Ameren Missouri
Lighting Impact and Process Evaluation:
Program Year 2014

May 15, 2015

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Nexant

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Executive Summary

Ameren Missouri engaged Cadmus and Nexant (the Cadmus team) to perform annual process and impact evaluations of the Lighting program for a three-year period from 2013 through 2015. This annual report covers the impact and process evaluation findings for Program Year 2014 (PY14), the period from January 1, 2014, through December 31, 2014.

Program Description

The Lighting program's design seeks to increase sales of energy-efficient lighting products through a variety of retail channels. In PY14, Ameren Missouri changed the name of the program from LightSavers (used in PY13) to the Lighting program. Ameren Missouri works with CLEAResult (formerly Applied Proactive Technologies) the Lighting program implementer, to provide a per-unit discount for eligible CFLs, LEDs, and lighting occupancy sensors. In addition to reducing prices, CLEAResult leverages its relationships with participating retailers to place discounted lighting in prominent locations within stores and locate Ameren Missouri signage and marketing materials nearby. Energy Federated Incorporated (EFI) also assists in markdown program implementation by maintaining the tracking system and selling discounted lighting products through an online store.

Lighting primarily operates through a point-of-sale markdown system at major chain retailers and through an online website. In addition to the markdown channel, the Lighting program includes two other channels: coupons and social marketing distribution (SMD). The coupon channel is available to retailers without a point-of-sale system (i.e., a computer software system that tracks all purchases). For these retailers, Ameren Missouri provides coupons that customers complete at the register to receive a discount. Through the SMD channel, Ameren Missouri distributes free 13W CFLs and 23W CFLs to lower income customers through partnerships with area food banks and related community organizations.

Table 1 shows PY14 total participation by the program's three distribution channels. Similarly to previous year, the overwhelming majority of program participation occurred through the markdown channel.

Table 1. PY14 Participation Summary

Lighting Program Channel	PY14 Participation (Bulbs)	Percent of Participation
Markdown	3,872,837	97.2%
Coupon	5,832	0.1%
SMD	105,360	2.6%
Total	**3,984,029**	**100%**

Key Impact Evaluation Findings

The PY14 evaluation used previous evaluation research, supplemented with several new research elements. The new elements with the greatest impact were an hours of use (HOU) lighting metering study and developing an Ameren-specific wattage baseline that accounts for the continued availability of non-compliant Energy Independence and Security Act of 2007 (EISA) regulated incandescents. The latter research element was informed by a shelf stocking study of local retailers.

In addition, the Cadmus team used PY14 sales data to update the leakage (i.e., upstream bulbs purchased by non-Ameren Missouri customers) and cross-sector sales (i.e., upstream bulbs purchased by nonresidential customers) estimates originally determined through store intercept surveys in PY13. Based on our analysis, leakage rose slightly in PY14, from 3.3% to 3.9%, and cross-sector sales decreased slightly, from 11% to 9%.

To evaluate the net savings, the Cadmus team again developed a demand elasticity model to estimate free ridership. Similarly to PY13, we also estimated nonparticipant spillover, lighting spillover, and market effects.

Gross Impacts

Table 2, below, presents *ex ante*, *ex post* energy savings, and realization rates. Overall, per-unit, *ex post* savings and realization rates dropped since last year's evaluation, primarily due to new information about average HOU. This decrease was partially offset by shelf survey-based market data from participating Lighting retailers that indicated 40W and 60W non-compliant EISA bulbs are still available within Ameren's service territory. Further explanation of these major factors follows:

- The Cadmus team analyzed lighting usage information gathered from 1,415 meters installed in 167 customer homes and determined the average efficient bulb HOU to be 2.2 hours per day. This represented a decrease from the previous HOU study, completed in 2010, which found efficient bulbs operated an average of 2.9 hours per day. The observed decrease in CFL HOU aligns with lighting theory indicating that HOU for efficient lighting decreases as the saturation of efficient lighting increases (i.e., as customers install efficient products in sockets they use less frequently), although this has not been found to be the case in some other utility HOU studies.
- We calculated baseline wattages for all program measures affected by EISA that account for the persistence of incandescent bulbs in the marketplace. (EISA prohibited the manufacture and import—not the sale—of certain types of inefficient lighting. Due to back stock, some non-compliant lighting products still remain on the shelf for purchase.) Our analysis found that baselines for 13W, 18W and 23W CFLs are equal to or higher than the values listed in Ameren's Technical Reference Manual (TRM) for post-EISA lighting sales, which served to increase *ex post* per-unit savings. We also, however, determined a baseline for the 12W dimmable LED that was lower than the TRM-recommended baseline. The 12W omni-directional LED is a dimmable bulb, and therefore treated as a specialty bulb by the TRM. However, like the 13W CFL, the bulb is a direct substitute for the 60 standard incandescent. Therefore, the Cadmus team applied the same adjustment that we applied to the 13W CFL.

Table 2. PY14 Summary: *Ex Ante* and *Ex Post* Program Gross per Unit Savings Comparison

Measure	Verified Number of Measures	*Ex Ante* Gross kWh Savings/ Year/Measure	*Ex Post* Gross kWh Savings/ Year/ Measure	Realization Rate
Upstream Markdown				
CFL - 13W (60W incand equiv)	2,740,188	31.5	37.8	120%
CFL - 18W (75W incand equiv)	115,408	37.4	36.0	96%
CFL - 23W (100W incand equiv)	455,045	51.2	47.7	93%
CFL - High Wattage Bulbs	3,901	113.0	138.7	123%
CFL - Reflector	152,478	44.1	45.6	103%
CFL - Specialty Bulbs	150,370	44.1	39.4	89%
LED - 10.5W Downlight E26	130,689	54.5	47.8	88%
LED - 12W Dimmable	98,542	48.0	34.0	71%
LED - 15W Flood Light PAR30 Bulb	2,455	35.0	55.0	157%
LED - 18W Flood Light PAR38 Bulb	5,968	32.0	66.8	209%
LED - 8W Globe Light G25	23,377	32.0	29.0	91%
Occupancy Sensor	248	217.0	28.4	13%
SMD				
CFL - 13W (60W incand equiv)	59,324	31.5	27.2	86%
CFL - 23W (100W incand equiv)	46,036	51.2	34.3	67%

Net Impacts

To estimate PY14 net-to-gross (NTG) ratios, the Cadmus team used the following formula:

NTG = 1.0 – Free Ridership + Participant Spillover + Nonparticipant Spillover + Market Effects

As noted, we re-estimated free ridership this year using PY14 sales data, finding very similar levels of overall lighting free ridership (26%) compared to last year (24%). We also updated the PY13 nonparticipant spillover analysis using PY14 marketing expenditures and program-specific implementation budgets, determining nonparticipant spillover (which precludes lighting measures) of 147,749 MWh in PY14—equivalent to 1.2% of program savings.

In PY13, the Cadmus team relied on home inventories at 172 randomly sampled residential customer homes to determine CFL saturations and, subsequently, to estimate participant spillover (lighting only) and market effects. We will conduct another set of 100 home inventories in PY15, but did not include similar visits as part of PY14 evaluation plan. It is likely, given our PY13 findings and the continuity and size of the Lighting program, that participant spillover and market effects also occurred in PY14. However, the exact magnitude of these impacts is unknown.

Since the PY13 site visits (completed in July 2013), Ameren's upstream lighting program has sold approximately 6.3 million bulbs.

While the sizable influx of CFLs contributes significantly to gross savings and market transformation, somewhat counterintuitively, it also reduces the magnitude of participant spillover and market effects as the opportunity of these effects lessens in a more transformed market. While previous research strongly suggests participant spillover and market effects very likely continued in PY14, the size of these effects probably were smaller than in PY13. Since no new data was collected for PY14, the Cadmus team recommends halving the PY13 values (28% and 20%, respectively, for participant spillover and market effects) and applying these lessened values to PY14. As necessary, we will verify and adjust both values in PY15, following the home inventory survey.

Table 3 shows contributing net savings elements.

Table 3. PY14 Net Impact Summary

	Ex Post Gross Savings (MWh/yr)	Free Ridership	Participant Spillover	NPSO	Market Effects	NTG Ratio	Net Savings (MWh/yr)
Lighting Program	156,842	25.8%	14.0%	1.2%	10.0%	99.4%	155,780

As shown in Table 4, the program achieved 161% of its proposed net energy savings target for PY14 (96,837 MWh) as well as 422% of its proposed net demand savings target (2,911 kW). Ameren's residential tariff, approved by the Missouri Public Service Commission (MPSC) in advance of the beginning of this program cycle in PY13, set the yearly targets for energy and demand savings.

Table 4. Lighting Net Savings Comparisons

Metric	MPSC-Approved Target[1]	*Ex Ante* Gross Savings Utility Reported[2]	*Ex Post* Gross Savings Determined by EM&V[3]	*Ex Post* Net Savings Determined by EM&V[4]	Percent of Goal Achieved[5]
Energy (MWh)	96,837	144,913	156,842	155,780	161%
Demand (kW)	2,911	12,420	12,358	12,287	422%

[1] http://www.ameren.com/-/media/missouri-site/Files/Rates/UECSheet191EEResidential.pdf
[2] Calculated by applying tracked program activity to TRM savings values.
[3] Calculated by applying tracked program activity to Cadmus' evaluated savings values.
[4] Calculated by multiplying Cadmus' evaluated gross savings and NTG ratio, which accounts for free ridership, participant spillover, nonparticipant spillover, and market effects.
[5] Compares MPSC Approved Target and *Ex Post* Net Savings Determined by EM&V.

Key Process Evaluation Findings

As the Cadmus team completed a comprehensive process evaluation of the Lighting program in PY13, the PY14 evaluation focused on the impacts of program changes in 2014. Key process findings for the PY14 program year are presented below:

- **Overall High Rate of Sale.** Program participation remained high in PY14 (4.0 million bulbs), just slightly less than the 4.1 million distributed in PY13, though upstream markdown and discount bulbs sales in PY14 (3.9 million) exceeded similar sales in PY13 (3.5 million). The remainder of bulbs were distributed through the SMD program.
- **Persistence of Incandescent Bulbs.** The Cadmus team found, despite EISA's ban on the manufacture of 100W and 75W bulbs in 2012 and 2013, respectively, these bulbs continued to be available on some retailers' shelves throughout the year. During the year, 2% to 11% of 100W equivalent program CFLs were sold in stores offering 100W bulbs, and 4% to 21% of 75W equivalent program CFLs were sold in stores offering 75W bulbs, varying by quarter. The ban on the manufacture of 60W and 40W bulbs began in 2014, but the phase-out from retail stores followed the same gradual trajectory. According to shelf stocking data collected by CLEAResult, 52% of the sampled retailers continued to sell these products even at the end of 2014, affecting the baseline for 60W equivalent CFLs and 60W equivalent LEDs.
- **LEDs Sales Rapidly Increasing.** Due to the popularity of LED bulbs with consumers, CLEAResult emphasized increasing LED sales in PY14. The program offered incentives that decreased only slightly over the year (from an average of $8 per bulb to an average of $6 per bulb), even as retail prices fell more steeply. As a result, program incentives for LEDs equaled a much higher proportion of the bulb price in 2014, in comparison to previous years. The program also introduced two additional LED lamp types in 2014 (obviously not previously discounted). Due to these actions, LEDs made up 6.6% of program participation in 2014, rising from less than 0.1% in 2013.
- **More Retailer Partners.** In PY14, the markdown program operated in a greater number of brick-and-mortar locations due to the addition of new retail partners. Two discount retailer chains joined the program, adding over 100 new locations. One former coupon-only partner also operated as a markdown retailer for LED sales. Not all new retailers lasted for the duration of the program. One of the new discount retailers, representing 90 locations, dropped out after the third quarter.
- **Mass Merchandise Stores Lead Sales.** Do-it-yourself (DIY) big box stores have been the lead sellers in the program for the past few years. However, in 2014, the mass merchandise category of retailers accounted for the most bulb sales. This was in part due to a new commitment to the program from mass merchandise stores. However, sales from big box DIY stores fell both in absolute terms and as percentage of total sales. This decline was due to a variety of reasons, most notably a corporate-wide shifts to emphasize LEDs at one large retail chain.
- **Reduced Availability for Occupancy Sensors.** Due to low *ex post* realization rates (17%) for occupancy sensors in PY13, CLEAResult only offered the product through its online store. Sales fell from 1,623 in 2013 to 248 in 2014.
- **Reduced SMD.** CLEAResult decreased the number of bulbs distributed through the SMD channel, from 651,744 in PY13 to 105,306 in PY14. CLEAResult decided to target this population through the increase in discount retailers instead of through the SMD. Using the markdown program is a more cost-effective channel than the SMD.

Key Conclusions and Recommendations

Based on the impact and process evaluation findings for the Lighting program, the Cadmus team offers the following conclusions and recommendations.

Conclusion 1. EISA regulations ending the manufacture of incandescent bulbs had a more gradual effect on the market than Ameren Missouri anticipated in its TRM. The Cadmus team found that even 100W incandescent bulbs—the first to be phased out under EISA regulations—persisted in 7% of retail locations in the last quarter of PY14. As a result, baseline wattages used to calculate energy savings were higher than expected.

> **Recommendation 1.** Anticipate that a slow phase out will "float" the baseline wattage above the "post-EISA" value for 40W and 60W at least one to two years after EISA implementation.

Conclusion 2. LEDs will continue to gain market share, providing a growing proportion of program savings. According to Ameren Missouri and CLEAResult staff, LEDs continue to be more popular with consumers than CFLs. In addition, LED prices continue to fall. As these bulbs become less expensive, they become even more cost-effective for the program to promote. Very likely, they will continue to grow in importance to the program. At the same time, overall saturation of efficient bulbs appears to be increasing rapidly, leading to declines in HOU and other possible implications such as socket-shifting. (A recent in-store survey in the northeast found that roughly one in five customers intended to replace a CFL with an LED.)

> **Recommendation 2.** To maintain market momentum and guarantee the program gets as much benefit from bulbs as possible, the program should consider marketing campaigns specifically focused on LEDs. Other upstream programs around the country are using marketing campaigns that showcase popular aspects of LEDs beyond energy savings, including their attractive light, appearance, and "cool factor." In addition, Massachusetts has launched a campaign that focuses on where efficient lighting products should be installed for the most benefit in terms of savings as well bulb function (i.e., they explain where it makes sense to use a PAR flood instead of BR flood, etc.). Since LEDs are always dimmable[1], it important to continue to have models in the program that are designed to work where dimmable function is most utilized, as the program has done by including the 8W globe and 15W and 18W flood models.
>
> However, the program should be selective when promoting LEDs. CFLs still account for over 70% of program sales, and offer by far the most cost-effective savings. LEDs should not be promoted in a way that would shift CFL sales to LEDs. Instead, focus LED sales where it aligns with retailer's marketing approach, such as DIY stores that want to preserve a wide array of LED options on their shelves, and minimize the number of CFLs.

[1] Note that middle levels of dimming do not always work well since older dimmer switches have a hard time figuring out the lower wattages. As such, dimmer switches may need to be updated to make some LEDs dim correctly.

Conclusion 3. In an effort to tap an otherwise hard-to-reach market, the program deliberately shifted more program sales into discount retailers in 2014. The effort was successful, in the sense that the percent of sales in discount retailers rose ten points. While we did not find evidence that there is any reduced free-ridership benefit to this market, the market does appear to be receptive to the program. The draft report from an unpublished northeastern study indicates that focusing more than three-quarters of program sales in hard-to-reach markets, including discount retail, may account for the high levels of saturation reached in other states.

> **Recommendation 3.** Continue to work with discount retailers to increase uptake at discount retail stores.

PY13 Recommendation	Cadmus Findings	Explanation
Recommendation 1. Update the TRM to account for these factors, more closely aligning *ex ante* and *ex post* estimation methodologies.	Not yet implemented	TRM was based on past evaluations. TRM will be updated for MEEIA Cycle 2
Recommendation 2. Continue to utilize the current mix of urban and rural stores, as current leakage rates are modest and the program benefits from nonresidential purchases.	Implemented	This recommendation will continue to be a focus in 2015.
Recommendation 3. Encourage customers to replace incandescent bulbs immediately with CFLs or LEDs through a call to action, presented through marketing materials, to replace incandescent bulbs without waiting for them to burn out.	Implemented	Recommendation is incorporated in marketing/educational material and is emphasized as part of training/education by lighting field reps to customers during regular store visits and lighting promo events.
Recommendation4. Perform additional analysis using the demand elasticity model and work with APT to conduct natural experiments to optimize program offerings, promotions, product placements, and incentive levels (balancing free ridership and incentive costs).	Implemented	Recommendation incorporated in 2014 and 2015 program design.
Recommendation 5. Continue to work with retailers to vary prices and promotions.	Implemented	Recommendation incorporated in 2014 and 2015 program design.
Recommendation 6. APT should streamline and combine its current reporting into one overall online tracking system.	Partially implemented	Ameren Missouri is working with Clearesult to modify their reporting data and to integrate all data in Vision database for export to Cadmus. Promotion and product placement will remain a separate report that is sent to Ameren Missouri/Cadmus quarterly.
Recommendation 8. Continue to work with retailers to maintain a wide variety of available energy-efficient products.	Implemented	This recommendation will continue to be a focus along with program education/promos in 2014 and 2015.

Introduction

Ameren Missouri engaged Cadmus and Nexant (the Cadmus team) to perform a process and impact evaluation of the Lighting program for a three-year period. This annual report covers the impact and process evaluation findings for Program Year 2014 (PY14), the period from January 1, 2014, through December 31, 2014.

For 2014, the Cadmus team assessed gross and net savings impacts and evaluated program processes. For the gross savings analysis, we conducted two empirical research studies:

- Collecting and evaluating bulb metering data initiated in 2013.
- Surveying retailer shelves to document the appropriate baseline technology (i.e., determining the phase out of incandescent bulbs impacted by Energy Independence and Security Act of [EISA] regulations).

The meter data allowed the Cadmus team to update the estimated hours of use (HOU) for program bulbs. The retailer shelf survey monitored the presence of EISA-impacted incandescent bulbs in participating retailer locations to update the savings baseline. Cadmus also updated the sales weights of the store intercept survey results from 2013 to be based on 2014 sales, changing the leakage rate and estimated percentage of bulbs going to residential applications.

To update net savings, the Cadmus team evaluated the free ridership rate, lighting-related spillover, non-lighting spillover, and the market effects rate for 2014. As in past years, we applied a demand elasticity model to measure customer price sensitivity and determine free ridership. We updated the allocation of the nonparticipant, non-lighting spillover rate by applying 2013 survey results to 2014 savings and marketing expenditures. In addition, we updated the estimated CFL and LED saturations to estimate lighting-related spillover and market effects for 2014.

For the process evaluation, the Cadmus team conducted interviews of Ameren Missouri program staff and implementer staff. The process evaluation focused on evaluating program changes implemented in 2014, which included the following:

- An increase in bulb sales
- Measuring the persistence of incandescent bulbs in the marketplace
- A greater focus on LEDs (combined with falling prices for LEDs in general).
- An increased retailer pool and an increased focus on discount retail.
- A reduced focus on occupancy sensors.
- A reduced bulb distribution through the Social Marketing Distribution (SMD) channel.

Program Description

In PY14, Ameren Missouri changed the name of the program from LightSavers (used in PY13) to the Lighting program. The Lighting program's design seeks to increase sales and customer awareness of ENERGY STAR®-qualified, residential lighting products. The program provides incentives to retail partners, allow price discounts and increased availability of qualifying lighting products. Specifically, the Lighting program encourages the purchase of new technologies such as LEDs and specialty CFLs, in addition to standard CFLs. The program offers incentives through several brick-and-mortar retailers and through an online store.

In addition to incentives, the Lighting program relies on various promotional techniques—improved product placements, off-shelf merchandising opportunities, and in-store demonstrations—to encourage adoption of higher-efficiency lighting and increase customer awareness of the benefits from high-efficiency bulbs. The program also uses an SMD channel, through which Ameren Missouri provides CFLs at no charge to income-eligible customers via partnerships with community organizations.

About the Target Market

Working through local and national chain lighting retailers, the Lighting program targets Ameren Missouri residential customers. While the program generates the most sales through its large, national retailer partners, program and implementer staff seek to include local retailers, regional chains, and small hardware stores that are themselves Ameren Missouri customers and that often serve Ameren Missouri residential customers in more rural locations.

Through its SMD channel, the program targets hard-to-reach low-income segments of the residential customer market. The program also targets this market through the discount retail chains that participate in the markdown channel.

The online store, accessible directly and linked on the Ameren Missouri website, offers another shopping option for customers. This channel ensures availability to customers unable to physically access a retail partner.

About the Program Implementers

Ameren Missouri contracted with CLEAResult (formerly Applied Proactive Technologies) and Energy Federation Incorporated (EFI) to implement the Lighting program for program years of 2013, 2014, and 2015.

- The CLEAResult team's experience in managing upstream lighting programs includes administering Ameren's Lighting program (formerly the Lighting and Appliance Program) for the past four years and administering similar programs for other utilities across the country.
- EFI processes program incentive payments and manages the online store that sells discounted CFLs and LEDs.

Program Activity

The program continued to rely on standard CFLs for the bulk of program savings, though specialty CFLs and LEDs also contributed significantly. LEDs increased as a proportion of total sales in 2014, up to 6% from just over 10,000 bulbs in PY13. A low number of occupancy sensor sales contributed a negligible savings. The overwhelming majority of sales came through brick-and-mortar retailers participating in the point-of-sale (POS) markdown program, though not all markdown retailers offered discounts on all types of program products. After the markdown program, distributions of 13W and 23W CFLs through the SMD program served as the second-largest contributor of savings, followed by product sales through the online store, and, finally, CFL sales through the coupon program. Of all retailer participants, mass market stores made the greatest contribution to total sales.

Table 5. Participation by Channel

Lighting Element	PY14 Participation	Percent of Participation
Markdown and Online	3,872,837	97.2%
Coupon	5,832	0.1%
SMD	105,360	2.6%
Total	**3,984,029**	**100%**

Evaluation Methodology

The Cadmus team identified the following impact and process evaluation objectives for the Lighting program in PY14.

Impact Evaluation Priorities

- Determine measure-specific savings, total gross savings, net energy savings, and generated demand reductions.
- Determine Ameren-specific HOU for average households and for specific room types.
- Determine baseline per-unit wattages by measure, adjusted on a quarterly basis and accounting for the persistence of 100W, 75W, 60W, and 40W incandescent bulbs in the market.
- Estimate free ridership and retailer spillover at participating and nonparticipating branch locations.
- Estimate the nonparticipant spillover and program market effects for PY14.

Process Evaluation Priorities

- Document changes to key program design and implementation aspects in 2014, including incentive levels, numbers and types of retail partners, frequency of promotional activities, and staffing levels.
- Assess the impacts of those changes on overall program performance.
- Define the target market, market segment imperfections, and market demands, per requirements of 4 CSR 240-22.070(8).[2]

Table 6 lists the evaluation activities conducted in PY14 to achieve these objectives, followed by brief summaries of each activity.

[2] http://sos.mo.gov/adrules/csr/current/4csr/4c240-22.pdf

Table 6. PY14 Process and Impact Evaluation Activities and Rationale

	Process	Impact	Rationale
Data Tracking Review	•	•	Ensure information was collected to inform the impact analysis. Provide ongoing support to ensure all necessary program data are tracked accurately; identify gaps for EM&V purposes.
Stakeholder Interviews	•		Interview utility staff and implementer staff to provide insights into program design, effectiveness of marketing, delivery, satisfaction, free ridership, and spillover.
EISA Shelf Study	•	•	Survey participating retail locations to determine the persistence of incandescent bulb types no longer manufactured (per EISA), and adjust the wattage baseline to more accurately reflect customer options.
HOU Metering		•	Use metering data gathered from participant households over 2013 and 2014 to determine the average household HOU for program bulbs.
Demand Elasticity Modeling		•	Assess impacts of price changes, marketing, and product placement on sales to estimate free ridership.
Spillover and Market Effects Analysis		•	Estimated change in saturation from PY13 home inventory study to gauge increase in efficient bulb use, and proportion due to spillover and market effects.
Cost-Effectiveness		•	Analyzed the cost-effectiveness of PY14 using Ameren Missouri avoided costs and utilizing DSMore.

Data Tracking Review

The Cadmus team reviewed the data content for working tracking databases and final, year-end reports of program activity. Data systems and sources accessed to facilitate the evaluation activities included the following:

- EFI report, provided by staff
- Select CLEAResult reports, provided by staff
- CLEAResult Salesforce database
- Ameren Missouri Vision database

Ameren Missouri commissioned Vision, a single database to house key data for all portfolio programs. The Cadmus team worked with Ameren Missouri and the database design team to identify information needs for evaluation. We used the database, after it launched in the summer 2014, to access data on sales and pricing. The database, however, experienced a malfunction at the end of the year. Consequently, we used the Salesforce database to obtain year-end sales data for the markdown and coupon programs.

Cadmus relied on Excel-based reports sent by CLEAResult or EFI staff for the following information (both periodically throughout the year and for final data): bulb distribution through the SMD channel, bulb sales through the online channel, promotional activity, and the quarterly shelf-study data.

Program Staff Interviews

The Cadmus team conducted two staff interviews in 2014, conducting one interview with an Ameren Missouri program staff member and one with two CLEAResult program staff members. To guide the interviews, we prepared an interview guide that addressed changes in program design, current performance, and ideas for midstream course corrections to improve the program. Appendix C provides a copy of the stakeholder interview guide.

Baseline Wattage Shelf Survey

Starting with 2012, EISA mandated the phase out of manufacturing common, medium-screw base, 40W, 60W, 75W, and 100W incandescent lamps. Retail sale of these bulbs, however, has phased out much more gradually as retailers sell through existing stock. These bulbs set the energy-usage baseline for several program measures and, therefore, impact program gross savings. Table 7 shows affected measure categories. The Cadmus team worked with CLEAResult to implement a survey of existing lighting inventories at a sample of program retailers, monitoring the persistence and availability of non-EISA compliant incandescent bulbs after EISA's enactment. We used this information to adjust the wattage baseline for each bulb type.

Table 7. Program Measure Categories Impacted by EISA Regulations

EISA-Impacted Bulbs	Impacted Program Measure Category
40W	CFL - 13W
60W	CFL - 13W, LED - 12W (Dimmable)
75W	CFL - 18W
100W	CFL - 23W

The Cadmus team modeled the survey design on a similar survey we are conducting for another Midwestern upstream lighting program, also implemented by CLEAResult. Specifically, we selected a sample of 60 participating stores, including a census of the top-selling stores, ensuring representation of the bulk of program sales. Table 8 presents the resulting sample.

Table 8. Shelf Survey Sample by Sales Tier

Tier	Tier Description	Program		Sample	
		Locations	Percent of 2013 Sales	Locations	Percent of 2013 Sales
1	35,000 or more in bulb sales	29	58%	29	58%
2	10,000 to 35,000 in bulb sales	53	35%	25	17%
3	Less than 10,000 in bulb sales	272	8%	6	<1%
		354	**100%**	**60**	**75%**

CLEAResult representatives conducted the survey at the end of each quarter during PY14, with the exception of the first quarter.[3] In June, September, and December 2014, a CLEAResult representative visited each location in the sample. The representative searched the lighting aisles for 100W, 75W, 60W, and 40W standard incandescent bulbs (not three-way, reflector, or other bulb types exempted from EISA legislation; bulbs did not need to be the same brand or model). If at least 10 bulbs[4] were available for sale for a given wattage, the representative indicated on the survey form that incandescents of that wattage were available. The required count was based on bulbs, not packages. Therefore, three four-packs would represent 12 bulbs and more than satisfy the required number of bulbs. Table 9 shows a sample of the data collection form.

Table 9. Sample from EISA-Impacted Bulbs Shelf Survey Form

Store Location	Date of Visit	Incandescent bulbs available? (More than 10 bulbs)			
		100W (Y/N)	75W (Y/N)	60W (Y/N)	40W (Y/N)
Retailer 1	6/29/2014	Y	Y	Y	Y
Retailer 2	6/29/2014	N	N	N	N
Retailer 3	7/9/2014	N	N	Y	N

For each wattage, the Cadmus team evaluated the percentage of sample stores where incandescent bulbs were available and weighted the percentage by sales of corresponding program bulbs (e.g., weighted results for 75W bulbs by sales of 18W CFLs). To validate results, the Cadmus team compared them to a similar study conducted for a Midwestern utility over the same time frame. That study weighted each measure by all program sales rather than sales of the corresponding measure.

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[3] As the Cadmus team launched the survey in May 2014, it did not collect data for Q1, and we filled the gap using values from an identical survey conducted for another Midwest utility.

[4] The Cadmus team chose the 10 bulb minimum to ensure that enough bulbs were available to provide customers with a visible incandescent choice. We recognize it may be preferable to quantify sales by bulb type or to base the analysis on percent of shelf space allocated to incandescents. Due to limited evaluation budgets this was not possible for PY14, however we determined this method to be an improvement over past methods that simply assumed incandescents were the baseline option for six months after EISA standards were implemented.

Nevertheless, the results showed a similar pattern of diminishing presence. Table 10 shows the other study's results.

Table 10. Percent of Stores with a Minimum of 10 Incandescent Bulbs: Comparison with Concurrent Midwestern Utility EISA Shelf Study

Measure	Q1*		Q2		Q3		Q4	
	Ameren	Other	Ameren	Other	Ameren	Other	Ameren	Other
100W Equivalent CFL	10%	10%	11%	2%	2%	3%	4%	1%
75W Equivalent CFL	19%	19%	21%	2%	5%	3%	4%	4%
60W Equivalent CFL	77%	77%	71%	61%	59%	50%	51%	34%
40W Equivalent CFL	66%	66%	65%	56%	41%	20%	44%	15%
60W Equivalent LED**	3%	n/a	3%	n/a	12%	n/a	26%	n/a

*Q1 values borrowed from comparable mid-west utility program conducting a similar study.

**Q1 LED value uses the Q2 LED value

Regulations on 60W incandescent bulbs went into effect on Jan. 1, 2014, making 2014 the first year EISA regulations impacted the baseline for 13W CFLs and 12W LEDs. As with other wattages previously impacted, 60W bulbs were slow to phase out of the market during the first year. Consequently, a high percentage of 60W equivalent CFLs were sold in stores still offering 60W incandescent bulbs.

The 60W equivalent LED did not follow the same trend, as, during the second quarter, over 90% of program 60W equivalent LEDs (10–12W "dimmable" LEDs) were sold in club stores not offering 60W incandescent bulbs. The sale of program 12W LEDs became progressively more distributed across program retailers during the third and fourth quarter, meaning the weight increased for other stores selling both 12W LEDs and 60W incandescent lamps. The different store distributions between LEDs and equivalent CFLs resulted in different baselines for each.

To determine the baseline for each affected program measure for each quarter, the Cadmus team created a blended baseline using the following formula:

$$Watts_{BaseMi} = \%PreEISA_{iM} * (Watts_{PreM}) + (1 - \%PreEISA_{iM}) * (Watts_{PostM})$$

Where:

$Watts_{BaseiM}$ = The baseline wattage for measure m for bulbs sold in quarter i

$\%PreEISA_{iM}$ = The percent of program sales of measure M in quarter in stores offering incandescent bulbs

$Watts_{PreM}$ = The pre-EISA baseline wattage for measure M

$Watts_{PostM}$ = The post-EISA baseline wattage for measure M

Cadmus assumed a "pre-EISA" baseline, based on an incandescent bulb wattage, and a "post-EISA" baseline, based on the maximum wattage for the associated lumen range allowed for manufacture under EISA. Table 11 shows these values. Cadmus determined per-unit savings for each bulb under the pre-EISA and post-EISA scenarios, then averaged them, weighted according to the shelf study results.

To create the annual baseline, each quarter value was combined, again weighted by sales. As 60W and 40W equivalent CFLs fit a combined measure category (13W CFLs), we created a separate baseline for each type of bulb, and then used a sales-weighted average of the two baselines to calculate the measure savings for the 13W CFL measure category.

Table 11. Baseline Wattages by Lumen Range

Minimum Lumens	Maximum Lumens	Incandescent Equivalent Pre-EISA (WattsBase)	Incandescent Equivalent Post-EISA (WattsBase)
1,490	2,600	100	72
1,050	1,489	75	53
750	1,049	60	43
310	749	40	29

HOU Metering Analysis

To update the average HOU values of the program bulbs, the Cadmus team installed meters in 172 Ameren Missouri residential customers' homes and left them in place for approximately 12 months.[5] The following details the process for collecting and analyzing lighting meter data to determine the average HOU for efficient bulbs.

Whole-House Lighting Inventory

Field technicians used an iPad-based tool to record the following data for each inventoried light:

- Room type
- Fixture type
- Lamp type
- Lamp shape
- Socket type
- Control type
- Number of lamps per fixture
- Whether lights were exposed to ambient natural light

Systemically moving room by room, technicians recorded detailed information for every identified interior and exterior fixture, and noted whether lights were part of a fixture group (i.e., a set of fixtures on the same circuit that turn on and off together). Typically, data collection took approximately one

5 The PY13 Lighting program evaluation provides details on creating the metering sample and the installation process.

hour to complete, although the exact times varied, depending on a home's size and its number of fixtures.

Light Meter Installation and Removal

After completing the lighting inventory, field technicians installed up to 10 light meters on randomly selected lighting fixture groups with incandescents, CFLs, and medium, screw-based LEDs installed. To ensure unbiased installations, the iPad tool randomly selected fixtures receiving meters. The iPad tool assigned meter installations based on room priorities, with the first five meters assigned to each of five priority room types (e.g., living area, dining room, kitchen, master bedroom, bathroom), and the remaining five meters randomly assigned to any fixture in any non-priority room (e.g., secondary bedrooms, closet, hall, basement, office, laundry, mechanical). Randomly assigning meters in this manner sought to improve precision around priority rooms (where most lamps were installed). The iPad tool also allowed field technicians to designate a given fixture as "off-limits" for metering due to accessibility, aesthetics, or other reasons (field technicians typically invoked this option for hard-to-reach or delicate fixtures, such as exterior lights or chandeliers).

The Cadmus team installed Onset UX 90 light loggers to record the on/off state for each metered light. To install light loggers successfully, field technicians adhered to all manufacturer recommendations for placements, settings, auto-calibrating, attaching, and fiber optic eye usage. Additionally, field technicians used the iPad-based tool to apply labels to every logger, specifying installation dates and launch times. After installing each light logger, the field technicians took photographs, documenting the condition of installations and areas around installations.

When installing the meters, field technicians took steps to avoid installations that could potentially result in unusable data. These steps included (but were not limited to) the following:

- Field technicians positioned loggers away from ambient light sources; so meters only recorded light from the metered fixture. If exposure to ambient light proved difficult to avoid, field technicians attached a fiber optic eye to the logger, which reduced the likelihood of ambient light interacting with the logger.
- Field technicians used hard plastic cable ties, adhesive strips, and magnets to secure loggers to fixtures, seeking to ensure their placement would remain unchanged throughout the metering period.

If an installation proved impossible to complete due to safety or accessibility issues, field technicians documented the technical conditions before metering another fixture group. In all cases, field technicians deferred to any and all participant preferences relating to meter placements.

Figure 1 shows a light meter, a fiber optic eye, and the units installed in a home for the EY5 study.

Figure 1. Left to Right: Light Meter; Fiber Optic Eye; Installed Meter and Fiber Optic Eye

Field technicians returned to sites in May and June 2014 to remove loggers. Data from removal site visits were incorporated into the iPad tool and database to augment the installation information for each site and meter. As part of the lighting logger removal process, technicians conducted a series of preremoval meter diagnostics, including the following:

- Completing a logger state test (which determined if the meter functioned properly and whether ambient light affected the meter's operation);
- A visual review of the total time the logger recorded the fixture being on;
- Verbal verification from the customer that they used the light fixture;
- Verbal verification from the customer that the logger remained in place for the study's duration; and
- Recording the condition of the logger and its battery status.

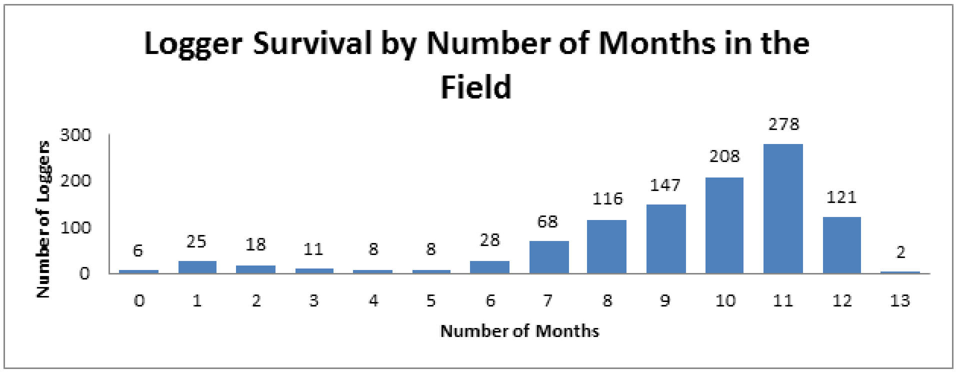
Information collected from these diagnostics informed the data cleaning process described below.

Data Cleaning

Field technicians removed the meters and downloaded all data collected. The Cadmus team analyzed light meter data as described below, determining HOU.

Figure 2 shows the distribution of meter battery failures recorded in the meter download tracker. This dataset indicated a small number of meters experienced battery failure very early in the metering period; we excluded these meters from analysis. Meters failing later in the metering period were not excluded from the analysis, as all data collected by these loggers remained available after the battery died.

Figure 2. Meter Survival Rate



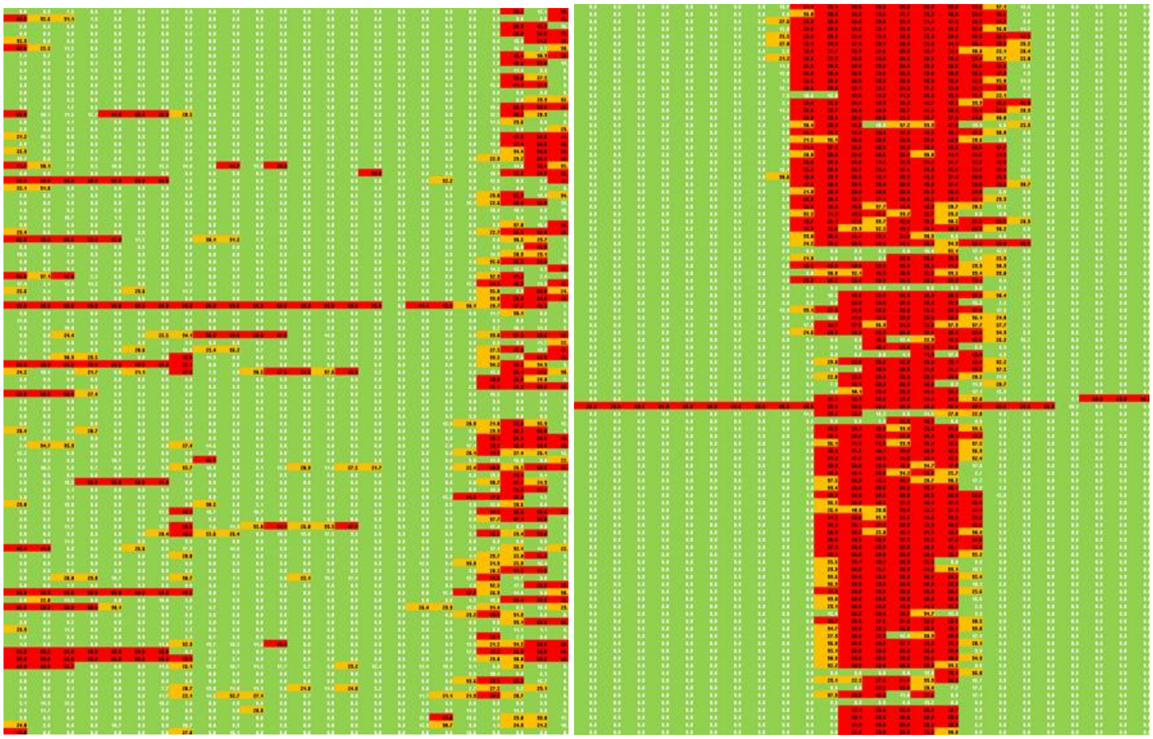
The Cadmus team followed a series of steps to clean the light metering data and determine if data from each individual light meter should be included or excluded from the analysis. First, we combined data from the installation database, the removal database, and the meter download tracker. In most cases, grouping these data revealed details about meters that allowed us to exclude light meters experiencing the following issues:

- Dead battery
- Corrupted data file
- Damaged meter
- Moved by participant during metering period
- Meters that did not pass the state test

Next, we reviewed if the light meter passed the “state test” during removal (i.e., after being installed for the entire metering period, did the meter still correctly report when the metered light was on and off). In most cases, we excluded the meter if it failed the state test. If the meter passed the state test, we reviewed the “exposure type,” “room type,” and “estimate of use” fields, along with the meter’s heat map, to determine if the meter should be included. Additional details about using heat maps follows below.

The Cadmus team used heat map analysis to determine if sunlight caused inaccurate data collection. Heat map analysis involved collapsing data from the entire metering period into hourly bins to identify loggers potentially affected by ambient light. For example, a logger installed on an exterior light showing high usage between 7:00 a.m. and 4:00 p.m. would be flagged as suspect. Heat maps could then be used to visualize usage data for every hour of the metering period, as shown in Figure 3.

Figure 3. Example Heat Maps (Left: Logger Included in Analysis; Right: Logger Excluded)



The heat map on the left represents a logger included in the final analysis dataset, and the heat map on the right represents a logger not included in the final analysis dataset. The colors indicate degrees of usage, with green as low (<20 minutes/hour), yellow as medium (between 20 and 40 minutes/hour), and red as high usage (more than 40 minutes/hour). Each box in the heat map represents one hour, and each row represents one day (with 24 boxes across).

The right heat map shows high light exposure during the middle of the day on an exterior light as well as the relationship between usage hours and length of the day. The heat map's bottom (representing the fall) shows a narrower band of red compared to the heat map's top (representing summer). This relationship between light exposure and daylight hours suggests the logger simply recorded daylight and not the lamp's light output.

Site and Metering Summary

The Evaluation Team visited a total of 172 homes to inventory lighting and to install lighting meters. Of these 172 homes, 167 provided useful data. Table 12 explains the reduction in sites.

Table 12. Summary of Site Visits

Sites	Quantity	Reasons for Differences in Quantities
Sites visited and inventoried	172	
Sites with meters installed	172	
Sites with meters recovered	167	Unresponsive participants.
		Uncooperative participants.
		Early removal from the study.

As discussed, the engineering team applied a number of quality control measures to mitigate meter attrition, including but not limited to the following:

- Highly experienced field technicians
- Field technician training, specific to the Ameren Missouri field campaign
- Detailed, project-specific field work protocols and plans
- Detailed scripts and instructions for schedulers and field technicians to screen and educate participants

These measures restricted meter attrition to the quantities shown in Table 13. This table also shows reasons for attrition, largely due to events outside of our control

Table 13. Summary of Light Meters

Light Meters	Quantity	Reasons for Differences in Quantities
Installed	1,691	
Removed	276	Meters missing within homes.
		Unresponsive participants.
		Uncooperative participants.
		Meter moved by participant during metering period.
		Inadequate logging duration for meters removed early (due to participants moving from homes).
		Battery dying before a minimum threshold.
		Exposure to sunlight causing inaccurate meter readings.
Used in analysis	1,415	

Weighting

The Cadmus team calculated and applied lamp room weights to the lighting analysis, making sampled lamps representative of the population of lamps in participating homes. This process adjusts the distribution of sampled of lamps to the distribution of population lamps. We used the following equation to calculate individual room lamp weights for each lamp type:

$$Lamp\ room\ weight = \frac{\left(\frac{total\ inventoried\ lamps\ by\ room\ type}{total\ inventoried\ lamps\ in\ all\ room\ types}\right)}{\left(\frac{total\ metered\ lamps\ by\ room\ type}{total\ metered\ lamps\ in\ all\ room\ types}\right)}$$

In addition to the lamp room weight, the Cadmus team weighted the metering data by homeownership to represent the Ameren's residential customer base.[6]

Annualization

Once the Cadmus team verified the raw metering files' quality, the total time each logger remained on could be calculated in seconds for each hour and each day of the metering period. We then calculated the total daily HOU for each logger by summing the time the lamp remained on across each hour of each day. We merged this dataset with records containing information collected by field technicians regarding household demographics and room types.

As logger failure prevented a full year of data collection, we estimated an annual average HOU for all lamps, fitting the data to a fixed-effects (for each logger) sinusoidal curve that represented changes in the hours of available daylight per day.[7] Using the following equation, we calculated separate intercepts and amplitudes for each room type and bootstrapped standard errors which accounted for variations of HOU at both the household and lamp level:

$$Hours\ of\ Use_{it} = \alpha_1 \ldots \alpha_i + \beta_j * Room\ type * Sin\left(-2\pi\left(\frac{284 + Day_t}{365}\right)\right) + \varepsilon_{it}$$

Where:

$Hours\ of\ Use_{it}$	=	HOU for each day of the year (*t*) for each logger (*i*)
α	=	Average daily HOU for each logger
β_j	=	Amplitude of sinusoid function for each room type (slope coefficient of the regression)
Room type	=	Room type of each logger, as recorded by field technicians
Day	=	Day of the year, where January 1 has a value of 1 and December 31 has a value of 365

[6] Cadmus adjusted our weighting methodology after the initial submission of this report. We found that the HOU results using the updated weight were not statistically different from the originally calculated value. Thus we are presenting the results using the original weighting method.

[7] Page 15 of the Uniform Methods Protocol for lighting impact evaluations recommends using the sinusoidal annualization approach due to the strong relationship between daylight hours and lighting usage observed in a large number of studies. Available online at: http://www1.eere.energy.gov/wip/pdfs/53827-6.pdf

ε_{it}	=	Error term of the regression

We calculated the overall HOU, room type HOU, and bulb type HOU by taking the weighted mean of predicted HOU. Findings are presented in the Gross Impact Evaluation Results section. Additionally, information about the distribution of inventoried and metered lamps are presented in the Gross Impact Evaluation Results section.

Engineering Analysis

To calculate lighting savings from CFLs and LEDs, the Cadmus team used the algorithms presented below. These algorithms were applied to each quarter of sales data, incorporating the impact of EISA legislation over time.

Equation 1

$$\Delta kWh_{RES} = \frac{\left[\left(Watt_{Base} - Watt_{EE}\right) * Hours_{RES} * WHF_{RES}\right] * \%RES * ISR * (1 - LKG)}{1{,}000}$$

Equation 2

$$\Delta kWh_{NRES} = \frac{\left[\left(Watt_{Base} - Watt_{EE}\right) * Hours_{NRES} * WHF_{NRES}\right] * (1 - \%RES) * ISR * (1 - LKG)}{1{,}000}$$

Where:

$Watts_{EE}$	=	The average program bulb wattage
$Watts_{Base}$	=	The lumen-equivalent wattage of replaced bulbs
$Hours_{RES/NRES}$	=	Average daily HOUs for residential or nonresidential applications
%Res	=	The percentage of program bulbs installed in residential applications
ISR	=	The installation rate (NRES is assumed to be the same as RES)
LKG	=	The leakage rate (bulbs sold to customers outside Ameren's service area)
$WHF_{RES/NRES}$	=	HVAC interaction factors (adjustments for HVAC interactive effects)

The Gross Impacts Section further explains the methodology used and presents the results.

Interactive Effects or Waste Heat Factor

The Cadmus team used a simulation model populated with a customer's typical home characteristics (identified from Ameren's recent potential study) to estimate how heating and cooling needs changed when converting incandescent lights to efficient CFLs or LEDs. Specifically, we used BEopt™ Version 2.0[8]

8 Developed by National Renewable Energy Laboratory, BeOpt uses the Energy Plus V8.0 simulation engine to generate hourly projected energy consumption, based on typical TMY3 weather data.

to model energy simulations needed for estimating WHF_e (energy) and WHF_d (demand) in residential homes.

The waste heat factor (WHF) depends on many influences, but the major considerations include the following:

- The length of the respective heating and cooling seasons (areas with long cooling seasons and low saturations of electric heating tend to have higher WHF_e values).
- Electric heating saturation.
- Cooling saturation.
- Electric resistance versus heat-pump electric heating.

We used Equation 3 to determine the WHF_e.

Equation 3. Waste Heat Factor for Energy

$$\frac{\Delta\ Lighting\ kWh + \Delta Cooling\ kWh + \ \Delta Heating\ kWh}{\Delta\ Lighting\ kWh} = WHFe$$

The WHF_d value depends on cooling saturation and cooling efficiency. We used Equation 4 to determine the WHF_d.

Equation 4. Waste Heat Factor for Demand

$$\frac{Average\ \Delta\ Lighting\ kW @\ Peak\ Period + Average\ \Delta Cooling\ kW\ @\ Peak\ Period}{Average\ \Delta\ Lighting\ kW\ @\ Peak\ Period} = WHFd$$

Where:

- A value of 1.0 would mean no net interaction between heating, cooling, and lighting.
- A value of less than 1.0 would mean a net reduction in total energy savings due to the higher heating load offsetting the lower cooling load.
- A value of more than 1.0 would mean a net increase in energy savings due to the lower cooling load offsetting the higher heating load.

Net-to-Gross Ratio Analysis

The Cadmus team calculated the program net-to-gross (NTG) ratio using the following formula:

$$NTG\ =\ 1 - \ Free\ ridership\ + Non\ Participant\ Lighting\ Spillover + Nonparticipant\ Non - Lighting\ Spillover + Market\ Effects$$

Free riders are customers who would have purchased the marked-down lighting independently of the program. They account for some program costs but none of its benefits and decrease program net savings. We estimated free ridership through the demand elasticity model, described in detail in the next section.

Nonparticipant lighting spillover is additional savings generated when program participants undertake additional energy-efficient measures or activities without financial assistance due to their experience participating in a given program. The Cadmus team updated estimates for two spillover types for the upstream lighting program: lighting spillover and non-lighting spillover.

For this program, we defined nonparticipant lighting spillover as "like" spillover, or increased purchases of nondiscounted, efficient lighting products that occurred due to the program through increased availability and education on the benefits of energy-efficient lighting. Nonparticipant nonlighting spillover equals additional savings generated when those exposed to education and advertising about energy efficiency make additional (nonlighting) energy savings improvements on their own.

Market effects are systemic changes to standard business practices, caused by program activities; they tend to persist long after program interventions have ended. The potential for demand-side management (DSM) programs to cause structural changes when intervening in a given market has become increasingly apparent as the following has occurred:

- Program delivery models have evolved (e.g., more have become upstream-focused programs); and
- Energy-efficiency investments have grown dramatically.

Programs have established long-term relationships with key market actors and trade allies. These relationships serve as a channel through which the program impacts the broader market—not only customers that experience program marketing and purchase program-discounted products.

Demand Elasticity Modeling to Estimate Free Ridership

As in PY12 and PY13, the Cadmus team used a demand elasticity model to analyze pricing impacts on sales and to determine free ridership levels for the lighting program.

We built the demand elasticity model for the Ameren Missouri program in 2012, and have refined and recalibrated the model each successive year, including 2014. Demand elasticity modeling is based on same economic principle that drives program design: that a change in price and promotion generates a change in the quantity sold (i.e., the upstream buy-down approach). All distribution channels are included in the model. Demand elasticity modeling uses sales and promotion information to:

- Quantify relationships of prices and promotions to sales;
- Determine the likely level of sales without the program's intervention (baseline sales); and
- Estimate free ridership by comparing modeled baseline sales with actual sales.

After estimating variable coefficients, we used the resulting model to predict sales that would have occurred *without* the program's price impact and promotional activity and sales that would have occurred *with* the program (and which should be close to actual sales with a representative model). We then calculated free ridership using the following formula:

$$FR\ Ratio = \left(\frac{Sales\ with\ Program - Model\ Predicted\ Sales\ without\ Program}{Sales\ with\ Program}\right)$$

The Net Impact Evaluation Results section provides our full methodology and results.

Lighting Spillover and Market Effects Analysis

The Cadmus team applied product adoption theory to estimate updated values for PY14 market effects and lighting spillover. This report's Net Impact Evaluation Results section provides a detailed description of the estimates.

NTG for SMD

As in previous years, we applied a 1.0 NTG for the SMD portion of the program, as the program e bulbs low-income customers who receive the CFLs free of charge.

Cost-Effectiveness Analysis

Using the final PY14 *ex post* gross and net savings estimates for the Lighting program, as presented in this report, Morgan Marketing Partners (MMP) determined the program's cost-effectiveness using DSMore.[9] MMP also calculated measure-specific cost-effectiveness. As shown in the Cost-Effectiveness Results section, we assessed cost-effectiveness using the five standard perspectives produced by DSMore:

- Total Resource Cost
- Utility Cost
- Societal Cost Test
- Participant Cost Test
- Ratepayer Impact Test

Impact CSR Summary

According to the Missouri Code of State Regulations (CSR)[10], demand-side programs that are part of a utility's preferred resource plan are subject to ongoing process and impact evaluations that meet certain criteria. Process evaluations must address, at a minimum, the five questions listed in Table 20. The table provides a summary response for each specified CSR process requirement, taken from both this year's evaluation and the prior year.

9 A financial analysis tool designed to evaluate the costs, benefits, and risks of DSM programs and services.

10 http://sos.mo.gov/adrules/csr/current/4csr/4c240-22.pdf

In addition, the CSR requires that impact evaluations of demand-side program satisfy the requirements noted in Table 14. The table indicates the data used in this evaluation that satisfy the CSR impact requirement.

Table 14. Summary Responses to CSR Impact Evaluation Requirements

CSR Requirement	Method Used	Description of Program Method
Approach: The evaluation must use one or both of the following comparisons to determine the program impact:		
Comparisons of pre-adoption and post-adoption loads of program participants, corrected for the effects of weather and other intertemporal differences	X	The program compares the pre-adoption load based on assumed baseline technology with the post-adoption load based on program technology, and estimates hours of use (based on metered data) and waste-heat impact (based on equipment simulation).
Comparisons between program participants' loads and those of an appropriate control group over the same time period		
Data: The evaluation must use one or more of the following types of data to assess program impact:		
Monthly billing data		
Hourly load data		
Load research data		
End-use load metered data	x	Metered lighting hours of use by room in a sample of homes in the program area during 2013-2014.
Building and equipment simulation models	x	Use simulation modeling to determine the waste-heat impact of efficient lighting
Survey responses	x	Surveyed metering participants on purchasing practices and date of purchase of efficient technology to determine installation rates.
Audit and survey data on:		
Equipment type/size efficiency	x	Evaluation team conducted an audit of all lighting in sample of homes in program area.
Household or business characteristics	x	Evaluation team Collected household characteristics from homes participating in lighting audit: home type, own/rent home
Energy-related building characteristics		

Process Evaluation Findings

This section provides the Cadmus team's process evaluation findings for Ameren's Lighting program. We organize the findings into four sections: Program Design, Program Operations, Marketing, and Satisfaction of Stakeholder partners.

Program Design

The Lighting program's design seeks to achieve energy savings by: (1) increasing use of high-efficiency light bulbs over lower-efficiency baseline options; and (2) educating consumers about energy-efficient lighting options. To do so, the program provides the following:

- POS discounts for high-efficiency light bulbs through major retail chains;
- Coupon discounts for smaller retailers in less urban parts of the service territory;
- Free CFL distributions to low-income populations; and
- Promotional events to demonstrate different lighting technologies and to educate consumers.

No major changes to the program occurred from the previous year, but the program changed in several small ways, and changes in the overall market impacted program performance.

Products and Incentives

In 2014, CLEAResult offered all of the same measures offered in 2013 and added two new LED measures. As in 2013, the standard 13W CFL served as the major product, accounting for over 70% of program sales. Table 15 shows the percentage of sales by measure for 2014.

Table 15. Participation and Savings by Measure

Measure	Participation (PY14)	% Gross Savings (PY14)
CFL - 13W (including SMD)	2,799,512	67.17%
CFL - 18W	115,408	2.54%
CFL - 23W (including SMD)	501,081	14.86%
CFL - High Wattage Bulbs (28W+)	3,901	0.35%
CFL – Reflector	152,478	4.44%
CFL - Specialty Bulbs	150,370	3.78%
LED - 10.5W Downlight	130,689	3.99%
LED - 12W Dimmable	98,542	2.14%
LED - 15W Flood Light PAR30 Bulb	2,455	0.04%
LED - 18W Flood Light PAR38 Bulb	5,968	0.25%
LED - 8W Globe Light	23,377	0.43%
Occupancy Sensor	248	0.00%
Program	**3,984,029**	**100.00%**

While standard bulbs continued to provide the bulk of program savings, CLEAResult increased the focus on LEDs in 2014. The implementer added two measure categories for the 2014 program year: 15W and 18W LED flood bulbs, in addition to three LED measures already offered through the program. The program offered these new bulbs through three big box retailers and one mass merchandise retailer. LED sales increased to 261,031 for 2014, up from 13,363 in 2013. LEDs sales represented 6.55% of total program participation in 2014.

This increase partly resulted from an initial increase for some LED incentives, combined with falling retail prices. This significantly increased the proportion of the price covered by the rebate, making the product that much more attractive to customers. Staff reported LED prices continued to fall dramatically over the year, and CLEAResult reduced incentives in the third and fourth quarters. Throughout the year, CFL incentives stayed more or less at the same level as in 2013.

Table 16 shows average per-bulb rebates for each measure in 2013 and 2014.

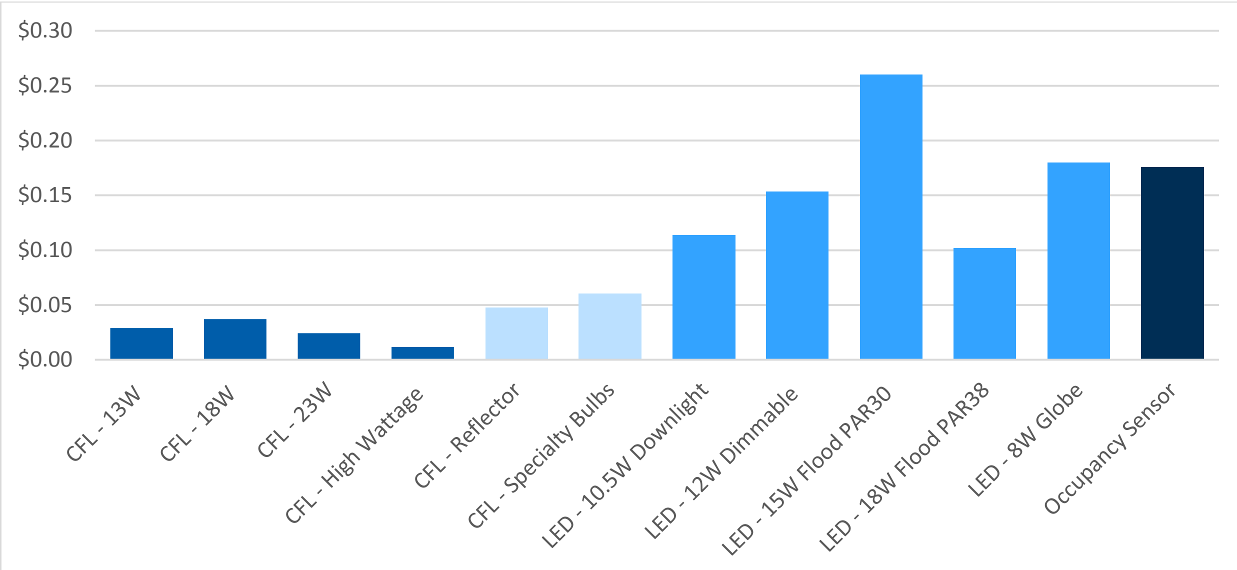
Table 16. Incented Products

Bulb Type	Measure	Average Per-Unit Incentive	
		2014	*2013*
Standard CFL	CFL - 13W (60W incand equiv)	$1.05	*$1.11*
	CFL - 18W (75W incand equiv)	$1.18	*$1.19*
	CFL - 23W (100W incand equiv)	$1.20	*$1.20*
	CFL - High Wattage Bulbs (28W+)	$1.64	*$1.68*
Specialty CFL	CFL - Reflector	$1.79	*$1.76*
	CFL - Specialty Bulbs	$1.86	*$1.77*
LED	LED - 10.5W Downlight E26 Light Bulb	$5.70	*$8.00*
	LED - 12W Dimmable Light Bulb (12W-14W)	$6.61	*$8.81*
	LED - 15W Flood Light PAR30 Bulb (15W-17W)	$7.43	*n/a*
	LED - 18W Flood Light PAR38 Bulb (18W+)	$7.05	*n/a*
	LED - 8W Globe Light G25 Bulb (8W-9W)	$5.17	*$8.00*
N/A	Occupancy Sensor	$5.00	*$6.30*

The 2013 evaluation found occupancy sensors, a new measure in 2013, had a realization rate of only 17% (13% in 2014). Although CLEAResult continued to offer the occupancy sensor in 2014, the measure had a somewhat reduced incentive and was only available through the online store.

Because they are a newer, higher-priced product, it is reasonable for the program to provide higher incentives for LEDs than CFLs to achieve market uptake. However, the per-unit savings from an LED are only slightly higher than those from a CFL. Considering the higher incentives required to move the product, LEDs remain far less cost-effective than CFLs. Figure 4 gives the dollars/kWh for each measure category, using total incentive dollars and net energy savings by measure.

Figure 4. Incentive Dollars Per Unit Energy Saved ($/Net kWh/unit)[1]



[1]This figure uses first-year savings for comparison.

Upstream Markdown Delivery Channel

The program's principle delivery stream is the POS markdown system ("markdown"), whereby discounts incorporated into a store's register system are applied when a customer completes a transaction. Stores then submit the required documentation for bulk reimbursement of these discounts. To participate in the upstream markdown distribution channel, stores must be able to meet the terms of the RFP and must have store locations in zip codes where are at least 70% of the residents have Ameren-owned meters.

Markdown Partners

As shown in Table 17Table 17, the Cadmus team evaluated retailers grouped into six retail markets. The majority of retailers participating in 2013 did so in 2014. One small mass merchandise retailer dropped out of the program, but it contributed minimal program sales in 2013. More significantly, one retail chain that formerly participated only through coupons switched to the markdown program for LED sales, and two large discount chains joined the program for the first time.

Table 17. Number of Store Locations and Percent of Program Sales, 2013 and 2014

	Storefront Locations		Percent of Sales	
Retail Markets	**2014**	***2013***	**2014**	***2013***
Club Stores	11	*11*	20.4%	*28.5%*
Discount Retail*	209	*93*	13.5%	*2.3%*
DIY	54	*52*	26.3%	*33.2%*

Drug/Grocery	161	*150*	5.4%	*3.3%*
Mass Merchandise	41	*47*	34.1%	*32.4%*
Online	n/a	*n/a*	0.3%	*0.3%*
Grand Total	**476**	***353***		

* Small discount retailers (e.g. Dollar Stores.)

To access harder-to-reach customers, the implementer staff made a deliberate attempt to shift sales into discount retail in PY14. The number of store locations in the discount retail category increased by 116 stores. Discount retail stores accounted for a significant share of markdown sales, up to 13% in 2014 from 2% in 2013. Despite the success, according to CLEAResult staff, one discount retailer was slow to reorder product when stocks ran low, and declined to participate in the fourth quarter. This retailer represented less than 0.1% of year-end sales and about 90 storefront locations. CLEAResult staff reported they did not know the reason for the limited participation, but they were contacting the company to discuss it further.

Another significant sales shift occurred through the emergence of mass merchandise stores as the retail type with the largest share of markdown sales. Big-box DIY stores were the primary sellers in 2013, but their total sales in 2014 dropped from 1,165,112 (33.2% of total) in 2013 to 918,891 (26.3% of total) in 2014. Meanwhile, mass merchandise stores sales increased from 1,147,816 in 2013 (32.4%, including roughly 10,000 in online sales) to 1,350,220 in 2014 (34.1%, with online sales categorized separately). This shift resulted in an increase in program bulbs going to residential applications (discussed in greater detail in the Updates to Leakage and Nonresidential Percentage section). Implementer and Ameren Missouri staff reported that a large mass merchandise retailer made a corporate-level decision to better leverage the utility's program in their stores, including changing stocking decisions for some products from the store manager level to the regional level.

Sales at big box DIY stores declined as a percentage of total program sales for a number of reasons, according to implementation staff. One significant obstacle was a supply issue related to a specific manufacturer. By the fourth quarter it was apparent the manufacturer was not going to increase supply, so the program worked with stores to stock alternative products. More significantly for the program going forward, one larger DIY retailer in this category decided at a corporate level to highlight LEDs in their stores, and was reluctant to stock many of the program CFLs, or dedicate as much shelf space to them. This retail chain led the program in sales of LEDs.

Like big box DIY, club stores saw a significant decline in their share of program sales while grocery/drug stores and discount stores saw significant increases. It was not clear what was driving the other shifts in program participation.

Upstream Coupon Delivery Channel

For small stores lacking the infrastructure to accommodate a POS system, Ameren Missouri offers a coupon discount system, in which booklets of coupons are left on the shelf near the product or at the register. After a customer fills out the coupon at the store, the store applies the discount; when the store has a bundle of coupons, it submits them to EFI for reimbursement. (EFI also maintains an online store offering program bulbs.)

Coupon stores in the program had to meet the following eligibility requirements: (1) be an Ameren Missouri customer; and (2) be located in a zip code that has at least 60% Ameren Missouri meters. The required concentration of Ameren Missouri meters is less for coupon stores that POS stores because coupon stores have historically demonstrated negligible leakage out of Ameren's territory. The customer base for coupon stores typically travels only a short distance to the store, which reduces the likelihood of leakage.

The sales database maintained records for 28 participating stores in 2014. CLEAResult staff noted, however, that branch locations of the same retail chain consolidate coupons and submit them jointly. The 28 stores only represented stores sending coupons to EFI for reimbursement. According to CLEAResult, roughly 60 locations participated in the coupon program during 2014.

Ameren Missouri offered coupons for bulbs in the 13W CFL, 18W CFL, 23W CFL, and high-wattage CFL measure categories. Coupon sales accounted for 5,832 bulbs in 2014, or 0.15% of participation.

SMD

Through the SMD channel, Ameren Missouri provides community organizations with energy-efficient CFLs (13W and 23W bulbs), which the organizations distribute to income-qualified Ameren Missouri customers within the communities they serve. Although CLEAResult has worked with several types of organization, they primarily work with food bank systems and community organizations that can distribute bulbs door-to-door.

In PY14, the SMD channel distributed bulbs through both methods, disseminating them to organizations that, in accordance with the program's requirement, operated in areas where at least 80% of the meters belonged to Ameren.

In 2014, the number of bulbs distributed through the SMD channel fell, from 651,744 in 2013 to 105,360 in 2014. According to CLEAResult staff, the shift resulted from an increase in discount retailers, which targeted lower-income customers. In addition, staff noted the 2013 evaluation finding that the SMD installation rate (ISR) was lower than other channels made SMD that much more expensive relative to the markdown or online channels.

Program Operations

This section describes the Cadmus team's assessment of various Lighting program management and delivery aspects; it contains feedback drawn from program stakeholder and retailer interviews.

Progress Toward Goals

In 2015, Ameren Missouri must meet portfolio-wide regulatory targets set by the Missouri Public Service Commission (MPSC) for energy and demand savings, based on implementation in PY13, PY14 and PY15. Although it need not meet interim targets on an annual basis or at the program level, examining program achievements against stated goals is important for planning purposes. Program staff reported that annual goal-setting occurs through a bottom-up process, in which CLEAResult provides participation goals for each measure, which are then multiplied by each measure's estimated savings—determined in the Ameren Missouri TRM—to generate an aggregate kWh/year target.

Table 18 shows annual targets for 2014, based on Ameren's filing from 2013, and Ameren's progress toward those goals. The savings targets in the filing decrease year to year from 2013 to 2015, perhaps in anticipation of a more rapid phase-out of incandescent bulbs and increasing saturation of CFLs in the marketplace. Although the program did not achieve savings as high as those of the previous year, it achieved savings far beyond the target in Ameren's filing. Last year the program achieved, net, 230% of its target energy savings, compared to 161% for 2014.

Table 18. Lighting 2014 Target and Achievement

Metric	MPSC-Approved Target	*Ex Post* Net Savings Determined by EM&V	Percent of Goal Achieved
Energy (MWh)	96,837	155,702	161%
Demand (kW)	2,911	12,287	422%

The program also uses key performance indicators (KPIs) to manage program performance throughout the year. KPIs for 2014 included the following:

- 180 promotional events
- 90% of better of payments to industry within 21 business days

CLEAResult conducted 233 promotional events in 2014. According to CLEAResult staff, they met the payments within 21 days KPI throughout the year, with a low of seven days on average in the first quarter.

Program Management

In 2014, CLEAResult merged with the former implementer, APT. CLEAResult left the management team and operations for the Ameren Missouri Lighting program intact. CLEAResult and Ameren Missouri staff reported no resulting changes in day-to-day operations. The CLEAResult and Ameren Missouri staff have established working relationships, and both organization experienced little to no turnover in the five years that CLEAResult (formerly as APT) has implemented the lighting program. According to both parties, frequent communication occurs, involving scheduled weekly calls and informal calls on an almost daily basis.

Ameren Missouri performed quality control on the program using two methods during the year:

- Ameren Missouri staff reviewed all invoices from CLEAResult against manufacturer records from EFI. This process eventually will be automated through the Vision database that Ameren Missouri has developed to manage efficiency program data.

- Ameren Missouri program staff visited participating store locations with a CLEAResult representative. They reviewed products, signage, and staff awareness of the program. Ameren Missouri staff made three trips to the field, visiting five to six stores during each trip.

In mid-2014, Ameren Missouri launched the Vision database, which it intends will house all of its residential and commercial efficiency program data in one location. Ameren Missouri assigned staff to manage development of the database; these staff consulted closely with program staff. Cadmus and CLEAResult also participated in the database design. The Cadmus team submitted data fields necessary for the evaluation and reviewed several database models. In particular, we requested the price change data necessary to run a demand elasticity model. CLEAResult tested database prototypes, including test submissions of program data. CLEAResult and EFI submitted data using Vision during the year's third and fourth quarter.

Program Marketing

Partner retailers serve as primary outreach channel for the Lighting program. The marketing and outreach efforts, overseen by the program implementer, serve two purposes: (1) educating customers about the availability and benefits of the products; and (2) engaging with market actors to deliver the message.

This program marketing approach remained mostly consistent from 2013 to 2014. The Cadmus team did not conduct a comprehensive marketing review for this evaluation, but did gather some information through staff interviews.

A few new marketing activities took place in 2014. CLEAResult and Ameren Missouri incorporated manufacturer promotions for LEDs into their materials. Ameren Missouri also worked with CLEAResult to send a mailer promoting the online store. Ameren Missouri launched an online banner advertisement for most of the year. The advertisement initially directed customers to the online store, but staff changed it to take customers to the online page explaining the program. Finally, Ameren Missouri offered free shipping for LED "four packs" through the online store. "Four-packs" were four individually packaged bulbs, distributed as a group.

At the end of 2013, CLEAResult produced two new education pieces related to LEDs, which were distributed through in-store promotions during 2014. The materials focused specifically on LEDs and discuss differences between LEDs and other types of efficient lighting, including CFLs.

CLEAResult conducted the following in-store activities in support of the program:

- **In-store promotions:** Approximately two per year for each participating big-box location.
- **In-store meetings:** Periodic meetings to discuss Lighting program details with sales associates and to provide a manual with the certified product list and rebate information.

- **Weekly visits:** Certain big box stores received weekly visits from field representatives, who checked stock levels, prices, and program signage, and who answered questions from store staff members and customers.

Through field representatives, CLEAResult ensured prominent placement of in-store materials in line with industry best practices (regarding messaging, specifications, and placement). CLEAResult also ensured all in-store signage conformed to specific brand guidelines of both retailers and Ameren. Site visits allowed CLEAResult staff to make sure participating stores remained fully stocked and employees understood which bulbs were in the program and the benefits of highly efficient bulbs (so they could explain this to their customers). Representatives also conducted in-store promotions.

Although the number of stores increased from 353 storefront locations to 476 in 2014, CLEAResult added only one field representative, for a total of 10. Part of their ability to maintain their schedule of store visits resulted from several retail locations not participating for the whole of the year. In addition, new locations primarily were discount outlets, which experience a slower product turnover rate and received fewer visits from CLEAResult staff.

As shown in Table 19, CLEAResult conducted 233 promotions in 2014, surpassing its KPI.

Table 19. Promotional Events and Impact

Quarter	Events	Customers Impacted	Retail Sales Associates Impacted
Quarter 1	66	2,754	287
Quarter 2	71	3,388	197
Quarter 3	72	2,020	242
Quarter 4	24	1,213	70
2014	**233**	**9,375**	**796**

Process CSR Summary

Table 20. Summary Responses to CSR Process Evaluation Requirements

CSR Requirement Number	CSR Requirement Description	Summary Response
1	What are the primary market imperfections common to the target market segment?	Customers lack information about energy-efficient lighting options (e.g., the difference in HOU, energy use, lighting quality), and the prices for some energy-efficient bulbs remain much higher than the incandescent baseline.
2	Is the target market segment appropriately defined, or should it be further subdivided or merged with other market segments?	The Lighting market is broadly defined, though the program is moving in the direction of targeting bulbs to new audiences, such as discount-retail shoppers. Recent market research shows younger customers could be a more interested audience.
3	Does the mix of end-use measures included in the program appropriately reflect the diversity of end-use energy service needs and existing end-use technologies within the target market segment?	Yes. The program offers a diversity of products that represent the majority of common consumer lighting needs, including a range of wattages, and specialty bulbs such as dimmables, globes, and reflectors, and LED bulbs. This year the program added occupancy sensors as well.
4	Are the communication channels and delivery mechanisms appropriate for the target market segment?	Retailers report Ameren Missouri signage is effective. New market research indicates greater online activity could effectively target younger customers.
5	What can be done to more effectively overcome the identified market imperfections and to increase the rate of customer acceptance and implementation of each end-use measure included in the program?	Ameren Missouri continues to reach out to more retailers and audiences and to expand the list of eligible measures, but awareness of the program remains low. Ameren Missouri has commissioned market research to identify market segments and should use this information to experiment with new messaging and market channels.

Gross Impact Evaluation Results

Table 21 lists *ex ante* and *ex post* gross program savings by measure for PY14. The comparison includes PY13 realization rates. Realization rates for all measures declined in PY14, largely due to the decline in HOU. Subsequent discussion and tables present details of the gross savings inputs and calculations.

Table 21. PY14 Gross Impact Results Summary

Bulb Type and Wattage	*Ex Ante* Savings/Unit	*Ex Post* Savings/Unit	Realization Rate	
			2014	*2013*
Upstream and Coupon Bulbs				
CFL - 13W	31.5	37.8	120%	*117%*
CFL - 18W	37.4	36.0	96%	*161%*
CFL - 23W	51.2	47.7	93%	*117%*
CFL - High Wattage	113.0	138.7	123%	*153%*
CFL - Specialty	44.1	45.6	103%	*111%*
CFL – Reflector	44.1	39.4	89%	*126%*
LED - 10.5W Downlight E26	54.5	47.8	88%	*111%*
LED - 12W Dimmable	48.0	34.0	71%	*147%*
LED - 15W Flood Light PAR30	35.0	55.0	157%	*n/a*
LED - 18W Flood Light PAR38	32.0	66.8	209%	*n/a*
LED - 8W Globe Light G25	32.0	29.0	91%	*123%*
Occupancy Sensor	217.0	28.4	13%	*17%*
SMD Bulbs				
CFL - 13W	31.5	27.2	86%	*80%*
CFL - 23W	51.2	34.3	67%	*79%*

CFL and LED Gross Savings

To calculate program-level lighting savings from CFLs and LEDs, the Cadmus team summed *ex post* savings, determined from using the following two equations:

Equation 1

$$\Delta kWh_{RES} = \frac{(Watt_{Base} - Watt_{EE}) * \%RES * ISR * (1 - LKG) * (Hours_{RES} * Days * WHF_{RES})}{1{,}000}$$

Equation 2

$$\Delta kWh_{NRES} = \frac{(Watt_{Base} - Watt_{EE}) * (1 - \%RES) * ISR * (1 - LKG) * (Hours_{NRES} * Days * WHF_{NRES})}{1{,}000}$$

Where:

$Watt_{BASE}$	=	Wattage of the original incandescent bulb replaced by program bulb
$Watt_{EE}$	=	Wattage of new bulb installed
LKG	=	Leakage rate (bulbs sold to customers outside Ameren's service area)
%Res	=	Is the percentage of program bulbs installed in residential applications as opposed to nonresidential applications
ISR	=	Installation rate (NRES is assumed to be the same as RES)
$Hours_{RES}$	=	Average HOU per day for bulbs installed in residential applications
$Hours_{NRES}$	=	Average HOU per day for bulbs installed in residential applications
Days	=	Days used per year
WHF_{RES}	=	HVAC interaction factor (adjustments for HVAC interactive effects) for bulbs installed in residential applications
WHF_{NRES}	=	HVAC interaction factor (adjustments for HVAC interactive effects) for bulbs installed in nonresidential applications
1,000	=	Conversion factor between Wh and kWh (Wh/kWh)

Table 22, which summarizes the savings assumptions and their sources, includes notes on how we calculated each value in 2014. The following sections provide additional information on the assumptions used to calculate gross savings.

Table 22. CFL and LED PY14 Savings Assumptions

Data Required	Data Source	Detail on Calculation
$Watts_{EE}$	Tracking database record of actual wattage of program bulbs	Sales-weighted average of the wattages within each measure category.
$Watts_{BASE}$	Lumen-equivalent wattage of standard alternative to the program bulb	Sales-weighted average of the baseline for each wattage within each measure category. Further weighted between an incandescent or regulated baseline by continued availability of incandescent bulbs.
LKG	Store Intercept Study (2013)	Survey results applied to 2014 sales to adjust weighting.
%RES	Store Intercept Study (2013)	Survey results applied to 2014 sales to adjust weighting.
ISR	Home Inventory Study (2013)	Inventory from sample of 172 homes.

Data Required	Data Source	Detail on Calculation
$Hours_{RES}$	Hours of Use Study (2014)	Based on analysis of light meters installed in inventory homes.
$Hours_{NRes}$	Average value for indoor nonresidential spaces, DEER 2008	Based on secondary research.
WHF_{Res}	Engineering simulation modeling	Based on Cadmus modeling analysis in 2013.
WHF_{NRes}	Engineering simulation modeling	Based on Cadmus modeling analysis in 2013.

$Watts_{EE}$ and $Watts_{Base}$

The Cadmus team determined the efficient wattage ($Watts_{EE}$) for each measure category by averaging the wattage of program bulbs within that measure. For example, bulbs sold in the 13W CFL measure category ranged from 9W to 17W. Cadmus determined the baseline wattage ($Watts_{BASE}$) for all measures not impacted by EISA by mapping the efficient wattages to lumen-equivalent incandescent wattages, and then averaging all baseline wattages within the measure category in the same manner applied for the efficient wattage.

For measures impacted by EISA (those that map to an EISA-regulated incandescent bulb), we established baseline wattages according to two scenarios: standard baseline assuming incandescent bulbs available, or EISA-established maximum wattage bulbs. We then used the shelf survey results to blend the two scenarios according to program sales. Table 23 shows the resulting baseline values for each measure category, with TRM values included for comparison. (See the Baseline Wattage Shelf Survey in the Evaluation Methodology section for more detail.)

Table 23. Evaluated Baseline Wattages by Measure Category

Baseline Category	TRM Value	Evaluated Value
$Watts_{BASE}$ (13W)	45.0	53.6
$Watts_{BASE}$ (18W)	56.0	56.0
$Watts_{BASE}$ (23W)	72.0	74.2
$Watts_{BASE}$ (HighWattage)	199.6	197.7
$Watts_{BASE}$ (Reflector)	72.5	64.4
$Watts_{BASE}$ (Specialty)	79.0	55.2
$Watts_{BASE}$ (8 W LED)	40.5	40.0
$Watts_{BASE}$ (10.5 W LED)	65.8	61.4
$Watts_{BASE}$ (12 W LED)	60.7	49.6*
$Watts_{BASE}$ (15 W LED)	50.5	75.0
$Watts_{BASE}$ (18 W LED)	50.5	90.0

* This baseline is lower than the TRM because Cadmus assumed the bulb was a substitute for incandescents under EISA. Stores that sold LEDs typically did not sell incandescents and the baseline was mostly based on halogens.

HOU ($Hours_{Res}$ and $Hours_{Nres}$)

For PY14, Cadmus updated the HOU value used in the residential savings algorithm using the metering study described in the Evaluation Methodology section. Table 24 presents average daily residential HOU for efficient and inefficient medium screw-base (MSB) bulb and specialty bulbs, along with overall, weighted, and average daily HOU. The table also contains the 90% confidence interval and the relative precision.

Table 24. Residential HOU Results Overall and by Technology

Bulb Type	n	HOU	Lower 90% CI	Upper 90% CI	Relative Precision
Overall MSB	1,233	1.6	1.5	1.8	11%
Efficient MSB	517	2.2	1.8	2.6	16%
Inefficient MSB	716	1.2	1.1	1.3	11%
Specialty	393	1.7	1.4	2.0	17%

An overall HOU estimate of 1.6 hours resulted for efficient and inefficient MSB. These estimates fell within the ranges of similar HOU studies of mature upstream lighting programs.

Table 25 lists efficient HOU by room type for efficient lighting along with the number of inventoried and metered bulbs.

Table 25. Residential Efficient HOU Results by Room Type

Room Type	Inventoried	Metered	HOU	Lower 90% CI	Upper 90% CI	Precision
Basement	256	25	2.6	1.1	4.2	59%
Bathroom	319	71	1.6	1.0	2.2	36%
Bedroom	505	98	1.4	1.1	1.7	21%
Closet	110	6	0.8	0.0	1.7	117%
Dining Room	104	32	1.9	1.3	2.5	30%
Garage	87	6	1.4	0.0	3.6	155%
Hall	231	45	1.5	0.7	2.4	53%
Kitchen	228	62	3.9	2.9	4.9	25%
Living Room	228	58	2.5	1.7	3.4	34%
Mechanical	51	5	3.0	0.0	9.5	218%
Office	84	20	1.7	1.1	2.4	38%
Outside	196	33	3.6	2.0	5.2	45%

The room types with highest hours of use are kitchens, outside, and mechanical. Due to the low sample sizes at the room level, there is higher precision around these estimates.

As seen in Figure 5, there is a strong relationship between efficient HOU and CFL saturation. When CFL saturation increases due to program success and unavailability of inefficient substitutes, CFLs are placed in lower use sockets. The equation in Figure 5 visualizes this strong relationship. Over 60% of the change in HOU can be attributed to CFL saturation. Table 26 presents a list of the other HOU studies included in the graph. As some of the studies are not publicly available, we have referenced several generically (e.g., Southwest Utility 1). Not all studies have reported this same correlation, for instance the Northeast Study with 33% saturation has an average HOU of 2.6.

Figure 5. Hours of Use by CFL Saturation

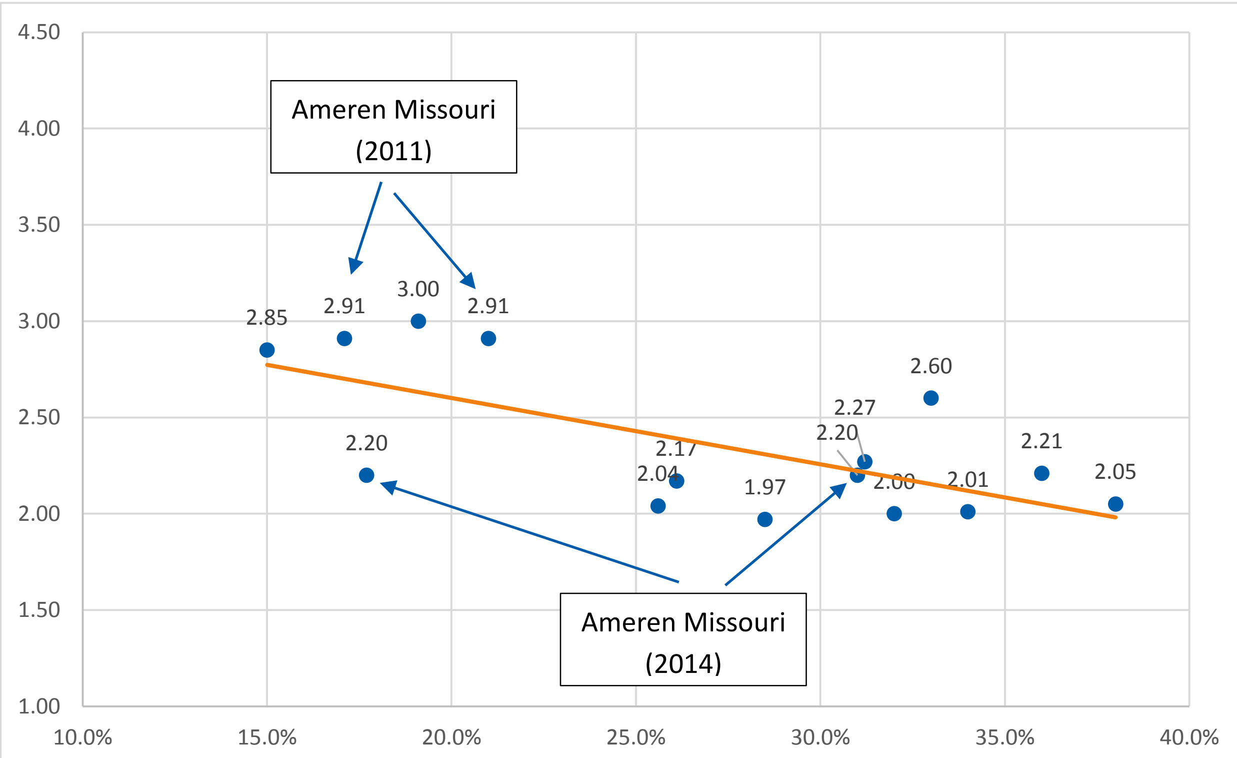


Table 26. Benchmarking CFL HOU and Saturation[11]

Utility	Report Year	CFL Saturation	HOU	Saturation Base
Ameren Missouri	2010	17.1%	2.91	All sockets
Ameren Missouri	2014	17.7%	2.20	All sockets
Ameren Missouri (MSB)	2010	21.0%	2.91	Medium screw base
Ameren Missouri MSB)	2014	31.0%	2.20	Medium screw base
Arkansas Joint Utilities	2013	26.1%	2.17	Not available
Dayton Power & Light	2010	15.0%	2.85	Not available
Efficiency Maine	2012	25.6%	2.04	All sockets
EmPOWER (Maryland)	2012	19.1%	3.00	Not available

[11] Auditor referenced a recent study from the northeast of HOU in 5 states: *Northeast Residential Lighting HOU Study*, NMR, 2014. Because there was no associated saturation data for the HOU estimate, they do not appear in Figure 5.

EmPOWER (Maryland)	2014	32.0%	2.00	Not available
Midwest Utility	2012	28.5%	1.97	Not available
Northeast Utility	2014	33.0%	2.60	All sockets
Southwest Utility 1	2014	36.0%	2.21	Not available
Southwest Utility 2	2014	38.0%	2.05	Not available
Wisconsin Focus on Energy (MF)	2014	34.0%	2.01	All sockets
Wisconsin Focus on Energy (SF)	2014	31.2%	2.27	All sockets

As the study clearly shows lighting usage differed between inefficient and efficient lighting technologies, the Cadmus team applied used 2.2 for residential HOU in the 2014 savings analysis. The value for nonresidential HOU did not change in 2014. This value was based on evaluation research completed as part of the concurrent business evaluation.

Table 27. Change in HOU from 2013 to 2014

Evaluation Year	2014	2013
HOURes	2.2	*2.91*
HOUNRes	8.76	*8.76*

Installation Rate

The ISR value did not change from 2013 to 2014. As shown in Table 28, while 95% of the bulbs are predicted to be installed over time, the net present value of the rate of installation was 94%. This ISR is based on the results of the home inventory survey that the Cadmus team conducted in 2013 (the PY13 Lighting program evaluation provides more detail on this research).

Table 28. Measure Installation

Delivery Channel	Percentage Installed and Operating
Upstream Markdown	94.0%
Coupon	94.0%
SMD	86.7%*

*The first year installation rate was lower for SMD than for the upstream program.

WHFRES and WHFNRes

The waste heat factor (WHF) values did not change for 2014. The Cadmus team used the Lighting program data—average home information from Ameren's 2009 potential study and from an engineering simulation model—to estimate the WHF for residential customers. We also worked with Ameren's nonresidential evaluation contractor to develop the WHF for nonresidential customers. Our analysis resulted in the residential and nonresidential WHFs shown in Table 29. (See the PY13 Lighting program evaluation for more detail.)

Table 29. WHF by Channel

Sector	Delivery Stream	WHF
Residential	Upstream Markdown	0.99
	Coupon	0.99
	SMD*	0.98
Nonresidential	Upstream Markdown and Coupon	1.10

*SMD varies slightly due to a different mix of heating and cooling types

Updates to Leakage and Nonresidential Percentage

In 2013, the Cadmus team conducted an in-store customer survey (known as an intercept survey) to determine the percentage of bulbs purchased through the program and installed outside of Ameren's territory (i.e., leakage). In addition, the survey identified the percentage of bulbs installed in residential versus nonresidential applications. For 2014, we updated leakage (LKG) and percent-residential (%Res) usage by weighting the 2013 store intercept survey results with 2014 sales. Table 30 presents the results of this weighting.

Table 30. Update to 2013 Leakage and Metrics

Value	2014 Rate	2013 Rate
Markdown Leakage	3.9%	3.3%
Percentage Residential	91%	89%

Leakage for coupon stores remains at 0% as customers must provide their Ameren Missouri utility account numbers to receive coupon discounts. We calculated SMD leakage through a survey of SMD participants in 2013. One customer (i.e., 1.3% out of 75) reported not being an Ameren Missouri customer. (Further details on leakage analysis for the Upstream Markdown delivery channel are provided in the PY13 evaluation of the Lighting program.)

Occupancy Sensor Gross Savings

The Cadmus team used the following equation to calculate *ex post* energy savings for occupancy sensors:

$$\Delta kWh = Watt_{est} * HOU * \frac{Days}{Year} * SF/1000$$

Where:

$Watt_{est}$ = Average interior fixture wattage from the PY13 home inventory study.

HOU	=	Daily HOU from PY14 metering study
Days/Year	=	Days per year
SF	=	Savings factor from Ameren Missouri TRM

Using this engineering algorithm, we determined an *ex post* energy savings value of 28.4 kWh/year for each installed occupancy sensor. This value represents approximately 13% of the program's *ex ante* value (217 kWh/year), as based on the Ameren Missouri TRM. The Ameren Missouri value assumed an occupancy sensor would control the entire home. As we established in the PY13 Lighting program evaluation, we find it more realistic to assume a sensor control a fixture, as controlling an entire home would require additional electrical work and multiple sensors.

Net Impact Evaluation Results

The Cadmus team calculated the program's NTG ratio using the following formula:

$$NTG = 1 - Free\ ridership + Non\ Participant\ Like\ Spillover + Nonparticipant\ Non - Like\ Spillover + Market\ Effects$$

We present details of how we arrived at the results for each input in the discussion below.

Free Ridership

The Cadmus team modeled bulb, pricing, and promotional data using an econometric model. The study modeled these data as a panel, with a cross-section of program package quantities modeled over time as a function of prices, promotional events, and retail channels. This involved testing a variety of specifications to ascertain price impacts—the main instrument affected by the program—on bulb demand. We estimated the basic equation for the model as follows (for bulb model i, in period t):

Equation 7

$$\ln(Q_{it}) = \sum_{\pi}(\beta_{\pi} ID_{\pi,\mathrm{i}}) + \sum_{\theta,\delta}(\beta_{\theta 1,\delta 1}[ln(P_{it}) * (Retail\ Channel_{\theta,\mathrm{i}}) * (Bulb\ Type_{\delta})]) + \sum_{\theta,\delta}(\beta_{\theta 2,\delta 2}[\text{Promotional Events}_{it} * (Retail\ Channel_{\theta,\mathrm{i}}) * (Bulb\ Type_{\delta})]) + \alpha Time\ Trend_t + \varepsilon_i + \gamma_t$$

Where:

ln	=	Natural log
Q	=	Quantity of bulb packs sold during the month
P	=	Retail price in that month
Retail Channel	=	Retail category (DIY or non-DIY)
Bulb Type	=	Product category (standard CFL, specialty CFL, or LED)
Promotional Events	=	Number of in-store promotions
ID	=	Dummy variable equaling 1 for each unique retail location and SKU; 0 otherwise
Time Trend	=	Quantitative trend representing the impact of secular trends not related to the program[12]
ε_i	=	Cross-sectional random-error term
γ_t	=	Time-series random-error term

[12] The time trend for this analysis represents shifts in sales due to nonprogram-related seasonality, calculated using normalized sales of program bulbs in the previous year without in-store promotions or price changes.

The model specification assumed a negative binomial distribution, which served as the best fit of the plausible distributions (lognormal, poisson, negative binomial, or gamma).

Data Collection

In PY14, Cadmus and Ameren Missouri continued work with CLEAResult, to provide greater granularity in the data to continue the improvements made in the PY13 demand elasticity model. However, there were some program elements from PY13 for which, due to lack of data, Cadmus was not able to update the estimates in PY14, notably product merchandising.

Price Variation

In PY14, Cadmus used a robust dataset (models with price variability were 38% of general purpose LEDs, 98% of specialty LED bulb sales, and 62% and 68% for specialty and standard CFLs sales, respectively) comparable to PY13 (83% of LED and 75% of specialty CFL sales had varying prices). CLEAResult successfully renegotiated markdown levels for the vast majority of products with most participating retailer's midway through the program year.

Promotional Displays

CLEAResult provided records of product displays collected by its field staff when they visited stores to ensure compliance with contractual agreements negotiated with retailers. The field staff verifies prices, product placements, and shelf signs indicating products included as part of Ameren's Act On Energy program. They also collect data that track whether or not program bulbs have been displayed in prominent, promotional displays (e.g., clip strips, end caps, pallet displays).

Data provided at the storefront level included:

- Retailer name
- Store address
- Date of store visit
- Display type

Though CLEAResult provided these data, Cadmus was not able to incorporate the information into the model as there was insufficient variation in the displays.

Model Adjustments

The Cadmus team ran numerous model scenarios to identify the model with the best parsimony and explanatory power using the following criteria:

- Model coefficient p-values (keeping values less than <0.1);[13]

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13 Where a qualitative variable had many states (such as bulb type), the Cadmus team did not omit variables if one state was not significant. Rather, we considered the joint significance of all states. We used robust

- Explanatory variable cross-correlation (minimizing where possible);
- Model AIC (minimizing between models) [14]; and
- Optimizing model fit.

The Cadmus team adjusted the model for three factors:

- Stocking issues: The model assumed supply would always meet demand; after verifying situations where this did not occur, the Cadmus team dropped a small number of observations from the analysis.
- Seasonality: To account for baseline lighting sales tending to follow a seasonal pattern, unrelated to price or promotion.
- Product Merchandising: To account for the increase in sales due to program products being featured on prominent displays, such as end caps or fence line displays.

The Cadmus team considered an adjustment to the model for brought-in products[15], but ultimately decided not to incorporate the adjustment and therefore the model determined free ridership were applied to stores with brought-in products as well..

Stocking Issues

In preparing to model the sales data, Cadmus observed inexplicable, dramatic sales drops that did not correspond to programmatic activity:

- With a wholesale club, one model appeared to be phased out halfway through the year as it was replaced with the same model in a two-pack. Since both sold concurrently and the single pack had a higher per-bulb price point, sales dropped sharply.
- There were several similar, low volume products at one retailer with considerable product diversity that had sales that fluctuated around zero to five or six packs per month. Because of the low volume and the erratic sales, elasticity estimates were extreme and unreliable. These products accounted for less than 1% of sales for standard CFLs within the retailer and were removed due to their outsize influence on the elasticity estimates given their representativeness of sales.

Cadmus' model implicitly assumed supply would always meet demand at the given price. This proved true for virtually all products in the analysis. However, where stocking issues arose for bulbs, the

estimations of model standard errors to properly represent model accuracy and to guide the specification process. The error structure involved clustering around cross-sectional units and an AR(1) autoregressive term.

14 Akaike's Information Criteria (AIC) was used to assess model fit, as the R-square statistic was undefined for nonlinear models. AIC also provided a desirable property in that it penalized overly complex models, similarly to the adjusted R-square.

15 Brought in products are those in stores that absent the program, would not sell any CFLs or LEDs.

available data precluded separating these effects from the influence of program factors. Therefore, the analysis excluded these bulbs as including these data would bias any elasticity estimates downward.

Seasonality Adjustment

In any economic analysis, it is critical to separate data variations resulting from seasonality from those resulting from relevant external factors. For example, suppose prices had been reduced on umbrellas at the beginning of the rainy season. Any estimate of the impact of this price shift would be skewed if the analysis did not account for the natural seasonality of umbrella sales.

To adjust for seasonal variations in sales, Cadmus used a secular monthly seasonal trend provided by CLEAResult in PY14. This represented national sales from a major lighting products manufacturer. Ideally, a trend would derive from historical data on aggregate sales of lighting products within Ameren's service territory (e.g., inefficient and efficient, program and nonprogram). Such data would represent overall trends in lighting product sales and would not suffer from potential confounding with programmatic activity to the same degree as CFL sales. However, the trend provided represented aggregated, nationwide CFL sales for a specific manufacturer.

Presumably, the trend includes some activity from various programs across the nation which could affect the sales trend, potentially leading to underestimated program impacts. However, we assume that program activity is somewhat random across all of the programs that could be included in the sales data used to develop the trend. In that case, program activity would be spread through the year and the variation between months would be driven primarily by non-program factors. Nevertheless, not controlling for seasonal variations could lead to program impact being overestimated by falsely attributing seasonal trends to price impacts (to the degree that they co-varied), or vice versa.

For example, July tends to be a month with lower sales (presumably due to longer daylight hours) so if program activity increased sales in July not controlling for seasonal variation would underestimate the program's impact. October, on the other hand, is a month with higher sales, and no control for seasonality would likely overestimate the impact of program activity occurring in that month.

Cadmus considered another option to account for seasonality using monthly fixed effects to control for differences between months and compared results to the model using the trend. In the fixed effects case, however, a substantial number of price changes occurred within the same month, and using fixed effects attributed program impacts to monthly averages, therefore misrepresenting the program impacts.

Additionally, Cadmus explored using the trend developed for PY13, derived from sales in PY12 that had no price variation, as well as a model with no seasonal trend. The QIC[16] fit statistics, as well as the lack of

[16] QIC is the Quasilikelihood under the independence model criterion statistic, analogous to Akaike's Information Criterion, used to compare model fit between model specifications when using generalized estimating equation models.

representativeness of the PY12 data for a program with expanded LED offerings, ruled out either of these options.

The trend provided by CLEAResult, given the national aggregation level, covered nonprogram products and areas without programs, therefore limiting the degree that the trend correlated with program activity. Absent a better alternative, Cadmus estimated model and subsequent free ridership ratios using ClearResult's trend.

Promotional Display Data

The tracking data on promotional displays did not include data for every participating storefront in every week of the program. Instead, the data included a sample of stores within a given week (i.e., the stores visited by program circuit riders that week). As a result, some weeks there were no records indicating whether products were displayed. Through consultations with CLEAResult, the Cadmus team verified that the sample listed in the tracking system within a given week reflected stores visited at random.

To enable modeling, Cadmus imputed values for the weeks lacking product display information by assuming the mid-point between the previous observation and the next observation. However, because there were multiple display types at many locations, this resulted in nearly continuous displays at the store locations that were sampled. Since variation is required to model the impact of promotional displays, the display variable nearly always indicating a display was present proved problematic.

In an attempt to address the issue, the Cadmus team considered several options for modeling the displays: as a binary indicator for any display within a location, as a proportion of products within a location, as major (end cap, pallet display, fence line) and minor displays (wing stacks, clip strips, register tips, etc.), as well as each display type separately. None of these produced reliable estimates.

The primary reason for the unreliable results is due to the constant presence of most displays. In addition, the usefulness of the display data is limited because the data do not track which specific products are on display as we have seen in other programs. This additional detail, which we are recommending that CLEAResult collect during PY15, will allow our team to directly associate sales with specific SKUs and thereby avoid using a more generic—and largely consistent—display indicator variable tied to all sales at a given retail location.

Because we found a meaningful impact for promotional displays using more varied data in PY13, but were unable to reliably estimate the omitted variable bias adjustment factor to control for displays in PY14 (with less varied data), we applied the PY13 display bias adjustment to the unadjusted PY14 results.

Brought-In Products

As foreshadowed in the PY13 evaluation report, EISA's continued impacts on the lighting market—most notably the ban on 60W incandescent production in 2014—means that evaluation should no longer deem brought-in efficient lighting products as having 0% free ridership. With the 60W incandescent bulbs less available, all customers have fewer choices for inexpensive, inefficient, substitute products, including those that frequent discount stores. Without an inexpensive substitute and in the program's absence, even dollar store shoppers have to choose between a halogen bulb or a CFL. Given the much smaller price differences between CFLs and halogen bulbs than between traditional incandescent bulbs and CFLs (with program CFLs being less expensive than halogens in most cases), bringing bulbs to a dollar store that would not otherwise stock them would very likely displace sales of other program bulbs for another retailer. As a result, the Cadmus team used our demand elasticity model to estimate sales net of free ridership for these participating stores in PY14.

Findings

Elasticities

Price elasticity of demand measures the percent change in the quantity demanded given a percent change in price. Due to the model's logarithmic functional form, the price elasticity simply represented the coefficients for each price variable. In previous similar analyses, the Cadmus team has seen elasticities range from -1 to -3 for CFLs, meaning a 10% drop in price leads to a 10% to 30% increase in the quantity sold. Early estimates suggested LED demand often proves much more sensitive to price, with elasticities ranging from -4 to -6. However, as LEDs are gaining market acceptance and price is coming down, more recent evaluations around the country have resulted in estimates more similar to CFLs (i.e., between -2 and -3). In short, demand for LEDs is still more sensitive to price, on average, than the demand for CFLs, but not as sensitive as early estimates.

The other factor affecting LED estimates is likely the increasing product diversity. As more products are discounted, we see varying price sensitivity for different types of products.

In addition, the model has a larger sample of cross sections with which to estimate the elasticities for LEDs in PY14 than in PY13, which means the elasticity estimates are less sensitive to a single observation. A cross section is the unique SKU/store location; this is the unit of analysis at which we measure the change in sales that result from changes to price or other program activity.

In PY13, there were five unique products that informed the elasticity estimate. Across all locations, these accounted for 33 of the cross sections. In PY14, there are a total of 20 unique LED products with price variation: 11 general purpose LEDs and nine specialty LEDs. Across all locations, these comprise a total of 242 cross sections to inform the elasticity estimates. This represents nearly an eight-fold increase in data to inform the model.

As shown in Table 31, elasticity estimates largely fell within expected ranges, though elasticities for standard and specialty CFLs are somewhat lower at DIY and Mass market retailers.

Table 31. Elasticity Estimates by Retail Channel and Bulb Type

Store Type	Bulb Type	Elasticity
CLUB	LED BULB	-2.14
CLUB	SPECIALTY LED BULB	-2.30
CLUB	STANDARD CFL BULB	-1.46

CLUB	SPECIALTY CFL BULB	-1.63
DIY	LED BULB	-1.75
DIY	SPECIALTY LED BULB	-1.92
DIY	STANDARD CFL BULB	-0.66
DIY	SPECIALTY CFL BULB	-0.83
MASS	LED BULB	-2.29
MASS	SPECIALTY LED BULB	-2.46
MASS	STANDARD CFL BULB	-0.54
MASS	SPECIALTY CFL BULB	-0.70

Program Price Impacts

Table 32 shows the sales-weighted, average sale price, the original price, and the markdown within the program, broken out by retail channel and bulb type. The table also shows the markdown as a share of the original price, which ranged from 26% to 70%.

Table 32. Mean Prices and Markdown by Retail Channel and Bulb Type

Store Type	Bulb Type	Mean Regular Price/Bulb	Mean Target Price/Bulb	Mean Markdown/ Bulb	% Markdown
CLUB	LED BULB	$10.10	$4.46	$5.64	56%
CLUB	SPEC LED BULB	$14.10	$6.11	$7.98	57%
CLUB	STAN BULB	$1.65	$1.17	$0.48	29%
CLUB	SPEC BULB	$3.44	$1.89	$1.54	45%
DIY	LED BULB	$11.24	$5.23	$6.01	53%
DIY	SPEC LED BULB	$25.71	$7.77	$17.94	70%
DIY	STAN BULB	$1.98	$1.07	$0.90	46%
DIY	SPEC BULB	$4.91	$1.78	$3.13	64%
MASS	LED BULB	$10.01	$4.30	$5.72	57%
MASS	SPEC LED BULB	$15.93	$7.20	$8.73	55%
MASS	STAN BULB	$1.61	$1.19	$0.42	26%
MASS	SPEC BULB	$3.54	$2.11	$1.42	40%

Some notable findings from the table are:

- LED markdowns were greater than 50% within each retail channel while standard CFLs were less than 50% in all retailer channels.
- DIY stores also had the greatest discounts on specialty LED bulbs, likely because the DIY retailers also had the highest price point for specialty LEDs, primarily outdoor flood lamps and reflectors.

- Specialty CFLs had slightly greater markdowns than standard CFLs but slightly higher free ridership, possibly because LEDs were marked down more aggressively to compete with CFLs.

Table 33 shows the final model results. To calculate net savings, the bias-adjusted rates were applied to per-unit savings values for the corresponding measures.[17]

One limitation of applying the PY13 bias adjustment to the PY14 findings is the higher level of LED sales in PY14 (relative to PY13). Due to the low level of LED free ridership in PY13, as well as the smaller number of LEDs incented though the program and therefore fewer featured in merchandising displays during PY13, we do not have a comparable bias adjustment to apply to LEDs as part of the current evaluation.

Because the program incorporated considerably more LEDs into the program in PY14, and some of those LEDs were likely featured in the merchandising displays, the Cadmus team's inability to bias adjust the LEDs' net of free ridership estimate shown below likely overstates actual LED free ridership in PY14. However, because there is no SKU-specific data regarding which products were featured in the merchandising displays, we were not able to estimate LED-specific bias. This resulted in standard CFLs having a lower level of free ridership than LEDs, an uncommon finding. As previously noted, the Cadmus team will work closely with Ameren Missouri and CLEAResult to improve the granularity and variation of promotional data available to support to the PY15 evaluation. This will allow our team to offer increasingly accurate estimation of net savings for the program overall, and between bulb types.

Table 33. Modeling Results

Bulb Type	Bulb Type	Net of FR	Bias Adjusted Net of FR
LED BULB	General Purpose	70%	70%
LED BULB	Specialty	54%	54%
CFL BULB	General Purpose	57%	76%
CFL BULB	Specialty	52%	58%
Overall		**57%**	**75%**

Uncertainty

Once the final model specification had been developed, the Cadmus team calculated "block bootstrap" standard errors to determine the net of free ridership ratios' sensitivity. To develop bootstrap standard errors, the team drew 500 new samples (with replacements drawn at the cross-section level) from the original data, estimating coefficients with each sample, and calculating a new NTG ratio. Using this

[17] The bias adjustment factor is described in the PY13 report (see Appendix I: Model Adjustments Promotional Displays).

method, the 5th and 95th percentiles in these NTG ratios represented the lower and upper bounds of the 90th confidence interval, as shown in Table 34.

Table 34. Bootstrap Standard Errors of Net of Free Ridership Estimates at 90% Confidence

Net of Free Ridership	LCLM (90%)	UCLM (90%)	Average Absolute Precision (90%)
75%	70%	80%	±5%

Nonparticipant Non-Lighting Spillover

Effective program marketing and outreach generates program participation *and* increases general energy-efficiency awareness among customers. The cumulative effect of sustained utility program marketing (which often occurs concurrently for multiple programs) can affect customers' perceptions of their energy usage and, in some cases, motivates customers to take efficiency actions outside of the utility's program. This phenomenon—called nonparticipant spillover (NPSO)—results in energy savings caused by but not rebated through a utility's DSM activity.

This section discusses the Cadmus team's estimate for NPSO from non-lighting measures. The following section discusses spillover from lighting measures.

During PY14, Ameren Missouri spent over $1.53 million dollars to market individual, residential efficiency programs and the portfolio-wide Act on Energy campaign. This amount almost equaled Ameren's PY13 marketing expenditure ($1.55M).

To understand whether Ameren's program-specific and general Act On Energy marketing efforts generated energy-efficiency improvements outside of Ameren's incentive programs, we implemented a general population survey of residential customers in PY13. We will repeat the survey in PY15 to compare differences in awareness and energy-efficiency actions between the first and last year of Ameren's three-year program implementation cycle.

While we did not conduct a similar general population survey in PY14, we believe—given Ameren's continued program activity and comparable marketing expenditures—PY13 survey results can be used to estimate NPSO that probably occurred in PY14.

Methodology

In PY13, the Cadmus team randomly selected and surveyed 401 customers, using Ameren's entire residential customer information system as the sample frame. We determined the sample contained a small number of customers (n=36) self-reporting that they participated in an Ameren Missouri residential program during PY13. When estimating NPSO, we excluded these customers from analysis, focusing on 365 identified nonparticipants; this avoided potential double-counting of program savings and/or program-specific spillover.

We also limited the NPSO analysis to the same efficiency measures rebated through Ameren Missouri programs (known as "like" spillover)—for example, removing a secondary refrigerator and installing a programmable thermostat. We did, however, exclude one notable category of "like" measures: lighting products. This precluded double-counting NPSO lighting savings already captured through the upstream Lighting program market affects analysis.

To ensure the responses included in the analysis represent electric spillover savings, Cadmus asked customers questions about fuel type for water heaters, heating systems, and cooling systems. Only savings associated with measures where there was a corresponding electric water heater, electric heat, or central air conditioning were counted as spillover in the analysis.

To confirm a relationship between Ameren's energy-efficiency programs, the Act On Energy awareness campaign, and actions taken by nonparticipants, the survey addressed nonparticipants' familiarity with Ameren's energy-efficiency programs and Act On Energy. To be included in the NPSO analysis, nonparticipating respondents had to meet the following criteria:

- They were familiar with Ameren's campaign; and
- Ameren's efficiency messaging motivated their purchasing decisions.

Results

Of 365 nonparticipants surveyed, 11 cited Ameren's marketing as "very important" or "somewhat important" in their decisions to purchase non-rebated, high-efficiency measures during 2013:[18]

- Among nonparticipants citing their knowledge of Ameren's energy-efficiency programs or the Act On Energy campaign as very important, we counted *ex post,* gross, per-unit savings, determined through the PY13 evaluation towards the NPSO analysis.
- If nonparticipants reported Ameren Missouri as somewhat important in their decisions, we applied a 50% decrement and applied one-half of *ex post* energy savings for the specified measure.

The analysis excluded nonparticipant responses indicating Ameren's programs or Act On Energy as not very important or not at all important to their efficiency actions.

Table 35 shows measures and PY13 gross evaluated kWh savings attributed to Ameren, with average savings per spillover measure of 242 kWh.

[18] This translates to approximately 3% of the general population, with a range of 90% confidence of 1.54% to 4.49%. Despite the range, the 3% middle point remains the most likely value. With 3% of the population undertaking actions on their own, the sample size of nearly 10,000 surveys would be needed to detect such a level with ±10%—clearly a prohibitive undertaking.

Table 35. NPSO Response Summary

Individual Reported Spillover Measures	Influence of Ameren Missouri Information on Purchase	PY13 Measure Savings (kWh)*	Allocated Savings	Total kWh Savings	Avg kWh Per Spillover Measure
Water Heater	Very	245.7†	100%	245.7	
Central Air Conditioner (CAC)	Somewhat	288*	50%	144.0	
Installed Programmable Thermostat	Somewhat	105†	50%	52.7	
Installed Programmable Thermostat	Somewhat	105†	50%	52.7	
Installed Programmable Thermostat	Somewhat	105†	50%	52.7	
Installed Programmable Thermostat	Somewhat	105†	50%	52.7	
Installed Programmable Thermostat	Somewhat	105†	50%	52.7	
Removed Refrigerator	Very	1,013ˆ	100%	1,013	
Scheduled CAC Tune-Up	Somewhat	993**	50%	496.5	
Water Heat Pipe Wrap	Very	363.8†	100	363.8	
Windows	Somewhat	271***	50%	136	
Total (n=11)				**2,662**	**242**

†Based on savings calculated for the Efficient Products program.

*Assumption used for the HVAC program's gross evaluated savings, based on a 2.5-ton unit rated at 15 SEER, with a baseline of 13 SEER.

ˆBased on savings calculated for the Refrigerator Recycling program.

**Assumption used for the HVAC program's gross evaluated savings, based on a 3-ton unit and a 7.7% efficiency improvement in heating and cooling for condenser cleaning.

***Based on savings calculated for the Home Energy Performance program.

To arrive at a single savings estimate (Variable A in Table 36, below), the Cadmus team used numbers in the Total kWh Savings column to calculate an average for the 11 measures assessed for NPSO. Thus, the estimate of 242 kWh represents average nonparticipant energy savings, per respondent attributing spillover to Ameren's residential programs.

To determine the total NPSO generated by Ameren Missouri marketing in 2013, we used the following variables, shown in Table 36:

- **A** is the average kWh savings per NPSO response.
- **B** is the number of NPSO measures attributed to the program.
- **C** is the number of nonparticipants contacted by the survey implementer.
- **D** is Ameren's total residential customer population.
- **E** is NPSO energy savings, extrapolated to the customer population, and calculated by dividing B by C, and then multiplying the result by A and D.

- **F** is Ameren's total reported 2014 program year *ex ante* gross savings for Refrigerator Recycling, HVAC, Lighting, Home Energy Performance, and Efficient Products. (Similarly to PY13, the PY14 analysis did not include the Low Income and New Homes programs.)[19]
- **G** (representing NPSO as a percentage of total evaluated savings) is the nonparticipant percentage used in the NTG calculations.

Using this information, the Cadmus team estimated overall, portfolio-level NPSO at 3.6% of total PY14 reported *ex ante* gross savings, as shown in Table 36. While, in percentage terms, a larger amount than last year (2.8% in PY13), this NPSO value represents the same number of MWH NPSO savings (7,592); it is only larger due to lower total reported gross savings in PY14. As discussed, the program's marketing expenditure in PY14—the primary driver of NPSO—was nearly identical ($1.55M vs. $1.53M) to PY13.

Table 36. NPSO Analysis

Variable	Metric	Value	Source
A	Average kWh Savings per Spillover Measure	242	Survey Data/Impact Evaluation
B	Number of Like Spillover Nonparticipant Measures	11	Survey data
C	Number Contacted	365	Survey disposition
D	Total Residential Population	1,040,928	Customer database
E	Non-Part SO MWh Savings Applied to Population	7,592	(((B÷C)×A) × D)/1000
F	Total Reported Gross Ex Ante Savings (MWh)	210,530	2014 Program Evaluations
G	NPSO as Percent of Total Evaluated Savings	3.6%	E ÷ F

In some jurisdictions, evaluators apply NPSO as an adjustment at the portfolio-level. Though a reasonable approach, it inherently assumes all programs contribute equally to generating observed NPSO. However, given the significant differences between the programs' marketing tactics and budgets as well as programs' designs and scales, an alternate approach likely produces a better attribution estimate.

The Cadmus team considered the following three approaches for allocating total observed NPSO to individual programs:

1. **Even Allocation**: The most straightforward approach, this allocates NPSO evenly across residential programs (i.e., makes a 3.6% adjustment to each program's NTG). Doing so, however, is the equivalent to applying NPSO at the portfolio-level, which, as noted, assumes all programs contribute equally to generating NPSO.
2. **"Like" Programs:** This approach allocates NPSO savings to specific programs, based on the measure installed by the nonparticipant or by the action they took. For example, one

[19] The Cadmus team excluded the Low Income program and the New Homes program as both exclusively employ very targeted marketing; so marketing for these programs would likely generate little NPSO. For Low Income, the program works directly with property managers of low-income buildings. For New Homes, most program marketing targets regional builders.

nonparticipant reported tuning up their CAC, based on energy-efficiency messaging from Ameren. Using this approach, we would assign NPSO savings associated with an HVAC tune-up.

While this approach establishes a clear connection between a reported NPSO measure and Ameren's program promoting that measure, our research has found this direct measure-program relationship does not prove as straightforward as it appears. Specifically, while our study found all 11 respondents reporting NPSO were familiar with Act on Energy or Ameren's energy-efficiency messaging, only nine could cite specific program names. Further, just over one-half of the customers (six of 11) reporting NPSO measures were unfamiliar with the program or the programs corresponding to the measure they installed. These findings indicated Ameren-generated NPSO through the cumulative effects of various program-specific and portfolio-level marketing efforts. Mapping NPSO measures solely to the program offering that measure could undervalue overall impacts of cumulative and sustained energy-efficiency messaging.

3. **Marketing Budget and Program Size.** The final allocation approach we considered—and eventually chose to use—assigned overall NPSO as a function of each program's marketing and program budget. This approach remains consistent with the theory that NPSO results from the cumulative effect of program-specific and Act On Energy marketing and program activity over a period of time, not necessarily by a single, program-specific marketing effort. In addition, while NPSO most commonly is associated with mass media marketing campaigns, the scale of program activity proves to be a factor. For example, even without a significant marketing campaign, a program's size can drive NPSO through word-of-mouth and in-store program messaging. We find this approach accurately reflects and attributes NPSO to programs, ensuring proper accounting for total costs (including marketing) and total benefits (net savings, including NPSO) when assessing overall program cost-effectiveness.

We distributed the portfolio-level result of 7,592 MWh NPSO to Ameren's residential programs (as explained, excluding Low Income and New Homes). As noted, we considered the PY14 program size (in terms of total gross *ex post* MWh savings) and each program's marketing budget (shown in Table 37) when allocating NPSO across programs.

Table 37. Program-Specific Savings and Marketing

Program	Program *Ex Ante* Gross Savings (MWh)	Percentage of Portfolio Savings	Total Marketing	Percentage of Total Marketing
Refrigerator Recycling	8,176	3.9%	$471,192	30.8%
HVAC	42,214	20.1%	$882,041	57.7%
Lighting	147,749	70.2%	$87,684	5.7%
Home Energy Performance	650	0.3%	$36,627	2.4%
Efficient Products	11,741	5.6%	$50,655	3.3%
Total	**210,530**	**100%**	**$1,528,199**	**100%**

The results of this approach—shown in Table 38 and Table 39—reflected each program's impact on the nonparticipant population, based on marketing expenditures and magnitude of the program's intervention in the regional marketplace.

Table 38. Combined Savings and Marketing Allocation Approach

Program	*Ex Ante* Gross Energy Savings (A)	Marketing Spending (B)	Combined Savings/Marketing (AxB)	Percentage of Combined Savings/Marketing
Refrigerator Recycling	3.9%	30.8%	1.2%	7.0%
HVAC	20.1%	57.7%	11.6%	68.1%
Lighting	70.2%	5.7%	4.0%	23.7%
Home Energy Performance	0.3%	2.4%	0.007%	0.04%
Efficient Products	5.6%	3.3%	0.2%	1.1%
Total	**100%**	**100%**	**17.0%**	**100%**

Analysis credited two programs with the greatest NPSO: HVAC (accounting for over one-half of all marketing dollars) at 5,171 MWh; and Lighting (accounting for 70% of total energy savings) at 1,799 MWh. As NPSO impacts program-specific NTG results,[20] all NPSO estimates have been reported as a percentage of each program's total gross energy savings.

As shown in Table 39, we allocated 147,749 MWh of NPSO to the Lighting program, representing 23.7% of the combined residential portfolio savings and marketing expenditure. This resulted in a 1.2% adjustment to the program's PY14 NTG—findings generally similar to the PY13 NPSO analysis.

Table 39. NPSO by Program

<table>
<tr><th>Program</th><th>Program Gross Savings (MWh)</th><th>Total NPSO (MWh)</th><th>Percentage of Combined Savings/Marketing</th><th>Program-Specific NPSO (MWh)</th><th>NPSO as a Percentage of Gross Savings</th></tr>
<tr><td>Refrigerator Recycling</td><td>8,176</td><td rowspan="5">7,592</td><td>7.0%</td><td>535</td><td>6.5%</td></tr>
<tr><td>HVAC</td><td>42,214</td><td>68.1%</td><td>5,171</td><td>12.3%</td></tr>
<tr><td>Lighting</td><td>147,749</td><td>23.7%</td><td>1,799</td><td>1.2%</td></tr>
<tr><td>Home Energy Performance</td><td>650</td><td>0.04%</td><td>3</td><td>0.5%</td></tr>
<tr><td>Efficient Products</td><td>11,741</td><td>1.1%</td><td>83</td><td>0.7%</td></tr>
<tr><td>Total</td><td>210,530</td><td></td><td>100%</td><td>7,592</td><td>3.6%</td></tr>
</table>

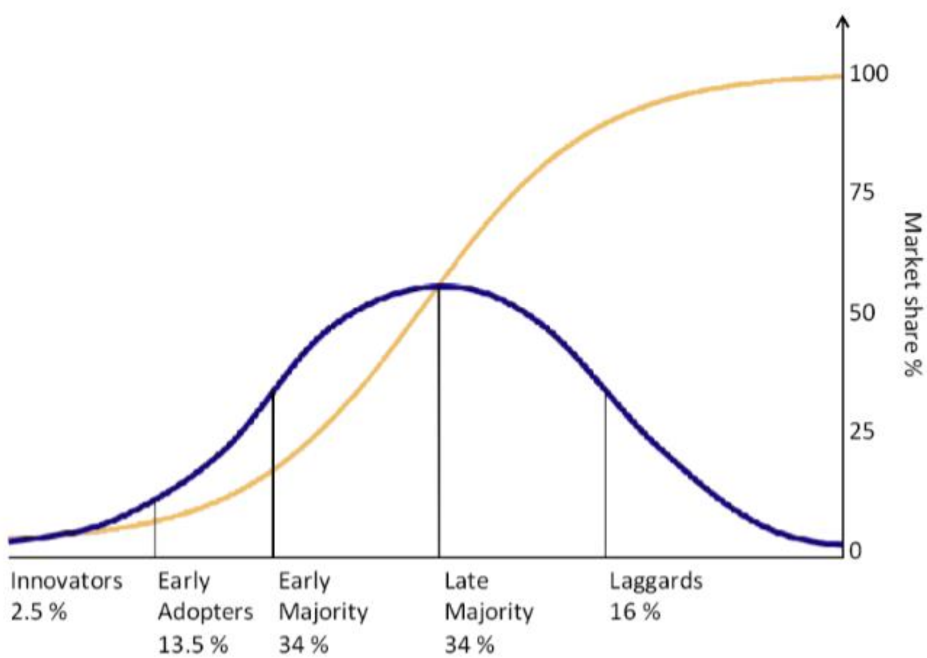
[20] NTG = 1 – Free Ridership + Participant Spillover + NPSO + Market Effects

Nonparticipant Lighting Spillover and Market Effects

In addition to the non-lighting spillover generated through marketing and program outreach on energy efficiency, the Ameren Missouri Lighting program creates energy savings through nonprogram purchases of efficient lightbulbs (lighting spillover), and broader changes to the market for lighting products (i.e., market effects) resulting in increased sales of efficient lighting.

According to product adoption theory developed by Everett Rogers in 1971, different groups of consumers adopt new technologies at different rates, until a product fully saturates a market. Groups range from those most open to change—the "innovators"—to those most sensitive to change—the "laggards." The yellow "S" curve, shown in Figure 6, illustrates the rate at which sales of high-efficiency bulbs can be expected to grow as each group adopts the new technology. The rate of increase in market share decreases over time, but remains positive until the product gains 100% of the market. Added incentives in the marketplace can accelerate the adoption rate by addressing increasing price sensitivity among consumers that have not yet adopted the product. This increase in the expected rate of adoption results from "market effects" caused by the program. The Cadmus team expects the trajectory of market share for efficient bulbs in Missouri to follow a similar path.

Figure 6. Normally Distributed Adoption Classes and Cumulative Adoption Curve



Source: Jeko, Christine. "The Downward Spiral of Compact Fluorescent Lamps in the Pacific Northwest–an Overestimation of the Saturation Point or Natural Fluctuations in the Adoption Path?" Northwest Energy Efficiency Alliance, 2012. http://www.usaee.org/usaee2012/submissions/OnlineProceedings/The%20Downward%20Spiral%20of%20Compact%20Fluorescent%20Lamps%20in%20the%20Pacific%20Northwest_Sept%206.pdf

In PY13, we used results from the home inventory study completed that year to determine the saturation of efficient bulbs in Missouri homes. The saturation value supported an estimate of the total market for efficient bulbs in Ameren's territory, and allowed us to attribute a portion of that market to spillover and the market effects we described above.

The scope of work for PY14 did not include an inventory survey to update the saturation value for PY14. While we did not know the precise rate of adoption or where exactly PY14 consumers sit on the "S" curve, we can reasonably expect market effects greater than zero. At the same time, as the rate of increase in market share decreases over time, program market effects were likely less than in PY13. As we did not have the information to make a more precise estimate, we adopted the midway point of zero and the PY13 market effects value. We applied the same principle to the rate of lighting spillover, taking the mid-point between 0 and the PY13 value. Table 40 shows suggested market effects and spillover values for PY14.

Table 40. Market Effects and Lighting Spillover

Net Impact	PY13 Value	PY14 Value
Market Effects	20%	10%
Lighting Spillover	28%	14%

The Cadmus team will verify lighting saturation in the PY15 home inventory study, adjusting PY15 market effects estimate to reflect any overestimate or underestimation in PY14.

Table 41. Market Effects and Lighting Spillover

Net Impact	Estimated PY13 Value	Proposed PY14 Value
Market Effects	20%	10%
Lighting Spillover	28%	14%

Summary

Table 42, below, presents the program's net energy savings impacts.

Table 42. PY14 Net Impacts Results Summary

Measure	*Ex post* Gross Savings (MWh/year)	Free-ridership	NPSO	Lighting Spillover	Market Effects	NTG	Net Savings (MWh/year)
Markdown							
CFL - 13W	103,569	24%	1%	14%	10%	101%	104,916
CFL - 18W	4,153	24%	1%	14%	10%	101%	4,207
CFL - 23W	21,686	24%	1%	14%	10%	101%	21,968
CFL - High Wattage	541	24%	1%	14%	10%	101%	548
CFL - Reflector	6,958	41%	1%	14%	10%	84%	5,775
CFL - Specialty	5,918	41%	1%	14%	10%	84%	4,912
LED - 10.5W Downlight	6,250	29%	1%	14%	10%	96%	5,925
LED - 12W Dimmable	3,355	29%	1%	14%	10%	96%	3,181
LED - 15W Flood PAR30	135	29%	1%	14%	10%	96%	128
LED - 18W Flood PAR38	399	29%	1%	14%	10%	96%	378
LED - 8W Globe	678	29%	1%	14%	10%	96%	643
Occupancy Sensor	7	N/A	N/A	N/A	N/A	100%	7
SMD							
CFL - 13W	1,613	N/A	N/A	N/A	N/A	100%	1,613
CFL - 23W	1,579	N/A	N/A	N/A	N/A	100%	1,579
Lighting Program	**156,842**						**155,780**

The program exceed its energy and demand targets for the 2014 program year, as shown in Table 43.

Table 43. Lighting Net Savings Impacts

Metric	MPSC-Approved Target[1]	Ex Ante Gross Savings Utility Reported[2]	Ex Post Gross Savings Determined by EM&V[3]	Ex Post Net Savings Determined by EM&V[4]	Percent of Goal Achieved[5]
Energy (MWh)	96,837	186,715	156,842	155,780	161%
Demand (kW)	2,911	12,420	12,358	12,287	422%

[1] http://www.ameren.com/-/media/missouri-site/Files/Rates/UECSheet191EEResidential.pdf

[2] Calculated by applying tracked program activity to TRM savings values.

[3] Calculated by applying tracked program activity to Cadmus' evaluated savings values.

[4] Calculated by multiplying Cadmus' evaluated gross savings and NTG ratio, which accounts for free ridership, participant spillover, nonparticipant spillover, and market effects.

[5] Compares MPSC Approved Target and Ex Post Net Savings Determined by EM&V.

Cost-Effectiveness Results

To analyze the PY14 Lighting program's cost-effectiveness, MMP utilized DSMore and assessed cost-effectiveness using the following five tests, defined by the California Standard Practice Manual:[21]

- Total Resource Cost (TRC) Test
- Utility Cost Test (UCT)
- Ratepayer Impact Measure (RIM)
- Participant Test (PART)
- Societal Test

DSMore took hourly energy prices and hourly energy savings from specific measures installed through the Lighting program and correlated prices and savings to 30 years of historic weather data. Using long-term weather ensured the model captured low-probability but high-consequence weather events and appropriately valued these. Consequently, the model's produced an accurate evaluation of the demand-side efficiency measure relative to other alternative supply options.

Key assumptions included the following:

Table 44. Assumptions and Sources for Cost-effectiveness Analysis

Assumption	Source
Discount Rate = 6.95%	Ameren Missouri MEEIA Filing
Line Losses = 5.72%	Ameren Missouri MEEIA Filing
Summer Peak occurred during the 16th hour of a July day, on average.	Ameren Missouri MEEIA Filing
Avoided Electric T&D = $31.01/kW	Ameren Missouri MEEIA Filing
Escalation rates for different costs occurred at the component level, with separate escalation rates for fuel, capacity, generation, transmission and distribution, and customer rates carried out over 25 years.	Ameren Missouri MEEIA Filing

In addition, MMP utilized the "Batch Tools" (model inputs) used by Ameren in its original analysis as input into the *ex post* DSMore analysis. By starting with the original DSMore Batch Tool used by Ameren Missouri and modifying it solely with new data from the evaluation (e.g., PY14-specific Lighting participation counts, per-unit gross savings, and NTG) ensured consistency. Particularly, model assumptions were driven by measure load shapes, which told the model when to apply savings during the day. This ensured the load shape for an end-use matched the system peak impacts of that end use and provided the correct summer coincident savings. MMP used measure lifetime assumptions and

[21] *California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects.* October 2001.

incremental costs based on the following: the program's database, the Ameren Missouri TRM, or the original Batch Tool.

A key step in the analysis process required acquiring PY14 Ameren Missouri program spending data: actual spending, broken down into implementation, incentives, and administration costs. MMP applied these numbers at the program level, not the measure level. While applying incentives at the measure level can be useful for planning purposes, it proves unnecessary for cost-effectiveness modeling as results are based on a program overall.

As determined through a consensus-building process with stakeholders, all the cost-effectiveness results shown include the program's share of portfolio-level or indirect costs. Each program's share of these costs was determined using the present value of each program's UCT lifetime benefits (i.e., the present value of avoided generation costs as well as deferral of capacity capital and transmission and distribution capital costs). The residential portfolio summary report discusses this in greater detail.

Table 45 summarizes the cost-effectiveness findings by test. Any benefit/cost score above 1.0 indicates the present value of the program's benefits is greater than the present value of its costs. In addition, the table includes the net present value (in 2013 dollars) of the UCT net lifetime benefits (net avoided costs minus program costs). As shown, the Lighting program passed the TRC, UCT, PART, and Societal TRC tests and generated more than $42M in UCT net lifetime benefits.

Table 45. Cost-Effectiveness Results (PY14)

	UCT	TRC	RIM	Societal	PART	UCT Net Lifetime Benefits
Lighting	5.86	3.74	0.58	4.45	7.57	$42,191,125

Appendix A. *Ex Post* Demand Reductions

MMP determined *ex post* demand reductions using the *ex post* energy savings estimated through this PY14 report and through DSMore (using load shapes provided by Ameren).

Table 46. PY14 Summary: *Ex Post* Net Per-Unit Demand Reductions

Measure	PY14 Participation	Per-Unit Net *Ex Post* Demand Reduction (kW)	Total Net *Ex Post* Savings (kW)*
CFL - 13W (60W incand equiv)	2,740,188	0.0029	8,351.7
CFL - 18W (75W incand equiv)	115,408	0.0026	320.6
CFL - 23W (100W incand equiv)	455,045	0.0036	1,748.9
CFL - High Wattage Bulbs	3,901	0.0105	43.6
CFL - Reflector	152,478	0.0035	466.8
CFL - Specialty Bulbs	150,370	0.0030	396.9
LED - 10.5W Downlight E26	130,689	0.0036	479.1
LED - 12W Dimmable	98,542	0.0026	257.1
LED - 15W Flood Light PAR30 Bulb	2,455	0.0021	5.2
LED - 18W Flood Light PAR38 Bulb	5,968	0.0051	30.6
LED - 8W Globe Light G25	23,377	0.0022	52.0
Occupancy Sensor	248	0.0014	0.4
SMD -13W (60W incand equiv)	59,324	0.0011	67.9
SMD - 23W (100W incand equiv)	46,036	0.0014	66.4
Total	**3,984,029**		**12,287**

*Accounts for line losses

Appendix B. Lumen-Equivalent Wattage

Cadmus mapped the wattage of each markdown bulb sold to the lumen-equivalent incandescent wattage in order to determine the wattage baseline under the incandescent scenario. Lumen-equivalent wattages are shown in Table 47 and Table 48.

Table 47. CFL Wattage Mapping

CFL Wattage	Lumen-Equivalent	CFL Wattage	Lumen-Equivalent
3	15	20	53
5	20	22	53
7	25	23	72
9	40	24	72
10	40	24	72
11	40	25	72
12	40	26	72
12	40	27	72
13	60	28	150
14	60	29	150
15	60	32	150
16	60	33	150
17	60	40	150
18	53	42	150
19	53	55	250

Table 48. LED Wattage Mapping

LED Wattage	Lumen-Equivalent Incandescent Wattage
8	40
10	40
11	60
12	60
13	60
14	75

Appendix C. Ameren Missouri Lighting Program Stakeholder Interview Guide (PY14)

Respondent name: ____

Respondent phone: ____

Interview date:______________________________________ Interviewer initials: _________________

This interview is to assess how well the program processes and implementation are working to achieve the goals of the program. The guide is particularly focused on any changes in how the program is performing relative to PY13.

Roles and Responsibilities

1. Has anything changed in terms of roles or responsibilities with relation to the lighting program?
2. How many field representatives are employed this year? [NOTE – last year there were nine. This year there are an additional 100 store locations in the markdown program.] How are their territories defined? What are their specific responsibilities?
3. Has Ameren Missouri/CLEAResult added or reduced staffing in any way for PY14?
4. Describe communication between Ameren and CLEAResult. Do you have regularly scheduled meetings? Is there informal or impromptu communication?
5. [AMEREN] Do you have any direct communication with EFI?
6. Have there been any issues with communication over the year? How were these resolved?
7. Please list and describe the reports that CLEAResult sends to Ameren, and other methods of sharing data.
8. Have there been any problems with data tracking or reporting this year? [PROBE: Data into Vision.] How were these resolved?
9. Does data tracking take up a large amount of time for the program managers or staff?
10. Are you planning on any improvements in management systems (forms, data tracking, communication, etc.) for next year? What are they?
11. What quality control measures did Ameren Missouri implement in PY14? Did Ameren Missouri perform any ride-alongs or independent quality control checks? Please explain.

Program Goals

What are the program's participation and savings goals for PY14? [Participation breakdown numbers – CLEAResult only]

Target	PY13 (Actual)	PY14 (Goal)	PY13 (Actual)	PY13 (Goal)
	Participation		MWh	
Overall	4.1 M	2.5 M (MEEIA filing	227,132 (Ex-Post gross)	96,837 (MEEIA filing)
Standard CFLs	3.1 M			
Specialty CFLs	320,349			
LEDS	13,363			
Controls	1,600			
SMD	651,744 (15% of total)			

1. How is the program doing relative to these goals? Have sales been at the level you expected throughout the year?
2. In terms of overall program sales, did you expect any differences from the previous year? What did you expect to be different and why? Did this impact what products were rebated in any way, or the level of incentives?
3. Does the program have any process or non-impact goals for PY14? (Probe: increased awareness, inclusion of rural areas/smaller retailers)? How are these determined?
4. How is the program doing relative to these non-impact goals?
5. Are there monthly or quarterly benchmarks in place to monitor progress throughout the year? What do you do if a goal is missed?

Program Design and Implementation

1. Did any new retailers join the program this year, or did any existing retailers expand their participation? [If yes] In your opinion, what attracted the retailers this year? Do you anticipate that all retailers will continue to participate next year? [Probe: Ask about specific retailers – see below. Also, LEDs in dollar stores, grocery?)
2. Did any retailers other than Big Lots not renew their MOU? [If yes] In your opinion, what concerned them about continuing with the program?
3. [AMEREN ONLY] Did you have any direct contact with participating retailers? Can you describe any feedback you received from them?
4. Was there any effort to expand the coupon portion of the program this year? [If yes] What was the result of that effort?

5. Did any retailers transition from the coupon system to the POP system? Is there any plan in place to assist coupon retailers to move to the markdown system?
6. What is your vision for the future of the coupon system?
7. Describe how the SMD program was implemented in 2014. Were there any changes from last year? What portion of the program was implemented as a distribution program at the food banks, versus a door-to-door program.
8. How do you ensure that different customers are receiving SMD bulbs each year?

Measures

1. How does the number of models of CFLs compare this year with the previous year? What about LEDs? Are you seeing increased or decreased consumer interest in different wattages or types of bulbs? (i.e., want more lumens, dimmables, etc.)
2. I noticed LED sales have been really strong this year. What drove LED sales, in your opinion?
3. Occupancy sensors sales were very low this year. Why is that? Will sensors continue to play a role in the program? [Note: OS has a realization rate of 17% in 2013 due to an error in the TRM.]
4. How were incentive amounts determined?
5. Does the schedule for evaluating saturation, installation rates, leakage, or other factors have any impact on the measure mix or incentive levels chosen for the program year? Is CLEAResult aware of this schedule?
6. Do you anticipate any major changes to the measure mix (any products in or out) or incentive levels in the coming year, for any products? [PROBE: LEDs in discount or SMD? Controls?]
7. What barriers do you see impacting the program in the coming years? Is there a plan for overcoming these barriers? [PROBE: EISA phasing in, increased saturation]

Marketing Efforts

1. Are you using any different marketing techniques in 2014? Have you added or discontinued anything, either in store or otherwise?
2. Have you changed the frequency or focus on any particular techniques (i.e., end-cap displays, wingtip displays, online/social media ads, in-store promotions?)
3. Please describe your approach to retailer education. Is there anything new or different from previous years, in terms of content or delivery?
4. Have you changed any of the messaging or educational materials or approaches for 2014? (Probe – to increase replacement of incandescents with CFLs/LEDs, or install in more high-use locations, or promote occupancy sensors)
5. Are you doing anything to evaluate the impact of particular marketing techniques, either in store or out of store?
6. Have you done any research around the messaging for marketing these products?
7. Have you differentiated your marketing for different product types?

8. What do you think have been the most influential program or market factors to attract program participation, either from retailers or from customers, this year?

Recommendations

1. How have 2013 evaluation recommendations to implementation been addressed (if not already discussed):
2. Update the TRM to better align ex ante and ex post gross savings: account for leakage, nonresidential purchases, installation rates less than 100%, and continued availability of EISA-impacted bulbs [NOTE: Cannot update until 2016]
3. Maintain mix of rural and urban stores, encourage nonresidential purchases at national-chain retailers
4. Encourage customers to replace incandescent bulbs immediately
5. Perform additional analysis using the demand elasticity model and work with CLEAResult to conduct natural experiments to optimize program offerings, promotions, product placements, and incentive levels
6. Continue to work with retailers to vary prices and promotions.
7. CLEAResult should streamline and combine its current reporting into one overall online tracking system.
8. Continue to offer a wide mix of efficient lighting types (as saturations increase)
9. Continue to work with retailers to maintain a wide variety of available energy-efficient products (as halogens increase market share, and EISA-impacted products decline)
10. Were these recommendations helpful? Why or why not?
11. How could evaluation recommendations be more helpful to you this year? Is there anything in particular you would like the evaluation to address?

Summary

1. Were there any major changes to the program design between PY13 and PY14 that we have not discussed? If yes, what were they and what was the impetus for the change?
2. What would you say is working particularly well so far in PY13? Why is that?
3. Conversely, what is not working as well as anticipated? Why is that?
4. From your perspective, what are the biggest challenges facing the program in PY13?
5. Is there anything else you'd like us to know about your experience administrating/implementing the program so far this year?
6. Cadmus is reaching out to program stakeholders earlier in the year for PY13 to figure out how each stakeholder group can best benefit from the program evaluation process. Is there anything specific you were hoping to learn from this evaluation?
7. Is there anything else you would like us to know?

Appendix D. Demand Elasticity Model Outputs

The Cadmus team ran numerous model scenarios to identify the model with the best parsimony and explanatory power using the following criteria:

- Model coefficient p-values (keeping values less than <0.1, see Table 51);[22]
- Explanatory variable cross-correlation (minimizing where possible);
- Model QIC (minimizing between models, see Table 52);[23]
- Minimizing multicollinearity; and
- Optimizing model fit.

The following tables are the output statistics and information generated by the final model.

Table 49. GEE Model Information

Model Information	
Data Set	WORK.FINALMODELDATA
Distribution	Negative Binomial
Link Function	Log
Dependent Variable	MonthlyPackSales
Number of Observations Read	17249
Number of Observations Used	15991
Number of Invalid Responses	99
Missing Values	1159

22 Where a qualitative variable had many states (such as bulb type), the Cadmus team did not omit variables if one of the states was not significant, but rather considered the joint significance of all states. The team used robust estimation of model standard errors to properly represent model accuracy and to guide the specification process.

23 Quasi Information Criteria (QIC) was used to assess model fit, as the R-square statistic is undefined for nonlinear models. QIC also has the desirable property that it penalizes overly complex models, similar to the adjusted R-square.

Table 50. Model Classification Variable Levels

Class Level Information		
Class	Levels	Values
id	2,006	BP4BATTERIES PLUS #268CFL10115A BP4BATTERIES PLUS #268CFL10466A BP4BATTERIES PLUS #268CFL10469A BP4BATTERIES PLUS #268CFL10470A BP4BATTERIES PLUS #268CFL10471A BP4BATTERIES PLUS #268CFL10472A BP4BATTERIES PLUS #268CFL10490A ...
Channel	3	CLUB DIY MASS
style	3	LED BULB SPEC BULB STAN BULB
CFL	2	0 1

Table 51. GEE Parameter Estimates with Empirical Standard Errors

Parm	Retail Channel	CFL Dummy	Estimate	Stderr	LowerCL	UpperCL	Z	ProbZ
Intercept		-	0.00	0.00	0.00	0.00	0.00	0.00
LogPromo*Channel*CFL	CLUB	0	-2.14	0.31	-2.75	-1.53	-6.87	0.00
LogPromo*Channel*CFL	CLUB	1	-1.47	0.09	-1.65	-1.29	-15.81	0.00
LogPromo*Channel*CFL	DIY	0	-1.76	0.20	-2.16	-1.36	-8.60	0.00
LogPromo*Channel*CFL	DIY	1	-0.67	0.06	-0.78	-0.55	-11.08	0.00
LogPromo*Channel*CFL	MASS	0	-2.30	0.22	-2.73	-1.86	-10.41	0.00
LogPromo*Channel*CFL	MASS	1	-0.54	0.05	-0.64	-0.45	-11.03	0.00
LogPromoPr*Specialty		-	-0.17	0.08	-0.32	-0.01	-2.06	0.04
Trend		-	0.16	0.02	0.12	0.20	8.03	0.00

Table 52. GEE QIC Fit Criteria

Criterion	Value
QIC	-4326371.74
QICu	-4322372.64

Appendix E. *Bibliography*

California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects. October 2001.

U.S. Department of Energy. *Uniform Methods Project for Determining Energy Efficiency Program Savings.* Available online at: http://www1.eere.energy.gov/office_eere/de_ump.html