	121%
118220	HVAC		35,014	9,140	26%
Total			109,078	110,980	102%

The ex ante energy models were not provided to review, therefore specific differences that caused the low realization rate is not entirely possible. The ex-ante energy model does not appear to be calibrated to the billing data using actual weather during that time period because the calibration done by ADM showed a 10% increase in energy usage between the actual weather baseline and the TMY3 weather baseline. Also, the ex-ante model has less baseline energy usage using TMY weather than the billing data shows. This would cause the ex-ante model to underestimate savings by lowering the overall building energy load.

Because the savings are approximately 25% of the estimated baseline energy usage, the savings should have been visible in the billing data; however, the reduction in energy usage due to the savings is not clearly visible in the bills and may be affected by other projects or measures at the facility.

The site-level verified energy savings are 110,981 kWh, resulting in a realization rate of 102%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	16,681	32,265	193%	29.38
	Heating	57,383	69,575	121%	0.00
	HVAC	35,014	9,140	26%	4.06
Total		109,078	110,980	102%	33.44

Site ID 6292

Data Collection

The participant received Custom Program incentives from Ameren Missouri for the installation of variable speed drives (VFDs) on process equipment in a new production plant addition.

During the M&V visit, ADM staff verified the installation of the VFDs and interviewed site personnel regarding equipment operation. Amp and VFD speed data from each motor, monthly facility production, and monthly facility kWh usage data were collected. ADM also gathered equipment nameplate data.

Analysis Results

VFD Savings Calculations

The facility built a new expansion wing onto the existing production facility to meet increased production demand. The new plant is functionally like the old plant except for the installation of VFDs on various pumps and fans. Because the new plant addition is similar to the old plant and serves the same production needs, with the exception of the VFDs, the old plant is used as the baseline for calculating energy savings. Energy savings were calculated using IPMVP Option C: Whole Facility analysis methodology. Old plant and new plant addition monthly billing data regressions were created by regressing production data against monthly billing data. The utilized monthly data includes both old and new plant billed kWh and production. Two linear regression models were created to determine how energy consumption of the new plant varied with the installation of the VFDs and increased production compared to the old plant. From the regressions, the following equations were derived and used to calculate monthly energy consumption for the old plant and new plant addition configurations:

$$Old\ Plant\ kWh_{monthly} = 15.88 \times Production + 637{,}219$$

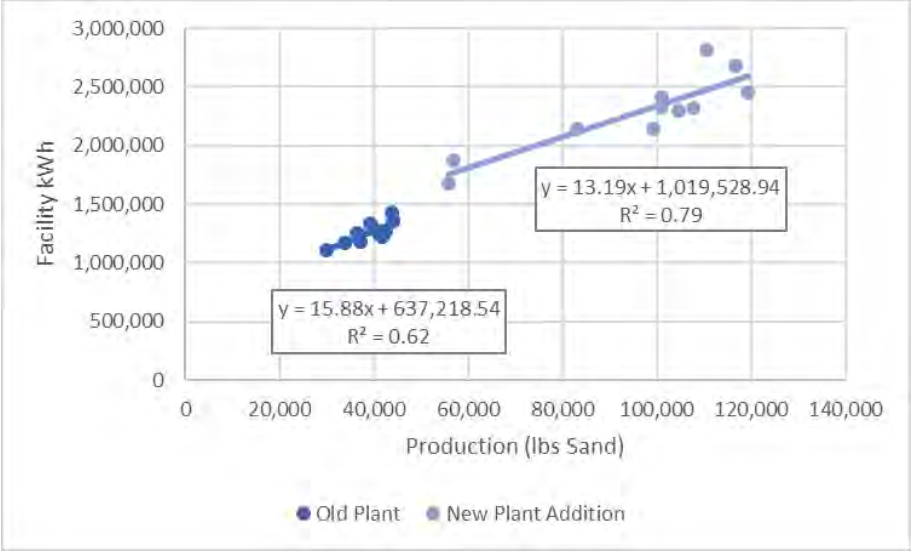
$$New\ Plant\ Addition\ kWh_{monthly} = 13.19 \times Production + 1{,}019{,}529$$

Where:

$kWh_{monthly}$ = Monthly kWh Consumption
Production = Pounds of Product Produced

Electric energy usage values were calculated on a monthly basis using the derived regression equations. The following plot compares the old and new plat addition monthly billed kWh to the monthly production:

Billed kWh vs. Monthly Production



Because the new plant addition billing data and production data include the old plant kWh energy usage and production, the old plant data had to be extrapolated out to determine the energy savings for the new plant addition. Annual kWh savings were determined by multiplying the efficiency of the old and new addition plants (represented by the slope of the regression line) by the average annual tons from the new plant addition. The intercept terms are ignored since it is assumed to be the baseloads of the facility before and after the addition. The following table outlines the variables used and calculation methodologies for each variable:

Average Monthly kWh Savings

Total Production	*Old Plant Production*	*New Plant Addition Production*	*Old Plant kWh*	*New Plant Addition kWh*	*Avg. Monthly Savings*
96,050	39,125	56,925	903,819	750,741	153,078

The following equations were used to determine the average monthly savings:

$$New\ Plant\ Addition\ Production = Total\ Plant\ Production - Old\ Plant\ Production$$

$$Old\ Plant\ kWh = Old\ Plant\ kWh/Ton * New\ Plant\ Addition\ Production$$

$$New\ Plant\ kWh = New\ Plant\ kWh/Ton * New\ Plant\ Addition\ Production$$

Where:

Total Production	= Average monthly tons from the new and old plant addition period
Old Plant Production	= Average monthly tons from the old plant period
New Plant Addition Production	= Average monthly tons from the new plant addition
Old Plant kWh	= Old plant kWh normalized to new plant addition production
New Plant Addition kWh	= New plant addition kWh normalized to new plant addition production
Savings	= Difference between old and new plant addition kWh

While trending data was obtained during M&V, the trend data required a significant amount of assumptions to calculate energy savings. Because only post amp and speed data were tended, motor

kWh had to be calculated using assumed full load amps, assumed power factor, assumed and full load kW. The baseline fan and pump operation also had to be assumed as constant, full load operation year-round was not probable. Due to the high number of assumptions with the trend data, realized energy savings are only based on billing and production data.

The total billing regression energy savings were used to determine measure level savings. Measure level savings are shown in the following table:

Custom Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
Motors VFD	1169	VFD for Process	Custom	2,056,320	1,836,937	89%
Total				2,056,320	1,836,937	89%

There were significant differences in the ex ante and ex post analysis methodologies for the custom measure, with a realization rate of 89%. The ex ante analysis didn't use actual site-specific trending, billing, or production data and made several assumptions. The largest assumption in the ex ante analysis was that the fans and pumps operated constantly at 60 Hz and would be reduced to 55 Hz. The ex ante also included savings for a soft starter on a conveyor, which doesn't save energy. The ex ante assumptions created significant uncertainty with the ex ante savings estimates. ADM used billing and production linear regressions to determine realized energy savings. The billing and production regressions compared the energy use of the new plant addition to a site specific "industry standard" baseline which was the old plant at the same facility. This method better accounts for actual site process energy usage than the ex ante calculations and compares the new plant addition to an actual baseline.

The verified annual site-level energy savings are 1,836,937 kWh, resulting in an 89% realization rate.

A table showing the energy savings achieved by the measures evaluated for this site is shown below:

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Custom	Motors	2,056,320	1,836,937	89%	253.39
Total		2,056,320	1,836,937	89%	253.39

Site ID 6302

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 11/01/18 and 11/28/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100201-Lighting-Non Linear LED Fixture Replacing T12 Fixture	1169	Lighting	Custom	11	11	164	37	4,030	1.09	4,656	6,155	132%
				26	26	164	37	2,520	1.09	11,006	9,095	83%
				11	8	164	40	2,937	1.09	4,954	4,773	96%
100101-Lighting-Linear Tube LED Fixture Replacing T12 Fixture				96	96	42	23	8,760	1.09	17,097	17,494	102%
Total										37,713	37,517	99%

The annual lighting hours of operation verified during the M&V site visit for the first line item in the table above (4,030) are greater than the annual hours of operation used to calculate ex ante savings (3,120), while the second and third line items are fewer (2,520 and 2,937, respectively). The fourth line item corresponds with the ex ante hours (8,760).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned large office facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[278]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 99%.

[278] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Lighting	37,713	37,517	99%	7.13
Total		37,713	37,517	99%	7.13

Site ID 6304

Data Collection

The participant received EMS incentives.

During the M&V visit, ADM staff verified equipment installation, baseline and the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed four photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 2/02/18 and 4/12/18.

Analysis Results

Lighting Controls Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Quantity*	*Controlled Wattage*	*Baseline Hours*	*Efficient Hours*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
108320-Lighting-Lighting Replacing Existing System	1169	Lighting	EMS	377	52	5,286	3,844	1.14	55,618	31,914	57%
Total									55,618	31,914	57%

Primary data were used to develop estimates of annual base and post lighting operating hours. The base hours were logged, and the post hours were verified through the facilities EMS program. For all facility areas monitored, the estimated annual base operating hours (5,286) were less than those used to develop the ex ante energy savings estimates (6,516). The monitoring system post annual hours (3,844) were greater than the ex ante hours (3,000).

A heating and cooling interactive factor of 1.14, applicable to a gas heated, assembly facility in St. Louis was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a 1.07 factor.

The peak coincident kW reduction was determined by applying the corresponding end use kW factor to the kWh savings.[279]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall realization rate is 57%. The ex ante energy savings estimate was premised on overestimated annual baseline lighting operating hours and underestimated post lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Lighting	55,618	31,914	57%	6.06
Total		55,618	31,914	57%	6.06

[279] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6305

Data Collection

The participant received EMS Program incentives from Ameren Missouri for adding fan schedules to the energy management system (EMS) that allow the HVAC fans to cycle off during unoccupied hours.

During the M&V visit, ADM staff verified the installation of new EMS controls and interviewed site personnel regarding equipment operation. Data from the EMS were collected where possible. ADM also acquired and reviewed the energy calculations used in the ex ante analysis.

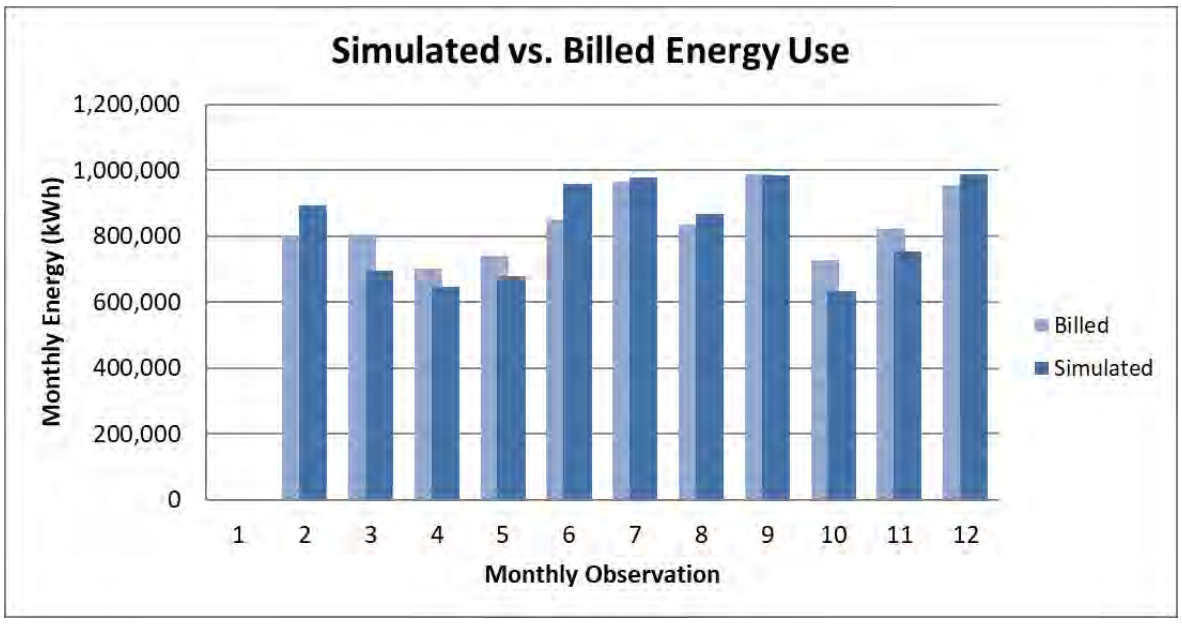
Analysis Results

EMS Controls Savings Calculations

Energy savings for the installed measures were calculated using IPMVP Option D: Calibrated Simulation. As part of a PY2017 project, ADM compiled an eQuest model of the baseline facility using the details and construction documents collected during the on-site M&V visit and from the project documentation.

Upon completion of the initial model, a custom weather file was created using NOAA weather data for the region. Using this weather file and the utility provided billing data for the building, ADM ensured that the model's energy load shape matched that of the bills. The results of this calibration effort can be seen below:

Monthly kWh Calibration



Upon completion of the calibration for the baseline eQuest model, the impacts of the installed measures were added using parametric runs. ADM added more parametric runs to the existing PY2017 model for this project. Once the new parametric runs were defined, the new baseline model and parametric runs were simulated using TMY3 weather data. The total realized energy savings are the differences

between the baseline and as-built models' energy usages, and the total site-level energy savings by end use can be seen in the following table:

Typical Year Energy Usage (kWh) by End Use

End-Use	*Baseline*	*As-Built*	*kWh Savings*
Lighting	2,647,672	2,647,672	0
Misc. Equipment	1,322,911	1,322,911	0
Heating	2,371,070	2,249,346	121,725
Cooling	1,670,365	1,694,326	-23,961
Heat Rejection	176,344	176,518	-174
Auxiliary (pumps)	792,367	793,650	-1,283
Vent Fans	1,108,809	1,065,735	43,073
Domestic Hot Water	187,790	187,596	194
Ext. Lighting	2,036	2,036	0
Total	10,279,364	10,139,789	139,574

Measure level savings are shown in the following table:

EMS Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
117920 – Cooling	1169	Cooling	EMS	47,477	-24,135	-51%
118220 – HVAC	1169	HVAC	EMS	70,904	43,073	61%
118120 – Heating	1169	Heating	EMS	29,127	120,636	414%
Total				147,508	139,574	95%

There were significant differences in the ex ante and ex post analyses for the EMS controls installed under this project, with a realization rate of 94%. The ex ante analysis uses bin calculations. ADM was provided the ex ante bin calculations, and ADM determined that many assumptions were made that lead to drastically different measure level savings. The largest difference is that the bin calculations do not accurately account for the outside air that was brought in during unoccupied hours before the fans could cycle off.

The ex post analysis uses eQuest energy simulations calibrated to actual billing data. This method accounts for interactive effects and HVAC system operations better than the ex ante bin calculations.

The ex post energy simulations show that a lot of the unoccupied hours during the cooling season are moderate enough that the outside air brought in for ventilation precooled the facility without a call for cooling. This loss of free precooling before an actual call for cooling resulted in negative cooling savings. Also due to the outside air that was brought in during unoccupied hours, heating savings are

significantly higher than expected. The bin calculations underestimated how much heating energy was required to heat the extra ventilation air that is no longer brought in.

Verified annual savings for the EMS Program incentives are 139,574 kWh, resulting in a site-level realization rate of 95%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	47,477	-24,135	-51%	-21.98
	HVAC	70,904	43,073	61%	19.12
	Heating	29,127	120,636	414%	0.00
Total		147,508	139,574	95%	-2.86

Site ID 6306

Data Collection

The participant received EMS Program incentives from Ameren Missouri for installing a new energy management system (EMS) to control HVAC schedules.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the EMS were collected where possible. ADM also gathered mechanical schedules and HVAC equipment nameplate information.

Analysis Results

EMS Optimization Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A monthly pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against monthly billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Cooling and Heating degree days (CDD & HDD) were calculated for each billing period and used with a pre/post binary flag variable in an electric usage regression resulting in an R^2 of 0.907 and adjusted R^2 of 0.892. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh_{monthly} = 56.40 \times CDD + 13.27 \times HDD - 5{,}387.87 \times PrePost + 17{,}753.20$$

Where:

$kWh_{monthly}$ = Monthly kWh Consumption
Days = Number of Days for the Billing Period
CDD = Cooling Degree Days for the Month with a Base Temperature of 71.51°F
HDD = Heating Degree Days for the Month with a Base Temperature of 59.00°F
PrePost = Pre/Post-Retrofit Binary Flag for Finalization of Implementation

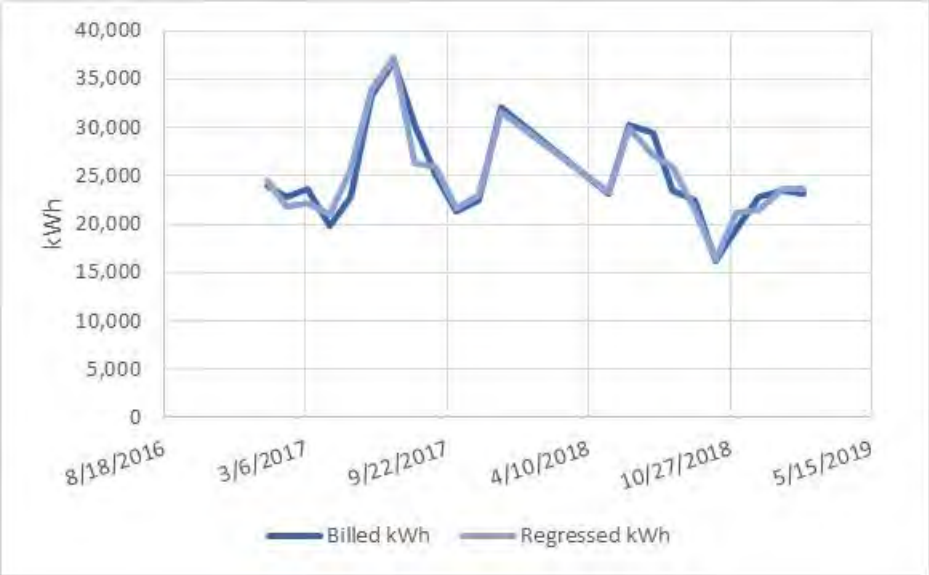
The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	*T Stat*
Intercept	19.96
CDD	12.52
HDD	8.25
PrePost	-7.24

Electric energy usage values were calculated on a monthly basis using the derived regression equation. The following plot compares the monthly billed kWh to the regressed kWh:

Billed vs. Regressed Monthly kWh



Annual kWh savings for the installed measures were determined by using typical year (TMY3) weather data and the derived equation to calculate monthly pre/post energy consumption of the site. Each month was summed for a year to obtain annual energy savings. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility, and can be seen in the following table:

Monthly kWh Savings

Month	*CDD*	*HDD*	*kWh*		
			Baseline	*As-Built*	*Savings*
Jan	0	930	30,096	24,709	5,388
Feb	0	682	26,798	21,411	5,388
Mar	12	363	23,235	17,847	5,388
Apr	28	173	21,659	16,271	5,388
May	38	61	20,698	15,310	5,388
Jun	207	2	29,447	24,059	5,388
Jul	303	0	34,818	29,430	5,388
Aug	211	0	29,639	24,252	5,388
Sep	86	12	22,776	17,388	5,388
Oct	9	198	20,877	15,489	5,388
Nov	1	457	23,872	18,484	5,388
Dec	0	856	29,111	23,723	5,388
Total			313,027	248,373	64,654

The total billing regression energy savings were used to determine measure level savings. Measure level savings are shown in the following table:

EMS Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
117920 -HVAC	1169	Cooling	EMS	20,182	40,795	202%
118220 -Cooling	1169	HVAC	EMS	11,804	23,860	202%
Total				31,986	64,654	202%

There were significant differences in the ex ante and ex post analysis methodologies for the EMS measures, with a realization rate of 202%.

The ex ante analysis for the HVAC optimization measures used bin analyses with assumed occupancy schedules, fan speeds, recovered loads, and HVAC loads. All these assumptions created significant uncertainty with the ex ante savings estimates. The ex ante analysis didn't use any site-specific trending or utility data. It should also be noted that the application was originally submitted with expected savings of 518,550 kWh. The number was significantly reduced to the current expected savings by the contractor prior to incentives. There wasn't a scope or detailed explanation for the change, but the submitted savings were obviously overestimated compared to the total annual energy usage of the facility. The adjusted ex ante savings appear to have been overly conservative. ADM used a billing regression with a good fit (R Square = 0.907) to determine realized energy savings. This method better accounts for actual site HVAC energy usage than the ex ante calculations.

The high realization rate is due to the ex ante analysis using schedules and setbacks in the baseline scenario. During the site visit, the sit contact indicated no schedules or setbacks were present before the project was implemented. The ex ante analysis had the baseline fans running from 4 AM to 10 PM, 7 days per week, or 6,205 hours annually, and used a 73°F occupied and 85°F unoccupied cooling schedule. Using a schedule and setbacks in the baseline lowered the potential savings compared to the fans running nearly year round and with not setbacks.

The verified annual site-level energy savings are 64,654 kWh, resulting in a 202% realization rate.

A table showing the energy savings achieved by the measures evaluated for this site is shown below:

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	20,182	40,795	202%	37.15
	HVAC	11,804	23,860	202%	10.59
Total		31,986	64,654	202%	47.74

Site ID 6307

Data Collection

The participant received EMS Program incentives from Ameren Missouri.

During the M&V visit, ADM staff verified the installation of EMS optimized start controls and VFD installation, and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered HVAC equipment nameplate information.

Analysis Results

EMS Controls Savings Calculations

Energy savings for the EMS controls were calculated using prototypical energy simulation. ADM used a calibrated eQuest model of a church from a project completed in a previous program year. To account for local weather, the calibrated model's HVAC systems were allowed to auto-sized during a sizing run with local weather data. Using project documents and the details collected during the on-site M&V visit, heating, cooling, and fan schedules were created for the baseline and as-built models. ADM ran parametric simulations to determine the prototypical annual energy usage of the model with EMS optimized start controls, and a VFD on a 25-horsepower supply fan. The realized energy savings are the differences between the parametric simulations' energy usages, and the energy savings by end use can be seen in the following table:

Prototypical Annual Energy Usage (kWh) by End Use

End Use	*Baseline (kWh)*	*Optimized Start (kWh)*	*As-Built (kWh)*
Cooling	219,442	214,738	210,929
Heat Rejection	6,661	6,599	6,265
Heating	0	0	0
Ventilation	297,038	285,998	260,590
Auxiliary Pumps	19,174	18,880	18,876
Misc. Equipment	106,319	106,319	106,319
Lighting	273,563	273,563	273,563
Total	922,197	906,096	876,543

The prototypical annual energy savings were normalized to modeled fan horsepower. This was done by dividing the difference in parametrically modeled savings by the modeled horsepower. This normalized kWh/hp savings value was multiplied by the horsepower of the controlled fans to determine site savings.

The following table presents information on prototypical and actual equipment and expected and realized energy savings for the EMS controls and VFD installed at the site:

EMS Controls Savings

Program	Measure	Fan HP		EMS Controls Savings		Realized kWh Savings
		Prototypical	Actual	Prototypical kWh	Normalized kWh/hp	
EMS	Fan Scheduling	56.7	35.7	16,100	284	10,137
HVAC	VFDs	56.7	27.5	29,554	521	14,313
Total						24,449

Measure level savings are shown in the following table:

Custom and EMS Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
117920-Cooling Existing System	1169	Cooling	EMS	3,361	3,001	89%
118220-HVAC Existing System	1169	HVAC	EMS	4,456	7,136	160%
113321-VFD for Fan Replacing Failed Equipment	1169	HVAC	EMS	20,496	14,313	70%
Total				28,313	24,449	86%

There were significant differences in the ex ante and ex post analysis methods for the EMS controls and VFD implementation, with a realization rate of 86%. ADM analysis utilized energy modeling to calculate savings whereas ex ante methodology included bin calculations with assumptions about operation hour reductions associated with optimized start programming. Additionally, ex ante savings calculations for the VFD installation used assumed bin hours for the fan operation profile.

Ex ante optimized start savings calculated cooling energy savings using the full load cooling capacity, which overestimated cooling energy savings. This is due to the cooling equipment not operating at full load for every hour of operation throughout the year. ADM's model showed that the majority of savings were realized through reduced fan operation hours as opposed to cooling energy reduction.

Additionally, the assumed bins used by ex ante calculations for VFD savings overestimated energy use reduction. The bins overestimated the amount of time the supply fan operates at part loads. The table below shows the ex ante bins versus bins calculated using modeled fan energy demand. Utilizing the updated bins and ex ante methodology, savings were calculated to be approximately 50% less than ex ante claimed savings.

Fan Operation Profile

Flow %	*Ex Ante Time (%)*	*Ex Post Time (%)*
100%	10%	47%
90%	15%	34%
80%	25%	2%
70%	25%	2%
60%	15%	2%
50%	10%	3%
40%	0%	2%
30%	0%	5%
20%	0%	3%
10%	0%	0%
0%	0%	0%

Verified annual savings for the EMS Program incentives are 24,449 kWh, resulting in a realization rate of 80%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	3,361	3,001	89%	2.7
	HVAC	4,456	7,136	160%	3.2
	HVAC	20,496	14,313	70%	6.4
Total		28,313	24,449	86%	12.3

Site ID 6309

Data Collection

The participant received New Construction lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 9/06/18 and 10/16/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
406123-Lighting-New Const. Lighting Power Density(LPD)	3000	Lighting	New Construction	225	225	108	31	6,218	1.09	150,671	148,390	98%
Total										150,671	148,390	98%

The lighting energy use of the installed lighting equipment is compared with the estimated lighting energy use associated with the applicable new construction baseline (ASHAE 90.1 2007) to determine realized lighting energy savings. The manufacturing facility constructed in St. Louis County was subject to the 2009 IECC code in effect during the building design, which allows for 1.0 lighting watts/SF for the office space and 1.30 lighting watts/SF for the manufacturing space. The code compliant baseline lighting wattage for the office space was 13,863 watts (1.0 watts/SF*13,863SF) and for the manufacturing space the lighting baseline was 10,374 watts (1.3 watts/SF*7,980SF).

The annual lighting hours of operation verified during the M&V site visit (6,218) are fewer than the annual hours of operation used to calculate ex ante savings (8.712).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned light manufacturing in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate did not account for heating and cooling interactive effects.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[280]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

[280] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
New Construction	Lighting	150,671	148,390	98%	28.19
Total		150,671	148,390	98%	28.19

Site ID 6310

Data Collection

The participant received Retro-Commissioning (RCx) Program incentives from Ameren Missouri.

During the M&V visit, ADM staff verified the optimization of building automation system (BAS) and interviewed site personnel regarding equipment operation. Data from the BAS were collected where possible. ADM also gathered site occupancy schedules, lighting information, and HVAC equipment nameplate data.

Analysis Results

RCx Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A monthly pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against monthly billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Cooling and heating degree days (CDD & HDD) were calculated for each billing period and used with a pre/post binary flag and school days variables in an electric usage regression resulting in an R^2 of 0.968 and adjusted R^2 of 0.958. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh_{monthly} = 228 \times CDD + 89.4 \times HDD - 11{,}550 \times Pre\_Post + 41.1 \times HDD\_Post + 1{,}853 \times School\_Days + 8{,}137$$

Where:

kWh$_{monthly}$ = Monthly kWh Consumption
CDD = Cooling Degree Days for the Month with a Base Temperature of 63°F
HDD = Heating Degree Days for the Month with a Base Temperature of 45°F
Pre_Post = Pre/Post-Retrofit Binary Flag
HDD_Post = HDD multiplied by Pre_Post
School_Days = Number of School Days for the Month

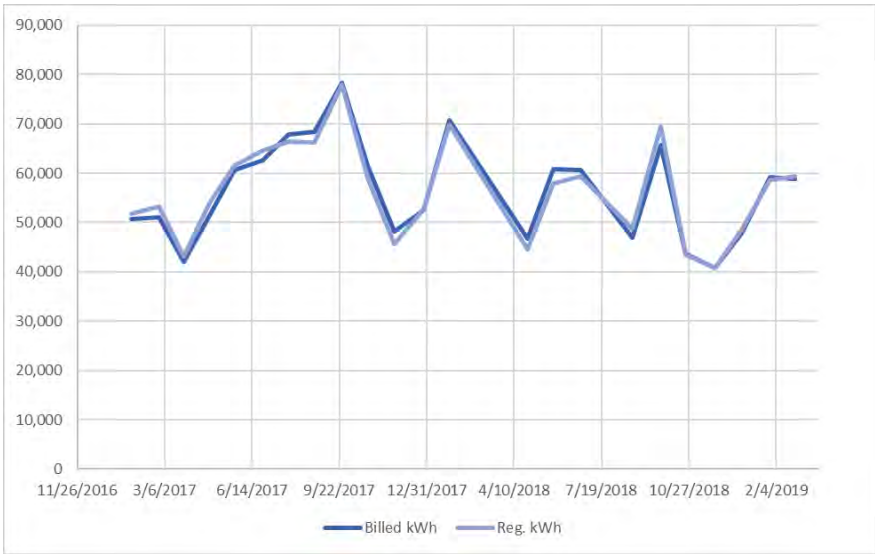
The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	*T Stat*
Intercept	2.71
School_Days	13.6
Pre_Post	-10.3
CDD	21.4
HDD	12.1
HDD_Post	4.04

Electric energy usage values were calculated on a monthly basis using the derived regression equation. The following plot compares the monthly billed kWh to the regressed kWh:

Billed vs. Regressed Monthly kWh



Annual kWh savings for the installed measures were determined by using typical year (TMY3) weather data and the derived equation to calculate monthly pre/post energy consumption of the site. Each month was summed for a year to obtain annual energy savings. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility, and can be seen in the following table:

Monthly kWh Savings

Month	*CDD*	*HDD*	*kWh*		
			Baseline	*As-Built*	*Savings*
Jan	0	279	64,642	64,586	56
Feb	1	179	63,246	59,070	4,176
Mar	17	54	53,997	44,688	9,309

Month	CDD	HDD	kWh		
			Baseline	As-Built	Savings
Apr	33	13	31,678	20,661	11,017
May	54	1	20,644	9,137	11,507
Jun	162	0	59,923	48,374	11,550
Jul	212	0	88,005	76,455	11,550
Aug	173	0	79,215	67,666	11,550
Sep	94	0	61,029	49,479	11,550
Oct	18	12	46,753	35,697	11,056
Nov	5	76	51,171	42,730	8,440
Dec	0	229	63,824	61,694	2,130
Total			684,126	580,237	103,889

The total billing regression energy savings were used to determine measure level savings. Another project, Project 2, was also completed at this site during the evaluated timeline but was not sampled. The expected savings for Project 2 are 63,536 kWh. Those savings were subtracted from the total billing regression savings to obtain the total site-level energy savings (103,889 – 63,536 = 40,353 kWh).

Measure level savings are shown in the following table:

RCx Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
113220 – HVAC	1169	HVAC	RCx	37,818	36,170	96%
115920 – Cooling	1169	Cooling	RCx	4,374	4,183	96%
Total				42,192	40,353	96%

There were significant differences in the ex ante and ex post analysis methodologies for the RCx measures, with a realization rate of 96%. The ex ante analysis for the HVAC optimization measures used bin analyses with assumed occupancy schedules, fan speeds, and HVAC loads. All these assumptions created significant uncertainty with the ex ante savings estimates. The ex ante analysis did not use any site-specific trending or utility data. ADM used a billing regression with a good fit (R Square = 0.968) to determine realized energy savings. This method better accounts for actual site HVAC energy usage compared to the ex ante calculations.

The verified annual site-level energy savings are 40,353 kWh, resulting in a 96% realization rate.

A table showing the energy savings achieved by the measures evaluated for this site is shown below:

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Retro -Commissioning	HVAC	37,818	36,170	96%	16.06
	Cooling	4,374	4,183	96%	3.81
Total		42,192	40,353	96%	19.87

Site ID 6312

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing personnel regarding lighting operating schedules and was determined that photo cells were in use as well as timers.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixture Replacing M H Fixture	1169	Exterior Lighting	Custom	36	36	455	84	4,308	1.00	58,578	57,616	98%
				669	669	455	84	2,920	1.00	725,718	725,833	100%
Total										784,296	783,449	100%

The annual lighting hours of operation for the line items in the above table using photo cells (4,308[281]) are less than the hours of operation used to calculate ex ante savings (4,380). In addition, the second line item above has a timer which turns the lighting off in the very early morning hours.

A heating and cooling interactive factor of 1.00, applicable to an unconditioned exterior space in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate did not account for heating and cooling interactive factors.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[282]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 100%.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	784,296	783,449	100%	4.40
Total		784,296	783,449	100%	4.40

[281] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[282] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6313

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 12/11/18 and 1/14/19.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306135-Lighting-LED Lamp Fixt Replac T5 Lamp Fixt	3088	Lighting	Standard	38	38	62	25	1,341	0.98	5,078	1,852	36%
306143-Lighting-LED Lamp Fixt Replac T8 Lamp Fixt	3025			2	2	59	25	1,120	0.98	245	75	31%
306135-Lighting-LED Lamp Fixt Replac T5 Lamp Fixt	3088			1	1	62	25	8,760	0.98	134	318	238%
				22	22	117	50	8,760	0.98	5,322	12,684	238%
306142-Lighting-LED Lamp Fix Replac T12 Lamp Fixt	3026			3	3	94	25	8,760	0.98	748	1,781	238%
306135-Lighting-LED Lamp Fixt Replac T5 Lamp Fixt	3088			7	7	62	25	1,120	0.98	935	285	30%
306143-Lighting-LED Lamp Fixt Replac T8 Lamp Fixt	3025			6	6	59	25	1,120	0.98	737	225	30%
306135-Lighting-LED Lamp Fixt Replac T5 Lamp Fixt	3088			26	26	360	150	2,294	0.98	19,717	12,305	62%
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025			14	14	114	50	1,120	0.98	3,236	986	30%
				3	3	114	50	1,120	0.98	693	211	30%
				130	130	59	25	3,001	0.98	15,961	13,031	82%
				6	6	59	25	1,636	0.98	737	328	44%
				42	42	59	25	1,120	0.98	5,156	1,572	30%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
				25	25	114	50	1,856	0.98	5,778	2,918	50%
				296	296	88	38	1,268	0.98	53,447	18,429	34%
				95	95	59	25	3,001	0.98	11,664	9,523	82%
301037-Lighting-LED <=20 Watt Lamp Fixt ReplHalogen A >=40 Watt Lamp Fixt	3011			14	14	43	10	3,237	0.98	1,617	1,469	91%
301039-Lighting-LED <=20 Watt Lamp Fixt Replacing HalogenPAR Lamp Fixt	3008			6	6	90	19	3,237	0.98	1,538	1,355	88%
				19	19	35	8	5,308	0.98	1,853	2,675	144%
				6	6	175	19	3,237	0.98	3,380	2,976	88%
Total										137,976	84,999	62%

The annual lighting hours of operation verified during the M&V site visit for the third through fifth- and nineteenth-line items in the table above (ranging form 5,308 to 8,760) are greater than the annual hours of operation used to calculate ex ante savings (3,375). The remaining measures have hours of operation (ranging from 1,120 to 3,001) which are fewer than the ex ante hours estimate (3,375).

An adjusted base wattage of 43W for the seventeenth line item in the table above was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

A heating and cooling interactive factor of 0.98, applicable to an electric heated, air conditioned education facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[283]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 62%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 94% of the installed measures and overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	End Use Category	kWh Savings			Gross Ex Post kW Reduction
		Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross Realization Rate	
Standard	Lighting	137,976	84,999	62%	16.15
Total		137,976	84,999	62%	16.15

[283] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6316

Data Collection

The participant received EMS Program incentives from Ameren Missouri for installing a new energy management system (EMS) to control HVAC schedules.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the EMS were collected where possible. ADM also gathered mechanical schedules and HVAC equipment nameplate information.

Analysis Results

EMS Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A monthly pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against monthly billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Cooling and heating degree days (CDD & HDD) were calculated for each billing period and used with a pre/post binary flag variable in an electric usage regression resulting in an R^2 of 0.947 and adjusted R^2 of 0.934. From the regression, the following equations were used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh/Day = 17{,}000 + 14.39 \times CDD - 3.558 \times HDD - 3{,}177 \times PrePost$$

$$kWh_{monthly} = kWh/Day \times Days$$

Where:

kWh/Day = Daily Average kWh for Each Day in the Billing Period
kWh$_{monthly}$ = Monthly kWh Consumption
Days = Number of Days for the Month
CDD = Cooling Degree Days for the Month with a Base Temperature of 65°F
HDD = Heating Degree Days for the Month with a Base Temperature of 65°F
PrePost = Pre/Post-Retrofit Binary Flag

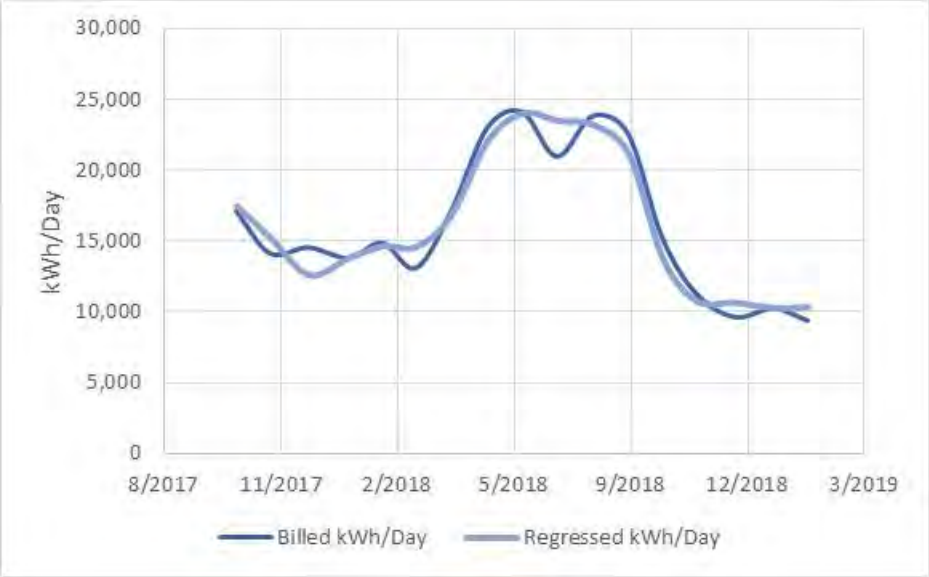
The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	*T Stat*
Intercept	14.2
CDD	4.32
HDD	-2.40
PrePost	-4.09

Electric energy usage values were calculated on a monthly basis using the derived regression equation. The following plot compares the monthly billed kWh to the regressed kWh:

Billed vs. Regressed kWh/Day



Annual kWh savings for the installed measures were determined by using typical year (TMY3) weather data and the derived equation to calculate monthly pre/post energy consumption of the site. Each month was summed for a year to obtain annual energy savings. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility, and can be seen in the following table:

Monthly kWh Savings

Month	*Days*	*CDD*	*HDD*	*kWh*		
				Baseline	*As-Built*	*Savings*
Jan	31	0	1,114	404,183	305,691	98,492
Feb	28	1	843	392,331	303,370	88,961
Mar	31	33	509	485,795	387,303	98,492
Apr	30	69	289	508,756	413,441	95,315
May	31	108	132	560,590	462,097	98,492

Month	Days	CDD	HDD	kWh		
				Baseline	As-Built	Savings
Jun	30	369	14	667,815	572,500	95,315
Jul	31	493	1	746,788	648,296	98,492
Aug	31	393	3	701,941	603,448	98,492
Sep	30	200	45	591,402	496,087	95,315
Oct	31	35	335	505,479	406,986	98,492
Nov	30	7	618	447,247	351,932	95,315
Dec	31	0	1,041	412,244	313,751	98,492
Total				6,424,570	5,264,901	1,159,668

The total billing regression energy savings were used to determine measure level savings. An additional project, Project 2, was completed at the facility during the regressed period; thus, the additional savings from this measure were captured by the regression. To calculate the realized savings and realization rate for this project, Project 2, the ex ante savings for the additional measure were subtracted from the regressed savings to find the final ex post savings. The following table summarizes the regressed versus measure savings:

Regressed vs Measure Savings

Total Regressed Savings	1,159,668
Ex Ante Savings for Additional Project	801,075
Ex Post Savings	358,593

Measure level savings are shown in the following table:

EMS Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
117920 - HVAC - Cooling	1169	Cooling	EMS	379,191	358,593	95%
Total				379,191	358,593	95%

There were significant differences in the ex ante and ex post analysis methodologies for the RCx measures, with a realization rate of 95%. The ex ante analysis for the HVAC optimization measures used bin analyses with assumed occupancy schedules, fan speeds, recovered loads, and HVAC loads. All these assumptions created significant uncertainty with the ex ante savings estimates. The ex ante analysis didn't use any site-specific trending or utility data. ADM used a billing regression with a good fit (R Square = 0.947) to determine realized energy savings. This method better accounts for actual site HVAC energy usage than the ex ante calculations.

The verified annual site-level energy savings are 358,593 kWh, resulting in a 95% realization rate.

A table showing the energy savings achieved by the measures evaluated for this site is shown below:

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	379,191	358,593	95%	326.57
Total		379,191	358,593	95%	326.57

Site ID 6319

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed nine photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 10/26/2018 and 11/28/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
201111Lighting LED<11WLamp ReplacHalgen A 28-52W Lamp	3011	Lighting	Standard	43	43	43	9	6,219	1.00	6,219	9,092	146%
305402-Lighting Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 W Linear ft	3025			3,151	3,151	32	14	5,352	1.01	248,579	308,003	124%
				44	44	32	14	5,544	1.01	3,471	4,428	128%
Total										258,269	321,523	124%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours exceeded those used to develop the ex ante energy savings estimates (4,096).

Quantities of 1,448 of the second line item in the above table, and 24 of the third line item, were installed at a separate manufacturing facility 1.5 miles from the designated project location.

An adjusted base wattage of 43W was used in the ex post savings analysis for the first line item in the above table to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned light manufacturing facility in St. Louis, was applied to the ex post lighting energy savings. A factor of 1.00 was used for unconditioned spaces. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[284]

[284] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 124%. The ex ante energy savings estimate was premised upon underestimated annual hours of operation.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	258,269	321,523	124%	61.08
Total		258,269	321,523	124%	61.08

Site ID 6320

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, baseline and the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed nine photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 11/02/18 and 12/03/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306135-Lighting-LED Lamp or Fixture Replacing T5 Lamp or Fixture	3088	Lighting	Standard	351	351	360	142	4,877	1.09	717,219	407,444	57%
				46	46	240	142	8,760	1.00	42,254	39,490	93%
Total										759,473	446,935	59%

Lighting Controls Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Quantity*	*Controlled Wattage*	*Baseline Hours*	*Efficient Hours*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
021400-301818-Lighting-Fixture Mounted Occupancy Sensor Controlling >50 and <=200 Watts Replacing No Controls	3077	Lighting	Standard	46	142	8,760	8,291	1.00	119,100	3,066	3%
Total									119,100	3,066	3%

The annual lighting hours of operation verified during the M&V site visit for the first line item in the first table above (4,877) are fewer than the annual hours of operation used to calculate ex ante savings (8,760). The ex ante hours for the entire facility (8,760) were premised on 24/7 usage however, the first line item baseline fixtures had occupancy sensors which would have produced a lower ex ante annual hour value.

The quantity of the Controls (46) listed in the second table above is fewer than the quantity used to calculate ex ante savings (397). The measure represents controls being installed where there were no controls as a baseline. There were existing controls on 351 baseline fixtures.

A heating and cooling interactive factor of 1.00, applicable to an unconditioned space in St. Louis was applied to the ex post lighting energy savings for all the warehouse spaces. A factor of 1.15 and 1.29 was used for freezer and refrigerator spaces respectively. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

During the M&V site visit, the baseline behavior for controlling lighting was determined by survey questions per usage area.

The peak coincident kW reduction was determined by applying the corresponding end use kW factor to the kWh savings.[285]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall realization rate is 51%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 88% of the installed measures and overestimated quantity of installed controls replacing no controls.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	878,573	450,000	51%	85.48
Total		878,573	450,000	51%	85.48

[285] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6322

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 10/25/18 and 11/26/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306135-Lighting-LED Lamp or Fixture Replacing T5 Lamp or Fixture	3088	Lighting	Standard	450	450	293	115	5,740	1.02	482,616	467,381	97%
Total										482,616	467,381	97%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours were slightly greater than those used to develop the ex ante energy savings estimates (5,631).

A heating and cooling interactive factor of 1.02, applicable to an electrically heated, air-conditioned retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[286]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 97%. The ex ante energy savings estimate was premised on overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	482,616	467,381	97%	88.79
Total		482,616	467,381	97%	88.79

[286] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6323

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 10/25/18 and 11/26/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306135-Lighting-LED Lamp or Fixture Replacing T5 Lamp or Fixture	3088	Lighting	Standard	416	416	293	115	5,519	1.02	446,151	415,403	93%
				36	36	293	109	5,285	1.02	39,911	35,585	89%
Total										486,062	450,988	93%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours were fewer than those used to develop the ex ante energy savings estimates (5,631).

A heating and cooling interactive factor of 1.02, applicable to an electrically heated, air-conditioned retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[287]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 93%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	486,062	450,988	93%	85.67
Total		486,062	450,988	93%	85.67

[287] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6324

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 10/31/18 and 11/26/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306135-Lighting-LED Lamp or Fixture Replacing T5 Lamp or Fixture	3088	Lighting	Standard	476	476	293	115	5,621	1.02	515,216	485,169	94%
Total										515,216	485,169	94%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours were slighting fewer than those used to develop the ex ante energy savings estimates (5,683).

A heating and cooling interactive factor of 1.02, applicable to an electrically heated, air-conditioned retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[288]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 94%. The ex ante energy savings estimate was premised on overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	515,216	485,169	94%	92.16
Total		515,216	485,169	94%	92.16

[288] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6325

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 10/25/18 and 11/26/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306135-Lighting-LED Lamp or Fixture Replacing T5 Lamp or Fixture	3088	Lighting	Standard	434	434	293	115	5,678	1.02	460,249	445,888	97%
				44	44	293	109	5,295	1.02	48,235	43,574	90%
Total										508,484	489,461	96%

The annual lighting hours of operation verified during the M&V site visit for the first line item in the table above (5,678) are greater than the annual hours of operation used to calculate ex ante savings (5,568), while the second line item has fewer hours (5,295).

A heating and cooling interactive factor of 1.02, applicable to an electrically heated, air-conditioned retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[289]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 96%. The ex ante energy savings estimate was premised on overestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	508,484	489,461	96%	92.98
Total		508,484	489,461	96%	92.98

[289] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6326

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 11/01/18 and 11/28/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306135-Lighting-LED Lamp or Fixture Replacing T5 Lamp or Fixture	3088	Lighting	Standard	380	380	293	115	5,542	1.02	402,982	381,045	95%
				52	52	293	109	5,215	1.02	57,004	50,724	89%
Total										459,986	431,768	94%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours were fewer than those used to develop the ex ante energy savings estimates (5,568).

A heating and cooling interactive factor of 1.02, applicable to an electrically heated, air-conditioned retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[290]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 94%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours and heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	459,986	431,768	94%	82.02
Total		459,986	431,768	94%	82.02

[290] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6328

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed nine photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 12/04/18 and 1/10/19.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100213-Lighting-Non Linear LED Fixture Replacing CFL Fixture	1169	Lighting	Custom	230	140	104	30	3,235	1.09	60,347	69,589	115%
306143-Lighting-LED Lamp or Fixt Replacing T8 Lamp or Fixture	3025		Standard	18	18	32	29	1,156	1.09	180	68	38%
100104-Lighting-Linear Tube LED Fixture Replacing T8 Fixture	1169		Custom	46	40	186	39	2,253	1.09	23,355	17,193	74%
				46	39	186	29	1,723	1.09	24,788	13,958	56%
306143-Lighting-LED Lamp or Fixt Replacing T8 Lamp or Fixture	3025		Standard	35	35	56	30	2,103	1.09	3,038	2,088	69%
				25	25	114	68	993	1.09	3,839	1,246	32%
Total										115,547	104,142	90%

The annual lighting hours of operation verified during the M&V site visit for the first line item in the table above (3,235) are greater than the annual hours of operation used to calculate ex ante savings (2,860). This measure was installed in common hallways with several continuous usage fixtures. The remaining line items had hours (ranging from 993 – 2,253) fewer than the ex ante hours (3,120).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned high school in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[291]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 90%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 53% of the project.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	7,057	3,402	48%	0.65
Custom		108,490	100,740	93%	19.14
Total		115,547	104,142	90%	19.78

[291] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6331

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 11/29/18 and 12/19/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixture Replacing MH Fixture	1169	Exterior Lighting	Custom	8	8	1,080	304	4,308	1.00	27,191	26,745	98%
				20	20	1,080	278	4,308	1.00	70,255	69,102	98%
				8	8	455	140	4,308	1.00	11,038	10,856	98%
100209-Lighting-Non Linear LED Fixture Replacing Pulse Start MH Fixture				4	4	450	78	4,308	1.00	6,517	6,410	98%
				20	20	450	103	4,308	1.00	30,397	29,898	98%
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026	Lighting	Standard	38	38	138	64	6,171	1.00	10,639	17,352	163%
Total										156,037	160,363	103%

The annual lighting hours of operation for the first five line items in the above table using photo cells (4,308[292]) are less than the hours of operation used to calculate ex ante savings (4,380). The fifth line item has annual lighting hours of operation verified during the M&V site visit (6,171) which are greater than the annual hours of operation used to calculate ex ante savings (3,536). The ex ante hours for the shop did not take into consideration the working hours of the facility nor that some of the measures have continuous usage.

A heating and cooling interactive factor of 1.00, applicable to an unconditioned space in St. Louis, was applied to the ex post lighting energy savings for all measure locations. The ex ante savings estimate accounted for a heating and cooling factor of 1.07 for the fifth line item above.

[292] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[293]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 103%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for the interior installation.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	10,639	17,352	163%	3.30
Custom	Exterior Lighting	145,398	143,011	98%	0.80
Total		156,037	160,363	103%	4.10

[293] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6332

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed eight photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 11/30/18 and 1/07/19.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
300938-Lighting-LED <=14 Watt Lamp Fixture Replacing Halogen BR/R Lamp or Fixt	3007	Lighting	Standard	12	12	65	9	3,160	1.09	3,905	2,325	60%
100213-Lighting-Non Linear LED Fixture Replac CFL Fixture	1169		Custom	100	100	42	11	3,509	1.09	17,988	11,911	66%
				28	28	15	7	3,509	1.09	1,381	914	66%
305013-Lighting-<=80 Watt Lamp or Fixture Replac Garage Exter 24/7HID100175 W Lamp Fixt	3006-1	Misc.		7	7	175	55	8,760	1.00	7,358	7,358	100%
200808-Lighting-LED <=13 W Lamp Replac Halog MR-16 35-50W Lamp Fixture	3012	Lighting		14	14	35	5	8,760	1.09	3,937	4,028	102%
305402-Lighting-Linear ft LED <=5.5 W/ft) Replacing T8 32 Watt	3025		Standard	1,000	1,000	32	14	3,439	1.09	86,670	67,773	78%
305114-Lighting-62-130 Watt Lamp Fixture Replac Garage Exter 24/7HID 176-300 Lamp Fixture	3004-1	Misc.		4	4	250	66	8,760	1.00	6,447	6,447	100%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear	3025	Lighting		1,000	1,000	32	17	5,333	1.09	64,200	87,584	136%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
301037-Lighting-LED <=20W Lamp Fixture Replac Halog >=40 Watt Lamp or Fixt	3011			12	12	43	9	4,375	1.09	1,695	1,954	115%
300938-Lighting-LED <=14 Watt Lamp Fixture Replacing Halogen BR/R Lamp or Fixt	3007			12	12	65	9	8,760	1.09	2,876	6,445	224%
301037-Lighting-LED <=20 Watt Lamp Fixture Replacing Halogen A >=40 Watt Lamp or Fixt	3011			12	12	43	10	4,813	1.09	1,644	2,087	127%
Total										198,101	198,828	100%

The annual lighting hours of operation verified during the M&V site visit for the fourth, fifth, and seventh line items in the table above (8,760) match the ex ante savings estimate hours. The annual hours for the first through third and sixth line items (ranging from 3,160 – 3,509) are fewer than the annual hours of operation used to calculate ex ante savings (ranging from 4,500 – 5,432). The last four line items had annual hours (ranging from 4,375 – 8,760) that were greater than the ex ante estimated hours (4,000).

An adjusted base wattage of 43W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp for the ninth and eleventh line item in the table above. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned large office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[294]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 100%.

[294] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	164,927	172,198	104%	32.71
	Miscellaneous	13,805	13,806	100%	1.90
Custom	Lighting	19,369	12,825	66%	2.44
Total		198,101	198,828	100%	37.05

Site ID 6336

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed seventeen photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 11/28/2018 and 12/17/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp or Fixt Replacing T12 Lamp or Fixture	3026	Lighting	Standard	180	180	164	60	2,172	1.09	60,411	44,526	74%
				6	6	82	44	1,222	1.09	736	305	41%
306143-Lighting-LED Lamp or Fixt Replacing T8 Lamp or Fixt	3025			15	15	114	80	2,399	1.09	1,646	1,340	81%
306142-Lighting-LED Lamp or Fixt Replacing T12 Lamp or Fixture	3026			50	50	164	60	1,519	1.09	16,781	8,651	52%
306143-Lighting-LED Lamp or Fixt Replacing T8 Lamp or Fixt	3025			50	50	114	80	2,081	1.09	5,486	3,874	71%
				7	7	59	32	1,891	1.09	610	391	64%
100211-Lighting-Non Linear LED Fixture Replacing HPS Fixture	1169	Exterior Lighting	Custom	10	10	465	60	4,308	1.00	17,739	17,446	98%
306142-Lighting-LED Lamp or Fixt Replacing T12 Lamp or Fixture	3026	Lighting	Standard	20	20	82	30	1,224	1.09	3,356	1,394	42%
306143-Lighting-LED Lamp or Fixt Replacing T8 Lamp or Fixt	3025			15	15	59	32	1,294	1.09	1,306	574	44%
306142-Lighting-LED Lamp or Fixt Replacing	3026			43	43	164	60	1,090	1.09	14,432	5,338	37%
				14	14	82	30	1,760	1.09	2,349	1,403	60%
				1	1	122	45	2,399	1.09	248	202	82%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
T12 Lamp or Fixture												
Total										125,100	85,444	68%

Primary data were used to develop estimates of annual lighting operating hours for the interior installations. For all interior facility areas monitored, the estimated annual operating hours (ranging from 1,222 – 2,399) were fewer than those used to develop the ex ante energy savings estimates (3,016). The annual lighting hours of operation for the seventh line item in the above table using photo cells (4,308[295]) are less than the hours of operation used to calculate ex ante savings (4,380).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned large office in St. Louis, was applied to the ex post lighting energy savings for the interior installations. The ex ante savings estimate accounted for a heating and cooling factor of 1.07. A factor of 1.00 was applied to the exterior measure which corresponds with the ex ante factor.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[296]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 68%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	End Use Category	kWh Savings			Gross Ex Post kW Reduction
		Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross Realization Rate	
Standard	Lighting	107,361	67,998	63%	12.92
Custom	Exterior Lighting	17,739	17,446	98%	0.10
Total		125,100	85,444	68%	13.02

[295] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[296] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6337

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed ten photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 11/27/2018 and 12/19/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp Fixt Replac T8 Lamp Fixt	3025	Lighting	Standard	115	115	88	51	1,513	1.09	11,837	7,024	59%
306142-Lighting-LED Lamp Fixt Replac T12 Lamp Fixt	3026			14	14	164	39	1,526	1.09	4,869	2,913	60%
300938-Lighting-LED <=14W Lamp FixtReplBRR Lamp Fixt	3007			20	20	65	11	1,252	1.09	3,005	1,475	49%
306143-Lighting-LED Lamp Fixt Replac T8 Lamp Fixt	3025			1	1	59	32	999	1.09	75	29	39%
306140-Lighting-LED Lamp Fixt ReplacIntHID Lamp Fixt	3004-1			35	35	460	115	2,479	1.09	26,241	32,653	124%
301039-Lighting-LED <=20W Lamp Fixt Replac HalogenPAR Lamp Fixt	3008			17	17	63	12	1,252	1.09	1,885	1,184	63%
306140-Lighting-LED Lamp Fixt ReplacIntHID Lamp Fixt	3004-1			56	56	465	120	2,626	1.09	42,006	55,348	132%
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025			275	275	114	76	2,280	1.09	22,720	25,990	114%
				5	5	59	38	3,566	1.09	228	409	179%
				16	16	114	50	1,532	1.09	2,783	1,711	61%
				8	8	114	50	1,532	1.09	1,391	856	62%
				130	130	114	80	2,965	1.09	9,610	14,297	149%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
				10	10	88	60	4,216	1.09	609	1,288	211%
				130	130	114	80	1,600	1.09	9,610	7,717	80%
				10	10	88	60	3,566	1.09	609	1,089	179%
Total										137,478	153,983	112%

The annual lighting hours of operation verified during the M&V site visit for the fifth, seventh through ninth, twelfth, thirteenth, and fifteenth line items in the above table (ranging from 2,280 to 4, 216) are greater than the annual hours of operation used to calculate ex ante savings (ranging from 2,031 to 2,032). The ex ante savings estimate did not account for the 24/7 fixtures throughout the facility. The verified hours for the remaining line items (ranging from 999 to 1,600) are fewer than those used to calculate ex ante savings (ranging from 2,032 to 2,600).

The ex post and ex ante savings estimate used an adjusted base wattage of 63W for the sixth line item in the table above to meet the EISA 2007 standard lumen equivalent for a 90W incandescent lamp.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned education based facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[297]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 112%. The ex ante energy savings estimate was premised upon underestimated annual hours for 62% of the installed measures and underestimated heating and cooling effects.

Site-Level Energy Savings

Incentive	End Use Category	kWh Savings			Gross Ex Post kW Reduction
		Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross Realization Rate	
Standard	Lighting	137,478	153,983	112%	29.25
Total		137,478	153,983	112%	29.25

[297] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6338

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed six photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 11/22/18 and 12/12/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025	Lighting	Standard	42	42	175	96	5,718	1.11	15,969	21,014	132%
				19	19	59	32	4,133	1.11	2,468	2,349	95%
				26	26	114	64	5,811	1.11	6,256	8,366	134%
				7	7	175	96	5,110	1.11	2,661	3,130	118%
Total										27,354	34,859	127%

The annual lighting hours of operation verified during the M&V site visit for the second line item in the table above (4,133) are fewer than the annual hours of operation used to calculate ex ante savings (4,498), while the remaining line items have hours (ranging from 5,110 – 5,811) greater. The ex ante did not consider fixtures with continuous usage.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[298]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 127%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for 80% of the installed measures and underestimated heating and cooling interactive effects.

[298] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	27,354	34,859	127%	5.62
Total		27,354	34,859	127%	5.62

Site ID 6339

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed six photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 11/22/18 and 12/12/18.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025	Lighting	Standard	59	59	175	96	5,729	1.11	22,174	29,573	133%
				16	16	114	64	5,580	1.11	3,806	4,944	130%
				6	6	88	48	4,485	1.11	1,523	1,192	78%
				4	4	59	32	4,429	1.11	514	530	103%
Total										28,017	36,239	129%

The annual lighting hours of operation verified during the M&V site visit for the first three line items in the table above (ranging from 4,485 – 5,729) are greater than the annual hours of operation used to calculate ex ante savings (4,446). The ex ante did not take into consideration the fixtures that have continuous usage. The last line item above has hours (4,429) slightly fewer than the ex ante hours (4,446).

The quantity of the third line item in the table above (6) verified during the M&V site visit is fewer than the ex ante savings quantity (8). During the M&V visit, ADM staff verified that the lamps were found in storage to be used as replacements.

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned retail facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[299]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 129%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for 95% of the installed measures and underestimated heating and cooling interactive effects.

[299] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	28,017	36,239	129%	6.88
Total		28,017	36,239	129%	6.88

Site ID 6340

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306135-Lighting-LED Lamp or Fixt ReplacingT5 Lamp or Fixt	3088	Lighting	Standard	136	136	64	26	8,653	1.14	48,441	50,866	105%
306143-Lighting-LED Lamp or Fixt ReplacingT8 Lamp or Fixt	3025			22	22	88	42	8,760	1.14	9,486	10,084	106%
306135-Lighting-LED Lamp or Fixt ReplacingT5 Lamp or Fixt	3088			57	57	28	22	8,760	1.14	3,206	3,408	106%
				86	86	28	13	8,760	1.14	12,091	12,854	106%
306143-Lighting-LED Lamp or Fixt ReplacingT8 Lamp or Fixt	3025			46	46	88	42	8,760	1.14	19,834	21,085	106%
				3	3	88	42	8,760	1.14	1,294	1,375	106%
				17	17	88	42	8,760	1.14	7,330	7,792	106%
				9	9	88	42	4,322	1.14	3,881	2,035	52%
				5	5	114	56	8,760	1.14	2,718	2,890	106%
306135-Lighting-LED Lamp or Fixt ReplacingT5 Lamp or Fixt	3088			16	16	28	13	8,760	1.14	2,249	2,391	106%
306143-Lighting-LED Lamp or Fixt ReplacingT8 Lamp or Fixt	3025			25	25	32	27	7,446	1.14	5,390	1,059	20%
				5	5	32	14	8,760	1.14	844	897	106%
				15	15	114	56	8,760	1.14	8,155	8,669	106%
				5	5	16	14	8,760	1.14	94	100	106%
				3	3	59	28	8,760	1.14	872	927	106%
				18	18	59	36	8,760	1.14	3,881	4,125	106%
				6	6	88	42	8,760	1.14	2,587	2,750	106%
100113-Lighting-Linear Tube LED Fixture Replacing CFL Fixture	1169		Custom	18	18	26	9	8,760	1.14	2,868	3,049	106%
				177	177	80	46	8,760	1.14	56,408	59,966	106%
Total										191,629	196,323	102%

The annual lighting hours of operation verified during the M&V site visit for the first, eighth, and eleventh line items in the table above (8,653, 4,322, and 7,446, respectively) are fewer than the annual hours of operation used to calculate ex ante savings (8,760). The remaining line items correspond with the ex ante hours (8,760).

The efficient wattage of the eleventh line item in the first table above (27W) verified during the M&V site visit is greater than the ex ante savings wattage (9W).

A heating and cooling interactive factor of 1.14, applicable to a gas heated, air-conditioned assembly in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[300]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 102%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 25% of the installed measures and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	132,353	133,307	101%	25.32
Custom		59,276	63,016	106%	11.97
Total		191,629	196,323	102%	37.29

[300] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6341

Data Collection

The participant received New Construction incentives from Ameren Missouri for installing a new electric furnace that is more efficient than the Industry Standard Practice. The new electric furnace is used in the glass manufacturing process.

During the M&V visit, ADM staff verified the installation of the new electric furnace. ADM interviewed staff about the equipment operation and gathered additional billing, production, and power data to estimate energy savings associated with the new furnace. The new electric furnace was installed and will operate in parallel with the existing electric furnace.

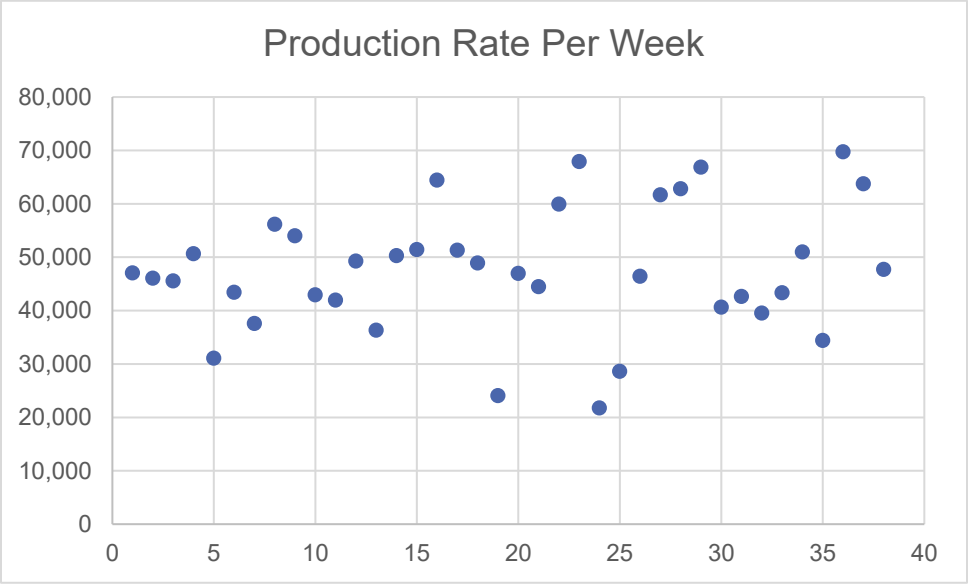
Analysis Results

Whole Building Savings Calculations

Energy savings for the above code whole building measures were calculated using IPMVP Option C: Whole Facility. ADM analyzed the whole facility billing data along with the production rates to estimate annual energy savings. The calculated energy savings for this site is the difference in expected annual usage and the baseline energy usage for the whole facility.

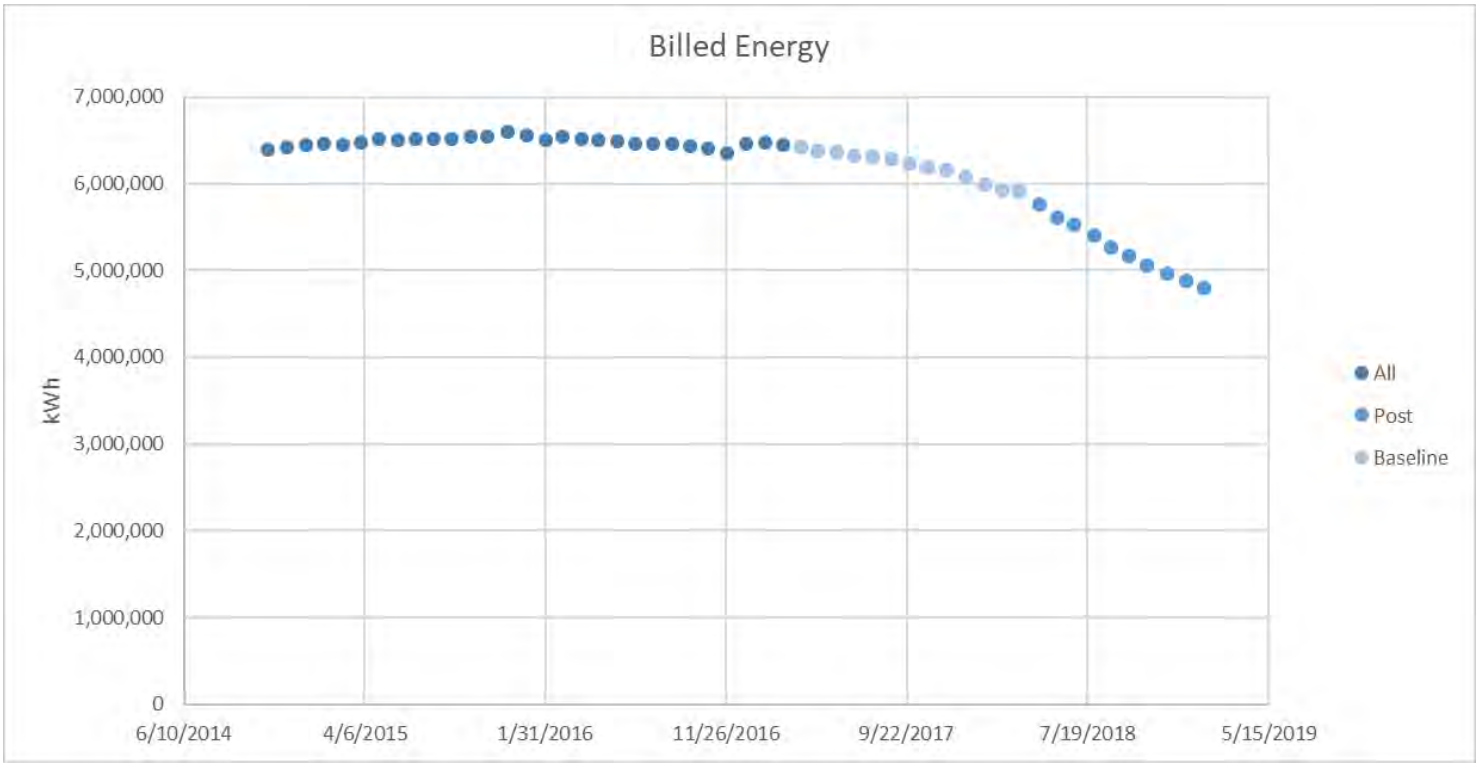
The production data provided showed a consistent trend of around 47,500 square feet per week and does not show any consistent increase over time, seen in the graph below, but it does show about a 32% increase in production versus the ex-ante calculations. Since the new furnace is installed to work with the existing system and is not used as a replacement, it is assumed that the facility production increased by 32% with the installation of the new electric furnace. This increase in production means the baseline energy usage needs to be normalized to the post production rates.

Production Trending Data



The billing data showed an annual seasonality with a dip in energy usage in the winter months, but this does not appear to be associated with heating or cooling degree days. In order to analyze the reduction

annual billing data ADM took the sum of the past 12 months of bills and then analyzed the trend over time as seen in the graph below. The average annual energy usage remains constant around 6.5 million kWh until around 12 months before the new electric furnace was installed where is gradually decreases. Then around the installation date the annual energy usage decreases linearly by an average 106,953 kWh per month. The data implies that something was done in March of 2017 to improve the facility energy efficiency which should not be part of the energy savings, therefore ADM estimated the baseline energy usage to be the 12 months prior to the measure implementation and then normalized it to the post production rate.



The proposed annual energy usage was calculated using a linear trendline of the post implementation data and the equations below:

$$kWh_{savings} = kWh_{baseline} - kWh_{proposed}$$

$$kWh_{baseline} = kWh_{baseline,unadjusted} x \frac{Prod_{proposed}}{Prod_{baseline}}$$

$$kWh_{proposed} = kWh_{baseline,unadjusted} - \left(Savings_{monthly} \times 12\right)$$

Where:

$kWh_{savings}$	=	Annual energy savings
$kWh_{baseline}$	=	Baseline annual energy usage adjusted for increased production
$kWh_{proposed}$	=	Proposed annual energy usage
$kWh_{baseline,unadjusted}$	=	Baseline annual energy usage
$Prod_{proposed}$	=	Proposed annual production rate
$Prod_{baseline}$	=	Baseline annual production rate

$Savings_{monthly}$ = Monthly energy reduction

$Prod_{baseline}$	$Prod_{proposed}$	$kWh_{baseline,\ unadjusted}$	$kWh_{baseline}$	$Savings_{monthly}$	$kWh_{proposed}$	$kWh_{savings}$
2,170,390	2,876,797	5,911,200	7,835,146	106,953	4,67,767	3,207,378

Measure level savings are shown in the following table:

New Construction Measure Level Savings

Measure Name/ID	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
191520 - Whole Building	Process Energy	New Construction	2,755,549	3,207,378	116%
Total			2,755,549	3,207,378	116%

The ex-ante calculations estimated energy savings as the reduction in energy usage per square foot of glass production separated into eight bins of glass thickness. The ex-ante calculation uses a unit efficiency of energy usage per square foot of production but did not provide any additional information to support the claimed efficiency rates. ADM attempted to try and calculate the energy efficiency rates using power production rates but was unable to correlate the provided trending data to power usage. For this reason, ADM estimated energy usage using the billing trending data. The two major differences in the calculation assumptions are: the ex-ante assumed the same production rate for pre and post and assumed that all the pre-production will shift to the new furnace. ADM used the ex-ante production rate and the collected data and assumed the facility increased the production rate with the introduction of another electric furnace. Savings are calculated using the actual energy savings seen in the billing data which will reflect the realistic savings associated with the installation of an efficient electric furnace.

The site-level verified energy savings are 3,207,378 kWh, resulting in a realization rate of 116%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
New Construction	Process Energy	2,755,549	3,207,378	116%	524.08
Total		2,755,549	3,207,378	116%	524.08

Site ID 6342

Data Collection

The participant received Retro-Commissioning (RCx) incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation and post-implementation connected loads, interviewed facility personnel regarding equipment operation. ADM also reviewed of the provided documentation and data.

The customer repaired 45 leaks in the compressed air system, totaling 169.54 cfm, as follows:

Leak Repair Log

TAG	LOCATION	SIZE
910	compressor room	L
911	#1 compressor	M
912	flange leak #1 compressor	XL
913	small compressor	L
914	514 lehr packers back	S
915	514 lehr south	M
916	514 lehr south	S
917	audit	M
918	audit	M
919	514 box maker	M
920	514 box maker	S
921	514 lehr noth side	M
922	512 lehr hood	M
923	512 pack lehr	M
924	511 plug gauge	S
925	511 lehr south side	S
926	511 lehr south side	S
927	511 lehr north side	S
928	511 lehr hood north	S
929	compressor in middle	M
930	compressor in middle	M
931	525 lehr south	S
932	525 lehr south	S
933	523 north	L
934	box machine front of office	L

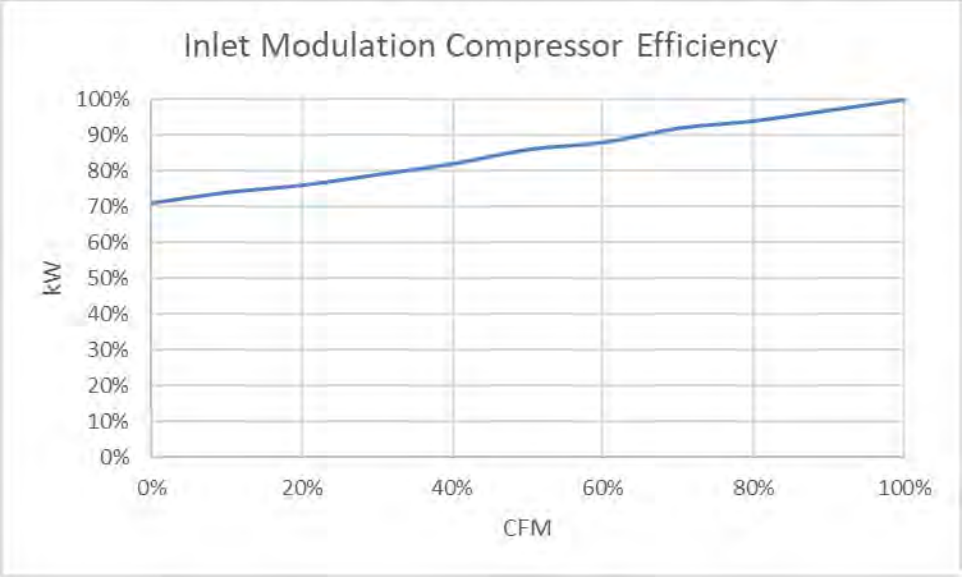
TAG	LOCATION	SIZE
935	523 end	S
936	522 lehr south	S
937	522 lehr south	L
938	522 end lehr north	L
939	522 north	S
940	521 end lehr north	S
941	521 machine	XL
942	reversal system 51	L
943	mixer	L
944	scale 3	L
945	scale 1	L
946	514 machine west blowoff	L
947	513 machine north	L
948	525 machine south	M
949	523 machine burner	M
950	523 machine blower	L
951	shop area above lab	M
952	air hose outside building	L

Correcting these leaks reduced the load on the compressors, resulting in less energy consumption. ADM reviewed all project documentation, including the “Compressed Air Study” provided by the contractor and obtained the baseline monitoring data referenced in the study. The monitoring data totaled seven days in 12 second intervals. Variables monitored that were used for the analysis included current (amperage) for the compressor. While four compressors ran during the monitoring period, the leak repair only affected the R110i 150hp compressor.

Analysis Results

Compressed Air Leak Repair Savings Calculations

ADM estimated energy savings using the 150-horsepower inlet modulation air compressor baseline amp monitoring data. The amp data was converted to kW at each monitoring point and the kW data was converted to CFM using a standard inlet modulation curve from Chapter 22: Compressed Air Evaluation Protocol of the Uniform Methods Project. The compressor curve is seen below:



An as-built CFM load profile was created from the calculated baseline CFM. At each baseline CFM data point, the 169.54 CFM leak was subtracted resulting in the theoretical as-built CFM. The compressor efficiency curve was then used to calculate the new kW values at each data point. This “new” kW profile represented the decreased demand as a result of repaired leaks.

Energy savings were calculated using a bin analysis by averaging the time the baseline and as-built compressor systems spent in each CFM bin. Because the baseline and as-built compressor efficiency curves are identical, the kW in each bin is the same for the baseline and as-built. The results of the bin analysis can be seen below:

CFM		*% Time*		*kW*	*kWh*	
Min	*Max*	*Baseline*	*As-Built*		*Baseline*	*As-Built*
0	50	6	10	93	549	888
50	100	2	1	96	166	67
100	150	1	1	98	137	86
150	200	1	2	101	53	229
200	250	0	8	104	36	795
250	300	1	4	107	93	389
300	350	1	3	109	133	323
350	400	6	2	112	683	195
400	450	6	11	115	659	1,239
450	500	3	496	118	307	58,440
500	550	2	4,308	120	272	519,047
550	600	3	3,879	123	321	478,012
600	650	128	37	126	16,118	4,599
650	700	2,688	0	129	346,078	0
700	750	5,305	0	132	697,692	0
750	800	607	0	134	81,537	0
800	850	0	0	137	0	0
850	900	0	0	140	0	0
Total		8,760	8,760	0	1,144,834	1,064,309

Savings is the sum of the difference between the baseline and as-built kWh in each bin. The analysis uses 8,760 hours because the facility operates 7 days a week, 24 hours a day with zero holidays. This method assumes the monitoring period represented a typical demand profile at the facility.

The site-level realization rate is 102%. The difference in savings is due to ex ante analysis calculating savings for all the operating air compressors as opposed to the main compressor in the ex post analysis. The ex ante analysis equally spreads the CFM leaks between all the compressors where most of the compressors have inlet modulation capacity control (similar to the ex post analysis); however, one compressor in the ex ante analysis has load/unload capacity control. The load/unload compressor changes the overall compressor system efficiency causing the difference in savings.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Retro - Commissioning	Compressed Air	79,054	80,525	102%	11.11
Total		79,054	80,525	102%	11.11

Site ID 6343

Data Collection

The participant received EMS Program incentives from Ameren Missouri for installing a new energy management system (EMS) to control HVAC schedules. In addition, Standard and Custom lighting incentives were provided.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered mechanical schedules and HVAC equipment nameplate information. ADM staff verified lighting equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed twelve photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 02/01/2018 and 11/02/2018.

Analysis Results

EMS Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A monthly pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against monthly billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Cooling degree days (CDD) were calculated for each billing period and used with two pre/post binary flags variables in an electric usage regression resulting in an R^2 of 0.944 and adjusted R^2 of 0.934. From the regression, the following equations were used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh/Day = 4.527 \times CDD - 809.2 \times PrePost_1 - 533.7 \times PrePost_2 + 5{,}128$$

$$kWh_{monthly} = kWh/Day \times Days$$

Where:

kWh/Day	= Daily Average kWh for Each Day in the Billing Period
$kWh_{monthly}$	= Monthly kWh Consumption
Days	= Number of Days for the Billing Period
CDD	= Cooling Degree Days for the Month with a Base Temperature of 65°F
$PrePost_1$	= Pre/Post-Retrofit Binary Flag for Majority of Implementation Complete
$PrePost_2$	= Pre/Post-Retrofit Binary Flag for Finalization of Implementation

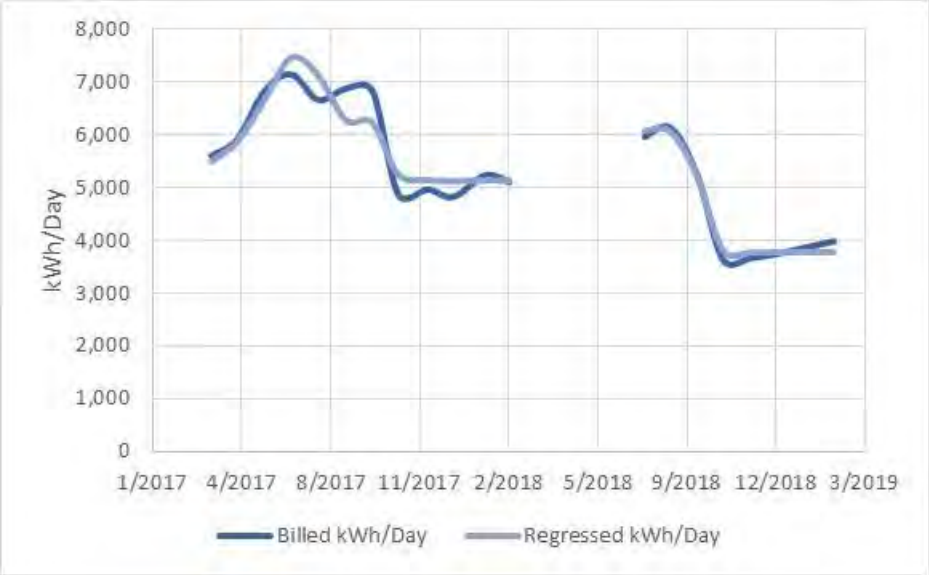
The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	*T Stat*
Intercept	42.7
CDD	9.45
$PrePost_1$	-3.90
$PrePost_2$	-1.98

Electric energy usage values were calculated on a monthly basis using the derived regression equation. The following plot compares the monthly billed kWh to the regressed kWh:

Billed vs. Regressed Monthly kWh



Annual kWh savings for the installed measures were determined by using typical year (TMY3) weather data and the derived equation to calculate monthly pre/post energy consumption of the site. Each month was summed for a year to obtain annual energy savings. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility, and can be seen in the following table:

Monthly kWh Savings

Month	*Days*	*CDD*	*kWh*		
			Baseline	*As-Built*	*Savings*
Jan	31	0	158,990	117,360	41,630
Feb	28	1	143,688	106,087	37,601
Mar	31	33	163,674	122,044	41,630
Apr	30	69	163,159	122,872	40,287
May	31	108	174,118	132,488	41,630

Month	Days	CDD	kWh		
			Baseline	As-Built	Savings
Jun	30	369	203,978	163,691	40,287
Jul	31	493	228,180	186,550	41,630
Aug	31	393	214,134	172,504	41,630
Sep	30	200	180,974	140,687	40,287
Oct	31	35	163,820	122,190	41,630
Nov	30	7	154,852	114,565	40,287
Dec	31	0	158,978	117,348	41,630
Total		1,707	2,108,547	1,618,387	490,159

The total billing regression energy savings were used to determine measure level savings. An additional lighting project, Project 2, was completed at this facility during the regressed period, thus the additional savings from this measure were captured by the regression. To calculate the realized savings and realization rate for this project, the realized ex post savings for the lighting measure were subtracted from the regressed savings to find the final ex post savings. The following table summarizes the regressed versus measure savings:

Regressed vs Measure Savings

Total Regressed kWh Savings	490,159
Ex Post Savings for Lighting Project	184,852
Ex Post Savings for this Project	305,307

Measure level savings are shown in the following table:

EMS Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
118220 -HVAC	1169	HVAC	EMS	207,159	170,972	83%
117920 -Cooling	1169	Cooling	EMS	162,768	134,335	83%
Total				369,927	305,307	83%

There were significant differences in the ex ante and ex post analysis methodologies for the EMS measures, with a realization rate of 83%. The ex ante analysis for the HVAC optimization measures used simple engineering calculations with assumed schedules and HVAC loads. These assumptions created significant uncertainty with the ex ante savings estimates. The ex ante analysis didn't use any site-specific trending or utility data. ADM used a billing regression with a good fit (R Square = 0.944) to determine realized energy savings. This method better accounts for actual site HVAC energy usage than the ex ante calculations.

The difference in realized savings is also due to the ex ante analysis using a pre implementation fan runtime of 8,760 hours. During the site visit, the site contact was unable to answer any questions regarding the pre implementation controls system. While the pre implementation fan runtime may have be significant, actual fan runtime of 8,760 hours is rarely verified. The actual pre implementation fan runtime was likely less than 8,760 hours contributing to the reduced savings.

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp Fixture Replacing T8 Lamp Fixture	3025	Lighting	Standard	12	12	32	15	2,079	1.09	528	463	88%
306142-Lighting-LED Lamp Fixture Replac T12 Lamp Fixture	3026			10	10	82	30	2,079	1.09	1,346	1,180	88%
306143-Lighting-LED Lamp Fixture Replacing T8 Lamp Fixture	3025			196	196	88	45	2,079	1.09	21,824	19,119	88%
				11	11	32	18	2,079	1.09	399	349	88%
				45	45	114	60	2,079	1.09	6,293	5,512	88%
306142-Lighting-LED Lamp Fixture Replac T12 Lamp Fixture	3026			10	10	164	60	2,079	1.09	2,693	2,359	88%
306143-Lighting-LED Lamp Fixture Replacing T8 Lamp Fixture	3025			822	822	59	30	2,079	1.09	61,726	54,077	88%
306135-Lighting-LED Lamp Fixture Replacing T5 Lamp Fixture	3088			24	24	360	150	2,728	1.09	13,051	15,001	115%
				14	14	240	100	2,728	1.09	5,075	5,834	115%
306143-Lighting-LED Lamp Fixture Replacing T8 Lamp Fixture	3025			20	20	175	90	2,728	1.09	4,402	5,060	115%
201316-Lighting-LEDr Electroluminescent Replac Incandescent Exit Sign	793			46	46	16	5	8,760	1.09	4,743	4,836	102%
306140-Lighting-LED Lamp Fixture Replacing Interior HID Lamp Fixture	3004-1			36	36	460	353	2,715	1.09	13,189	11,410	87%
100207-Lighting-Non Linear LED Fixt Replac T5 HO Fixture	1169		Custom	25	10	360	185	2,728	1.09	18,514	21,281	115%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
100208-Lighting-Non Linear LED Fixt Replac M H Fixture				14	14	100	30	1,862	1.09	2,538	1,991	78%
100212-Lighting-Non Linear LED Fixt Replac Incandescent/ Halogen Lamp Fixture				10	10	50	12	1,862	1.09	984	772	78%
100208-Lighting-Non Linear LED Fixt Replac M H Fixture				16	16	128	22	4,308	1.00	7,428	7,306	98%
100213-Lighting-Non Linear LED Fixt Replac CFL Fixture				39	16	52	20	4,308	1.00	7,481	7,358	98%
100208-Lighting-Non Linear LED Fixt Replac M H Fixture		Exterior Lighting		3	6	455	70	4,308	1.00	4,139	4,071	98%
				20	20	95	20	4,308	1.00	6,570	6,462	98%
100114-Lighting-Linear Tube LED Fixture Replac Ineffic Signage Fixt				3	3	86	43	4,308	1.00	565	556	98%
100208-Lighting-Non Linear LED Fixt Replac M H Fixture				9	9	128	30	4,308	1.00	3,863	3,800	98%
306143-Lighting-LED Lamp Fixture Replacing T8 Lamp Fixture	3025	Lighting	Standard	22	22	175	90	2,970	1.09	4,842	6,058	125%
Total										192,193	184,852	96%

The annual lighting hours of operation verified during the M&V site visit for the eleventh line item in the table above corresponds with the ex ante savings estimate for hours (8,760). For the eighth, ninth, tenth, thirteenth, and twenty-second line items in the lighting table above (ranging from 2,728 – 2,970) are greater than the annual hours of operation used to calculate ex ante savings (2,420). The remaining measures had annual hours (ranging from 1,862 – 4,308[301]) which are fewer than the ex ante hours (ranging from 2,420 – 4,380)

For the interior installations a heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned education facility in St. Louis, was applied to the ex post lighting energy savings. The

[301] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

ex ante savings estimate accounted for a heating and cooling factor of 1.07. The ex post and ex ante applied a factor of 1.00 for the exterior measures.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[302]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 92%. The lighting ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 92% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
EMS	HVAC	207,159	170,972	83%	75.91
	Cooling	162,768	134,335	83%	122.34
Standard	Lighting	140,111	131,256	94%	24.93
Custom		22,036	24,043	109%	4.57
	Exterior Lighting	30,046	29,553	98%	0.17
Total		532,120	490,159	92%	227.92

[302] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6344

Data Collection

The participant received EMS Program incentives from Ameren Missouri for installing a new energy management system (EMS) to control HVAC schedules.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered mechanical schedules and HVAC equipment nameplate information.

Analysis Results

EMS Controls Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A monthly pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against monthly billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Heating degree days (HDD) were calculated for each billing period and used with a pre/post binary flag and days variables in an electric usage regression resulting in an R^2 of 0.985 and adjusted R^2 of 0.981. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh_{monthly} = 53.0 \times HDD - 25{,}318 \times Pre_{Post} + 1{,}387 \times \#Days + 4{,}331$$

Where:

$kWh_{monthly}$	= Monthly kWh Consumption
HDD	= Heating Degree Days for the Month with a Base Temperature of 46.7°F
Pre_Post	= Pre/Post-Retrofit Binary Flag
#Days	= Number of Days for the Month

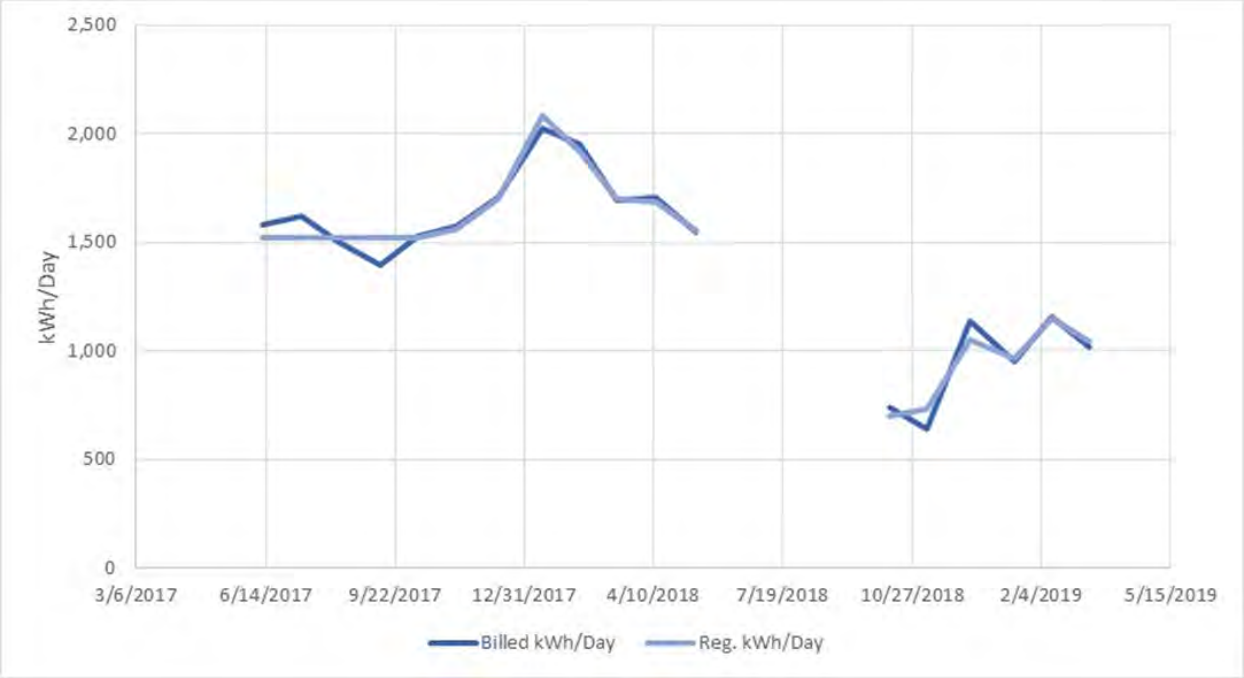
The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	*T Stat*
Intercept	0.62
#Days	5.98
Pre_Post	-28.0
HDD	12.8

Electric energy usage values were calculated on a monthly basis using the derived regression equation. The following plot compares the monthly billed kWh to the regressed kWh:

Billed vs. Regressed Monthly kWh



Annual kWh savings for the installed measures were determined by using typical year (TMY3) weather data and the derived equation to calculate monthly pre/post energy consumption of the site. Each month was summed for a year to obtain annual energy savings. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility, and can be seen in the following table:

Monthly kWh Savings

Month	*HDD*	*#Days*	*kWh*		
			Baseline	*As-Built*	*Savings*
Jan	295	31	62,951	37,634	25,318
Feb	194	28	53,458	28,140	25,318
Mar	65	31	50,744	25,426	25,318
Apr	17	30	46,823	21,506	25,318
May	2	31	47,431	22,113	25,318
Jun	0	30	45,932	20,614	25,318
Jul	0	31	47,318	22,000	25,318
Aug	0	31	47,318	22,000	25,318
Sep	0	30	45,932	20,614	25,318
Oct	17	31	48,232	22,914	25,318
Nov	90	30	50,707	25,389	25,318
Dec	248	31	60,488	35,170	25,318
Total			607,335	303,520	303,814

Total billing regression energy savings were used to determine measure level savings. Another project, Project 2, was also completed at this site during the evaluated timeline but was not sampled. The expected savings for Project 2 is 63,536 kWh. Those savings were subtracted from the total billing regression savings to obtain the total site-level energy savings (303,814 – 87,485 = 216,329 kWh). ADM also allocated the savings for this project, to cooling and heating measures in the same ratios as the ex ante analysis.

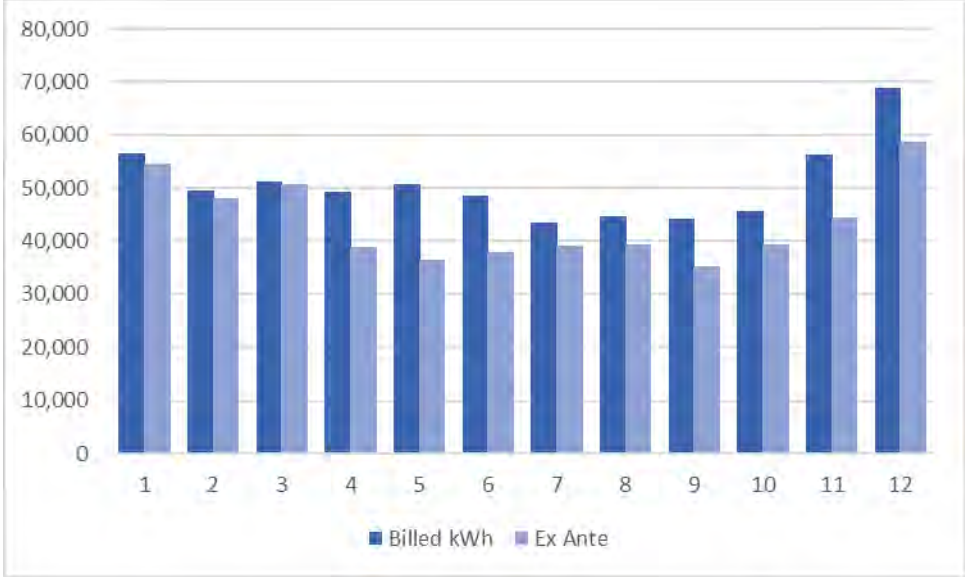
Measure level savings are shown in the following table:

EMS Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
117920 – HVAC Optimization – Cooling	1169	Cooling	EMS	30,057	32,450	108%
118120– HVAC Optimization – Heating	1169	Heating	EMS	170,321	183,880	108%
Total				200,378	216,329	108%

There were significant differences in the ex ante and ex post analysis methodologies for the EMS measures, with a realization rate of 108%. The ex ante analysis uses an uncalibrated Trane Trace model with assumed schedules and equipment loads. The following is a plot of the ex ante calibration:

Ex Ante Model Calibration



These assumptions and lack of calibration to utility billing data created significant uncertainty with the ex ante savings estimates. ADM used a billing regression with a good fit (R Square = 0.985) to determine realized energy savings. This method better accounts for actual site and HVAC energy usages than the ex ante calculations.

The verified annual site-level energy savings are 216,329 kWh, resulting in a 108% realization rate.

A table showing the energy savings achieved by the measures evaluated for this site is shown below:

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	30,057	32,450	108%	29.55
	Heating	170,321	183,880	108%	0.00
Total		200,378	216,329	108%	29.55

Site ID 6345

Data Collection

The participant received EMS Program incentives from Ameren Missouri for installing a new energy management system (EMS) to control HVAC equipment and schedules.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered mechanical schedules and HVAC equipment nameplate information.

Analysis Results

EMS Controls Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A monthly pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against monthly billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Cooling degree days (CDD) were calculated for each billing period and used with a pre/post binary flag in an electric usage regression resulting in an R^2 of 0.972 and adjusted R^2 of 0.968. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh_{monthly} = 75.2 \times CDD - 5{,}844 \times Pre\_Post - 44.5 \times CDD\_Post + 19{,}444$$

Where:

$kWh_{monthly}$ = Monthly kWh Consumption
Pre_Post = Pre/Post-Retrofit Binary Flag
CDD = Cooling Degree Days for the Month with a Base Temperature of 51.9°F
CDD_Post = CDD multiplied by Pre_Post

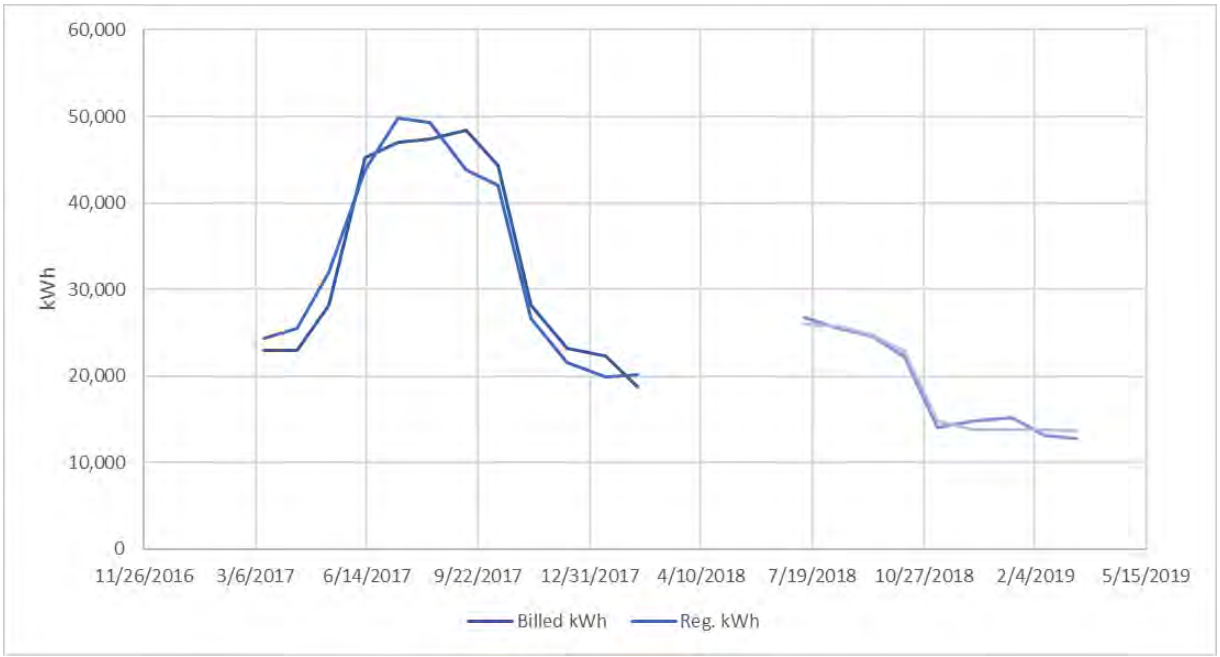
The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	*T Stat*
Intercept	19.5
Pre_Post	-4.13
CDD	17.8
CDD_Post	-7.59

Electric energy usage values were calculated on a monthly basis using the derived regression equation. The following plot compares the monthly billed kWh to the regressed kWh:

Billed vs. Regressed Monthly kWh



Annual kWh savings for the installed measures were determined by using typical year (TMY3) weather data and the derived equation to calculate monthly pre/post energy consumption of the site. Each month was summed for a year to obtain annual energy savings. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility, and can be seen in the following table:

Monthly kWh Savings

Month	*CDD*	*kWh*		
		Baseline	*As-Built*	*Savings*
Jan	6	19,884	13,780	6,104
Feb	12	20,341	13,966	6,375
Mar	66	24,430	15,633	8,797
Apr	115	28,054	17,110	10,944
May	185	33,340	19,265	14,075
Jun	346	45,440	24,197	21,243
Jul	415	50,652	26,321	24,331
Aug	368	47,105	24,875	22,229
Sep	253	38,487	21,363	17,124
Oct	86	25,930	16,244	9,686
Nov	31	21,768	14,548	7,221
Dec	2	19,593	13,661	5,932
Total		375,023	220,962	154,061

Total billing regression energy savings were used to determine measure level savings. Another project, Project 2, was also completed at this site during the evaluated timeline but was not sampled. The expected savings for Project 2 are 121,000 kWh. Those savings were subtracted from the total billing regression savings to obtain the total site-level energy savings (154,061 – 121,000 = 33,061 kWh). ADM also allocated the savings for this project, to cooling and HVAC measures in the same ratios as the ex ante analysis.

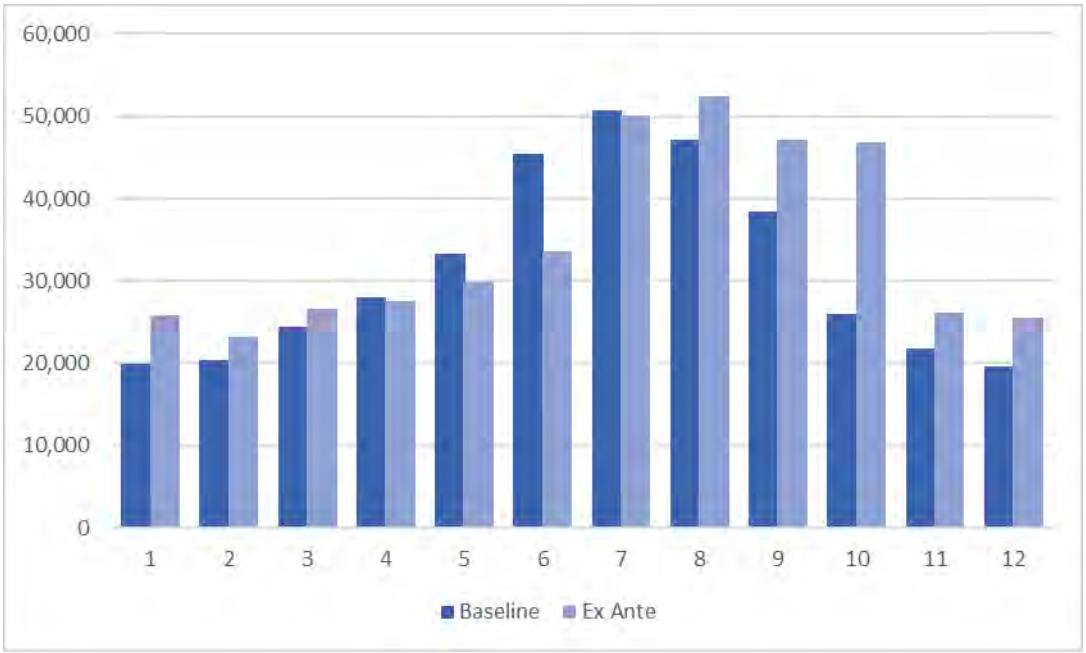
Measure level savings are shown in the following table:

EMS Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
117920 – HVAC Optimization – Cooling	1169	Cooling	EMS	29,626	13,886	47%
118220 – HVAC Optimization – HVAC	1169	HVAC	EMS	40,912	19,175	47%
Total				70,538	33,061	47%

There were significant differences in the ex ante and ex post analysis methodologies for the EMS measures, with a realization rate of 47%. The ex ante analysis uses an uncalibrated Trane Trace model with assumed occupancies, schedules, and equipment loads. The calibration of the ex ante model is shown here:

Baseline Ex Ante Model Calibration



The ex ante modeling assumptions and lack of calibration to utility billing data created significant uncertainty with the ex ante savings estimates. ADM used a billing regression with a good fit (R Square = 0.972) to determine realized energy savings. This method better accounts for actual site and HVAC energy usages than the ex ante calculations. It's also unclear how the final ex ante estimates account for project 22090. It appears that the savings for that project were subtracted from the model; however,

the final application's energy usage are significant less than the extrapolated as-built billing regression (111,043 kWh vs. 220,962 kWh).

The verified annual site-level energy savings are 33,061 kWh, resulting in a 47% realization rate. If 22090 had been sampled with this project, the site-level realization rate would have been 80%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below:

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	29,626	13,886	47%	12.65
	HVAC	40,912	19,175	47%	8.51
Total		70,538	33,061	47%	21.16

Site ID 6346

Data Collection

The participant received EMS Program incentives from Ameren Missouri for installing a new energy management system (EMS) to control new HVAC equipment including schedules and temperature set-backs.

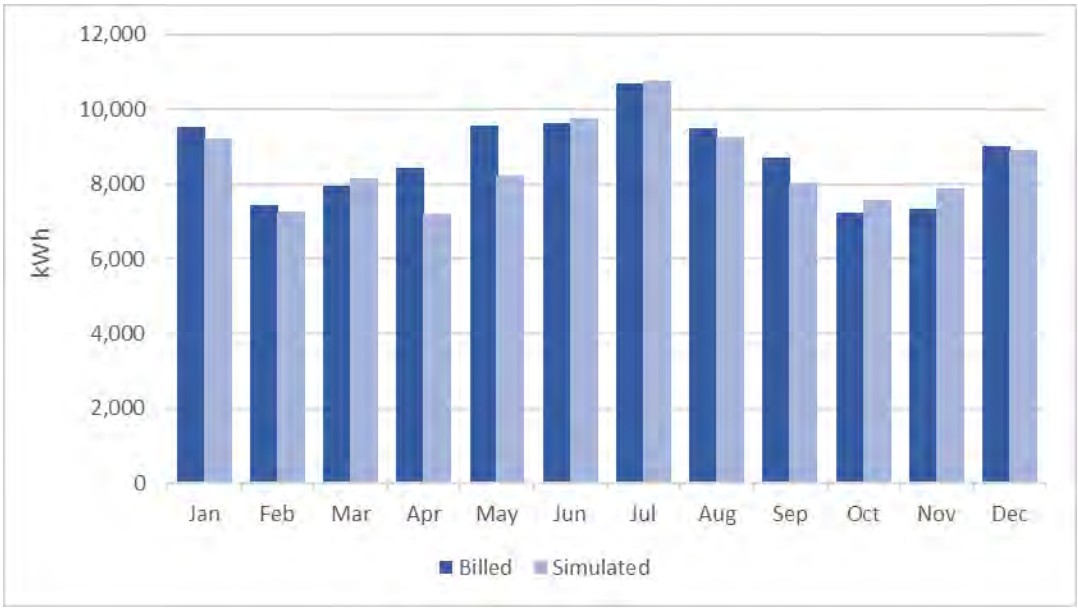
During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered mechanical schedules and HVAC equipment nameplate information. Lastly, ADM acquired and reviewed the ex ante Trane Trace energy models used for ex ante energy savings estimates.

Analysis Results

EMS HVAC Controls Savings Calculations

Energy savings for the implemented above code new construction measures were calculated using IPMVP Option D, Calibrated Simulation. This was completed using Trane Trace 700 energy simulation. ADM was provided the Trane Trace archived model used to estimate ex ante energy savings. ADM reviewed the as-built model's inputs and adjusted the model based on information collected during the on-site visit. The model was then run using 2017 weather data for the St. Louis region to ensure that the model was properly calibrated to the billed energy consumption of the facility. The results of the calibration effort can be seen in the following plot:

Trane Trace Model Calibration



Upon the calibration of the baseline model using 2017 billing data, an alternative model run was utilized in Trane Trace to determine the energy impacts of the replacing the existing HVAC equipment. This was not part of this site; however, it is the baseline for Project 1. Project 1 is a lighting project completed at the site at the same time as this project, Project 2. Another alternative run was used in Trane Trace

to simulate the lighting savings. The baseline was calculated as 1.72 W/sq. ft., and the installed was calculated at 0.72 W/ sq. ft. ADM used the same lighting schedule as the ex ante model. The two models were run using typical weather (TMY3) for the region to determine the typical annual savings for the lighting project. The annual savings are the difference between the annual consumption of the baseline and as-built models. The lighting energy savings from the model are presented in the following table:

Lighting Energy Savings

Month	*TMY3 Savings*		
	Baseline	*As-Built*	*Savings*
January	9,298	7,963	1,335
February	7,641	6,428	1,213
March	7,086	5,512	1,574
April	6,441	4,983	1,458
May	6,375	4,710	1,665
June	7,025	5,245	1,780
July	7,162	5,540	1,622
August	7,079	5,255	1,824
September	5,950	4,365	1,585
October	6,577	5,030	1,547
November	7,346	5,971	1,375
December	8,337	7,049	1,288
Total	86,317	68,051	18,266

The as-built alternative run for the lighting project, Project 1, is the baseline for this EMS project, Project 2. ADM used the same alternative run as the ex ante; however, it reflects calibration and lighting changes from the three previous alternatives. The final alternative was run using typical weather (TMY3) for the region to determine the typical annual savings for the EMS controls. The annual savings are the difference between the annual consumption of the baseline and as-built models and are presented in the following table:

EMS Energy Savings

Month	*TMY3 Savings*		
	Baseline	*As-Built*	*Savings*
January	7,963	5,458	2,505
February	6,428	4,234	2,194
March	5,512	3,396	2,116
April	4,983	2,966	2,017

Month	TMY3 Savings		
	Baseline	As-Built	Savings
May	4,710	2,991	1,719
June	5,245	4,197	1,048
July	5,540	4,579	961
August	5,255	4,189	1,066
September	4,365	2,980	1,385
October	5,030	2,941	2,089
November	5,971	3,703	2,268
December	7,049	4,752	2,297
Total	68,051	46,387	21,664

Measure level savings are shown in the following table:

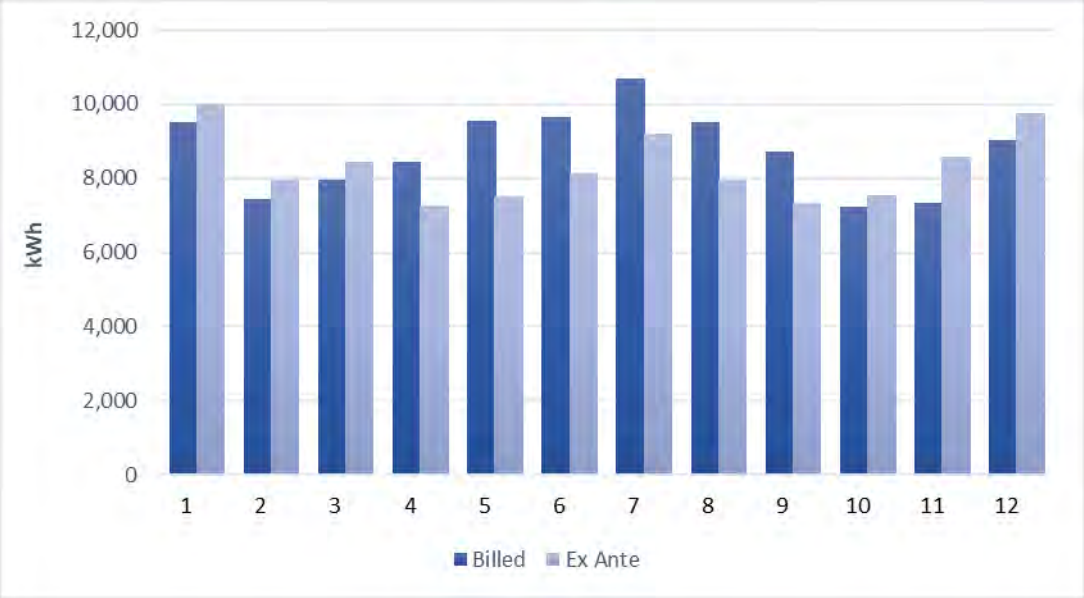
EMS Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
117920 – HVAC Optimization – Cooling	1169	Cooling	EMS	9,175	3,339	36%
118120– HVAC Optimization – Heating	1169	Heating	EMS	13,592	8,484	62%
118220 – HVAC Optimization – HVAC	1169	HVAC	EMS	11,213	9,841	88%
Total				33,980	21,664	64%

Verified annual savings for implementation of the EMS controls measures are 21,664 kWh, resulting in a site-level realization rate of 64%. The differences in realized savings can be attributed to calibration of the provided Trane Trace model. The calibration adjustments to the model included: adjusting lighting power densities and modifying baseline fan operations.

The ex ante model used an assumed baseline lighting power density and assumed fan operations. As a result, the model's calibration appears slightly off and can be seen in the following figure:

Monthly Energy Usage of Baseline Ex Ante Model vs. 2017 Utility Bills



While the ex ante baseline calibration only appears to underestimate cooling, it was determined that the model under-predicted lighting energy usage and over-predicted cooling, heating, and fan energy usage. The ex ante model only had 5,771 kWh of annual lighting energy compared to 31,697 kWh from the ex post calibration of the model. The lighting project associated with this site, 22092, had expected energy savings of 25,942 kWh. The ex post simulation predicts less lighting savings, 18,266 kWh. The difference is less hours in the model than those assumed in the project application. The simulated lighting savings are still more three times the energy usage of the ex ante baseline model. The main difference was increasing the lighting power density from 1.5 W/sq. ft. and 0 W/sq. ft. to 1.72 W/sq. ft. to be in alignment with the project application for 22092. The ex ante modeled much of the facility as 0 W/sq. ft., which resulted in the significant under-estimation of lighting energy usage in the model.

The ex post model calibration resulted in less savings for all end use categories. The cooling, heating, and HVAC savings decreased because the lighting power density was changed, and fans were allowed to cycle on and off in the baseline. ADM made the fan operation change in the model for calibration purposes. This was most likely the operation of the fans because the baseline had thermostats that were most likely set to auto fan control.

ADM also performed a meta-billing analysis, which showed that savings for both projects associated with this site, including lighting, are most likely less than 40,000 kWh. The combined energy savings using the calibrated model for projects 22092 and 21858 are 39,931 kWh compared to combined expected savings of 59,992 kWh. ADM decided that Option D, calibrated simulation resulted in the best estimate of savings, but the meta-analysis justifies the ex post savings.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	9,175	3,339	36%	3.04
	Heating	13,592	8,484	62%	0.00
	HVAC	11,213	9,841	88%	4.37
Total		33,980	21,664	64%	7.41

Site ID 6347

Data Collection

The participant received EMS Program incentives from Ameren Missouri for installing a new energy management system (EMS) to control HVAC equipment and schedules.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered mechanical schedules and HVAC equipment nameplate information.

Analysis Results

EMS Controls Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A monthly pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against monthly billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Cooling and heating degree days (CDD & HDD) were calculated for each billing period and used with a pre/post binary flag and school days variables in an electric usage regression resulting in an R^2 of 0.973 and adjusted R^2 of 0.968. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh_{monthly} = 34.3 \times CDD + 86.9 \times HDD - 13{,}766 \times Pre\_Post + 10{,}046$$

Where:

$kWh_{monthly}$ = Monthly kWh Consumption
Pre_Post = Pre/Post-Retrofit Binary Flag
CDD = Cooling Degree Days for the Month with a Base Temperature of 33°F
HDD = Heating Degree Days for the Month with a Base Temperature of 75°F

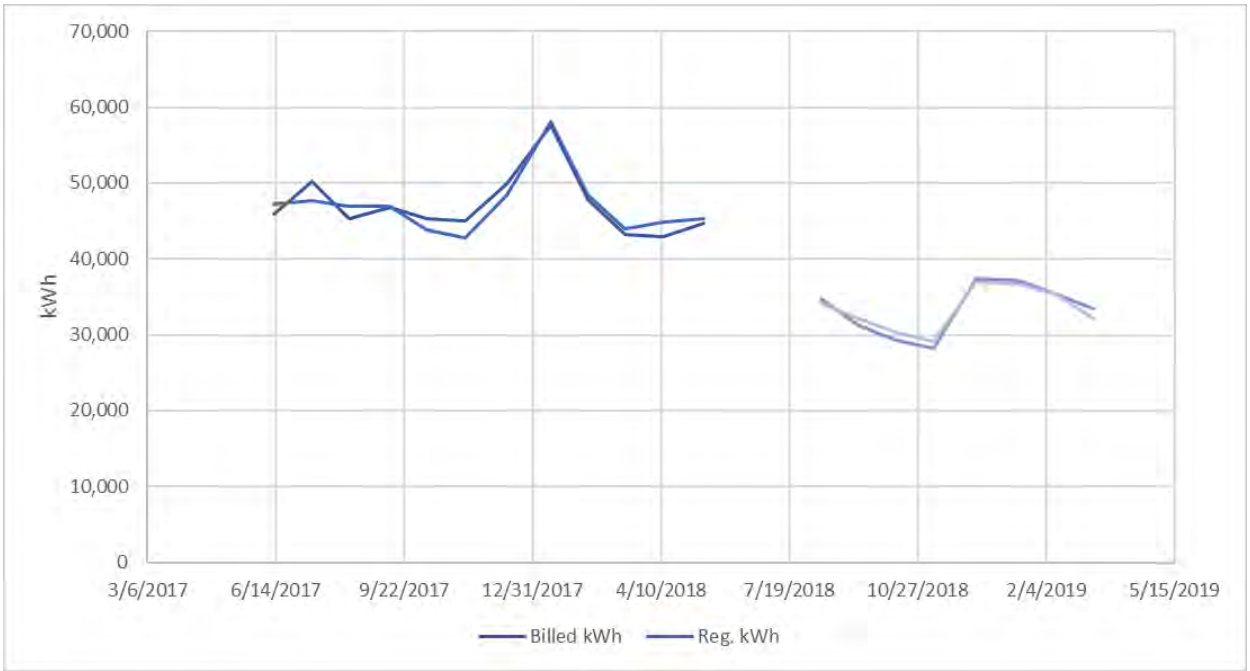
The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	*T Stat*
Intercept	2.63
Pre_Post	-21.4
CDD	9.25
HDD	10.3

Electric energy usage values were calculated on a monthly basis using the derived regression equation. The following plot compares the monthly billed kWh to the regressed kWh:

Billed vs. Regressed Monthly kWh



Annual kWh savings for the installed measures were determined by using typical year (TMY3) weather data and the derived equation to calculate monthly pre/post energy consumption of the site. Each month was summed for a year to obtain annual energy savings. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility, and can be seen in the following table:

Monthly kWh Savings

Month	*CDD*	*HDD*	*kWh*		
			Baseline	*As-Built*	*Savings*
Jan	102	456	53,128	39,362	13,766
Feb	125	359	45,528	31,762	13,766
Mar	403	253	45,847	32,080	13,766
Apr	555	172	44,012	30,246	13,766
May	724	113	44,632	30,866	13,766
Jun	979	26	45,843	32,077	13,766
Jul	1,104	11	48,821	35,054	13,766
Aug	1,029	18	46,898	33,131	13,766
Sep	831	62	43,916	30,150	13,766
Oct	520	197	44,935	31,169	13,766
Nov	283	292	45,074	31,307	13,766
Dec	80	432	50,351	36,585	13,766
Total			558,985	393,789	165,196

Total billing regression energy savings were used to determine measure level savings. Another project, Project 1, was also completed at this site during the evaluated timeline but was not sampled. The expected savings for Project 1 are 31,676 kWh. Those savings were subtracted from the total billing regression savings to obtain the total site-level energy savings (165,196 – 31,676 = 133,520 kWh). ADM also allocated the savings for this project, Project 2, to cooling heating, and HVAC measures in the same ratios as the ex ante analysis.

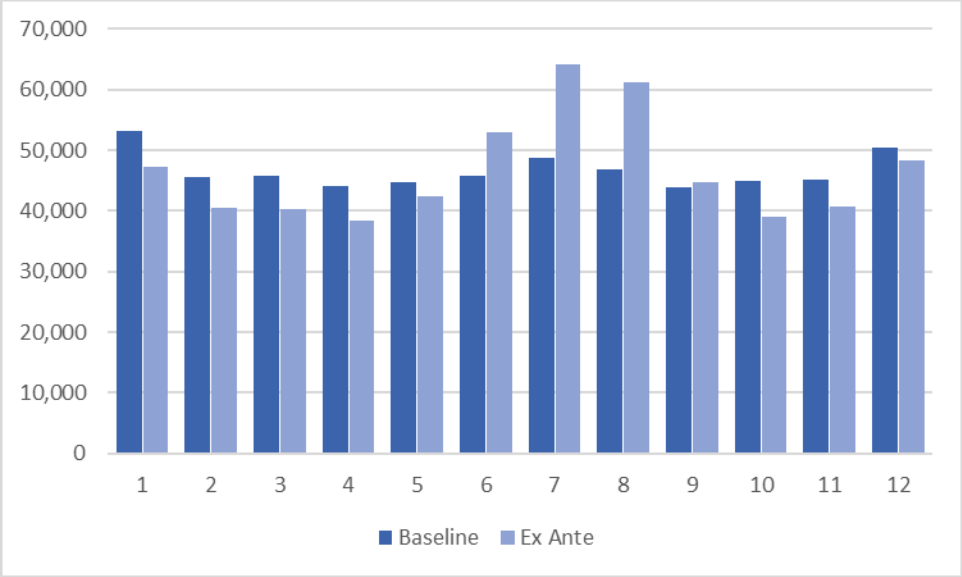
Measure level savings are shown in the following table:

EMS Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
117920 – HVAC Optimization – Cooling	1169	Cooling	EMS	24,430	45,398	186%
118220 – HVAC Optimization – HVAC	1169	HVAC	EMS	41,674	77,442	186%
118120– HVAC Optimization – Heating	1169	Heating	EMS	5,748	10,681	186%
Total				71,852	133,520	186%

There were significant differences in the ex ante and ex post analysis methodologies for the EMS measures, with a realization rate of 186%. The ex ante analysis uses an uncalibrated Trane Trace model with assumed occupancies, schedules, and equipment loads. The calibration of the ex ante model is shown here:

Baseline Ex Ante Model Calibration



The ex ante modeling assumptions and lack of calibration to utility billing data created significant uncertainty with the ex ante savings estimates. ADM used a billing regression with a good fit (R Square = 0.973) to determine realized energy savings. This method better accounts for actual site and HVAC energy usages than the ex ante calculations. It's also unclear how the final ex ante estimates account for project 22087.

The verified annual site-level energy savings are 133,520 kWh, resulting in a 186% realization rate. If 22087 had been sampled with this project, the site-level realization rate would've been 129%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below:

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	24,430	45,398	186%	41.34
	HVAC	41,674	77,442	186%	34.38
	Heating	5,748	10,681	186%	0.00
Total		71,852	133,520	186%	75.73

Site ID 6348

Data Collection

The participant received EMS Program incentives from Ameren Missouri for implementing new energy management system (EMS) controls for VAV boxes and DCV controls.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the EMS were collected where possible. ADM also gathered mechanical schedules and HVAC equipment nameplate information.

Analysis Results

EMS Optimization Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A monthly pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against monthly billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Cooling degree days (CDD) and number of school days were calculated for each billing period and used with a post-installation CDD variable in an electric usage regression, resulting in an R^2 of 0.984 and adjusted R^2 of 0.981. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh_{monthly} = 22{,}593.2 + 49.61 \times CDD + 870.7 \times School\_Days - 36.54 \times CDD\_Post$$

Where:

$kWh_{monthly}$ = Monthly kWh Consumption
CDD = Cooling Degree Days for the Month with a Base Temperature of 56°F
School_Days = Number of School Days in that Billing Period
CDD_Post = Cooling Degree Days for the Post-Install Month with a Base Temperature of 56°F

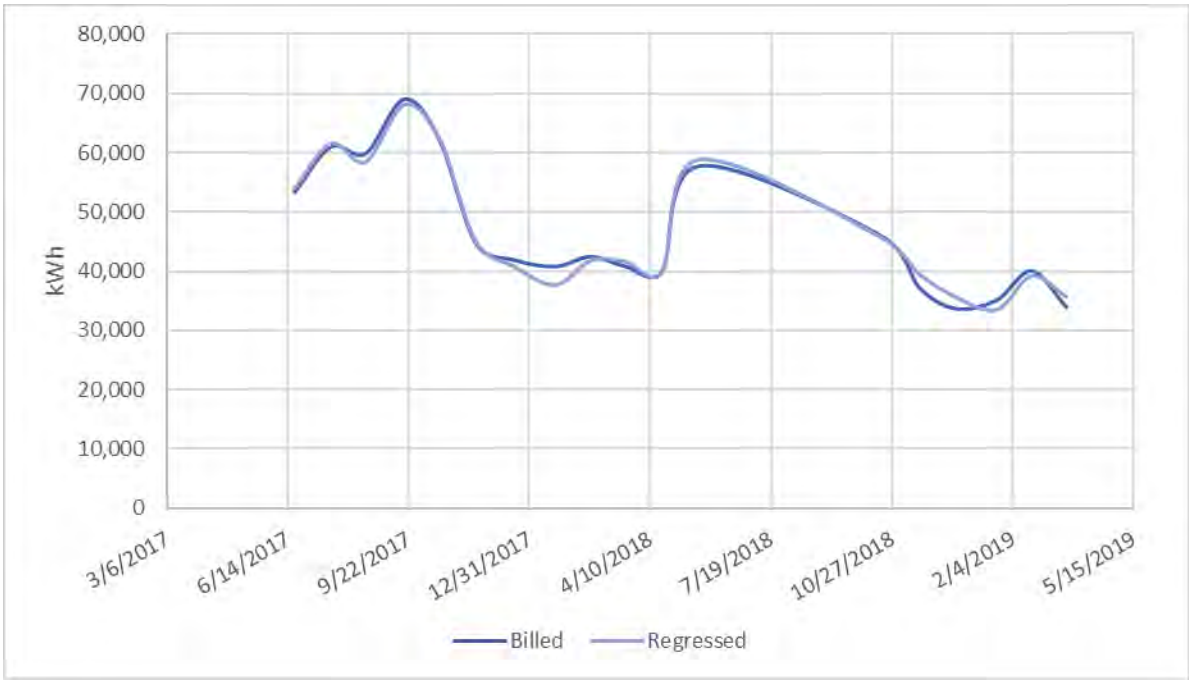
The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	*T Stat*
Intercept	16.1
CDD	28.3
CDD Post	-8.3
School Days	12.5

Electric energy usage values were calculated on a monthly basis using the derived regression equation. The following plot compares the monthly billed kWh to the regressed kWh:

Billed vs. Regressed Monthly kWh



Annual kWh savings for the installed measures were determined by using typical year (TMY3) weather data and the school day counts from the 2017-2018 school year. The derived equation was then used to calculate monthly pre/post energy consumption of the site. Each month was summed for a year to obtain annual energy savings. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility, and can be seen in the following table:

Monthly kWh Savings

Month	*School Days*	*CDD*	*kWh*		
			Baseline	*As-Built*	*Savings*
Jan	17	6	37,684	37,471	212
Feb	21	14	41,566	41,059	506
Mar	21	101	45,887	42,197	3,690
Apr	17	178	46,223	39,720	6,503
May	19	294	53,726	42,979	10,748
Jun	0	629	53,809	30,814	22,995
Jul	0	775	61,038	32,717	28,321
Aug	3	674	58,631	34,008	24,623
Sep	21	439	62,651	46,612	16,039
Oct	20	122	46,072	41,604	4,467
Nov	21	44	43,047	41,449	1,598
Dec	19	2	39,240	39,164	76

Month	School Days	CDD	kWh		
			Baseline	As-Built	Savings
Total			589,574	469,794	119,780

The total billing regression energy savings were used to determine measure level savings.

Measure level savings are shown in the following table:

EMS Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
117920 -HVAC-Cooling Replacing Existing System	1169	Cooling	EMS	25,535	20,363	80%
118220 -HVAC-HVAC Replacing Existing System	1169	HVAC	EMS	124,671	99,417	80%
Total				150,206	119,780	80%

There were significant differences in the ex ante and ex post analysis methodologies for the EMS measures, with a realization rate of 80%. The ex ante analysis for the HVAC optimization measures used bin calculations based on outdoor air temperature from TMY data and calculated fan energy use based on air parameters such as humidity and enthalpy. These bin calcs relied upon assumptions about energy use reductions during unoccupied periods, outdoor air mixing, the relationship between heating and cooling requirement and OAT, and fan operation at different temperatures. These assumptions introduce uncertainty into the ex ante analysis, whereas ex post analysis used actual site-level billing data to quantify savings.

Also, the during the site visit it was found that the pneumatic VAV boxes were failing and not controlled very well, however, that does not mean they were constant volume as calculated in the ex ante analysis. Even though the VAV boxes were not controlled well, this lowers the potential savings.

The high R^2 value of the regression model shows a high degree of accuracy between modeled and billed kWh usage. This use of real-world data, subsequently accurate model, and the pneumatic VAV boxes working intermittently indicate support for the 80% realization rate.

The verified annual site-level energy savings are 119,780 kWh, resulting in an 80% realization rate.

A table showing the energy savings achieved by the measures evaluated for this site is shown below:

Site-Level Energy Savings

Measure Name/ID	*End Use Category*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*	*Gross Ex Post kW Reduction*
EMS	Cooling	25,535	20,363	80%	18.5
	HVAC	124,671	99,417	80%	44.1
Total		150,206	119,780	80%	62.7

Site ID 6349

Data Collection

The participant received EMS Program incentives from Ameren Missouri.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered HVAC equipment nameplate information.

Analysis Results

EMS Controls Savings Calculations

Energy savings for the EMS controls were calculated using prototypical energy simulation. ADM used a DEER prototypical eQuest model of an office. The model's HVAC system was auto-sized during a sizing run with local weather data. Using project documents and the details collected during the on-site M&V visit, heating, cooling, and fan schedules were created for the baseline and as-built models. ADM ran parametric simulations to determine the prototypical annual energy usage of the model with EMS fan schedule changes. The realized energy savings are the differences between the parametric simulations' energy usages, and the energy savings by end use can be seen in the following table:

Prototypical Annual Energy Usage (kWh) by End Use

End Use	*Baseline (kWh)*	*As-Built (kWh)*	*Savings (kWh)*
Space Cool	71,000	42,866	28,134
Heat Reject.	0	0	0
Space Heat	0	0	0
Vent. Fans	51,416	16,206	35,211
Pumps & Aux.	1,642	1,670	-28
Misc. Equip.	60,945	60,945	0
Area Lights	58,819	58,819	0
Total	243,822	180,505	63,317

The prototypical annual energy savings were normalized to modeled fan horsepower. This was done by dividing the difference in baseline and as-built modeled savings by the modeled horsepower. This normalized kWh/hp savings value was multiplied by the horsepower of the controlled fans to determine site savings.

The following table presents information on prototypical and actual equipment and expected and realized energy savings for the EMS controls installed at the site:

EMS Controls Savings

Program	Measure	Fan HP		EMS Controls Savings		Realized kWh Savings
		Prototypical	Actual	Prototypical kWh	Normalized kWh/hp	
EMS	Fan Scheduling	7.80	2.33	63,317	8,120	18,947
Total						18,947

Measure level savings are shown in the following table:

Custom and EMS Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
117920-Cooling Existing System	1169	Cooling	EMS	27,893	8,419	30%
118220-HVAC Existing System	1169	Ventilation	EMS	5,313	10,536	198%
Total				33,206	18,955	57%

There were significant differences in the ex ante and ex post analysis methods for the EMS controls, with a realization rate of 57%. ADM analysis utilized energy modeling to calculate savings whereas the ex ante methodology included bin calculations with assumptions about HVAC loads and fan loads at given outdoor air temperatures. Since ex ante calculations relied primarily on outdoor air temperature to calculate savings, it overestimated cooling energy savings and underestimated ventilation fan savings. The ex post analysis, which modeled savings by modifying fan availability schedules, more accurately calculates how savings would be realized primarily through reduced fan usage during unoccupied hours, and less savings would be derived from cooling energy reduction.

The ex ante calculations also relied upon the assumption that fan scheduling would change from 24/7 to 6am to 4pm. ADM's site visit verified schedules were changed to 6am to 5:30 pm. The additional 1.5 hours of fan availability accounts for approximately 10% less savings than ex ante calculations. Additionally, ADM's site visit determined that controls were only applied to 4 fans instead of the 6 used in ex ante calculations. This reduction in controlled fans accounts for 33% less savings. These 10% and 33% savings reductions account for the 43% fewer savings calculated in ex post analysis.

Verified annual savings for the EMS Program incentives are 18,955 kWh, resulting in a realization rate of 57%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	27,893	8,419	30%	7.67
	Ventilation	5,313	10,536	198%	4.68
Total		33,206	18,955	57%	12.34

Site ID 6350

Data Collection

The participant received EMS incentives from Ameren Missouri for adding controls to the existing energy management system (EMS). The new EMS controls allow for the implementation of constant volume (CV) to variable air volume (VAV) fan controls, optimum start, demand-controlled ventilation (DCV), supply fan (SF) modulation, and static pressure (SP) reset.

During the M&V visit, ADM staff verified the EMS measures, equipment installation, the post-retrofit connected loads, and interviewed facility personnel regarding equipment operating schedules.

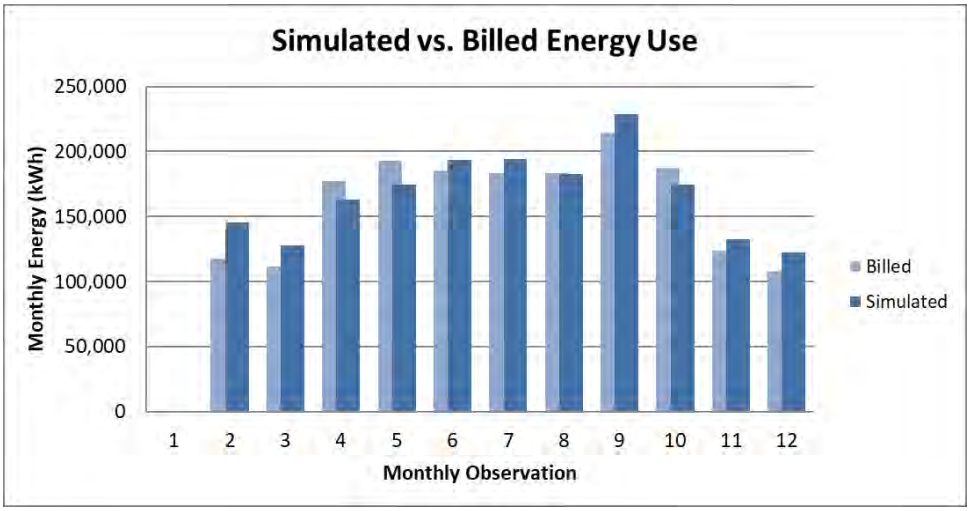
Analysis Results

HVAC and EMS Savings Calculations

Energy savings for the EMS measure were calculated using IPMVP Option D: Calibrated Simulation. ADM compiled an eQuest model of the baseline facility using the details and construction documents collected during the on-site M&V visit and from the project documentation.

Upon completion of the initial model, a custom weather file was created using NOAA weather data for the region. Using this weather file and the utility provided billing data for the facility, ADM ensured that the model's energy load shape matched that of the bills. The results of this calibration effort can be seen below:

Monthly kWh Calibration



After the calibration for the baseline eQuest model, the impacts of the installed measures were calculated using parametric runs and an updated TMY3 weather file to determine typical year savings. The first parametric run was added to the baseline model to account for the addition of thermostat setback schedules. This was done since monthly billed data, as shown above, implied that thermostat setbacks were not operating until after retrofit. The new model with thermostat setbacks was then used as the new baseline for further parametric runs. The subsequent parametric runs implemented optimized start, CV to VAV fan control, DCV, and SP reset for air handler RTG-1. More parametric runs were defined for the optimized start controls installed on AHU-2 and AHU-3. The total realized energy

savings are the differences between the baseline and as-built models' energy usages, and the total site-level energy savings by end use can be seen in the following table:

Site-Level Typical Year Energy Usage (kWh) by End Use

End-Use	*Baseline kWh*	*As-Built kWh*	*Annual kWh Savings*
Lighting	*992,805*	*992,805*	*0*
Misc. Equipment	*307,189*	*307,189*	*0*
Heating	*0*	*0*	*0*
Cooling	*264,660*	*227,939*	*36,721*
Pumps	*83,139*	*94,819*	*-11,680*
Fans	*161,312*	*84,209*	*77,104*
Domestic Hot Water	*0*	*0*	*0*
Heat Rejection	*22,395*	*21,170*	*1,225*
Total	1,831,501	1,728,132	103,369

Measure level savings for the EMS measures are shown in the following table:

EMS Measure Level Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
117920 - Cooling - Existing System	1169	Cooling	EMS	25,734	36,721	143%
118220 - HVAC- Existing System	1169	HVAC	EMS	86,151	66,649	77%
Total				111,885	103,369	92%

There were significant differences in the ex ante and ex post analysis results for the EMS measures, with a 92% realization rate.

The ex ante analysis utilizes bin calculations that do not rely on actual billing or trending data. The bin analysis calculates savings based primarily on supply fan rated CFM and a cooling IPLV of 0.7. Also, the ex ante calculations assume that the supply fan and cooling equipment are operational when outdoor air temperatures are over 65°F. However, ex post modeling revealed this assumption overestimates savings, because in the model there are several times when the air temperature was over 65°F and the cooling equipment was not operating.

For optimized start, the ex ante calculator modifies the availability schedule of the fans to begin operation one hour later. While this assumption may be accurate over an entire year, this methodology is not completely representative of how optimized start controls modify HVAC start times the ex post model's fan start time is delayed until the fan run time matches that needed to meet the desired zone temperatures. For DCV savings, the ex ante analysis calculates a constant outdoor air percent

reduction, whereas the ex post model estimates the CO_2 differential between the system return air stream and outside air intake air stream to determine the hourly minimum outside air fraction.

ADM's calibrated simulation for the ex post analysis was calibrated using actual billing and weather data, information collected during the M&V visit, and data from the project documentation. The ex post energy model better accounts for actual facility and HVAC energy usage than the ex ante bin calculations based on the model's ability to determine interactive effects and model all of the measures in one building as opposed to using separate bin calculations that do not interact with one another.

The site-level verified energy savings are 103,369 kWh, resulting in a realization rate of 92%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	25,734	36,721	143%	33.44
	HVAC	86,151	66,649	77%	29.59
Total		111,885	103,369	92%	63.03

Site ID 6351

Data Collection

The participant received EMS Program incentives from Ameren Missouri for modifying an existing, unmaintained Energy Management System (EMS) to implement optimized start, control HVAC equipment using CO2 sensors, implement supply air reset, and implement static pressure reset.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered mechanical schedules and HVAC equipment nameplate information.

Analysis Results

BAS Optimization Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A monthly pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against monthly billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Heating degree days (HDD), cooling degree days (CDD), and number of days in the billing periods were calculated and used with the HDDs and CDDs post-installation in an electric usage regression resulting in an R^2 of 0.969 and adjusted R^2 of 0.958. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh_{monthly} = 6{,}016 + 22.03 \times HDD + 12.73 \times CDD + 453.2 \times Days - 8.61 \times HDD\_Post - 10.94 \times CDD\_Post$$

Where:

$kWh_{monthly}$ = Monthly kWh Consumption
CDD = Cooling Degree Days for the Month with a Base Temperature of 65°F
HDD = Heating Degree Days for the Month with a Base Temperature of 65°F
School_Days = Number of Days in that Billing Period
CDD_Post = Cooling Degree Days for the Post-Install Month with a Base Temperature of 65°F
HDD_Post = Heating Degree Days for the Post-Install Month with a Base Temperature of 65°F

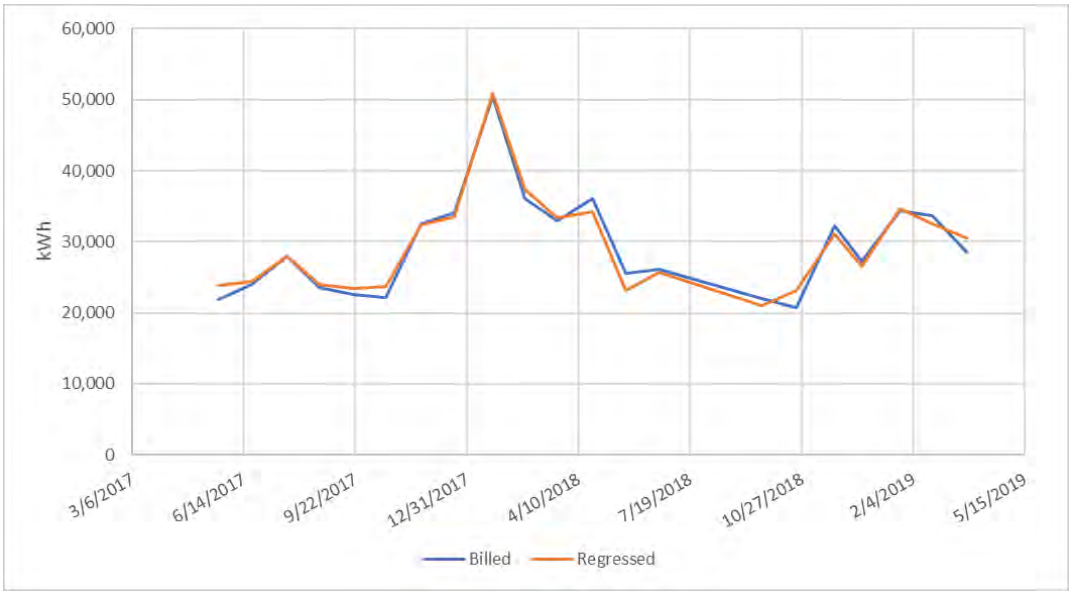
The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	T Stat
HDD	12.6
CDD	3.7
Days	2.6
HDD Post	-8.0
CDD Post	-2.8

Electric energy usage was calculated on a monthly basis using the derived regression equation. The following plot compares the monthly billed kWh to the regressed kWh:

Billed vs. Regressed Monthly kWh



Annual kWh savings for the installed measures were determined by using typical year (TMY3) weather data and billing period data. The derived equation was then used to calculate monthly pre/post energy consumption of the site. Each month was summed for a year to obtain annual energy savings. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility, and can be seen in the following table:

Monthly kWh Savings

Month	*Days*	*HDD*	*CDD*	*kWh*		
				Baseline	*As-Built*	*Savings*
Jan	31	1,114	0	44,612	35,017	9,596
Feb	28	843	1	37,293	30,023	7,270
Mar	31	511	33	31,742	26,993	4,749
Apr	30	289	68	26,847	23,641	3,206

Month	Days	HDD	CDD	kWh		
				Baseline	As-Built	Savings
May	31	135	106	24,381	22,111	2,270
Jun	30	14	369	24,615	20,623	3,992
Jul	31	1	493	26,362	21,181	5,181
Aug	31	3	394	25,143	20,986	4,157
Sep	30	44	204	23,181	20,657	2,524
Oct	31	334	35	27,859	24,620	3,240
Nov	30	608	8	33,110	27,789	5,321
Dec	31	1,040	0	42,975	34,020	8,955
Total				368,120	307,659	60,461

The total billing regression energy savings were used to determine measure level savings.

Measure level savings are shown in the following table:

EMS Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
117920-HVAC-Cooling Existing System	1169	Cooling	EMS	8,905	9,674	109%
118120-HVAC-Heating Existing System	1169	Heating	EMS	32,837	35,672	109%
118220-HVAC-HVAC Existing System	1169	Ventilation	EMS	13,914	15,115	109%
Total				55,656	60,461	109%

There were significant differences in the ex ante and ex post analysis methodologies for the EMS measures, with a realization rate of 109%. Ex ante calculations did not provide detailed sources for their calculated energy savings reduction percentages. The ex ante calculations assumed a total of 30% total savings with ~3% from optimized start, ~5% from static pressure reset, ~8% from temperature reset, and ~15% from DCV savings. Further, the calculations assumed 50% of the site energy use was from HVAC equipment.

The ex post analysis used actual billing data to produce a regression model with an accurate fit to real-world data. This model predicted baseline energy usage that was less than 1% different than the annual average two years prior to installation. This indicates reliability of the regression model and the high R^2 indicates further reliability of the modeled as-built kWh usage.

The verified annual site-level energy savings are 60,461 kWh, resulting in a 109% realization rate.

A table showing the energy savings achieved by the measures evaluated for this site is shown below:

Site-Level Energy Savings

Incentive	*End Use Category*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*	*Gross Ex Post kW Reduction*
EMS	Cooling	8,905	9,674	109%	8.81
	Heating	32,837	35,672	109%	0.00
	Ventilation	13,914	15,115	109%	6.71
Total		55,656	60,461	109%	15.52

Site ID 6352

Data Collection

The participant received EMS Program incentives from Ameren Missouri for adding occupancy-based temperature setbacks to the energy management system (EMS). In addition, they received Standard and Custom lighting incentives.

During the M&V visit, ADM staff verified the EMS controls and interviewed site personnel regarding equipment operation. Data from the EMS were collected where possible. ADM also gathered site occupancy schedules, lighting information, and HVAC equipment nameplate data. The ADM staff verified lighting equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED LampFixture Replac T8 LampFixture	3025	Lighting	Standard	88	88	59	22	5,342	1.09	30,520	19,044	62%
100208-Lighting-Non Linear LED Fixt Replac M H Fixture	1169	Exterior Lighting	Custom	10	10	455	123	4,308	1.00	14,542	14,303	98%
306143-Lighting-LED LampFixture Replac T8 LampFixture	3025	Lighting	Standard	26	26	88	33	4,745	1.09	13,404	7,429	55%
				21	21	55	21	6,753	1.09	6,693	5,279	79%
				20	20	59	30	4,745	1.09	5,437	3,013	55%
100208-Lighting-Non Linear LED Fixt Replac M H Fixture	1169	Exterior Lighting	Custom	14	7	95	17	4,308	1.00	5,304	5,217	98%
306143-Lighting-LED LampFixture Replac T8 LampFixture	3025	Lighting	Standard	2	2	114	44	521	1.09	1,312	80	6%
				2	2	88	30	521	1.09	1,087	66	6%
Total										78,299	54,431	70%

The annual lighting hours of operation for the second- and sixth-line items in the above table using photo cells (4,308[303]) are less than the hours of operation used to calculate ex ante savings (4,380). The remaining measures had hours (ranging from 521 to 6,753) fewer than the ex ante hours (8,760). The ex ante assumed continuous usage throughout the facility which was inaccurate.

[303] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07. The ex post and ex ante used a factor of 1.00 for the exterior measures.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[304]

EMS Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A monthly pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against monthly billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Cooling and heating degree days (CDD & HDD) were calculated for each billing period and used with a pre/post binary flag and number of days variables in an electric usage regression resulting in an R^2 of 0.923 and adjusted R^2 of 0.908. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh_{monthly} = 103.9 \times CDD + 23.58\ HDD - 8{,}761 \times Pre\_Post + 37{,}165$$

Where:

$kWh_{monthly}$ = Monthly kWh Consumption
CDD = Cooling Degree Days for the Month with a Base Temperature of 65.36°F
HDD = Heating Degree Days for the Month with a Base Temperature of 62.64°F
Pre_Post = Pre/Post-Retrofit Binary Flag

The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	*T Stat*
Pre_Post	-8.51
CDD	9.58
HDD	4.68

Electric energy usage values were calculated on a monthly basis using the derived regression equation. The following plot compares the monthly billed kWh to the regressed kWh:

[304] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Billed vs. Regressed Monthly kWh

Annual kWh savings for the installed measures were determined by using typical year (TMY3) weather data and the derived equation to calculate monthly pre/post energy consumption of the site. Each month was summed for a year to obtain annual energy savings. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility, and can be seen in the following table:

Monthly kWh Savings

Month	*CDD*	*HDD*	*kWh*		
			Baseline	*As-Built*	*Savings*
Jan	0	399	46,574	37,813	8,761
Feb	0	298	44,222	35,461	8,761
Mar	12	172	42,439	33,677	8,761
Apr	24	92	41,840	33,078	8,761
May	38	38	41,976	33,214	8,761
Jun	132	3	50,947	42,186	8,761
Jul	177	0	55,561	46,800	8,761
Aug	140	0	51,760	42,999	8,761
Sep	71	11	44,748	35,987	8,761
Oct	12	106	40,912	32,151	8,761
Nov	2	212	42,419	33,658	8,761
Dec	0	371	45,908	37,146	8,761
Total			549,307	444,170	105,137

The total billing regression energy savings were used to determine measure-level savings. Another project, Project 2, was also completed at this site during the evaluated timeline but was not part of the evaluation sample for PY2018. The expected savings for Project 2 are 82,466 kWh. ADM reviewed the ex ante analysis for this project and performed a lighting analysis to determine ex post savings of 54,431 kWh. The difference in savings is mainly due to different lighting hours found during the M&V site visit. These savings are subtracted from the total billing regression savings to obtain the measure-level energy savings (105,137 – 54,431 = 50,706 kWh) for Project 6352. ADM also allocated measure-level savings the same as the ex ante analysis.

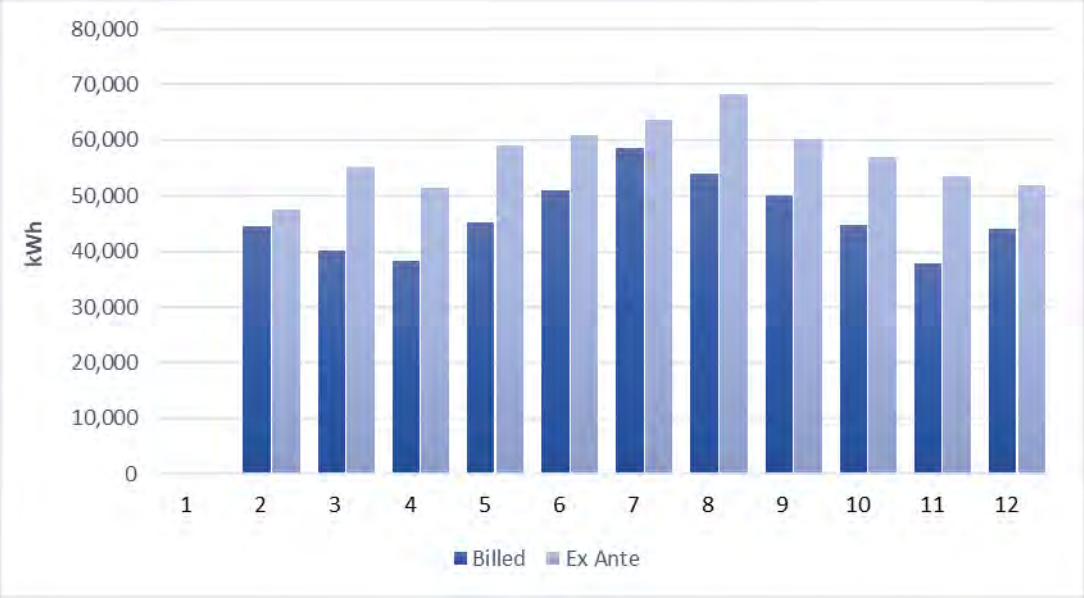
Measure level savings are shown in the following table:

EMS Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
117920 – Cooling	1169	Cooling	EMS	38,231	29,409	77%
118120 – Heating	1169	Heating	EMS	6,592	5,071	77%
118220 – HVAC	1169	HVAC	EMS	21,093	16,226	77%
Total				65,916	50,706	77%

There were significant differences in the ex ante and ex post analysis methodologies for the EMS measures, with a realization rate of 77%. The ex ante analysis for the HVAC optimization measures uses an uncalibrated Trane Trace model with assumed schedules, equipment loads, and installed controls. All these assumptions and the fact that the ex ante analysis didn't calibrate the model to actual billing data created significant uncertainty with the ex ante savings estimates. The following plot illustrates the comparison of 2017 billing data to the ex ante baseline model:

Ex Ante Baseline Model



ADM reviewed the ex ante model and attempted to calibrate the baseline and as-built energy simulations to billing data but determined there was still significant uncertainty with simulating the

installed controls accurately. ADM also noticed that the annual extrapolated post energy usage is significantly more than what was simulated in the ex ante as-built model, which explains why there is less realized energy savings. So, instead of using energy simulation, ADM used a billing regression with a good fit (R Square = 0.923) to determine realized energy savings. This method better accounts for actual billed energy savings from the implemented measures. Along with the uncertainty in the ex ante analysis, the reduced realized savings may also be explained by the how the controls were implemented. The ex ante model assumed that the occupancy based controls would be implemented on the majority of the facility, but during the M&V site visit, it appeared that the controls were only implemented on a select number of HVAC zones.

The verified annual site-level energy savings are 50,706 kWh, resulting in a 77% realization rate.

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 73%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	58,453	34,911	60%	6.63
Custom	Exterior Lighting	19,846	19,520	98%	0.11
EMS	Cooling	38,231	29,409	77%	26.78
	Heating	6,592	5,071	77%	0.00
	HVAC	21,093	16,226	77%	7.20
Total		144,215	105,137	73%	40.73

Site ID 6353

Data Collection

The participant received EMS Program incentives from Ameren Missouri for installing a new energy management system (EMS) to control HVAC schedules.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered mechanical schedules and HVAC equipment nameplate information.

Analysis Results

EMS Optimization Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A monthly pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against monthly billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Cooling and heating degree days (CDD & HDD) were calculated for each billing period and used with a pre/post binary flag and billed days variables in an electric usage regression resulting in an R^2 of 0.924 and adjusted R^2 of 0.910. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh_{monthly} = 182{,}718 + 265.9 \times CDD + 102.1 \times HDD - 39{,}814 \times PrePost$$

Where:

$kWh_{monthly}$ = Monthly kWh Consumption
CDD = Cooling Degree Days for the Month with a Base Temperature of 47.2°F
HDD = Heating Degree Days for the Month with a Base Temperature of 57.9°F
PrePost = Pre/Post-Retrofit Binary Flag

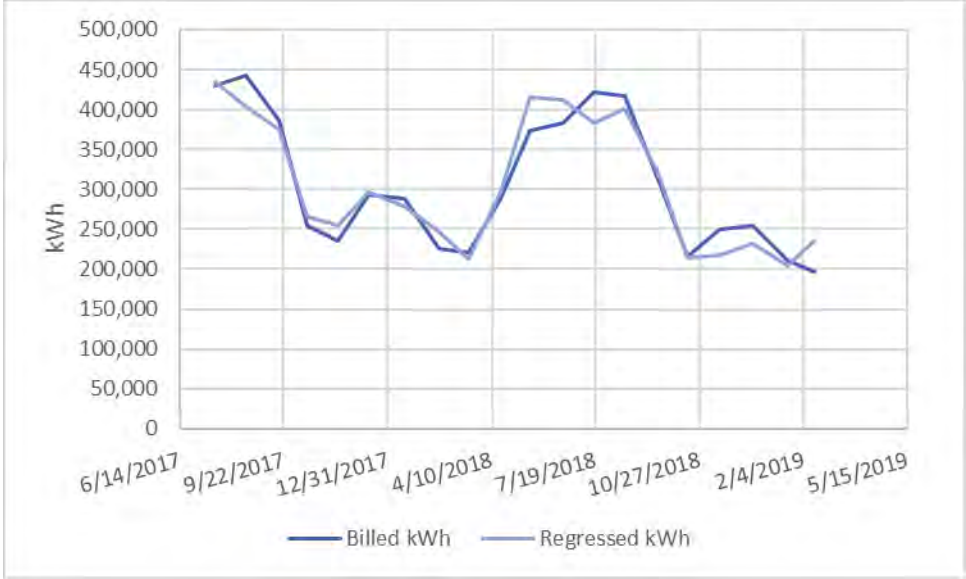
The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	*T Stat*
Intercept	7.47
CDD	9.14
HDD	2.94
PrePost	-3.44

Electric energy usage values were calculated on a monthly basis using the derived regression equation. The following plot compares the monthly billed kWh to the regressed kWh:

Billed vs. Regressed Monthly kWh



Annual kWh savings for the installed measures were determined by using typical year (TMY3) weather data and the derived equation to calculate monthly pre/post energy consumption of the site. Each month was summed for a year to obtain annual energy savings. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility, and can be seen in the following table:

Monthly kWh Savings

Month	CDD	HDD	kWh		
			Baseline	As-Built	Savings
Jan	26	898	281,311	241,498	39,814
Feb	46	653	261,685	221,871	39,814
Mar	209	338	272,899	233,086	39,814
Apr	349	156	291,387	251,573	39,814
May	533	52	329,683	289,870	39,814
Jun	889	1	419,174	379,360	39,814
Jul	1,043	0	460,189	420,375	39,814
Aug	941	0	433,058	393,245	39,814
Sep	688	9	366,678	326,864	39,814
Oct	288	176	277,341	237,527	39,814
Nov	109	429	255,461	215,648	39,814
Dec	10	823	269,343	229,529	39,814
Total	5,131	3,536	3,918,210	3,440,446	477,764

The total billing regression energy savings were used to determine measure level savings. An additional project, Project 1, was completed at this facility during the regressed period; thus, the additional savings

from this project were captured by the regression. To calculate the realized savings and realization rate for this project, Project 2, the ex ante savings for the additional measure were subtracted from the regressed savings to find the final ex post savings. The following table summarizes the regressed versus measure savings:

Regressed vs Project-Level Savings

Total Regressed Savings	477,764
Ex Ante Savings for Project 1	59,565
Ex Post Savings for Project 2	418,199

Measure level savings are shown in the following table:

EMS Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
117920-HVAC Optimization-Cooling	1169	Cooling	EMS	151,912	142,187	94%
118220-HVAC Optimization-HVAC	1169	HVAC	EMS	294,889	276,012	94%
Total				446,801	418,199	94%

There were significant differences in the ex ante and ex post analysis methodologies for the EMS measures, with a realization rate of 94%. The ex ante analysis for the HVAC optimization measures used bin analyses with assumed occupancy schedules, fan speeds, recovered loads, and HVAC loads. All these assumptions created significant uncertainty with the ex ante savings estimates. The ex ante analysis did not use any site-specific trending or utility data. ADM used a billing regression with a good fit (R Square = 0.924) to determine realized energy savings. This method better accounts for actual site HVAC energy usage than the ex ante calculations.

The verified annual site-level energy savings are 418,199 kWh, resulting in a 94% realization rate.

A table showing the energy savings achieved by the measures evaluated for this site is shown below:

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	151,912	142,187	94%	129.49
	HVAC	294,889	276,012	94%	122.54
Total		446,801	418,199	94%	252.03

Site ID 6354

Data Collection

The participant received EMS Program incentives from Ameren Missouri.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered HVAC equipment nameplate information.

Analysis Results

EMS Controls Savings Calculations

Energy savings for the EMS controls were calculated using prototypical energy simulation. ADM used a DEER prototypical eQuest model of a school. The model's HVAC system was auto-sized during a sizing run with local weather data. Using project documents and the details collected during the on-site M&V visit, heating, cooling, and fan schedules were created for the baseline and as-built models. ADM ran parametric simulations to determine the prototypical annual energy usage of the model with EMS fan schedule changes, optimized start implementation, and demand-controlled ventilation (DCV) programming on various supply fans. The realized energy savings are the differences between the parametric simulations' energy usages. For the fans labeled LG RTU and FCU, the efficiency measure implemented was reducing the scheduled fan hours from 5AM-9PM to 7AM-6PM and implementing optimized start controls. The energy savings by end use for these modifications can be seen in the following table:

Prototypical Annual Energy Usage (kWh) by End Use - (7AM to 6PM Fan Schedule & Opt Start)

End-Use	*Baseline (kWh)*	*As-Built (kWh)*	*Savings (kWh)*
Lighting	542,103	542,103	0
Misc. Equipment	314,463	314,463	0
Heating	0	0	0
Cooling	193,047	191,053	1,995
Pumps	34,597	32,275	2,323
Fans	175,904	128,298	47,606
Hot Water	0	0	0
Exterior Lighting	0	0	0
Total	1,260,115	1,208,191	51,924

For RTU 14, the above measure was implemented in addition to DCV controls. DCV savings were modeled in eQuest, and the energy savings by end use for these modifications can be seen in the following table:

Prototypical Annual Energy Usage (kWh) by End Use - (DCV)

End-Use	*Baseline (kWh)*	*As-Built (kWh)*	*Savings (kWh)*
Lighting	542,103	542,103	0
Misc. Equipment	314,463	314,463	0
Heating	0	0	0
Cooling	193,047	193,311	-263
Pumps	34,597	34,299	298
Fans	175,904	128,283	47,621
Hot Water	0	0	0
Exterior Lighting	0	0	0
Total	1,260,115	1,212,459	47,656

For RTU 7 & 8, the HVAC equipment was being controlled with local thermostats as opposed to the EMS system. Savings were modeled by parametrically changing the baseline thermostat schedule to a constant temperature and the as-built thermostat schedule to include setbacks. Additionally, the fan availability schedule was parametrically changed to 6AM-9PM in the as-built scenario since these hours were shown in the collected trend data. Savings by end use for these modifications can be seen below:

Prototypical Annual Energy Usage (kWh) by End Use - (Temperature Setback Schedule)

End-Use	*Baseline (kWh)*	*As-Built (kWh)*	*Savings (kWh)*
Lighting	542,103	542,103	0
Misc. Equipment	314,463	314,463	0
Heating	0	0	0
Cooling	276,179	193,895	82,285
Pumps	43,776	33,921	9,855
Fans	175,904	164,910	10,994
Hot Water	0	0	0
Exterior Lighting	0	0	0
Total	1,352,425	1,249,292	103,134

The prototypical annual energy savings were normalized to fan horsepower. Since there were different measures implemented for different systems' baseline and as-built conditions, individual savings were calculated for each fan based on the measures involved. These savings were divided by the modeled fan horsepower, and these normalized kWh/hp savings were multiplied by the actual fan horsepower to determine savings for each fan.

The following table presents information on prototypical and actual equipment, and expected and realized energy savings for the EMS controls installed at the site:

EMS Controls Savings

Program	Measure	Fan kW		EMS Controls Savings		Realized kWh Savings
		Prototypical	Actual	Prototypical kWh	Normalized kWh/kW	
EMS	LG RTU - Fan Scheduling & Optimized Start	23.7	11.2	51,924	2,188	24,442
EMS	RTU 7 & 8 - Fan & Thermostat Scheduling		4.8	103,134	4,345	20,691
EMS	FCU - Fan Scheduling & Optimized Start		19.4	51,924	2,188	42,426
EMS	RTU 14 - Fan Scheduling, Opt. Start, & DCV		4.8	47,656	2,008	9,735
					Total	97,293

Measure level savings are shown in the following table:

Custom and EMS Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
117920 - Cooling Existing System	1169	Cooling	EMS	39,252	19,023	48%
118220-HVAC Existing System	1169	HVAC	EMS	58,877	78,270	133%
Total				98,129	97,293	99%

There were significant differences in the ex ante and ex post analyses for the EMS controls, with a realization rate of 99%. Because ex ante savings were only claimed for cooling and fan energy use savings, ADM modified thermostat schedules to be consistent with provided schedules used in ex ante calculations. The only exception is for RTU 14 where the baseline thermostat schedule was set to a constant temperature as described above and later parametric runs were implemented to introduce setback temperatures into the model.

The provided ex ante analysis relied on bin calculations to determine the number of hours in each temperature bin during which the building was occupied for the baseline and as-built scenarios. ADM could not verify the source of this weather data. This analysis also assumed that any time the outdoor air temperature was above 55 degrees, the cooling equipment would be operating. However, modeled results show that when the air temperature is above 55 degrees, the cooling equipment is off approximately 21% of the time. This assumption and the assumption that there is a linear relationship between cooling load and outdoor air temperature account for the high cooling energy savings calculated in ex ante bin calculations.

Also, the ex ante bin calculations rely on the assumption that fan energy use during unoccupied hours follows the below equation:

$$Unoccupied\ Fan\ kW = (Rated\ Fan\ kW) \times (20\%) \times (Cooling\ Load\ \%)$$

This assumption likely underestimates fan energy use, particularly at low cooling loads, since a cooling load of 50% during unoccupied hours would result in a fan kW reduction of 90% compared to the same cooling load during occupancy. Consequently, due to this calculated low unoccupied energy use, the fan energy savings are mitigated due to the underestimation of baseline fan energy use during unoccupied hours and the subsequent reduction in potential savings from reducing the availability of that fan through scheduling. It is unlikely that the fan energy would be reduced so significantly due simply to being unoccupied. This likely accounts for the higher calculated fan energy use in ex post analysis that more realistically models fan energy demands.

Verified annual savings for the EMS Program incentives are 97,293 kWh, resulting in a realization rate of 99%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	39,252	19,023	48%	17.32
	HVAC	58,877	78,270	133%	34.75
Total		98,129	97,293	99%	52.07

Site ID 6355

Data Collection

The participant received incentives from Ameren Missouri for installing an Energy Management System (EMS) and additional control equipment and sensors. Energy is saved with this application in three ways, Improved scheduling, Demand Control Ventilation (DCV), and a fan motor static pressure reset strategy.

During the M&V visit, ADM staff verified the measures, equipment installation, the post-retrofit connected loads, interviewed facility personnel regarding lighting and equipment operating schedules, collected EMS control strategies, and collected equipment nameplates.

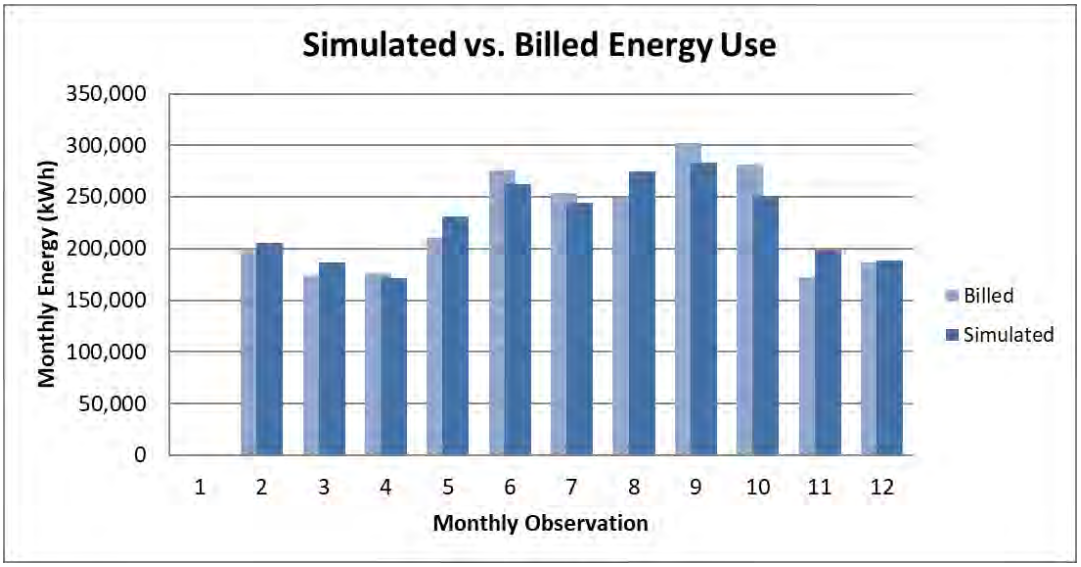
Analysis Results

Whole Building Savings Calculations

Energy savings for the Energy Management System (EMS) measures were calculated using IPMVP Option D: Calibrated Simulation. ADM compiled an eQuest model of the as-built facility using the details and construction documents collected during the on-site M&V visit and from the project documentation.

Upon completion of the initial model, a custom weather file was created using NOAA weather data for the region. Using this weather file and the utility provided billing data for the facility, ADM ensured that the model's energy load shape matched that of the bills. The results of this calibration effort can be seen below:

Monthly kWh Calibration



Upon completion of the calibration for the as-built eQuest model, the impacts of the installed measures were removed using parametric runs. Once the parametric runs were defined, the as-built model and parametric runs were simulated using TMY3 weather data. The total realized energy savings are the differences between the baseline and as-built models' energy usages, and the total site-level energy savings by end use can be seen in the following table:

Typical Year Energy Usage (kWh) by End Use

End-Use	*Baseline*	*As-Built*	*kWh Savings*
Lighting	1,107,813	1,107,813	0
Misc. Equipment	184,277	184,277	0
Heating	0	0	0
Cooling	794,177	526,896	267,281
Heat Rejection	87278	55071	32,207
Auxiliary (pumps)	457,049	274,392	182,657
Vent Fans	147,453	61,437	86,016
Domestic Hot Water	0	0	0
Ext. Lighting	0	0	0
Total	2,778,047	2,209,886	568,161

Measure level savings are shown in the following table:

New Construction Measure Level Savings

Measure Name/ID	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
117920-HVAC-Cooling Replacing Existing System	Cooling	EMS	248,942	267,281	107%
118220-HVAC-HVAC Replacing Existing System	HVAC	EMS	292,236	300,880	103%
Total			541,178	568,161	105%

There were significant differences in the ex ante and ex post analysis results for the EMS measures, with a 105% realization rate. The ex-ante analysis utilizes an excel based calculation method that made several assumptions regarding the equipment operation based on outside air temperature. ADM created an energy model using eQuest to calculate energy savings the model was calibrated to actual billing using actual weather data.

The ex-ante savings calculation method assumed the baseline ventilation fans operated 8,760 at constant speed and the heating a cooling operated with a linear relationship to outside air temperature. Savings are achieved from the ventilation fans, cooling and heating energy to operate on a schedule of 7 AM to 4 PM Monday through Friday and the system will operate at 20% when in unoccupied mode.

The ex-post analysis used a calibrated model to estimate the heating and cooling energy associated with the facility and then adjusted the fan schedule to operate 7 am to 4 pm, added demand control ventilation, and calculated savings with a static pressure reset by adjusting the fan efficiency curve.

The site-level verified energy savings are 568,161 kWh, resulting in a realization rate of 105%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	248,942	267,281	107%	243.41
	HVAC	292,236	300,880	103%	133.59
Total		541,178	568,161	105%	376.99

Site ID 6356

Data Collection

The participant received EMS Program incentives from Ameren Missouri for installing a new energy management system (EMS) to control existing HVAC equipment including schedules and temperature set-backs.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered mechanical schedules and HVAC equipment nameplate information. Lastly, ADM acquired and reviewed the ex ante Trane Trace energy models used for ex ante energy savings estimates.

Analysis Results

EMS Controls Savings Calculations

Energy savings for the implemented EMS measures were calculated using IPMVP Option D, Calibrated Simulation. This was completed using Trane Trace 700 energy simulation. ADM was provided the Trane Trace archived model used to estimate ex ante energy savings. ADM reviewed the baseline model's inputs and adjusted the model based on information collected during the on-site visit. The model was then run using weather data for the St. Louis region to ensure that the model was properly calibrated to the billed energy consumption of the facility. The results of the calibration effort can be seen in the following plot:

Trane Trace Model Calibration

Upon the calibration of the baseline model using 2017 billing data, an alternative model run was utilized in Trane Trace to determine the energy impacts of the EMS measures. The two models were run using typical weather for the region to determine the typical annual savings for the project. The annual savings

are the difference between the annual consumption of the baseline and as-built models. The EMS energy savings from the model are presented in the following table:

EMS Energy Savings

Month	*Typical Savings*		
	Baseline	*As-Built*	*Savings*
January	205,300	187,539	17,761
February	189,794	173,456	16,338
March	183,104	166,116	16,988
April	149,829	138,282	11,547
May	181,552	170,642	10,910
June	203,117	189,612	13,505
July	214,847	200,835	14,012
August	209,174	195,340	13,834
September	170,358	158,890	11,468
October	162,165	148,655	13,510
November	161,314	147,549	13,765
December	229,172	211,082	18,090
Total	2,259,726	2,087,997	171,729

Measure level savings are shown in the following table:

EMS Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
117920 – HVAC Optimization – Cooling	1169	Cooling	EMS	99,173	104,745	106%
118120 – HVAC Optimization – Heating	1169	Heating	EMS	45,651	51,731	113%
118220 – HVAC Optimization – HVAC	1169	HVAC	EMS	12,593	15,253	121%
Total				157,417	171,729	109%

Verified annual savings for implementation of the EMS controls measures are 171,729 kWh, resulting in a site-level realization rate of 109%. The differences in realized savings can be attributed to calibration of the provided Trane Trace model. The calibration adjustments to the model included: adjusting equipment power densities and schedules and modifying baseline heating set-backs.

The ex post model calibration resulted in more savings for all end use categories. The cooling, heating, and HVAC savings increased because equipment power densities and schedules and baseline heating set-backs were slightly adjusted in the baseline model for calibration purposes.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	99,173	104,745	106%	95.39
	Heating	45,651	51,731	113%	0.00
	HVAC	12,593	15,253	121%	6.77
Total		157,417	171,729	109%	102.16

Site ID 6359

Data Collection

The participant received EMS Program incentives from Ameren Missouri for installing a new energy management system (EMS) to control air handlers, implement optimized start, and perform static pressure reset.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered mechanical schedules and HVAC equipment nameplate information.

Analysis Results

BAS Optimization Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A monthly pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against monthly billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Cooling degree days (CDD) and number of school days were calculated for each billing period and used with a post-installation CDD variable in an electric usage regression resulting in an R^2 of 0.930 and adjusted R^2 of 0.917. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh_{monthly} = 44{,}888 + 505.9 \times CDD + 1{,}863 \times School\_Days - 126.3 \times CDD\_Post$$

Where:

$kWh_{monthly}$ = Monthly kWh Consumption
CDD = Cooling Degree Days for the Month with a Base Temperature of 69°F
School_Days = Number of School Days in that Billing Period
CDD_Post = Cooling Degree Days for the Post-Install Month with a Base Temperature of 69°F

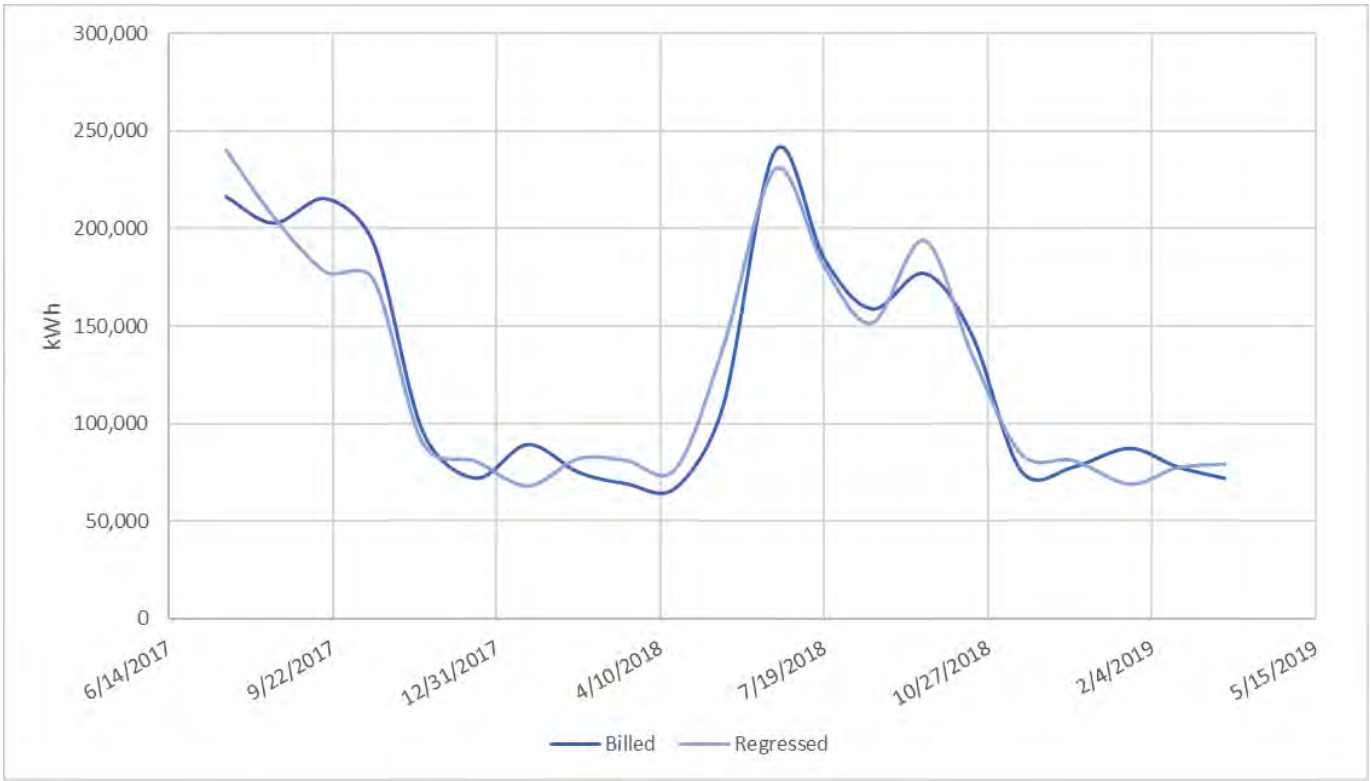
The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	*T Stat*
Intercept	3.2
CDD	12.3
School Days	2.7
CDD Post	-3.1

Electric energy usage values were calculated on a monthly basis using the derived regression equation. The following plot compares the monthly billed kWh to the regressed kWh:

Billed vs. Regressed Monthly kWh



Annual kWh savings for the installed measures were determined by using typical year (TMY3) weather data and the school day counts from the 2018-2019 school year. The derived equation was then used to calculate monthly pre/post energy consumption of the site. Each month was summed for a year to obtain annual energy savings. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility, and can be seen in the following table:

Monthly kWh Savings

Month	*School Days*	*CDD*	*kWh*		
			Baseline	*As-Built*	*Savings*
Jan	22.5	0	86,806	86,806	-
Feb	18.5	0	79,354	79,354	-
Mar	15.5	18	82,840	80,574	2,266
Apr	19.5	41	102,008	96,816	5,192
May	17.5	57	106,560	99,301	7,259
Jun	0.0	266	179,426	145,830	33,596
Jul	0.0	373	233,480	186,386	47,094
Aug	12.5	277	208,543	173,492	35,051
Sep	18.5	127	143,525	127,501	16,024

Month	School Days	CDD	kWh		
			Baseline	As-Built	Savings
Oct	20.0	16	90,270	88,242	2,028
Nov	17.5	3	78,942	78,579	362
Dec	14.5	0	71,902	71,902	-
Total			1,463,657	1,314,784	148,873

The total billing regression energy savings were used to determine measure level savings.

Measure level savings are shown in the following table:

EMS Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
117920-HVAC-Cooling Existing System	1169	HVAC	EMS	54,308	58,061	107%
118220-HVAC-HVAC Existing System	1169	Cooling	EMS	84,943	90,813	107%
Total				139,251	148,873	107%

There were significant differences in the ex ante and ex post analysis methodologies for the EMS measures, with a realization rate of 107%. The ex ante analysis for the HVAC optimization measures used bin calculations based on outdoor air temperature from TMY data, and calculated fan energy use based on air parameters such as humidity and enthalpy. These bin calcs relied upon assumptions about energy use reductions during unoccupied periods, outdoor air mixing, the relationship between heating and cooling requirement and OAT, and fan operation at different temperatures. These assumptions introduce uncertainty into the ex ante analysis, whereas ex post analysis used actual site-level billing data to quantify savings.

The verified annual site-level energy savings are 148,873 kWh, resulting in a 107% realization rate.

A table showing the energy savings achieved by the measures evaluated for this site is shown below:

Site-Level Energy Savings

Incentive	End Use Category	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate	Gross Ex Post kW Reduction
EMS	Cooling	54,308	58,061	107%	52.9
	HVAC	84,943	90,813	107%	40.3
Total		139,251	148,873	107%	93.2

Site ID 6360

Data Collection

The participant received EMS Program incentives from Ameren Missouri for implementing optimum start on HVAC equipment.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered HVAC equipment nameplate information.

Analysis Results

EMS Controls Savings Calculations

Energy savings for the EMS controls were calculated using prototypical energy simulation. ADM used a DEER prototypical eQuest model of a community college. The model's HVAC system was auto-sized during a sizing run with local TMY3 weather data. Using project documents and the details collected during the on-site M&V visit, heating, cooling, and fan schedules were created for the baseline and as-built models. ADM ran parametric simulations to determine the prototypical annual energy usage of the model with EMS fan optimized start implementation on various HVAC fans. The realized energy savings are the differences between the parametric simulations' energy usages. The energy savings by end use for these modifications can be seen in the following table:

Prototypical Annual Energy Usage (kWh) by End Use - (Optimized Start)

End-Use	*Baseline (kWh)*	*As-Built (kWh)*	*Savings (kWh)*
Lighting	922,748	922,748	0
Misc. Equipment	1,151,057	1,151,057	0
Heat Rejection	6,802	7,009	-208
Cooling	253,001	243,811	9,189
Pumps	154,330	137,138	17,192
Fans	179,329	155,151	24,177
Hot Water	0	0	0
Exterior Lighting	0	0	0
Total	2,667,267	2,616,916	50,350

The prototypical annual cooling energy savings were normalized to modeled cooling capacity, while the HVAC energy savings were normalized to modeled supply fan horsepower. The normalized kWh/ton and kWh/hp values were then multiplied by the total site cooling tonnage and total supply fan horsepower respectively to generate savings.

The following table presents information on prototypical and actual equipment, and expected and realized energy savings for the EMS controls installed at the site:

EMS Controls Savings

Program	Measure	Fan kW			EMS Controls Savings		Realized kWh Savings
		Units	Prototypical	Actual	Prototypical kWh	Normalized kWh/Unit	
EMS	HVAC Fans -Optimized Start	HP	198.0	865.6	41,161	208	179,903
EMS	Cooling - Optimized Start	Tons	658.6	1,980	9,189	14	27,626
Total							207,529

Measure level savings are shown in the following table:

Custom and EMS Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
118220-HVAC-Existing System	1169	HVAC	EMS	185,931	179,903	97%
117920- Cooling - Existing System	1169	Cooling	EMS	33,017	27,626	84%
Total				218,948	207,529	95%

There were significant differences in the ex ante and ex post analyses for the EMS controls, with a realization rate of 95%. Because ex ante savings were only claimed for cooling and fan energy use savings, ADM modified thermostat schedules to be consistent with provided schedules used in ex ante calculations.

Ex ante savings relied on bin calculations that used outdoor air temperature, and assumptions about the operating parameters of the HVAC equipment. The ex ante calculator calculates cooling and fan hours saved based on whether the outdoor air temperature at start time is greater or less than 50°F. The total hours saved are then multiplied by the peak rated kW of the HVAC equipment for cooling savings, and the peak rated kW of the supply fans for fan energy savings.

These assumptions likely overestimate energy savings since, with 25 fans and 2 chillers on site, not all fans and HVAC equipment will be operating at full capacity simply because the outdoor temperature isn't 50°F. For instance, cooling and HVAC fan demand will be greater on the eastern side of the building in the morning due to the heat gain from the morning sun; whereas, supply fans on the western side of the building may not have any cooling demand at 50°F. Consequently, the ex ante calculator's assumption that if the outdoor air temperature is over 50°F, there will be savings for all supply fans and both chillers overestimates both fan savings and cooling energy savings. These differences account for the different savings between ex ante and ex post calculations.

Verified annual savings for the EMS Program incentives are 207,529 kWh, resulting in a realization rate of 95%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	HVAC	185,931	179,903	97%	79.87
	Cooling	33,017	27,626	84%	25.16
Total		218,948	207,529	95%	105.03

Site ID 6361

Data Collection

The participant received EMS, Standard, and Custom incentives from Ameren Missouri for lighting and HVAC retrofits and installation of a new energy management system (EMS). The HVAC retrofits consisted of replacing packaged singe zone (PSZ) rooftop units (RTUs) with multi-zone (MZ) packaged RTUs. The new EMS allowed for new controls to be implemented for scheduling, optimum start, and demand-controlled ventilation (DCV).

During the M&V visit, ADM staff verified the EMS, HVAC, and lighting measures, equipment installation, the post-retrofit connected loads, and interviewed facility personnel regarding lighting and equipment operating schedules.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
301039-Lighting-LED <=20 W Lamp Fixture Replacing Halogen PAR Lamp Fixture	3008	Lighting	Standard	2	2	63	19	2,268	1.09	23	218	947%
				6	6	22	19	4,308	1.00	74	88	119%
				9	9	22	19	2,268	1.09	77	76	98%
306143-Lighting-LED Lamp Fixture Replacing T8 Lamp Fixture	3025			1	1	59	24	2,268	1.09	82	87	106%
				1	1	100	48	2,268	1.09	83	129	155%
306142-Lighting-LED Lamp Fixture Replacing T12 Lamp Fixture	3026			1	1	139	24	2,268	1.09	123	285	231%
301037-Lighting-LED <=20 W Lamp Fixture Replac Halog A >=40 Watt Lamp Fixture	3011			2	2	43	9	2,268	1.09	168	168	100%
306142-Lighting-LED Lamp Fixture Replacing T12 Lamp Fixture	3026			3	3	139	48	3,622	1.09	292	1,079	369%
				2	2	139	48	3,622	1.09	463	719	155%
201316-Lighting-LED Electroluminescent Replacing Incandescent Exit Sign	793			13	13	20	3	8,760	1.09	2,071	2,112	102%
306143-Lighting-LED Lamp oFixture Replacing T8 Lamp Fixture	3025			34	34	52	24	2,268	1.09	2,422	2,355	97%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
306142-Lighting-LED Lamp Fixture Replacing T12 Lamp Fixture	3026			10	10	139	24	2,268	1.09	2,707	2,845	105%
				12	12	344	92	2,268	1.09	10,872	7,482	69%
306140-Lighting-LED Lamp Fixture Replacing Interior HID Lamp Fixture	3004-1			14	14	460	132	3,622	1.09	14,249	18,145	127%
306142-Lighting-LED Lamp Fixture Replacing T12 Lamp Fixture	3026			158	158	82	24	2,268	1.09	33,338	22,674	68%
306143-Lighting-LED Lamp Fixture Replacing T8 Lamp Fixture	3025	Lighting	Standard	359	359	76	36	2,268	1.09	33,803	35,530	105%
Total										100,847	93,991	93%

The annual lighting hours of operation verified during the M&V site visit for the tenth line item in the table above corresponds with the ex ante hours (8.760). The second line item above using photo cells (4,308[305]) are greater than the hours of operation used to calculate ex ante savings (3,400). The third, seventh, eleventh, thirteenth, and fifteenth line items have annual hours (2,268) fewer than the ex ante estimate hours (ranging from 2,378 to 3,360). The remaining measures above have hours (ranging from 2,268 to 3,622) which are greater than the ex ante savings estimate hours (ranging from 250 to 2,200).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned education facility in St. Louis, was applied to the ex post lighting energy savings. A factor of 1.00 was used for the exterior unconditioned space. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[306]

HVAC and EMS Savings Calculations

Energy savings for the HVAC and EMS measures were calculated using IPMVP Option D: Calibrated Simulation. ADM compiled an eQuest model of the baseline facility using the details and construction documents collected during the on-site M&V visit and from the project documentation.

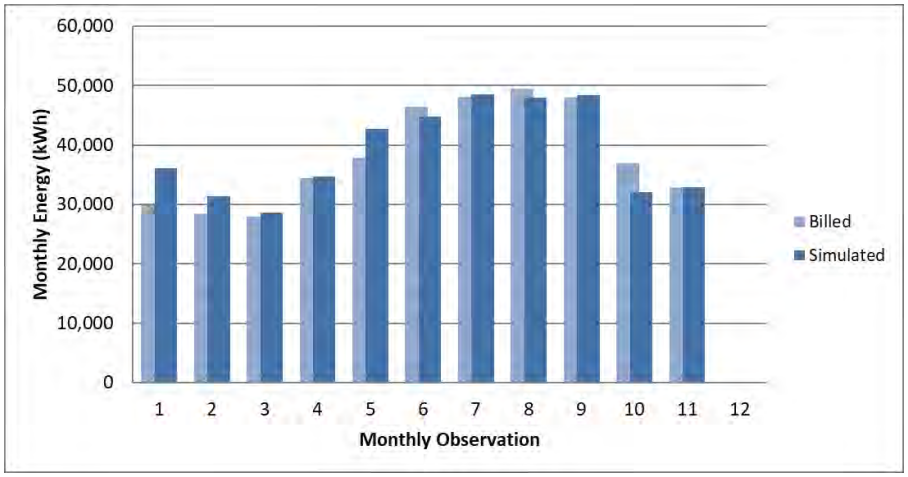
Upon completion of the initial model, a custom weather file was created using NOAA weather data for the region. Using this weather file and the utility provided billing data for the facility, ADM ensured that

[305] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[306] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

the model's energy load shape matched that of the bills. The results of this calibration effort can be seen below:

Monthly kWh Calibration



After the calibration for the baseline eQuest model, the impacts of the installed measures were calculated using parametric runs and another model derived from the calibrated model. The first parametric run was added to the baseline model to account for the lighting measures. After the first parametric run was completed, a new baseline model was created by only changing some of the baseline HVAC system types to account for the replacement of PSZ RTUs with MZ/VAV RTUs. More parametric runs were defined for the new baseline model to account for the EMS measures and to create the as-built model. The as-built model and parametric runs were simulated using TMY3 weather data. The total realized energy savings are the differences between the baseline and as-built models' energy usages, and the total site-level energy savings by end use can be seen in the following table:

Site-Level Typical Year Energy Usage (kWh) by End Use

End-Use	*Baseline*	*As-Built*	*kWh Savings*
Lighting	137,163	52,966	84,197
Misc. Equipment	53,489	53,489	0
Heating	13,935	18,824	-4,890
Cooling	67,297	46,097	21,200
Heat Rejection	0	0	0
Auxiliary (pumps)	5,064	5,167	-103
Vent Fans	195,927	86,642	109,285
Domestic Hot Water	0	0	0
Ext. Lighting	413	413	0
Total	473,288	263,599	209,689[307]

The realized savings for the HVAC retrofits are the difference in the lighting parametric run and the same model run with revised HVAC system types, PSZ to MZ/VAV RTUs. The measure level savings by end use can be seen in the following table:

Custom HVAC Typical Year Energy Usage (kWh) by End Use

End-Use	*Baseline*	*As-Built*	*kWh Savings*
Lighting	52,966	52,966	0
Misc. Equipment	53,489	53,489	0
Heating	19,582	24,665	-5,083
Cooling	59,081	64,543	-5,462
Heat Rejection	0	0	0
Auxiliary (pumps)	5,073	5,250	-177
Vent Fans	190,859	152,351	38,508
Domestic Hot Water	0	0	0
Ext. Lighting	413	413	0
Total	381,464	353,677	27,786

The realized savings for the EMS HVAC controls are the difference in the HVAC model run and the final as-built model run. The measure level savings by end use can be seen in the following table:

[307] The total simulated savings are slightly less due to the ex post lighting analysis used for realized energy savings being performed outside of eQuest.

EMS Typical Year Energy Usage (kWh) by End Use

End-Use	*Baseline*	*As-Built*	*kWh Savings*
Lighting	52,966	52,966	0
Misc. Equipment	53,489	53,489	0
Heating	24,665	18,824	5,841
Cooling	64,543	46,097	18,446
Heat Rejection	0	0	0
Auxiliary (pumps)	5,250	5,167	83
Vent Fans	152,351	86,642	65,709
Domestic Hot Water	0	0	0
Ext. Lighting	413	413	0
Total	353,677	263,599	90,079

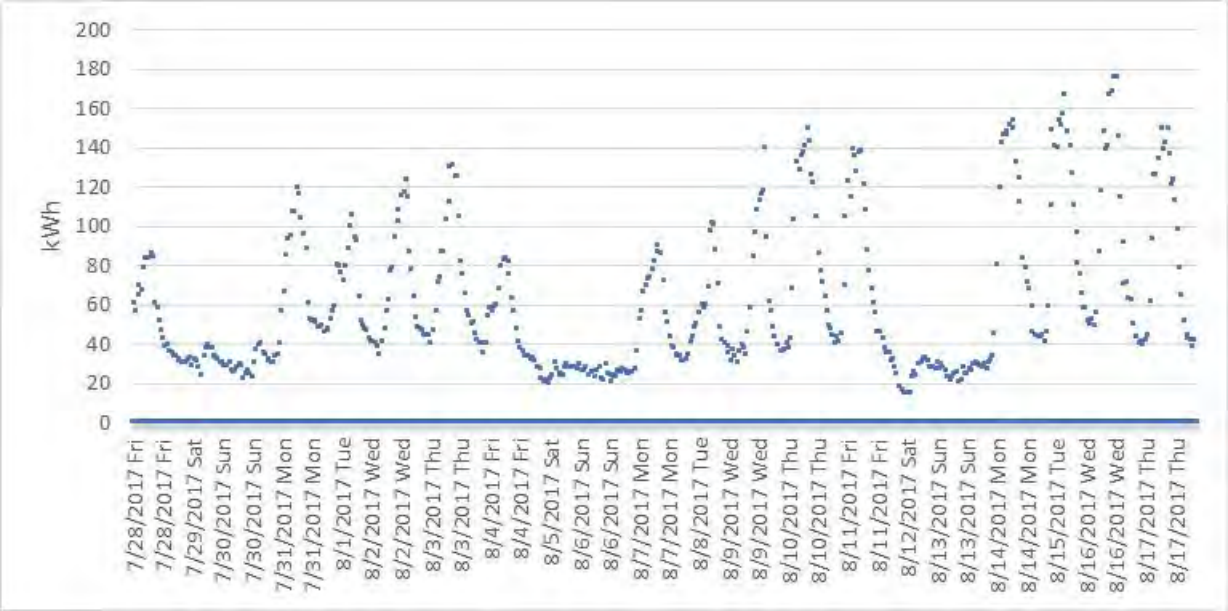
Measure level savings for the Custom and EMS measures are shown in the following table:

Custom and EMS Measure Level Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
112721 – Packaged RTU – Cooling	1169	HVAC	Custom	69,418	27,786	40%
118120 – HVAC Controls – Heating	1169	Heating	EMS	3,437	5,841	170%
117920 – HVAC Controls – Cooling	1169	Cooling	EMS	54,793	18,446	34%
118220 – HVAC Controls – HVAC	1169	HVAC	EMS	132,688	65,792	50%
Total				260,336	117,865	45%

There were significant differences in the ex ante and ex post analysis results for the EMS and Custom measures, with a 45% realization rate. The ex ante analysis utilizes bin calculations that don't rely on any actual billing or trending data. The ex ante analysis also relies on several assumptions about HVAC equipment schedules and controls. The biggest assumption that was found to be incorrect was that the baseline HVAC schedules were not 24/7 without any temperature setbacks. The following plot illustrates that the baseline had HVAC schedules for afterhours and weekends.

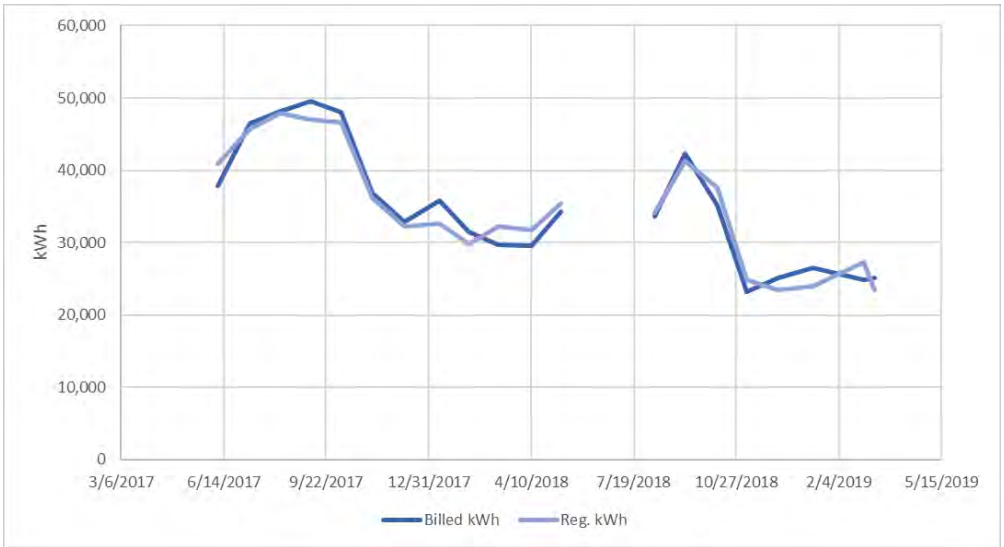
Baseline Hourly Billing Data



ADM used calibrated simulation for the ex post analysis. The ex post model was calibrated using actual billing and weather data, information collected during the M&V visit, and data from the project documentation. The ex post energy model better accounts for actual facility and HVAC energy usage than the ex ante bin calculations. When combining the expected cooling savings for the Custom and EMS projects, the expected savings are more than the cooling energy used by the facility in the calibrated baseline model. Furthermore, the ex ante bin calculations for the EMS project also result in an 87% reduction of fan energy in the calibrated baseline model, which isn't accurate because the fan operation wasn't 24/7 in the baseline as mentioned previously.

Lastly, ADM performed a meta-billing analysis to determine if the expected savings could be seen in the utility billing data. Approximately, five to eight months of post billing data were available at the time of the evaluation of this project. The regression resulted in an R square of 0.943, and the fit can be seen in the following plot:

Monthly Billed and Regressed Energy Usage



The results of the billing analysis, with the limited amount of post data, were site-level energy savings between 75,000 kWh and 127,000 kWh. This is significantly less than both ex post and ex ante analyses. It's likely less than it should be in actuality due to lack of enough post data, including summer months where substantial energy savings occur. However, a large amount of the expected energy savings for this project are not weather related and should be seen in any post billing data. The magnitude of the energy savings seen in the bills further shows that the ex ante analysis overestimated energy savings.

ADM also applied a different end use category for the packaged RTUs. ADM used HVAC end use instead of cooling because all the energy savings for the Custom measure are coming from ventilation.

The site-level verified energy savings are 211,856 kWh, resulting in a realization rate of 59%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	100,847	93,991	93%	17.85
Custom	HVAC	69,418	27,786	40%	12.34
EMS	Heating	3,437	5,841	170%	0.00
	Cooling	54,793	18,446	34%	16.80
	HVAC	132,688	65,792	50%	29.21
Total		361,183	211,856	59%	76.19

Site ID 6362

Data Collection

The participant received EMS Program incentives from Ameren Missouri for new controls that allow the supply fan (SF) variable speed drives (VFDs) to modulate and reset the SF static pressure based on damper position. In addition, CO_2 sensors were installed in spaces to control outdoor air with demand-controlled ventilation (DCV).

During the M&V visit, ADM staff verified the installation of EMS controls and associated sensors and interviewed site personnel regarding equipment operation. Data from the EMS were collected where possible.

Analysis Results

BAS Optimization Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A daily pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against daily billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Cooling and heating degree days (CDD & HDD) were calculated for each billing period and used with a pre/post binary flag and billed days variables in an electric usage regression resulting in an R^2 of 0.890 and adjusted R^2 of 0.888. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh_{monthly} = 3{,}448.34 \times Days + 60.14 \times CDD - 2{,}711.52 \times Weekends - 2{,}069.54 \times Holidays - 297.73 \times PrePost \times Days$$

Where:

$kWh_{monthly}$	= Monthly kWh Consumption
Days	= Number of Days for the Month
CDD	= Cooling Degree Days for the Month with a Base Temperature of 49.75°F
Weekends	= Total Number of Weekend Days for the Month
Holidays	= Total Number of Holidays for the Month
PrePost	= Pre/Post-Retrofit Binary Flag

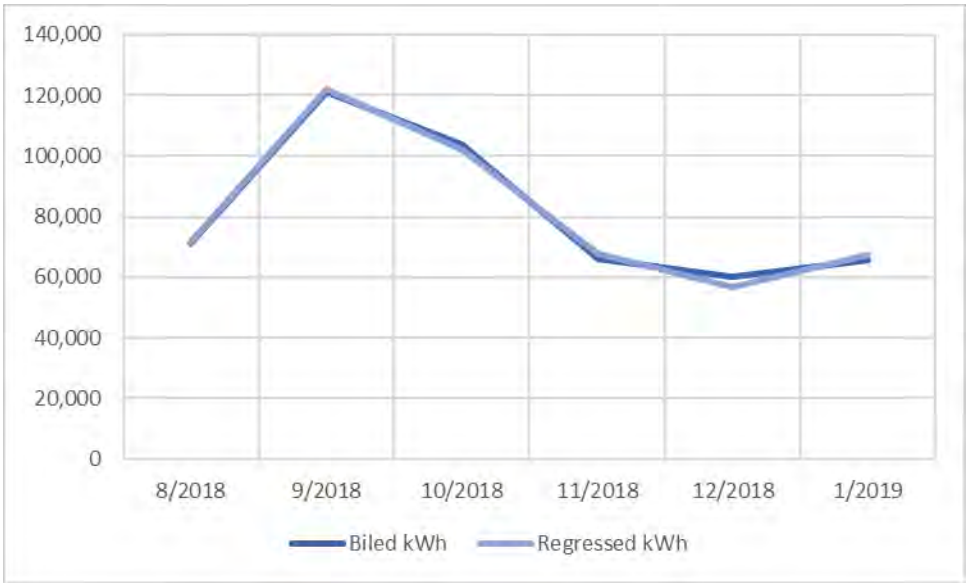
The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	*T Stat*
Intercept	3,448.34
CDD	60.14
Weekend	-2,711.52
Holiday	-2,069.54
PrePost	-297.73

Electric energy usage values were calculated on a monthly basis using the derived regression equation. The following plot compares the monthly billed kWh to the regressed kWh:

Billed vs. Regressed Monthly kWh



Annual kWh savings for the installed measures were determined by using typical year (TMY3) weather data and the derived equation to calculate monthly pre/post energy consumption of the site. Each month was summed for a year to obtain annual energy savings. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility, and can be seen in the following table:

Monthly kWh Savings

Month	*Days*	*CDD*	*Weekends*	*Holidays*	*kWh*		
					Baseline	*As-Built*	*Savings*
Jan	31	18	8	3	80,079	70,850	9,230
Feb	28	34	8	2	72,779	64,443	8,336
Mar	31	171	10	5	79,693	70,464	9,230
Apr	30	291	8	1	97,213	88,281	8,932

Month	Days	CDD	Weekends	Holidays	kWh		
					Baseline	As-Built	Savings
May	31	459	8	0	112,824	103,595	9,230
Jun	30	813	10	0	125,203	116,271	8,932
Jul	31	965	8	0	143,221	133,992	9,230
Aug	31	863	9	0	134,372	125,143	9,230
Sep	30	612	9	1	113,789	104,857	8,932
Oct	31	230	8	2	94,898	85,668	9,230
Nov	30	84	9	4	75,833	66,902	8,932
Dec	31	6	9	7	68,387	59,157	9,230
Total					1,198,293	1,089,623	108,670

The total billing regression energy savings were used to determine measure level savings. Measure level savings are shown in the following table:

EMS Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
117920 - Cooling	1169	Cooling	EMS	39,441	39,613	100%
118220 - HVAC	1169	HVAC	EMS	68,758	69,057	100%
Total				108,199	108,670	100%

There were significant differences in the ex ante and ex post analysis methodologies for the EMS measures, with a realization rate of 100%. The ex ante analysis for the HVAC optimization measures used bin analyses with assumed occupancy schedules, setpoint schedules, fan speeds, and HVAC loads. All these assumptions created uncertainty with the ex ante savings estimates. The ex ante analysis did not use any site-specific trending or utility data. ADM used a billing regression with a good fit (R Square = 0.890) to determine realized energy savings. This method better accounts for actual site HVAC energy usage than the ex ante calculations.

The verified annual site-level energy savings are 108,670 kWh, resulting in an 100% realization rate.

A table showing the energy savings achieved by the measures evaluated for this site is shown below:

Site-Level Energy Savings

Incentive	End Use Category	kWh Savings			Gross Ex Post kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
EMS	Cooling	39,441	39,613	100%	36.07
	HVAC	68,758	69,057	100%	30.66
Total		108,199	108,670	100%	66.74

Site ID 6363

Data Collection

The participant received EMS Program incentives from Ameren Missouri for cycling HVAC fans.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered HVAC equipment nameplate information.

Analysis Results

EMS Controls Savings Calculations

Energy savings for the EMS controls were calculated using prototypical energy simulation. ADM used a DEER prototypical eQuest model of a secondary school. The model's HVAC system was auto-sized during a sizing run with local weather data. Using project documents and the details collected during the on-site M&V visit, heating, cooling, and fan schedules were created for the baseline and as-built models. ADM ran parametric simulations to determine the prototypical annual energy usage of the model with EMS fan operation changes. The realized energy savings are the differences between the parametric simulations' energy usages, and the energy savings by end use can be seen in the following table:

Prototypical Annual Energy Usage (kWh) by End Use

End Use	*Baseline (kWh)*	*As-Built (kWh)*	*Savings (kWh)*
Space Cool	260,232	242,725	17,506
Heat Reject.	0	0	0
Space Heat	0	0	0
Vent. Fans	213,741	46,563	167,178
Pumps & Aux.	52,303	63,538	-11,235
Misc. Equip.	314,463	314,463	0
Area Lights	542,103	542,103	0
Total	1,382,842	1,209,392	173,450

The prototypical annual energy savings were normalized to HVAC supply fan horsepower. The difference between the baseline energy use and the as-built modeled energy use is the modeled energy savings. These savings were divided by the modeled HVAC supply fan horsepower, and these normalized kWh/HP savings were multiplied by the actual site supply fan horsepower to determine site savings.

The following table presents information on prototypical and actual equipment and expected and realized energy savings for the EMS controls installed at the site:

EMS Controls Savings

Program	Measure	Supply Fan Horsepower		EMS Controls Savings		Realized kWh Savings
		Prototypical	Actual	Prototypical kWh	Normalized kWh/HP	
EMS	Fan Cycling	58.74	18.00	173,450	2,952.95	53,153
Total						53,153

Measure level savings are shown in the following table:

Custom and EMS Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
118220-EMS-HVAC Existing System	1169	HVAC	EMS	59,300	53,153	90%
Total				59,300	53,153	90%

There were significant differences in the ex ante and ex post analyses for the EMS controls, with a realization rate of 90%.

The difference in realization is due to difference in ex ante and ex post calculation approaches. The ex ante analysis relies on bin calculations to determine the number of hours in each temperature bin during which the building was occupied for the baseline and as-built scenarios. Cooling load was estimated using outside air temperature and a linear curve when occupied and estimated as at a min cooling load when unoccupied. The cooling load curve was used to directly calculate the fan operation reduction and thus savings from changing the supply can operation from constant to cycling. The ex post analysis uses eQuest to calculate the fan operation reduction and resulting savings.

Verified annual savings for the EMS Program incentives are 53,153 kWh, resulting in a realization rate of 90%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	End Use Category	kWh Savings			Gross Ex Post kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
EMS	HVAC	59,301	53,153	90%	23.60
Total		59,301	53,153	90%	23.60

Site ID 6364

Data Collection

The participant received Standard lighting, Custom Envelope and HVAC, and EMS incentives from Ameren Missouri. The HVAC and EMS incentives are for replacing existing water-source heat pumps (WSHPs) and installing a new energy management system (EMS) to control the new HVAC equipment which includes schedules and temperature set-backs. Air-sealing was also performed on portions of the building envelope.

During the M&V visit, ADM staff verified equipment installation, EMS controls, the post-retrofit connected loads, interviewed facility personnel regarding lighting operating schedules, and installed three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 12/11/18 and 1/14/19. Data from the EMS were collected where possible. ADM also gathered mechanical schedules and HVAC equipment nameplate information. Lastly, ADM acquired and reviewed the ex ante Trane Trace energy models used for ex ante energy savings estimates.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp/ Fixture Replac T12 Lamp/ Fixture	3026	Lighting	Standard	2	2	48	13	8,760	0.98	656	602	92%
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025			3	3	59	25	1,194	0.98	224	120	53%
				12	12	59	25	1,856	0.98	895	744	83%
				62	62	59	25	1,194	0.98	4,624	2,473	53%
				104	104	59	25	1,856	0.98	7,756	6,448	83%
				86	86	88	38	2,547	0.98	9,432	10,757	114%
				33	33	59	25	1,194	0.98	2,461	1,316	53%
				24	24	59	25	2,547	0.98	1,790	2,041	114%
				6	6	59	25	1,856	0.98	447	372	83%
				100	100	88	38	1,194	0.98	10,968	5,865	53%
				347	347	88	38	1,488	0.98	38,057	25,367	67%
				12	12	88	38	1,856	0.98	1,316	1,094	83%
				307	307	88	38	1,488	0.98	33,670	22,443	67%
				11	11	175	75	1,488	0.98	2,413	1,608	67%
				48	48	114	50	1,856	0.98	6,738	5,602	83%
				1	1	114	50	1,856	0.98	140	117	83%
306140-Lighting-LED Lamp/ Fixture Replac Inter HIDLamp Fixt	3004-1			16	16	460	178	1,486	0.98	16,294	6,586	40%
				19	19	295	80	2,547	0.98	14,752	10,219	69%
301037-Light-LED <=20 W Lamp/Fixt	3011			6	6	43	10	2,547	0.98	693	495	71%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
Replac Halog A >=40 W Lamp/ Fixture												
Total										153,326	104,270	68%

The annual lighting hours of operation verified during the M&V site visit for the first line item in the table above (8,760) corresponds with the ex ante hours. The annual hours for the sixth- and eighth-line items (2,547) are greater than the annual hours of operation used to calculate ex ante savings (2,050). The remaining measures had hours of operation (ranging from 1,194 to 2,547) which are fewer than the hours used in the ex ante estimate (ranging from 2,050 to 3,375).

An adjusted base wattage of 43W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp. The ex ante base wattage of 42W was computed within the application by factoring 70% of a 60W incandescent lamp.

A heating and cooling interactive factor of 0.98, applicable to an electrically heated, air-conditioned education facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

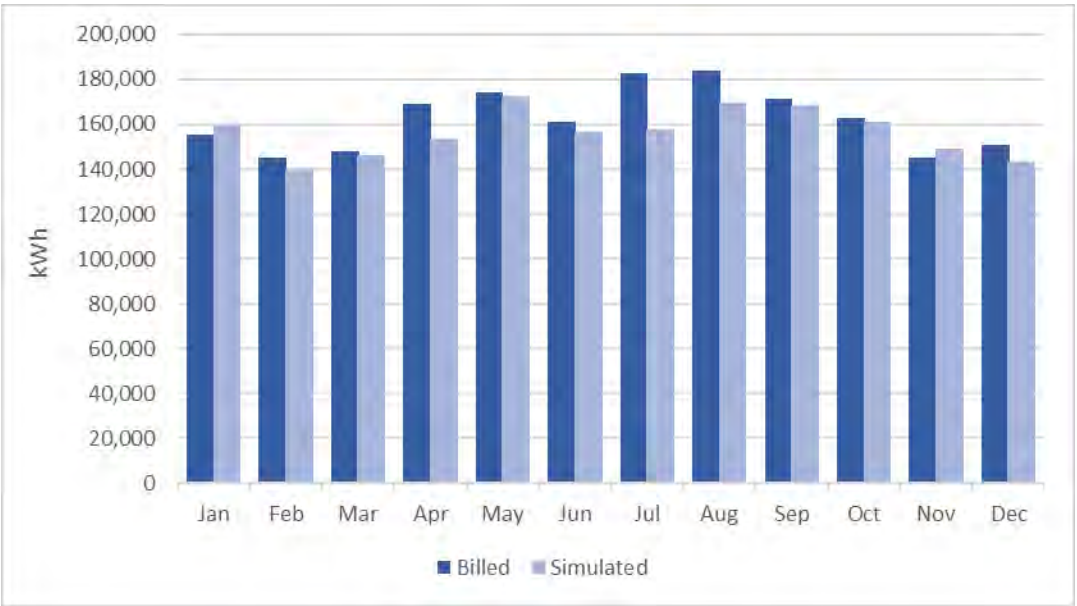
The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[308]

EMS and Custom HVAC Savings Calculations

Energy savings for the new WSHPs and implemented EMS controls were calculated using IPMVP Option D, Calibrated Simulation. This was completed using Trane Trace 700 energy simulation. ADM was provided the Trane Trace archived models used to estimate ex ante energy savings. ADM reviewed the baseline model's inputs and adjusted the model based on information collected during the on-site visit. The model was then run using 2017 weather data for the St. Louis region to ensure that the model was properly calibrated to the billed energy consumption of the facility. The results of the calibration effort can be seen in the following plots:

[308] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Trane Trace Model Calibration



Trane Trace Model Peak kW Calibration

Upon calibrating the baseline model using 2017 billing data, an alternative model was run utilizing Trane Trace by modifying the lighting power density (LPD) to create the baseline model for the Custom HVAC part of Project 1. This was done to account for the lighting savings calculated outside of the model and summarized in the previous section. Another alternative run was created to determine the energy impacts of replacing the existing HVAC equipment with WSHPs. The two models were run using typical weather (TMY3) for the region to determine the typical annual savings for the HVAC project. The annual savings are the difference between the annual consumption of the baseline and as-built models. The HVAC energy savings from the model are presented in the following table:

HVAC Energy Savings

Month	*TMY3 Savings*		
	Baseline	*As-Built*	*Savings*
January	157,067	120,634	36,433
February	136,610	106,392	30,218
March	139,670	111,721	27,949
April	140,659	114,435	26,224
May	153,840	127,082	26,758
June	148,409	129,277	19,132
July	150,138	130,259	19,879
August	157,881	138,279	19,602
September	152,481	126,280	26,201
October	143,514	116,767	26,747
November	140,245	111,224	29,021
December	140,435	106,593	33,842
Total	1,760,946	1,438,939	322,006

The as-built alternative run for the HVAC project, Project 1, is the baseline for the EMS project, Project 2. ADM used a similar alternative run as the ex ante; however, it reflects calibration and other changes from the previous alternatives. The change that resulted in the biggest difference between the ex ante and ex post models was the ex ante model set the fans to cycle, while the ex post model set the fans to not cycle. This change was determined to be appropriate during M&V. Also, the ex post savings are based on a run using typical weather (TMY3) for the region to determine the typical annual savings for the EMS controls. The annual savings are the difference between the annual consumption of the baseline and as-built models and are presented in the following table:

EMS Energy Savings

Month	*TMY3 Savings*		
	Baseline	*As-Built*	*Savings*
January	120,634	104,663	15,971
February	106,392	89,625	16,767
March	111,721	95,198	16,523
April	114,435	93,572	20,863
May	127,082	102,296	24,786
June	129,277	83,137	46,140
July	130,259	90,384	39,875

Month	TMY3 Savings		
	Baseline	As-Built	Savings
August	138,279	85,942	52,337
September	126,280	105,183	21,097
October	116,767	95,985	20,782
November	111,224	91,656	19,568
December	106,593	100,147	6,446
Total	1,438,939	1,137,788	301,151

For the building shell measure, ADM reviewed the ex ante calculations and found them to be reasonable. The shell energy savings were included outside of the model.

Measure level EMS and Custom savings are shown in the following table:

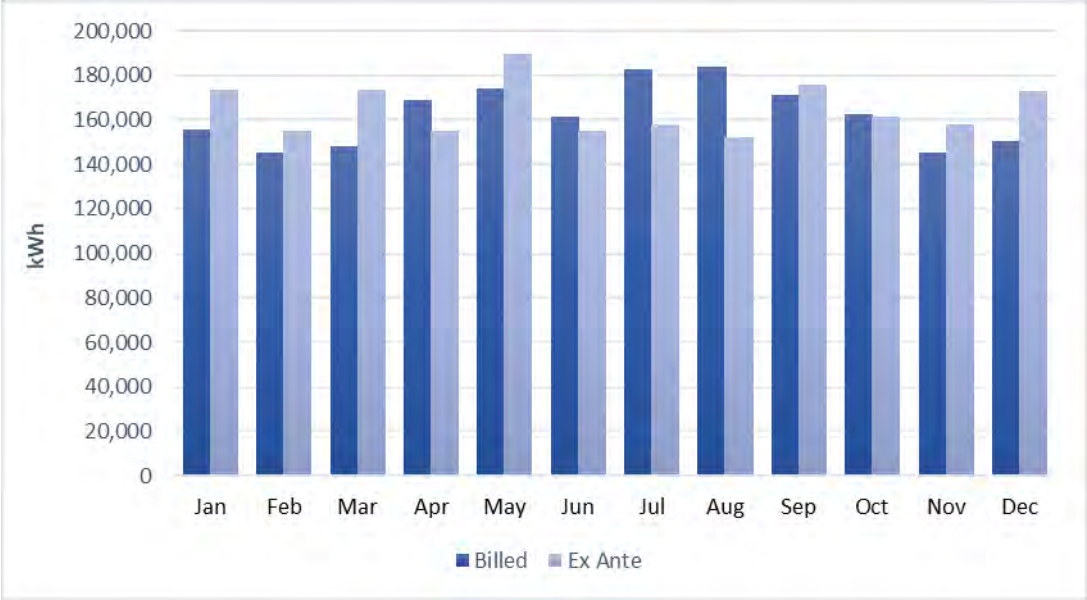
EMS and Custom Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
118220 – HVAC Optimization – HVAC	1169	HVAC	EMS	360,121	127,982	36%
117920 – HVAC Optimization – Cooling	1169	Cooling	EMS	126,803	155,825	123%
428420 – HVAC Optimization – Misc.	1169	Misc.	EMS	20,288	17,344	85%
113020 – WSHP Replacement – Cooling	1169	Cooling	Custom	113,924	73,808	65%
113020 – WSHP Replacement – HVAC	1169	HVAC	Custom	228,902	248,198	108%
191520 – Bldg. Envelope Repair – Shell	1169	Shell	Custom	23,140	23,140	100%
Total				873,178	646,298	74%

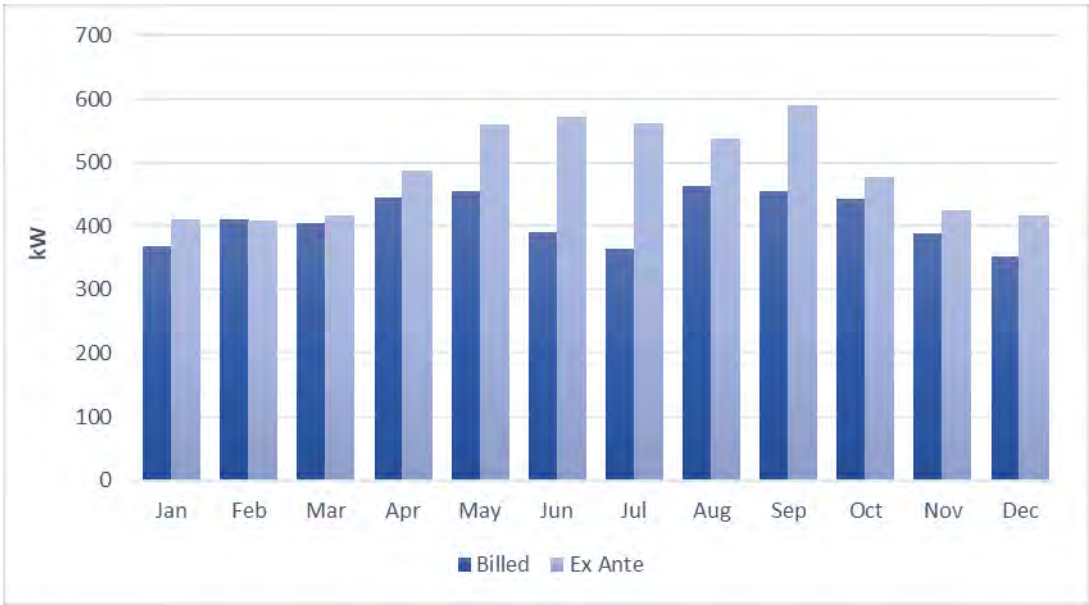
Verified annual savings for implementation of the EMS measures are 301,151 kWh, resulting in a project-level realization rate of 59%. Verified annual savings for the Custom measures are 345,146 kWh, resulting in a project-level realization rate of 94%. The differences in realized savings can be attributed to calibration of the provided Trane Trace model. The calibration adjustments to the model included: adjusting lighting power densities and modifying the baseline model's: fan operations, temperature schedules, equipment efficiencies. Lastly, the as-built fan operation was changed to not cycle, which had a large impact on the HVAC EMS savings.

The ex ante model used an assumed baseline lighting power density, equipment operations, and existing controls. The ex ante also assumed that existing controls were nonexistent. As a result, the model's calibration appears slightly off and can be seen in the following figure:

Monthly Energy Usage of Baseline Ex Ante Model vs. 2017 Utility Bills



Monthly Peak Demand of Baseline Ex Ante Model vs. 2017 Utility Bills

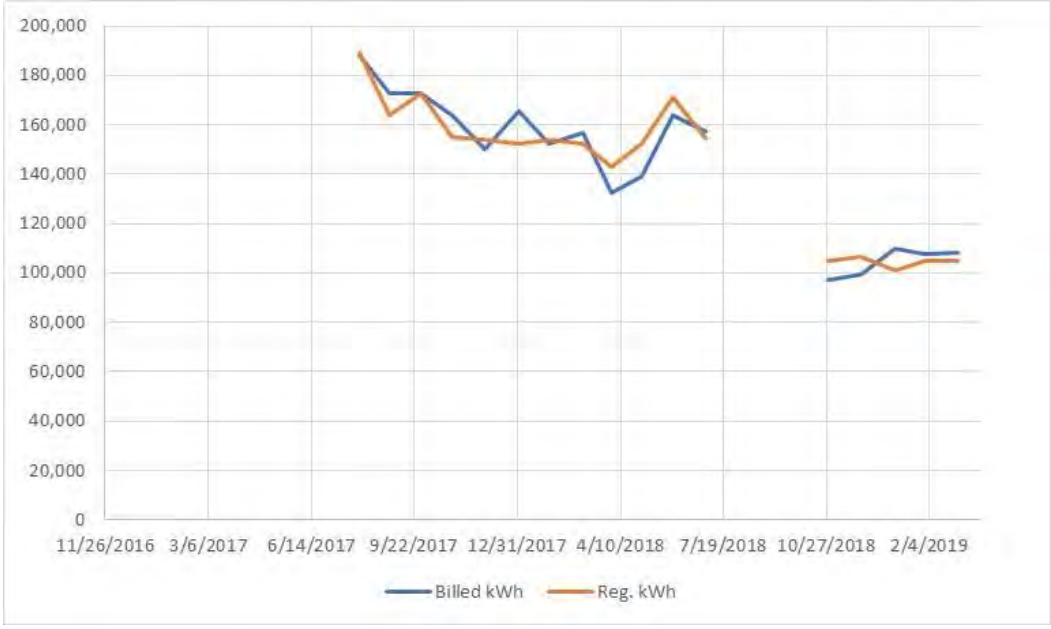


The overall gross realization rate for the lighting incentive is 68%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 91% of the installed measures and overestimated heating and cooling interactive effects.

Verified annual savings for implementation of the Standard, Custom, and EMS incentives are 750,568 kWh, resulting in a site-level realization rate of 73%.

ADM also performed a meta-billing analysis to determine if the expected savings could be seen in the utility billing data. Approximately, five to eight months of post billing data were available at the time of the evaluation of this project. The regression resulted in an R square of 0.929, and the fit can be seen in the following plot:

Monthly Billed and Regressed Energy Usage



The results of the billing analysis, with the limited amount of post data, were site-level energy savings between 673,000 kWh and 468,000 kWh. This is significantly less than both ex post and ex ante analyses. The total site-level energy savings are underestimated using the bills due to lack of enough post data, including summer months where substantial energy savings occur. When adding the cooling savings from the model to the regressed billing savings, the energy savings are between 688,000 kWh and 893,000 kWh. The regressed energy savings plus the cooling savings from the model justify the total ex post energy savings and further show that the ex ante analysis overestimated total site-level energy savings.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	153,326	104,270	68%	19.81
EMS	HVAC	360,121	127,982	36%	56.82
	Cooling	126,803	155,825	123%	141.91
	Misc	20,288	17,344	85%	2.39
Custom	Cooling	113,924	73,808	65%	67.22
	HVAC	228,902	248,198	108%	110.19
	Shell	23,140	23,140	100%	10.27
Total		1,026,504	750,568	73%	408.62

Site ID 6366

Data Collection

The participant received New Construction lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 12/08/18 and 1/09/19.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
406123-Lighting-New Construction Lighting Power Density (LPD)	3000	Lighting	New Construction	877	877	1,139	137	3,270	1.06	2,776,672	2,810,351	101%
Total										2,776,672	2,810,351	101%

The lighting energy use of the installed lighting equipment is compared with the estimated lighting energy use associated with the applicable new construction baseline (ASHAE 90.1 2001) to determine realized lighting energy savings. The manufacturing facility constructed in the City of Bridgeton was subject to the 2003 IECC code in effect during the building design, which the facility had two space types. The warehouse allowed for 1.2 lighting watts/SF and the office allowed for 1.30 lighting watts/SF. The code compliant baseline lighting wattage for the warehouse was 955,200 watts (1.2 watts/SF*796,000SF) and the office area was 44,200 watts (1.3 watts/SF *34,000SF).

The annual lighting hours of operation verified during the M&V site visit (3,270) are greater than the annual hours of operation used to calculate ex ante savings (3,255).

A heating and cooling interactive factor of 1.11, applicable to a gas heated, air-conditioned office areas and 1.00 for the unconditioned warehouse areas in St. Louis was applied to the ex post lighting energy savings. The ex ante savings estimate did not account for heating and cooling interactive effects.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[309]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 101%.

[309] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
New Construction	Lighting	2,776,672	2,810,351	101%	533.86
Total		2,776,672	2,810,351	101%	533.86

Site ID 6367

Data Collection

The participant received New Construction lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed seven photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 1/28/19 and 2/19/19.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
406123-Lighting-New Constr. Lighting Power Density(LPD)	3000	Lighting	New Construction	245	245	488	90	4,000	1.09	459,759	451,530	98%
Total										459,759	451,530	98%

The lighting energy use of the installed lighting equipment is compared with the estimated lighting energy use associated with the applicable new construction baseline (ASHAE 90.1 2007) to determine realized lighting energy savings. The distribution facility constructed in St. Louis County allows for 1.2 lighting watts/SF for the warehouse space and 1.3 lighting watts/SF for the office space. The code compliant baseline lighting wattage for the warehouse was 114,000 watts (1.2 watts/SF*95,000SF) and for the office was 6,500 watts (1.3 watts/SF*5,000SF).

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours (4,000) were fewer than those used to develop the ex ante energy savings estimates (4,680).

The quantity of the installed measures (245) verified during the M&V site visit is less than the ex ante savings quantity (250).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned light manufacturing in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate did not account for heating and cooling interactive effects.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[310]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%.

[310] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
New Construction	Lighting	459,759	451,530	98%	85.77
Total		459,759	451,530	98%	85.77

Site ID 6368

Data Collection

The participant received New Construction lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 1/29/19 and 3/05/19.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
406123-Lighting-New Con Lighting Power Density (LPD)	3000	Lighting	New Construction	312	312	417	154	7,770	1.00	450,736	636,732	141%
Total										450,736	636,732	141%

The lighting energy use of the installed lighting equipment is compared with the estimated lighting energy use associated with the applicable new construction baseline (ASHAE 90.1 2007) to determine realized lighting energy savings. The manufacturing facility constructed in St. Louis County, which allows for 1.3 lighting watts/SF. The code compliant baseline lighting wattage for this project was 130,000 watts (1.3 watts/SF*100,000SF).

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours (7,770) exceeded those used to develop the ex ante energy savings estimates (5,500).

A heating and cooling interactive factor of 1.00, applicable to an unconditioned light manufacturing in St. Louis, was applied to the ex post lighting energy savings which corresponds to the ex ante savings estimate.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[311]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 141%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours.

[311] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
New Construction	Lighting	450,736	636,732	141%	120.96
Total		450,736	636,732	141%	120.96

Site ID 6369

Data Collection

The participant received Retro-Commissioning (RCx) incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation and post-implementation connected loads, interviewed facility personnel regarding equipment operation. ADM also reviewed of the provided documentation and data.

The customer repaired several leaks in the compressed air system, totaling 344 cfm, as follows:

Leak Repair Log

TAG	LOCATION	SIZE
110	106 Press	L
101	106 Press	L
111	104 Press	M
103	104 Press	S
105	103 Press	L
96	114 Press	M
109	114 Press	S
112	Shell Welder	XL
113	Crimp Press(Tree City)	S
74	Press 2194 (1625 Line)	L
108	18276 LH Press (1525 Line)	L
106	LH Air Tester (1525 Line)	XL
114	Flare Press B00047 (1850)	S
115	500321 Baffle Weld (1800)	M
118	4195 Line Autowelder	S
119	4195 Pinstamp	S
129	4195 Pinstamp	S
139	4160 B01460	L
138	4165 Harley Line	M
121	Stamp Press 2100 Line	M
122	2000 Line 4pt spot welder 9567	S
124	Asset 9566 Auto Welder	S
125	30062 Vertical Press	S
126	B00269 Asset	M
179	4640 Line 60 Ton Press	S

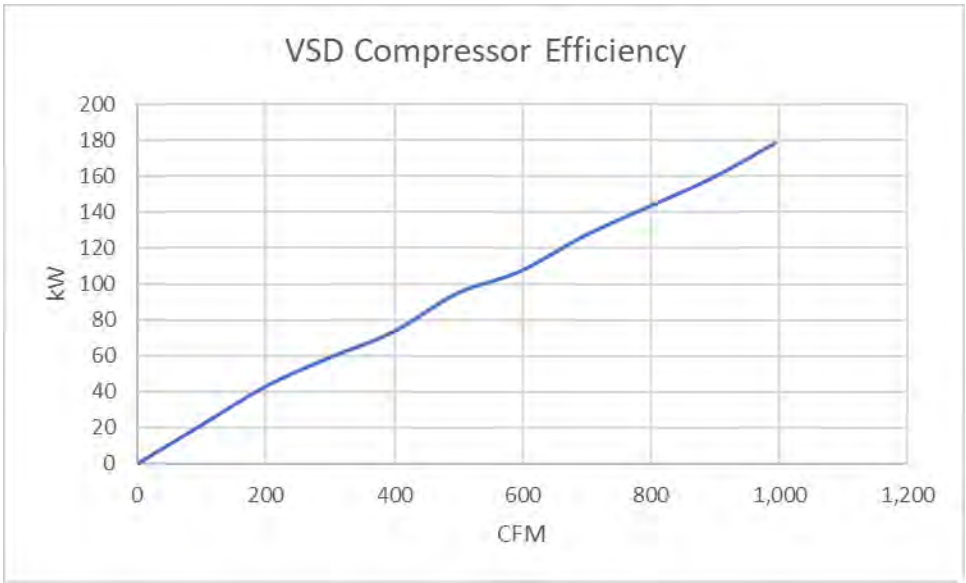
TAG	LOCATION	SIZE
22	4165 DX-73424-1	S
137	B00422	S
149	Asset 29718 4307 Line GM610	S
136	B00935 Autowelder	L
148	8438 Asset Tag Bender	M
199	Asset 23655	S
147	3950 Line 23655	M
146	4120 Line Bender B00729	L
187	B01053 Asset 4800 Line Bender	L
189	217704340 Line	S
130	German Bender 4340 Line 410234 Asset	L
132	191065 Asset	M
134	13583 Asset	M
133	2400 Asset Bender	M
142	B01542 Scribe	XL
141	DX73837 Gauge	L
39	B01413 Asset Hess	M
197	1740 Line Seam Roller B01800	S
194	201891	S
190	4225 Line Air Tester Ford	S
69	2485 Line	S
186	2485 Line	M
185	Dx-57497 Asset	L
193	701593 Asset	M
191	1400 Line Extruder	S
23	1400 Line Muffler Extruder	L
145	23081 Asset Resistance Weld	L
192	Lockseamer LCKSMR01	M
24	B01915	S
143	29512 Asset	S
31	29709 Asset	M
42	701349 Converter	L
120	500 505 Asset	L
131	0301 Haven	S

TAG	LOCATION	SIZE
43	1500/1525 Line	S
44	1500/1525 Line	L
184	B01484 Asset	M
127	GMX-OM-651	L
28	701593	M
350	Press 2194 (1625 Line)	S
355	Pin Strap Machine 6900	S
354	Press at beam K6	L
356	B0161 By Beam E8	L
358	Line 4100 Bend Cell 07 Davinci Bender	L
360	C-Segment Rig Workstation K11	L
361	C-Segment Rig Workstation K11	L
363	Mic3 Work Station K12	L
365	701233 Autowelder	L
366	1625-201811 62	M
367	Seam Welder 1625	L
368	Press 29215 Beam K2	S
369	Filter Bowl Mounted to Beam K2	L
370	DT018 L6	M
371	B01712 Bender at F-10	L
372	2129 Weld Station F9	M
373	Bend Cell 4350 29588 F11	XL
375	Mercedes Robot #1	L
376	Volkswagen 2455	M
377	Line 2400 Etcher	L
378	B010199 Auto Welder	XL

Correcting these leaks reduced the load on the compressors, resulting in less energy consumption. ADM reviewed all project documentation, including the “Compressed Air Study” provided by the contractor, and obtained the baseline monitoring data referenced in the study. The monitoring data totaled seven days in 12 second intervals. Variables monitored included: current (amperage) for each of the two compressors (for five days), flow (CFM), and pressure (psi) for each of the two compressors (for seven days). One 150 horsepower Ingersoll Rand fixed speed compressor and one 200 horsepower Ingersoll Rand VSD compressor operated during the monitoring period.

Compressed Air Leak Repair Savings Calculations

ADM estimated energy savings using the facility's compressed air load profile derived from baseline monitoring data. The 150 horsepower fixed speed air compressor runs full load while the 200 horsepower VSD runs trim. Thus, the savings result from reduced load on the 200 horsepower VSD compressor. The kW at each monitoring point was determined using the load (CFM) values and a Uniform Methods Project standard air compressor curve. Using the full load compressor power and flow, the following compressor efficiency curve of kW vs cfm was used to calculate the baseline compressor power:



The compressor efficiency curve was used to calculate the new load (kW) values for decreasing the post implementation load by the 344 cfm in leaks repaired. This "new" load profile represented the decreased demand as a result of repaired leaks.

Energy savings were calculated by taking the difference in energy requirements of baseline and post-RCx compressed air systems, at each monitoring point, summing over the monitoring period, and scaling to an annual basis. This method assumes the monitoring period represented a typical demand profile at the facility.

The site-level realization rate is 107%. This is primarily due to ex ante calculating savings for 339 CFM of leaks and including the base loaded compressor in the savings calculations. The project documentation outlines 344 CFM of leaks, which is used in the ex post analysis and the ex post analysis only calculates savings using the trim compressor because the base load compressor is not affected by the leak repair.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Retro-Commissioning	Compressed Air	491,009	527,466	107%	72.76
Total		491,009	527,466	107%	72.76

Site ID 6370

Data Collection

The participant received Retro-Commissioning (RCx) incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation and post-implementation connected loads, interviewed facility personnel regarding equipment operation. ADM also reviewed of the provided documentation and data.

The customer repaired several leaks in the compressed air system, totaling 534 cfm, as follows:

Leak Repair Log

TAG	LOCATION	DESCRIPTION	SIZE
TNGA West			
876	nnze00550	air hose leaking blue	L
295	nndm00081	elbow leaking	XL
296	nndm00082	air hose leaking	L
297	TNGA	air hose on small crane	M
298	TNGA-check cell 6 beside wheel	air switch on backside	L
299	TNGA-check cell 6 beside wheel	air switch check on	M
130	nnze00549	air hose blue	L
131	final	air the crane	M
2R Casting Line			
165	2R L8CA01	Holding Furnace	XL
166	nndm00035	Hand air line	M
167	nndm00029	Hand air line	L
168	L8DR02	D-fin Hand air line	XL
169	nndm00032	Hand air line	M
870	old zero shot blast	elbow on top	S
871	2R West Final	air line by step	M
872	2R West Final by AGV	hose reel	M
2GR CH Finishing			
873	2GR CH Finishing	hose reel left side	L
874	bze-0237 Left Side	1" reg bowl CKD	L
875	Station #2	hose	L
2R East Finish			
160	2R East	Air Hose	L
161	2R East	Push Fitting	L

TAG	LOCATION	DESCRIPTION	SIZE
162	HP Machine #4	Reg BZI1048	L
163	HP Machine #4	Oiler by Trim Press	L
164	HP Machine #3	Air Hose on Hoist insp. Table	L
Line #5			
983	TV#10	Fitting	M
984	nndm00094	Air hoist	M
985	nndm00093	Air hoist check on it	L
GR Machine 1			
140	Work Bench	1/2" filter regulator	L
141	Waste Water	1/4" small fitting	M
142	Waste Water	1/4" shut off	L
143	Sand Rec	AL5000-10	L
144	Sand Rec	Push Fitting 1/4" 90	S
145	Sand Rec	BSX00-40 1/4" Hose	M
146	Sand Rec	Dynamic Air Valve seal leak	XL
147	GR Machine 1	Air Line in the floor	L
Line #1-#2			
148	bm0059 furnace area GR	3/8" airline has hole in it	L
149	L1CA02	1" regulator	L
120	nndm00010 furnace area GR	1/4" airline fitting	S
121	nndm00011 furnace area GR	air line leak	L
122	nndm00021 furnace area GR	hole in air line	XL
123	nndm00022 furnace area GR	fitting leaking	L
180	D-fin Robot #3	air line	L
181	D-fin Robot #2	air line	L
182	D-fin Robot #1	air fitting house	L
183	nncm00022	1" SMC Reg Coupler	M
184	nncm00014	Regulator	S
185	nncm00010	Coupler Leaking	M
186	nncm00012	Coupler Leaking	M
187	B-10 heat treat BFT-0005	Coupler Leaking	L
188	under L2CA09	unknown	L
189	under L2CA05	unknown	L
990	under nndm00064	unknown	XL

TAG	LOCATION	DESCRIPTION	SIZE
991	under nndm00068	user air line	M
992	nndm00071	air hoist	L
993	C3-D3 col on the rail GR Dye Maint	coupler ice blaster	L
994	BF11-90 heat treat by GR D-M	1/4" quick coupler	S
Cabinet Cabler by E2-Cul			
995	nnze-00262 shot blast	on hand air gun	M
996	nnze-00262 shot blast on back side	large hose	L
Line 3 - GR Kia			
997	on machine nncm00017	hose reel bad back side	XL
998	nncm00016	on top of machine unknown	M
999	nncm00016	af60-10d need filter bowl	S
124	nncm00016	needs gasket	M
125	nncm00016	fixed	L
170	L35h05	air hose on air gun	XL
171	Machine #5	air hose on air gun	XL
172	L3CA04	air line 1/2"	M
173	L3CA06	air line 1/2"	M
174	L3CA06	side of furnace	M
175	L3-9	fitting crack	M
176	L3CA05	AF60-10 need filter bowl	XL
177	L4Thu05	needs tighten left side	M
Line 4 - UR - AR			
178	L45h04	hole in hose right side	M
179	L4hF06	quick coupler	S
190	L4thu06	need gasket	L
191	L4Sh02	leak around plug	M
192	bze-0316 marking device	needs o-ring	L
193	bze-0316 marking device	air gun	M
194	L4Ca10	air hose of gun	M
195	L45Sh04	push fitting leak	M
196	L4Ca01	air hose for air gun	L

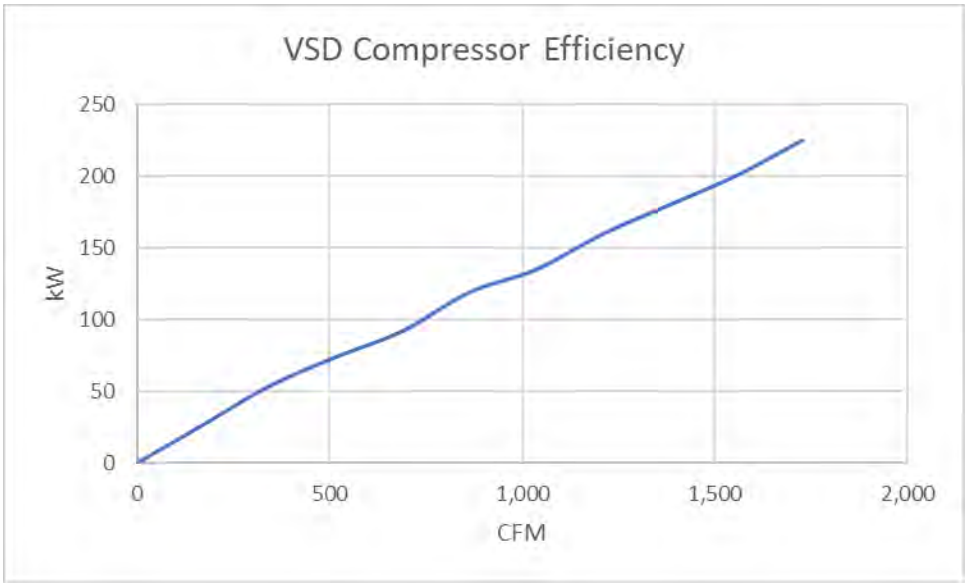
Correcting these leaks reduced the load on the compressors, resulting in less energy consumption. ADM reviewed all project documentation, including the “Compressed Air Study” provided by the contractor, and obtained the baseline monitoring data referenced in the study. The monitoring data totaled seven days in 20 second intervals. Variables monitored included: current (amperage) and

pressure (psi). Nine air compressors in two groups are used to meet the air demand. Compressors 6 through 9 are base loaded while compressors 1 through 5 are trim. Within the trim group, a 300 horsepower VSD compressor 4 is operated as trim to meet the variable demand while compressors 1 through 3 and compressor 5 are base loaded.

Analysis Results

Compressed Air Leak Repair Savings Calculations

ADM estimated energy savings using the facility's compressed air load profile derived from baseline monitoring data. Because the VSD compressor's operation is varied to meet load, the savings result from reduced load on this compressor. The kW at each monitoring point was determined using the amperage data. The CFM at each monitoring point was then determined using the kW data and the Uniform Methods Project standard air compressor curve. Using the full load compressor power and flow, the following compressor efficiency curve of kW vs CFM was used to calculate the baseline compressor power:



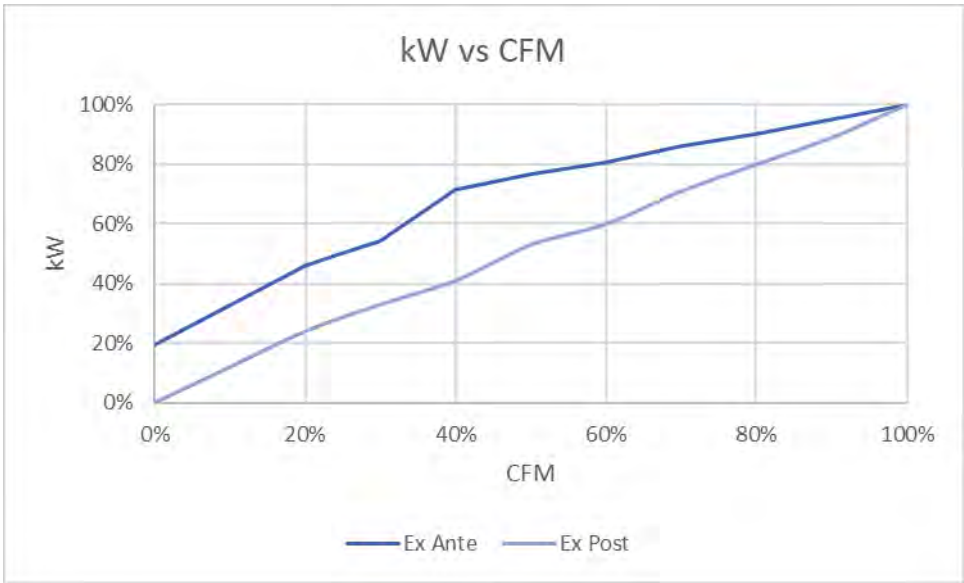
The compressor efficiency curve was used to calculate the new load (kW) values for decreasing the post implementation load by the 534 CFM in leaks repaired. This "new" load profile represented the decreased demand as a result of repaired leaks.

Energy savings were calculated by taking the difference in energy requirements of baseline and post-RCx compressed air systems, at each monitoring point, summing over the monitoring period, and scaling to an annual basis. This method assumes the monitoring period represented a typical demand profile at the facility.

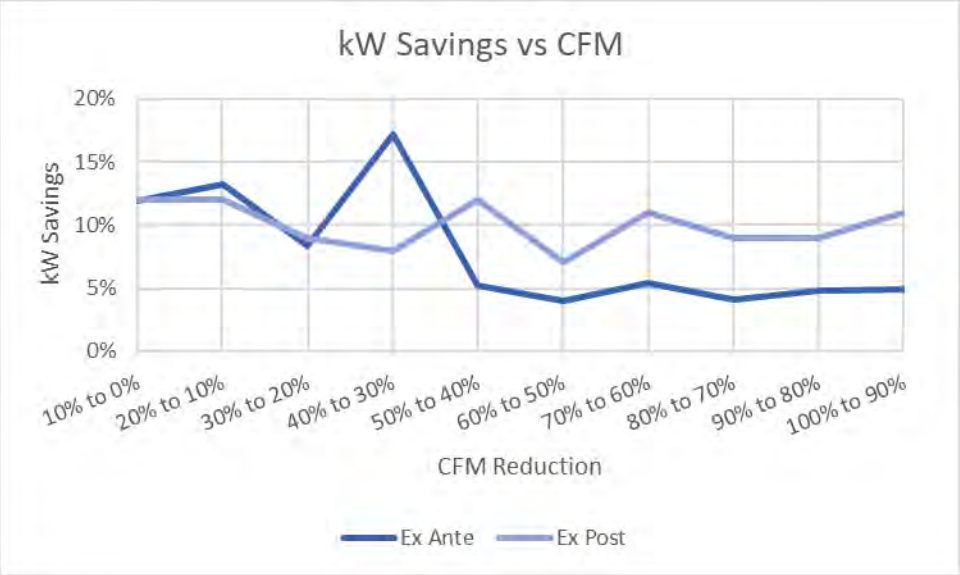
The site-level realization rate is 119%. This is primarily due to the ex ante calculating savings for 529 CFM of leaks as opposed to the ex post calculating savings for 534 CFM of leaks. The ex post CFM leak calculations were derived from the CFM leak repair log and average of the system pressure. The ex ante CFM leak calculations were not provided, thus not appreciable differences can be inferred.

In addition, the ex ante analysis included all the base loaded trim compressors in the savings calculations. The ex post only calculates savings using the VSD trim compressor because the base

loaded compressors are run fully loaded and are not affected by the leak repair. Using the entire group of compressors to calculate the savings results in a lower efficiency curve as seen below:



Using the ex ante analysis' lower efficiency curve, created from all the trim group compressors, to estimate savings decreased the potential savings compared to the ex post efficiency curve of only the VSD compressor. Approximate savings from reducing the CFM by 10% at various points in the ex ante and ex post curves are summarized below:



Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Retro-Commissioning	Compressed Air	425,871	507,695	119%	70.03
Total		425,871	507,695	119%	70.03

Site ID 6371

Data Collection

The participant received Retro-Commissioning (RCx) Program incentives from Ameren Missouri for scheduling improvements, programming of temperature reset schedule based on OA, installing of new VFDs, and converting some roof top units to DDC with VAV boxes.

During the M&V visit, ADM staff verified the optimization of building automation system (BAS) setpoints and interviewed site personnel regarding equipment operation. Data from the BAS were collected where possible. ADM also gathered temperature setpoint programming, meter locations and what buildings they serve, and HVAC equipment nameplate data.

Analysis Results

BAS Optimization Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A monthly pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against monthly billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Cooling and heating degree days (CDD & HDD) were calculated for each billing day and used with a pre/post binary flag and weekends variable in an electric usage regression resulting in an R^2 of 0.832 and adjusted R^2 of 0.830. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh/Day = 21{,}600 - 5{,}625 \times Weekends + 472.8 \times CDD + 291.6 \times HDD - 7{,}356 \times PrePost$$

$$kWh_{monthly} = kWh/Day \times Days$$

Where:

kWh/Day	= Daily Average kWh for Each Day in the Billing Period
$kWh_{monthly}$	= Monthly kWh Consumption
Days	= Number of Days for the Month
Weekends	= Number of Weekend Days for the Month
CDD	= Cooling Degree Days for the Month with a Base Temperature of 43.3°F
HDD	= Heating Degree Days for the Month with a Base Temperature of 73.0°F
PrePost	= Pre/Post-Retrofit Binary Flag

The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	*T Stat*
Intercept	36.13
Weekend	-22.91
CDD	26.48
HDD	18.84
PrePost	-16.23

Electric energy usage values were calculated on a monthly basis using the derived regression equation. The following plot compares the monthly billed kWh to the regressed kWh:

Billed vs. Regressed Monthly kWh

Annual kWh savings for the installed measures were determined by using typical year (TMY3) weather data and the derived equation to calculate monthly pre/post energy consumption of the site. Each month was summed for a year to obtain annual energy savings. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility, and can be seen in the following table:

Monthly kWh Savings

Month	*Days*	*Weekend*	*CDD*	*HDD*	*kWh*		
					Baseline	*As-Built*	*Savings*
Jan	31	8	42	1,363	1,042,036	814,002	228,033
Feb	28	8	68	1,067	903,374	697,409	205,966
Mar	31	10	284	734	961,724	733,691	228,033
Apr	30	8	450	484	956,917	736,240	220,677

Month	Days	Weekend	CDD	HDD	kWh		
					Baseline	As-Built	Savings
May	31	8	650	301	1,019,800	791,767	228,033
Jun	30	10	1,007	60	1,085,201	864,524	220,677
Jul	31	8	1,165	20	1,181,400	953,366	228,033
Aug	31	9	1,063	34	1,131,746	903,713	228,033
Sep	30	9	806	154	1,023,609	802,932	220,677
Oct	31	8	389	556	970,332	742,299	228,033
Nov	30	9	159	852	921,135	700,457	220,677
Dec	31	9	19	1,290	1,003,899	775,865	228,033
Total					12,201,173	9,516,264	2,684,909

The total billing regression energy savings were used to determine measure level savings. Measure level savings are shown in the following table:

RCx Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
115920 – HVAC Optimization – Cooling	1169	Cooling	RCx	1,764,840	1,579,684	90%
113220 – HVAC Optimization – HVAC	1169	HVAC	RCx	1,234,770	1,105,225	90%
Total				2,999,6410	2,684,909	90%

There were significant differences in the ex ante and ex post analysis methodologies for the RCx measures, with a realization rate of 90%. The ex ante analysis for the HVAC optimization measures used bin analyses with assumed occupancy schedules, fan speeds, recovered loads, and HVAC loads. All these assumptions created significant uncertainty with the ex ante savings estimates. The ex ante analysis didn't use any site-specific trending or utility data. ADM used a billing regression with a good fit (R Square = 0.831) to determine realized energy savings. This method better accounts for actual site HVAC energy usage than the ex ante calculations.

The verified annual site-level energy savings are 2,684,909 kWh, resulting in an 90% realization rate.

A table showing the energy savings achieved by the measures evaluated for this site is shown below:

Site-Level Energy Savings

Incentive	End Use Category	kWh Savings			Gross Ex Post kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Retro - Commissioning	Cooling	1,764,840	1,579,684	90%	1,438.59
	HVAC	1,234,770	1,105,225	90%	490.70
Total		2,999,6410	2,684,909	90%	1,929.29

Site ID 6374

Data Collection

The participant received EMS Program incentives from Ameren Missouri.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered HVAC equipment nameplate information.

Analysis Results

EMS Controls Savings Calculations

Energy savings for the EMS controls were calculated using prototypical energy simulation. ADM used a DEER prototypical eQuest model of a school. The model's HVAC system was auto-sized during a sizing run with local weather data. Using project documents and the details collected during the on-site M&V visit, heating, cooling, and fan schedules were created for the baseline and as-built models. ADM ran parametric simulations to determine the prototypical annual energy usage of the model with EMS fan schedule changes. The realized energy savings are the differences between the parametric simulations' energy usages. The energy savings by end use can be seen in the following tables for each of the schedule change types:

Prototypical Annual Energy Usage (kWh) by End Use - (5AM to 11PM Schedule)

End Use	*Baseline (kWh)*	*As-Built (kWh)*	*Savings (kWh)*
Space Cool	121,540	103,540	18,000
Heat Reject.	0	0	0
Space Heat	0	0	0
Vent. Fans	93,700	62,910	30,790
Pumps & Aux.	2,360	2,370	-10
Misc. Equip.	113,200	113,200	0
Area Lights	166,490	166,490	0
Total	497,280	448,510	48,770

Prototypical Annual Energy Usage (kWh) by End Use - (12AM to 11PM Schedule)

End Use	*Baseline (kWh)*	*As-Built (kWh)*	*Savings (kWh)*
Space Cool	125,610	103,540	22,070
Heat Reject.	0	0	0
Space Heat	0	0	0
Vent. Fans	101,830	62,910	38,920
Pumps & Aux.	2,350	2,370	-20
Misc. Equip.	113,200	113,200	0
Area Lights	166,490	166,490	0
Total	509,480	448,510	60,970

The prototypical annual energy savings were normalized to HVAC cooling tonnage. Since there were two different fan schedules used in the baseline control system, a weighted average was taken of the modeled energy use for each baseline schedule type and using the respective HVAC cooling tonnages as the weighting factor. The difference between this weighted average baseline energy use (shown above), and the as-built modeled energy use is the modeled energy savings. These savings were divided by the modeled HVAC tonnage, and these normalized kWh/ton savings were multiplied by the actual site total HVAC tonnage to determine site savings.

The following table presents information on prototypical and actual equipment and expected and realized energy savings for the EMS controls installed at the site:

EMS Controls Savings

Program	*Measure*	*HVAC Tonnage*		*EMS Controls Savings*		*Realized kWh Savings*
		Prototypical	*Actual*	*Prototypical kWh*	*Normalized kWh/ton*	
EMS	Fan Scheduling	111.0	262	60,970	549	143,666
Total						143,666

Measure level savings are shown in the following table:

Custom and EMS Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
117920-EMS-Cooling Existing System	1169	Cooling	EMS	79,992	45,074	56%
118220-EMS-HVAC Existing System	1169	HVAC	EMS	46,979	77,958	166%
Total				126,971	123,032	97%

There were significant differences in the ex ante and ex post analyses for the EMS controls, with a realization rate of 97%. Since ex ante savings were only claimed for cooling and fan energy use savings, ADM modified thermostat schedules to be consistent with provided schedules used in ex ante calculations. Then, two parametric runs were performed to isolate savings associated with changing fan operation schedules from either of the two baseline scenarios to the as-built fan schedule.

The ex ante analysis that was provided relied upon bin calculations to determine the number of hours in each temperature bin during which the building was occupied for the baseline and as-built scenarios. ADM could not verify the source of this weather data. The ex ante analysis relied upon assumptions regarding the thermostat setpoints and design outdoor air temperature to calculate HVAC load adjustment factors for occupied and unoccupied hours. Additionally, the analysis assumed a linear relationship between outdoor air temperature and HVAC load although this is not realistic. Further, the analysis assumed that no cooling would occur at temperatures under 62 degrees Fahrenheit. These assumptions introduced uncertainty into the ex ante analysis, and account for the difference between ex ante and ex post savings values.

ADM's use of a prototypical model isolated savings for cooling and ventilation changes based on the modified thermostat and fan availability schedules. The measure-level realization rates for this project vary significantly due to the ex ante analysis using an unspecified allocation rate for cooling and ventilation savings values.

Verified annual savings for the EMS Program incentives are 123,032 kWh, resulting in a realization rate of 97%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	79,992	45,074	56%	41.05
	HVAC	46,979	77,958	166%	34.61
Total		126,971	123,032	97%	75.66

Site ID 6375

Data Collection

The participant received EMS Program incentives from Ameren Missouri.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered HVAC equipment nameplate information.

Analysis Results

EMS Controls Savings Calculations

Energy savings for the EMS controls were calculated using prototypical energy simulation. ADM used a DEER prototypical eQuest model of a school. The model's HVAC system was auto-sized during a sizing run with local weather data. Using project documents and the details collected during the on-site M&V visit, heating, cooling, and fan schedules were created for the baseline and as-built models. ADM ran parametric simulations to determine the prototypical annual energy usage of the model with EMS fan schedule and thermostat setpoint changes. The realized energy savings are the differences between the parametric simulations' energy usages, and the energy savings by end use can be seen in the following table:

Prototypical Annual Energy Usage (kWh) by End Use

End Use	*Baseline (kWh)*	*As-Built (kWh)*	*Savings (kWh)*
Space Cool	189,030	180,760	8,270
Heat Reject.	0	0	0
Space Heat	0	0	0
Vent. Fans	146,840	112,520	34,320
Pumps & Aux.	2,300	2,310	-10
Misc. Equip.	113,200	113,200	0
Area Lights	166,490	166,490	0
Total	617,860	575,280	42,580

The prototypical annual energy savings were normalized to HVAC cooling tonnage. This was done by dividing the difference in baseline and as-built modeled savings by the modeled HVAC tonnage. This normalized kWh/ton savings value was multiplied by the actual site total HVAC tonnage to determine site savings.

The following table presents information on prototypical and actual equipment and expected and realized energy savings for the EMS controls installed at the site:

EMS Controls Savings

Program	Measure	HVAC Tonnage		EMS Controls Savings		Realized kWh Savings
		Prototypical	Actual	Prototypical kWh	Normalized kWh/ton	
EMS	Fan Scheduling	100	116	42,580	383	44,331
Total						44,331

Measure level savings are shown in the following table:

Custom and EMS Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
117920-EMS-Cooling Existing System	1169	Cooling	EMS	28,134	8,600	31%
118220-EMS-HVAC Existing System	1169	Ventilation	EMS	16,523	35,731	216%
Total				44,657	44,331	99%

There were significant differences in the ex ante and ex post analysis methods for the EMS controls, with a realization rate of 99%. Since ex ante savings were claimed for cooling and fan energy use savings, ADM modified thermostat and fan availability schedules between the baseline and as-built models. Two parametric runs were performed to isolate savings associated with ventilation fans, and savings associated with cooling energy reduction.

The ex ante analysis that was provided relied upon bin calculations to determine the number of hours in each temperature bin during which the building was occupied for the baseline and as-built scenarios. ADM could not verify the source of this weather data. Additionally, ex ante calculations relied upon methodology that resulted in the unoccupied HVAC load being only 47% of the occupied HVAC load. This is an unrealistic reduction in cooling energy demand and assumes that the HVAC load will be reduced by the same factor for every outdoor air temperature. In reality, at greater outdoor air temperatures the HVAC load will not vary significantly whether the building is occupied or not. This is due to the heat gain from high outdoor air temperatures being much greater than the reduced interior loads during unoccupied hours. Consequently, a constant 47% energy reduction overestimates cooling energy savings.

Further, the ex ante bin calculations didn't account for the ventilation fan energy savings and the total savings were simply allocated between cooling and fan savings. The source of these allocation rates could not be verified. ADM's modeling of fan schedule changes showed that the reduced hours of use resulted in the greatest source of energy savings for this project, whereas the cooling setback changes accounted for a much smaller portion of savings than expected.

Verified annual savings for the EMS Program incentives are 44,331 kWh, resulting in a realization rate of 99%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
EMS	Cooling	28,134	8,600	31%	7.8
	Ventilation	16,523	35,731	216%	15.9
Total		44,657	44,331	99%	23.7

Site ID 6376

Data Collection

The participant received EMS Program incentives from Ameren Missouri.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered HVAC equipment nameplate information.

Analysis Results

EMS Controls Savings Calculations

Energy savings for the EMS controls were calculated using prototypical energy simulation. ADM used a DEER prototypical eQuest model of a school. The model's HVAC system was auto-sized during a sizing run with local weather data. Using project documents and the details collected during the on-site M&V visit, heating, cooling, and fan schedules were created for the baseline and as-built models. ADM ran parametric simulations to determine the prototypical annual energy usage of the model with EMS fan schedule and thermostat setpoint changes. The realized energy savings are the differences between the parametric simulations' energy usages, and the energy savings by end use can be seen in the following table:

Prototypical Annual Energy Usage (kWh) by End Use

End Use	*Baseline (kWh)*	*As-Built (kWh)*	*Savings (kWh)*
Space Cool	111,390	89,800	21,590
Heat Reject.	0	0	0
Space Heat	0	0	0
Vent. Fans	104,160	50,240	53,920
Pumps & Aux.	2,390	2,390	0
Misc. Equip.	113,200	113,200	0
Area Lights	166,490	166,490	0
Total	497,620	422,120	75,500

The prototypical annual energy savings were normalized to HVAC cooling tonnage. This was done by dividing the difference in baseline and as-built modeled savings by the modeled HVAC tonnage. This normalized kWh/ton savings value was multiplied by the actual site total HVAC tonnage to determine site savings.

The following table presents information on prototypical and actual equipment and expected and realized energy savings for the EMS controls installed at the site:

EMS Controls Savings

Program	Measure	HVAC Tonnage		EMS Controls Savings		Realized kWh Savings
		Prototypical	Actual	Prototypical kWh	Normalized kWh/ton	
EMS	Fan Scheduling	111	177	21,590	194	34,394
Total						34,394

Measure level savings are shown in the following table:

Custom and EMS Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
117920-HVAC-Cooling Replacing Existing System	1169	Cooling	EMS	35,170	34,378	98%
Total				35,170	34,378	98%

There were significant differences in the ex ante and ex post analysis methods for the EMS controls, with a realization rate of 98%. Since ex ante savings were only claimed for cooling energy use savings, only cooling savings were evaluated for this project. ADM modified fan availability schedules between the baseline and as-built models and parametric runs were performed to isolate savings associated with cooling energy reduction. The difference in savings is due to the ex ante bin calculations assuming a constant 47% HVAC load reduction during unoccupied hours for all outdoor air temperatures while the ex post used eQuest to determine the load reduction.

Additionally, it was determined via the EMS online portal that the occupancy schedules were reduced from 17 hours to 9 hours per weekday, however the schedules weren't modified during unoccupied periods such as during the summer. Consequently, the same weekly schedule was used all year in the energy model without any unoccupied periods.

Verified annual savings for the EMS Program incentives are 34,378 kWh, resulting in a realization rate of 98%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	End Use Category	kWh Savings			Gross Ex Post kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
EMS	Cooling	35,170	34,378	98%	31.3
Total		35,170	34,378	98%	31.3

Site ID 6378

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed nine photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 12/20/18 and 2/20/19.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
201316-Lighting-LED Electroluminescent Replac IncaExitSign	793	Lighting	Standard	13	13	30	2	8,760	1.07	3,412	3,419	100%
201317-Lighting-LED Electroluminescent Replac CFLExitSign	8001			31	31	9	2	8,760	1.07	2,034	2,038	100%
301132-Lighting-LED 7-20 W Lamp ReplacHalogen A 53-70 W Lamp	3009			7	7	72	13	793	1.07	334	351	105%
				7	7	72	13	4,027	1.07	1,563	1,783	114%
				16	16	72	13	4,213	1.07	3,056	4,264	140%
				2	2	72	13	4,213	1.07	509	533	105%
201111-Lighting-LED <=11 Watt Lamp Replacing Halogen A 28-52WLamp	3011			4	4	43	7	793	1.07	117	122	105%
100216-Lighting-Non Linear LED Fixt Replac Existing Inefficient Light Fixture	1169		Custom	374	374	65	19	8,760	1.07	161,148	161,229	100%
				40	40	58	25	6,217	1.07	9,333	8,799	94%
				1,908	1,908	78	21	3,084	1.07	483,220	359,583	74%
				108	108	87	19	4,213	1.07	35,083	32,978	94%
				1,560	1,560	96	24	2,233	1.07	320,766	269,617	84%
Total										1,020,575	844,717	83%

The annual lighting hours of operation verified during the M&V site visit for the first, second, and eighth line items in the table above (8,760) correspond the annual hours of operation used to calculate ex ante savings. The annual hours for the third through seventh line items (ranging from 794 to 4,213) are greater than the hours used for the ex ante estimate (ranging from 783 to 4,176). The remaining measure had hours (ranging from 2,233 to 6,217) which were less than the ex ante hours (ranging from 2,672 to 6,588).

An adjusted base wattage of 72W was used in the ex post savings analysis for the third through sixth line items above and 43W for the seventh line to meet the EISA 2007 standard lumen equivalent for a 100W and 60W incandescent lamp. The ex ante base wattage of 70W and 42W was computed within the application by factoring 70% of a 100W and 60W incandescent lamp.

A heating and cooling interactive factor of 1.07, applicable to a gas heated, air conditioned hospital in St. Louis, was applied to the ex post lighting energy savings and corresponds with the ex ante savings estimate.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[312]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 83%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 89% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	11,025	12,511	113%	2.38
Custom		1,009,550	832,206	82%	158.09
Total		1,020,575	844,717	83%	160.47

[312] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6380

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed twenty-three photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 1/16/2019 and 2/13/2019.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
301132-Lighting-LED 7-20 Watt Lamp Repla Halogen A 53-70WLamp	3009	Lighting	Standard	-	-	-	-	-	-	273	-	0%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replac T12 <=40 Watt Linear ft	3026			8	8	40	18	1,725	1.09	443	331	75%
301132-Lighting-LED 7-20 Watt Lamp Repla Halogen A 53-70WLamp	3009			3	3	70	8	2,088	1.09	482	427	89%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replac T12 <40W Linear ft	3026			168	168	40	18	3,269	1.09	9,333	13,182	141%
301132-Lighting-LED 7-20 W Lamp Replac Halogen A 53-70 Watt Lamp	3009			2	2	72	15	3,038	1.09	129	378	293%
305233-Lighting-85-225W Lamp Fixture Replac Interior HID 301-500W Lamp Fixture	3005-1			3	3	350	100	278	1.09	1,926	227	12%
201111-Lighting-LED <=11 W Lamp ReplaHalogen A 28-52WLamp	3011			8	8	43	10	1,526	1.09	334	446	134%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8	3025			120	120	32	18	2,127	1.09	4,242	3,898	92%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
32 Watt Linear ft												
305801-Lighting Delamping ReplT12<=40W	3084			8	-	40	-	1,725	1.09	809	602	74%
305802-Lighting Delamping Repla T8 32 W				120	-	32	-	2,127	1.09	9,697	8,910	92%
306143-Lighting LED Lamp Fixt Replacing T8 Lamp Fixture	3025			12	12	114	36	3,038	1.09	2,645	3,102	117%
306140-Lighting-LED Lamp Fixture Replac Interior HID Lamp Fixt	3004-1			24	24	349	100	3,038	1.09	14,995	19,804	132%
306142-Lighting-LED Lamp Fixture Replacing T12 Lamp Fixture	3026			3	3	164	72	1,526	1.09	398	459	115%
306143-Lighting-LED Lamp Fixture Replacing T8 Lamp oFixture	3025			1	1	88	16	1,526	1.09	77	120	156%
				17	17	114	36	3,038	1.09	1,814	4,394	242%
306142-Lighting-LED Lamp Fixture Replacing T12 Lamp Fixture	3026			2	2	82	36	1,526	1.09	133	153	115%
306143-Lighting-LED Lamp Fixture Replacing T8 Lamp Fixture	3025			3	3	59	40	1,651	1.09	535	103	19%
				3	3	56	14	3,401	1.09	242	467	193%
				10	10	56	42	591	1.09	270	90	33%
				4	4	56	22	3,401	1.09	262	505	193%
100212-Lighting-Non Linear LED Fixture Replac Incan/Halogen Lamp Fixture	1169		Custom	4	7	94.5	18	1,616	1.09	2,395	450	19%
306143-Lighting-LED Lamp Fixture Replacing T8 Lamp Fixture	3025			10	10	114	36	3,038	1.09	2,204	2,585	117%
				10	10	114	36	1,725	1.09	1,836	1,468	80%
				1	1	114	36	9	1.09	91	1	1%
306142-Lighting-LED Lamp Fixture Replacing T12 Lamp Fixture	3026			10	10	82	36	2,477	1.09	541	1,243	230%
				4	4	164	72	707	1.09	433	284	66%
			Standard	4	4	82	36	707	1.09	217	142	65%
				6	6	164	72	3,038	1.09	945	1,829	194%
				20	20	164	72	591	1.09	819	1,187	145%
306143-Lighting-LED Lamp Fixture Replacing T8 Lamp Fixture	3025			14	14	114	36	1,028	1.09	584	1,225	210%
				5	5	114	36	1,725	1.09	459	734	160%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
306142-Lighting-LED Lamp Fixture Replacing T12 Lamp Fixture	3026			11	11	164	72	591	1.09	450	653	145%
Total										60,013	69,399	116%

The annual lighting hours of operation verified during the M&V site visit for the second, third, sixth, eighth, ninth, tenth, seventeenth, nineteenth, twenty-first, twenty-third, twenty-fourth, twenty-sixth, and twenty-seventh line items (ranging from 9 to 2,127) are less than the annual hours of operation used to calculate ex ante savings (ranging from 1,100 to 8,760). The verified hours for the remaining line items (ranging from 591 to 3,401) are greater than those used to calculate ex ante savings (ranging from 416 to 2,640).

Adjusted base wattages of 72W, 43W, and 94.5W were used for the fifth, seventh, and twenty-first line items in the above table, respectively, to meet the EISA 2007 standard lumen equivalents for 100W, 60W, and 135W incandescent lamps, respectively. The ex ante savings estimate used adjusted base wattages of 70W, 42W, and 94.5W by multiplying the provided wattage by 70%.

The quantity of the first line item in the above table (0) verified during the M&V site visit is less than the ex ante savings quantity (4). The plastic lamps were damaged by the stove they were installed above and were quickly replaced by 4 glass 100W incandescent A-line lamps.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned education based facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[313]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 116%. The ex ante energy savings estimate was premised upon underestimated annual hours of operation for 58% of the installed measures and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	End Use Category	kWh Savings			Gross Ex Post kW Reduction
		Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross Realization Rate	
Standard	Lighting	57,618	68,949	120%	13.10
Custom		2,395	450	19%	0.09
Total		60,013	69,399	116%	13.18

[313] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6381

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed twenty-two photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 1/8/2019 and 1/28/2018.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
305401-LightingLinearftLED<5.5Watts/ftReplacT12<40WLinearft	3026	Lighting	Standard	132	132	40	10	4,420	1.09	14,830	19,164	129%
305402-LightingLinearftLED<=5.5Watts/ftReplacT832W Linear ft	3025			2	2	32	13	3,252	1.09	142	135	95%
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026			5	5	82	26	5,252	1.09	1,049	1,610	153%
				40	40	82	32	4,870	1.09	7,490	10,664	142%
				236	236	82	30	3,421	1.09	40,968	45,963	112%
				10	10	82	24	2,069	1.09	1,936	1,314	68%
				2	2	56	18	1,851	1.09	254	154	61%
				1	1	64	34	101	1.09	83	3	4%
306140-Lighting-LED Lamp Fixt Replacing Interior HID Lamp Fixt	3004-1			6	6	210	30	5,252	1.09	10,123	6,211	61%
306142-Lighting-LED Lamp Fixt Replac T12 Lamp Fixt	3026			2	2	46	12	2,787	1.09	189	208	110%
				88	88	48	12	8,760	1.09	8,813	30,385	345%
				256	256	64	30	2,693	1.09	24,214	25,667	106%
301037-Lighting-LED <=20 WLamp Fixt Replac Halogen A >=40 Watt Lamp Fixt	3011			33	33	53	9	3,751	1.09	3,994	5,964	149%
306142-Lighting-LED Lamp Fixt Replac T12 Lamp Fixt	3026			1	1	28	9	2,787	1.09	54	58	107%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
300938-Lighting-LED <=14W Lamp Fixt Replac HalogenBRR Lamp Fixt	3007			65	65	75	8	1,791	1.09	12,116	8,541	70%
200808-Lighting-LED <=13W Lamp ReplHalogen MR163550W Lamp Fixt	3012			12	12	50	12	2,787	1.09	1,269	1,392	110%
306135-Lighting-LED Lamp Fixt Replac T5 Lamp Fixt	3088			6	6	50	24	2,512	1.09	521	429	82%
301039-Lighting-LED <=20WLamp Fixt Replac HalogenPAR Lamp Fixt	3008			33	33	63	14	5,252	1.09	5,399	9,299	172%
306142-Lighting-LED Lamp Fixt Replac T12 Lamp Fixt	3026			9	9	82	24	992	1.09	1,743	567	33%
				111	111	82	30	2,365	1.09	19,269	14,947	78%
				4	4	82	17	2,787	1.09	868	793	91%
300938-Lighting-LED <=14W Lamp Fixt Replac HalogenBRR Lamp Fixt	3007			8	8	75	9	3,252	1.09	1,762	1,880	107%
306142-Lighting-LED Lamp Fixt Replaci T12 Lamp Fixt	3026			2	2	56	9	2,787	1.09	314	287	91%
301037-Lighting-LED <=20W Lamp Fixt Replac Halogen A >=40 Watt Lamp Fixt	3011			16	16	53	9	2,364	1.09	2,324	1,822	78%
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	3026			263	263	82	30	1,514	1.09	45,656	22,665	50%
				15	15	46	12	1,780	1.09	1,702	994	58%
				1	1	56	9	2,512	1.09	157	129	82%
				6	6	82	24	992	1.09	1,162	378	33%
				34	34	48	12	1,866	1.09	4,086	2,501	61%
				4	4	28	9	4,870	1.09	254	405	160%
				4	4	82	17	2,787	1.09	868	793	91%
301039-Lighting-LED <=20W Lamp Fixt Replac HalogenPAR Lamp Fixt	3008			23	23	63	14	3,252	1.09	3,762	4,012	107%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
300938-Lighting-LED <=14W Lamp Fixt Replac HalogenBRR Lamp Fixt	3007			7	7	75	9	1,941	1.09	1,542	982	64%
301039-Lighting-LED <=20W Lamp Fixt Replac HalogenPAR Lamp Fixt	3008			16	16	53	12	2,097	1.09	2,163	1,506	70%
301037-Lighting-LED <=20W Lamp Fixt Replac Halogen A >=40 Watt Lamp Fixt	3011			23	23	53	9	5,202	1.09	3,340	5,764	173%
306142-Lighting-LED Lamp Fixt Replac T12 Lamp Fixt	3026			337	337	64	30	2,767	1.09	38,251	34,706	91%
300938-Lighting-LED <=14W Lamp Fixt Replac HalogenBRR Lamp Fixt	3007			58	58	75	12	2,097	1.09	12,198	8,391	69%
301039-Lighting-LED <=20W Lamp Fixt Replac HalogenPAR Lamp Fixt	3008			15	15	63	14	3,252	1.09	2,454	2,617	107%
306142-Lighting-LED Lamp Fixt Replac T12 Lamp Fixt	3026			4	4	64	17	2,787	1.09	628	574	91%
				1	1	56	9	2,787	1.09	157	143	91%
				282	282	82	30	2,447	1.09	48,955	39,289	80%
				6	6	82	17	2,787	1.09	1,302	1,190	91%
300938-Lighting-LED <=14W Lamp Fixt Replac HalogenBRR Lamp Fixt	3007			2	2	60	7	84	1.09	354	10	3%
301037-Lighting-LED <=20W Lamp Fixt Replac Halogen A >=40 Watt Lamp Fixt	3011			3	3	43	9	5,252	1.09	331	587	177%
306142-Lighting-LED Lamp Fixt Replacing T12 Lamp or Fixture	3026			2	2	82	24	2,787	1.09	387	354	91%
				334	334	82	30	3,678	1.09	57,982	69,950	121%
				6	6	82	24	992	1.09	1,162	378	33%
				4	4	82	17	2,787	1.09	868	793	91%
				1	1	56	9	2,787	1.09	157	143	91%
Total										389,602	386,712	99%

The annual lighting hours of operation verified during the M&V site visit for the first, third through fifth, tenth through fourteenth, sixteenth, eighteenth, twenty-second, thirtieth, thirty-second, thirty-fifth, thirty-eighth, forty-fourth, and forty-sixth line items in the above table (ranging from 2,787 to 8,760) are greater than the annual hours of operation used to calculate ex ante savings (ranging from 2,600 to 3,500). The remaining measures have the verified hours for the remaining line items (ranging from 101 to 5,252) fewer than those used to calculate ex ante savings (ranging from 2,600 to 8,760).

The ex ante savings estimate used adjusted base wattages of 52.5W for the thirteenth, twenty-fourth, thirty-fourth and thirty sixth line items in the above table, 63W for the eighteenth, thirty-second, and thirty-eighth line items, and 42W for the forty-fourth line item by multiplying the provided wattage by 70%. Adjusted base wattages of 53W and 43W were used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalents for 75W and 60W incandescent lamps, respectively.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned office in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[314]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 99%.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	389,602	386,712	99%	73.46
Total		389,602	386,712	99%	73.46

[314] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6382

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025	Lighting	Standard	41	41	59	15	5,579	1.09	10,617	11,020	104%
				600	600	114	30	5,579	1.09	296,604	307,877	104%
				150	150	114	30	5,579	1.09	74,151	76,969	104%
				175	175	114	60	5,579	1.09	55,613	57,727	104%
				165	165	114	60	5,579	1.09	52,435	54,428	104%
				143	143	59	15	5,579	1.09	37,028	38,436	104%
				900	900	114	30	5,579	1.09	444,906	461,815	104%
				409	409	114	60	5,579	1.09	129,976	134,916	104%
				14	14	114	45	5,579	1.09	5,685	5,901	104%
				150	150	114	30	5,579	1.09	74,151	76,969	104%
				25	25	114	60	5,579	1.09	7,945	8,247	104%
				432	432	114	30	5,579	1.09	213,555	221,671	104%
				177	177	114	60	5,579	1.09	56,249	58,387	104%
				109	109	59	15	5,579	1.09	28,224	29,297	104%
				598	598	114	60	5,579	1.09	190,038	197,261	104%
				496	496	114	30	5,579	1.09	245,193	254,512	104%
				125	125	59	15	5,579	1.09	32,368	33,598	104%
				346	346	114	60	5,579	1.09	109,955	114,134	104%
				600	600	114	30	5,579	1.09	296,604	307,877	104%
				300	300	114	60	5,579	1.09	95,337	98,960	104%
				200	200	59	15	5,579	1.09	51,788	53,756	104%
				400	400	114	45	5,579	1.09	162,426	168,599	104%
				400	400	88	30	5,579	1.09	136,532	141,721	104%
				301	301	59	15	5,579	1.09	77,941	80,903	104%
				99	99	59	30	5,579	1.09	16,896	17,538	104%
Total										2,902,217	3,012,521	104%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours (5,579) exceeded those used to develop the ex ante energy savings estimates (5,500).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned large facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[315]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 104%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours and underestimated heating and cooling interactive effects.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	2,902,217	3,012,521	104%	572.27
Total		2,902,217	3,012,521	104%	572.27

[315] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6383

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed nine photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 01/17/19 and 02/18/19.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp/ Fixture	3025	Lighting	SBDI	31	31	64	28	5,996	1.09	2,388	7,320	307%
306140-Lighting-LED Lamp/Fixture Replacing Interior HID Lamp or Fixture	3004-1			5	5	199	36	5,996	1.09	3,820	5,346	140%
306143-Lighting-LED Lamp/Fixture Replacing T8 Lamp or Fixture	3025			51	51	96	28	8,760	1.09	32,507	33,231	102%
				10	10	128	28	8,760	1.09	9,373	9,582	102%
				41	41	96	28	2,492	1.09	5,966	7,598	127%
306140-Lighting-LED Lamp/Fixture Replacing Interior HID Lamp or Fixture	3004-1			2	2	1,100	380	8,760	1.09	13,497	13,798	102%
306143-Lighting-LED Lamp/Fixture Replacing T8 Lamp or Fixture	3025			25	25	64	28	8,760	1.09	8,436	8,624	102%
				9	12	128	28	2,404	1.09	1,926	2,146	111%
Total										77,913	87,645	112%

The annual lighting hours of operation verified during the M&V site visit for the first, second, fifth, and eighth line items in the table above (5,996, 5,996, 2,492, and 2,404, respectively) are greater than the annual hours of operation used to calculate ex ante savings (2,000, 4,380, 2,000, and 2,000, respectively). The remaining line items match ex ante hours of operation (8,760).

The efficient quantity of the eighth line item in the table above (12) verified during the M&V site visit is greater than the ex ante savings quantity (9).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned office facility in Kirksville, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[316]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 112%. The ex ante energy savings estimate was premised on underestimated annual lighting operating hours for 50% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	77,913	87,645	112%	16.65
Total		77,913	87,645	112%	16.65

[316] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6384

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed thirteen photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 01/10/19 and 02/04/19.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025	Lighting	Standard	127	127	59	28	3,904	1.09	18,451	16,829	91%
				15	15	88	42	1,921	1.09	3,234	1,452	45%
				2	2	114	56	8,760	1.09	544	1,113	205%
				113	113	59	28	8,760	1.09	32,834	33,598	102%
				63	63	114	56	1,988	1.09	17,124	7,955	46%
				96	96	114	56	2,166	1.09	26,095	13,204	51%
				10	10	114	56	8,760	1.09	5,436	5,563	102%
306142-Lighting-LED Fixture Replacing T12 Fixture	3026			71	71	164	56	8,760	1.09	71,873	73,545	102%
				66	66	164	56	4,446	1.09	33,406	34,699	104%
				17	17	82	28	8,760	1.09	8,604	8,805	102%
				38	38	82	28	8,760	1.09	9,617	19,681	205%
				6	6	48	14	1,275	1.09	956	285	30%
				85	85	122	42	4,803	1.09	31,869	35,757	112%
				4	4	122	42	8,760	1.09	2,999	3,069	102%
				4	4	56	18	2,134	1.09	713	355	50%
				6	6	74	24	2,134	1.09	1,406	701	50%
306143-Lighting-LED Fixture Replac T8 Fixture	3025			53	53	23	12	8,760	1.09	5,464	5,592	102%
				2	2	56	30	945	1.09	238	54	23%
306142-Lighting-LED Fixture ReplacT12 Fixture	3026			14	14	82	30	8,760	1.09	6,823	6,982	102%
				4	4	82	30	4,524	1.09	975	1,030	106%
				5	5	138	86	3,508	1.09	2,437	999	41%
306140-Lighting-LEDFixtureReplac Interior HID Fixt	3004-1			5	5	295	100	8,760	1.09	9,139	9,351	102%
200808-Lighting-LED <=13W Lamp Replaci Halogen MR16 3550W Fixt	3012			10	10	50	7	5,046	1.09	4,031	2,376	59%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
100208-Lighting-Non Linear LED Fixture Replacing MH Fixture	1169	Exterior Lighting	Custom	7	7	295	30	4,308	1.00	8,125	7,991	98%
100213-Lighting-Non Linear LED Fixture Replacing CFL Fixture		Lighting		107	107	26	9	5,412	1.09	8,097	10,779	133%
				67	67	26	9	8,760	1.09	10,676	10,924	102%
100208-Lighting-Non Linear LED Fixture Replacing MH Fixture		Exterior Lighting		5	5	128	30	4,308	1.00	4,292	2,111	49%
100213-Lighting-Non Linear LED Fixture Replacing CFL Fixture		Lighting		22	22	26	12	8,760	1.09	2,887	2,954	102%
				2	2	23	11	8,760	1.09	225	230	102%
306143-Lighting-LED Fixture ReplaciT8 Fixture	3025		Standard	49	49	160	96	8,760	1.09	29,394	30,078	102%
201316-Lighting-LED Replacing Incand. Exit Sign	793			9	9	40	2	8,760	1.09	3,205	3,280	102%
				3	3	40	2	8,760	1.09	1,068	1,093	102%
100208-Lighting-Non Linear LED Fixture Replacing MH Fixture	1169	Exterior Lighting	Custom	1	1	215	18	4,308	1.00	863	849	98%
Total										363,100	353,282	97%

The annual lighting hours of operation verified during the M&V site visit for the first, second, fifth, sixth, twelfth, fifteenth, sixteenth, eighteenth, twenty-first, and twenty-third line items in the table above (ranging from 945 - 5,046) are fewer than the annual hours of operation used to calculate ex ante savings (ranging from 4,280 - 8,760). The annual hours for the third, ninth, eleventh, thirteenth, twentieth, and twenty-fifth line items (ranging from 4,446 – 8,760) were greater than the ex ante savings hours (ranging from 4,160 – 4,380). The ex post and ex ante hours corresponded for the fourth, seventh, eighth, tenth, fourteenth, seventeenth, nineteenth, twenty-second, twenty-sixth, and twenty-eighth through the thirty-second line items (8,760). The annual lighting hours of operation for the twenty-fourth, twenty-seventh, and thirty-third line items were exterior fixtures using photo cells (4,308[317]) are less than the hours of operation used to calculate ex ante savings (4,380).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned large office in St. Louis, was applied to the ex post lighting energy savings. A factor of 1.00 was applied for the exterior measures. The ex ante savings estimate accounted for a heating and cooling factor of 1.07, and a factor of 1.00 for exterior measures.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[318]

[317] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[318] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 97%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 32% of the measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	327,935	317,445	97%	60.30
Custom	Lighting	21,885	24,887	114%	4.73
	Exterior Lighting	13,280	10,950	82%	0.06
Total		363,100	353,282	97%	65.09

Site ID 6385

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed twelve photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 1/10/2019 and 2/4/2019.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp/ Fixt Replacin T8 Lamp/ Fixt	3025	Lighting	Standard	13	13	114	34	8,760	1.09	9,748	9,975	102%
306142-Lighting-LED Lamp/ Fixt Replaci T12 Lamp/ Fixt	3026			48	48	164	34	5,292	1.09	10,015	36,156	361%
306143-Lighting-LED Lamp/ Fixt Replacin T8 Lamp/ Fixtu	3025			8	8	59	28	8,760	1.09	398	2,379	598%
				124	124	88	28	4,323	1.09	33,117	35,216	106%
306142-Lighting-LED Lamp/ Fixt Replaci T12 Lamp/ Fixt	3026			343	343	164	28	1,825	1.09	207,639	93,207	45%
				15	15	122	42	8,760	1.09	11,248	11,509	102%
306143-Lighting-LED Lamp/ Fixt Replacing T8Lamp Fixt	3025			36	36	59	28	2,361	1.09	4,968	2,885	58%
				9	9	56	30	8,325	1.09	376	2,133	567%
306142-Lighting-LED Lamp/ Fixt ReplacinT12 Lamp/Fixt	3026			17	17	82	30	665	1.09	3,934	644	16%
				5	5	82	30	4,845	1.09	417	1,379	331%
301037-Lighting-LED WattLamp/ Fixt Replac HalogWatt Lamp/Fixt	3011			2	2	72	9	1,013	1.09	534	140	26%
100213-Lighting-N L LED Fixture Replacing CFL Fixture	1169		Custom	46	46	26	8.5	8,380	1.00	6,899	6,773	98%
100208-Lighting-N L		Exterior Lighting		5	5	1,080	188	4,308	1.00	19,535	19,212	98%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
LED Fixt Replac MH												
306142-Lighting-LED Lamp/ Fixt Replaci T12 Lamp/ Fixt	3026	Lighting	Standard	4	4	258	42	12	1.09	1,387	11	1%
100213-Lighting-Non Linear LED FixtReplacin CFL Fixture	1169		Custom	2	2	26	12	8,760	1.09	262	269	103%
Total										310,477	221,889	71%

The annual lighting hours of operation verified during the M&V site visit for the first, sixth, and fifteenth line items in the above table (8,760) are consistent with the annual hours of operation used to calculate ex ante savings. The verified hours for the second, third, fourth, eighth, and tenth line items (ranging from 4,323 to 8,760) are greater than those used to calculate ex ante savings (ranging from 1,500 to 8,760), while the verified hours for the remaining line items (ranging from 12 to 8,380) are fewer. The installation locations for the interior measures had varying usage compared to the ex ante hours. The thirteenth line item in the above table using photo cells (4,308[319]) are less than the hours of operation used to calculate ex ante savings (4,380).

The ex ante savings estimate used an adjusted base wattage of 70W for the eleventh line item in the above table by multiplying the provided wattage by 70%. An adjusted base wattage of 72W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 100W incandescent lamp.

The efficient wattages verified during the M&V site visit for the eleventh and twelfth line items in the table above (9 and 8.5, respectively) were less than the efficient wattages used to calculate ex ante savings (10 and 10, respectively).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned office space in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07. In addition, factor of 1.00 was applied to the exterior measures which corresponds with the ex ante factor.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[320]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 71%. The ex ante savings estimate was premised upon overestimated annual hours of operation for 67% of the installed measures.

[319] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[320] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	283,781	195,634	69%	37.16
Custom	Lighting	7,161	7,042	98%	1.34
	Exterior Lighting	19,535	19,212	98%	0.11
Total		310,477	221,889	71%	38.61

Site ID 6386

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed thirteen photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 1/08/19 and 1/28/19.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025	Lighting	SBDI	62	62	221	68	2,178	1.00	23,752	20,665	87%
				17	17	221	68	2,269	1.00	6,512	5,907	91%
				62	62	59	24	2,543	1.02	5,433	5,609	103%
				3	3	32	18	2,396	1.02	106	102	96%
Total										35,803	32,284	90%

The annual lighting hours of operation verified during the M&V site visit for the first and second line items in the table above (2,178 and 2,269, respectively) are fewer than the annual hours of operation used to calculate ex ante savings (2,340). The remaining line items have hours of operation (ranging form 2,396-2,543) that are greater than the same ex ante hours.

A heating and cooling interactive factor of 1.02, applicable to an electrically heated, air-conditioned retail facility in St. Louis, was applied to the ex post lighting energy savings regarding the final two line items in the table above. The first two line items above had a factor of 1.00 applied due to the measures installed in unconditioned locations. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[321]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 90%. The ex ante energy savings estimate was premised on overestimated heating and cooling interactive effects.

[321] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	35,803	32,284	90%	6.13
Total		35,803	32,284	90%	6.13

Site ID 6387

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed seventeen photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 1/10/2019 and 2/4/2019.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	4	4	82	28	1,439	1.09	486	339	70%
306143-Lighting-LED Lamp Fixture Replacing T8 Lamp or Fixture	3025			16	16	175	102	2,473	1.09	2,625	3,151	120%
				2	2	88	34	1,700	1.09	243	200	82%
306142-Lighting-LED Lamp Fixture Replacing T12 Lamp or Fixture	3026			18	18	82	28	1,863	1.09	2,185	1,976	90%
306143-Lighting-LED Lamp Fixture Replacing T8 Lamp or Fixture	3025			3	3	59	28	799	1.09	210	81	39%
				8	8	59	34	1,075	1.09	449	234	52%
				92	92	114	34	1,750	1.09	16,538	14,050	85%
301037-Lighting-LED <=20W Lamp Fixture Replacing Halogen A >=40 W Lamp or Fixture	3011			6	6	72	15	523	1.09	52	195	375%
201316-Lighting-LED Electroluminescent Replacing Incand Exit Sign	793			9	9	30	4	8,760	1.09	2,194	2,236	102%
301037-Lighting-LED <=20 W Lamp Fixture Replacing Halogen A >=40 W Lamp or Fixture	3011			5	5	29	10	1,075	1.09	224	111	50%
Total										25,206	22,575	90%

The annual lighting hours of operation verified during the M&V site visit for the ninth line item in the above table (8,760) are consistent with the annual hours of used to calculate ex ante savings. The verified hours for the second and eighth line items (2,473 and 523, respectively) are greater than those used to calculate ex ante savings (2,100 and 150, respectively), while the verified hours for the remaining line items (ranging from 799 to 1,863) are fewer than the ex ante hours (2,200 for the tenth line item, 2,100 for the remaining line items).

The ex ante savings estimate used adjusted base wattages of 70W and 28W for the eighth and tenth line items in the above table, respectively, by multiplying the provided wattage by 70%. Adjusted base wattages of 72W and 29W were used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalents for 100W and 40W incandescent lamps, respectively.

The efficient wattage of the tenth line item in the above table (10W) is greater than the wattage used in ex ante savings calculations (9W).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned education based facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[322]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 90%. The ex ante energy savings estimate was premised upon overestimated annual hours of operation for 81% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	25,206	22,575	90%	4.29
Total		25,206	22,575	90%	4.29

[322] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6388

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed six photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 01/17/19 and 02/12/19.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp Replacing T8 Lamp	3025	Lighting	SBDI	51	51	221	102	3,351	1.09	25,975	22,249	86%
				3	3	88	51	4,968	1.09	475	603	127%
				1	1	88	34	848	1.09	231	50	22%
				6	6	114	68	3,072	1.09	1,181	928	79%
306142-Lighting-LED Lamp Replac. T12 Lamp	3026			8	8	122	51	2,611	1.09	2,431	1,622	67%
306140-Lighting-LED Lamp Replac. Interior HID Lamp	3004-1			8	8	460	102	3,349	1.09	12,258	10,491	86%
306143-Lighting-LED Lamp Replac. T8 Lamp	3025			4	4	114	34	692	1.09	1,370	242	18%
Total										43,921	36,185	82%

The annual lighting hours of operation verified during the M&V site visit for the second line item in the table above (4,968) are greater than the annual hours of operation used to calculate ex ante savings (4,000), while the remaining line items have fewer hours of operation (ranging from 692 – 3,351).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned light manufacturing facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[323]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 82%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 96% of the installed measures.

[323] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	43,921	36,185	82%	6.87
Total		43,921	36,185	82%	6.87

Site ID 6389

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed eleven photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 1/9/2019 and 1/30/2019.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp/ Fixture Replacing T8 Lamp or Fixture	3025	Lighting	SBDI	47	47	88	44	796	1.09	5,178	1,788	35%
306142-Lighting-LED Lamp/ Fixture Replacing T12 Lamp or Fixture	3026			1	1	164	44	414	1.09	301	54	18%
306143-Lighting-LED Lamp/ Fixture Replacing T8 Lamp or Fixture	3025			11	11	59	24	6,069	1.09	964	2,537	263%
301037-Lighting-LED <=20 Watt Lamp or Fixture Replacing Halogen A >=40 Watt Lamp or Fixture	3011			97	97	43	9.8	501	1.09	7,529	1,752	23%
306142-Lighting-LED Lamp/ Fixture Replacing T12 Lamp or Fixture	3026			43	43	164	44	1,669	1.09	12,920	9,351	72%
306143-Lighting-LED Lamp/ Fixture Replacing T8 Lamp or Fixture	3025			12	12	88	44	1,669	1.09	1,321	957	72%
				4	4	59	24	1,399	1.09	350	213	61%
				8	8	59	24	1,402	1.09	701	426	61%
306142-Lighting-LED Lamp/ Fixture Replacing T12 Lamp or Fixture	3026			8	8	164	44	1,359	1.09	2,403	1,417	59%
306143-Lighting-LED Lamp/ Fixture Replacing T8 Lamp or Fixture	3025			7	7	114	48	1,033	1.09	1,157	518	45%
				87	87	88	44	1,073	1.09	9,584	4,459	47%
Total										42,408	23,473	55%

The annual lighting hours of operation verified during the M&V site visit for the third line item in the above table (6,069) are greater than the annual hours of operation used to calculate ex ante savings (2,340). 64% of this measure had been installed in 24/7/365 stairwells. The hours verified for the remaining line items (ranging from 414 to 1,669) are fewer than those used to calculate ex ante savings

(2,340). The ex ante hours were calculated for a site with usage of six days per week, 8am-5pm, while the facility's calendar only shows usage on Sundays 10am-6pm.

The ex ante savings estimate used an adjusted base wattage of 42W for the fourth line item in the above table by multiplying the provided wattage by 70%. An adjusted base wattage of 43W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp.

The efficient wattage of the fourth line item in the above table (9.8W) verified during the M&V site visit is less than the ex ante savings efficient wattage (11W).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned education facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[324]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 55%. The ex ante energy savings estimate was premised upon overestimated annual hours of operation for 97% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	42,408	23,473	55%	4.46
Total		42,408	23,473	55%	4.46

[324] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6390

Data Collection

The participant received Standard and SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed eighteen photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 1/11/2019 and 2/6/2019.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting -LED Lamp or Fixt Replac T8 Lamp Fixture	3025	Lighting	SBDI	14	14	88	30	694	1.14	1,356	641	47%
306142-Lighting -LED Lamp Fixt ReplacT12 Lamp Fixture	3026			4	4	82	30	526	1.14	462	124	27%
306143-Lighting -LED Lamp or Fixt Replac T8 Lamp Fixture	3025			3	3	114	30	240	1.14	422	69	16%
306142-Lighting -LED Lamp or Fixt ReplacT12 Lamp Fixture	3026			1	1	164	30	1,578	1.14	299	241	80%
				20	20	122	30	1,517	1.14	3,071	3,175	103%
				16	16	122	30	663	1.14	1,071	1,110	104%
				16	16	164	30	557	1.14	3,578	1,359	38%
306143-Lighting -LED Lamp or Fixt Replac T8 Lamp Fixture	3025			2	2	56	15	240	1.14	137	22	16%
				6	6	88	30	240	1.14	581	95	16%
306142-Lighting -LED Lamp or Fixt ReplacT12 Lamp Fixture	3026			2	2	164	30	719	1.14	596	219	37%
				4	4	82	30	467	1.14	348	111	32%
301037-Lighting -LED <=20 W Lamp Fixture ReplaHalogen A >=40 Watt Lamp Fixture	3011			45	45	43	10	2,426	1.14	3,205	4,098	128%
306142-Lighting -LED Lamp or Fixt ReplacT12 Lamp Fixture	3026			3	3	164	30	1,578	1.14	895	722	81%
300938-Lighting -LED <=14 W LampFixtRepla Halogen BR/R Lamp Fixture	3007			2	2	70	13	321	1.14	95	42	44%

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Baseline Quantity	Efficient Quantity	Baseline Wattage	Efficient Wattage	Annual Hours of Operation	Heating Cooling Interaction Factor	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Realization Rate
301037-Lighting -LED <=20 W Lamp Fixture ReplaHalogen A >=40 Watt Lamp Fixture	3011		Standard	96	96	43	9	755	1.14	2,644	2,802	106%
301039-Lighting -LED <=20 W Lamp Fixture Repla Halogen PAR Lamp Fixt	3008			16	16	49	15	821	1.14	454	508	112%
Total										19,214	15,337	80%

The annual lighting hours of operation verified during the M&V site visit for the fourteenth line item in the above table (2,426) are greater than the annual hours of operation used to calculate ex ante savings (2,080). The verified hours for the remaining line items (ranging from 240 to 1,578) are fewer than those used to calculate ex ante savings (ranging from 780 to 2,080).

The ex ante savings estimate used adjusted base wattages of 42W for the fourteenth and eighteenth line items in the above table, and 49W for the nineteenth, by multiplying the provided wattage by 70%. An adjusted base wattage of 43W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 60W incandescent lamp.

A heating and cooling interactive factor of 1.14, applicable to a gas heated, air conditioned assembly facility in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[325]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 80%. The ex ante energy savings estimate was premised upon overestimated annual hours of operation for 82% of the installed measures.

Site-Level Energy Savings

Incentive	End Use Category	kWh Savings			Gross Ex Post kW Reduction
		Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross Realization Rate	
Standard	Lighting	3,098	3,310	107%	0.63
SBDI		16,116	12,027	75%	2.28
Total		19,214	15,337	80%	2.91

[325] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6391

Data Collection

The participant received SBDI lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed ten photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 1/11/2019 and 2/6/2019.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306142-Lighting-LED Lamp/Fixture Replacing T12 Lamp or Fixture	3026	Lighting	SBDI	18	18	82	28	1,266	1.09	2,164	1,340	62%
				1	1	227	44	2,134	1.11	407	432	106%
306143-Lighting-LED Lamp/Fixture Replacing T8 Lamp or Fixture	3025			4	4	221	84	2,067	1.11	1,220	1,253	103%
				2	2	88	42	2,067	1.11	204	210	103%
306142-Lighting-LED Lamp/Fixture Replacing T12 Lamp or Fixture	3026			10	10	164	34	735	1.11	2,893	1,057	37%
				7	7	82	28	2,077	1.11	841	868	103%
				5	5	82	34	2,054	1.11	534	545	102%
				2	2	56	18	1,134	1.11	169	95	56%
306143-Lighting-LED Lamp/Fixture Replacing T8 Lamp or Fixture	3025			1	1	59	28	2,266	1.11	70	78	111%
301037-Lighting-LED <=20 Watt Lamp or Fixture Replacing Halogen A >=40 Watt Lamp or Fixture	3011			26	26	29	9	454	1.11	1,099	261	24%
300938-Lighting-LED <=14 Watt Lamp or Fixture Replacing Halogen BR/R Lamp or Fixture	3007			88	88	60	11	201	1.10	9,597	951	10%
				11	11	40	7	50	1.11	808	20	3%
306142-Lighting-LED Lamp/Fixture Replacing T12 Lamp or Fixture	3026			14	14	138	44	63	1.00	2,930	83	3%
306143-Lighting-LED Lamp/Fixture Replacing T8 Lamp or Fixture	3025			1	1	59	28	-	1.00	70	-	0%
300938-Lighting-LED <=14 Watt Lamp/ Fixture Replacing Halogen BR/R Lamp or Fixture	3007			7	7	60	11	50	1.11	764	19	2%
306142-Lighting-LED Lamp/Fixture Replacing T12 Lamp or Fixture	3026			2	2	82	28	50	1.11	241	6	2%
				2	2	164	34	1,161	1.11	579	334	58%
Total										24,590	7,552	31%

The annual lighting hours of operation verified during the M&V site visit for the second, third, fourth, sixth, seventh, and ninth line items in the above table (ranging from 2,054 to 2,266) are greater than the annual hours of operation used to calculate ex ante savings (2,080). The verified hours for the remaining line items (ranging from 0 to 1,266) are fewer than those used to calculate ex ante savings (2,080). It appears that the unoccupied areas of the facility were not considered when calculating ex ante savings.

The ex ante savings estimate used an adjusted base wattage of 28W for the tenth line item in the above table by multiplying the provided wattage by 70%. An adjusted base wattage of 29W was used in the ex post savings analysis to meet the EISA 2007 standard lumen equivalent for a 40W incandescent lamp.

A heating and cooling interactive factor of 1.00, applicable to an unconditioned space, was applied to the ex post lighting energy savings of the warehouse areas of the facility. A factor of 1.11, applicable to a gas heated, air-conditioned small office in St. Louis, was applied to the ex post savings of the remaining areas. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[326]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 31%. The ex ante savings estimate was premised upon overestimated annual hours of use throughout the entire facility.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
SBDI	Lighting	24,590	7,552	31%	1.43
Total		24,590	7,552	31%	1.43

[326] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6392

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed six photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 1/15/2019 and 2/11/2019.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Lamp or Fixt Replacing T8 Lamp or Fixt	3025	Lighting	Standard	75	75	114	68	8,760	1.07	32,338	32,487	100%
306142-Lighting-LED Lamp or Fixt ReplacingT12 Lamp or Fixt	3026			7	7	164	50	8,760	1.07	7,479	7,514	100%
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	3025			26	26	114	50	8,760	1.07	15,597	15,669	100%
				6	6	56	41	4,201	1.07	843	406	48%
				125	125	114	64	4,660	1.07	58,583	31,310	53%
				10	10	114	64	8,760	1.07	4,687	4,708	100%
				154	154	114	64	8,760	1.07	72,174	72,507	100%
				4	4	114	46	8,760	1.07	2,550	2,561	100%
				24	24	88	46	6,931	1.07	2,524	7,510	298%
Total										196,775	174,672	89%

The annual lighting hours of operation verified during the M&V site visit for the fourth and fifth line items in the above table (4,201 and 4,660, respectively) are fewer than the annual hours used to calculate ex ante savings (8,760), while the verified hours for the last line item (6,931) are greater than those used for ex ante savings (2,340). The verified hours for the remaining line items are consistent with the hours used to calculate ex ante savings (8,760).

A heating and cooling interactive factor of 1.07, applicable to a gas heated, air-conditioned hospital in Cape Girardeau, was applied to the ex post lighting energy savings. This factor is consistent with the heating and cooling interactive factor used to calculate ex ante savings.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[327]

[327] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 89%. The ex ante energy savings estimate was premised upon overestimated annual hours of operation for 30% of the installed measures.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	196,775	174,672	89%	33.18
Total		196,775	174,672	89%	33.18

Site ID 6393

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed thirteen photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 01/16/19 and 02/27/19.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replac T8 32 Watt Linear ft	3025	Lighting	Standard	234	234	32	14	1,969	1.09	14,061	9,074	65%
				282	282	32	17	4,731	1.00	33,891	20,013	59%
				2,632	2,632	32	14	4,414	1.02	379,584	213,739	56%
				58	58	32	15	979	1.09	3,292	1,056	32%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T12 <=40W Linear ft	3026			22	22	96	43	3,067	1.05	16,786	3,760	22%
				400	400	40	14	2,304	1.09	34,719	26,208	75%
Total										482,333	273,849	57%

The annual lighting hours of operation verified during the M&V site visit (ranging from 979 – 4,731) are less than the annual hours of operation used to calculate ex ante savings (ranging from 3,120 – 7,488).

The quantity of the fifth line item in the first table above (22) verified during the M&V site visit is less than the ex ante savings quantity (40).

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air conditioned office in St. Louis, was applied to the ex post lighting energy savings. A factor of 1.00 was used for unconditioned spaces. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[328]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 57%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

[328] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	482,333	273,849	57%	52.02
Total		482,333	273,849	57%	52.02

Site ID 6394

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed nine photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 01/18/19 and 02/12/19.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
306143-Lighting-LED Fixt Replacing T8 Fixture	3025	Lighting	Standard	1,437	1,437	59	28	4,482	1.01	238,326	201,583	85%
100105-LightingLinear Tube LED Fixture Replacing T8 HO Fixture	1169	Exterior Lighting	Custom	35	35	160	86	4,306	1.00	11,344	11,151	98%
Total										249,670	212,734	85%

The annual lighting hours of operation verified during the M&V site visit for the first line item in the table above (4,482) are less than the annual hours of operation used to calculate ex ante savings (5,000). The ex ante hours are greater than the posted hours for the facility (4,218). For the second line item above, the annual lighting hours of operation with fixtures using photo cells (4,306[329]) are less than the hours of operation used to calculate ex ante savings for exterior lighting (4,380).

A heating and cooling interactive factor of 1.01, applicable to an electric heated, air-conditioned large single-story retail facility in St. Louis, was applied to the ex post lighting energy savings for the interior installations. A factor of 1.00 was applied to exterior spaces. The ex ante savings estimate accounted for a heating and cooling factor of 1.07 for interior installations, and a factor of 1.00 for exterior spaces.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[330]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 85%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

[329] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[330] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	238,326	201,583	85%	38.29
Custom	Exterior Lighting	11,344	11,151	98%	0.06
Total		249,670	212,734	85%	38.36

Site ID 6395

Data Collection

The participant received Retro-Commissioning (RCx) Program incentives from Ameren Missouri.

During the M&V visit, ADM staff verified the optimization of building automation system (BAS) and interviewed site personnel regarding equipment operation. Data from the BAS were collected where possible. ADM also gathered site occupancy schedules, lighting information, and HVAC equipment EMS data.

Analysis Results

BAS Optimization Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A monthly pre/post billing data regression was created by equating weather data from the nearest NOAA weather station against monthly billing data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Cooling and heating degree days (CDD & HDD) were calculated for each billing period and used with a pre/post binary flag in an electric usage regression resulting in an R^2 of 0.958 and adjusted R^2 of 0.953. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh_{monthly} = 15{,}257 + 33.3 \times CDD + 116.7 \times HDD - 6{,}820 \times Pre\_Post$$

Where:

$kWh_{monthly}$ = Monthly kWh Consumption
CDD = Cooling Degree Days for the Month with a Base Temperature of 55°F
HDD = Heating Degree Days for the Month with a Base Temperature of 55°F
PrePost = Pre/Post-Retrofit Binary Flag

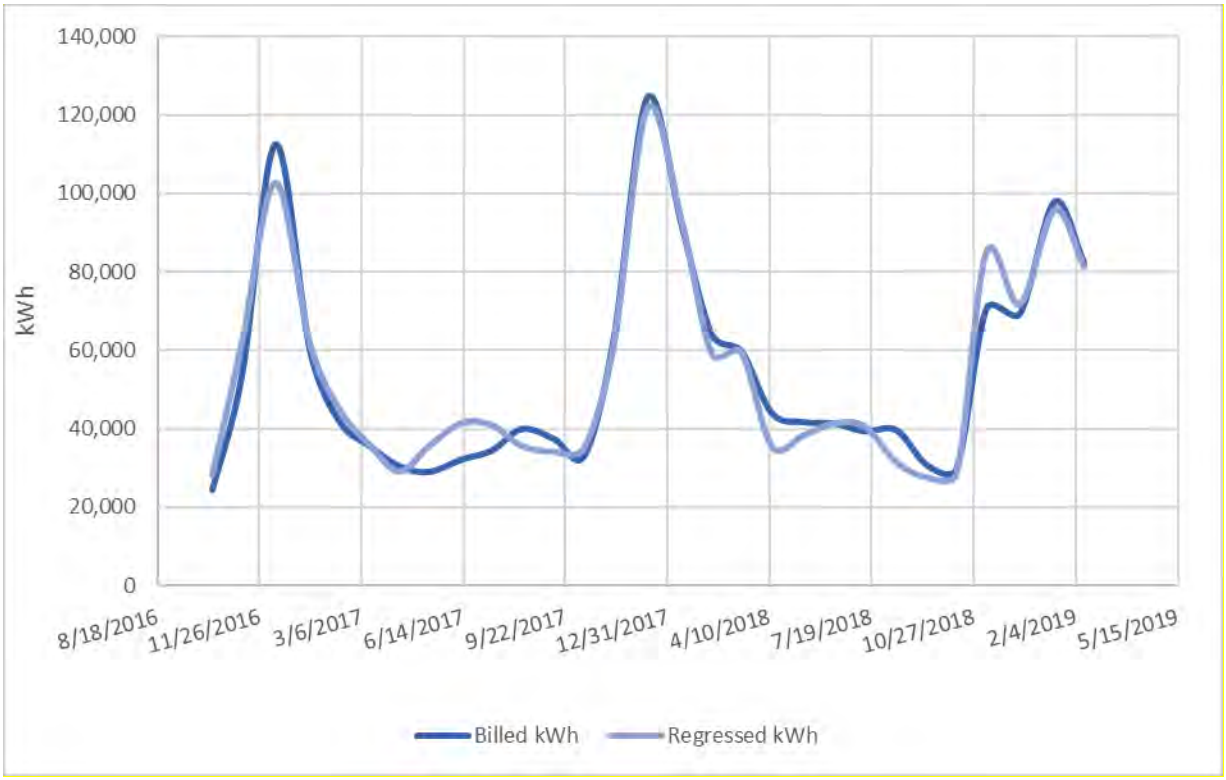
The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	*T Stat*
Intercept	4.7
Pre/Post	-2.7
HDD	18.8
CDD	5.8

Electric energy usage values were calculated on a monthly basis using the derived regression equation. The following plot compares the monthly billed kWh to the regressed kWh:

Billed vs. Regressed Monthly kWh



Annual kWh savings for the installed measures were determined by using typical year (TMY3) weather data and the derived equation to calculate monthly pre/post energy consumption of the site. Each month was summed for a year to obtain annual energy savings. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility, and can be seen in the following table:

Monthly kWh Savings

Month	HDD	CDD	kWh		
			Baseline	As-Built	Savings
Jan	811	7	110,132	103,313	6,820
Feb	578	16	83,295	76,476	6,820
Mar	277	109	51,186	44,366	6,820
Apr	112	192	34,718	27,899	6,820
May	34	315	29,773	22,953	6,820
Jun	0	655	37,064	30,244	6,820
Jul	0	802	41,947	35,127	6,820
Aug	0	701	38,578	31,758	6,820
Sep	3	463	31,004	24,184	6,820
Oct	124	135	34,164	27,344	6,820
Nov	349	49	57,547	50,727	6,820
Dec	732	2	100,777	93,957	6,820
Total			650,185	568,348	81,840

The total billing regression energy savings were used to determine measure level savings. Measure level savings are shown in the following table:

RCx Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
113220– HVAC Optimization – HVAC	1169	HVAC	RCx	61,816	59,105	96%
115920– HVAC Optimization – Cooling	1169	Cooling	RCx	23,778	22,735	96%
Total				85,594	81,840	96%

There were significant differences in the ex ante and ex post analysis methodologies for the RCx measures, with a realization rate of 96%. The ex ante analysis for the HVAC optimization measures used unspecified calculation methodology to determine fan and cooling energy savings. It is unclear if the ex ante analysis used any site-specific trending or utility data. ADM used a billing regression with a good fit (R Square = 0.958) to determine realized energy savings. This method better accounts for actual site HVAC energy usage than the ex ante calculations.

The verified annual site-level energy savings are 81,837 kWh, resulting in a 96% realization rate.

A table showing the energy savings achieved by the measures evaluated for this site is shown below:

Site-Level Energy Savings

Measure Name/ID	*End Use Category*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*	*Gross Ex Post kW Reduction*
Retro-Commissioning	HVAC	61,816	59,105	96%	26.2
	Cooling	23,778	22,735	96%	20.7
Total		85,594	81,840	96%	46.9

Site ID 6396

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306140-Lighting-LED Lamp or Fixture Replacing Interior HID Lamp or Fixture	3004-1	Lighting	Standard	449	449	460	213	1,842	1.00	248,961	204,331	82%
				44	44	460	213	8,760	1.00	101,403	95,204	94%
				131	131	460	213	363	1.00	14,403	11,754	82%
Total										364,767	311,288	85%

The annual lighting hours of operation verified during the M&V site visit for the first and third line items in the table above (1,842 and 363, respectively) are fewer than the annual hours of operation used to calculate ex ante savings (2,000 and 500, respectively). The second item was confirmed to operate continuously as claimed in the ex ante hours.

The quantities of the first and third line items above (449 and 131, respectively) verified during the M&V site visit varies the ex ante savings quantities (471 and 109, respectively).

A heating and cooling interactive factor of 1.00, applicable to an unconditioned site in St. Louis, was applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[331]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 85%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours for 93% of the installed measures, overestimated heating and cooling interactive effects, and differing installed quantities in two locations.

[331] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	364,767	311,288	85%	59.13
Total		364,767	311,288	85%	59.13

Site ID 6398

Data Collection

The participant received Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, post-retrofit connected loads, and determined the lighting operating schedule. Annual lighting operating hours were verified by interviewing facility personnel regarding lighting operating schedules with the use of photo-cells.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
100208-Lighting-Non Linear LED Fixture Replac M H Fixture	1169	Exterior Lighting	Custom	3	3	455	234	4,308	1.00	2,904	2,856	98%
				9	9	455	163	4,308	1.00	11,511	11,322	98%
Total										14,415	14,178	98%

The annual lighting hours of operation verified during the M&V site visit in the table above table using photo cells (4,308[332]) are less than the hours of operation used to calculate ex ante savings (4,380).

A heating and cooling interactive factor of 1.00, applicable to an exterior installation in St. Louis, was applied to the ex post lighting energy savings which corresponds with the ex ante savings estimate.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[333]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 98%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Custom	Exterior Lighting	14,415	14,178	98%	0.08
Total		14,415	14,178	98%	0.08

[332] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[333] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site ID 6399

Data Collection

The participant received Custom incentives from Ameren Missouri for whole building and HVAC measures.

During the M&V visit, ADM staff verified the installed measures, operating schedules, and control strategies. EMS trend data and hourly electric meter data were obtained as well.

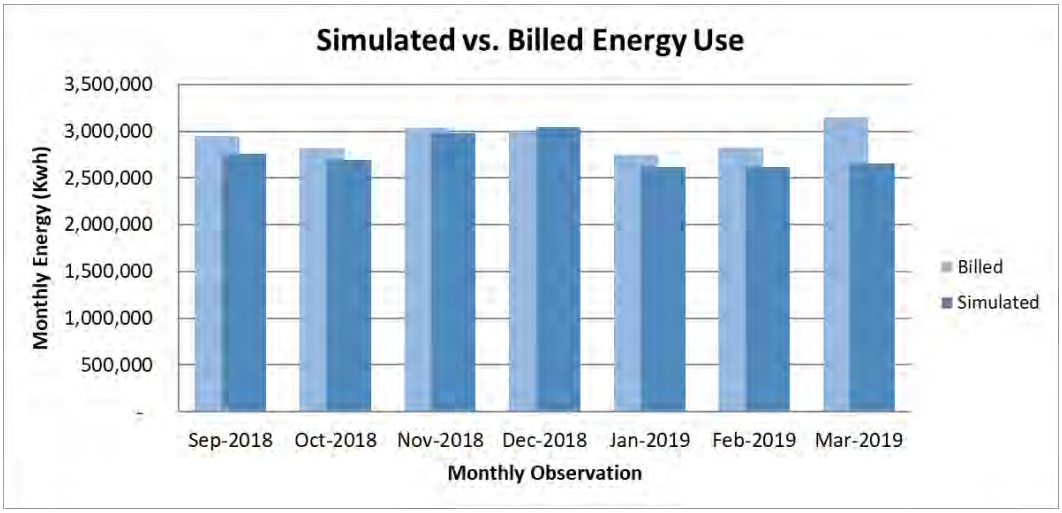
Analysis Results

Whole Building Savings Calculations

Energy savings for the above code whole building measures were calculated using IPMVP Option D: Calibrated Simulation. ADM compiled an eQuest model of the as-built facility using the details and construction documents collected during the on-site M&V visit and from the project documentation.

Upon completion of the initial model, a custom weather file was created using NOAA weather data for the region. Using this weather file and the utility provided billing data for the facility, ADM ensured that the model's energy load shape matched that of the bills. The results of this calibration effort can be seen below:

Monthly kWh Calibration



Upon calibration for the as-built eQuest model, the impacts of the installed measures were removed and replaced with the code compliant equipment to create the baseline model. Once the baseline model was created, the as-built model and the baseline model were simulated using TMY3 weather data. The total realized energy savings are the differences between the baseline and as-built models' energy usages, and the total site-level energy savings by end use can be seen in the following table:

Typical Year Energy Usage (kWh) by End Use

End-Use	*Baseline*	*As-Built*	*kWh Savings*
Lighting	4,568,677	4,568,677	0
Misc. Equipment	21,163,909	20,272,558	891,351
Cooling	8,565,237	3,882,041	4,683,196
Heat Rejection	46,444	134,901	-88,457
Auxiliary (pumps)	254,082	933,786	-679,704
Vent Fans	4,127,641	4,077,373	50,268
Total	38,725,994	33,869,339	4,856,655

The facility added two expansion wings to the existing manufacturing building and added a storage building. The existing HVAC system and process cooling system were not meeting the demand and this project used code efficiency for HVAC system as in a new construction project.

Measure level savings are shown in the following table:

Custom Measure Level Savings

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*
115921-Cooling Only HVAC Equipment Replacing	1169	Cooling	Custom	3,984,759	3,309,194	83%
112421-Water Cooled Chiller Replacing	1169	Process	Custom	1,863,372	1,547,461	83%
Total				5,848,131	4,856,655	83%

There were significant differences in the ex ante and ex post analysis results for the whole building and HVAC measures, with an 83% realization rate. The ex ante analysis used uncalibrated energy model using IESVE simulation model for the HVAC portion and added process cooling savings outside of the model using an engineering calculation. ADM used eQuest for both measures and calibrated the model to the actual billing data. Calibrated simulation better accounts for actual facility and HVAC energy usage. ADM found (4) 700-ton chillers were installed on site two serving chilled water to air handlers and two serving process cooling. The facility is using N+1 redundancy to protect the facility operation in case of equipment malfunction. For a reference, the total pre-existing chiller capacity for process cooling was 324 Ton and the facility expanded by 15% of its total floor space, a single 700-ton chiller was able to serve existing load plus additional load from expansion on top of larger cooling tower providing water side economizing. The central plant was oversized for future expansion in production and utilizing energy efficiency at low part load. The facility plans to complete phase 3 of the project on site in PY2019 and possibly expand production in the future upon completion. ADM assumed the expanded space would have similar energy density as the existing portion of the building to calculate the final energy savings.

The site-level verified energy savings are 4,856,655 kWh, resulting in a realization rate of 83%.

A table showing the energy savings achieved by the measures evaluated for this site is shown below.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Custom	Cooling	3,984,759	3,309,194	83%	3,013.63
	Process	1,863,372	1,547,461	83%	213.46
Total		5,848,131	4,856,655	83%	3,227.09

Site ID 6400

Data Collection

The participant received Standard lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed ten photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 2/02/19 and 2/20/19.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
306135-Lighting -LED LampFixture Replac T5 LampFixture	3088	Lighting	Standard	425	425	468	224	7,639	1.06	972,001	843,019	87%
306143-Lighting-LED LampFixture Replac T8 LampFixture	3025			120	120	88	35	6,870	1.10	59,614	48,120	81%
Total										1,031,615	891,139	86%

Primary data were used to develop estimates of annual lighting operating hours. For all facility areas monitored, the estimated annual operating hours (ranging from 6,870 to 7,639) were fewer than those used to develop the ex ante energy savings estimates (8,760). Not all locations where the measures were installed had continuous usage.

Heating and cooling interactive factors of 1.11, 1.09, and 1.00, applicable to a gas heated, air conditioned office, gas heated, air conditioned industrial, and unconditioned spaces, respectively, in St. Louis, were applied to the ex post lighting energy savings. The ex ante savings estimate accounted for a heating and cooling factor of 1.07.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[334]

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 86%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

[334] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	1,031,615	891,139	86%	169.28
Total		1,031,615	891,139	86%	169.28

Site ID 6402

Data Collection

The participant received Standard and Custom lighting incentives from Ameren Missouri.

During the M&V visit, ADM staff verified equipment installation, the post-retrofit connected loads, interviewing facility personnel regarding lighting operating schedules, and installed five photo-sensor loggers to monitor lighting operation. The photo-sensor loggers collected data between 1/18/19 and 2/12/19.

Analysis Results

Lighting Retrofit Savings Calculations

Measure Name/ID	*TRM Measure Reference Number*	*End Use Category*	*Program*	*Baseline Quantity*	*Efficient Quantity*	*Baseline Wattage*	*Efficient Wattage*	*Annual Hours of Operation*	*Heating Cooling Interaction Factor*	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Realization Rate*
100208-Ltg -Non Linear LED Fixture Replacing M H Fixture	1169	Exterior Lighting	Custom	184	82	1,080	570	4,306	1.00	665,672	654,365	98%
				52	52	455	146	4,306	1.00	70,378	69,182	98%
306140-Ltg -LED Lamp Fixt Replac Interior HID Lamp Fixt	3004-1	Lighting	Standard	8	8	460	150	4,719	1.09	17,248	12,780	74%
306143-Ltg -LED Lamp Fixt Replac T8 Lamp or Fixture	3025			1,050	1,050	221	102	4,719	1.09	869,027	643,907	74%
				150	150	114	42	4,719	1.09	75,114	55,656	74%
				350	350	59	34	4,719	1.09	60,856	45,092	74%
Total										1,758,295	1,480,981	84%

The annual lighting hours of operation for the first two line items in the above table using photo cells (4,306[335]) are fewer than the hours of operation used to calculate ex ante savings (4,380). The remaining interior measures also have annual hours (4,719) fewer than the ex ante savings estimate hours (6,000). The posted facility hours represent 4,224 annual hours.

A heating and cooling interactive factor of 1.09, applicable to a gas heated, air-conditioned large retail in Kirksville, was applied to the ex post lighting energy savings for the interior measures. The ex ante savings estimate accounted for a heating and cooling factor of 1.07. The ex post and ex ante used a factor of 1.00 for the exterior measures.

The peak coincident demand reduction was determined by applying the corresponding end use kW factor to the kWh savings.[336]

[335] Sun or Moon Rise/Set Table for One Year. U.S. Naval Observatory. <http://aa.usno.navy.mil/data/docs/RS_OneYear.php>

[336] Ameren Missouri (Cycle 2) Missouri Energy Efficiency Investment Act (MEEIA) filing.

A table showing the energy savings achieved by the measures evaluated for this site is shown below. The overall gross realization rate is 84%. The ex ante energy savings estimate was premised on overestimated annual lighting operating hours.

Site-Level Energy Savings

Incentive	*End Use Category*	*kWh Savings*			*Gross Ex Post kW Reduction*
		Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	
Standard	Lighting	1,022,245	757,434	74%	143.88
Custom	Exterior Lighting	736,050	723,547	98%	4.06
Total		1,758,295	1,480,981	84%	147.95

Site ID 6405

Data Collection

The participant received EMS Program incentives from Ameren Missouri for upgrading an energy management system (EMS) to control air handlers, replace pneumatic controls, and implement demand control ventilation.

During the M&V visit, ADM staff verified the installation of EMS controls and interviewed site personnel regarding equipment operation. Data from the energy management system (EMS) were collected where possible. ADM also gathered mechanical schedules and HVAC equipment nameplate information.

Analysis Results

BAS Optimization Savings Calculations

Energy savings for the site were calculated using IPMVP Option C: Whole Facility analysis methodology. A monthly pre/post submeter data regression was created by equating weather data from the nearest NOAA weather station against monthly submeter data. This was done to determine how energy consumption of the facility varied with changes in weather and the implemented measures.

Cooling degree days (CDD) and number of school days were calculated for each billing period and used with a post-installation CDD variable in an electric usage regression resulting in an R^2 of 0.971 and adjusted R^2 of 0.965. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post-retrofit configurations:

$$kWh_{monthly} = 721{,}257 + 416.2 \times CDD + 3{,}697 \times School\_Days - 416.2 \times CDD\_Post$$ -619 x HDD

Where:

$kWh_{monthly}$ = Monthly kWh Consumption
CDD = Cooling Degree Days for the Month with a Base Temperature of 53°F
School_Days = Number of School Days in that Billing Period with EMS System scheduled
Pre_Post = Flag for pre and post period
HDD = Heating Degree Days for the Month with a Base Temperature of 63°F

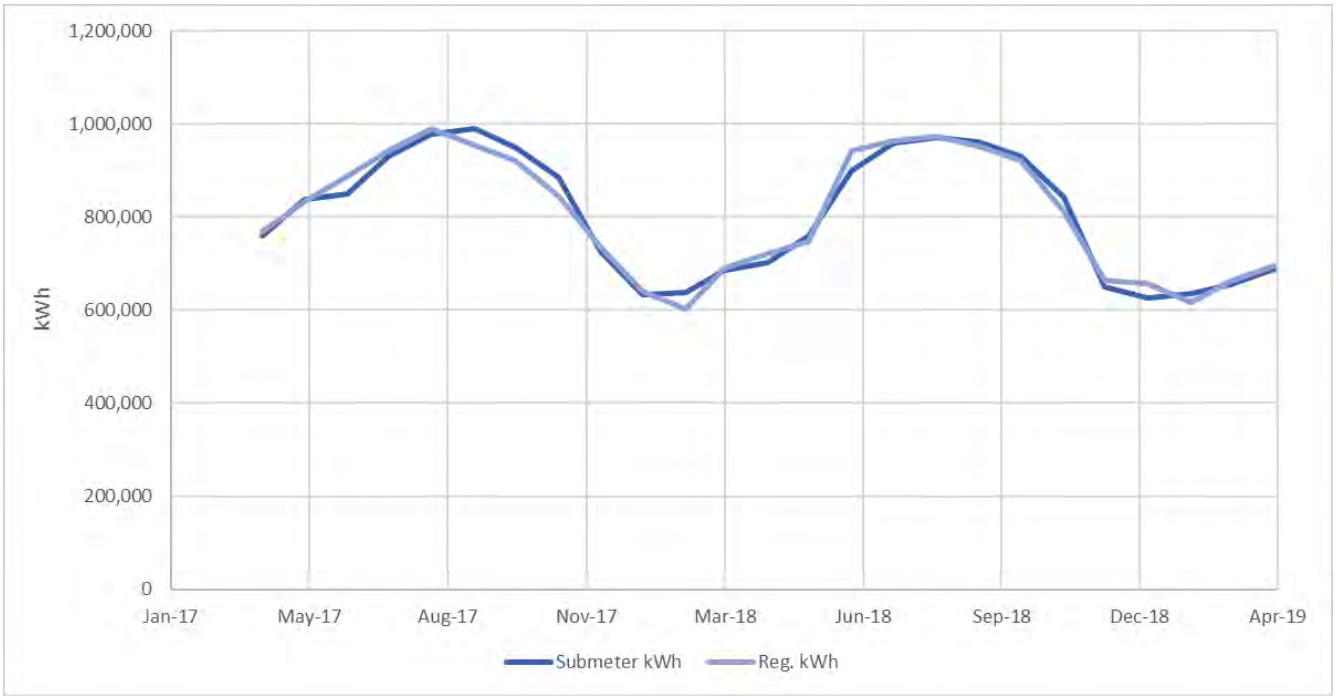
The following table presents the T Statistics for the regression variables:

Significance of kWh Regression Variables

Variable	*T Stat*
Intercept	25.9
CDD	4.4
School Days	3.6
PrePost	-1.9

Electric energy usage values were calculated on a monthly basis using the derived regression equation. The following plot compares the monthly billed kWh to the regressed kWh:

Submetered vs. Regressed Monthly kWh



Annual kWh savings for the installed measures were determined by using typical year (TMY3) weather data and the extended breaks between semesters. The derived equation was then used to calculate monthly pre/post energy consumption of the site. Each month was summed for a year to obtain annual energy savings. Annual kWh savings are the difference between baseline and as-built energy consumption for the facility, and can be seen in the following table:

Monthly kWh Savings

Month	*School Days*	*CDD*	*kWh*		
			Baseline	*As-Built*	*Savings*
Jan	31	4	582,000	562,595	19,405
Feb	31	9	647,050	627,645	19,405
Mar	28	54	733,351	713,946	19,405
Apr	31	95	812,176	792,771	19,405
May	24	156	847,363	827,958	19,405
Jun	27	310	947,687	928,282	19,405
Jul	26	377	974,252	954,847	19,405
Aug	31	331	973,152	953,747	19,405

Month	School Days	CDD	kWh		
			Baseline	As-Built	Savings
Sep	31	220	918,795	899,390	19,405
Oct	30	68	787,187	767,782	19,405
Nov	31	24	706,519	687,115	19,405
Dec	30	1	594,577	575,172	19,405
Total			9,524,107	9,291,249	232,858

The total billing regression energy savings were used to determine measure level savings.

Measure level savings are shown in the following table:

EMS Savings

Measure Name/ID	TRM Measure Reference Number	End Use Category	Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Realization Rate
Project 1 117920-HVAC-Cooling Existing System	1169	Cooling	EMS	31,449	28,297	90%
118220-HVAC-HVAC Existing System	1169	HVAC	EMS	125,016	112,485	90%
Project 2-HVAC-Cooling Existing System	1169	Cooling	EMS	63,447	57,087	90%
118220-HVAC-HVAC Existing System	1169	HVAC	EMS	38,887	34,989	90%
Total				258,799	232,858	90%

There were significant differences in the ex ante and ex post analysis methodologies for the EMS measures, with a realization rate of 90%. The ex ante analysis for the VFD measures used bin calculations based on outdoor air temperature from a weather station 120 mile further North. The savings for the new air handler controls were based on a savings calculator using maximum design capacity of the existing equipment. One of the air handlers was replaced with a higher capacity unit. These assumptions introduce uncertainty into the ex ante analysis, whereas ex post analysis used actual submeter data to quantify savings.

The verified annual site-level energy savings are 232,588 kWh, resulting in a 90% realization rate.

A table showing the energy savings achieved by the measures evaluated for this site is shown below:

Site-Level Energy Savings

Incentive	*End Use Category*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Realization Rate*	*Gross Ex Post kW Reduction*
EMS	Cooling	94,896	85,384	90%	37.9
EMS	HVAC	163,903	147,474	90%	134.3
Total		258,799	232,858	90%	172.2

3. Sampling Plans

This appendix presents detailed technical data regarding the sampling plans that facilitated estimation of energy savings.

Table 3-1 shows the Custom Program project population from which the sample was drawn.1 These samples fell into five energy savings strata defined by ex ante kWh savings boundaries. Note that in this table, as well as in succeeding tables presenting population statistics used for sample design, the values presented, including coefficients of variation, are calculated based on final program data.

Table 3-1 Population Statistics Used for Custom Program Sample Design

Variables	*Stratum 1*	*Stratum 2*	*Stratum 3*	*Stratum 4*	*Stratum 5*	*Stratum 6*	*Totals*
Strata boundaries (kWh)	50,000,000 - 4,999,999	4,999,999 - 1,400,000	1,400,000 - 800,000	800,000 - 300,000	300,000 - 73,000	73,000 - 0	
Population Size	1	5	11	44	203	1192	1456
Total kWh savings	5,848,131	11,897,198	10,768,15	19,406,47	28,975,65	22,884,21	99,779,831
Average kWh Savings	5,848,131	2,379,440	978,923	441,056	142,737	19,198	
Standard deviation of kWh	-	608,128	185,839	133,033	55,330	16,667	
Coefficient of variation	-	0.26	0.19	0.30	0.39	0.87	
Final design sample	1	2	3	8	24	50	88

Table 3-2 shows the Standard non-HIM population from which the sample was drawn. These samples fell into five energy savings strata defined by ex ante kWh savings boundaries.

Table 3-2 Population Statistics Used for Non-HIM Standard Program Sample Design

Variables	*Stratum 1*	*Stratum 2*	*Stratum 3*	*Stratum 4*	*Stratum 5*	*Totals*
Strata boundaries (kWh)	50,000,000 - 250,000	250,000 - 100,000	100,000 - 50,000	50,000 - 5,000	5,000 - 0	
Population Size	51	76	170	1,318	935	2,550
Total kWh savings	24,414,895	11,628,388	11,632,821	23,032,522	2,010,743	72,719,369
Average kWh	478,723	153,005	68,428	17,475	2,151	
Standard deviation of kWh	217,963	39,276	13,498	11,481	1,445	
Coefficient of	0.46	0.26	0.20	0.66	0.67	
Final design	15	4	6	45	21	91

Table 3-3 shows the Standard high impact measure 3025 LED linear lamp replacing T8 fluorescent lamp population from which the sample was drawn. These samples fell into three energy savings strata defined by ex ante kWh savings boundaries.

Table 3-3 Statistics Used for Standard Program HIM 3025 Sample Design

Variables	*Stratum 1*	*Stratum 2*	*Stratum 3*	*Stratum 4*	*Stratum 5*	*Totals*
Strata boundaries (kWh)	50,000,000 – 2,500,000	2,500,000 - 650,000	650,000 – 160,000	160,000 – 40,000	40,000 –0	
Population Size	1	6	61	390	1,915	2,373
Total kWh savings	2,902,217	5,429,731	15,797,977	29,073,466	18,652,921	71,856,312
Average kWh Savings	2,902,217	904,955	258,983	74,547	9,740	
Standard deviation of kWh	-	319,492	101,697	28,736	9,711	
Coefficient of variation	-	0.35	0.39	0.39	1.00	
Final design sample	1	1	8	27	88	125

Table 3-4 shows the Standard high impact measure 3026 LED linear lamp replacing T12 fluorescent lamp population from which the sample was drawn. These samples fell into three energy savings strata defined by ex ante kWh savings boundaries.

Table 3-4 Population Statistics Used for Standard Program HIM 3026 Sample Design

Variables	*Stratum 1*	*Stratum 2*	*Stratum 3*	*Stratum 4*	*Stratum 5*	*Totals*
Strata boundaries (kWh)	50,000,000 - 90,000	90,000 - 30,000	30,000 – 20,000	20,000 – 10,000	10,000 - 0	
Population Size	66	415	278	598	1,489	2,846
Total kWh savings	9,306,480	20,101,455	6,837,743	8,569,448	6,621,923	51,437,049
Average kWh Savings	141,007	48,437	24,596	14,330	4,447	
Standard deviation of kWh	69,317	14,983	2,903	2,863	2,705	
Coefficient of variation	0.49	0.31	0.12	0.20	0.61	
Final design sample	7	21	6	12	40	86

Table 3-5 shows the New Construction project population from which the sample was drawn. These samples fell into four energy savings strata defined by ex ante kWh savings boundaries.

Table 3-5 Population Statistics Used for New Construction Program Sample Design

Variables	*Stratum 1*	*Stratum 2*	*Stratum 3*	*Stratum 4*	*Stratum 5*	*Totals*
Strata boundaries (kWh)	50,000,000 – 2,500,000	2,500,000 - 1,000,000	1,000,000 - 450,000	450,000 – 170,000	170,000 - 0	
Population Size	1	4	9	20	54	88
Total kWh savings	2,778,672	5,382,579	5,491,554	5,610,928	2,565,923	21,829,656
Average kWh Savings	2,778,672	1,345,645	610,173	280,546	47,517	
Standard deviation of kWh	-	198,601	117,500	63,144	42,915	
Coefficient of variation	-	0.15	0.19	0.23	0.90	
Final design sample	1	1	3	3	9	17

Table 3-6 shows the Retro-Commissioning projects with the four sampling strata and the ex ante kWh savings.

Table 3-6 Population Statistics Used for Retro-Commissioning Program Sample Design

Variables	*Stratum 1*	*Stratum 2*	*Stratum 3*	*Stratum 4*	*Totals*
Strata boundaries (kWh)	50,000,000 - 1,000,000	1,000,000 - 400,000	400,000 - 90,000	90,000 - 0	
Population size	1	5	2	7	15
Total kWh savings	2,999,610	2,863,657	413,728	424,552	6,701,547
Average kWh savings	2,999,610	572,731	206,864	60,650	
Standard deviation of kWh	-	114,385	71,538	20,088	
Coefficient of variation	-	0.20	0.35	0.33	
Final design sample	1	2	1	5	9

Table 3-7 shows the Small Business Direct Install non-HIM population from which the sample was drawn. These samples fell into three energy savings strata defined by ex ante kWh savings boundaries.

Table 3-7 Population Statistics Used for Non-HIM Small Business Direct Install Sample Design

Variables	*Stratum 1*	*Stratum 2*	*Stratum 3*	*Totals*
Strata boundaries (kWh)	50,000,000 - 20,000	20,000 - 10,000	10,000 - 0	
Population Size	26	65	629	720
Total kWh savings	887,251	913,640	1,339,384	3,140,275
Average kWh Savings	34,125	14,056	2,129	
Standard deviation of kWh	13,011	2,730	2,396	
Coefficient of variation	0.38	0.19	1.13	
Final design sample	4	8	49	61

Table 3-8 shows the Small Business Direct Install high impact measure 3025 LED linear lamp replacing T8 fluorescent lamp population from which the sample was drawn. These samples fell into four energy savings strata defined by ex ante kWh savings boundaries.

Table 3-8 Population Statistics Used for SBDI Program HIM 3025 Sample Design

Variables	*Stratum 1*	*Stratum 2*	*Stratum 3*	*Stratum 4*	*Totals*
Strata boundaries (kWh)	50,000,000 - 50,000	50,000 - 16,000	16,000 - 5,000	5,000 - 0	
Population Size	1	32	125	280	438
Total kWh savings	60,596	728,219	1,078,731	531,754	2,399,300
Average kWh Savings	60,596	22,757	8,630	1,899	
Standard deviation of kWh	-	6,249	2,877	1,457	
Coefficient of variation	-	0.27	0.33	0.77	
Final design sample	1	5	15	23	44

Table 3-9 shows the Small Business Direct Install high impact measure, 3026 LED linear lamp replacing T12 fluorescent lamp, population from which the sample was drawn. These samples fell into three energy saving strata defined by ex ante kWh savings boundaries.

Table 3-9 Population Statistics Used for SBDI Program HIM 3026 Sample Design

Variables	*Stratum 1*	*Stratum 2*	*Stratum 3*	*Stratum 4*	*Totals*
Strata boundaries (kWh)	50,000,000 - 30,000	30,000 - 10,000	10,000 – 4,000	4,000 - 0	
Population Size	51	298	403	397	1,149
Total kWh savings	2,181,368	4,848,313	2,699,172	804,062	10,532,915
Average kWh Savings	42,772	16,270	6,698	2,025	
Standard deviation of kWh	15,188	5,082	1,691	1,184	
Coefficient of variation	0.36	0.31	0.25	0.58	
Final design sample	8	31	42	41	122

The Custom Program stratified sample shown in Table 3-10 resulted in samples that total 23% of the ex ante population kWh savings.

Table 3-10 Ex Ante kWh Savings of Custom Program Sampled Projects by Stratum

Stratum	*Sample Ex Ante kWh Savings*	*Total Ex Ante kWh Savings*	*Percentage of Ex Ante Savings in Sample*
1	5,848,131	5,848,131	100%
2	4,811,870	11,897,198	40%
3	3,196,394	10,768,154	30%
4	3,786,455	19,406,475	20%
5	3,726,724	28,975,655	13%
6	1,310,446	22,884,218	6%
Total	22,680,020	99,779,831	23%

The standard non-HIM projects' stratified sample shown in Table 3-11 resulted in samples that total 13% of the ex ante population kWh savings.

Table 3-11 Ex Ante kWh Savings of Non-HIM Standard Program Sampled Projects by Stratum

Stratum	*Sample Ex Ante kWh Savings*	*Total Ex Ante kWh Savings*	*Percentage of Ex Ante Savings in Sample*
1	7,700,232	24,414,895	32%
2	614,086	11,628,388	5%
3	478,476	11,632,821	4%
4	927,114	23,032,522	4%
5	49,682	2,010,743	2%
Total	9,769,590	72,719,369	13%

The standard HIM 3025 projects stratified sample shown in Table 3-12 resulted in samples that total 13% of the ex ante population kWh savings.

Table 3-12 Ex Ante kWh Savings of Standard Program HIM 3025 Sampled Projects by Stratum

Stratum	*Sample Ex Ante kWh Savings*	*Total Ex Ante kWh Savings*	*Percentage of Ex Ante Savings in Sample*
1	2,902,217	2,902,217	100%
2	1,004,997	5,429,731	19%
3	2,223,455	15,797,977	14%
4	2,191,504	29,073,466	8%
5	1,158,355	18,652,921	6%
Total	9,480,528	71,856,312	13%

The standard HIM 3026 projects stratified sample shown in Table 3-13 resulted in samples that total 5% of the ex ante population kWh savings.

Table 3-13 Ex Ante kWh Savings of Standard Program HIM 3026 Sampled Projects by Stratum

Stratum	*Sample Ex Ante kWh Savings*	*Total Ex Ante kWh Savings*	*Percentage of Ex Ante Savings in Sample*
1	1,261,446	9,306,480	14%
2	1,071,674	20,101,455	5%
3	143,519	6,837,743	2%
4	177,129	8,569,448	2%
5	145,354	6,621,923	2%
Total	2,799,122	51,437,049	5%

The new construction projects' stratified sample shown in Table 3-14 resulted in samples that total 35% of the ex ante population kWh savings.

Table 3-14 Ex Ante kWh Savings of New Construction Program Sampled Projects by Stratum

Stratum	*Sample Ex Ante kWh Savings*	*Total Ex Ante kWh Savings*	*Percentage of Ex Ante Savings in Sample*
1	2,778,672	2,778,672	100%
2	1,592,560	5,382,579	30%
3	1,602,564	5,491,554	29%
4	911,459	5,610,928	16%
5	697,166	2,565,923	27%
Total	7,582,421	21,829,656	35%

The retro-commissioning project census shown in Table 3-15 resulted in samples that total 67% of ex ante population kWh savings.

Table 3-15 Ex Ante kWh Savings of Retro-Commissioning Program Sampled Projects by Stratum

Stratum	*Sample Ex Ante kWh Savings*	*Total Ex Ante kWh Savings*	*Percentage of Ex Ante Savings in Sample*
1	2,999,610	2,999,610	100%
2	916,880	2,863,657	32%
3	257,449	413,728	62%
4	320,040	424,552	75%
Total	4,493,979	6,701,547	67%

The small business direct install non-HIM projects stratified sample shown in Table 3-16 resulted in samples that total 13% of the ex ante population kWh savings.

Table 3-16 Ex Ante kWh Savings of Small Business Direct Install Non-HIM Program Sampled Projects by Stratum

Stratum	*Sample Ex Ante kWh Savings*	*Total Ex Ante kWh Savings*	*Percentage of Ex Ante Savings in Sample*
1	146,568	887,251	17%
2	110,803	913,640	12%
3	136,113	1,339,384	10%
Total	393,484	3,140,275	13%

The small business direct install HIM 3025 projects stratified sample shown in Table 3-17 resulted in samples that total 15% of the ex ante kWh savings.

Table 3-17 Ex Ante kWh Savings of SBDI HIM 3025 Program Sampled Projects by Stratum

Stratum	*Sample Ex Ante kWh Savings*	*Total Ex Ante kWh Savings*	*Percentage of Ex Ante Savings in Sample*
1	60,596	60,596	100%
2	112,360	728,219	15%
3	131,364	1,078,731	12%
4	49,435	531,754	9%
Total	353,755	2,399,300	15%

The small business direct install HIM 3026 projects stratified sample shown in Table 3-18 resulted in samples that total 12% of the ex ante population kWh savings.

Table 3-18 Ex Ante kWh Savings of SBDI HIM 3026 Program Sampled Projects by Stratum

Stratum	*Sample Ex Ante kWh Savings*	*Total Ex Ante kWh Savings*	*Percentage of Ex Ante Savings in Sample*
1	371,855	2,181,368	17%
2	490,701	4,848,313	10%
3	285,218	2,699,172	11%
34	80,489	804,062	10%
Total	1,228,263	10,532,915	12%

4. Ex Post Gross Savings Technical Data

This appendix presents detailed technical data regarding the estimation of ex post gross energy savings.

4.1. M&V Sample Site-Level and Measure-Level Gross Savings

Table 4-1 shows the ex ante and ex post gross Custom Program energy savings by sample site.

Table 4-1 Ex Ante and Ex Post Gross Annual kWh Savings for Custom Program by Sampled Site

Custom ID	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*
6001	228,633	184,388	81%
6003	59,497	58,521	98%
6004	35,364	34,783	98%
6005	32,009	31,485	98%
6006	31,480	30,962	98%
6007	24,813	24,405	98%
6008	4,726	4,648	98%
6021	7,911	7,781	98%
6022	7,911	7,781	98%
6023	7,911	7,781	98%
6024	7,911	7,781	98%
6044	149,218	196,603	132%
6045	103,077	97,402	94%
6047	160,571	154,395	96%
6048	93,951	92,454	98%
6049	163,686	178,806	109%
6050	159,629	170,768	107%
6051	204,684	218,979	107%
6052	169,383	184,890	109%
6053	211,120	189,131	90%
6054	55,366	49,812	90%
6056	53,925	50,343	93%
6057	5,729	5,635	98%
6058	1,300,908	1,222,166	94%
6059	110,901	109,081	98%
6060	130,677	128,532	98%
6061	8,705	9,812	113%
6062	7,647	7,522	98%
6063	1,551	1,525	98%

Custom ID	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*
6064	21,024	20,679	98%
6065	476,072	443,741	93%
6068	74,286	73,058	98%
6069	292,956	293,015	100%
6070	1,950	953	49%
6072	135,812	135,769	100%
6073	59,515	58,538	98%
6075	8,957	7,352	82%
6078	187,643	184,623	98%
6079	62,054	44,793	72%
6080	223,336	222,247	100%
6081	129,326	93,179	72%
6082	89,017	89,725	101%
6085	29,994	31,012	103%
6092	4,665	4,703	101%
6094	28,050	27,588	98%
6095	885,936	719,084	81%
6122	13,590	7,352	54%
6130	100,214	98,567	98%
6153	400,107	441,150	110%
6154	300,630	276,813	92%
6155	169,632	185,505	109%
6218	27,790	26,025	94%
6259	117,281	113,148	96%
6282	385,727	422,821	110%
6284	223,994	194,328	87%
6290	42,656	40,019	94%
6292	2,056,320	1,836,937	89%
6302	37,713	37,517	99%
6307	20,496	14,313	70%
6312	784,296	783,449	100%
6317	337,607	420,205	124%
6328	108,490	100,740	93%
6329	40,850	37,401	92%
6330	70,583	69,424	98%
6331	145,398	143,011	98%
6332	19,369	12,825	66%
6336	17,739	17,446	98%
6340	59,276	63,015	106%
6341	2,755,550	3,207,378	116%
6343	52,082	53,597	103%
6352	24,013	22,535	94%

Custom ID	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*
6361	69,418	27,786	40%
6364	365,966	345,146	94%
6378	1,009,550	832,206	82%
6380	2,395	450	19%
6384	35,165	35,838	102%
6385	26,696	26,254	98%
6394	11,344	11,151	98%
6398	14,415	14,178	98%
6399	5,848,131	4,856,655	83%
6402	736,050	723,547	98%
Sampled Total	22,680,020	21,416,963	94%
All Non-Sample Measures	77,099,811	74,594,453	97%
Total	99,779,831	96,011,416	96%

The ex post gross kWh savings of the sampled Custom Program measures are presented in Table 4-2.

Table 4-2 Ex Ante and Ex Post Gross Annual kWh Savings for Sampled Custom Program Measures

Measure Name	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*
100101-Lighting-Linear Tube LED Fixture Replacing T12 Fixture	135,106	197,262	146%
100102-Lighting-Linear Tube LED Fixture Replacing T12 HO Fixture	317	231	73%
100104-Lighting-Linear Tube LED Fixture Replacing T8 Fixture	636,025	656,321	103%
100105-Lighting-Linear Tube LED Fixture Replacing T8 HO Fixture	11,344	11,151	98%
100107-Lighting-Linear Tube LED Fixture Replacing T5 HO Fixture	573,842	502,030	87%
100113-Lighting-Linear Tube LED Fixture Replacing CFL Fixture	59,276	63,015	106%
100114-Lighting-Linear Tube LED Fixture Replacing Inefficient Signage Fixture	565	556	98%
100201-Lighting-Non Linear LED Fixture Replacing T12 Fixture	268,352	268,142	100%
100202-Lighting-Non Linear LED Fixture Replacing T12 HO Fixture	10,011	9,909	99%
100203-Lighting-Non Linear LED Fixture Replacing T12 VHO Fixture	57,255	56,315	98%
100204-Lighting-Non Linear LED Fixture Replacing T8 Fixture	2,448,787	2,213,579	90%
100207-Lighting-Non Linear LED Fixture Replacing T5 HO Fixture	980,224	898,407	92%
100208-Lighting-Non Linear LED Fixture Replacing Metal Halide Fixture	4,306,213	4,308,308	100%

Measure Name	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*
100209-Lighting-Non Linear LED Fixture Replacing Pulse Start Metal Halide Fixture	63,614	62,570	98%
100210-Lighting-Non Linear LED Fixture Replacing Mercury Vapor Fixture	21,598	20,390	94%
100211-Lighting-Non Linear LED Fixture Replacing High Pressure Sodium Fixture	409,424	422,972	103%
100212-Lighting-Non Linear LED Fixture Replacing Incandescent/Halogen Lamp Fixture	16,413	13,890	85%
100213-Lighting-Non Linear LED Fixture Replacing CFL Fixture	205,343	203,468	99%
100216-Lighting-Non Linear LED Fixture Replacing Existing Inefficient Lighting Fixture	1,017,430	839,940	83%
101108-Lighting-New Efficient Lighting Fixture Replacing Metal Halide Fixture	1,743	695	40%
101113-Lighting-New Efficient Lighting Fixture Replacing CFL Fixture	37,001	37,382	101%
101116-Lighting-New Efficient Lighting Fixture Replacing Existing Inefficient Lighting Fixture	252,295	294,005	117%
103621-Lighting-On/Off Occupancy Sensor Replacing No Existing Equipment or Replacing Failed Equipment	473	473	100%
112421-HVAC-Water Cooled Chiller Replacing No Existing Equipment or Replacing Failed Equipment	1,863,372	1,547,461	83%
112720-HVAC-Packaged / Rooftop Unit Replacing Existing Inefficient Equipment or Early Replacement	42,656	40,019	94%
112721-HVAC-Packaged / Rooftop Unit Replacing No Existing Equipment or Replacing Failed Equipment	69,418	27,786	40%
113020-HVAC-Water Loop Heat Pump Replacing Existing Inefficient Equipment or Early Replacement	342,826	322,006	94%
113321-HVAC-VFD for Fan Replacing No Existing Equipment or Replacing Failed Equipment	20,496	14,313	70%
115921-HVAC-Cooling Only HVAC Equipment Replacing No Existing Equipment or Replacing Failed Equipment	3,984,759	3,309,194	83%
166021-Motors-VFD for Process Motor Replacing No Existing Equipment or Replacing Failed Equipment	2,056,320	1,836,937	89%
191520-Building Shell-Wall Insulation Replacing Existing Inefficient Equipment or Early Replacement	2,778,690	3,230,518	116%
191521-Building Shell-Wall Insulation Replacing No Existing Equipment or Replacing Failed Equipment	4,167	3,015	72%
424220-Miscellanous-Efficient Equipment Replacing Existing Inefficient Equipment or Early Replacement	4,665	4,703	101%
Total	22,680,020	21,416,963	94%

Table 4-3 shows the ex ante and ex post gross energy savings of the EMS Pilot Program by site. Note that for the EMS Pilot Program, the evaluation team performed an M&V census rather than develop a sample.

Table 4-3 Ex Ante and Ex Post Gross Annual kWh Savings for EMS Pilot Program Sites

ID	*Ex Ante kWh Savings*	*Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*
5642	130,597	138,488	106%
6025	60,966	51,334	84%
6090	135,139	72,630	54%
6179	60,498	52,478	87%
6180	29,141	23,843	82%
6290	110,246	109,155	99%
6291	109,078	110,980	102%
6304	55,618	31,914	57%
6305	147,508	139,574	95%
6306	31,986	64,655	202%
6307	7,817	10,137	130%
6316	379,191	358,593	95%
6343	369,927	305,307	83%
6344	200,378	214,742	107%
6345	70,538	33,061	47%
6346	33,980	21,664	64%
6347	71,852	133,521	186%
6348	150,206	119,780	80%
6349	33,206	18,955	57%
6350	111,885	103,370	92%
6351	55,656	56,268	101%
6352	65,916	47,690	72%
6353	446,801	418,199	94%
6354	98,129	97,293	99%
6355	541,178	568,161	105%
6356	157,417	171,729	109%
6359	139,251	148,874	107%
6360	218,948	207,529	95%
6361	190,918	90,079	47%
6362	108,199	108,670	100%
6363	59,301	53,153	90%
6364	507,212	301,151	59%
6374	126,971	123,032	97%
6375	44,657	44,331	99%
6376	35,170	34,378	98%
6405	258,799	232,857	90%
Sampled Total	5,354,280	4,817,575	90%

The ex post gross kWh savings of the EMS Pilot Program are presented by measure in Table 4-4.

Table 4-4 Ex Ante and Ex Post Gross Annual kWh Savings for EMS Pilot Program Measures

EMS Program Measure Name	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*
108320-Lighting-Lighting Replacing Existing System	55,618	31,914	57%
117920-HVAC-Cooling Replacing Existing System	2,123,736	1,900,649	89%
118120-HVAC-Heating Replacing Existing System	424,654	499,452	118%
118220-HVAC-HVAC Replacing Existing System	2,729,984	2,368,217	87%
428420-Miscellaneous-Miscellaneous Replacing Existing System	20,288	17,344	85%
Total	5,354,280	4,817,575	90%

Table 4-5 shows the ex ante and ex post gross Standard Program annual energy savings by sample site.

Table 4-5 Ex Ante and Ex Post Gross Annual kWh Savings for Standard Program by Sampled Site

ID	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*
6001	5,941	2,429	41%
6009	43,424	57,828	133%
6010	29,979	37,894	126%
6011	29,113	42,366	146%
6012	27,651	38,142	138%
6013	13,574	14,103	104%
6014	8,155	8,682	106%
6015	5,425	9,828	181%
6016	2,918	2,975	102%
6017	40,487	47,203	117%
6018	23,555	30,242	128%
6019	23,369	27,654	118%
6020	12,520	12,974	104%
6029	3,659	3,981	109%
6030	7,039	6,483	92%
6031	12,185	8,066	66%
6033	29,700	24,049	81%
6039	35,491	20,697	58%

ID	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*
6041	29,262	22,907	78%
6043	88,989	89,400	100%
6046	235,282	228,032	97%
6054	17,137	10,523	61%
6055	153,922	187,303	122%
6057	241,437	155,388	64%
6061	65,586	73,562	112%
6062	164,496	164,532	100%
6063	46,309	57,483	124%
6064	21,293	24,122	113%
6065	50,600	40,657	80%
6066	384,723	296,892	77%
6068	116,440	108,946	94%
6069	109,382	116,878	107%
6070	7,498	3,839	51%
6071	40,942	18,241	45%
6072	172,820	171,190	99%
6074	50,530	33,647	67%
6075	46,255	41,487	90%
6076	30,952	33,269	107%
6077	24,409	24,820	102%
6078	70,982	70,262	99%
6079	39,756	46,653	117%
6083	262,685	233,003	89%
6084	434,335	443,241	102%
6085	43,867	27,300	62%
6095	5,668	3,080	54%
6096	293,940	320,184	109%
6098	47,187	45,278	96%
6102	5,544	21,719	392%
6105	31,084	39,960	129%
6106	45,395	65,089	143%
6107	75,368	68,077	90%
6108	66,133	90,581	137%
6109	26,482	32,438	122%
6113	49,303	50,064	102%
6114	34,256	42,746	125%
6115	2,481	3,449	139%
6116	3,898	4,386	113%

ID	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*
6117	11,927	10,085	85%
6122	87,751	26,892	31%
6123	63,755	55,099	86%
6124	57,910	84,849	147%
6125	110,289	111,828	101%
6126	447,121	389,198	87%
6127	442,640	413,682	93%
6144	25,589	25,054	98%
6154	111,785	91,477	82%
6213	530,979	258,489	49%
6217	801,435	718,500	90%
6218	345,535	169,857	49%
6242	2,378	2,084	88%
6259	32,954	22,906	70%
6261	158,655	131,268	83%
6263	1,061,684	770,746	73%
6264	176,646	85,111	48%
6265	116,985	136,604	117%
6268	295,821	282,326	95%
6272	215,438	213,152	99%
6282	120,000	28,959	24%
6284	43,361	42,089	97%
6285	212,990	271,958	128%
6286	253,818	250,736	99%
6287	104,118	77,585	75%
6293	9,369	9,896	106%
6294	3,452	3,229	94%
6295	5,423	5,044	93%
6296	1,479	1,218	82%
6297	13,313	12,706	95%
6298	6,472	12,634	195%
6299	6,325	5,120	81%
6300	8,675	7,890	91%
6301	7,239	5,414	75%
6313	137,976	84,998	62%
6317	9,591	2,224	23%
6319	258,269	321,523	124%
6320	878,573	450,000	51%
6322	482,616	467,381	97%

ID	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*
6323	486,062	450,988	93%
6324	515,216	485,169	94%
6325	508,484	489,462	96%
6326	459,986	431,769	94%
6328	7,057	3,402	48%
6331	10,639	17,352	163%
6332	178,732	186,001	104%
6333	10,209	9,072	89%
6334	13,757	12,179	89%
6335	11,310	9,315	82%
6336	107,361	67,998	63%
6337	137,478	153,983	112%
6338	27,354	34,859	127%
6339	28,017	36,239	129%
6340	132,353	133,307	101%
6343	140,111	131,258	94%
6352	58,453	34,911	60%
6361	100,847	93,991	93%
6364	153,328	104,269	68%
6378	11,025	12,510	113%
6380	57,618	68,949	120%
6381	389,602	386,711	99%
6382	2,902,217	3,012,519	104%
6384	327,935	317,446	97%
6385	283,781	195,634	69%
6390	3,098	3,310	107%
6392	196,775	174,672	89%
6393	482,333	273,850	57%
6394	238,326	201,583	85%
6396	364,767	311,289	85%
6400	1,031,615	891,139	86%
6402	1,022,245	757,435	74%
Sampled Total	22,049,240	19,458,607	88%
All Non-Sample Measures	173,963,490	156,486,199	90%
Total	196,012,730	175,944,805	90%

The ex ante and ex post gross kWh savings for the sampled Standard Program measures are presented by measure in Table 4-6.

Table 4-6 Ex Ante and Ex Post Gross Annual kWh Savings for Sampled Standard Measures

Measure Name	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*
200102-Lighting-Linear LED Lamp <=22 Watt Lamp Replacing T8 32 Watt Lamp	127,608	75,192	59%
200808-Lighting-LED <=13 Watt Lamp Replacing Halogen MR-16 35-50 Watt Lamp or Fixture	13,648	11,938	87%
200909-Lighting-LED <=14 Watt Lamp Replacing Halogen BR/R 45-66 Watt Lamp or Fixture	15,674	24,312	155%
201010-Lighting-LED <=20 Watt Lamp Replacing Halogen PAR 48-90 Watt Lamp or Fixture	10,621	7,270	68%
201111-Lighting-LED <=11 Watt Lamp Replacing Halogen A 28-52 Watt Lamp	39,579	32,195	81%
201316-Lighting-LED or Electroluminescent Replacing Incandescent Exit Sign	32,683	33,407	102%
201317-Lighting-LED or Electroluminescent Replacing CFL Exit Sign	3,065	3,002	98%
201618-Lighting-Single Technology Occupancy Sensor Controlling Lighting Circuit >120 Watts	920	123	13%
201718-Lighting-Dual Technology Occupancy Sensor Controlling Lighting Circuit >150 Watts	31,920	5,796	18%
300938-Lighting-LED <=14 Watt Lamp or Fixture Replacing Halogen BR/R Lamp or Fixture	86,542	82,246	95%
301037-Lighting-LED <=20 Watt Lamp or Fixture Replacing Halogen A >=40 Watt Lamp or Fixture	27,396	47,748	174%
301039-Lighting-LED <=20 Watt Lamp or Fixture Replacing Halogen PAR Lamp or Fixture	34,543	40,162	116%
301132-Lighting-LED 7-20 Watt Lamp Replacing Halogen A 53-70 Watt Lamp	34,538	50,665	147%
301818-Lighting-Fixture Mounted Occupancy Sensor Controlling >50 and <=200 Watts Replacing No Controls	332,100	144,323	43%
305005-Lighting-<=80 Watt Lamp or Fixture Replacing Interior HID 100-175 Watt Lamp or Fixture	359,160	175,011	49%
305013-Lighting-<=80 Watt Lamp or Fixture Replacing Garage or Exterior 24/7 HID 100-175 Watt Lamp or Fixture	327,335	238,994	73%
305114-Lighting-62-130 Watt Lamp or Fixture Replacing Garage or Exterior 24/7 HID 176-300 Watt Lamp or Fixture	6,447	6,447	100%
305233-Lighting-85-225 Watt Lamp or Fixture Replacing Interior HID 301-500 Watt Lamp or Fixture	1,294,200	1,125,971	87%
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T12 <=40 Watt Linear ft	584,289	521,240	89%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	2,331,433	2,043,632	88%
305502-Lighting-Linear ft T8 25 Watt (<=7 Watts/ft) Replacing T8 32 Watt Linear ft	47,187	45,278	96%
305801-Lighting-Delamping Replacing T12 <=40 Watt	202,133	179,790	89%
305802-Lighting-Delamping Replacing T8 32 Watt	97,539	72,817	75%
306036-Lighting-Linear ft LED (<=7.5 Watts/ft) Replacing T5 HO Lamp	45,668	37,188	81%
306135-Lighting-LED Lamp or Fixture Replacing T5 Lamp or Fixture	5,571,495	4,821,554	87%
306140-Lighting-LED Lamp or Fixture Replacing Interior HID Lamp or Fixture	1,128,917	996,792	88%
306141-Lighting-LED Lamp or Fixture Replacing Garage or Exterior 24/7 HID Lamp or Fixture	26,280	26,280	100%

Measure Name	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	2,214,833	1,775,635	80%
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	7,021,487	6,833,598	97%
Total	22,049,240	19,458,607	88%

Table 4-7 shows the ex ante and ex post gross New Construction Program annual energy savings by sample site.

Table 4-7 Ex Ante and Ex Post Gross Annual kWh Savings for New Construction Program by Sampled Site

ID	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*
6086	692,069	668,152	97%
6089	40,140	38,098	95%
6094	1,592,560	1,531,880	96%
6130	243,040	128,786	53%
6131	30,179	28,450	94%
6134	104,114	104,106	100%
6221	288,102	310,673	108%
6257	75,378	69,902	93%
6258	4,700	4,854	103%
6260	291,984	263,912	90%
6262	380,317	285,888	75%
6309	150,671	148,390	98%
6366	2,778,672	2,810,351	101%
6367	459,759	451,530	98%
6368	450,736	636,732	141%
Sampled Total	7,582,421	7,481,704	99%
All Non-Sample Measures	14,247,235	13,410,832	94%
Total	21,829,656	20,892,536	96%

The ex ante and ex post gross kWh savings for the sampled New Construction Program measures are presented by measure in Table 4-8.

Table 4-8 Ex Ante and Ex Post Gross Annual kWh Savings for Sampled New Construction Measures

Measure Name	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*
112321-HVAC-Air Cooled Chiller Replacing No Existing Equipment or Replacing Failed Equipment	7,050	6,029	86%
112421-HVAC-Water Cooled Chiller Replacing No Existing Equipment or Replacing Failed Equipment	239,990	216,853	90%
112721-HVAC-Packaged / Rooftop Unit Replacing No Existing Equipment or Replacing Failed Equipment	132,937	138,750	104%
113221-HVAC-HVAC Controls / EMS Replacing No Existing Equipment or Replacing Failed Equipment	113,788	87,759	77%
113321-HVAC-VFD for Fan Replacing No Existing Equipment or Replacing Failed Equipment	87,909	94,770	108%
115921-HVAC-Cooling Only HVAC Equipment Replacing No Existing Equipment or Replacing Failed Equipment	128,107	124,881	97%
191521-Building Shell-Wall Insulation Replacing No Existing Equipment or Replacing Failed Equipment	24,566	16,097	66%
406123-Lighting-New Construction Lighting Power Density (LPD)	6,469,645	6,432,453	99%
426325-Miscellaneous-New Construction Energy Efficiency Upgrades Over Baseline Building	378,429	364,112	96%
Total	7,582,421	7,481,704	99%

Table 4-9 shows the ex ante and ex post gross Retro-Commissioning Program annual energy savings by sample site.

Table 4-9 Ex Ante and Ex Post Gross kWh Savings for Retro-Commissioning Program by Sampled Site

ID	*Ex Ante kWh Savings*	*Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*
6092	44,621	70,010	157%
6093	68,579	64,228	94%
6250	257,449	152,184	59%
6310	42,192	40,353	96%
6342	79,054	80,525	102%
6369	491,009	527,466	107%
6370	425,871	507,695	119%
6371	2,999,610	2,684,909	90%
6395	85,594	81,840	96%
Sampled Total	4,493,979	4,209,210	94%
All Non-Sample Measures	2,207,568	2,400,335	109%
Total	6,701,547	6,609,545	99%

The ex ante and ex post gross kWh savings for the sampled Retro-Commissioning Program measures are presented by measure in Table 4-10.

Table 4-10 Ex Ante and Ex Post Gross Annual kWh Savings for Sampled Retro-Commissioning Program Measures

Measure Name	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*
112420-HVAC-Water Cooled Chiller Replacing Existing Inefficient Equipment or Early Replacement	910,567	990,966	109%
113220-HVAC-HVAC Controls / EMS Replacing Existing Inefficient Equipment or Early Replacement	357,664	347,421	97%
116620-HVAC-HVAC Optimization - Airside	665,413	724,166	109%
187320-Compressed Air-Compressed Air System Leak Repair	774,422	742,256	96%
Total	2,708,066	2,804,809	104%

Table 4-11 shows the ex ante and ex post gross SBDI Program annual energy savings by sample site.

Table 4-11 Ex Ante and Ex Post Gross Annual kWh Savings for SBDI Non-HIM by Sampled Site

ID	*Ex Ante kWh Savings*	*Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*
6002	57,875	46,757	81%
6026	18,133	21,450	118%
6032	11,568	11,830	102%
6034	6,581	11,466	174%
6035	9,260	11,670	126%
6036	440	310	70%
6037	1,132	2,733	241%
6038	15,259	13,614	89%
6040	31,149	57,273	184%
6041	553	1,128	204%
6042	104,593	91,860	88%
6118	15,066	32,432	215%
6119	15,172	6,129	40%
6135	11,738	11,789	100%
6136	23,834	28,620	120%
6137	14,168	17,000	120%
6143	19,576	25,813	132%
6146	15,215	11,708	77%
6147	12,980	5,443	42%
6148	4,526	4,012	89%
6149	7,585	4,930	65%
6163	56,671	56,102	99%

ID	*Ex Ante kWh Savings*	*Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*
6164	15,344	11,739	77%
6166	21,567	15,541	72%
6167	16,441	14,150	86%
6168	23,864	14,097	59%
6169	38,844	23,988	62%
6171	33,059	33,689	102%
6172	12,239	10,015	82%
6173	6,549	4,794	73%
6174	12,639	12,076	96%
6176	16,435	20,189	123%
6178	6,079	5,744	94%
6181	6,163	3,501	57%
6182	33,317	17,185	52%
6183	14,887	10,582	71%
6184	52,776	25,340	48%
6186	2,509	2,292	91%
6187	7,610	9,269	122%
6188	2,047	1,665	81%
6189	901	2,213	246%
6190	5,076	5,364	106%
6191	1,224	1,813	148%
6192	5,607	4,251	76%
6193	5,873	1,309	22%
6194	13,163	14,432	110%
6195	9,142	3,572	39%
6196	7,860	5,850	74%
6197	15,094	8,150	54%
6198	18,548	7,926	43%
6199	4,204	4,399	105%
6200	34,319	23,417	68%
6201	7,551	9,984	132%
6202	16,716	9,516	57%
6203	14,782	22,671	153%
6204	11,920	18,538	156%
6205	4,237	1,957	46%
6206	760	1,583	208%
6208	4,219	4,323	102%
6209	3,442	4,796	139%
6210	39,190	45,655	116%

ID	*Ex Ante kWh Savings*	*Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*
6211	8,139	15,651	192%
6212	18,612	18,166	98%
6224	2,963	2,978	101%
6225	7,333	7,205	98%
6226	3,246	3,042	94%
6227	32,381	32,223	100%
6228	14,036	13,771	98%
6229	13,180	16,856	128%
6230	8,101	10,340	128%
6231	3,766	5,490	146%
6233	59,652	38,254	64%
6234	10,015	4,724	47%
6235	6,405	6,573	103%
6236	9,132	8,782	96%
6237	7,233	5,724	79%
6238	3,850	2,535	66%
6239	4,895	5,293	108%
6240	21,789	25,735	118%
6241	5,892	5,848	99%
6242	2,802	1,997	71%
6243	22,685	19,409	86%
6244	5,739	1,843	32%
6245	7,608	7,583	100%
6246	11,092	12,683	114%
6247	13,484	12,732	94%
6249	4,938	4,549	92%
6251	13,772	45,466	330%
6252	24,593	3,799	15%
6253	8,838	4,913	56%
6255	10,628	7,083	67%
6256	24,992	17,841	71%
6270	110,693	93,011	84%
6271	68,403	68,851	101%
6274	27,506	10,905	40%
6275	22,509	21,566	96%
6276	17,888	19,781	111%
6277	4,326	10,369	240%
6278	25,828	14,988	58%
6279	4,513	848	19%

ID	Ex Ante kWh Savings	Ex Post kWh Savings	Gross kWh Savings Realization Rate
6280	7,001	6,084	87%
6281	2,400	2,698	112%
6288	2,427	2,417	100%
6289	24,989	17,735	71%
6383	77,913	87,645	112%
6386	35,803	32,283	90%
6387	25,206	22,573	90%
6388	43,921	36,185	82%
6389	42,408	23,472	55%
6390	16,116	12,028	75%
6391	24,590	7,552	31%
Sampled Total	1,975,502	1,771,723	90%
All Non-Sample Measures	14,096,988	12,562,169	89%
Total	16,072,490	14,333,892	89%

The ex ante and ex post gross kWh savings for the sampled SBDI measures are presented by measure in Table 4-12.

Table 4-12 Ex Ante and Ex Post Gross Annual kWh Savings for Sampled SBDI Measures

Measure Name	Ex Ante kWh Savings	Ex Post Gross kWh Savings	Gross kWh Savings Realization Rate
200808-Lighting-LED <=13 Watt Lamp Replacing Halogen MR-16 35-50 Watt Lamp or Fixture	6,325	5,148	81%
200909-Lighting-LED <=14 Watt Lamp Replacing Halogen BR/R 45-66 Watt Lamp or Fixture	10,349	8,118	78%
201111-Lighting-LED <=11 Watt Lamp Replacing Halogen A 28-52 Watt Lamp	35	37	106%
201316-Lighting-LED or Electroluminescent Replacing Incandescent Exit Sign	11,275	10,340	92%
201518-Lighting-Single Technology Occupancy Sensor Controlling Lighting Circuit >50 and <=120 Watts	125	9	7%
201618-Lighting-Single Technology Occupancy Sensor Controlling Lighting Circuit >120 Watts	7,360	745	10%
300938-Lighting-LED <=14 Watt Lamp or Fixture Replacing Halogen BR/R Lamp or Fixture	40,499	38,550	95%
301037-Lighting-LED <=20 Watt Lamp or Fixture Replacing Halogen A >=40 Watt Lamp or Fixture	75,355	55,546	74%
301039-Lighting-LED <=20 Watt Lamp or Fixture Replacing Halogen PAR Lamp or Fixture	16,157	16,602	103%
301132-Lighting-LED 7-20 Watt Lamp Replacing Halogen A 53-70 Watt Lamp	975	429	44%
305233-Lighting-85-225 Watt Lamp or Fixture Replacing Interior HID 301-500 Watt Lamp or Fixture	1,327	0	0%

Measure Name	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*
305401-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T12 <=40 Watt Linear ft	55,089	57,037	104%
305402-Lighting-Linear ft LED (<=5.5 Watts/ft) Replacing T8 32 Watt Linear ft	5,417	5,594	103%
305802-Lighting-Delamping Replacing T8 32 Watt	2,740	2,905	106%
306135-Lighting-LED Lamp or Fixture Replacing T5 Lamp or Fixture	21,575	18,593	86%
306140-Lighting-LED Lamp or Fixture Replacing Interior HID Lamp or Fixture	186,238	193,012	104%
306141-Lighting-LED Lamp or Fixture Replacing Garage or Exterior 24/7 HID Lamp or Fixture	13,149	6,500	49%
306142-Lighting-LED Lamp or Fixture Replacing T12 Lamp or Fixture	1,173,174	1,008,488	86%
306143-Lighting-LED Lamp or Fixture Replacing T8 Lamp or Fixture	348,338	344,070	99%
Total	1,975,502	1,771,723	90%

4.2. High Impact Measures

BizSavers measures may or may not be characterized in the Ameren Missouri Technical Reference Manual (TRM). High Impact Measures (HIM) are defined at the program-level as those measures with the greatest program-level ex ante energy savings that, in the aggregate, account for at least 50% of the total program-level ex ante savings associated with all program TRM measures. Measures were implemented under the Standard Program and SBDI Program that are characterized in the Ameren Missouri TRM. The top contributing measures remained consistent during the program year which are all lighting measures. For the Standard program, the HIM measures were linear LEDs replacing fluorescent lamps. The TRM measure 3025 is for a basline of T8 lamps, and the measure 3026 for the baseline of T12 lamps. For the SBDI program, the same measures, 3025 and 3026 were also the high impact measures. The results are presented to identify the variance of the parameters for the lighting measure savings algorithm, between the ex ante values and the ex post values:

$$kWh\ Savings = Hours \times (Q_{Base} x W_{Base} - Q_{Post} W_{Post}) \times HCIF/1000$$

Where,

Hours = Annual hours of use

Q_{base} = Baseline quantity

W_{base} = Baseline watts

Q_{post} = Installed quantity

W_{post} = Installed watts

HCIF = Heating Cooling Interactive Factor

1000 = W/kW conversion

For sampling, multiple measures of the same type were counted as “one” per project. A project may have many listings of the same measure, based on installed usage area, hours of use and existing fixture wattages.

4.2.1. Standard HIM Measure - 3025 Linear LED replacing T8 fluorescent tube

This Standard measure applies to the replacement of T8 fluorescent linear lamps and replacing with LED linear lamps (Type A, Type B, Type C) or fixtures.

4.2.1.1. Sampling

Summary data regarding the sampling plan is presented in report Volume I. This HIM measure included 125 projects with linear LEDs. The samples are counted unique within a project if installed in different usage areas, for a total of 390 observations. The ex ante savings of 71,856,312 kWh from this HIM measure is 37% of the total Standard program ex ante savings, down from 40% in the prior year. The sample group of 9,480,528 kWh achieved a precision of 8.9% at 90% confidence level.

4.2.1.2. Results

The results are presented to review the inputs of the savings algorithm for lighting measures. The quantity figures illustrate the relationship between the ex ante lamp quantity and the verified quantity from the ex post project level site visit evaluations.

The power figures illustrate the relationship between the ex ante power of the lamp or fixture compared to the ex post project level site visit verification.

The HOU (annual hours of use) figures illustrate the relationship between the ex ante hours and the metered or verified hours from the usage areas from project level site visits. The hours for each project-measure may be aggregated depending on the size or complexity of the usage areas for metering the lighting operation.

The HCIF (heating cooling interactive factor) compares the ex ante and ex post stated factor used in the savings algorithm. The ex post factor is determined based on climate zone, building type, HVAC equipment type and usage area.

Figure 4-1 Standard Measure 3025: Quantity

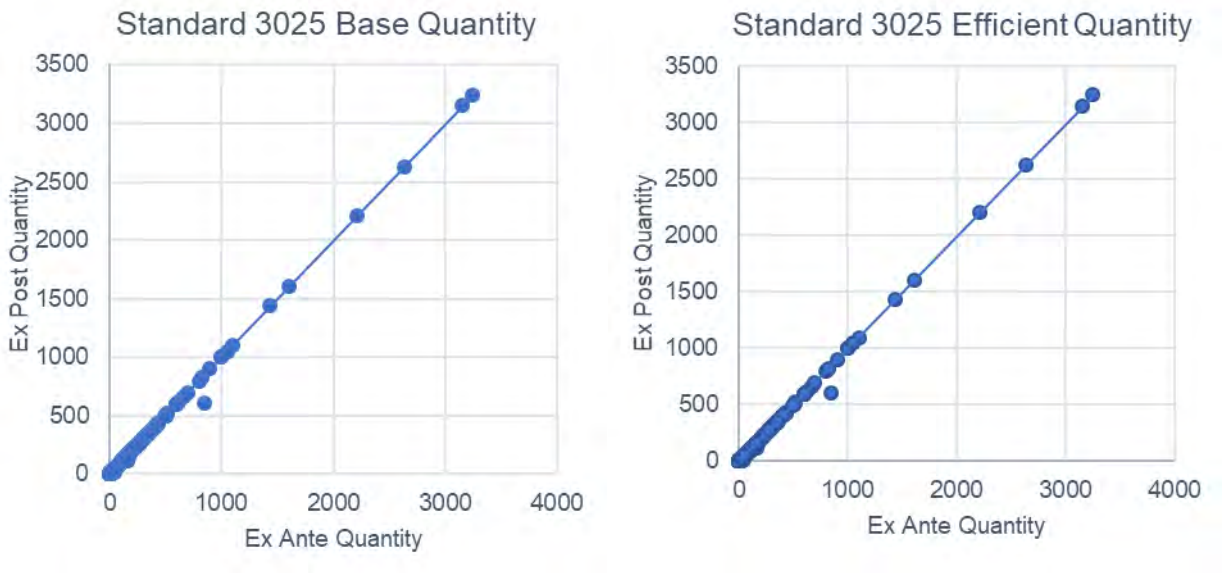


Table 4-13 Standard Measure 3025: Quantity

Variable	*Ex Ante Base Quantity*		*Ex Post Base Quantity*			*Ex Ante Efficient Quantity*		*Ex Post Efficient Quantity*	
Mean	132		131			132		131	
Min/Max	1	3,246	1	3,246		1	3,246	1	3,246
Observations*	390		390			390		390	
Pearson Correlation	0.99931					0.99931			
t Stat	1.531					1.543			

*Observation quantity varies from sample, as the sample quantity aggregates all the measures installed within a single project.

Figure 4-2 Standard Measure 3025: Power

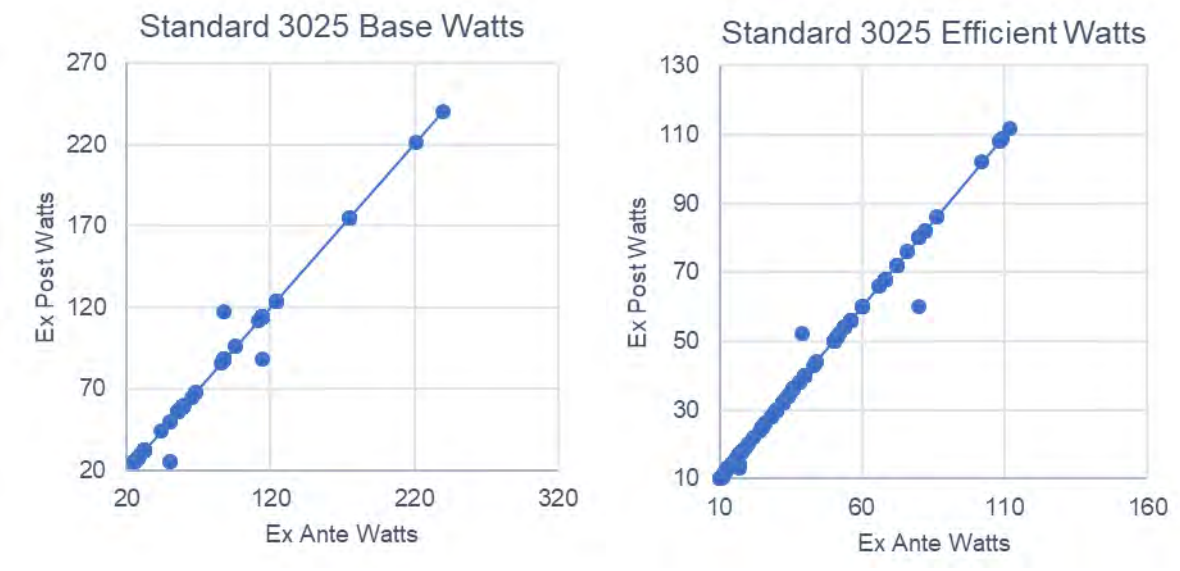


Table 4-14 Standard Measure 3025: Power

Variable	*Ex Ante Base Watts*		*Ex Post Base Watts*			*Ex Ante Efficient Watts*		*Ex Post Efficient Watts*	
Mean	71.1		70.9			34.6		34.6	
Min/Max	16	240	14	240		8	112	8	112
Observations*	390		390			390		390	
Pearson Correlation	0.99768					0.99777			
t Stat	1.121					0.017			

*Observation quantity varies from sample, as the sample quantity aggregates all the measures installed within a single project

Figure 4-3 Standard Measure 3025: HOU, HCIF

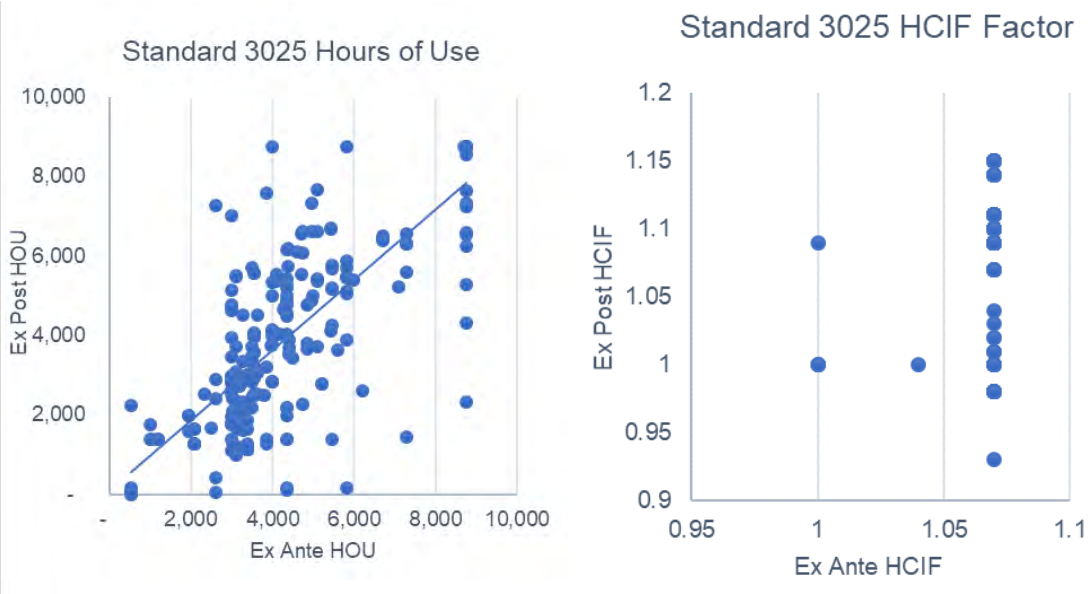


Table 4-15 Standard Measure 3025: HOU, HCIF

Variable	*Ex Ante HOU*		*Ex Post HOU*			*Ex Ante HCIF*		*Ex Post HCIF*	
Mean	4,516		4,120			1.07		1.09	
Min/Max	500	8,760	0	8,760		1.00	1.07	0.93	1.15
Observations*	390		390			390		390	
Pearson Correlation	0.75046					0.17419			
t Stat	4.639					-7.841			

4.2.1.3. Observations

The two-sample t-test and Pearson correlation for this high impact measure identified inputs to the lighting savings algorithm which may produce ex post savings different than the ex ante kWh savings. The difference of the means of the ex ante and ex post observations are not significant for the base lighting watts, base lighting quantity, efficient watts and efficient quantity. The verified quantities are similar across low and high installed quantities, verified linear tube fixture watts are similar across single lamp to six lamp fixtures. But, the inputs for annual hours of use and heating-cooling interactive factor show a difference between the ex ante and ex post groups. Hours of use may be higher or lower than expected. The ex ante HCIF indicates a bimodal population, as the application assigns either an exterior value of 1.0 or an interior value of 1.07 regardless of the building type or HVAC equipment within the building.

4.2.2. Standard HIM Measure - 3026 Linear LED replacing T12 fluorescent lamp

This Standard measure applies to the removal of T12 fluorescent linear lamp or fixtures and replacing with LED linear lamps (Type A, Type B, Type C) or fixtures.

4.2.2.1. Sampling Plan

Summary data regarding the sampling plan is presented in report Volume I. This HIM measure included 86 measure samples. The samples are counted unique within a project if installed in different usage areas, for a total of 192 observations. The ex ante savings of 51,437,049 kWh from this HIM measure is 26% of the total Standard program ex ante savings, up from 18% in the prior year. The sample group of 2,799,122 kWh has a precision of 7.2% at 90% confidence level.

4.2.2.2. Results

The results are presented to review the inputs of the savings algorithm for lighting measures.

Figure 4-4 Standard Measure 3026: Quantity

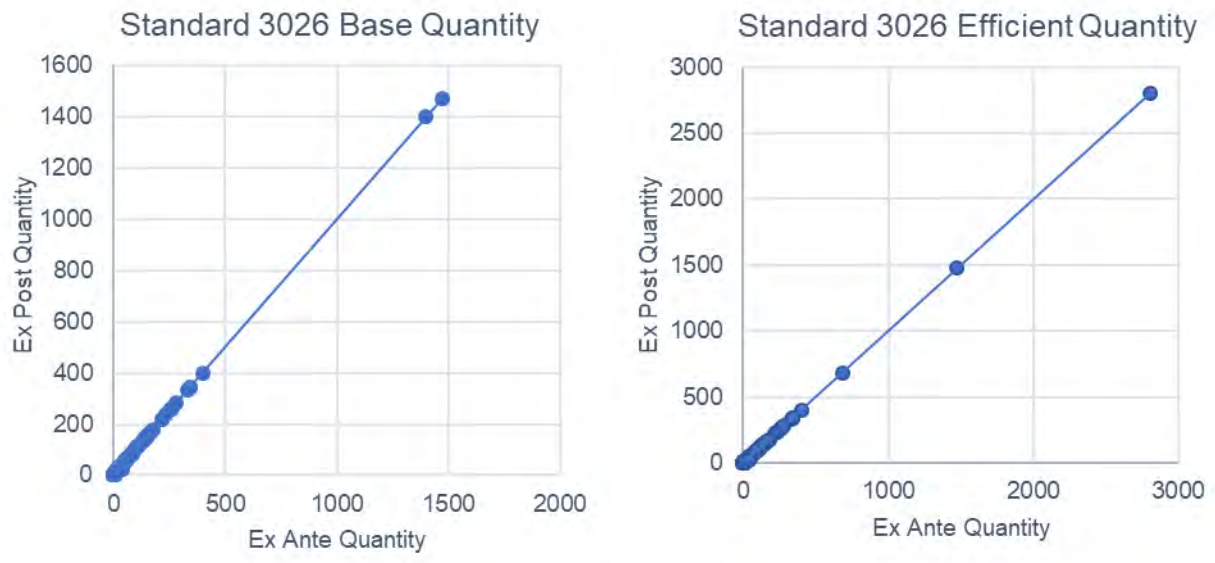


Table 4-16 Standard Measure 3026: Quantity

Variable	*Ex Ante Base Quantity*		*Ex Post Base Quantity*			*Ex Ante Efficient Quantity*		*Ex Post Efficient Quantity*	
Mean	58		58			68		67	
Min/Max	1	1,474	1	1,474		1	2,800	1	2,800
Observations*	192		192			192		192	
Pearson Correlation	0.99996					0.99998			
t Stat	1.607					1.698			

**Observation quantity varies from sample, as the sample quantity aggregates all the measures installed within a single project*

Figure 4-5 Standard Measure 3026: Power

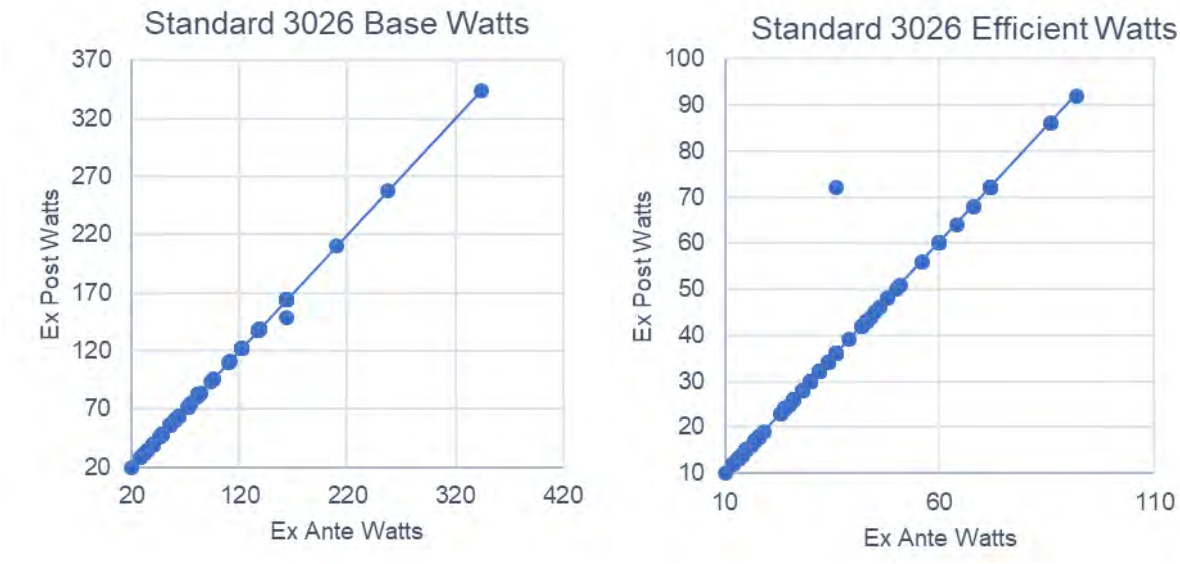


Table 4-17 Standard Measure 3026: Power

Variable	*Ex Ante Base Watts*		*Ex Post Base Watts*			*Ex Ante Efficient Watts*		*Ex Post Efficient Watts*	
Mean	96.4		96.4			30.8		31.0	
Min/Max	17	344	17	344		8	92	8	92
Observations*	192		192			192		192	
Pearson Correlation	0.99977					0.98856			
t Stat	1.000					-1.000			

*Observation quantity varies from sample, as the sample quantity aggregates all the measures installed within a single project

Figure 4-6 Standard Measure 3026: HOU, HCIF

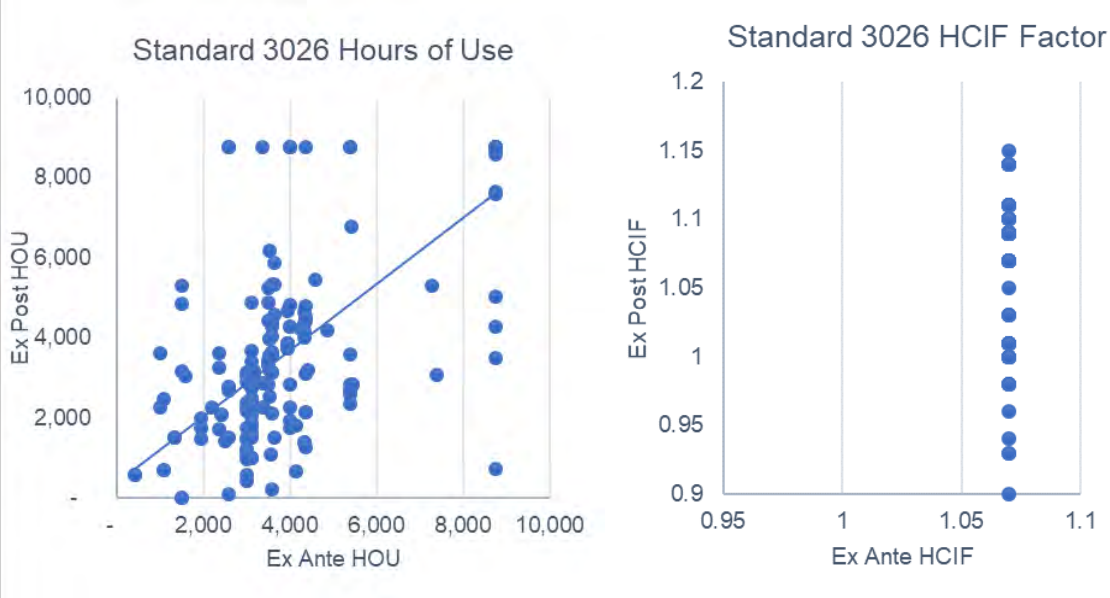


Table 4-18 Standard Measure 3026: HOU, HCIF

Variable	*Ex Ante HOU*		*Ex Post HOU*			*Ex Ante HCIF*		*Ex Post HCIF*	
Mean	4,214		3,863			1.07		1.09	
Min/Max	416	8,760	12	8,760		1.07	1.07	0.90	1.15
Observations*	192		192			390		390	
Pearson Correlation	0.71136					0.17419			
t Stat	2.681					-7.841			

*Observation quantity varies from sample, as the sample quantity aggregates all the measures installed within a single project

4.2.2.3. Observations

The two-sample t-test and Pearson correlation for this high impact measure identified inputs to the lighting savings algorithm which may produce ex post savings different than the ex ante kWh savings. The difference of the means of the ex ante and ex post observations are not significant for the base lighting watts, and efficient watts. The inputs for annual hours of use and heating-cooling interactive factor show a difference between the ex ante and ex post groups. Hours of use may be higher or lower than expected. The ex ante HCIF indicates a single value, whereas the ex post identified the building type and HVAC systems for the corresponding interactive factor.

4.2.3. SBDI HIM Measure - 3026 Linear LED replacing T12 fluorescent lamp

This SBDI measure applies to the removal to T12 linear lamps and replacing with LED linear lamps (Type A, Type B, Type C) or fixtures.

Sampling Plan

Summary data regarding the sampling plan is presented in report Volume I. This HIM measure included 122 measure samples. The samples are counted unique within a project if installed in different usage areas, for a total of 273 observations. The 10,532,915 kWh from this HIM measure is 65% of the total SBDI Program ex ante savings, up from 29% the prior year. The sample group of 1,228,263 kWh achieved a precision of 5.9% at 90% confidence level.

4.2.3.1. Results

Figure 4-7 SBDI Measure 3026: Quantity

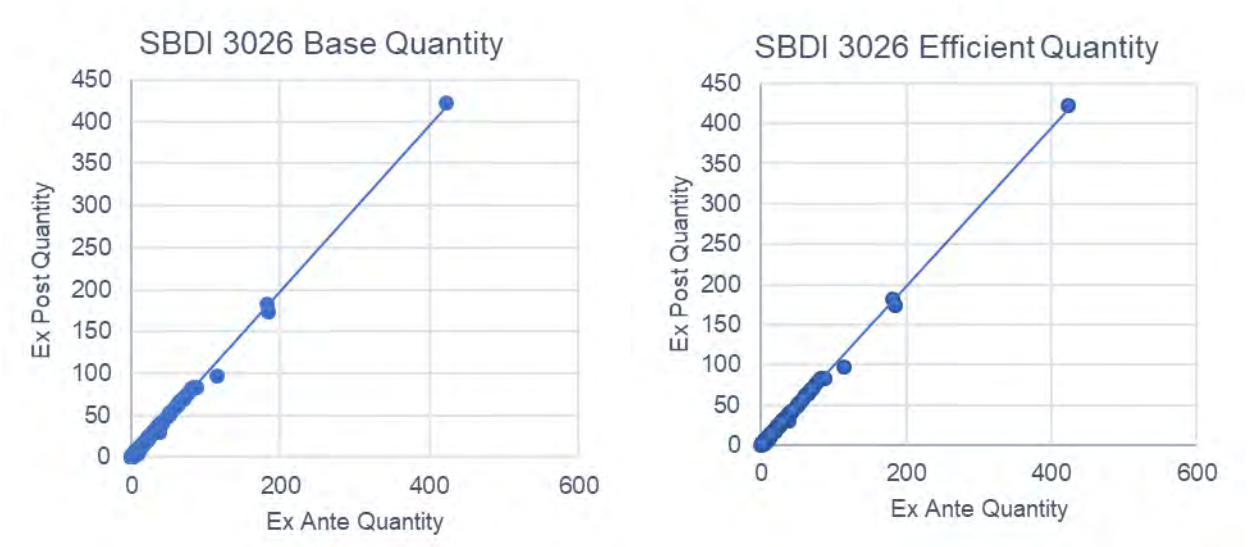


Table 4-19 SBDI Measure 3026: Quantity

Variable	*Ex Ante Base Quantity*		*Ex Post Base Quantity*			*Ex Ante Efficient Quantity*		*Ex Post Efficient Quantity*	
Mean	18.4		18.2			18.4		18.2	
Min/Max	1	423	1	423		1	423	1	423
Observations*	273		273			273		273	
Pearson Correlation	0.99914					0.99914			
T Stat	2.494					2.494			

Figure 4-8 SBDI Measure 3026: Power

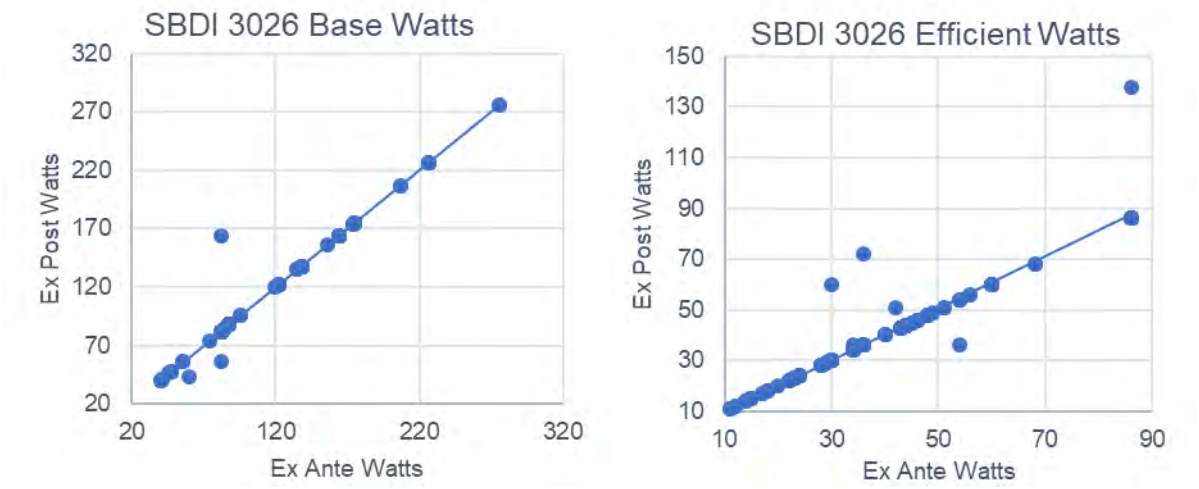


Table 4-20 SBDI Measure 3026: Power

Variable	*Ex Ante Base Watts*		*Ex Post Base Watts*			*Ex Ante Efficient Watts*		*Ex Post Efficient Watts*	
Mean	131.0		131.2			39.3		39.6	
Min/Max	40	276	40	276		9	86	0	138
Observations*	273		273			273		273	
Pearson Correlation	0.99302					0.96948			
t Stat	-0.444					-1.173			

*Observation quantity varies from sample, as the sample quantity aggregates all the measures installed within a single project

Figure 4-9 SBDI Measure 3026: HOU, HCIF

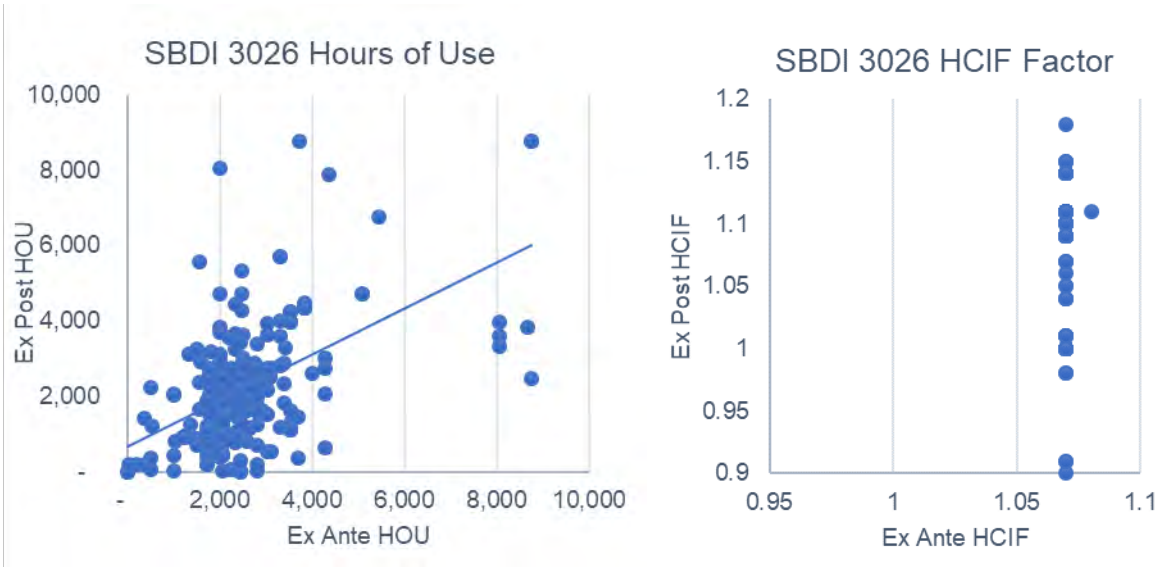


Table 4-21 SBDI Measure 3026: HOU, HCIF

Variable	*Ex Ante HOU*		*Ex Post HOU*			*Ex Ante HCIF*		*Ex Post HCIF*	
Mean	2,503		2,126			1.07		1.08	
Min/Max	100	8,736	0	8,760		1.07	1.08	0.90	1.18
Observations*	273		273			273		273	
Pearson Correlation	0.52423					0.02049			
t Stat	4.518					-2.304			

4.2.3.2. Observations

The two-sample t-test and Pearson correlation for this high impact measure identified inputs to the lighting savings algorithm which may produce ex post savings different than the ex ante kWh savings. The difference of the means of the ex ante and ex post observations are not significant for the base lighting watts, base lighting quantity, and efficient quantity. The efficient watts had variation from ex ante to ex post values, as the ex post verified the model tags on the fixtures or lamps during the site visit. The verified quantities are similar across low and high installed quantities, verified linear tube fixture watts are similar across single lamp to six lamp fixtures. But, the inputs for annual hours of use and heating-cooling interactive factor show a difference between the ex ante and ex post groups. Hours of use may be higher or lower than expected. The ex ante HCIF indicated a single value inputted from the application, and the ex post identified the building type and HVAC system of the corresponding interactive factor.

4.2.4. SBDI HIM Measure 3025 LED Linear Lamp Replacing Fluorescent

This SBDI measure applies to the removal to T8 linear lamps and replacing with LED linear lamps (Type A, Type B, Type C) or fixtures..

4.2.4.1. Sampling Plan

Summary data regarding the sampling plan is presented in report Volume I. This HIM measure included 44 measure samples. The samples are counted unique within a project if installed in different usage areas, for a total of 103 observations. The 2,399,300 kWh from this HIM measure is 15% of the total SBDI Program ex ante savings, similar to 14% in the prior year. The sample group of 353,755 kWh achieved a precision of 9.9% at 90% confidence level.

4.2.4.2. Results

Figure 4-10 SBDI Measure 3025 Quantity

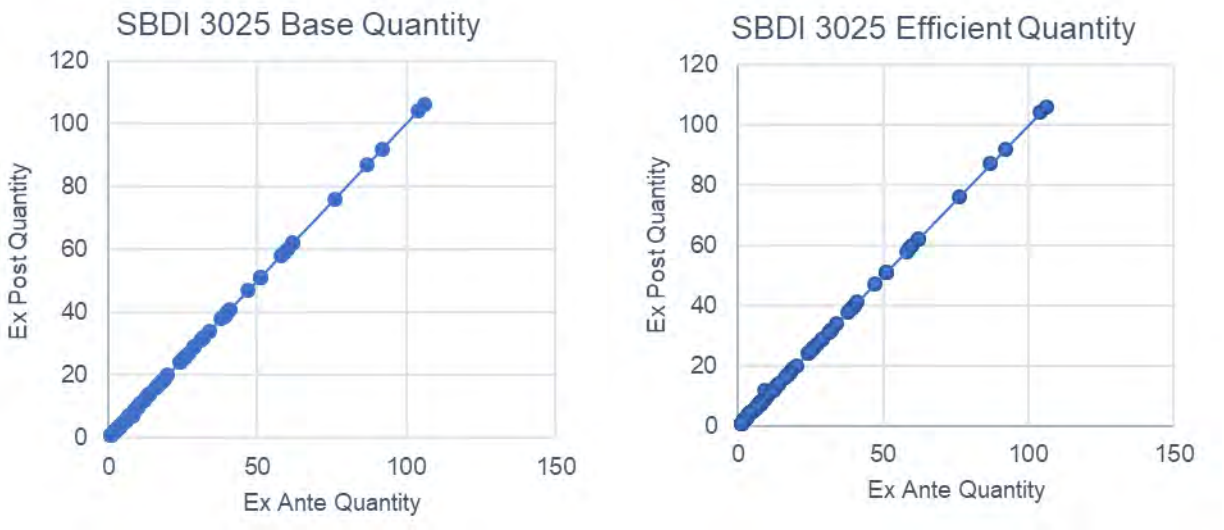


Table 4-22 SBDI Measure 3025: Quantity

Variable	*Ex Ante Base Quantity*		*Ex Post Base Quantity*			*Ex Ante Eff Qty*		*Ex Post Eff Qty*	
Mean	19.5		19.5			19.5		19.5	
Min/Max	1	106	1	106		1	106	1	106
Observations	103		103			103		103	
Pearson Correlation	0.99999					0.99991			
t Stat	1.000					-0.631			

Figure 4-11 SBDI Measure 3025: Power

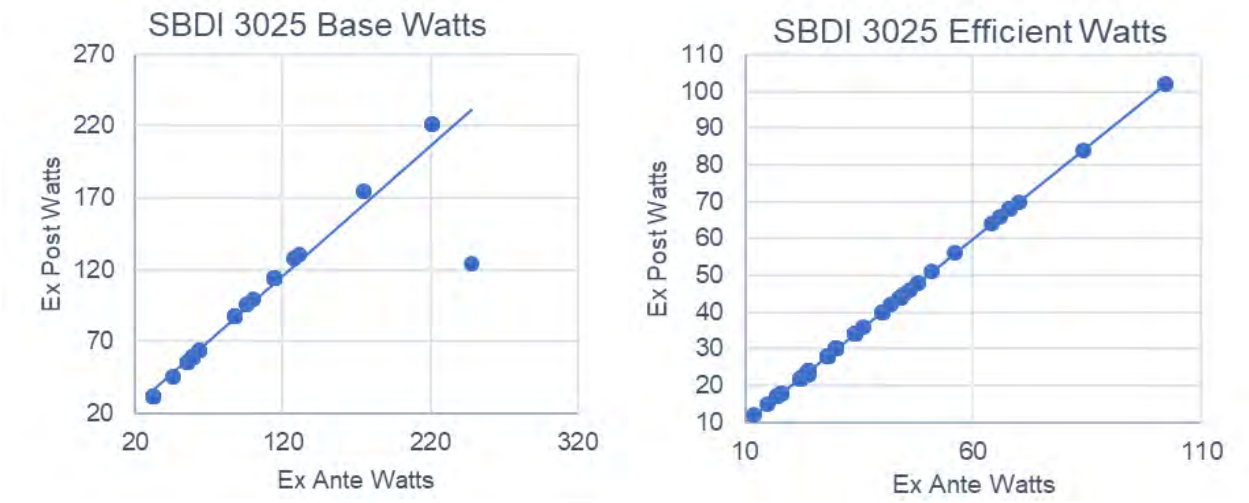


Table 4-23 SBDI Measure 3025: Power

Variable	*Ex Ante Base Watts*		*Ex Post Base Watts*			*Ex Ante Eff Watts*		*Ex Post Eff Watts*	
Mean	89.5		88.3			34.9		34.9	
Min/Max	32	248	32	221		9	102	9	102
Observations	103		103			103		103	
Pearson Correlation	0.96079					0.99998			
t Stat	1.000					1.000			

**Observation quantity varies from sample, as the sample quantity aggregates all the measures installed within a single project*

Figure 4-12 SBDI Measure 3025: HOU, HCIF

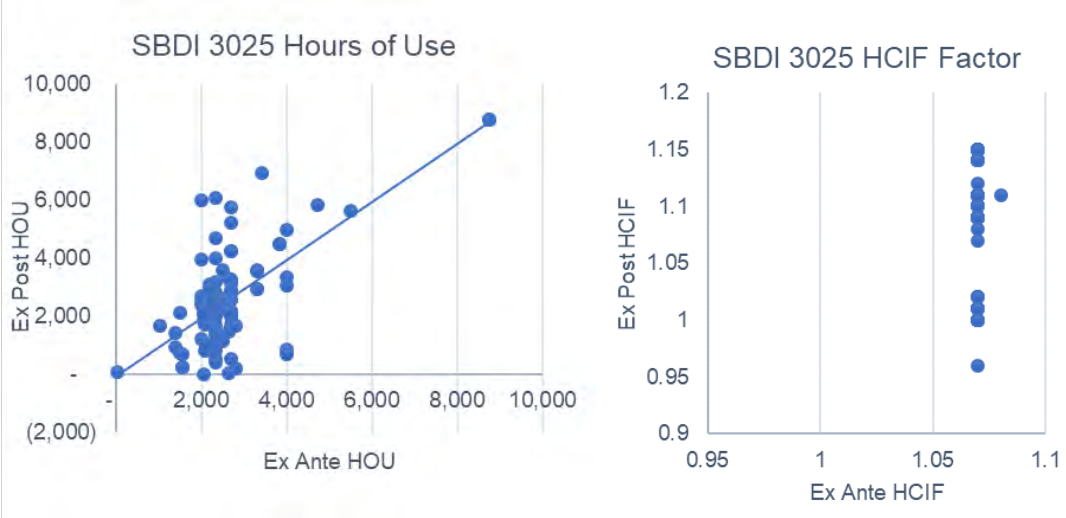


Table 4-24 SBDI Measure 3025: HOU, HCIF

Variable	*Ex Ante HOU*		*Ex Post HOU*			*Ex Ante HCIF*		*Ex Post HCIF*	
Mean	2,686		2,597			1.07		1.09	
Min/Max	50	8,760	1	8,760		1.07	1.08	0.96	1.15
Observations*	103		103			103		103	
Pearson Correlation	0.71247					0.03465			
t Stat	0.721					-4.817			

4.2.4.3. Observations

The two-sample t-test and Pearson correlation for this high impact measure identified inputs to the lighting savings algorithm which may produce ex post savings different than the ex ante kWh savings. The difference of the means of the ex ante and ex post observations are not significant for the base lighting watts, base lighting quantity, and efficient quantity. The efficient watts had variation from ex ante to ex post values, as the ex post verified the model tags on the fixtures or lamps during the site visit. The verified quantities are similar across low and high installed quantities, verified linear tube fixture watts are similar across single lamp to six lamp fixtures. But, the inputs for annual hours of use and heating-cooling interactive factor show a difference between the ex ante and ex post groups. Hours of use may be higher or lower than expected. The ex ante HCIF indicated a single value inputted from the application, and the ex post identified the building type and HVAC system of the corresponding interactive factor.

5. Staff and Implementer Interview Guides

Ameren Program Manager

Roles & Responsibilities

Now, I'd like to hear about invoice review and auditing.

[In all questions, probe as appropriate about the EMS and SBDI]

First, please briefly describe your activities relating to the BizSavers program. *[Probe about reports received]*

Who do you interact with, both at Ameren and Lockheed, in your invoice review and auditing function?

Those are all my questions. Thank you very much for your time.

Roles & Responsibilities

Q1. Let's start with a bit about you. You are currently the BizSavers Program Manager, correct?

Q2. About how much of your time is devoted to the Ameren Missouri BizSavers program?

Q3. How is that going so far? Any unexpected challenges?

Q4. And can you give me an update on staffing, responsibilities, or the reporting structure for BizSavers at Ameren Missouri? *[If needed: Who do you report to? Who reports to you?]*

Q5. Who replaced [*employee name redacted*] in invoice review and auditing? How is that working out?

Q6. Are there any other planned changes in staffing, responsibilities, or reporting structure? If so, what are they?

Q7. Are the current staffing levels sufficient for supporting the administration and oversight needs of the program?

Program Progress

Let's talk about how the BizSavers programs are progressing.

Q8. Overall, how well are the various programs progressing relative to goals and expectations?

Q9. There were 48 RCx projects started in the 2016/17 program year but as of July 1, none started in 2018/18. Do you know why that might be? Have you spoken with Lockheed Martin about that?

Q10. It looks like EMS has picked up, with 10 2016/17 program year projects started as of July 1. What do you think at this point of the potential for that pilot?

Q11. What needs to be done achieve success with the EMS pilot?

Q12. Is EMS still getting support from other Ameren staff? What additional support, if any, might be needed?

Q13. SBDI participation declined from December 2016 through February of this year, but it began increasing again in March. Is participation meeting your expectations?

If not: What needs to be done to achieve success with SBDI?

Have you discussed this with Lockheed? If so, what did you discuss and how did that go?

Q14. Is SBDI still getting support from other Ameren staff? What additional support, if any, might be needed?

Q15. So far, how are the other program elements – standard, custom, and new construction – doing relative to goals? *[Probe about savings goals, project completions, pipeline, achievement of non-lighting savings.]*

If not doing well: What might the program do to improve progress toward goals?

Program Measures

Q16. I understand that the program started providing incentives again for exterior lighting. Is this having the desired effect?

If not: Why do you think that is? What else might be done?

[Note that lighting and controls kWh in PY 2016/17 was 73% of PY 2015, while HVAC was 154% of PY 2015. Over the first four months of PY 2018/18, lighting and controls kWh is 136% of same period in 2016/17, and HVAC is about the same.]

Q17. What other measures been added or modified in the past year, if any? *[Probe about reasons and uptake. Were these new prescriptive measures?]*

Marketing and Outreach

[For all questions, probe about EMS and SBDI]

Now, just a couple of questions about the status of marketing and outreach activities for the program.

Q18. Can you give me an update on program marketing, including Ameren marketing activities, Lockheed activities, and coordination between them? *[Probe: Does Ameren conduct any program marketing independent of Lockheed? If so, what?]*

Q19. How have Lockheed Martin's program marketing and outreach efforts in the current program year fit with your expectations? *[Probe: What are they doing well? In what ways, if any, do they fall short of expectations?]*

Q20. Are program marketing and outreach targeting the right business subsectors?

If not: Have you spoken with Lockheed about that? What do they plan to do? Will that be sufficient?

Q21. From your perspective, how well is Lockheed Martin recruiting and managing trade allies or other program partners?

Communication

Next, I'd like to hear briefly about how communication processes are working both within Ameren and between Ameren and Lockheed.

Q22. How has communication been between Ameren and Lockheed staff? *[Probe about: Frequency and type of reports and meetings, monthly meetings/webinars with KAEs and CSAs, LM reports to CSAs about projects in their territory, Ameren keeping LM informed on key accounts, LM presentations to Ameren.]*

Q23. And how has communication been among Ameren staff regarding the BizSavers program? *[Probe about any changes in frequency or type of meeting.]*

[If issues identified, ask Q24]

Q24. What do you think should be done to improve communication?

Tracking, Reporting, QA/QC

Next, I'd also like to hear about tracking, reporting, and QA/QC.

Q25. How well is the current tracking and reporting process working to meet your needs? *[Probe about additional reports or information that would be useful.]*

Q26. What tracking and reporting changes were made, if any, this program year? How have those worked out?

Q27. From your perspective, how is Lockheed doing with program QA/QC? *[Probe about any problems or challenges identified] [If problems or challenges identified, ask:]*

Q28. What has been done to address those issues? What else needs to be done?

Conclusion

Q29. Is there anything that you would like to see changed in how Lockheed is implementing the program?

Q30. Is there anything else about the program that we have not discussed that you feel should be mentioned?

Q31. What would you like to learn from the program evaluation?

Those are all of my questions. Thank you very much for your time.

Lockheed Martin Program Manager

Roles & Responsibilities

Q1. Let's start with a bit about you. You are still the current BizSavers Program Manager for Lockheed Martin, correct?

Q2. The last time you were interviewed for the evaluation, this past December, you said that your job was focusing more on the outreach and business development aspects of the program rather than on engineering and operations. Is that still the case? If not, what has changed?

Q3. Have your job title or responsibilities regarding the BizSavers program changed in any other way since the last time you were interviewed? If so, how?

Q4. About how much of your time is devoted to the Ameren Missouri BizSavers program?

Q5. Since we last spoke last December, have there been any changes to staffing, responsibilities, or the reporting structure for BizSavers at Lockheed? If so, please describe.

Q6. Are there any other planned changes in staffing, responsibilities, or reporting structure? If so, what are they?

Q7. Do you think the current level of staff support is sufficient for supporting the program implementation needs?

Program Progress

Let's talk about how the BizSavers programs are progressing, including any recent program changes. For any of these questions, just let me know if Justin or Kristen would have more direct knowledge.

Q8. Overall, how well are the various programs progressing relative to goals and expectations?

Q9. There were 48 RCx projects started in the 2016/17 program year but as of July 1, none started in 2018/18. Do you know why that might be?

Q10. What is being done or planned, if anything, to increase RCx project uptake? What else might be done?

Q11. It looks like EMS has picked up. What do you think at this point of the potential for that pilot? *[If needed: as of July 1, there were 10 new 2016/17 program year project starts.]*

Q12. What needs to be done, if anything, to achieve success with the EMS pilot?

Q13. SBDI participation declined from December 2016 through February of this year, but it began increasing again in March. Is participation meeting your expectations?

If not: What needs to be done, if anything, to achieve success with SBDI?

Q14. New construction project starts were much higher in 2016 than in previous program years, and they continue at a high rate in 2018. What do you think has driven that increase?

Q15. So far, how are the standard and custom programs doing relative to goals? *[Probe about savings goals, project completions, pipeline, achievement of non-lighting savings.]*

If not doing well: What might the program do to improve progress toward goals?

Program Measures

Q16. I understand that the program started providing incentives again for exterior lighting. Is this having the desired effect?

If not: Why do you think that is? What else might be done?

[Note that lighting and controls kWh in PY 2016/17 was 73% of PY 2015, while HVAC was 154% of PY 2015. Over the first four months of PY 2018/18, lighting and controls kWh is 136% of same period in 2016/17, and HVAC is about the same.]

Q17. What other measures been added or modified in the past year, if any? *[Probe about reasons and uptake. Were these new prescriptive measures?]*

Q18. Do any other measures need to be added or modified?

Q19. Have you discussed those possible additions or modifications with anyone else? If so, who? What is the outcome of those discussions?

Marketing and Outreach

[For all questions, probe about EMS and SBDI]

Now, just a couple of questions about the status of marketing and outreach activities for the program.

Q20. Overall, how well have the program marketing and outreach efforts in the current program year worked?

[Probe: Are they sufficient to deliver the program participation and savings goals?]

Q21. Are program marketing and outreach targeting the right business subsectors?

[If concerns are noted about marketing and outreach, ask Q24]

Q22. What is being done about those concerns? What else should be done?

Communication

Next, I'd like to hear briefly about how communication processes are working between and within staff at Ameren Missouri and Lockheed.

Q23. How has communication been between Ameren and Lockheed staff? *[Probe about: Frequency and type of reports and meetings, monthly meetings/webinars with KAEs and CSAs, LM reports to CSAs about projects in their territory, Ameren keeping LM informed on key accounts, LM presentations to Ameren.]*

Q24. And how has communication been within the Lockheed BizSavers staff about the program? *[Probe about any changes in frequency or type of meeting.]*

[If issues identified, ask Q27]

Q25. What do you think should be done to improve communication?

Tracking, Reporting, QA/QC

Next, I'd also like to hear about tracking, reporting, and QA/QC.

Q26. How well is the current tracking and reporting process working to meet your needs? *[Probe about additional reports or information that would be useful.]*

Q27. What tracking and reporting changes were made, if any, this program year? How have those worked out?

Q28. What changes have been made, if any, to QA/QC procedures?

Q29. I know you are aware that ADM has continued to find discrepancies between the quantities of applied-for and installed lighting. Can you tell me what Lockheed is doing to address this? What else might you do?

Q30. What other issues, if any, have arisen with program QA/QC, including anything that Ameren identified and brought to your attention through its review and audit of invoices?

Q31. What kinds of corrective measures have been taken? Have those measures been effective?

Conclusion

Q32. Is there anything that you would like to see changed in how Ameren Missouri is managing Lockheed's implementation of the program?

Q33. Is there anything else about the program that we have not discussed that you feel should be mentio0ned?

Q34. What would you like to learn from the program evaluation this year?

Those are all of my questions. Thank you very much for your time.

Marketing Manager

Roles & Responsibilities

Q1. Let's start with a bit about you. Is your title still Marketing Manager?

Q2. Have any of your responsibilities changed since this past December, when you were last interviewed? If so, how?

Q3. You previously reported that about 75% of your time is devoted to the BizSavers program. Is that still about right? If not, how has it changed?

Q4. This past December, you noted that Lockheed has hired two new marketing coordinators supporting BizSavers programs. How is that working out?

Are they still supporting other utilities in addition to Ameren Missouri?

Marketing

Q5. You previously reported that Lockheed had worked with Ameren to change the look of marketing materials to make new materials distinct from old ones. How is that working out?

What feedback, if any, have you gotten from trade allies on that or Ameren account staff on that?

Q6. You mentioned before that Lockheed was moving away from distributing hard copy case studies and fact sheets toward online distribution. The goal was to use email campaigns to drive customers and TAs to the website. How is that working out?

How do you know that? *[Probe about metrics used to assess new strategy]*

Q7. Can you give me an update on any new marketing activities started since last December? *[Probe about anything listed in monthly summaries]*

What are the goals?

How are you assessing success?

How are they working so far?

Q8. What, if anything, is being done to raise awareness of the new construction and retro-commissioning programs, among customers or trade allies? In particular, what is being done, if anything, to raise awareness of the need to involve program staff early in the design phase for new construction projects? *[Probe about cross-program promotion]*

Q9. Back in December, you mentioned there had been some changes to the look and navigation of the website. What metrics do you have on how that has improved its usability?

Q10. Can you give me any updates on the program's efforts to reach specific market segments? *[Probe about specific segments identified, what has been done, and what the metrics for success are]*

Q11. Also, can you give me an update on coordination of marketing with Ameren Missouri? *[Review prior interview notes and probe on comments made previously]*

Q12. What other changes are planned, if any, for BizSavers marketing and outreach?

Communication

Next I'd like to hear briefly about how communication processes are working between and within staff at Ameren Missouri and Lockheed.

Q13. How has communication been between Lockheed and Ameren staff? *[Probe about: Frequency and type of reports and meetings, monthly meetings/webinars with KAEs and CSAs, LM reports to CSAs about projects in their territory, Ameren keeping LM informed on key accounts, LM presentations to Ameren.]*

Q14. And how has communication been within the Lockheed BizSavers staff about the program? *[Probe about any changes in frequency or type of meeting.]*

[If issues identified, ask Q15]

Q15. What do you think should be done to improve program communication?

Tracking & Reporting

Next, I'd also like to hear about tracking and reporting.

Q16. From your perspective, how well is the current process of tracking and reporting program data?

Are you getting the information you need? Would any other reports or information be useful?

Any differences by program?

Conclusion

Q17. Is there anything that you would like to see changed in program offerings in the future?

Q18. Is there anything else about the program that we have not discussed that you feel should be mentioned?

Q19. What would you like to learn from the program evaluation?

Those are all of my questions. Thank you very much for your time.

Lockheed Martin Operations Lead

Roles & Responsibilities

Q1. Let's start with a bit about you. I have your job title as Operations Lead – is that correct? If not, what is your current job title?

Q2. Please let me know if any of your responsibilities changed since we last spoke?

Q3. In the latest organization chart, we have, you oversee four project coordinators, a finance lead, and a data analyst. Do you still oversee these staff? If not, what has changed?

Q4. What are the key responsibilities of the four project coordinators (Laurie, Mackenzie, Taylor, and Jordan)?

Program Processes

Q5. In last year's evaluation, we got feedback from trade allies and participants that suggested the application process was challenging, particularly for custom projects. What, if anything, has been done to make the process smoother? *[For example, one-quarter of surveyed participants had to resubmit custom applications, largely to correct errors in calculating incentives, or had to provide additional supporting documentation].*

Q6. One of the recommendations the evaluation team made was to add information about documentation requirements to the "welcome" tab of the incentive application. Has Lockheed considered this or implemented it? If not, why not? .

Q7. Another recommendation was to record the incentive calculation errors made, as part of the project record, so that either Lockheed or the evaluation team can identify the most common types of errors. Has Lockheed considered this or implemented it? If not, why not?

Q8. Has Lockheed made any changes to how the New Construction or SBDI programs under your purview are implemented? If so, what are they?

If changes made:

Q9. Why were those changes made? What effect have they had?

Q10. This past December, you mentioned that business development representatives had become more involved in the new construction program. How has the involvement of business development representatives affected the new construction projects you see coming into the program? *[Probe about: number of projects, type of projects, completeness of applications, concerns or questions that applicants have had.]*

Q11. It seems like a main limitation to getting more savings from the new construction program has been in getting involved early in project planning. Do you agree with that and, if so, what do you think are the reasons for that?

Q12. Are there any specific actors – building owners, architects, designers, and so forth – that the program has had difficulty engaging? What can be done about that?

Q13. We are planning to interview architects and designers this year to get their sense of what's needed to get the new construction program involved earlier in the planning of projects. What would you most like to learn from this group about that would help the program engage them more in the new construction program?

Q14. What do you see as the biggest challenge to the new construction program? What is being done to address that challenge?

Q15. What changes, if any, would you like to see made to the new construction program? Why?

Q16. Has Lockheed made any other changes to any program processes? If so, what are they?

If changes made:

Q17. Why were those changes made? What effect have they had?

Communication

Next I'd like to hear briefly about how communication processes are working between and within staff at Ameren Missouri and Lockheed.

Q18. How has communication been between Lockheed and Ameren staff? *[Probe about: Frequency and type of reports and meetings, monthly meetings/webinars with KARs and CSAs, LM reports to CSAs about projects in their territory, Ameren keeping LM informed on key accounts, LM presentations to Ameren.]*

Q19. And how has communication been within the Lockheed BizSavers staff about the program? *[Probe about any changes in frequency or type of meeting.]*

[If issues identified, ask Q12]

Q20. What do you think should be done to improve program communication?

Trade Allies & Other Service Providers

I'd also like to get an update on how the program is working with trade allies and other program partners.

Q21. When Lockheed staff were last interviewed this past December, we learned that the program has focused on recruiting only the TAs that had been active prior to the program lapse. But the Monthly Marketing Summaries show that the program

has continued recruiting TAs and is up to 276. Does this reflect a change in strategy? If so, why? *[Probe about: Effect on program savings.]*

Month	*Cum. TAs*	*# Co. Approved this Month*	*# Pending Training*
March	*258*	*5*	*2*
April	*265*	*7*	*1*
May	*272*	*7*	*1*
June	*276*	*3*	*3*

Q22. In the previous end of year report, the evaluation team recommended that Lockheed increase re-introduce distributing printed collateral to TAs to help improve program awareness. Has Lockheed considered or done this? If not, why not?

Q23. I counted seven SBDI SPs who started projects in the current program year but didn't start any before this program year. Six of them were in the list from last program year, but one – [*company name removed*] – was not in last year's list. Does that sound accurate to you? Have you recruited any new SPs other than Lighting Solutions? Do you plan to recruit any more SPs? Why or why not?

Q24. It looks like most of the SPs have started more projects than they did last year. What do you think accounts for the increased activity?

Q25. And can you give me an update on efforts to keep TAs informed of program offerings and changes? *[Probe about training, events, and newsletters, and things mentioned in Monthly Summary: Trade Ally Awards program, including the videos (March), TAN Awards Winners page and home page banner on website.]*

Q26. Have there been any new special campaigns to increase TA activity, like the money-savings deals and "4 simple steps" campaigns Lockheed did last year? Or do you plan any? If so, please describe them. *[Probe about purpose and goals; how they track success (e.g., could they tell that campaigns increased number of applications?)]*

Q27. Last December, you indicated you were working on moving away from basing TAN tiers on cumulative project completions. Can you update me on the progress there?

Q28. In last evaluation, we found some evidence that contractors' incomplete understanding of the new construction incentive process may have resulted in some customers' getting less incentives than they might otherwise. What, if anything, is being done, to ensure that trade allies fully understand the rules for the new construction program? *[If needed: One customer did not receive incentives for HVAC and water heater because contractor thought they could apply for incentives after purchasing equipment. Probe about recommendations made in*

the prior report to provide specific training on new construction program rules and processes and provide some special recognition to contractors who attend such training—for example, identifying such contractors as "new construction program specialists" on the trade ally website and providing special new construction program co-branding]

Q29. What other changes, if any, are planned for outreach to, and interaction with, trade allies and other service providers? *[Probe about types of TA, including RSPs and NC.]*

Tracking & Reporting

Next, I'd also like to hear about tracking and reporting.

Q30. From your perspective, how well is the current tracking and reporting process working? *[Probe about additional reports or information that would be useful. Probe about differences by program]*

Q31. What tracking and reporting changes were made, if any, this program year? How have those worked out?

Q32. What changes have been made, if any, to QA/QC procedures?

Q33. I know you are aware that ADM has continued to find discrepancies between the quantities of applied-for and installed lighting. Can you tell me what Lockheed is doing to address this? What else might you do?

Q34. Can you help clarify when savings are and are not associated with the "study" measure in new construction projects?

1. We noticed that sometimes there are savings associated with a study and another measure variable, sometimes there are savings shown only for a study, and sometimes there are savings shown only for other measures.
2. Also, projects that show savings only for the study measure never have a status beyond "committed." Why is that?

Conclusion

Q35. Is there anything that you would like to see changed in program offerings in the future?

Q36. Is there anything else about the program that we have not discussed that you feel should be mentioned?

Q37. What would you like to learn from the program evaluation?

Those are all of my questions. Thank you very much for your time.

Lockheed Martin Specialty Programs Lead

Roles & Responsibilities

Q1. Let's start with a bit about you. I understand you are the Special Programs Lead for the Ameren Missouri programs and you are managing the New Construction and SBDI programs as well as the Trade Ally Network. Is that accurate?

Q2. Have any of your responsibilities changed since this past December? If so, how?

Q3. Are you still full time on Ameren or do you have responsibilities for other programs?

Program Processes

Q4. Has Lockheed made any changes to how the New Construction or SBDI programs under your purview are implemented? If so, what are they?

If changes made:

Q5. Why were those changes made? What effect have they had?

Q6. This past December, you mentioned that business development representatives had become more involved in the new construction program. How has the involvement of business development representatives affected the new construction projects you see coming into the program? *[Probe about: number of projects, type of projects, completeness of applications, concerns or questions that applicants have had.]*

Q7. It seems like a main limitation to getting more savings from the new construction program has been in getting involved early in project planning. Do you agree with that and, if so, what do you think are the reasons for that?

Q8. Are there any specific actors – building owners, architects, designers, and so forth – that the program has had difficulty engaging? What can be done about that?

Q9. We are planning to interview architects and designers this year to get their sense of what's needed to get the new construction program involved earlier in the planning of projects. What would you most like to learn from this group about that would help the program engage them more in the new construction program?

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Q12. When you were last interviewed this past December, you mentioned that the program has focused on recruiting only the TAs that had been active prior to the program lapse. But the Monthly Marketing Summaries show that the program has continued recruiting TAs and is up to 276. Does this reflect a change in strategy? If so, why? *[Probe about: Effect on program savings.]*

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Q15. It looks like most of the SPs have started more projects than they did last year. What do you think accounts for the increased activity?

Q16. And can you give me an update on efforts to keep TAs informed of program offerings and changes? *[Probe about training, events, and newsletters, and things mentioned in Monthly Summary: Trade Ally Awards program, including the videos (March), TAN Awards Winners page and home page banner on website.]*

Q17. Have there been any new special campaigns to increase TA activity, like the money-savings deals and "4 simple steps" campaigns Lockheed did last year? Or do you plan any? If so, please describe them. *[Probe about purpose and goals; how they track success (e.g., could they tell that campaigns increased number of applications?)]*

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the new construction program? *[If needed: One customer did not receive incentives for HVAC and water heater because contractor thought they could apply for incentives after purchasing equipment. Probe about recommendations made in the prior report to provide specific training on new construction program rules and processes and provide some special recognition to contractors who attend such training—for example, identifying such contractors as "new construction program specialists" on the trade ally website and providing special new construction program co-branding]*

Q20. What other changes, if any, are planned for outreach to, and interaction with, trade allies and other service providers? *[Probe about types of TA, including RSPs and NC.]*

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Next I'd like to hear briefly about how communication processes are working between and within staff at Ameren Missouri and Lockheed.

Q21. How has communication been between Lockheed and Ameren staff? *[Probe about: Frequency and type of reports and meetings, monthly meetings/webinars with KARs and CSAs, LM reports to CSAs about projects in their territory, Ameren keeping LM informed on key accounts, LM presentations to Ameren.]*

Q22. And how has communication been within the Lockheed BizSavers staff about the program? *[Probe about any changes in frequency or type of meeting.]*

[If issues identified, ask Q18]

Q23. What do you think should be done to improve program communication?

Tracking & Reporting

Next, I'd also like to hear about tracking and reporting.

Q24. From your perspective, how well is the current process of tracking and reporting projects working? Any differences by program? *[Probe about additional reports or information that would be useful.]*

Conclusion

Q25. Is there anything that you would like to see changed in program offerings in the future?

Q26. Is there anything else about the program that we have not discussed that you feel should be mentioned?

Q27. What would you like to learn from the program evaluation?

Those are all of my questions. Thank you very much for your time.

6. Online Participant Survey

GROUP: Participants across five programs: Standard, Custom, Retro-commissioning, New Construction, SBDI, and EMS Program Participants

1. Our records indicate you were the main contact for the energy efficient project(s) completed at [FR_LOC1] in [YEAR].

   Many of the following questions are about your organization's financial decision making and the project planning process.

   Were you involved in the decision to complete this project(s)?

   1. Yes, I was involved in the decision to complete the project(s)
   2. No, I was involved in the project(s) but not the decision to complete the project(s)
   3. No, I was not involved in the project(s)
   4. No, I do not work for [ORGANIZATION] but provided services for the project(s)
   88. Don't know

[DISPLAY Q2 IF Q1 = 2-4; THEN Q3, THEN SKIP TO END]

2. Could you please provide the name and contact information of the person most knowledgeable about the decision to install the energy efficient equipment at the [LOCATION]?

   1. [OPEN ENDED] Name and Email

3. What is your job title or role?

   1. Facilities Manager
   2. Energy Manager
   3. Other facilities management/maintenance position
   4. Chief Financial Officer
   5. Other financial/administrative position
   6. Proprietor/Owner
   7. President/CEO
   8. Manager
   9. Other (Specify) ____

4. Which of the following, if any, does your company have in place at [FR_LOC1]? [Select all that apply]

   1. A person or persons responsible for monitoring or managing energy usage
   2. Defined energy savings goals
   3. A specific policy requiring that energy efficiency be considered when purchasing equipment

4. Carbon reduction goals
5. Other – please describe: _____
6. None of the above
88. Don't know

Awareness

5. Had you applied for or received Ameren Missouri incentives for any equipment replacements or building upgrades before the one(s) you did in [YEAR]?

1. Yes
2. No
88. Don't know

[DISPLAY Q6 IF Q5 = 2 OR 88]

6. How did you learn about Ameren Missouri's incentives for efficient equipment or upgrades? (Select all that apply)

1. From the contractor, equipment vendor, or energy consultant who did the energy efficient project(s) completed at [FR_LOC1] in [YEAR]
2. From some other contractor, equipment vendor, or energy consultant
3. From an Ameren Missouri Account Representative
4. From a BizSavers representative
5. From a search engine (Google, Yahoo, Bing)
6. At an event/trade show
7. Received an email blast or electronic newsletter
8. Received an informational brochure
9. From a program sponsored webinar
10. From mobile advertising
11. From Ameren Missouri's website
12. TV / radio ad's sponsored by Ameren Missouri
13. Friends or colleagues
14. Through past experience with the program
15. Other (please explain)
88. Don't know

[DISPLAY Q7 IF Q5 = 1]

7. When you first applied for Ameren Missouri incentives for efficient equipment or upgrades, how did you learn about those incentives? (Select all that apply)

1. From the contractor, equipment vendor, or energy consultant who did the energy efficient project(s) completed at [FR_LOC1] in [YEAR].
2. From some other contractor, equipment vendor, or energy consultant.
3. From an Ameren Missouri Account Representative

4. From a BizSavers representative (not the person who actually did the project)
5. From a search engine (Google, Yahoo, Bing)
6. At an event/trade show
7. Received an email blast or electronic newsletter
8. Received an informational brochure
9. From a program sponsored webinar
10. From mobile advertising
11. From Ameren Missouri's website
12. TV / radio ad's sponsored by Ameren Missouri
13. Friends or colleagues
14. Other (please explain)
88. Don't know

[DISPLAY Q8 ONLY IF STANDARD = 1 AND CUSTOM = 0]

8. In addition to the incentives for specific standard equipment upgrades you received, did you know you could qualify for incentives by proposing a custom energy-upgrade project that fits your specific facility needs?

1. Yes
2. No
88. Don't know

[DISPLAY Q9 ONLY IF SBDI = 1 (AND ALL OTHER INCENTIVE TYPES = 0)]

9. In addition to the discounted lighting equipment you received, did you know you could qualify for incentives for other types of energy efficient equipment, such as heating, cooling, hot water, and refrigeration?

1. Yes
2. No
88. Don't know

[DISPLAY Q10 ONLY IF SBDI = 1 (AND ALL OTHER INCENTIVE TYPES = 0]

10. If the space heating, cooling, or refrigeration equipment at [FR_LOC1] needed repair or replacement, who would be financially responsible for the repair or replacement?

1. Our firm/organization
2. The building owner (not our firm/organization)
3. A property management or energy management firm
4. Other (please explain)
88. Don't know

[DISPLAY Q11 ONLY IF Q10 = 1 (OUR FIRM/ORGANIZATION)]

[FOR Q11, INSERT 5-POINT SCALE, WITH 1 LABELED AS “NOT AT ALL INTERESTED” AND 5 LABELED AS “EXTREMELY INTERESTED” BUT 2, 3, AND 4 NOT LABELED. INCLUDE “DON’T KNOW” OPTION.]

11. If the space heating, cooling, or refrigeration equipment at [FR_LOC1] needed repair or replacement, how interested would you be in using Ameren Missouri incentives to replace your equipment with new, energy efficient equipment.

    Please answer using a scale of 1-5 where one means “not at all interested” and 5 means “extremely interested.”

[DISPLAY Q12 IF NEW CONSTRUCTION = 1]

12. You recently received incentives through Ameren Missouri’s New Construction program. At what point did you learn about the availability of those incentives?

    1. Before we even started discussing any new construction project
    2. After we had started discussing a project but before selecting the major energy-using equipment
    3. After we had started the design but before selecting the major energy-using equipment
    4. After we had selected the major energy-using equipment
    88. Don’t know

[DISPLAY Q13 IF NEW CONSTRUCTION = 1]

13. At the time you applied for Ameren Missouri incentives for your new construction projects, did you understand that you could not receive incentives for any energy efficient equipment that was already part of your design before you talked to program representatives?

    1. Yes
    2. No
    88. Don’t know

[DISPLAY Q14 IF NEW CONSTRUCTION = 1]

[FOR Q14, INSERT 5-POINT SCALE, WITH 1 LABELED AS “NOT AT ALL” AND 5 LABELED AS “COMPLETELY” BUT 2, 3, AND 4 NOT LABELED. INCLUDE “DON’T KNOW” OPTION.]

14. How well did the New Construction program’s range of incentive options fit your needs?

[DISPLAY Q15 ONLY IF Q14 < 4]

15. What caused the range of incentive options offered to fail to meet your needs completely? [OPEN-ENDED RESPONSE]

[DISPLAY Q16 AND Q17 ONLY IF RCX = 1]

16. You recently received incentives for a retro-commissioning project. Which of these other Ameren Missouri program incentives are you aware of?

    1. New Construction and major building renovation incentives
    2. Standard incentives for specific measures such as lighting, HVAC, refrigeration, and water heating equipment
    3. Custom incentives for non-standard measures
    4. None of the above

[FOR Q17, INSERT 5-POINT SCALE, WITH 1 LABELED AS “NOT AT ALL” AND 5 LABELED AS “COMPLETELY” BUT 2, 3, AND 4 NOT LABELED. INCLUDE “DON’T KNOW” OPTION.]

17. How well did the Retro-commissioning program’s range of incentive options fit your needs?

[DISPLAY Q18 ONLY IF Q17 < 4]

18. In what way did the range of incentive options offered fail to meet your needs completely? [OPEN-ENDED RESPONSE]

[DISPLAY Q19 ONLY IF CUSTOM = 1 OR Q8 = 1]

19. Were you aware that the custom incentives for cooling equipment increased from $.07/kWh to $.15/kWh, starting in 2016?

    1. Yes
    2. No
    88. Don’t know

Program Delivery Efficiency

Application Process [do not display]

20. Which of the following people worked on completing your application for program incentives (including gathering required documentation)? (Select all that apply)

    1. Yourself
    2. Another member of your company
    3. A contractor
    4. An equipment vendor
    5. A designer or architect
    6. Someone else – please define: _____
    88. Don’t know

[DISPLAY Q21 IF Q20 = 1 AND SBDI = 0]

[FOR Q21, INSERT 5-POINT SCALE, WITH 1 LABELED AS “NOT AT ALL CLEAR” AND 5 LABELED AS “COMPLETELY CLEAR” BUT 2, 3, AND 4 NOT LABELED. INCLUDE “DON’T KNOW” OPTION.]

21. Thinking back to the application process, please rate the clarity of information on how to complete the application…

[DISPLAY Q22 ONLY IF Q21 < 4]

22. What information, including instructions on forms, needs to be further clarified?

[DISPLAY Q23 ONLY IF FAST TRACK = 1 AND SBDI = 0 AND NC = 0]

23. At the time you submitted your application, which of the following best describes what your understanding of the application rules was?

1. I had to purchase and install all of the equipment before applying for incentives
2. I had to purchase all equipment before applying for incentives but I could install equipment after applying
3. I could purchase equipment after applying for incentives
4. Other
88. Don’t know

[DISPLAY Q23 ONLY IF FAST TRACK = 1 AND SBDI = 0 AND NC = 0]

24. At the time you submitted your application, which of the following best describes what your understanding of the application rules was?

1. After Ameren Missouri approved my planned equipment replacement, I had to purchase and install all of the equipment before completing the incentive application
2. After Ameren Missouri approved my planned equipment replacement, I had to purchase all equipment before completing the incentive application but I could install equipment after completing the application
3. After Ameren Missouri approved my planned equipment replacement, I could purchase equipment after completing the application
4. Other
88. Don’t know

[DISPLAY Q25 ONLY IF Q20 = 1 (YOURSELF) AND SBDI = 0]

[FOR Q25, INSERT 5-POINT SCALE, WITH 1 LABELED AS “COMPLETELY UNACCEPTABLE” AND 5 LABELED AS “COMPLETELY ACCEPTABLE” BUT 2, 3, AND 4 NOT LABELED.

FOR ALL ITEMS, INCLUDE “DON’T KNOW” OPTION.

FOR ITEM 25A, INCLUDE OPTION “NOT APPLICABLE - DID NOT GET FORMS FROM THE WEBSITE”.

FOR ITEM 25D, INCLUDE OPTION “NOT APPLICABLE - NO DOCUMENTATION REQUIRED]

25. Using a 5-point scale, where 1 = “completely unacceptable” and 5 = “completely acceptable,” how would you rate. . .

a. …the ease of finding forms on Ameren Missouri’s website
b. …the ease of using the electronic application worksheets
c. …the time it took to approve the application
d. …the effort required to provide required invoices or other supporting documentation
e. …the overall application process

[DISPLAY Q26 ONLY IF SBDI = 0]

26. Did you have a clear sense of whom you could go to for assistance with the application process?

1. Yes
2. No
88. Don’t know

[DISPLAY Q27 ONLY IF CUSTOM = 1 OR RCX = 1 OR NC = 1 OR EMS = 1]

27. After initial submission, were you (or anyone acting on your behalf) required to resubmit or provide additional documentation before your application was approved?

1. Yes
2. No
88. Don’t know

[DISPLAY Q28 ONLY IF Q27= 1 (YES)]

28. Which of the following were reasons that you had to resubmit your application? (Please select all that apply)

1. Issues related to how energy savings were calculated
2. [DISPLAY IF RCx = 1] Other issues related to the Audit
3. [DISPLAY IF NC = 1] Other issues related to the Technical Analysis study
4. Issues related to additional supporting documentation such as invoices
5. Other issues – please specify: _____
88. Don’t know

[DISPLAY Q29 ONLY IF SBDI = 0]

29. How did the incentive amount compare to what you expected?

1. It was much less
2. It was somewhat less

3. It was about the amount expected
4. It was somewhat more
5. It was much more
88. Don't know

[DISPLAY Q30 ONLY IF SBDI = 1 AND STANDARD = 0 AND CUSTOM = 0 AND RCX = 0 AND NC = 0 AND EMS = 0]

30. How did the project cost compare to what you expected?

1. It was much less
2. It was somewhat less
3. It was about the amount expected
4. It was somewhat more
5. It was much more
88. Don't know

[DISPLAY Q31 IF DELAMP = 1]

31. According to our records you received an incentive for permanently removing [DELAMP_QUANT] linear fluorescent lamps. Were all of these lamps installed and operating at the time the removal work began?

1. Yes
2. No
88. Don't know

[DISPLAY Q32 ONLY IF Q31=2]

32. Approximately what share of the lamps that you received an incentive for permanently removing were NOT installed and operating at the time they were removed?

1. ____ Percent of lamps not installed and operating
88. Don't know

[DISPLAY Q33 ONLY IF Q31=2]

33. Thinking about the lamps that were NOT installed and operating when the removal work began, when were those lamps last installed and operating? Was it…

1. Less than one month before the removal work
2. One month to less than six months before the removal work
3. Six to 12 months before the removal work
4. More than one year before the removal work
88. Don't know

Equipment Selection

[FOR EACH PART OF Q34, INSERT FOLLOWING RESPONSE OPTIONS:

1 = No interaction with this type of person or they provided no input

2 = Input had no effect on decision

3 = Small effect on decision

4 = Moderate to large effect on decision

5 = Critical effect – could not have made decision without it

88 = I don't know how the interactions affected the decision

34. How did each of the following affect your decision to install the efficient equipment?

    a. [IF STANDARD = 1 OR CUSTOM = 1 OR EMS = 1] Vendor (retailer)
    b. [IF STANDARD = 1 OR CUSTOM = 1 OR RCX = 1 OR EMS = 1] Contractor (installer)
    c. [IF STANDARD = 1 OR CUSTOM = 1 OR NC = 1] Designer or architect
    d. [IF SBDI = 1] SBDI Service Provider (contractor)
    e. Ameren Missouri staff member, such as an account representative
    f. BizSavers program representative
    g. [IF RCX = 1] Audit Results
    h. [IF RCX = 1] Your RCx service provider
    i. [IF NC = 1] The "design team" process
    j. [IF NC = 1] General Contractor
    k. [IF NC = 1] The technical analysis study (energy modeling study)
    l. Someone else, please specify

[DISPLAY Q35 ONLY IF Q34L = 3 -5]

35. Who was the someone else that affected your decision to install the efficient equipment?

[DISPLAY Q36 ONLY IF STANDARD = 1]

36. You were required to submit a completed application, along with invoices and other documentation within 180 days after installing your project. Does this time frame limit the types of projects, like HVAC, water heating or other standard upgrades that you might propose to do through the program?

    1. No
    2. Yes
    88. Don't know

Measurement and Verification

37. After your project was completed, did a program representative other than the contractor inspect the work done through the program?

    1. Yes
    2. No
    88. Don't know

[DISPLAY Q38 IF Q37=1]

[FOR Q38, INSERT 5-POINT SCALE, WITH 1 LABELED AS "NOT AT ALL AGREE" AND 5 LABELED AS "COMPLETELY AGREE" BUT 2, 3, AND 4 NOT LABELED.]

FOR ALL ITEMS, INCLUDE "DON'T KNOW" OPTION]

38. Using a scale of 1-5 where one means Not at all agree and 5 means Completely agree, please rate your agreement with the following statements:

    a. The inspector was courteous
    b. The inspector was efficient

Customer Satisfaction

39. In the course of doing this project did you have any interactions with program staff? Program staff DO NOT include anyone hired by you to install the equipment, conduct an audit or design your system.

    1. Yes
    2. No
    88. Not sure

[DISPLAY Q40 IF Q39 = 1]

[FOR Q40, INSERT 5-POINT SCALE, WITH 1 LABELED AS "NOT AT ALL KNOWLEDGEABLE" AND 5 LABELED AS "VERY KNOWLEDGEABLE" BUT 2, 3, AND 4 NOT LABELED. INCLUDE "NOT SURE" OPTION]

40. On the scale provided, please indicate how knowledgeable were program staff about the issues you discussed with them?

[DISPLAY Q41 IF Q39 = 1]

[FOR Q41, INSERT 5-POINT SCALE, WITH 1 LABELED AS "NOT AT ALL SATISFIED" AND 5 LABELED AS "VERY SATISFIED" BUT 2, 3, AND 4 NOT LABELED. INCLUDE "NOT SURE" AND "NOT APPLICABLE – HAD NO QUESTIONS OR CONCERNS" OPTIONS]

41. On the scale of 1-5 where 1 means not at all satisfied and 5 means very satisfied, please indicate how satisfied you are with the following:

a. how long it took program staff to address your questions or concerns
b. how thoroughly they addressed your question or concern

[FOR Q42, INSERT 5-POINT SCALE, WITH 1 LABELED AS “NOT AT ALL SATISFIED” AND 5 LABELED AS “VERY SATISFIED” BUT 2, 3, AND 4 NOT LABELED. INCLUDE “NOT SURE” OPTION]

42. On the scale of 1-5 where 1 means not at all satisfied and 5 means very satisfied, please indicate how satisfied you are with the following:

a. the steps you had to take to get through the program
b. [IF RCx=0] the equipment that was installed
c. [IF RCx=0] the quality of the installation
d. [IF RCx=0] the amount of time it took to deliver and install the equipment
e. [IF SBDI=0] the amount of time it took to get your rebate or incentive
f. [IF SBDI=0 and RCx=0] the range of equipment that qualifies for incentives
g. [IF SBDI=1] the types of equipment that you were able to get through the program
h. [IF SBDI=1] how well the contractor explained the program rules and processes
i. [IF SBDI=1] how well the contractor explained the equipment recommendations
j. [IF SBDI=1] how well the contractor explained how much the incentives would cover
k. [IF SBDI=1] the walk-through assessment you received
l. [IF SBDI=1] the cost of the new lighting or other equipment
m. [IF SBDI=1] the time it took to get your new lighting or other equipment
n. the program, overall

[DISPLAY Q43 IF Q42 A-N < 4]

43. Please describe the ways in which you were not satisfied with the aspects of the program mentioned above?_____

Net-To-Gross Section

Free-Ridership [Do Not Display]

44. Before you knew about the BizSavers Program had you purchased and installed any energy efficient equipment at the [FR_LOC1] location?

1. Yes
2. No
88. Don’t know

45. Has your organization purchased any significant energy efficient equipment in the last three years for which you did not apply for a financial incentive through an energy efficiency program at the [FR_LOC1] location?

1. Yes. Our organization purchased energy efficient equipment but did not apply for incentive.
2. No. Our organization purchased significant energy efficient equipment and applied for an incentive.
3. No significant energy efficient equipment was purchased by our organization.
88. Don't know

46. Before participating in the BizSavers Program had you implemented any equipment or measure similar to [FR_MEAS 1] at the [FR_LOC1] location?

1. Yes
2. No
88. Don't know

47. Did you have plans to [INSTALL] the [FR_MEAS 1] at the [FR_LOC1] location before participating in the BizSavers Program?

1. Yes
2. No
88. Don't know

48. Would you have completed the [FR_MEAS 1] project even if you had not participated in the program?

1. Yes
2. No
88. Don't know

[DISPLAY Q49 IF Q5= 1]

49. How important was previous experience with the BizSavers Program in making your decision to [INSTALL] the [FR_MEAS 1] at the [FR_LOC1] location?

1. Very important
2. Somewhat important
3. Only slightly important
4. Not at all important
5. Did not have previous experience with the program.
88. Don't know

[DISPLAY Q50 IF SBDI = 1]

50. If the Service Provider that completed the onsite energy assessment had nor not recommended [INSTALLING] the [FR_MEAS 1], how likely is it that you would have [INSTALLED] it anyway?

1. Definitely would have installed
2. Probably would have installed

3. Probably would not have installed
4. Definitely would not have installed
88. Don't know

51. Did a BizSavers Program or other Ameren Missouri representative recommend that you [INSTALL] the [FR_MEAS 1] at the [FR_LOC1] location?

1. Yes
2. No
88. Don't know

[DISPLAY Q52 IF Q51 = 1]

52. If the BizSavers Program representative had not recommended [INSTALLING] the [FR_MEAS 1], how likely is it that you would have [INSTALLED] it anyway?

1. Definitely would have installed
2. Probably would have installed
3. Probably would not have installed
4. Definitely would not have installed
88. Don't know

53. Would you have been financially able to [INSTALL] the [FR_MEAS 1] at the [FR_LOC1] location without the financial incentive from the BizSavers Program?

1. Yes
2. No
88. Don't know

[DISPLAY Q54 IF Q53 = 2]

54. To confirm, your organization would NOT have allocated the funds to complete a similar energy saving project if the program incentive was not available. Is that correct?

1. Yes, that is correct.
2. No, that is not correct.
88. Don't know

[DISPLAY Q55 IF Q54 = 2]

55. In your own words, can you tell me what your organization would have likely done if the financial incentive was not available from the program?

56. If the financial incentive from the BizSavers Program had not been available, how likely is it that you would have [INSTALLED] the [FR_MEAS 1] at the [FR_LOC1] location anyway?

1. Definitely would have installed

2. Probably would have installed
3. Probably would not have installed
4. Definitely would not have installed
88. Don't know

[DISPLAY Q57 IF QUANT > 1]

57. We would like to know whether the availability of information and financial incentives through the [PROGRAM] affected the quantity (or number of units) of [FR_MEAS1] that you purchased and [INSTALLED] at the [FR_LOC1] location.

    Did you purchase and [INSTALL] more [FR_MEAS 1] than you otherwise would have without the program?

1. Yes
2. No, program did not affect quantity purchased and [INSTALLED].
88. Don't know

[DISPLAY Q58 IF ENERGY_USING = 1]

58. We would like to know whether the availability of information and financial incentives through the BizSavers Program affected the level of energy efficiency you chose for [FR_MEAS 1] at the [FR LOC1] location.

    Did you choose equipment that was more energy efficient than you would have chosen because of the program?

1. Yes
2. No, program did not affect level of efficiency chosen for equipment.
88. Don't know

[DISPLAY 59 IF Q58 = 1]

59. What type of equipment, if any, would you have installed if the program was not available?

[DISPLAY Q60 IF NC = 0]

60. We would like to know whether the availability of information and financial incentives through the BizSavers Program affected the timing of your purchase and installation of the [FR_MEAS1] at the [FR_LOC1] location.

    Did you purchase and [INSTALL] the [FR_MEAS1] earlier than you otherwise would have without the program?

1. Yes
2. No, program did not affect did not affect timing of purchase and [INSTALLATION].
88. Don't know

[DISPLAY Q61 IF Q60 = 1]

61. When would you otherwise have [INSTALLED] the equipment?

1. Less than 6 months later
2. 6-12 months later
3. 1-2 years later
4. 3-5 years later
5. More than 5 years later
88. Don't know

[DISPLAY Q62 IF NUMBER OF MEASURE TYPES > 1]

62. Our records indicate you [INSTALLED_FR2] [FR_MEAS2] at the [FR_LOC2] location in addition to [FR_MEAS1] at the [FR__LOC1] location. Did both of these projects go through the same decision making process or was a separate decision made for each?

1. The same decision making process applies to both projects.
2. A different decision making process applies to each project.
3. We did not [INSTALL_FR2] [FR_MEAS2] at the [FR_LOC2] location.
88. Don't know

[IF Q62 = 1, CYCLE THROUGH Q46- Q61 FOR FR_MEAS2]

Spillover

[DISPLAY IF SPILLOVER = 1]

63. According to our records, you also installed some [SPILL_MEASURES] at the [SPILL_LOC] that you did not receive an incentive for. Is that correct?

1. Yes
2. No, did not install that equipment
3. No, we received an incentive for the equipment we installed
88. Don't know

[DISPLAY Q64 IF Q63 = 1]

64. How important was your experience with the BizSavers Program in your decision to install this [SPILL_MEASURES], using a scale of 0 to 10, where 0 is not at all important and 10 is extremely important?"

[SCALE: 0 "NOT AT ALL IMPORTANT" - 10 "VERY IMPORTANT", 88 = DON'T KNOW]

65. If you had not participated in the BizSavers Program, how likely is it that your organization would still have installed this [SPILL_MEASURES], using a 0 to 10 scale, where 0 means you definitely WOULD NOT have installed this equipment and 10 means you definitely WOULD have installed this equipment?

[SCALE: 0 “DEFINITELY WOULD NOT HAVE INSTALLED” - 10 “DEFINITELY WOULD HAVE INSTALLED”, 88 = DON’T KNOW]

[DISPLAY Q66 IF Q64=0,1,2,3 AND Q65=0,1,2,3 OR IF Q64=8,9,10 AND Q65=8,9,10]

66. You scored the importance of your program experience to your decision to implement the [SPILL_MEASURES], [SPILL_MEASURES], with [Q53 RESPONSE] out of 10 possible points. You ALSO scored the likelihood of implementing the [SPILL_MEASURES], if your organization had not participated in the program with [Q54 RESPONSE] out of 10 possible points. Can you please explain the role the program made in your decision to implement this measure?

[OPEN ENDED]

[DISPLAY Q67 IF SPILLOVER = 1]

67. Because of your experience with the program, has your organization installed any other energy efficiency measures at this facility or at your other facilities within Ameren Missouri’s service territory that did NOT receive incentives through Ameren Missouri’s BizSavers Program?

1. Yes
2. No
88. Don’t know

General Spillover Questions

[DISPLAY IF SPILLOVER = 0]

68. We would like to know if you have installed any additional energy efficient equipment because of your experience with the program that you DID NOT receive an incentive for.

    Since participating in the BizSavers Program has your organization installed any ADDITIONAL energy efficiency measures at this facility or at your other facilities within Ameren Missouri’s service territory that did NOT receive incentives through Ameren Missouri’s BizSavers Program?

1. Yes
2. No
88. Don’t know

[DISPLAY Q69 IF Q68 = 1]

69. What additional equipment have you installed? [MULTI SELECT]

1. Lighting
2. Lighting controls or occupancy sensors
3. Unitary or split air conditioning system or chiller

4. Refrigeration equipment
5. Kitchen equipment
6. Something else
96. Didn’t implement any measures [SKIP TO FIRMOGRAPHICS]
88. Don’t know [SKIP TO FIRMOGRAPHICS]

[DISPLAY Q70 IF Q68 = 1]

70. Why didn’t you apply for or receive incentives for those items? [MULTI SELECT RANDOMIZE ORDER, BUT FIX OTHER AND DON’T KNOW]

1. Didn't know whether equipment qualified for financial incentives
2. Equipment did not qualify for financial incentives
3. Too much paperwork for the financial incentive application
4. Financial incentive was insufficient
5. Didn't have time to complete paperwork for financial incentive application
6. Didn't know about financial incentives until after equipment was purchased
7. Other reason (please describe): _____
8. We did receive an incentive from Ameren Missouri for that equipment [SKIP TO FIRMOGRAPHICS]
88. Don’t know

Lighting

[DISPLAY Q71 IF Q69 = 1]

71. What type of lighting did you install? [MULTI-SELECT]

1. T8 lamps or fixtures
2. T5 lamps or fixtures
3. Highbay Fixtures
4. Metal Halides
5. LED lamps
6. High Intensity Discharge Lamps (HID)
7. Another type [OPEN ENDED]
88. Don’t know

[DISPLAY Q73 IF Q71 = 1]

72. What type of T8 lamps or fixtures did you install?

1. 4’ lamps
2. 2 lamp fixtures
3. 4 lamp fixtures
4. 6 lamp fixtures
5. Another type
88. Don’t know

[DISPLAY Q74 IF Q73 = 5]

73. What other type of T8 lamp or fixtures did you install?

[OPEN ENDED]

[DISPLAY Q75 IF Q71 = 2]

74. What type of T5 lamps or fixtures did you install?

1. 4’ lamps
2. 2 lamp fixtures
3. 4 lamp fixtures
4. 6 lamp fixtures
5. Another type
88. Don’t know

[DISPLAY Q76 IF Q75 = 5]

75. What other type of T5 lamp or fixtures did you install?

[OPEN ENDED]

[DISPLAY Q77 IF Q71 = 3]

76. What type of highbay lighting did you install?

1. T5
2. T8
3. Another type
88. Don’t know

[DISPLAY Q78 IF Q77 = 3]

77. What other type of highbay lighting did you install?

[OPEN ENDED]

[DISPLAY Q79 IF Q71 = 3]

78. How many lamps per fixture are there in the High Bay Fixtures?

[OPEN ENDED] lamps per fixture

[DISPLAY Q80 IF Q71 = 4]

79. What type of metal halide lighting fixture did you install?

1. Ceramic
2. Pulse start
3. Other
88. Don’t know

[DISPLAY Q81 IF Q71 = 5]

80. What type of LED lamps did you install?

1. BAR/R
2. PAR
3. A-line
4. MR16
5. Exit Sign
6. Linear
7. Another type
88. Don't know

[DISPLAY Q82 IF Q81 = 6]

81. How long are the linear LED lamps that you installed?

1. 2 foot
2. 4 foot
3. 8 foot
4. Other (Please specify)
88. Don't know

[DISPLAY Q83 IF Q82 = 4]

82. What other type of LED did you install?

1. [OPEN ENDED]

[LOOP Q84-Q89 FOR EACH TYPE SELECTED IN Q71]

83. How many [Q71 RESPONSE] did you install?

1. [OPEN ENDED, NUMERIC]

84. What was the average wattage of the [Q71 RESPONSE]?

1. [OPEN ENDED, NUMERIC]

85. Were they installed inside or outside?

1. Inside
2. Outside
88. Don't know

86. What type of building did you install the [Q71 RESPONSE] lighting in?

1. College/University
2. Elementary School
3. Exterior
4. Garage (24/7 lighting)
5. Garage

6. Grocery
7. Heavy Industry
8. High School/Middle School
9. Hospital
10. Hotel/Motel – Common
11. Hotel/Motel – Guest Rooms
12. Light Industry
13. Miscellaneous
14. Multifamily Common Area
15. Office
16. Religious Worship/Church
17. Restaurant
18. Retail/Service
19. Warehouse
20. Other (Please specify)
88. Don't know

87. What type of lighting did the [Q71 RESPONSE] replace?

1. T12s (LINEAR FLOURESCENTS)
2. T8s (LINEAR FLOURESCENTS)
3. Metal halide
4. High Intensity Discharge Lamps (HID)
5. Something else (VERBATIM)
88. Don't know

88. How many of the old lamps or bulbs did you remove?

1. [OPEN ENDED, NUMERIC]

[DISPLAY Q90 IF Q71 = 1-7]

89. How important was your experience with the BizSavers Program in your decision to install this lighting equipment, using a scale of 0 to 10, where 0 is not at all important and 10 is extremely important?"

[SCALE: 0 "NOT AT ALL IMPORTANT" - 10 "VERY IMPORTANT", 88 = DON'T KNOW]

[DISPLAY Q91 IF Q71 = 1-7]

90. If you had not participated in the BizSavers Program, how likely is it that your organization would still have installed this lighting equipment, using a 0 to 10 scale, where 0 means you definitely WOULD NOT have installed this equipment and 10 means you definitely WOULD have installed this equipment?

[SCALE: 0 "DEFINITELY WOULD NOT HAVE INSTALLED" - 10 "DEFINITELY WOULD HAVE INSTALLED", 88 = DON'T KNOW]

[DISPLAY Q92 IF Q90=0,1,2,3 AND Q91=0,1,2,3

OR IF Q90=8,9,10 AND Q91=8,9,10]

91. You scored the importance of your program experience to your decision to implement additional lighting measures with [Q90 RESPONSE] out of 10 possible points. You ALSO scored the likelihood of implementing additional lighting measures if your organization had not participated in the program with [Q91 RESPONSE] out of 10 possible points. Can you please explain the role the program made in your decision to implement this measure?

1. [OPEN ENDED]

Lighting Controls

[DISPLAY Q93 IF Q69 = 2]

92. What type of lighting controls did you install?

1. Centralized lighting control system
2. Occupancy sensors
3. Something else (Please explain)
88. Don't know

[DISPLAY Q94 IF Q69 = 2]

93. How many square feet is the area being controlled?

1. [NUMERIC] sq. ft.

[DISPLAY Q95 IF Q93 = 2]

94. How many fixtures are being controlled by the lighting controls?

1. [OPEN ENDED, NUMERIC]

[DISPLAY Q96 IF Q93 = 2]

95. On average, how many lamps or bulbs does each fixture contain?

1. [OPEN ENDED, NUMERIC]

[DISPLAY Q97 IF Q93 = 2]

96. What is the average wattage of these lamps?

1. [OPEN ENDED, NUMERIC]

[DISPLAY Q98 IF Q69 = 2]

97. What type of building did you install the controls in?

1. College/University
2. Elementary School

3. Exterior
4. Garage (24/7 lighting)
5. Garage
6. Grocery
7. Heavy Industry
8. High School/Middle School
9. Hospital
10. Hotel/Motel – Common
11. Hotel/Motel – Guest Rooms
12. Light Industry
13. Miscellaneous
14. Multifamily Common Area
15. Office
16. Religious Worship/Church
17. Restaurant
18. Retail/Service
19. Warehouse
20. Other (Please specify)
88. Don't know

[DISPLAY Q99 IF Q69 =2]

98. How important was your experience with the [PROGRAM_NAME] Program in your decision to install lighting controls, using a scale of 0 to 10, where 0 is not at all important and 10 is extremely important?"

[SCALE: 0 "NOT AT ALL IMPORTANT" - 10 "VERY IMPORTANT", 88 = DON'T KNOW]

[DISPLAY Q100 IF Q69= 2]

99. If you had not participated in the [PROGRAM_NAME] Program, how likely is it that your organization would still have installed lighting controls, using a 0 to 10 scale, where 0 means you definitely WOULD NOT have installed this equipment and 10 means you definitely WOULD have installed this equipment?

[SCALE: 0 "DEFINITELY WOULD NOT HAVE INSTALLED" - 10 "DEFINITELY WOULD HAVE INSTALLED", 88 = DON'T KNOW]

[DISPLAY Q101 IF Q99=0,1,2,3 AND Q100=0,1,2,3

OR IF Q99=8,9,10 AND Q100=8,9,10]

100. You scored the importance of your program experience to your decision to implement lighting controls with [Q99 RESPONSE] out of 10 possible points. You ALSO scored the likelihood of implementing lighting controls if your organization had not participated in the program with [Q100 RESPONSE] out of 10 possible

points. Can you please explain the role the program made in your decision to implement this measure?

1. [OPEN ENDED]

HVAC Measures

[DISPLAY Q102 IF Q69 = 3]

101. What types of energy efficient equipment did you install as part of the HVAC project? [MULTI SELECT]

1. Air conditioning system
2. Heat pump (A heating and cooling system that transfers heat energy from a source to a destination)
3. Ground Source Heat pump (A heating and cooling system that transfers heat to or from the ground)
4. Air cooled chiller (A system that produces cold liquid sent around to individual spaces used for cooling air usually found in larger facilities)
5. Water cooled chiller (A system that produces cold liquid sent around to individual spaces used for cooling air usually found in larger facilities)
6. HVAC Occupancy Controls
7. Another type
88. Don't know

[DISPLAY Q103 IF Q102 = 7]

102. What other type of HVAC equipment did you install?

1. [OPEN ENDED]

[DISPLAY Q104 IF Q102 = 1]

103. What is the size (tons) of the air conditioning system installed?

1. [NUMERIC] tons

[DISPLAY Q105 IF Q102 = 2]

104. What is the size (tons) of the heat pump installed?

1. [NUMERIC] tons

[DISPLAY Q106 IF Q102 = 3]

105. What is the size (tons) of the ground source heat pump installed?

1. [NUMERIC] tons

[DISPLAY Q107 IF Q102 = 4]

106. What type of air cooled chiller was installed?

1. Reciprocating
2. Screw

[DISPLAY Q108 IF Q102=4]

107. What is the coefficient of performance (COP) and the integrated part load value (IPLV) of the installed air cooled chiller?

1. [NUMERIC] COP
2. [NUMERIC] IPLV

[DISPLAY Q109 IF Q102 = 4]

108. What is the size (tons) of the air cooled chiller installed?

1. [NUMERIC] tons

[DISPLAY Q110 IF Q102=5]

109. What type of water cooled chiller was installed?

1. Centrifugal
2. Screw
88. Don’t know

[DISPLAY Q111 IF Q102=5]

110. What is the integrated part load value (IPLV) of the installed water cooled chiller?

1. [NUMERIC] IPLV

[DISPLAY Q112 IF Q102 = 5]

111. What is the size (tons) of the water cooled chiller installed?

1. [NUMERIC] tons

[DISPLAY Q113 IF Q102=6]

112. How many buildings have HVAC occupancy controls installed?

1. [OPEN ENDED, NUMERIC]

[DISPLAY Q114 IF Q69=3]

113. How important was your experience with the BizSavers Program in your decision to install this HVAC equipment, using a scale of 0 to 10, where 0 is not at all important and 10 is extremely important?”

[SCALE: 0 “NOT AT ALL IMPORTANT” - 10 “VERY IMPORTANT”, 88 = DON’T KNOW]

[DISPLAY Q115 IF Q Q69= 3]

114. If you had not participated in the BizSavers Program, how likely is it that your organization would still have installed this HVAC equipment, using a 0 to 10 scale,

where 0 means you definitely WOULD NOT have installed this equipment and 10 means you definitely WOULD have installed this equipment?

[SCALE: 0 “DEFINITELY WOULD NOT HAVE INSTALLED” - 10 “DEFINITELY WOULD HAVE INSTALLED”, 88 = DON’T KNOW]

[DISPLAY Q116 IF Q114=0,1,2,3 AND Q115=0,1,2,3

OR IF Q114=8,9,10 AND Q115=8,9,10]

115. You scored the importance of your program experience to your decision to implement HVAC measures with [Q114 RESPONSE] out of 10 possible points. You ALSO scored the likelihood of implementing HVAC measures if your organization had not participated in the program with [Q115 RESPONSE] out of 10 possible points. Can you please explain the role the program made in your decision to implement this measure?

1. [OPEN ENDED]

Commercial Refrigeration Equipment

[DISPLAY Q117 IF Q69 = 4]

116. What types of energy efficient refrigeration equipment did you install?

1. ENERGY STAR Commercial freezer
2. ENERGY STAR Commercial refrigerator
3. Anti-sweat heater controls
4. Strip Curtain
5. Some other type of refrigeration equipment
88. Don’t know

[DISPLAY Q118 IF Q117= 5]

117. What other type of energy efficient refrigeration equipment did you install?

1. [OPEN ENDED]

[DISPLAY Q119 IF Q117 = 1]

118. How many ENERGY STAR commercial freezers did you install?

1. [NUMERIC]

[DISPLAY Q120 IF Q117 = 1, LOOP FOR EACH UP TO THREE TIMES]

119. What is the volume in cubic feet of the first freezer?

1. [NUMERIC] cubic feet

[DISPLAY Q121 IF Q117 = 1, LOOP FOR EACH UP TO THREE TIMES]

120. Does this freezer have a solid door or a glass door?

1. Solid door
2. Glass door
88. Don’t know

[DISPLAY Q122 IF Q117 = 2]

121. How many ENERGY STAR commercial refrigerators did you install?

1. [NUMERIC]

[DISPLAY Q123 IF Q117 = 2, REPEAT FOR EACH UP TO THREE TIMES]

122. What is the volume in cubic feet of the first refrigerator?

1. [NUMERIC] cubic feet

[DISPLAY Q124 IF Q117 = 2, REPEAT FOR EACH UP TO THREE TIMES]

123. Does this refrigerator have a solid door or a glass door?

1. Solid door
2. Glass door
88. Don’t know

[DISPLAY Q125 IF Q117 = 3]

124. How many anti-sweat heater controls did you install?

1. [NUMERIC]

[DISPLAY Q126 IF Q117 = 4]

125. How many strip curtains were installed?

1. [NUMERIC]

[DISPLAY Q127 IF Q117 = 4]

126. Where were the strip curtains installed?

1. Walk-in freezer
2. Walk-in cooler
88. Don’t know

[DISPLAY Q128IF AND Q117= 1-5]

127. How important was your experience with the BizSavers Program in your decision to install the energy efficient refrigeration equipment, using a scale of 0 to 10, where 0 is not at all important and 10 is extremely important?”

[SCALE: 0 “NOT AT ALL IMPORTANT” - 10 “VERY IMPORTANT”, 88 = DON’T KNOW]

[DISPLAY Q129IF AND Q117= 1-5]

128. If you had not participated in the BizSavers Program, how likely is it that your organization would still have installed this energy efficient refrigeration equipment, using a 0 to 10 scale, where 0 means you definitely WOULD NOT have installed this equipment and 10 means you definitely WOULD have installed this equipment?

[SCALE: 0 “DEFINITELY WOULD NOT HAVE INSTALLED” - 10 “DEFINITELY WOULD HAVE INSTALLED”, 88 = DON’T KNOW]

[DISPLAY Q130 IF Q128=0,1,2,3 AND Q129=0,1,2,3 AND Q117 = 1-5

OR IF Q128=8,9,10 AND Q129=8,9,10 AND Q117 = 1-5]

129. You scored the importance of your program experience to your decision to implement energy efficient refrigeration equipment with [Q128 RESPONSE] out of 10 possible points. You ALSO scored the likelihood of implementing energy efficient refrigeration equipment if your organization had not participated in the program with [Q129 RESPONSE] out of 10 possible points. Can you please explain the role the program made in your decision to implement this measure?

1. [OPEN ENDED]

Commercial Kitchen Equipment

[DISPLAY Q131IF Q69 = 5]

130. What type of kitchen equipment did you install?

1. ENERGY STAR Commercial steam cookers
2. ENERGY STAR hot food holding cabinets
3. ENERGY STAR ice machines
4. Low-flow pre-rinse sprayer
5. Some other type of kitchen equipment
88. Don’t know

[DISPLAY Q132 IF Q131 = 5]

131. What other type of kitchen equipment did you install?

1. [OPEN ENDED]

[DISPLAY Q133 IF Q131 = 1]

132. How many ENERGY STAR commercial steam cookers did you install?

1. 3 pan steam cookers [NUMERIC]
2. 4 pan steam cookers [NUMERIC]
3. 5 pan steam cookers [NUMERIC]

4. 6 pan steam cookers [NUMERIC]

[DISPLAY Q134IF Q131 = 2]

133. How many ENERGY STAR hot food holding cabinets did you install?

1. [NUMERIC]

[DISPLAY Q135 IF Q131 = 3]

134. How many ENERGY STAR ice machines did you install?

1. [NUMERIC]

[DISPLAY Q136 IF Q131 = 3]

135. What is the average production (lbs ice/day) of the ice machine(s) installed?

1. [NUMERIC] lbs ice/day

[DISPLAY Q137 IF Q131 = 4]

136. Do any of the low-flow pre-rinse sprayers reduce the use of electrically heated water?

1. Yes
2. No
88. Don't know

[DISPLAY Q138 IF Q137= 1]

137. How many low-flow pre-rinse sprayers that reduce the use of electrically heated water did you install?

1. [NUMERIC] pre-rinse sprayers

[DISPLAY Q139 IF AND Q131=1-5]

138. How important was your experience with the BizSavers Program in your decision to install this kitchen equipment, using a scale of 0 to 10, where 0 is not at all important and 10 is extremely important?"

[SCALE: 0 "NOT AT ALL IMPORTANT" - 10 "VERY IMPORTANT", 88 = DON'T KNOW]

[DISPLAY Q140 IF AND Q131=1-5]

139. If you had not participated in the BizSavers Program, how likely is it that your organization would still have installed this kitchen equipment, using a 0 to 10 scale, where 0 means you definitely WOULD NOT have installed this equipment and 10 means you definitely WOULD have installed this equipment?

[SCALE: 0 "DEFINITELY WOULD NOT HAVE INSTALLED" - 10 "DEFINITELY WOULD HAVE INSTALLED", 88 = DON'T KNOW]

[DISPLAY Q141 IF Q139=0,1,2,3 AND Q140=0,1,2,3

OR IF Q139=8,9,10 AND Q140=8,9,10 AND Q131=1-5]

140. You scored the importance of your program experience to your decision to implement energy efficient kitchen equipment with [Q139 RESPONSE] out of 10 possible points. You ALSO scored the likelihood of implementing energy efficient kitchen equipment if your organization had not participated in the program with [Q140 RESPONSE] out of 10 possible points. Can you please explain the role the program made in your decision to implement this measure?

1. [OPEN ENDED]

Commercial Misc. Equipment [DO NOT DISPLAY]

[DISPLAY Q142 IF Q69 = 6]

141. What type of equipment did you install?

1. Heat pump water heater
2. ENERGY STAR vending machine
3. Low flow faucet aerator
4. Low flow showerhead
5. Efficient pump
6. VFD controls
7. Other equipment
88. Don’t know

[DISPLAY Q143 IF Q142 =7]

142. What other type of equipment did you install?

1. [OPEN ENDED]

[DISPLAY Q144 IF Q142=1]

143. How many heat pump water heaters did you install?

1. [NUMERIC]

[DISPLAY Q145 IF Q142=2]

144. How many ENERGY STAR vending machines did you install?

1. [NUMERIC]

[DISPLAY Q146 IF Q142=1]

145. What is the average size (MBH) of the heat pump water heaters?

1. [NUMERIC] MBH

[DISPLAY Q147 IF Q142=3]

146. Do any of the buildings in which you installed the low-flow faucet aerators have electric water heating?

1. Yes
2. No
88. Don't know

[DISPLAY Q148 IF Q147=1]

147. How many buildings with electric water heating had low flow faucet aerators installed?

1. [NUMERIC]

[DISPLAY Q149 IF Q142= 5]

148. How many pump motors did you install?

1. [NUMERIC]

[DISPLAY Q150 IF Q142=5]

149. What is the average horsepower of the newly installed pump motors?

1. [NUMERIC]

[DISPLAY Q151 IF Q142=5]

150. What is the average efficiency of the new pump motors?

1. [OPEN ENDED]

[DISPLAY Q152 IF Q142=6]

151. How many motors had VFDs installed?

1. [OPEN ENDED, NUMERIC]

[DISPLAY Q153 IF Q142=6]

152. What is the application of the motor?

1. [OPEN ENDED]

[DISPLAY Q154 IF Q142=6]

153. What is the average horse power of the motors controlled by the VFDs?

1. [OPEN ENDED]

[DISPLAY Q155 IF AND Q142=1-7]

154. How important was your experience with the BizSavers Program in your decision to install this additional equipment, using a scale of 0 to 10, where 0 is not at all important and 10 is extremely important?"

[SCALE: 0 “NOT AT ALL IMPORTANT” - 10 “VERY IMPORTANT”, 88 = DON’T KNOW]

88. Don’t know

[DISPLAY Q156 IF AND Q142 = 1-7]

155. If you had not participated in the BizSavers Program, how likely is it that your organization would still have installed this additional equipment, using a 0 to 10 scale, where 0 means you definitely WOULD NOT have installed this equipment and 10 means you definitely WOULD have installed this equipment?

[SCALE: 0 “DEFINITELY WOULD NOT HAVE INSTALLED” - 10 “DEFINITELY WOULD HAVE INSTALLED”, 88 = DON’T KNOW]

[DISPLAY Q157 IF Q155=0,1,2,3 AND Q156=0,1,2,3

OR IF Q155=8,9,10 AND Q156=8,9,10]

156. You scored the importance of your program experience to your decision to implement energy efficient additional equipment with [Q155 RESPONSE] out of 10 possible points. You ALSO scored the likelihood of implementing energy efficient additional equipment if your organization had not participated in the program with [Q156 RESPONSE] out of 10 possible points. Can you please explain the role the program made in your decision to implement this measure?

1. [OPEN ENDED]

Firmographic

[Note to reviewer: The customer database has many fields indicating much of the “firmographic” data we will want to capture. However, we have not yet established how much of it is populated. Therefore, we propose the following questions. If the database provides sufficient firmographic data, we will be able to eliminate some or all of these questions.]

157. Which of the following best describes the type of work that your firm or organization does at [FR_LOC1]?

1. Industrial
2. Restaurant (not fast food)
3. Fast food restaurant
4. Retail
5. Office
6. Grocery and convenience
7. School
8. Lodging
9. Warehouse

10. Other – specify: ____
88. Not sure

158. Does your organization rent, own and occupy, or own and rent the facility to someone else at this location?

1. Own
2. Own and occupy
3. Own and rent to someone else
88. Don't know

159. Including all the properties, how many separate work locations does your organization own or lease space in, in Ameren Missouri territory? (A work location may consist of multiple buildings in close proximity to each other, such as a university campus – please indicate the number of locations) _____

160. Please list any other properties that could benefit from energy efficient electric or gas equipment upgrades which may qualify for an incentive. Please provide company name, contact person, and phone number and/or email address. _____ [OPEN-ENDED RESPONSE]

161. How many square feet (indoor space) is the part of the property at [LOCATION] that your firm or organization occupies? (If your firm or organization occupies the entire property, indicate the total size of that property.)

1. Less than 5,000
2. 5,001 to 10,000
3. 10,001 to 20,000
4. 20,001 to 50,000
5. 50,001 to 75,000
6. 75,001 to 100,000
7. 100,001 to 250,000
8. 250,001 to 500,000
9. 500,001 to 1,000,000
10. More than 1,000,000
88. Not sure

162. How can the BizSavers Program implementation team provide you with better service? _____ [OPEN-ENDED RESPONSE]

7. Non-Participant Survey

Phone

Screening [ALL]

Hello, this is [Interviewer] calling from Opinion Dynamics on behalf of Ameren Missouri with a few brief questions about energy usage. I was hoping to speak with someone who knows how decisions are made in your organization about facility upgrades and major equipment purchases.

[If appropriate respondent]

Ameren Missouri is trying to learn how companies make decisions about energy use, particularly about replacing or upgrading energy-using equipment and facilities. Your organization was selected at random for a brief telephone survey. The survey will take about 10 or 12 minutes of your time. Would you like to do the survey now?

[If respondent agrees to take survey]

First, I need to ask a couple of questions to see if you are eligible for this survey.

[ALL]

S1. When it comes to purchasing energy-using equipment for your facilities/sites, do you…?

[SINGLE RESPONSE]

1. Make those decisions
2. Provide input to others who make those decisions
3. Have no involvement with those decisions

[IF S1=3]

S2. Could you please let us know the name and contact information (phone and/or email) of someone who is involved in those decisions?

1. [OPEN-END RESPONSE]

[IF S1 = 3, DISPLAY FOLLOWING AND TERMINATE:

WE HAVE NO FURTHER QUESTIONS FOR YOU. THANK YOU FOR YOUR TIME.]

[IF S1= 1 OR 2]

S3. To the best of your knowledge, has your organization replaced or upgraded electricity-using equipment in the past three years for which it received or is expecting to receive a cash incentive from Ameren Missouri?

[*Interviewer: "electricity-using equipment" means equipment that requires electricity to operate, such as lighting, motors, computers, etc.*]

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know

[IF S3 = 1, DISPLAY FOLLOWING AND TERMINATE:

THANK YOU. WE ARE LOOKING FOR COMPANIES THAT HAVE NOT RECEIVED AND ARE NOT EXPECTING TO RECEIVE AMEREN MISSOURI EQUIPMENT INCENTIVES. THEREFORE, WE HAVE NO FURTHER QUESTIONS FOR YOU. THANK YOU FOR YOUR TIME.]

Program Awareness and Sources of Awareness

[ALL]

Q1. Which types of equipment does your organization make equipment maintenance or replacement decisions about?

[*Do not read; after each response, say: anything else? Until respondent indicates no other equipment.*]

[MULTIPLE BINARY RESPONSE, EXCEPT 98 AND 99 PRECLUDE OTHER RESPONSES]

1. Lighting
2. Heating
3. Cooling
4. Computers
5. Refrigeration
6. Motors
7. Other: [OPEN-ENDED RESPONSE]
98. Don't know

[ALL]

Q2. Before we contacted you, were you aware that Ameren Missouri provides cash incentives for energy efficient equipment purchases and upgrades for existing and new buildings?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know

[IF Q2 = YES]

Q3. In the past year, from what sources have you gotten information about the energy efficiency incentives from Ameren Missouri? Please try to name all the sources you have gotten information from.

[*Do not read; after each response, say: what else? Until respondent indicates no other sources.*]

1. A bill insert, mailing, or flyer from Ameren
2. An email or online newsletter from Ameren
3. An Ameren advertisement in the newspaper
4. An Ameren advertisement on TV or radio
5. An Ameren representative
6. Ameren's website
7. Social media
8. Searching the internet (online)
9. Word of mouth (friend, neighbor, family, co-worker, colleague)
10. Trade (contractors, distributors, manufacturers, retailers, installers, etc)
11. None
12. Other, specify: _____
98. Don't know
99. Refused

Upgrades to Energy-using Equipment

Now we'd like to know about any recent or planned equipment purchases.

[ALL]

Q4. What equipment or building features, if any, has your organization replaced or upgraded in the past two years?

[MULTIPLE BINARY RESPONSE; HOWEVER, OPTIONS 11, 98, AND 99 CANNOT BE SELECTED IF ANY OTHER RESPONSES ARE SELECTED]

1. Windows
2. Insulation (ceiling, attic or wall)
3. Heating, cooling, HVAC
4. Water heating
5. Motors or motor controls
6. Cooking (ovens)
7. Refrigeration or freezing
8. Lighting
9. Lighting controls, including occupancy sensors or dimmers
10. Data center or IT equipment

11. Other - specify: _____
12. None
98. Don't know

[IF Q4.8 (LIGHTING) IS SELECTED]

Q5. What type of lighting was installed?

1. LED
2. Fluorescent tube
3. Other – specify: _____
98. Don't know

[IF Q4.8 (LIGHTING) IS SELECTED AND USAGE >= 4000]

Q6. Who did your organization purchase the lighting from? Please select all that apply.

1. Distributor
2. Retailer
3. Contractor/installer
4. Other – specify: _____
98. Don't know

[IF Q4.8 (LIGHTING) IS SELECTED AND Q6.1 (DISTRIBUTOR) IS SELECTED AND USAGE >= 4000]

Q7A. Did the distributor your organization bought lighting from mention the energy-efficiency incentives available from Ameren Missouri?

1. Yes
2. No
98. Don't know

[IF Q4.8 (LIGHTING) IS SELECTED AND Q6.2 (RETAILER) IS SELECTED AND USAGE >= 4000]

Q7B. Did the retailer your organization bought lighting from mention the energy-efficiency incentives available from Ameren Missouri?

1. Yes
2. No
98. Don't know

[IF Q4.8 (LIGHTING) IS SELECTED AND Q6.3 (CONTRACTOR/INSTALLER) IS SELECTED AND USAGE >= 4000]

Q7C. Did the contractor or installer who provided the lighting mention the energy-efficiency incentives available from Ameren Missouri?

1. Yes

2. No
98. Don’t know

[IF Q4.8 (LIGHTING) IS SELECTED AND USAGE < 4000]

Q7D. Did anyone your organization bought lighting from mention the energy-efficiency incentives available from Ameren Missouri? If yes, who?

1. [OPEN-END RESPONSE]
98. Don’t know

[IF Q4.1 OR Q4.2 OR Q4.3 OR Q4.4 OR Q4.5 OR Q4.6 OR Q4.7 OR Q4.9 OR Q4.10 (ANYTHING BUT LIGHTING) IS SELECTED]

Q8. You said your organization installed some non-lighting equipment. Who did your organization purchase that equipment from?

1. Distributor
2. Retailer
3. Contractor/installer
4. Other – specify: _____
98. Don’t know

[IF Q4.1 OR Q4.2 OR Q4.3 OR Q4.4 OR Q4.5 OR Q4.6 OR Q4.7 OR Q4.9 OR Q4.10 (ANYTHING BUT LIGHTING) AND Q8.1 (DISTRIBUTOR) IS SELECTED]

Q9A. Did the distributor your organization bought non-lighting equipment from mention the energy-efficiency incentives available from Ameren Missouri?

1. Yes
2. No
98. Don’t know

[IF Q4.1 OR Q4.2 OR Q4.3 OR Q4.4 OR Q4.5 OR Q4.6 OR Q4.7 OR Q4.9 OR Q4.10 (ANYTHING BUT LIGHTING) AND Q8.2 (RETAILER) IS SELECTED]

Q9B. Did the retailer your organization bought non-lighting equipment from mention the energy-efficiency incentives available from Ameren Missouri?

1. Yes
2. No
98. Don’t know

[IF Q4.1 OR Q4.2 OR Q4.3 OR Q4.4 OR Q4.5 OR Q4.6 OR Q4.7 OR Q4.9 OR Q4.10 (ANYTHING BUT LIGHTING) AND Q8.3 (CONTRACTOR/INSTALLER) IS SELECTED]

Q9C. Did the contractor or installer who provided the non-lighting equipment mention the energy-efficiency incentives available from Ameren Missouri?

1. Yes

2. No
98. Don't know

[IF (Q4.11 NOT SELECTED AND Q4.98 NOT SELECTED AND Q4.99 NOT SELECTED (HAS REPLACED EQUIPMENT)] AND USAGE >=4000]

Q10. In general, how much does input from each of the following types of people influence your organization's decisions about equipment replacements and upgrades? Please answer on a scale from 1 to 7, where 1 means "no influence" and 7 means "very great influence".

[*Read each item. Repeat response options as needed. If someone indicates they received no input from a type of person, record as 1 "no influence".*]

1. Equipment distributors
2. Equipment retailers
3. Contractor or installers
4. Someone else, please specify: _____

[IF (Q4.11 NOT SELECTED AND Q4.98 NOT SELECTED AND Q4.99 NOT SELECTED) (HAS REPLACED EQUIPMENT) AND USAGE <4000]

Q11. In general, how much do equipment vendors influence your organization's decisions about equipment replacements and upgrades? Please answer on a scale from 1 to 7, where 1 means "no influence" and 7 means "very great influence".

[INSERT 1-7 SCALE WITH 98 = DK, 99 = REF]

[ALL]

Q12. How likely is it that you will use Ameren Missouri incentives to increase the energy efficiency level of any equipment replacements or upgrades you will make in the next two years? This could include replacements that might result from unexpected equipment failures as well as planned replacements. Please answer on a scale from 1 to 7, where 1 means "not at all likely" and 7 means "extremely likely".

[INSERT 1-7 SCALE WITH 98 = DK, 99 = REF]

Interest in New Construction

[IF USAGE >=4000]

Q13. Is your organization considering undertaking any new construction or major building renovation projects within the next five years?

[*If needed: this could include adding a new wing, gutting an existing building, or building an entirely new building.*]

1. Yes

2. No
98. Don't know

[IF Q13= 1 (YES)]

Q14. Has your organization begun discussing the project design with an architect, design engineer, or other type of contractor?

1. Yes
2. No
98. Don't know

[IF Q14= 1 (YES)]

Q15. In those discussions, has anyone brought up the possibility of using energy-efficiency incentives from Ameren Missouri?

1. Yes
2. No
98. Don't know

[IF Q14= 1 (YES)]

Q16. In general, how much does input from the design professionals you have dealt with influence your organization's decisions about the equipment you will use in the new construction or major building renovation project? Please answer on a scale from 1 to 7, where 1 means "no influence" and 7 means "very great influence".

[INSERT SCALE FROM 1 (NO INFLUENCE) TO 7 (VERY GREAT INFLUENCE) WITH 98=DK]

Interest in SBDI

[IF RATE CLASS = 2M]

Q17. Is your organization responsible for purchasing the lighting at your location?

1. Yes
2. No
98. Don't know
99. Refused

[IF RATE CLASS= 2M AND Q17= 1 (YES)]

Q18. Thinking about all of the lighting at your work location, about what proportion does LED lighting make up? Would you say…

1. None or very little
2. More than very little, but less than half
3. About half

4. More than half, but not nearly all
5. All or nearly all
98. Don't know

[IF RATE CLASS = 2M AND Q17= 1]

Q19. About what percentage of your organization's total monthly operating costs do your electricity bills make up?

1. OPEN END: ____
98. Don't know

[Q20 AND Q21 ARE PRESENTED IN RANDOM ORDER]

[IF RATE CLASS = 2M AND Q17 = 1 (YES)]

Q20. Would you replace your organization's lighting if you could reduce monthly electric bills by 10% to 20%?

1. Yes
2. Maybe
3. No

[IF RATE CLASS = 2M AND Q17= 1 (YES)]

Q21. Would you replace your organization's lighting if you could reduce monthly electric bills by more than 20%?

1. Yes
2. Maybe
3. No

[IF RATE CLASS = 2M AND Q17= 1 (YES) AND USAGE>=4000]

Q22. The Ameren Missouri Small Business Direct Install, or SBDI, program provides free walk-through energy assessments and cash incentives that typically cover at least half the cost of new, efficient lighting equipment. Several designated Service Providers provide the walk-through assessments and completely handle the application process.

If an SBDI Service Provider contacted your organization, how likely is it that your organization would schedule a free walk-through energy assessment? Please use a 1 to 7 scale where 1 means "not at all likely" and 7 means "extremely likely".

[INSERT SCALE FROM 1 (NOT AT ALL) TO 7 (EXTREMELY) WITH 98 = DK]

[IF RATE CLASS = 2M AND Q17= 1 AND Q22 <> 7 AND USAGE>=4000]

Q23. What might keep your organization from scheduling a free walk-through energy assessment with an Ameren Missouri Small Business Direct Install Service Provider?

[*Follow initial response with "what else"?*]

1. [OPEN-END RESPONSE]
98. Don't know

Interest in EMS Pilot

[IF TAX EXEMPT = YES]

Q24. The next questions are about Energy Management Systems, or EMSs, which control, monitor, and log energy consumption of a building or of specific equipment such as lighting, air conditioning, or security systems. To your knowledge, does your organization have an EMS installed at your facility?

1. Yes
2. No
98. Don't know

[IF TAX EXEMPT = YES]

Q25. Before reading the above description, how familiar were you with Energy Management Systems?

1. I knew a lot about them
2. I knew a moderate amount about them
3. I knew little or nothing about them
99. Refused

[IF TAX EXEMPT = YES]

Q26. Ameren Missouri is now offering incentives to tax-exempt organizations to install an EMS. The incentive covers up to $35,000 or 50% of the cost of equipment and software, whichever is less. Based on that information, how interested would your organization be in learning more about Ameren Missouri incentives for an EMS? Please use a 1 to 7 scale where 1 means "not at all" and 7 means "extremely".

[INSERT SCALE FROM 1 (NOT AT ALL) TO 7 (EXTREMELY) WITH 98 = DK]

[IF TAX EXEMPT = YES AND Q26 <> 7]

Q27. What might keep your company from applying for these new incentives for an EMS?

[*Follow initial response with "what else"?*]

1. [OPEN-END RESPONSE]

98. Don't know

Organization Description

We are almost finished. I'd like to ask you just a few final questions about you and your organization.

[ALL]

Q28. What is your job title?

[*Do not read list. Record one response. If necessary, ask: is that most like {and read list}*]

1. Accounting/Finance (accountant, treasurer, bookkeeper)
2. Administrative (secretary, receptionist, office specialist)
3. President or Vice President
4. CEO/CFO/Officer Position
5. Director
6. Proprietor/Owner/Partner
7. Manager
8. Controller
9. Maintenance/Facilities Management
10. Pastor
11. Other (Specify) ____
98. Don't know
99. Refused

[IF TYPE = NULL]

Q29. What is your organization's primary business or activity?

[*Do not read list. Record one response. Probe to code. List is ordered from most to least common.*

"Professional services" covers a wide range of generally office-based services, including banking/financial, consulting, advertising, real estate management & sales, telecommunications, but excludes government offices, which is a separate category.]

1. Professional services (office)
2. Transportation (trucking, boating, air)
3. Construction and related trades (e.g., contractors)
4. Retail
5. Restaurant
6. Grocery/convenience store
7. Government

8. Warehouse
9. Healthcare
10. Auto Service (garage, gas, towing, rental)
11. Industrial/manufacturing
12. State-certified K-12 school (public or private)
13. Other school type
14. Entertainment
15. Lodging
16. Agriculture
17. Religious
18. Not applicable
19. Service or non-profit
20. Related to real estate/property management
21. Other, please describe _____
98. Don't know
99. Refused

[IF USAGE >= 4000]

Q30. Including all the properties, how many separate work locations does your organization own or lease space in, in Ameren Missouri territory?

[*If needed: a work location may consist of multiple buildings in close proximity to each other, such as a university campus.*]

1. [OPEN-END RESPONSE]
98. Don't know

[IF USAGE >= 4000]

Q31. What is the approximate total square footage of the facility or facilities that your organization owns or leases in Ameren Missouri territory? Your best guess is fine.

1. [OPEN-END RESPONSE]
98. Don't know

[IF USAGE < 4000]

Q32. What is the approximate total square footage of your workplace? Your best guess is fine.

1. [OPEN-END RESPONSE]
98. Don't know

[ALL]

Q33. Thinking about your work location, does your organization…

1. Own and occupy the entire building

2. Own the building and occupy part of it while leasing parts to others
3. Lease the space
4. Other – specify: _____
98. Don't know

Implementer Contact

[ALL]

Q34. Would you be interested in having someone contact you to provide more information on Ameren Missouri's cash incentives for energy-efficiency upgrades?

1. Yes – respondent is correct contact
2. Yes – respondent provides different contact: _____
3. No
98. Don't know
99. Refused

Web

Screening [ALL]

Thank you for agreeing to help Ameren Missouri with this important activity.

This should take no more than 15 minutes, and we encourage you to complete it in one session. However, if you do need to take a break at any time, just exit the browser. Later, you can click on the survey link again and it will take you back to where you started.

First, please answer a couple of questions to see if you are eligible for this survey.

[ALL]

S1. When it comes to purchasing energy-using equipment for your facilities/sites, which of the following best describes your role?

[SINGLE RESPONSE]

1. I make those decisions
2. I provide input to others who make those decisions
3. I have no involvement with those decisions

[IF S1=3]

S2. Please let us know the name and contact information (phone and/or email) of someone who is involved in those decisions:

1. [OPEN-END RESPONSE]

[IF S1 = 3, DISPLAY FOLLOWING AND TERMINATE:

WE HAVE NO FURTHER QUESTIONS FOR YOU. THANK YOU FOR YOUR TIME.]

[ALL]

S3. To the best of your knowledge, has your organization replaced or upgraded electricity-using equipment in the past three years for which it received or is expecting to receive a cash incentive from Ameren Missouri?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know

[IF S3 = 1, DISPLAY FOLLOWING AND TERMINATE:

THANK YOU. WE ARE LOOKING FOR COMPANIES THAT HAVE NOT RECEIVED AND ARE NOT EXPECTING TO RECEIVE AMEREN MISSOURI EQUIPMENT INCENTIVES. THEREFORE, WE HAVE NO FURTHER QUESTIONS FOR YOU. THANK YOU FOR YOUR TIME.]

Program Awareness and Sources of Awareness

[ALL]

Q1. Please select all of the types of equipment for which your company or organization makes maintenance or replacement decisions at its work locations.

[MULTIPLE BINARY RESPONSE, EXCEPT 98 AND 99 PRECLUDE OTHER RESPONSES]

1. Lighting
2. Heating
3. Cooling
4. Computers
5. Refrigeration
6. Motors
7. Other: [OPEN-ENDED RESPONSE]
98. Don't know

[ALL]

Q2. Before we contacted you, were you aware that Ameren Missouri provides cash incentives for energy efficient equipment purchases and upgrades for existing and new buildings?

[SINGLE RESPONSE]

1. Yes
2. No

98. Don’t know

[IF Q2 = YES]

Q3. In the past year, from what sources have you gotten information about the energy efficiency incentives from Ameren Missouri? Please try to name all the sources you have gotten information from.

1. [OPEN-END RESPONSE]
98. Don’t know

Upgrades to Energy-using Equipment

Now we’d like to know about any recent or planned equipment purchases.

[ALL]

Q4. What equipment or building features, if any, has your organization replaced or upgraded in the past two years?

[MULTIPLE BINARY RESPONSE; HOWEVER, OPTIONS 11, 98, AND 99 CANNOT BE SELECTED IF ANY OTHER RESPONSES ARE SELECTED]

1. Windows
2. Insulation (ceiling, attic or wall)
3. Heating, cooling, HVAC
4. Water heating
5. Motors or motor controls
6. Cooking (ovens)
7. Refrigeration or freezing
8. Lighting
9. Lighting controls, including occupancy sensors or dimmers
10. Data center or IT equipment
11. Other - specify: _____
12. None
98. Don’t know

[IF Q4.8 (LIGHTING) IS SELECTED]

Q5. What type of lighting was installed?

1. LED
2. Fluorescent tube
3. Other – specify: _____
98. Don’t know

[IF Q4.8 (LIGHTING) IS SELECTED AND USAGE >= 4000]

Q6. Who did your organization purchase the lighting from? Please select all that apply.

1. Distributor
2. Retailer
3. Contractor/installer
4. Other – specify: _____
98. Don't know

[IF Q4.8 (LIGHTING) IS SELECTED AND Q6.1 (DISTRIBUTOR) IS SELECTED AND USAGE >= 4000]

Q7. Did the distributor your organization bought lighting from mention the energy-efficiency incentives available from Ameren Missouri?

1. Yes
2. No
98. Don't know

[IF Q4.8 (LIGHTING) IS SELECTED AND Q6.2 (RETAILER) IS SELECTED AND USAGE >= 4000]

Q8. Did the retailer your organization bought lighting from mention the energy-efficiency incentives available from Ameren Missouri?

1. Yes
2. No
98. Don't know

[IF Q4.8 (LIGHTING) IS SELECTED AND Q6.3 (CONTRACTOR/INSTALLER) IS SELECTED AND USAGE >= 4000]

Q9. Did the contractor or installer who provided the lighting mention the energy-efficiency incentives available from Ameren Missouri?

1. Yes
2. No
98. Don't know

[IF Q4.8 (LIGHTING) IS SELECTED AND USAGE < 4000]

Q10. Did anyone your organization bought lighting from mention the energy-efficiency incentives available from Ameren Missouri? If yes, who?

1. [OPEN-END RESPONSE]
98. Don't know

[IF Q4.1 OR Q4.2 OR Q4.3 OR Q4.4 OR Q4.5 OR Q4.6 OR Q4.7 OR Q4.9 OR Q4.10 (ANYTHING BUT LIGHTING) IS SELECTED]

Q11. You said your organization installed some non-lighting equipment. Who did your organization purchase that equipment from? Please select all that apply.

1. Distributor
2. Retailer
3. Contractor/installer
4. Other – specify: _____
98. Don't know

[IF Q4.1 OR Q4.2 OR Q4.3 OR Q4.4 OR Q4.5 OR Q4.6 OR Q4.7 OR Q4.9 OR Q4.10 (ANYTHING BUT LIGHTING) AND Q11.1 (DISTRIBUTOR) IS SELECTED]

Q12. Did the distributor your organization bought non-lighting equipment from mention the energy-efficiency incentives available from Ameren Missouri?

1. Yes
2. No
98. Don't know

[IF Q4.1 OR Q4.2 OR Q4.3 OR Q4.4 OR Q4.5 OR Q4.6 OR Q4.7 OR Q4.9 OR Q4.10 (ANYTHING BUT LIGHTING) AND Q11.2 (RETAILER) IS SELECTED]

Q13. Did the retailer your organization bought non-lighting equipment from mention the energy-efficiency incentives available from Ameren Missouri?

1. Yes
2. No
98. Don't know

[IF Q4.1 OR Q4.2 OR Q4.3 OR Q4.4 OR Q4.5 OR Q4.6 OR Q4.7 OR Q4.9 OR Q4.10 (ANYTHING BUT LIGHTING) AND Q11.3 (CONTRACTOR/INSTALLER) IS SELECTED]

Q14. Did the contractor or installer who provided the non-lighting equipment mention the energy-efficiency incentives available from Ameren Missouri?

1. Yes
2. No
98. Don't know

[IF (Q4.11 NOT SELECTED AND Q4.98 NOT SELECTED AND Q4.99 NOT SELECTED (HAS REPLACED EQUIPMENT)] AND USAGE >=4000]

Q15. In general, how much does input from each of the following types of people influence your organization's decisions about equipment replacements and upgrades?

[INSERT SCALE FROM 1 (NO INFLUENCE) TO 7 (VERY GREAT INFLUENCE) WITH 98=DK. RANDOMIZE ORDER OF ITEMS 1-4]

1. Equipment distributors
2. Equipment retailers

3. Contractor or installers
4. Someone else, please specify: _____

[IF (Q4.11 NOT SELECTED AND Q4.98 NOT SELECTED AND Q4.99 NOT SELECTED) (HAS REPLACED EQUIPMENT) AND USAGE <4000]

Q16. In general, how much do equipment vendors influence your organization's decisions about equipment replacements and upgrades?

[INSERT SCALE FROM 1 (NO INFLUENCE) TO 7 (VERY GREAT INFLUENCE) WITH 98=DK]

[ALL]

Q17. How likely is it that you will use Ameren Missouri incentives to increase the energy efficiency level of any equipment replacements or upgrades you will make in the next two years? Please answer on a scale from 1 to 7, where 1 means "not at all likely" and 7 means "extremely likely".

[INSERT 1-7 SCALE WITH 98 = DK, 99 = REF]

Interest in New Construction

[IF USAGE >=4000]

Q18. Is your organization considering undertaking any new construction or major building renovation projects within the next five years? This could include adding a new wing, gutting an existing building, or building an entirely new building.

1. Yes
2. No
98. Don't know

[IF Q18 = 1 (YES)]

Q19. Has your organization begun discussing the project design with an architect, design engineer, or other type of contractor?

1. Yes
2. No
98. Don't know

[IF Q19 = 1 (YES)]

Q20. In those discussions, has anyone brought up the possibility of using energy-efficiency incentives from Ameren Missouri?

1. Yes
2. No
98. Don't know

[IF Q19 = 1 (YES)]

Q21. In general, how much does input from the design professionals you have dealt with influence your organization's decisions about the equipment you will use in the new construction or major building renovation project?

[INSERT SCALE FROM 1 (NO INFLUENCE) TO 7 (VERY GREAT INFLUENCE) WITH 98=DK]

Interest in SBDI

[IF 2M = YES]

Q22. Is your organization responsible for purchasing the lighting at your location?

1. Yes
2. No
98. Don't know
99. Refused

[IF 2M = YES AND Q22 = 1 (YES)]

Q23. Thinking about all of the lighting at your work location, about what proportion does LED lighting make up? Would you say…

1. None or very little
2. More than very little, but less than half
3. About half
4. More than half, but not nearly all
5. All or nearly all
98. Don't know

[IF 2M = YES AND Q22 = 1]

Q24. About what percentage of your organization's total monthly operating costs do your electricity bills make up?

1. OPEN END: ____
98. Don't know

[Q25 AND Q26 ARE PRESENTED IN RANDOM ORDER]

[IF 2M=YES AND Q22 = 1 (YES)]

Q25. Would you replace your organization's lighting if you could reduce monthly electric bills by 10% to 20%?

1. Yes
2. Maybe
3. No

[IF 2M=YES AND Q22 = 1 (YES)]

Q26. Would you replace your organization's lighting if you could reduce monthly electric bills by more than 20%?

1. Yes
2. Maybe
3. No

[IF 2M=YES AND Q22 = 1 (YES) AND USAGE>=4000]

Q27. The Ameren Missouri Small Business Direct Install, or SBDI, program provides free walk-through energy assessments and cash incentives that typically cover at least half the cost of new, efficient lighting equipment. Several designated Service Providers provide the walk-through assessments and completely handle the application process.

If an SBDI Service Provider contacted your organization, how likely is it that your organization would schedule a free walk-through energy assessment?

[INSERT SCALE FROM 1 (NOT AT ALL) TO 7 (EXTREMELY) WITH 98 = DK]

[IF 2M=YES AND Q22 = 1 AND Q27 <> 7 AND USAGE>=4000]

Q28. What might keep your organization from scheduling a free walk-through energy assessment with an Ameren Missouri Small Business Direct Install Service Provider?

1. [OPEN-END RESPONSE]
98. Don't know

Interest in EMS Pilot

[IF TAX_EXEMPT = YES]

Q29. The next questions are about Energy Management Systems, or EMSs, which control, monitor, and log energy consumption of a building or of specific equipment such as lighting, air conditioning, or security systems. To your knowledge, does your organization have an EMS?

1. Yes
2. No
98. Don't know

[IF TAX_EXEMPT = YES]

Q30. Before reading the above description, how familiar were you with Energy Management Systems?

1. I knew a lot about them

2. I knew a moderate amount about them
3. I knew little or nothing about them
99. Refused

[IF TAX_EXEMPT = YES]

Q31. Ameren Missouri is now offering incentives to tax-exempt organizations to install an EMS. The incentive covers up to $35,000 or 50% of the cost of equipment and software, whichever is less. Based on that information, how interested would your organization be in learning more about Ameren Missouri incentives for an EMS?

[INSERT SCALE FROM 1 (NOT AT ALL) TO 7 (EXTREMELY) WITH 98 = DK]

[IF TAX_EXEMPT = YES AND Q31 <> 7]

Q32. What might keep your company from applying for these new incentives for an EMS?

1. [OPEN-END RESPONSE]
98. Don't know

Organization Description

We are almost finished. I'd like to ask you just a few final questions about you and your organization.

[ALL]

Q33. What is your job title?

1. [OPEN-END RESPONSE]
98. Don't know

[IF TYPE = NULL]

Q34. What is your organization's primary business or activity?

1. [OPEN-END RESPONSE]
98. Don't know

[IF USAGE >= 4000]

Q35. Including all the properties, how many separate work locations does your organization own or lease space in, in Ameren Missouri territory?

1. [OPEN-END RESPONSE]
98. Don't know

[IF USAGE >= 4000]

Q36. What is the approximate total square footage of the facility or facilities that your organization owns or leases in Ameren Missouri territory?

1. [OPEN-END RESPONSE]
98. Don't know

[IF USAGE < 4000]

Q37. What is the approximate total square footage of your workplace?

1. [OPEN-END RESPONSE]
98. Don't know

[ALL]

Q38. Thinking about your work location, does your organization…

1. Own and occupy the entire building
2. Own the building and occupy part of it while leasing parts to others
3. Lease the space
4. Other – specify: _____
98. Don't know

Implementer Contact

[ALL]

Q39. Would you be interested in having someone contact you to provide more information on Ameren Missouri's cash incentives for energy-efficiency upgrades?

1. Yes – respondent is correct contact
2. Yes – respondent provides different contact: _____
3. No
98. Don't know
99. Refused

8. Trade Ally Interview Guide

Screening Questions

[ASK ALL]

S1. Which of the following types of equipment does your company deal in? Please select all that apply, even if your company handles very little of that equipment type.

[SELECT ALL THAT APPLY]

1. Cooling
2. Heating
3. Cooking
4. Building shell
5. Lighting
6. Water heating
7. Motors
8. Air compression
9. Industrial process
10. Refrigeration
11. Energy management systems (EMS)
12. Building management or automation systems (BMS or BAS)
96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know

[ASK IF S1.5 (LIGHTING) NOT SELECTED AND LIGHTING = 1]

S2. You did not identify “lighting” as an equipment type your company deals with, but BizSavers program records identify your company as associated with at least one lighting project. Please clarify whether your company sells or installs lighting equipment at all, even if it is a small part of your business.

1. My company has sold lighting equipment
2. My company does not sell or install lighting equipment at all
98. Don't know
99. Refused

[ASK ALL]

S3. Which of the following describe the kind of work your company does? Please select all that apply.

[MULTIPLE SELECTION]

1. Sells equipment to contractors who install the equipment. [Will go to Vendor block (Q1), then process evaluation block]
2. Sells equipment directly to businesses and other end-users. [If selected and 1 is not selected: Go to contractor block (Q9), then process evaluation block]
3. Installs equipment at end-user sites. [If selected, and 1 is not selected: Go to contractor block (Q9), then process evaluation block]
4. Neither sells nor installs equipment. [UNIQUE RESPONSE] [Will go to process evaluation block]

98. Don't know [UNIQUE RESPONSE] [Will go to process evaluation block]

[ASK IF S3 = 4 (NEITHER SELLS NOR INSTALLS EQUIPMENT)]

S4. Please briefly describe what your company does:

1. [OPEN-END RESPONSE]
   [GO TO PROCESS EVALUATION QUESTIONS]

[ASK IF S1.5 (LIGHTING) IS SELECTED OR S2 = 1 (SELLS LIGHTING EQUIPMENT)]

S5. When describing the high-efficient lighting you have sold and/or installed in the past year in Ameren Missouri's service territory, will you be answering only for yourself, for a specific company location, or for the entire company's work in Ameren Missouri service territory?

1. I will be answering only for myself
2. I will be answering for everyone at a specific company location
3. I will be answering for my entire company's work at multiple locations in Ameren Missouri service territory

[GO TO VENDOR QUESTIONS IF EITHER (S1.5 (LIGHTING) IS SELECTED OR S2 = 1 (SELLS LIGHTING EQUIPMENT)) AND S3.1 IS SELECTED]

[GO TO CONTRACTOR QUESTIONS IF EITHER (S1.5 (LIGHTING) IS SELECTED OR S2 = 1 (SELLS LIGHTING EQUIPMENT)) AND ONE OF THE FOLLOWING CONDITIONS APPLIES:

- S3.1 IS NOT SELECTED AND EITHER (S3.2 IS SELECTED OR S3.3 IS SELECTED)
- S3.1 IS NOT SELECTED AND S3.4 IS NOT SELECTED AND S3.98 IS NOT SELECTED]

[GO TO PROCESS EVALUATION QUESTIONS IF EITHER:

- S1.5 (LIGHTING) IS NOT SELECTED AND S2 <> 1 (DOESN'T CONFIRM SELLS LIGHTING EQUIPMENT)
- S3.1 IS NOT SELECTED AND S3.2 IS NOT SELECTED AND S3.3 IS NOT SELECTED]

Vendor Questions

[ASK ALL VENDORS]

Q1. Which of the following types of lighting did your company sell within the Ameren Missouri service territory from March 1, 2018, through February 28, 2019?

Please select all that apply. If your company sold none of the types listed, please select the last option.

1. LED interior lighting
2. LED high bay/low bay interior fixtures
3. LED exterior fixtures
4. Lighting controls
5. None of the above types of equipment [UNIQUE RESPONSE]

[ASK IF Q1 = 5]

Q2. Please briefly describe the types of lighting equipment your company sold within Ameren Missouri service territory from March 1, 2018 through February 28, 2019:

1. [OPEN-END RESPONSE] [Go to Process Evaluation Block]

[ASK IF Q1 ≠ 5]

Q3. How many of the following specific types of lighting did you sell within the Ameren Missouri service territory from March 1, 2018 through February 28, 2019?

[PROGRAMMER: Display only the specific lighting measures that are associated with lighting types selected in Q1, as shown in column 1 of the table.]

DISPLAY IF SELECTED IN Q1	SPECIFIC LIGHTING MEASURE	# Sold or installed
	1. LED A-lamp (11W or less)	
	2. LED A-lamp (over 11W)	
	3. LED Reflector lamps (screw-In), includes flood, BR, PAR	
	4. LED downlight fixture	

ASK IF Q1_1 (LED interior) is selected	5. LED 4ft linear tube, plug and play (Type A) (count lamps and lamps in fixtures)	
	6. LED 4ft linear tube, direct wire-ballast bypass (Type B) (count lamps and lamps in fixtures)	
	7. LED 4ft linear tube/strips/kits, external driver (Type C) (count lamps and lamps in fixtures)	
ASK IF Q1_2 (LED high/low bay interior) is selected	8. LED high bay fixtures, interior	
	9. LED low bay fixtures and garage fixtures	
ASK IF Q1_3 (LED exterior) is selected	10. LED parking lot fixtures, exterior	
	11. LED wall wash fixtures, exterior	
ASK IF Q1_4 (Lighting controls) is selected	12. Daylighting controls	
	13. Ceiling-mounted occupancy sensors	
	14. Wall-mounted occupancy sensors	
	15. Fixture-mounted occupancy sensors	

[ASK IF Q1 ≠ 5]

Q4. For each of the following equipment types, about what percentage of your sales in Ameren Missouri service territory were directly to the end-users, NOT to contractors or other equipment dealers?

[PROGRAMMER: Display only the types of lighting selected in Q1.]

Display Logic	Lighting Type	Percentage sold to contractors
ASK IF Q1_1 IS SELECTED	1. LED interior lighting	FOR EACH ITEM, INSERT OPTIONS: 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%, DON'T KNOW
ASK IF Q1_2 IS SELECTED	2. LED high bay/low bay interior fixtures	
ASK IF Q1_3 IS SELECTED	3. LED exterior fixtures	
ASK IF Q1_4 IS SELECTED	4. Lighting controls	

[ASK IF Q1 ≠ 5 AND ANY OF Q4_1, Q4_2, Q4_3, Q4_4 > 0% - I.E., ANY SALES DIRECTLY TO END-USERS]

The next questions are about your sales of lighting equipment to businesses or other end-users. They do not apply to your sales to contractors.

Q5. Of your sales of each of the following equipment types to businesses or other end-users in Ameren Missouri service territory, about what percentage of the time did the customer indicate that they would apply for BizSavers incentives?

[PROGRAMMER NOTE: Display only the types of lighting selected in Q1.]

Display Logic	Lighting Type	Percentage of customers that indicated they would apply for BizSavers incentives
ASK IF Q1_1 IS SELECTED AND Q4_1 IS <100%	1. LED interior lighting	FOR EACH ITEM, INSERT OPTIONS: 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%, DON'T KNOW
ASK IF Q1_2 IS SELECTED AND Q4_2 IS <100%	2. LED high bay/low bay interior fixtures	
ASK IF Q1_3 IS SELECTED AND Q4_3 IS <100%	3. LED exterior fixtures	
ASK IF Q1_4 IS SELECTED AND Q4_4 IS <100%	4. Lighting controls	

[ASK ALL VENDORS]

Q6. And when you make a sale of lighting equipment directly to businesses or other end-users, about what percentage of the time do you recommend equipment for their job? (As opposed to times when the customer did not request a recommendation and you did not offer one.)

1. [OPEN-END RESPONSE] percent

[ASK ALL VENDORS]

Q7. And when you recommend equipment to an end-user customer for a lighting job, about what percentage of your recommendations do your customers accept, on average?

1. [OPEN-END RESPONSE] percent

[ASK ALL VENDORS]

Q8. Please use a number from 0 to 100 to indicate how much influence the BizSavers program had on the equipment recommendations you have made to end-user customers. A "0" means that the program had no influence on your recommendations, and a "100" means that the program totally influenced your recommendations – that is, you would not have made the recommendations without the program's influence.

(You may consider any way in which the program may have influenced your recommendations, such as by making you aware of the incentives for equipment or by providing you information on the advantages of specific types of equipment.)

[PROGRAMMER NOTE: Insert 0%, 10%, 20%, 30%, 40%, 50%, 60% 70%, 80%, 90%, 100%, and “Not sure” options]

Contractor Questions

[ASK ALL CONTRACTORS]

Q2. Which of the following types of lighting did your company sell within the Ameren Missouri service territory from March 1, 2018, through February 28, 2019? [FORCE RESPONSE]

Please select all that apply. If your company sold none of the types listed, please select the last option.

1. LED interior lighting
2. LED high bay/low bay interior fixtures
3. LED exterior fixtures
4. Lighting Controls
5. None of the above types of equipment [UNIQUE RESPONSE]

[ASK IF Q9= 5]

Q3. Please briefly describe the types of equipment your company sold within Ameren Missouri service territory from March 1, 2018, through February 28, 2019:

1. [OPEN-END RESPONSE] [Go to Process Evaluation Block]

[ASK IF Q9 ≠ 5]

Q4. How many of the following specific types of lighting did you sell within the Ameren Missouri service territory from March 1, 2018, through February 28, 2019?

[PROGRAMMER: Display only the specific lighting measures that are associated with lighting types selected in Q9, as shown in column 1 of the table.]

DISPLAY IF SELECTED IN Q9	SPECIFIC LIGHTING MEASURE	# Sold or installed
ASK IF Q9_1 (LED	1. LED A-lamp (11W or less)	
	2. LED A-lamp (over 11W)	

interior) is selected	3. LED reflector lamps (Screw-In), includes flood, BR, PAR	
	4. LED downlight fixture	
	5. LED 4ft linear tube, plug and play (Type A) (count lamps and lamps in fixtures)	
	6. LED 4ft linear tube, direct wire-ballast bypass (Type B) (count lamps and lamps in fixtures)	
	7. LED 4ft linear tube/strips/kits, external driver (Type C) (count lamps and lamps in fixtures)	
ASK IF Q9_2 (high/low bay interior) is selected	8. LED high bay fixtures, interior	
	9. LED low bay fixtures and garage fixtures	
ASK IF Q9_3 (LED exterior) is selected	10. LED parking lot fixtures, exterior	
	11. LED wall wash fixtures, exterior	
ASK IF Q9_4 (Lighting controls) is selected	12. Daylighting controls	
	13. Ceiling-mounted occupancy sensors	
	14. Wall-mounted occupancy sensors	
	15. Fixture mounted occupancy sensors	

[ASK IF Q9 ≠ 5]

Q5. Thinking about the lighting jobs you have done, about what percent of the time did the vendor that sold you the equipment make an equipment recommendation? (As opposed to times when you did not request a recommendation and the vendor did not offer one.)

1. OPEN-END RESPONSE percent

[ASK IF Q9 ≠ 5]

Q6. And when you do a lighting job, about what percentage of the time do you recommend equipment to your customer? (As opposed to times when your customer does not request a recommendation and you do not offer one.)

1. OPEN-END RESPONSE percent

[ASK IF Q9 ≠ 5]

Q7. And when you recommend equipment for a lighting job, about what percentage of your recommendations do your customers accept, on average?

1. OPEN-END RESPONSE percent

[ASK IF Q9 ≠ 5]

Q8. Of your sales of each of the following equipment types to businesses or other end-users in Ameren Missouri service territory, about what percentage of the time did your customer apply for BizSavers incentives?

[PROGRAMMER NOTE: Display only the types of lighting selected in Q9.]

Display Logic	Lighting Type	Percentage of customers that indicated they would apply for BizSavers incentives
ASK IF Q9_1 IS SELECTED	1. LED interior lighting	FOR EACH ITEM, INSERT OPTIONS: 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%, DON'T KNOW
ASK IF Q9_2 IS SELECTED	2. LED high bay/low bay interior fixtures	
ASK IF Q9_3 IS SELECTED	3. LED exterior fixtures	
ASK IF Q9_4 IS SELECTED	4. Lighting controls	

[ASK IF Q9 ≠ 5]

Q9. Please use a number from 0 to 100 to indicate how much influence **vendor** recommendations, when given, had on the equipment recommendations you have made to customers. A "0" means that the vendor recommendations had no influence on your recommendations, and a "100" means that the vendor recommendations totally influenced your recommendations – that is, you would not have made the recommendations without the influence of the vendor recommendations.

[PROGRAMMER NOTE: Insert 0%, 10%, 20%, 30%, 40%, 50%, 60% 70%, 80%, 90%, 100% and "Not sure" options]

[ASK IF Q9 ≠ 5]

Q10. Please use a number from 0 to 100 to indicate how much influence the **BizSavers program** had on the equipment recommendations you have made to customers. A "0" means that the program had no influence on your recommendations, and a "100" means that the program totally influenced your recommendations – that is, you would not have made the recommendations without the program's influence.

(You may consider any way in which the program may have influenced your recommendations, such as by making you aware of the incentives for equipment or by providing you information on the advantages of specific types of equipment.)

[PROGRAMMER NOTE: Insert 0%, 10%, 20%, 30%, 40%, 50%, 60% 70%, 80%, 90%, 100% and “Not sure” options]

Process Questions

We have few remaining questions to get your thoughts and feedback about Ameren Missouri’s nonresidential energy efficiency programs.

General

[ASK ALL]

Q11. Please rate your agreement or disagreement with the following statements about Ameren Missouri and the BizSavers Program.

[INSERT SCALE FROM 1 (STRONGLY DISAGREE) TO 7 (STRONGLY AGREE) WITH 98=DK]

1. The BizSavers Program motivates businesses to invest in energy efficiency more than they would otherwise do
2. [IF STANDARD = YES] The application process for Standard incentives is reasonable
3. [IF CUSTOM = YES] The application process for Custom incentives is reasonable
4. [IF NC = YES] The application process for new construction incentives is reasonable
5. [IF RCX = YES] The application process for retro-commissioning incentives is reasonable
6. [IF SBDISP = YES] The application process for SBDI incentives is reasonable
7. The BizSavers Program communicates well with me
8. The BizSavers Program has followed a consistent approach to managing the trade allies network
9. The BizSavers Program helps me get work

Program Awareness

[ASK ALL]

Q12. About what proportion of your customers already knew about the Ameren Missouri BizSavers incentives before you mentioned the incentives to them?

1. None or very few
2. More than very few but less than half
3. About half

4. More than half but not nearly all
5. All or nearly all
98. Don't know

General Awareness of Incentive Changes

[ASK ALL]

Q13. Starting in 2016, the Custom program provides higher incentive levels for cooling, HVAC, cooking, building shell, lighting, and water heating, and lower incentives for refrigeration equipment. The incentive levels for motors, air compression, and process-related measures remained the same.

Before reading the above, were you aware of this change?

1. Yes
2. No
3. Not sure

Cooling Incentives and Sales

[ASK IF S1.1 IS SELECTED]

Q14. Which of the following best describes your company's sales goal for non-residential cooling equipment during the current program year compared to the 2016-2017 program year?

[SINGLE RESPONSE]

1. Significantly higher goal than the previous year
2. Slightly higher goal than the previous year
3. About the same as the previous year
4. Slightly lower goal than the previous year
5. Significantly lower goal than the previous year
6. Do not have specific sales goals set for non-residential cooling
98. Don't know

[ASK IF Q21 = 1 OR 2 (HIGHER GOALS)]

Q15. To what degree were the increased sales goals for non-residential cooling equipment influenced by increased BizSavers incentives for that equipment type?

[SINGLE RESPONSE]

1. Completely, the increased incentives were the only reason for the increased sales goals
2. Largely, but there were some other reasons for the increased sales goals
3. Somewhat, but other reasons had a greater influence on the increased sales goals
4. Little or not at all, we increased sales goals almost entirely for other reasons

98. Don't know

[ASK IF Q22 <> 1 (INCREASED INCENTIVES WERE NOT THE ONLY REASON FOR INCREASED SALES GOALS)]

Q16. What other reasons did your company have for increasing sales goals for non-residential cooling equipment?

[SINGLE RESPONSE]

1. [OPEN-ENDED RESPONSE]
98. Don't know

[ASK IF S1.1 IS SELECTED]

Q17. A BizSavers business development representative who specializes in cooling measures is available to help with savings calculations and modeling for custom cooling incentives. Have you ever received assistance from this individual?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know

[ASK IF Q24 = 1 (YES)]

Q18. How valuable was that assistance?

[INSERT SCALE FROM 1 (NOT AT ALL VALUABLE) TO 7 (EXTREMELY VALUABLE) WITH 98=DK]

[ASK IF Q24 = 2 (NO) OR 98 (DK)]

Q19. Were you aware that this individual is available to help with these calculations?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know

[ASK IF S1.1 IS SELECTED]

Q20. What challenges, if any, have you encountered in getting customers to apply for the BizSavers cooling equipment incentives?

1. [OPEN-ENDED RESPONSE]
98. Don't know

Lighting Incentives and Sales

[ASK IF S1.5 (LIGHTING) IS SELECTED OR S2 = 1 (SELLS LIGHTING EQUIPMENT)]

Q21. Starting this program year, BizSavers lighting incentives are calculated on per-watt-saved rather than per-unit basis. Overall, would you say this was a change for the better, the worse, or neither?

[SINGLE RESPONSE]

1. For the better
2. For the worse
3. Neither good nor bad
4. I was not aware of this change
98. Don't know

[ASK IF Q28 = 1 (CHANGE FOR THE BETTER)]
Q22. In what way was it a change for the better?

1. [OPEN-ENDED RESPONSE]
98. Don't know

[ASK IF Q28 = 2 (CHANGE FOR THE WORSE)]
Q23. In what way was it a change for the worse?

1. [OPEN-ENDED RESPONSE]
98. Don't know

[ASK IF S1.5 (LIGHTING) IS SELECTED OR S2 = 1 (SELLS LIGHTING EQUIPMENT)]
Q24. Also starting this program year, lighting fixture replacements can be done without having to apply for a Custom incentive. Overall, would you say this was a change for the better, the worse, or neither ?

[SINGLE RESPONSE]

1. For the better
2. For the worse
3. Neither good nor bad
4. I was not aware of this change
98. Don't know

[ASK IF Q31 = 1 (CHANGE FOR THE BETTER)]
Q25. In what way was it a change for the better?

1. [OPEN-ENDED RESPONSE]
98. Don't know

[ASK IF Q31 = 2 (CHANGE FOR THE WORSE)]
Q26. In what way was it a change for the worse?

1. [OPEN-ENDED RESPONSE]
98. Don't know

[ASK IF S1.5 (LIGHTING) IS SELECTED OR S2 = 1 (SELLS LIGHTING EQUIPMENT)]

Q27. In August 2018, the lighting incentive levels decreased from 40 cents to 30 cents per-watt-saved. Did this make it harder at all for your company to sell high efficiency lighting?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know

[ASK IF S1.5 (LIGHTING) IS SELECTED OR S2 = 1 (SELLS LIGHTING EQUIPMENT)]

Q28. When discussing non-residential lighting projects, how often do you discuss integration of advanced lighting controls such as networked controls, luminaire-level lighting controls, or integration of lighting controls with other building control systems?

[SINGLE RESPONSE]

1. Never
2. Rarely
3. Sometimes
4. Often
5. Always
98. Don't know

[IF Q35 <> 98]

Q29. What are some issues or challenges in your attempts to sell advanced lighting controls to non-residential customers?

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know

[ASK IF S1.5 (LIGHTING) IS SELECTED OR S2 = 1 (SELLS LIGHTING EQUIPMENT)]

Q30. For about what percent of the lighting products your company sold March 1, 2018 through February 28, 2019, was your company able to verify the lighting was installed before the incentive application was submitted? (That is, your company either installed the lighting or was able to verify that someone else did.)

[SINGLE RESPONSE] [FORCE NUMERIC RESPONSE]

1. [NUMERIC RESPONSE OR PROVIDE 0-100 SCALE]
98. Don't know

SBDI

[ASK IF SBDI SP=1]

Q31. For the BizSavers Small Business Direct Install (SBDI) program, which of the following is your understanding of when an SBDI service provider may hire a third-party contractor to install incented equipment?

[SINGLE RESPONSE]

1. As long as the third-party contractor sends an invoice directly to the customer.
2. As long as the customer receives one invoice from the service provider.
3. As long as the customer receives an invoice from *either* the service provider *or* the third-party contractor.
4. None of the above: The SBDI program does not allow service providers to hire third-party contractors to install incented equipment.
5. I don't know the correct SBDI guideline regarding working with third-party contractors.

[ASK IF SBDI SP=1]

Q32. The correct SBDI guideline regarding working with third-party contractors to install incented equipment is that "Service providers can hire third-party contractors to install incented equipment as long as the customer receives one invoice from the service provider." Does this guideline cause any challenges for your company and, if so, what are they?

[SINGLE RESPONSE]

1. Yes – please specify: [OPEN-ENDED RESPONSE]
2. No
98. Don't know

TA Advisory Board

[ASK ALL]

Q33. Ameren Missouri recently established a Trade Ally Advisory Board to get feedback from trade allies. Are you a member of this Trade Ally Advisory Board?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know

[ASK IF Q40 = 2 OR 98]

Q34. Before learning about it here, were you aware of the existence of the Trade Ally Advisory Board?

1. Yes
2. No
98. Don't know

[ASK IF Q40 = 1 OR Q41 = 1]

Q35. Please rate your agreement or disagreement with the following statements about the Advisory Board.

[INSERT SCALE FROM 1 (STRONGLY DISAGREE) TO 7 (STRONGLY AGREE) WITH 98=DK]

1. The Advisory Board provides a good platform to air concerns or grievances
2. The Advisory Board provides a good platform to get feedback on the programs
3. BizSavers program representatives respect the input of the Advisory Board
4. The Advisory Board represents the interests of all BizSavers trade allies

Event Attendance

[ASK ALL]

Q36. How many BizSavers informational or training events did you attend during this program year? Do not include check presentations or purely social events, like a trade ally happy hour.

[MULTIPLE RESPONSE]

1. None
2. One
3. Two or three
4. Four or more
98. Don't know

[ASK IF Q43 <> 1 (NONE)]

Q37. Regarding those events, please indicate how much you agree or disagree with each of the following statements. If you attended more than one event, please your average agreement.

[INSERT SCALE FROM 1 (STRONGLY DISAGREE) TO 7 (STRONGLY AGREE) WITH 98=DK]

1. The information presented was clear
2. All relevant topics were covered
3. The time was convenient
4. The location was convenient

[ASK IF Q43 <> 1 (NONE) AND Q44.1 < 6]

Q38. What, if anything, was unclear about the way information was presented?

1. [OPEN-ENDED RESPONSE]

[ASK IF Q43 <> 1 (NONE) AND Q44.2 < 6]

Q39. What topics, if any, should have been covered in the events you attended?

1. [OPEN-ENDED RESPONSE]

[ASK IF Q43 <> 1 (NONE)]

Q40. What additional types of events would you be interested in attending?

1. [OPEN-ENDED RESPONSE]

Other

[ASK ALL]

Q41. Please let us know of any ways in which you think the Ameren Missouri BizSavers Program could be improved or anything that Ameren Missouri could do to more effectively promote energy efficiency among its nonresidential customers:

1. [OPEN-END RESPONSE]
98. Don't know

End Script for Those Who Completed

Thank you again for taking the time to complete the survey. As mentioned, we would like to thank you with a $50 gift card. We will send it to [EMAIL ADDRESS]. You will receive your gift card within the next 3 business days

9. Non-Participant Spillover Methodology

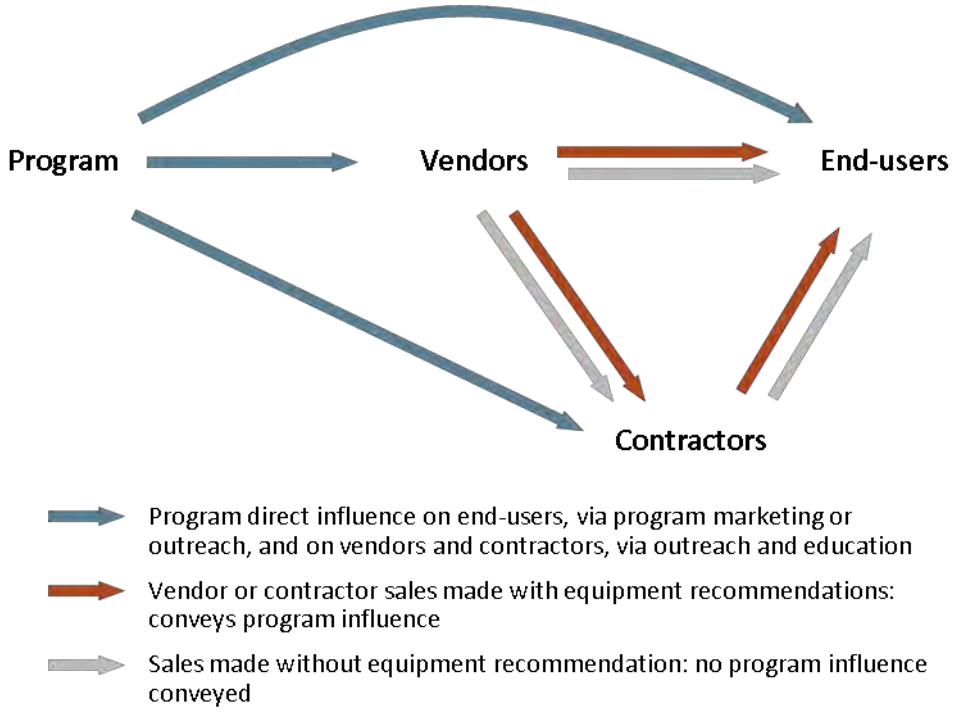
The evaluation team estimated lighting-related spillover by estimating the number of program-attributable lighting measures that surveyed vendors (distributors and manufacturer representatives) and installation contractors sold during program year 2018 (PY2018).

The method is based on the observation that a program may influence end-users' un-incented equipment sales directly, via the program experience itself (in the case of participants) or program marketing (in the case of nonparticipants), or indirectly, via its influence on vendors and contractors who then convey that influence through their equipment recommendations. The method further takes the following considerations into account:

- Distributors may sell to contractors or directly to end-users.
- In each transaction, the seller may recommend equipment to the buyer or may not recommend equipment (if the buyer specifies equipment).

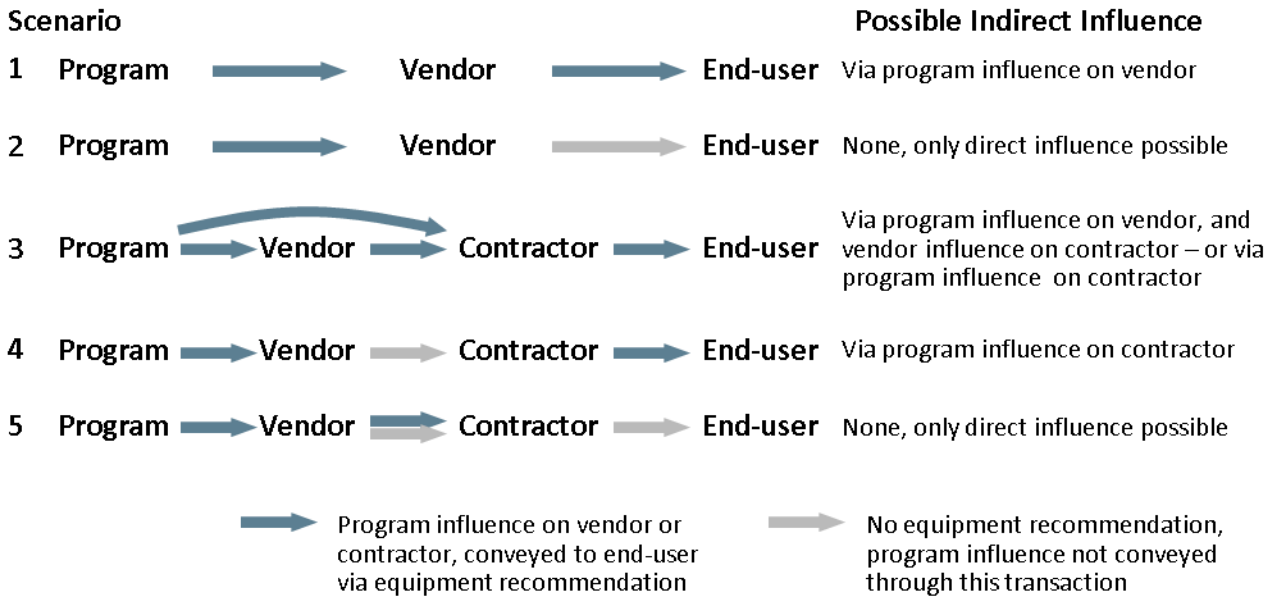
Figure 9-1 illustrates the above considerations.

Figure 9-1 Program Influence and Equipment Sales Channels



The above shows that there are multiple possible scenarios in which program influence may or may not be indirectly conveyed via equipment recommendations (Figure 9-2).

Figure 9-2 Sales Scenarios and Program Influence



This figure illustrates two important facts. First, while program direct influence may be possible in any scenario, it is the only possible influence in those scenarios where no vendor or contractor makes an equipment recommendation to the end-user. Second, if the vendor recommends equipment to the contractor and the contractor recommends equipment to the end-user, there are two possible channels of program indirect influence: 1) via the program influence on the vendor and the vendor influence on the contractor; and 2) via the program influence on the contractor.

The evaluation team surveyed vendors and contractors to estimate number of units of program-eligible un-incented lighting measures sold with and without recommendations, and to assess the program's influence on each vendor and contractor's recommendations as well as the influence those recommendations had on their buyers. This allowed the team to allocate each survey respondent's sales to one of the above channels and to estimate the strength of program influence operating on those sales. Details of the approach follow.

Description of Survey

The evaluation team designed an online survey instruments for vendors and installation contractors. The survey asked respondents to identify which of five types of high-efficiency lighting they sold within Ameren Missouri service territory within the 2018

program year (PY2018) and, for each lighting type they sold, the number of units of each specific measure they sold (Table 9-1).

Table 9-1 Lighting Types and Measures Assessed

Specific Lighting Measure
LED A-lamp (11W or less)
LED A-lamp (over 11W)
LED Reflector lamps (screw-In), includes flood, BR, PAR
LED 4ft linear tube, plug and play (Type A)
LED 4ft linear tube, direct wire-ballast bypass (Type B)

The evaluation team identified the above 5 lighting measures by aggregating the program-eligible lighting types into typical categories of efficient lighting that varied by wattage.

The survey then asked questions designed to allocate the total reported sales to the five channels identified above. The survey asked vendors what percentage of total sales (by measure type) went to contractors versus to end-users. The survey asked both vendors and contractors about the percentages of sales in which the respondent made equipment recommendations to end-users. They also asked contractors to report the percentage of their sales in which the vendor had made an equipment recommendation to them.

The survey asked respondents to report the percentage of end-user sales, within each lighting type, for which the customers reported they would apply for BizSavers incentives.

The survey asked all respondents to rate the program's influence on their recommendations with the following question:

> Please use a number from 0 to 100 to indicate how much influence the BizSavers program had on the equipment recommendations you have made to **end-user customers**. A "0" means that the program had no influence on your recommendations, and a "100" means that the program totally influenced your recommendations – that is, you would not have made the recommendations without the program's influence.
>
> (You may consider any way in which the program may have influenced your recommendations, such as by making you aware of the incentives for equipment or by providing you information on the advantages of specific types of equipment.)

The survey also used a similar question with contractors to assess the influence of vendor recommendations on the contractors' own recommendations to end-user customers.

Finally, the survey assessed the respondents' influence on their end-user customers by asking what percentage of their recommendations the customers accepted.

In anticipation that more than one respondent from the same company might answer the survey, the survey included a question asking whether the respondent was reporting sales just for him/herself, for the respondent's company location (in the case of companies with multiple locations), or for the company as a whole.

Sampling and Data Collection Methodology

The target population for the spillover survey was any lighting vendors and contractors doing business in the Ameren Missouri service territory. On the assumption that most of the vendors and contractors with significant lighting work in the Ameren Missouri service territory had done at least one *BizSavers* project, we defined the survey frame as any firm that had done any *BizSavers* projects during the current program cycle.

The evaluation team conducted the lighting spillover survey as part of a general online survey of trade allies who were active in Ameren Missouri's service territory. The team sent up to three email invitations to take the survey to 442 individual trade allies, representing 287 companies, who had completed at least one BizSavers project in the 2018 program year. Of those 442 trade allies, 393 individuals, representing 244 companies, were associated with lighting projects in the program tracking database.

The email invitation to complete the online survey explained the purpose of the survey and offered a $50 gift card for completing the survey. The invitation provided contact information for key evaluation team and Ameren Missouri staff. The team sent up to three weekly follow-up emails to all recipients of the email survey invitation.

The above efforts resulted in the completion of the lighting spillover survey by 87 lighting vendors (n = 48) and contractors (n = 39). In some cases, multiple respondents from the same company answered the survey. In those cases, the team followed these procedures to prevent double-counting:

- If at least one individual indicated he/she was responding for the entire company, across locations, the team counted that respondent.
- If no one was responding for the entire company but two or more were responding for a given company location, the team counted the respondent reporting the highest total lighting sales.
- If two or more were responding for the same company but different locations, all responses were counted.
- If all respondents for a company were reporting only for themselves, then all responses were counted.

Applying those rules brought the counted total to 76 vendors (n = 39) and contractors (n = 37). Together, those 76 respondents represented 37% of the PY2018 *BizSavers* lighting ex ante savings.

Estimation of Un-Incented Units Sold

As noted above, the survey asked each respondent to estimate the percentage of sales of each lighting type for which customers applied for BizSavers incentives. For each surveyed lighting vendor or contractor, the evaluation team estimated the number of *un-incented* units of each lighting type sold by multiplying the total number sold by one minus the estimated percentage of such sales for which customers applied for incentives.[337]

The program implementer had already identified participant spillover savings associated with completed *BizSavers* projects ("project-level spillover") and recorded those savings in the program database. The evaluation team subtracted any such measures from the totals produced by the above method to produce a net number of un-incented measures sold for each survey respondent.

The team then used the survey responses to allocate the savings from the net un-incented sales of each lighting measure to the five scenarios described above, specifically:

- Scenario 1 (vendor sales to end-users with recommendations): percentage of vendor sales to end-users x percentage of vendor sales with recommendations.
- Scenario 2 (vendor sales to end-users without recommendations): percentage of vendor sales to end-users x (1 - percentage of vendor sales with recommendations).
- Scenario 3 (contractor sales to end-users with both vendor and contractor recommendations): percentage of sales to end-users x percentage of sales with recommendations from vendors x percentage of sales with recommendations to end-users.
- Scenario 4 (contractor sales to end-users with only contractor recommendations): percentage of sales to end-users x (1 - percentage of sales with recommendations from vendors) x percentage of sales with recommendations to end-users.

[337] In previous years, the evaluation team also used a second method – subtracting total tracked incented sales from the reported total sales – and, for each respondent, used whichever method produced the more conservative estimate of un-incented sales. The team found that this second method rarely produced a more conservative estimate than the method that used only the survey data. One possible reason is that the project tracking database does not always identify the contractor or vendor who sold the equipment and so it may under-report the total incented sales for a given survey respondent. Therefore, the evaluation team opted not to consider this second method.

- Scenario 5 (contractor sales to end-users with no contractor recommendations[338]): percentage of sales to end-users x (1 - percentage of sales with recommendations to end-users).

None of the scenarios includes the vendors' reported sales to contractors. That is because all vendor sales to contractors also represent contractor sales to end-users. Since this approach already counts the contractors' reported sales to end-users, adding vendor sales to contractors would double-count those sales.

Calculation of Program Indirect Influence on End-Users

The team used survey respondent data to calculate the program *indirect* influence on each respondent's sales in Scenarios 1, 3, and 4, in which indirect influence is possible. In all cases, the indirect influence was calculated as the product of the influence values occurring in each transaction, where each influence value may range from 0% to 100%.[339] Thus, the final indirect influence value must be equal to or less than the greatest influence of any individual transaction.

For all but one influence value, the team used the survey respondent's own survey response (that is, the respondent's rating of others' influence on the respondent or the respondent's reported percentage of recommendations accepted). The exception is for Scenario 3, for which program indirect influence – calculated as the product of program influence on the vendor, vendor influence on the contractor, and contractor influence on end-users – is applied to contractor-reported sales. Since the contractors could not provide a rating of the program influence on vendors, the evaluation team used the mean vendor rating in this case.

The above methods produced mean indirect influence values of 60% for Scenario 1, 37% for Scenario 3, and 65% for Scenario 4.

Calculation of Program Direct Influence on End-Users

The nonparticipant survey for PY2018 did not assess program influence on un-incented energy efficiency equipment purchases. The PY2014 and PY2016 evaluations included nonparticipant surveys in which respondents rated the program's influence on efficiency upgrades. In the PY2014 survey, responses from 27 respondents provided a mean program influence of 14.8% on efficiency upgrades.[340] Of 52 respondents who reported

[338] In this case, it does not matter whether or not the vendor made an equipment recommendation, as no such recommendation would be passed on to the end-user.

[339] For program influence on vendors and contractors and vendor influence on contractors, the 0-100 rating was divided by 100 to produce a percentage. The influence of vendors and contractors on end-users was already a percentage – the reported percentage of recommendations that were accepted.

[340] Respondents rated program influence from 1 (none) to 5 (great). The evaluation team converted the 1-5 ratings to percentages, as 0%, 25%, 50%, 75%, and 100%.

equipment upgrades in the PY2016 survey, none reported that the program influenced their upgrade decisions. For the current evaluation, the team used the weighted mean influence of 5% from those two evaluations as the mean program direct influence on un-incented equipment sales.

Application of Maximum Influence Channel in Each Scenario

Direct program influence is possible in all five scenarios, which indirect influence is also possible in Scenarios 1, 3, and 4. For Scenarios 2 and 5, only program direct influence is possible, and so the evaluation team calculated program-attributable sales in those scenarios as the estimated number of un-incented measures sold in those scenarios times the estimated program direct influence, or 5%.

For Scenarios 1, 3, and 4, the evaluation team calculated program-attributable sales as the estimated number of un-incented measures sold in those scenarios times the greater of: 1) the estimated program *indirect* influence in each scenario; and 2) the estimated mean program direct influence. In most cases, the program indirect influence was greater than the direct influence.

Application of Savings Values to Program-Attributable Measures

The evaluation team used the Ameren Missouri TRM to assign a kWh savings value for each of the evaluated lighting measure categories. This allowed the evaluation team to estimate the total energy savings that resulted from each survey respondent's program-attributable un-incented sales of high-efficiency lighting.

10. Heating and Cooling Interactive Factors

Building Type	Cooling Type	Heating Type	Cape Girardeau			Jefferson City			Kirksville			St. Louis		
			kWh HIF	kWh CIF	Peak Demand HCIF	kWh HIF	kWh CIF	Peak Demand HCIF	kWh HIF	kWh CIF	Peak Demand HCIF	kWh HIF	kWh CIF	Peak Demand HCIF
Assembly	Packaged Single Zone	Gas	0.00	0.14	1.12	0.00	0.15	1.34	0.00	0.13	1.26	0.00	0.14	1.33
Assembly	Packaged Single Zone	Heat Pump	-0.11	0.14	1.12	-0.11	0.15	1.34	-0.10	0.12	1.23	-0.11	0.14	1.31
Bio Manufacturer	Packaged Single Zone	Gas	0.00	0.10	1.54	0.00	0.11	1.57	0.00	0.10	1.49	0.00	0.11	1.59
Bio Manufacturer	Packaged Single Zone	Heat Pump	-0.05	0.11	1.54	-0.06	0.11	1.58	-0.08	0.10	1.49	-0.06	0.11	1.60
Conditioned Storage	Packaged Single Zone	Gas	0.00	0.09	2.30	0.00	0.10	2.15	0.00	0.08	2.30	0.00	0.10	1.92
Conditioned Storage	Packaged Single Zone	Heat Pump	-0.09	0.10	2.31	-0.10	0.10	2.17	-0.09	0.08	2.30	-0.09	0.10	1.94
Education (Community College)	VAV+Packaged Single Zone	Heat Pump	0.00	0.07	1.48	0.00	0.08	1.43	0.00	0.07	1.43	0.00	0.09	1.42
Education (Community College)	VAV+Packaged Single Zone	Gas	0.00	0.07	1.48	0.00	0.08	1.43	0.00	0.07	1.43	0.00	0.09	1.42
Education (High School)	Fan Coil+Packaged Single Zone	Gas	0.00	0.10	1.18	0.00	0.10	1.14	0.00	0.08	1.16	0.00	0.09	1.23
Education (High School)	Fan Coil+Packaged Single Zone	Heat Pump	-0.03	0.10	1.18	-0.03	0.10	1.14	-0.03	0.08	1.16	-0.03	0.09	1.23
Education (High School)	VAV	Gas	0.00	0.08	1.18	0.00	0.09	1.09	0.00	0.06	1.18	0.00	0.08	1.07
Education (Primary School)	Packaged Single Zone	Gas	0.00	0.09	1.11	0.00	0.09	1.14	0.00	0.08	1.17	0.00	0.09	1.17
Education (Primary School)	Packaged Single Zone	Heat Pump	-0.10	0.09	1.11	-0.11	0.09	1.14	-0.11	0.08	1.16	-0.11	0.09	1.16
Education (Relocatable Classroom)	Packaged Single Zone	Electric Resistance	-0.28	0.11	1.11	-0.30	0.11	1.12	-0.34	0.09	1.13	-0.30	0.11	1.12
Education (Relocatable Classroom)	Packaged Single Zone	Heat Pump	-0.08	0.06	1.09	-0.09	0.06	1.09	-0.09	0.05	1.11	-0.09	0.06	1.10
Education (Relocatable Classroom)	Packaged Single Zone	Gas	0.00	0.09	1.09	0.00	0.09	1.09	0.00	0.07	1.11	0.00	0.08	1.10
Education (University)	VAV	Gas	0.00	0.08	1.41	0.00	0.09	1.38	0.00	0.09	1.61	0.00	0.09	1.36
Hospital	VAV+Packaged Single Zone	Heat Pump	0.00	0.07	1.18	0.00	0.07	1.21	0.00	0.06	1.18	0.00	0.07	1.17
Hospital	VAV+Packaged Single Zone	Gas	0.00	0.07	1.18	0.00	0.07	1.21	0.00	0.06	1.18	0.00	0.07	1.17
Hotel	PVAV+PTHP+PSZ	Heat Pump	-0.01	0.20	1.29	-0.01	0.20	1.38	-0.01	0.16	1.37	-0.01	0.18	1.31
Hotel	VAV+FPFC+PHP	Heat Pump	0.00	0.11	1.23	0.00	0.11	1.21	0.00	0.10	1.36	0.00	0.11	1.43
Hotel	VAV+PTAC+PSZ	Electric Resistance	-0.16	0.20	1.30	-0.19	0.20	1.39	-0.26	0.16	1.38	-0.20	0.19	1.35
Hotel	VAV+PTHP+PSZ	Heat Pump	-0.01	0.20	1.29	-0.01	0.19	1.37	-0.01	0.16	1.36	-0.01	0.18	1.37
Light Manufacturing	Packaged Single Zone	Gas	0.00	0.09	1.52	0.00	0.10	1.49	0.00	0.08	1.48	0.00	0.09	1.46
Light Manufacturing	Packaged Single Zone	Heat Pump	-0.09	0.09	1.53	-0.09	0.10	1.50	-0.08	0.08	1.48	-0.09	0.10	1.46
Motel	Packaged Terminal AC	Electric Resistance	-0.22	0.17	1.43	-0.24	0.16	1.40	-0.29	0.15	1.38	-0.24	0.16	1.44
Motel	Packaged Terminal HP	Heat Pump	-0.04	0.16	1.41	-0.04	0.16	1.39	-0.03	0.14	1.36	-0.04	0.15	1.43
Nursing Home	Fan Coil+Packaged Single Zone	Heat Pump	0.00	0.14	1.52	0.00	0.14	1.34	0.00	0.12	1.38	0.00	0.14	1.35
Nursing Home	VAV	Gas	0.00	0.09	1.54	0.00	0.10	1.47	0.00	0.08	1.53	0.00	0.09	1.44
Nursing Home	Fan Coil+Packaged Single Zone	Gas	0.00	0.14	1.52	0.00	0.14	1.34	0.00	0.12	1.38	0.00	0.14	1.34
Office (Large)	Water Loop Heat Pump	Heat Pump	-0.06	0.24	1.39	-0.07	0.23	1.41	-0.08	0.19	1.40	-0.07	0.22	1.41
Office (Large)	VAV	Gas	0.00	0.10	1.32	0.00	0.09	1.30	0.00	0.08	1.30	0.00	0.09	1.41
Office (Small)	Packaged Single Zone	Gas	0.00	0.10	1.39	0.00	0.11	1.38	0.00	0.09	1.37	0.00	0.11	1.36
Office (Small)	Packaged Single Zone	Heat Pump	-0.09	0.11	1.39	-0.10	0.11	1.38	-0.09	0.09	1.38	-0.09	0.11	1.37
Restaurant (Fast Food)	Packaged Single Zone	Gas	0.00	0.10	1.24	0.00	0.11	1.33	0.00	0.09	1.37	0.00	0.10	1.33
Restaurant (Fast Food)	Packaged Single Zone	Heat Pump	-0.08	0.10	1.25	-0.08	0.11	1.33	-0.08	0.09	1.37	-0.08	0.10	1.34
Restaurant (Full-Service)	Packaged Single Zone	Gas	0.00	0.12	1.21	0.00	0.13	1.36	0.00	0.11	1.40	0.00	0.12	1.35
Restaurant (Full-Service)	Packaged Single Zone	Heat Pump	0.00	0.03	1.29	0.00	0.04	1.28	0.00	0.02	1.36	0.00	0.03	1.09
Retail (Large 3-Story)	VAV	Gas	0.00	0.08	1.35	0.00	0.10	1.36	0.00	0.10	1.33	0.00	0.11	1.34
Retail (Large Single-Story)	Packaged Single Zone	Gas	0.00	0.10	1.26	0.00	0.11	1.28	0.00	0.09	1.32	0.00	0.10	1.29
Retail (Large Single-Story)	Packaged Single Zone	Heat Pump	-0.09	0.10	1.28	-0.10	0.11	1.29	-0.08	0.09	1.31	-0.09	0.10	1.28
Retail (Small)	Packaged Single Zone	Gas	0.00	0.11	1.26	0.00	0.11	1.25	0.00	0.10	1.30	0.00	0.11	1.28
Retail (Small)	Packaged Single Zone	Heat Pump	-0.10	0.11	1.27	-0.10	0.12	1.26	-0.09	0.10	1.30	-0.10	0.11	1.28
Freezer Space (Low Temp)	N/A	N/A	0.00	1.50	1.50	0.00	1.50	1.50	0.00	1.50	1.50	0.00	1.50	1.50
Med. Temp Refrig Space	N/A	N/A	0.00	1.29	1.29	0.00	1.29	1.29	0.00	1.29	1.29	0.00	1.29	1.29
High Temp Refrig. Space	N/A	N/A	0.00	1.18	1.18	0.00	1.18	1.18	0.00	1.18	1.18	0.00	1.18	1.18
Walk-in/In Store Refrigerator	N/A	N/A	0.00	1.40	1.40	0.00	1.40	1.40	0.00	1.40	1.40	0.00	1.40	1.40

11. Cost Effectiveness Technical Data

The following appendix presents the critical technical data used to develop the cost effectiveness test results, at the portfolio and program level. ADM provided the inputs for the cost effectiveness testing by measure end use and effective useful life. The analysis was performed by Morgan Marketing Partners using DSMore.

One of the key objectives of the economic modeling was to assure that the analysis was comparable to the Ameren Missouri's planning analysis. This allows Ameren Missouri to compare evaluated results with the expected numbers within the plan. First, the same analysis tool was used (DSMore). Second, Ameren Missouri provided economic and financial assumptions used to develop the model. Some of those assumptions include:

- Discount Rate = 6.46% for Utility Cost Test (UCT), Total Resource Cost (TRC) test, Ratepayer Impact Measure (RIM) test, and Participant Cost Test (PCT); 3.00% for Societal Cost Test (SCT).
- Line losses = 4.84%
- Summer Peak would occur during the 16th hour of a July day on average
- Avoided costs from the 2018 Integrated Resource Plan that was filed October 1, 2018 were used for all measures.
- Escalation rates for different costs occur at the component level with separate escalation rates for fuel, capacity, generation, T&D and customer rates carried out over 25 years.
- Cost Escalation Rate = 2%

The PY2018 cost effectiveness analysis is premised on cost data received to date (end of March 2019).

The model assumptions are driven by measure loadshapes, which tells the model when to apply the savings during the day. This assures that the loadshape for that end use matches the system peak impacts of that end use and provides the correct summer coincident savings.

A number of business portfolio-level costs are reflected in the program-level cost effectiveness analysis. These business portfolio-level costs include those for EM&V, education and outreach, portfolio administration, and data tracking. Business portfolio costs were allocated by the program's share of the net present value (NPV) of the utility cost test (UCT) benefits of the business portfolio. The NPV of the UCT benefits and the apportionment factors are shown in Table 11-1.

Table 11-1 Business Portfolio Cost Apportionment Factors

Program	*NPV of UCT Benefits (2016 Dollars)*	*Apportionment Factor*
Custom	$45,344,680	28%
Standard	$89,136,901	55%
New Construction	$11,830,564	7%
Retro-Commissioning	$4,615,618	3%
Small Business Direct Install	$7,493,718	5%
EMS	$4,055,756	2%
Total	$162,477,237	100%

Table 11-2 presents summarizes program UCT costs by cost category. The values presented below are inclusive of the allocated portfolio costs and are shown in 2016 dollars.

Table 11-2 Ameren Missouri PY2018 Cost Data

C&I EE PROGRAM COSTS (PY2018)	*Administrative Costs (2016 Dollars)*	*Incentive Costs (2016 Dollars)*	*Total Costs (2016 Dollars)*
Custom	$5,642,767	$6,648,109	$12,290,877
EMS	$338,197	$1,607,748	$1,945,945
Standard	$6,475,124	$17,110,651	$23,585,775
New Construction	$759,511	$1,981,080	$2,740,591
Retro-Commissioning	$582,947	$683,347	$1,266,294
Small Business Direct Install	$447,756	$2,646,627	$3,094,383
Total C&I Program Costs	$14,246,302	$30,677,563	$44,923,864

Each cost test provides a benefit-cost ratio that reflects the net benefit or cost to a specific stakeholder. For example, the Utility Cost Test (UCT) takes into account all program costs and benefits from the utility (or program administrator) perspective, to demonstrate how the program impacts the utility relative to other program stakeholders. If the ratio is less than one, the costs outweigh the benefits; if the ratio is greater than one, the benefits outweigh the costs. Table 11-3 below is a summary of benefit and cost inputs for each cost test performed.

Table 11-3 Summary of Benefits and Costs Included in Each Cost Effectiveness Test[341]

Test	Benefits	Costs
UCT	Perspective of utility, government agency, or third party implementing the program	
	▪ Energy-related costs avoided by the utility, ▪ Capacity-related costs avoided by the utility, including generation, transmission, and distribution	▪ Program overhead costs ▪ Utility/program administrator incentive costs, ▪ Utility/program administrator installation costs
TRC	Benefits and costs from the perspective of all utility customers (participants and non-participants) in the utility service territory	
	▪ Energy-related costs avoided by the utility, ▪ Capacity-related costs avoided by the utility, including generation, transmission, and distribution, ▪ Additional resource savings ▪ Applicable tax credits	▪ Program overhead costs, ▪ Program installation costs, ▪ Incremental measure costs (Whether paid by the customer of utility)
RIM	Impact of efficiency measure on non-participating ratepayers overall	
	▪ Energy-related costs avoided by the utility, ▪ Capacity-related costs avoided by the utility, including generation, transmission, and distribution	▪ Program overhead costs, ▪ Utility/program administrator incentive costs, ▪ Utility/program administrator installation costs, ▪ Lost revenue due to reduced energy bills
PCT	Benefits and costs from the perspective of the customer installing the measure	
	▪ Bill savings, ▪ Incremental installation costs ▪ Applicable tax credits or incentives	▪ Incentive payments, ▪ Incremental equipment costs
SCT	Benefits and costs from the perspective of society	
	▪ Energy-related costs avoided by the utility, ▪ Capacity-related costs avoided by the utility, including generation, transmission, and distribution, ▪ Additional resource savings ▪ Non-monetized benefits (and costs) such as cleaner air or health impacts (not quantified in this analysis)	▪ Program overhead costs, ▪ Program installation costs, ▪ Incremental measure costs (Whether paid by the customer of utility)

*Incentives are considered incremental measure costs

The following sections provide a detailed review of the cost test results at the portfolio and program levels. The evaluation team presents the majority of costs and savings on a net basis, meaning that the net-to-gross ratio was applied to account for the impact of free ridership and spillovers. However, the evaluation team presents the participant borne costs, as applied to the Participant Cost Test (PCT), on a gross basis. For the PCT, the participant cost is based on what a single customer sees as the value times the number of participants.

BizSavers Portfolio Level Cost Test Inputs and Results

Table 11-4 summarizes the key financial benefit and cost inputs for the portfolio level Utility Costs Test (UCT). Ameren Missouri's avoided cost of energy is $162.5 million. Incentives and overhead totaled $44.9 million, which yields a benefit-cost ratio of 3.62.

Table 11-4 Utility Cost Test (UCT) Inputs and Results - Portfolio Level

UCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$101,833,882	
Avoided Electric Capacity	$43,647,505	
Avoided T&D Electric	$16,995,851	
Incentives		$30,677,563
EM&V, Admin, Data Tracking		$14,246,302
Total	$162,477,237	$44,923,864
UCT Benefit - Cost Ratio	3.62	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

The TRC test results, shown in Table 11-5, reflect the BizSavers Program impacts on all customers in the Ameren Missouri service territory, participants and non-participants. The participant measure costs and overhead make up the total portfolio costs of $103.5 million. The benefits consist of the utility's total avoided costs of $162.5 million, which yields a benefit-cost ratio of 1.57.

[341] EPA, Understanding Cost-Effectiveness of energy efficiency Programs: Best Practices, Technical Methods, and Emerging Issues for Policy-Makers, 2008. http://www.epa.gov/cleanenergy/documents/suca/cost-effectiveness.pdf, pg. 3-2

Table 11-5 Total Resource Cost Test (TRC) Inputs and Results – Portfolio Level

TRC Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$101,833,882	
Avoided Electric Capacity	$43,647,505	
Avoided T&D Electric	$16,995,851	
Participation Costs (net)		$88,005,742
EM&V, Admin, Data Tracking		$15,449,098
Total	$162,477,237	$103,454,839
TRC Benefit – Cost Ratio	1.57	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

The portfolio level RIM test reflects the program impacts on utility rates. Table 11-6 summarizes key inputs for the RIM test. The net benefits include the avoided utility costs of $162.5 million, and the costs of $296.4 million. The same costs are included in the RIM, as they are in the UCT; however, lost revenues from reduced energy bills are also included. The financial data for the RIM test yields a benefit-cost ratio of 0.55. The ratio suggests that rates have potential to increase over time. However, a RIM < 1 does not always mean that rates will increase, in the long term. Energy efficiency programs are designed to reduce the capacity needs of the system, which may increase or decrease rates depending on the level of capital costs saved.[342]

Table 11-6 Ratepayer Impact Measure Test (RIM) Inputs and Results – Portfolio Level

RIM Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$101,833,882	
Avoided Electric Capacity	$43,647,505	
Avoided T&D Electric	$16,995,851	
Incentives		$30,677,563
EM&V, Admin, Data Tracking		$14,246,302
Lost Revenues		$251,484,444
Total	$162,477,237	$296,408,308
RIM Benefit - Cost Ratio	0.55	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

[342] EPA, Understanding Cost-Effectiveness of energy efficiency Programs: Best Practices, Technical Methods, and Emerging Issues for Policy-Makers, 2008. http: //www.epa.gov/cleanenergy/documents/suca/cost-effectiveness.pdf, pg. 3-6

Table 11-7 summarizes the key financial inputs to the portfolio level PCT, which reflects the program impacts on the participants. The portfolio level benefits include the program incentives and energy bill savings, which total $294.3 million. The costs include gross participant costs, totaling $94 million and yielding a benefit-cost ratio of 3.13.

Table 11-7 Participant Cost Test (PCT) Inputs and Results – Portfolio Level

PCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Bill Savings (Gross) Incentives	$263,596,873 $30,677,563	
Participant Cost (Gross)		$93,918,539
Total	$294,274,435	$93,918,539
PCT Benefit - Cost Ratio	3.13	

The portfolio level SCT reflects the program impacts on society; the key financial inputs are displayed in Table 11-8. The net benefits include the avoided utility costs of $223.6 million and the costs of $109.1 million. The financial data for the SCT test yields a benefit-cost ratio of 2.05.

Table 11-8 Societal Cost Test (SCT) Inputs and Results - Portfolio Level

SCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$138,913,601 $61,999,529 $22,693,554	
Participation Costs (net) EM&V, Admin, Data Tracking		$94,017,669 $15,118,054
Total	$223,606,684	$109,135,723
SCT Benefit - Cost Ratio	2.05	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

BizSavers Custom Program Cost Test Inputs and Results

The evaluation team performed cost tests for each of the four BizSavers Programs, those results were rolled into the portfolio level analysis that was presented above. The following sections provide a more in-depth look at how each individual program performed from a cost effectiveness perspective.

Table 11-9 summarizes the key financial benefit and cost inputs for the Custom Program UCT. The Custom Program attained $45.3 million in avoided utility costs. Incentives,

overhead and other program costs totaled $12.3 million, which yields a benefit-cost ratio of 3.69.

Table 11-9 Utility Cost Test (UCT) Inputs and Results – Custom Program

UCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$26,046,699	
Avoided Electric Capacity	$13,849,285	
Avoided T&D Electric	$5,448,697	
Incentives		$6,648,109
EM&V, Admin, Data Tracking		$5,642,767
Total	$45,344,680	$12,290,877
UCT Benefit - Cost Ratio	3.69	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

The TRC test results, shown in Table 11-10, reflect the Custom Program impacts on all customers in the Ameren Missouri service territory, participants and non-participants. The participant measure costs, overhead, and other program costs total $37.3 million. The benefits consist of the utility's total avoided costs of $45.3 million, which yields a benefit-cost ratio of 1.22.

Table 11-10 Total Resource Cost Test (TRC) Inputs and Results - Custom Program

TRC Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$26,046,699	
Avoided Electric Capacity	$13,849,285	
Avoided T&D Electric	$5,448,697	
Participation Costs (net)		$30,720,922
EM&V, Admin, Data Tracking		$6,598,777
Total	$45,344,680	$37,319,699
TRC Benefit - Cost Ratio	1.22	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

The Custom Program RIM test reflects the program impacts on utility rates. Table 11-11 summarizes key inputs for the RIM test. The net benefits include the avoided utility costs of $45.3 million. The same costs are included in the RIM, as they are in the UCT; however lost revenues from reduced energy bills are also included totaling $71.6 million. The financial data for the RIM test yields a benefit-cost ratio of 0.63.

Table 11-11 Ratepayer Impact Measure Test (RIM) Inputs and Results - Custom Program

RIM Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$26,046,699	
Avoided Electric Capacity	$13,849,285	
Avoided T&D Electric	$5,448,697	
Incentives		$6,648,109
EM&V, Admin, Data Tracking		$5,642,767
Lost Revenues		$59,289,402
Total	$45,344,680	$71,580,279
RIM Benefit - Cost Ratio	0.63	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

The Custom Program PCT reflects the program impacts on the participants; Table 11-12 summarizes the key financial inputs. The portfolio level benefits include the program incentives and energy bill savings, which total $76.1 million. The costs include measure incentives and gross participant costs; totaling $35.9 million and yielding a benefit-cost ratio of 2.12.

Table 11-12 Participant Cost Test (PCT) Inputs and Results – Custom Program

PCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Bill Savings (Gross)	$69,405,097	
Incentives	$6,648,109	
Participant Cost (Gross)		$35,932,336
Total	$76,053,206	$35,932,336
PCT Benefit - Cost Ratio	2.12	

The Custom Program SCT reflects the program impacts on society; Table 11-13 summarizes the key financial inputs. The net benefits include the avoided utility costs of $61.9 million and the costs of $38.8 million. The financial data for the SCT test yields a benefit-cost ratio of 1.59.

Table 11-13 Societal Cost Test (SCT) Inputs and Results – Custom Program

SCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$35,171,574	
Avoided Electric Capacity	$19,492,121	
Avoided T&D Electric	$7,217,106	
Participation Costs (net)		$32,819,558
EM&V, Admin, Data Tracking		$6,000,066
Total	$61,880,801	$38,819,624
SCT Benefit – Cost Ratio	1.59	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

BizSavers Standard Cost Test Inputs and Results

Table 11-14 provides the key financial benefit and cost inputs for the Standard Program UCT. The Standard Program attained $89.1 million in avoided utility costs. Incentives and other costs totaled $23.6 million, which yields a benefit-cost ratio of 3.78.

Table 11-14 Utility Cost Test (UCT) Inputs and Results – Standard Program

UCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$60,299,961	
Avoided Electric Capacity	$20,803,054	
Avoided T&D Electric	$8,033,886	
Incentives		$17,110,651
EM&V, Admin, Data Tracking		$6,475,124
Total	$89,136,901	$23,585,775
UCT Benefit - Cost Ratio	3.78	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

The TRC test results, shown in Table 11-15, reflect the Standard Program impacts on all customers in the Ameren Missouri service territory, participants and non-participants. The participant measure costs, overhead, and other program costs total $45.0 million. The benefits consist of the utility's total avoided costs of $89.1 million, which yields a benefit-cost ratio of 1.98.

Table 11-15 Total Resource Cost Test (TRC) Inputs and Results - Standard Program

TRC Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$60,299,961	
Avoided Electric Capacity	$20,803,054	
Avoided T&D Electric	$8,033,886	
Participation Costs (net)		$38,359,128
EM&V, Admin, Data Tracking		$6,614,351
Total	$89,136,901	$44,973,479
TRC Benefit - Cost Ratio	1.98	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

The Standard Program RIM test reflects the program impacts on utility rates. Table 11-16 summarizes the key inputs for the RIM test. The net benefits include the avoided utility costs of $89.1 million. The same costs are included in the RIM, as they are in the UCT; however lost revenues from reduced energy bills are also included totaling $179.2 million. The financial data for the RIM test yields a benefit-cost ratio of 0.50.

Table 11-16 Ratepayer Impact Measure Test (RIM) Inputs and Results - Standard Program

RIM Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$60,299,961	
Avoided Electric Capacity	$20,803,054	
Avoided T&D Electric	$8,033,886	
Incentives		$17,110,651
EM&V, Admin, Data Tracking		$6,475,124
Lost Revenues		$155,591,041
Total	$89,136,901	$179,176,816
RIM Benefit - Cost Ratio	0.50	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

The Standard Program PCT reflects the program impacts on the participants; Table 11-17 displays the key financial inputs. The Standard Program benefits include the program incentives and energy bill savings, which total $174.0 million. The costs include gross participant costs; totaling $38.7 million and yielding a benefit-cost ratio of 4.50.

Table 11-17 Participant Cost Test (PCT) Inputs and Results – Standard Program

PCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Bill Savings (Gross) Incentives	$156,841,206 $17,110,651	
Participant Cost (Gross)		$38,679,121
Total	$173,951,856	$38,679,121
PCT Benefit - Cost Ratio	4.50	

Table 11-18 summarizes the Standard Program SCT test results. The net benefits include the avoided utility costs of $123.3 million and the costs of $47.8 million. The financial data for the SCT test yields a benefit-cost ratio of 2.58.

Table 11-18 Societal Cost Test (SCT) Inputs and Results – Standard Program

SCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$82,733,004 $29,785,015 $10,802,377	
Participation Costs (net) EM&V, Admin, Data Tracking		$40,979,551 $6,858,230
Total	$123,320,397	$47,837,781
SCT Benefit - Cost Ratio	2.58	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

BizSavers New Construction Cost Test Inputs and Results

Table 11-19 provides the key financial benefit and cost inputs for the New Construction Program UCT. The New Construction Program attained $11.8 million in avoided utility costs. Incentives and overhead totaled $2.7 million, which yields a benefit-cost ratio of 4.32.

Table 11-19 Utility Cost Test (UCT) Inputs and Results– New Construction Program

UCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$6,648,247	
Avoided Electric Capacity	$3,727,792	
Avoided T&D Electric	$1,454,525	
Incentives		$1,981,080
EM&V, Admin, Data Tracking		$759,511
Total	$11,830,564	$2,740,591
UCT Benefit - Cost Ratio	4.32	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

The TRC test results, shown Table 11-20 reflect the New Construction Program impacts on all customers in the Ameren Missouri service territory, participants and non-participants. The participant measure costs, overhead, and other program costs total $12 million. The benefits consist of the utility's total avoided costs of $11.8 million, which yields a benefit-cost ratio of 0.99.

Table 11-20 Total Resource Cost Test (TRC) Inputs and Results - New Construction Program

TRC Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$6,648,247	
Avoided Electric Capacity	$3,727,792	
Avoided T&D Electric	$1,454,525	
Participation Costs (net)		$11,109,428
EM&V, Admin, Data Tracking		$869,540
Total	$11,830,564	$11,978,968
TRC Benefit - Cost Ratio	0.99	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

The New Construction Program RIM test reflects the program impacts on utility rates. Table 11-21 summarizes the key inputs for the RIM test. The net benefits include the avoided utility costs of $11.8 million. The same costs are included in the RIM, as they are in the UCT; however lost revenues from reduced energy bills are also included totaling $18.7 million. The financial data for the RIM test yields a benefit-cost ratio of 0.63.

Table 11-21 Ratepayer Impact Measure Test (RIM) Inputs and Results - New Construction Program

RIM Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$6,648,247	
Avoided Electric Capacity	$3,727,792	
Avoided T&D Electric	$1,454,525	
Incentives		$1,981,080
EM&V, Admin, Data Tracking		$759,511
Lost Revenues		$15,926,830
Total	$11,830,564	$18,667,421
RIM Benefit - Cost Ratio	0.63	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

The New Construction Program PCT reflects the program impacts on the participants; Table 11-22 summarizes the key financial inputs. The New Construction Program benefits include the program incentives and energy bill savings, which total $18.9 million. The costs include measure incentives and gross participant costs, totaling $11.6 million and yielding a benefit-cost ratio of 1.63.

Table 11-22 Participant Cost Test (PCT) Inputs and Results – New Construction Program

PCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Bill Savings (Gross)	$16,891,899	
Incentives	$1,981,080	
Participant Cost (Gross)		$11,562,627
Total	$18,872,979	$11,562,627
PCT Benefit - Cost Ratio	1.63	

Table 11-23 summarizes the New Construction Program SCT test results. The net benefits include the avoided utility costs of $16.1 million and the costs of $12.7 million. The financial data for the SCT test yields a benefit-cost ratio of 1.28.

Table 11-23 Societal Cost Test (SCT) Inputs and Results – New Construction Program

SCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$8,974,150	
Avoided Electric Capacity	$5,272,407	
Avoided T&D Electric	$1,935,460	
Participation Costs (net)		$11,868,345
EM&V, Admin, Data Tracking		$820,174
Total	$16,182,018	$12,688,519
SCT Benefit - Cost Ratio	1.28	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

BizSavers Retro-Commissioning Cost Test Inputs and Results

Table 11-24 summarizes key financial benefit and cost inputs for the Retro-Commissioning Program UCT. The Retro-Commissioning Program attained $4.6 million in avoided utility costs. Incentives and overhead totaled $1.3 million, which yields a benefit-cost ratio of 3.64.

Table 11-24 Utility Cost Test (UCT) Inputs and Results – Retro-Commissioning Program

UCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$2,082,557	
Avoided Electric Capacity	$1,813,580	
Avoided T&D Electric	$719,481	
Incentives		$683,347
EM&V, Admin, Data Tracking		$582,947
Total	$4,615,618	$1,266,294
UCT Benefit - Cost Ratio	3.64	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

The TRC test results, shown Table 11-25 reflect the Retro-Commissioning Program impacts on all customers in the Ameren Missouri service territory, participants and non-participants. The participant measure costs, overhead, and other program costs total $1.2 million. The benefits consist of the utility's total avoided costs of $4.6 million, which yields a benefit-cost ratio of 3.93.

Table 11-25 Total Resource Cost Test (TRC) Inputs and Results – Retro-Commissioning Program

TRC Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$2,082,557	
Avoided Electric Capacity	$1,813,580	
Avoided T&D Electric	$719,481	
Participation Costs (net)		$592,835
EM&V, Admin, Data Tracking		$582,947
Total	$4,615,618	$1,175,782
TRC Benefit - Cost Ratio	3.93	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

The Retro-Commissioning Program RIM test reflects the program impacts on utility rates. Table 11-26 summarizes key inputs for the RIM test. The net benefits include the avoided utility costs of $4.6 million. The same costs are included in the RIM, as they are in the UCT; however lost revenues from reduced energy bills are also included totaling $5.8 million. The financial data for the RIM test yields a benefit-cost ratio of 0.80.

Table 11-26 Ratepayer Impact Measure Test (RIM) Inputs and Results – Retro-Commissioning Program

RIM Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$2,082,557	
Avoided Electric Capacity	$1,813,580	
Avoided T&D Electric	$719,481	
Incentives		$683,347
EM&V, Admin, Data Tracking		$582,947
Lost Revenues		$4,500,693
Total	$4,615,618	$5,766,987
RIM Benefit - Cost Ratio	0.80	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

The Retro-Commissioning Program PCT reflects the program impacts on the participants; Table 11-27 displays the key financial inputs. The Retro-Commissioning Program benefits include the program incentives and energy bill savings, which total $5.2 million. The costs include gross participant costs totaling $590,772 and yielding a benefit-cost ratio of 8.75.

Table 11-27 Participant Cost Test (PCT) Inputs and Results – Retro-Commissioning Program

PCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Bill Savings (Gross) Incentives	$4,486,751 $683,347	
Participant Cost (Gross)		$590,772
Total	$5,170,098	$590,772
PCT Benefit - Cost Ratio	8.75	

Table 11-28 summarizes the Retro-Commissioning Program SCT test. The net benefits include the avoided utility costs, totaling $6.3 million. The costs total $1.2 million. The financial data for the SCT test yields a benefit-cost ratio of 5.05.

Table 11-28 Societal Cost Test (SCT) Inputs and Results – Retro-Commissioning Program

SCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$2,786,094 $2,541,419 $949,078	
Participation Costs (net) EM&V, Admin, Data Tracking		$633,333 $608,424
Total	$6,276,591	$1,241,757
SCT Benefit - Cost Ratio	5.05	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

BizSavers SBDI Cost Test Inputs and Results

Table 11-29 summarizes key financial benefit and cost inputs for the SBDI Program UCT. The SBDI Program attained $7.5 million in avoided utility costs. Incentives and overhead totaled $3.1 million which yields a benefit-cost ratio of 2.42.

Table 11-29 Utility Cost Test (UCT) Inputs and Results – SBDI Program

UCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$5,065,482 $1,752,918 $675,317	
Incentives EM&V, Admin, Data Tracking		$2,646,627 $447,756
Total	$7,493,718	$3,094,383
UCT Benefit - Cost Ratio	2.42	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

The TRC test results, shown Table 11-30 reflect the SBDI Program impacts on all customers in the Ameren Missouri service territory, participants and non-participants. The participant measure costs, overhead, and other program costs total $4.4 million. The benefits consist of the utility's total avoided costs of $7.5, which yields a benefit-cost ratio of 1.72.

Table 11-30 Total Resource Cost Test (TRC) Inputs and Results – SBDI Program

TRC Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$5,065,482	
Avoided Electric Capacity	$1,752,918	
Avoided T&D Electric	$675,317	
Participation Costs (net)		$3,905,505
EM&V, Admin, Data Tracking		$445,286
Total	$7,493,718	$4,350,792
TRC Benefit - Cost Ratio	1.72	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

The SBDI Program RIM test reflects the program impacts on utility rates. Table 11-31 summarizes key inputs for the RIM test. The net benefits include the avoided utility costs of $7.5 million. The financial data for the RIM test yields a benefit-cost ratio of 0.46.

Table 11-31 Ratepayer Impact Measure Test (RIM) Inputs and Results – SBDI Program

RIM Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$5,065,482	
Avoided Electric Capacity	$1,752,918	
Avoided T&D Electric	$675,317	
Incentives		$2,646,627
EM&V, Admin, Data Tracking		$447,756
Lost Revenues		$13,047,777
Total	$7,493,718	$16,142,160
RIM Benefit - Cost Ratio	0.46	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

The SBDI Program PCT reflects the program impacts on the participants; Table 11-32 displays the key financial inputs. The New Construction Program benefits include the program incentives and energy bill savings, which total $15.5 million. The costs include gross participant costs totaling $3.8 million and yielding a benefit-cost ratio of 4.03. The

results indicate that participants' energy bill savings is more than four and a half times the costs.

Table 11-32 Participant Cost Test (PCT) Inputs and Results – SBDI Program

PCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Bill Savings (Gross) Incentives	$12,856,723 $2,646,627	
Participant Cost (Gross)		$3,849,867
Total	$15,503,350	$3,849,867
PCT Benefit - Cost Ratio	4.03	

Table 11-33 summarizes the SBDI Program SCT test. The net benefits include the avoided utility costs of $10.4 million and the costs of $4.6 million. The financial data for the SCT test yields a benefit-cost ratio of 2.24.

Table 11-33 Societal Cost Test (SCT) Inputs and Results – SBDI Program

SCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$6,968,294 $2,516,102 $909,980	
Participation Costs (net) EM&V, Admin, Data Tracking		$4,172,302 $472,613
Total	$10,394,376	$4,644,914
SCT Benefit - Cost Ratio	2.24	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

BizSavers EMS Cost Test Inputs and Results

Table 11-34 summarizes key financial benefit and cost inputs for the SBDI Program UCT. The EMS Program attained $4.1 million in avoided utility costs. Incentives and overhead totaled $1.9 million which yields a benefit-cost ratio of 2.08.

Table 11-34 Utility Cost Test (UCT) Inputs and Results – EMS Program

UCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$1,690,936	
Avoided Electric Capacity	$1,700,876	
Avoided T&D Electric	$663,944	
Incentives		$1,607,748
EM&V, Admin, Data Tracking		$338,197
Total	$4,055,756	$1,945,945
UCT Benefit - Cost Ratio	2.08	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

The TRC test results, shown Table 11-35 reflect the EMS Program impacts on all customers in the Ameren Missouri service territory, participants and non-participants. The participant measure costs, overhead, and other program costs total $3.7 million. The benefits consist of the utility's total avoided costs of $4.1 million, which yields a benefit-cost ratio of 1.11.

Table 11-35 Total Resource Cost Test (TRC) Inputs and Results – EMS Program

TRC Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$1,690,936	
Avoided Electric Capacity	$1,700,876	
Avoided T&D Electric	$663,944	
Participation Costs (net)		$3,317,923
EM&V, Admin, Data Tracking		$338,197
Total	$4,055,756	$3,656,120
TRC Benefit - Cost Ratio	1.11	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

The EMS Program RIM test reflects the program impacts on utility rates. Table 11-36 summarizes key inputs for the RIM test. The net benefits include the avoided utility costs of $4.1 million. The same costs are included in the RIM, as they are in the UCT; however lost revenues from reduced energy bills are also included totaling $5.1 million. The financial data for the RIM test yields a benefit-cost ratio of 0.80.

Table 11-36 Ratepayer Impact Measure Test (RIM) Inputs and Results – EMS Program

RIM Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$1,690,936	
Avoided Electric Capacity	$1,700,876	
Avoided T&D Electric	$663,944	
Incentives		$1,607,748
EM&V, Admin, Data Tracking		$338,197
Lost Revenues		$3,128,701
Total	$4,055,756	$5,074,645
RIM Benefit - Cost Ratio	0.80	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

The EMS Program PCT reflects the program impacts on the participants; Table 11-37 displays the key financial inputs. The New Construction Program benefits include the program incentives and energy bill savings, which total $4.7 million. The costs include gross participant costs totaling $3.3 million and yielding a benefit-cost ratio of 1.43.

Table 11-37 Participant Cost Test (PCT) Inputs and Results – EMS Program

PCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Bill Savings (Gross)	$3,115,197	
Incentives	$1,607,748	
Participant Cost (Gross)		$3,303,816
Total	$4,722,945	$3,303,816
PCT Benefit - Cost Ratio	1.43	

Table 11-38 summarizes the EMS Program SCT test. The net benefits include the avoided utility costs of $5.6 million, against the costs of $3.9 million. The financial data for the SCT test yields a benefit-cost ratio of 1.42.

Table 11-38 Societal Cost Test (SCT) Inputs and Results – EMS Program

SCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$2,280,484	
Avoided Electric Capacity	$2,392,465	
Avoided T&D Electric	$879,553	
Participation Costs (net)		$3,544,580
EM&V, Admin, Data Tracking		$358,547
Total	$5,552,501	$3,903,127
SCT Benefit - Cost Ratio	1.42	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

12. Glossary of Terms

Adjustments: Modifications on ex ante analysis conditions (e.g. hours of lighting operation) because of observations made by ADM field technicians during the measurement and verification (M&V) on-site visit, which change baseline energy or energy demand values.

Baseline: The projected scenario where the subject project or program was not implemented. Baseline conditions are sometimes referred to as “business-as-usual” conditions. Baselines are defined as either project-specific baselines or performance standard baselines.

Confidence (level): A confidence level is a value that indicates the reliability of a calculated estimate from a sample. A higher confidence level indicates a stronger estimate that is more likely to lie within the population parameter. It is an indication of how close an estimated value derived from a sample is to the true population value of the quantity in question. The confidence level is the likelihood that the evaluation has captured the true impacts of the program within a certain range of values (i.e., precision).

Cost-effectiveness: The present value of the estimated benefits produced by an energy efficiency program compared to the estimated total costs to determine if the proposed investment or measure is desirable (e.g., whether the estimated benefits exceed the estimated costs from a societal perspective). It is an indicator of the relative performance or economic attractiveness of any energy efficiency investment or practice.

Deemed Savings: An estimate of the gross energy savings or gross energy demand savings for a single unit of an installed energy efficiency measure. This estimate (a) comes from data sources and analytical methods that are widely accepted for the particular measure and purpose, and (b) is applicable to the situation being evaluated.

Demand: The time rate of energy flow. Demand usually refers to electric power measured in kW (equals kWh/h) but can also refer to natural gas, usually as Btu/hr., kBtu/hr., therms/day, etc.

Effective Useful Life: An estimate of the median number of years that the efficiency measures installed under a program are still in place and operable.

Energy Efficiency: The use of less energy to provide the same or an improved level of service to the energy consumer in an economically efficient way, or using less energy to perform the same function. “Energy conservation” is a term that has also been used, but it has the connotation of doing without a service in order to save energy rather than using less energy to perform the same function.

Energy Efficiency Measure: Installation of equipment, subsystems or systems, or modification of equipment, subsystems, systems, or operations on the customer side of

the meter, for the purpose of reducing energy and/or demand (and, hence, energy and/or demand costs) at a comparable level of service.

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

Evaluation: The performance of studies and activities aimed at determining the effects of a program. This includes any of a wide range of assessment activities associated with understanding or documenting program performance, assessing program or program-related markets and market operations; any of a wide range of evaluative efforts including assessing program-induced changes in energy efficiency markets, levels of demand or energy savings, and program cost-effectiveness.

Ex Ante: The saving calculated by the implementation contractor, Lockheed Martin, per the TRM. These numbers are developed prior to ADM's analysis.

Ex Post: The savings that have been verified by the EM&V contractor. This includes adjustments for equipment that may not have been installed, calculation errors, and differences in assumptions.

Free Rider: A program participant who would have implemented the program measure or practice in the absence of the program incentive. Free riders can be total (who would have implemented all of the same measures without the incentives), partial (who would have implemented some of the same measures without the incentives), or deferred (who would have implemented the measures, but at some time in the future).

Ex Ante kWh Savings: The estimation of electrical energy (kWh) expected to be saved by implementing energy efficiency measures, calculated by the implementation contractor before measures are enacted and without considering externalities like free ridership and spillovers. Savings are typically reported as annual savings.

Ex Ante Peak kW Savings: The estimation of electrical energy demand (kW) expected to be saved by implementing energy efficiency measures, calculated by the implementation contractor before measures are enacted and without considering externalities like free ridership and spillovers. Savings are typically reported as annual savings.

Ex Post Gross kWh Savings: The estimation of electrical energy (kWh) saved by implementing energy efficiency measures, calculated by ADM, after measures were enacted, and without considering externalities like free ridership and spillovers. Savings are typically reported as annual savings.

Ex Post Gross Peak kW Savings: The estimation of electrical energy demand (kW) saved by implementing energy efficiency measures, calculated by ADM, after measures were enacted, and without considering externalities like free ridership and spillovers. Savings are typically reported as annual savings.

Gross kWh Savings Realization Rate: The ratio of ex post (or "realized") gross kWh savings over ex ante gross kWh savings.

Gross Peak kW Savings Realization Rate: The ratio of ex post (or "realized") gross kW savings over ex ante gross kW savings.

Gross Realization Rate: The ratio of ex post gross energy savings over ex ante gross energy savings

Gross Savings: The change in energy consumption and/or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated.

Impact Evaluation: An evaluation of the program-specific, directly induced changes (e.g., energy and/or demand usage) attributable to an energy efficiency program.

Interaction Factors: Changes in energy use or demand occurring beyond the measurement boundary of the M&V analysis.

kWh Savings Target: The goal of energy savings for programs and their components set by utility companies before the programs began.

Measure: Energy efficient equipment or service that is implemented to conserve energy.

Measurement: A procedure for assigning a number to an observed object or event.

Measurement and Verification (M&V): The data collection, monitoring, observations, and analysis by field technicians used for the calculation of ex post gross energy and demand savings for individual sites or projects. M&V can be a subset of program impact evaluation.

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

Monitoring: Gathering of relevant measurement data, including but not limited to energy-consumption data, over time to evaluate equipment or system performance. Examples include chiller electric demand, inlet evaporator temperature and flow, outlet evaporator temperature, condenser inlet temperature, and ambient dry-bulb temperature and relative

humidity or wet-bulb temperature, for use in developing a chiller performance map (e.g., kW/ton vs. cooling load and vs. condenser inlet temperature).

Net Ex Post kWh Savings: The estimation of electrical energy (kWh) savings from programs or measures after the measures have been installed and after adjusting for possible externalities, such as free ridership and spillovers.

Net Ex Post Peak kW Savings: The estimation of electrical energy demand (kW) savings from programs or measures after the measures have been installed and after adjusting for possible externalities, such as free ridership and spillovers.

Net Savings: The amount of energy reduced based on the particular project after subtracting the negative free ridership effects and adding the positive spillover effects. Therefore, net savings equal gross savings, minus free ridership, plus the summation of participant spillovers, and non-participant spillovers. It is a better estimate of how much energy reductions occurred particularly because of the program incentive(s).

Net-to-Gross-Ratio (NTGR): A factor representing net program savings divided by gross program savings. It is applied to gross program impacts to convert gross program impacts into net program load impacts that are adjusted for free ridership and spillover. Net-to-Gross-Ratio (NTGR) = (1 – Free-Ridership % + Spillover %), also defined as Net Savings / Gross Savings.

Non-participant: A consumer who was eligible but did not participate in the subject efficiency program in a given program year. Each evaluation plan should provide a definition of a non-participant as it applies to a specific evaluation.

Participant: A consumer who received a service offered through the subject efficiency program in a given program year. The term “service” is used in this definition to suggest that the service can be a wide variety of services, including financial rebates, technical assistance, product installations, training, energy efficiency information or other services, items, or conditions. Each evaluation plan should define “participant” as it applies to the specific evaluation.

Peak Demand: The maximum level of metered demand during a specified period, such as a billing month or a peak demand period.

Peak kW Savings Target: The goal of energy demand savings set by the utility company for their program or program component before the program time frame begins.

Portfolio: Either (a) a collection of similar programs addressing the same market (e.g., a portfolio of residential programs), technology (e.g., motor-efficiency programs), or mechanisms (e.g., loan programs) or (b) the set of all programs conducted by one organization, such as a utility (and which could include programs that cover multiple markets, technologies, etc.).

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

Process Evaluation: A systematic assessment of an energy efficiency program's process. The assessment includes documenting program operations at the time of the examination, and identifying and recommending improvements to increase the program's efficiency or effectiveness for acquiring energy resources while maintaining high levels of participant satisfaction.

Program: A group of projects, with similar characteristics and installed in similar applications. Examples could include a utility program to install energy-efficient lighting in commercial buildings, a developer's program to build a subdivision of homes that have photovoltaic systems, or a state residential energy efficiency code program.

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

Ratepayer Impact Test (RIM): RIM tests measure the distributional impacts of conservation programs from the viewpoint of all of the utility's customers. The test measures what happens to average price levels due to changes in utility revenues and operating costs caused by a program. A benefit/cost ratio less than 1.0 indicates the program will influence prices upward for all customers. For a program passing the TRC but failing the RIM, average prices will increase, resulting in higher energy service costs for customers not participating in the program.

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

Reporting Period: The time following implementation of an energy efficiency activity during which savings are to be determined.

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

Spillover: A positive externality related to a participant or non-participant enacting additional energy efficiency measures without an incentive because of a participant's experience in the program. There can be participant and/or non-participant spillover rates depending on the rate at which participants (and non-participants) adopt energy efficiency measures or take other types of efficiency actions on their own (i.e., without an incentive being offered).

Stipulated Values: See "deemed savings."

Total Resource Cost Test (TRC): This test compares the program benefits of avoided supply costs against the costs for administering a program and the cost of upgrading equipment. This test examines efficiency from the viewpoint of an entire service territory. When a program passes the TRC, this indicates total resource costs will drop, and the total cost of energy services for an average customer will fall.

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

Utility Cost Test (UCT): Also known as the Program Administrator Test (PACT), this test measures cost-effectiveness from the viewpoint of the sponsoring utility or program administrator. If avoided supply costs exceed program administrator costs, then average costs will decrease.