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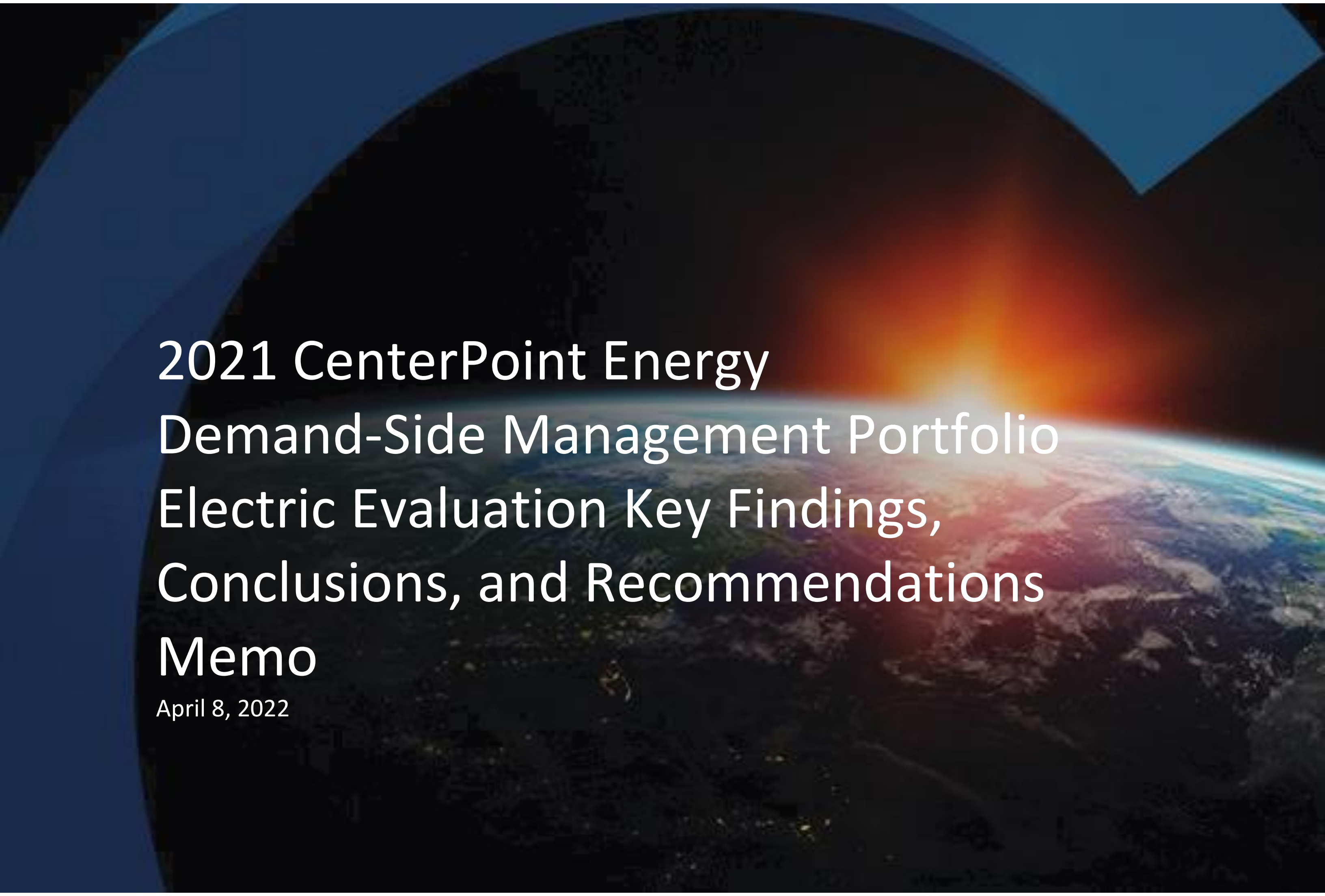

2021 CenterPoint Energy Demand-Side Management Portfolio Electric Evaluation Key Findings, Conclusions, and Recommendations Memo

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Prepared for:

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Impact Evaluation Link

Market Performance Indicators Link

Acronyms

Acronym	Definition
ACS	American Community Survey
AFUE	Annual fuel utilization efficiency
AHRI	Air Conditioning, Heating, & Refrigeration Institute
AMI	Advanced metering infrastructure
ASHP	Air source heat pump
BTUH	British thermal units per hour
BYOT	Bring Your Own Thermostat
C&I	Commercial and industrial
CAC	Central air conditioner
CADR	Clean air delivery rate
CDD	Cooling degree days
CLSD	Calibrated DSMore Load-Shape Differences
CEF	Combined energy factor
CF	Coincidence factor
CFL	Compact fluorescent lamp
CFM	Cubic feet per minute
COP	Coefficient of performance
CVR	Conservation voltage reduction
DHP	Ductless heat pump
DHW	Domestic hot water
DK/RF	Don't know/refused
DOE	U.S. Department of Energy
DSF	Demand savings factor
DSM	Demand-side management
ECM	Electronically commutated motor
EER	Energy efficiency ratio
EES Program	Energy Efficient Schools Program
EFLH	Equivalent full load hours
EISA	Energy Security and Independence Act of 2007
ERI	Energy Rating Index
ESF	Energy saving factor
EUL	Effective useful life
FLH	Full load hours
FPL	Federal poverty level
GSL	General service LED
HDD	Heating degree days
HEA Program	Home Energy Assessment Program
HER	Home energy report

Acronym	Definition
HERS	Home Energy Rating System
HEW	Home Energy Worksheet
HOU	Hours of use
hp	Horsepower
HSPF	Heating seasonal performance factor
IHCDA	Indiana Housing and Community Authority
IMEF	Integrated modified energy factor
IQW Program	Income Qualified Weatherization Program
IPLV	Integrated part load value
IRC	Indiana Residential Code
ISR	In-service rate
IWF	Integrated water factor
kBtu	Kilowatt per British thermal unit
kBtuh	Kilowatt per British thermal unit per hour
KPI	Key performance indicator
kSF	Thousand square feet
Kw	Kilowatt
kWh	Kilowatt per hour
LED	Light-emitting diode
MMBTU	One million British thermal units
MFDI Program	Multifamily Direct Install Program
NEF	National Energy Foundation
NTG	Net to gross
OLS	Ordinary least square
QA/QC	Quality assurance/quality control
RBS Program	Residential Behavioral Savings Program
RECS	Residential Energy Consumption Survey
RESNET	Residential Energy Services Network
RNC Program	Residential New Construction Program
SBES Program	Small Business Energy Solutions Program
SEER	Seasonal energy efficiency ratio
SKU	Stock keeping unit
TMY3	Typical meteorological year
TRM	Technical reference manual
UMP	Uniform Methods Project
VFD	Variable frequency drive
VVO	Volt/var optimization
WHF	Waste heat factor

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Executive Summary

CenterPoint Energy in Indiana has a demand-side management (DSM) portfolio containing 14 programs, 11 of which contribute electric energy savings and demand reductions to the portfolio.[1] CenterPoint Energy administers the portfolio in conjunction with several third-party implementers. The programs serve the residential, income-qualified, multifamily, commercial, and industrial sectors.

CenterPoint Energy tasked Cadmus with evaluating its 2021 DSM programs, which involved conducting process and impact evaluations and a market performance indicator assessment for the programs:

- Through the ***process evaluation***, Cadmus examined the program from the perspective of customers, trade allies, and program staff and sought to determine the aspects of the program that worked well, areas that may need improvement, and recommendations to refine the program.
- Through the ***impact evaluation***, Cadmus verified measure installation, determined freeridership and spillover (net-to-gross [NTG] ratio), and reviewed deemed savings and assumptions. Cadmus calculated electric impacts for all programs and measures.
- To assess ***market performance indicators,*** Cadmus reviewed and updated logic models to map each program's activities and established key performance indicators (KPIs) to track market trends over time.

This memo provides the key findings, conclusions, and recommendations of Cadmus' evaluation of CenterPoint Energy's 2021 DSM electric portfolio.[2] Full impact evaluation and market performance indicator analysis results are contained in the online CenterPoint Energy evaluation dashboard.

Table 1 shows the evaluation tasks completed for each of CenterPoint Energy's programs.

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1 The Targeted Income, Energy Efficient Schools, and Multifamily Direct Install programs contribute natural gas savings only.

2 Natural gas impacts are reported separately in the *2021 CenterPoint Energy Demand-Side Management Portfolio Natural Gas Evaluation Key Findings, Conclusions, and Recommendations Memo.*

Table 1. 2021 Evaluation Tasks by Program

Program	Process Evaluation	Impact Evaluation	Market Performance Indicators
Residential Programs			
Residential Specialty Lighting	✓	✓	✓
Residential Prescriptive	✓	✓	✓
Residential New Construction	✓	✓	✓
Residential Midstream Pilot	✓	✓	✓
Income Qualified Weatherization	✓	✓	✓
Residential Behavioral Savings	✓	✓	✓
Smart Cycle	✓	✓	
Appliance Recycling	✓	✓	✓
Community Based LED Specialty Bulb Distribution	✓	✓	✓
Commercial and Industrial Programs			
C&I Prescriptive	✓	✓	✓
C&I Custom	✓	✓	✓
Small Business Energy Solutions	✓	✓	✓

Portfolio-Level Impacts

Table 2 and Table 3 present the electric savings and demand reduction achieved by the 2021 CenterPoint Energy DSM Portfolio.[3] Overall, the portfolio achieved 30,601,326 kWh of evaluated, net electric savings and 7,502 kW evaluated, net demand reduction.

Table 2. 2021 CenterPoint Energy DSM Program Portfolio Electric Savings[1]

Program	*Ex Ante* Savings (kWh)			Evaluated *Ex Post* Savings (kWh)	Realization Rate (kWh)	NTG Ratio	Evaluated Net Savings (kWh)	Net Savings Goal (kWh)	Percent Net Savings Goal Achieved
	Reported	Audited	Verified						
Residential Programs									
Residential Specialty Lighting	6,646,639	6,646,639	5,915,509	5,861,368	88%	35%	2,062,730	2,902,472	71%
Residential Prescriptive	3,366,090	3,447,472	3,388,204	3,371,863	100%	58%	1,955,763	2,751,327	71%
Residential New Construction	373,827	373,827	373,827	144,301	39%	57%	82,251	174,593	47%
Income Qualified Weatherization	434,820	435,558	433,279	374,823	86%	100%	374,823	378,931	99%
Residential Behavioral Savings	7,718,618	7,718,618	7,718,618	7,089,988	92%	100%	7,089,988	7,020,000	101%
Appliance Recycling	1,438,561	1,438,561	1,438,561	1,376,142	96%	52%	710,771	904,475	79%
Smart Cycle	89,391	88,409	87,348	90,238	101%	94%	85,073	245,579	35%
Community Based LED Specialty Bulb Distribution	1,997,113	1,997,113	1,342,714	1,410,282	71%	91%	1,278,861	1,159,239	110%
Commercial and Industrial Programs									
C&I Prescriptive	12,714,310	12,714,310	12,714,310	13,038,378	103%	76%	9,909,167	12,569,662	79%
C&I Custom	1,714,556	1,714,556	1,714,556	1,714,556	100%	93%	1,594,537	4,675,000	34%
Small Business Energy Solutions	5,196,177	5,196,177	5,196,177	5,426,531	104%	88%	4,775,347	4,040,000	118%
Total	**41,690,102**	**41,771,240**	**40,323,103**	**39,898,470**	**96%**	**75%**	**29,919,313**	**36,821,277**	**81%**
Nonparticipant Spillover	N/A	N/A	N/A	N/A	N/A	5%	682,013	N/A	N/A
Total Adjusted Portfolio	**41,690,102**	**41,771,240**	**40,323,103**	**39,898,470**	**96%**	**77%**	**30,601,326**	**36,821,277**	**83%**

[1] Nonparticipant Spillover is included as informational only and is not included in CenterPoint Energy Lost Revenues and Performance Incentive calculations.

[3] Reported *ex ante* electric and demand savings are derived from CenterPoint Energy's 2021 Electric DSM scorecard.

Table 3. 2021 CenterPoint Energy DSM Program Portfolio Demand Reduction

Program	*Ex Ante* Savings (Coincident Peak kW)			Evaluated *Ex Post* Savings (Coincident Peak kW)	Realization Rate (Coincident Peak kW)[1]	NTG Ratio	Evaluated Net Savings (Coincident Peak kW)	Net Savings Goal (Coincident Peak kW)	Percent Net Savings Goal Achieved
	Reported	Audited	Verified						
Residential Programs[1]									
Residential Specialty Lighting	924	959	853	808	87%	35%	284	401	71%
Residential Prescriptive	2,129	2,652	2,609	1,658	78%	60%	993	1,495	66%
Residential New Construction	148	181	181	57	39%	57%	33	65	50%
Income Qualified Weatherization	145	67	67	56	39%	100%	56	112	50%
Residential Behavioral Savings	1,350	1,350	1,350	1,431	106%	100%	1,431	1,350	106%
Appliance Recycling	151	151	151	214	141%	54%	116	95	122%
Smart Cycle	200	198	196	0	0%	94%	0	550	0%
Community Based LED Specialty Bulb Distribution	322	321	221	167	52%	91%	153	161	95%
Commercial and Industrial Programs									
C&I Prescriptive	2,541	2,541	2,541	3,757	148%	76%	2,856	2,369	121%
C&I Custom	376	376	376	376	100%	93%	349	578	60%
Small Business Energy Solutions	632	1,189	1,189	1,225	194%	88%	1,078	450	240%
Total	**8,918**	**9,984**	**9,733**	**9,750**	**109%**	**75%**	**7,349**	**7,626**	**96%**
Nonparticipant Spillover	N/A	N/A	N/A	N/A	N/A	5%	153	N/A	N/A
Total Adjusted Portfolio	**8,918**	**9,984**	**9,733**	**9,750**	**109%**	**77%**	**7,502**	**7,626**	**98%**

[1] CenterPoint Energy forecasts demand reductions using a program average for the residential portfolio. Because forecasting is at the program level rather than the measure level, kW realization rates are expected to fluctuate more than energy realization rates (kWh). CenterPoint Energy uses evaluated kW for planning purposes only.

Summary of Recommendations

Based on the findings from the 2021 evaluation, Cadmus proposed several recommendations to enhance CenterPoint Energy's DSM portfolio.

Table 4. 2021 Program Recommendations

Program	Recommendations
Residential Programs	
Residential Specialty Lighting	Monitor the DOE's EISA outcome and incorporate effective changes in program design. Review inclusion of specialty and reflector LEDs as part of the upcoming Indiana Technical Reference Manual (TRM) update process to provide guidance for any future savings for these measures in upstream programs.
Residential Prescriptive	• Increase communication with contractors about the Midstream channel. Share information including program updates, measure lists, and promotional materials for Midstream channel measures directly with contractors. • To improve performance tracking at the channel level, report measures in the scorecard by delivery channel. For Online Marketplace, align naming conventions between the program tracking data and the scorecard to allow accurate comparisons. • To improve the accuracy of reported savings and increase realization rates, report channel- or measure-specific kW demand savings in the scorecard. • Consider offering an early replacement measure for electronically commutated motor (ECM) furnace fans. Applications could confirm the state of the equipment, if it can be considered early replacement, and if the applicant is a CenterPoint Energy electric customer. Advocate for review of savings for early replacement of ECM furnace fans as part of the upcoming Indiana Technical Reference Manual (TRM) update process to provide guidance for adding this measure to the Residential Prescriptive Program • On the clothes washer rebate application, collect clothes dryer and water heater fuel type to claim the appropriate electric or gas savings associated with these additional end uses. • The implementer should validate customer eligibility to receive incentives in the Online Marketplace, which will ensure CenterPoint Energy achieves accurate savings for measures it promotes through this channel. For each measure, consider limiting the quantity per customer to a reasonable amount for single-family home use.
Residential New Construction	The 2020 Indiana Residential Code (IRC) increased the efficiency of the baseline for the Residential New Construction Program. As a result of these lower program energy savings, this program will be discontinued at the end of 2021, except where carryover rebates are paid in 2022 for projects completed in 2021.
Income Qualified Weatherization	To increase the accuracy of savings for Whole Home projects, the implementer should provide more thorough documentation and descriptions of each project.
Residential Behavioral Savings	Electric only wave savings should be monitored to see if the unusually low savings were a random occurrence or could be due to some other factor, including the new report design.
Appliance Recycling	Though savings will inevitably decline over time, monitor the effects of promotions like the Oldest Fridge Contest on participation from customers with older appliances.

Program	Recommendations
Smart Cycle	• Increase focus on the Bring Your Own Thermostat (BYOT) program vendor's EnergyHub to further encourage participation across BYOT and Smart Cycle programs. Increase the variety of creative and engaging marketing campaigns such as "Be Smart, Be a Genius" to promote program awareness and participation. • For planning purposes, assume no coincident peak demand savings for normal use of smart thermostats until the new Indiana TRM is released and provides updated guidance. During the Indiana TRM update process, encourage discussion of peak demand savings for smart thermostats.
Community Based LED Specialty Bulb Distribution	• Consider revising the survey administration process to prominently display a quick response (QR) code and survey link directly on the giveaway packaging so participants can take the survey immediately, rather than submitting a postcard to take a survey later. CenterPoint Energy and its implementer are already exploring opportunities for updates. • If CenterPoint Energy continues to collect participant contact information for the survey via a postcard, consider requesting the participant's email address as well as the phone number. Update survey messaging to promote the financial incentive of being entered in a drawing for a $100 VISA gift card. In addition, since the customer is already providing responses to a few questions from the implementer via the postcard, consider removing the opt-out option to allow for a more robust evaluation survey population. • To optimize net savings and for the larger benefit and engagement of income-qualified customers, focus on hosting community events with organizations such as community action agencies that serve the income-qualified population. For such agencies that host a giveaway, perhaps along with an energy education event, Cadmus would assume the population of that event would all be income-qualified, and the NTG would be 100%. • To improve realization rates, consider estimating reported savings for any new measures, in this case, for LED bulbs with different wattages. For 4-watt candelabras, assume gross, per-unit savings of 31.36 kWh and 0.0043 kW. Cadmus could assist with forecasting savings for future measures. • For program planning purposes, assume that the in-service rates for specialty LED bulbs will be about 72%, as determined in this evaluation, rather than about 84%, as in 2019.
Commercial and Industrial Programs	
C&I Prescriptive	• The implementer and Cadmus should agree on a building type mapping for reporting lighting savings. Also, consider specifying the building type mapping or other source (i.e., the application) for the lighting hours, waste heat factors, and coincidence factors in the database. • Monitor potential changes to the commercial energy efficiency code to inform future program design. Advocate for the review of the measure as part of the upcoming Indiana TRM update process. CenterPoint Energy should also conduct market research to determine whether manufacturers are exclusively producing equipment to meet code requirements in most states and, therefore, are more efficient than the minimum required in Indiana.
C&I Custom	Though building tune-ups are targeted to buildings between 50,000 and 150,000 square feet, consider specifically targeting hospital and health care facilities. Only one hospital participated in the C&I Custom Program by implementing a single measure.

Program	Recommendations
Small Business Energy Solutions	• Update no-cost measures, such as thermostats, to low-cost measures, requiring a co-pay to incentivize trade allies to install these measures. • Ensure that the building heating type, heating and cooling setback details, and business hours of operation, including days closed, in the tracking data, are correctly tracked in the eQuest model. • CenterPoint Energy should update its *ex ante* savings to use a coincidence factor of 100%.

Key Findings, Conclusions, and Recommendations

This section summarizes the key findings, conclusions, and recommendations for each program. Additional details for measure-level savings can be found in *Appendix A. Impact Evaluation Methodology.*

Residential Programs

Residential Specialty Lighting Program

Through the ***Residential Specialty Lighting Program,*** CenterPoint Energy provides upstream discounts on a variety of ENERGY STAR®-certified lighting products (specialty and reflector bulbs). CenterPoint Energy works with retailers and manufacturers to offer reduced prices at the point of sale. In 2021, CLEAResult, the program implementer, worked with 13 retailers, including big box stores, discount stores, wholesale stores, hardware stores, and general retailers.

Program Visibility

In 2021, program visibility was reduced by the removal of general service LEDs (GSLs) from the program and by continued limitations on the implementer's retail access to conduct in-store events due to COVID-19 safety precautions. In late 2020, CenterPoint Energy discontinued program-sponsored incentives for GSLs from participating retailer stores. GSLs typically take up the most prominent shelf space in the lighting section at retail stores, which meant that most signage for CenterPoint Energy point-of-purchase lighting was limited to the shelf area with program-eligible reflector and specialty bulbs. Due to COVID-19 safety precautions, the implementer conducted only two in-store events in 2021 and none in 2020, compared with 12 in-store events in 2019.

Baseline Uncertainty

U.S. Department of Energy's (DOE's) regulatory rule may increase residential lighting baselines for programs as soon as 2023. In December of 2021, the DOE's Office of Energy Efficiency and Renewable Energy again proposed a rule to codify the 45 lumen per watt standard with a comment period open through January 27, 2022.[4] The rule is expected to be finalized in 2022 and implemented in early 2023. It is anticipated to fully implement the Energy Security and Independence Act of 2007 (EISA) for all medium screw-based lamps and require applicable reflector and specialty lamps to follow the same efficiency standards as GSLs. The new, stricter minimum efficiency standard of 45 lumens per watt means that, starting in 2023, the sale of incandescent or halogen lamps would be prohibited.

Based on this regulatory change, as of 2023, Cadmus anticipates that the baseline comparison lamp for medium screw based lighting will likely be LEDs, given the absence of incandescent, halogen, and CFL lamp alternatives after the new lumen standard has been implemented.

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4 Federal Register. December 13, 2021. "Energy Conservation Program: Backstop Requirements for General Service Lamps." https://www.federalregister.gov/documents/2021/12/13/2021-26807/energy-conservation-program-backstop-requirement-for-general-service-lamps

This regulatory change also impacts 2021 savings for carryover lamps. Since nearly all program incented LEDs will not receive savings credit in 2023 and beyond, Cadmus included only one year of carryover savings in the gross savings assumptions for 2021. Based on prior Indiana research,[5] 86% of LED lamps are expected to be installed in the first year after purchase. Using the Uniform Methods Project, which states that approximately 24% of stored lamps will be installed in the first year following purchase, Cadmus applied an adjusted in-service rate of 89% for all lamp types sold through the program in 2021.

Recommendation: Monitor the DOE's EISA outcome and incorporate effective changes in program design. Review inclusion of specialty and reflector LEDs as part of the upcoming Indiana Technical Reference Manual (TRM) update process to provide guidance for any future savings for these measures in upstream programs.

Impact Evaluation Overview

Table 5 lists the evaluated savings summary for the Residential Specialty Lighting Program. Cadmus reviewed the 2021 program tracking database to check savings estimates and calculations against CenterPoint Energy's reported savings from the 2021 Electric DSM Scorecard and to confirm the accurate application of the savings assumptions. Cadmus exactly matched energy savings and total number of program lamps in the tracking data to the scorecard but found that the tracking data showed 35 kW (3.8%) more total demand savings than reported.

Table 5. 2021 Residential Specialty Lighting Program Electric Savings

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rates	NTG Ratio	Evaluated Net Savings
	Reported	Audited	Verified				
Total kWh	6,646,639	6,646,639	5,915,509	5,861,368	88%	35%	2,062,730
Total kW	924	959	853	808	87%	35%	284

Variance in realization rates is largely because Cadmus' calculation of *ex post* savings differed from CenterPoint Energy's calculation of *ex ante* savings. To determine *ex ante* savings, CenterPoint Energy applied fixed per-unit kWh and kW for each bulb category, based on 2019 evaluated savings. To determine *ex post* savings, Cadmus used the ENERGY STAR lumens binning approach recommended in the Uniform Methods Project to determine replacement baseline wattages for each program lamp.[6]

[5] Cadmus applied first-year in-service rates, derived through the *2014 Market Effects Study* from Opinion Dynamics (2015), the most current research available from Indiana. More recent studies in Maryland (86%, 2016) and New Hampshire (87%, 2016) have similar first year LED ISRs. ISRs for LEDs typically range between 74% (Wyoming, 2016) and 97% (New Hampshire, 2016).

[6] Dimetrosky, S., K. Parkinson, and N. Lieb. October 2017. "Chapter 6: Residential Lighting Evaluation Protocol." *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.* https://www.nrel.gov/docs/fy17osti/68562.pdf

Table 6 provides per-unit annual gross savings for each program measure. Both reflectors and specialty LEDs had, in aggregate, per-unit evaluated savings that closely matched reported savings and historical savings estimates.

Table 6. 2021 Residential Specialty Lighting Program Per-Unit Gross Savings

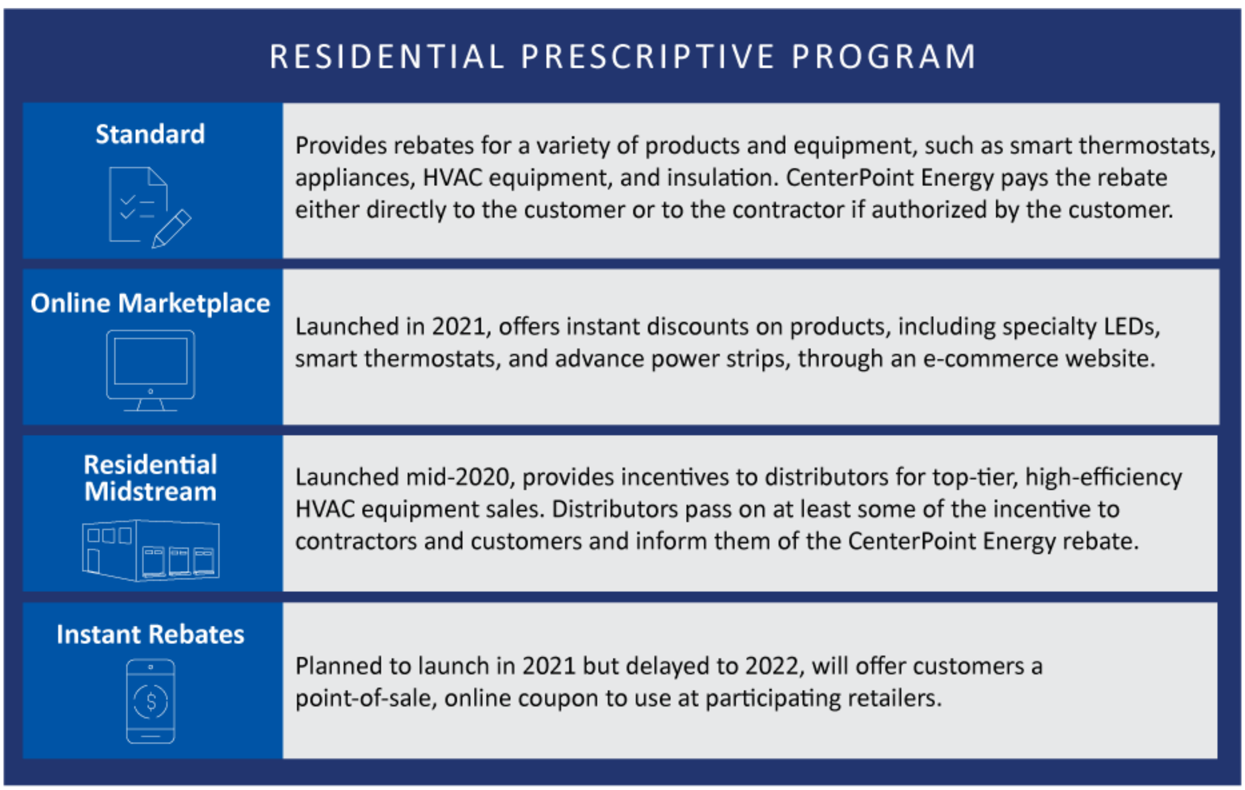
Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
	Reported	Evaluated	Reported[1]	Evaluated
LED Reflector	48.8	50.1	0.005	0.007
LED Specialty	28.7	26.7	0.005	0.004

[1] CenterPoint Energy's 2021 Electric DSM Scorecard reported an averaged, per-unit kW savings value.

Residential Prescriptive Program

Through the ***Residential Prescriptive Program,*** CenterPoint Energy seeks to achieve energy savings by influencing residential customers to purchase energy-efficient residential equipment and products. The program includes four channels, shown in Figure 1. All residential customers are eligible to participate through these channels and receive rebates or discounts that vary by measure. CLEAResult is the program implementer for the Standard and Midstream channels. EFI is the program implementer for the Online Marketplace and Instant Rebate channels.

Figure 1. Residential Prescriptive Program Channels



Customer Satisfaction

Standard and Online Marketplace channel customers are satisfied with the program. From customer surveys, 97% of Standard participants and 89% of Online Marketplace participants said they were satisfied with the program overall. Cadmus did not evaluate Midstream customer satisfaction because participant contact information was not available for that channel. Standard participants had significantly higher levels of satisfaction than Online Marketplace participants across all measured satisfaction categories, but all satisfaction ratings across both channels were 85% or higher.[7]

Contractor Engagement

Midstream contractors prefer participating in the Standard channel. Seven of 10 interviewed contractors said they preferred the Standard channel to the Midstream channel because it was familiar, and because they did not rely on the distributors for the incentive. Two of these contractors provided specific responses: to get payment from distributors, they needed to go through multiple steps, which took longer than they anticipated. Furthermore, contractor engagement and perception of the program directly influences customer participation and perception of the program. In 2021, 46% of Standard channel customers learned of the program from a contractor. Of all program satisfaction categories, customers rated contractors the highest; 99% of customers who worked with a contractor in 2021 were very satisfied with their contractor. Low contractor buy-in to the Midstream channel could reduce trade ally and customer satisfaction if CenterPoint Energy continues to shift more of the Residential Prescriptive Program to the Midstream channel without addressing contractors' perception of this channel.

Recommendation: Increase communication with contractors about the Midstream channel. Share information including program updates, measure lists, and promotional materials for Midstream channel measures directly with contractors.

Residential Prescriptive Program Scorecard Reporting

Residential Prescriptive Program savings and participants on the scorecard should be channel-specific. Program data for each channel did not completely align with the scorecard. Some measures were reported on the scorecard under different channels than were recorded in the program tracking data. For example, all air source heat pump installations were reported under the Midstream channel on the electric scorecard, even though some were installed under the Standard channel. Online Marketplace measures in particular had different naming conventions on the scorecard than in the program tracking data. Online Marketplace measures also had a significantly different number of installations than the program tracking data. Addressing these inconsistencies would increase the accuracy of reported savings, improving realization rates.

Recommendation: To improve performance tracking at the channel level, report measures in the scorecard by delivery channel. For Online Marketplace, align naming conventions between the program tracking data and the scorecard to allow accurate comparisons.

[7] Significant at 90% confidence, 10% margin of error.

Low Online Marketplace Demand Realization Rate

Evaluated Online Marketplace demand savings were much lower than reported in the scorecard. CenterPoint Energy reported an average, per-unit kW savings across all program measures in its 2021 Electric DSM Scorecard. Online Marketplace measures in particular have lower demand savings on a per-unit basis compared with measures in other channels. This resulted in much higher reported than evaluated kW savings.

Recommendation: To improve the accuracy of reported savings and increase realization rates, CenterPoint Energy should report channel- or measure-specific kW demand savings in the scorecard.

Pool Pump Federal Standard

A new federal standard will affect pool pump savings beginning in 2022. A federal standard requiring that pool pumps be variable speed came into effect on July 19, 2021.[8] The regulation applies to motors between approximately 1 hp and 5 hp.[9] CenterPoint Energy continued to offer the variable speed pool pump rebate through the end of 2021 as dealers sold through their stock, but savings for this measure will no longer be available in 2022, except where carryover rebates are paid for measures installed in 2021.

Early Replacement Furnace ECM Savings

Savings could be claimed for an electronically commutated motor (ECM) upgrade to furnaces replaced before the end of their useful life. ECM furnace fans are now required by federal standards, but there are still non-ECM furnace fans in CenterPoint Energy's service territory. As furnaces fail over the coming years, their fan motors will have to be replaced by ECMs. However, some customers could retire their furnaces early and install an ECM furnace fan sooner than they would otherwise. Savings could be claimed for this proactive behavior.

Recommendation: Consider offering an early replacement measure for ECM furnace fans. Applications could confirm the state of the equipment, if it can be considered early replacement, and if the applicant is a CenterPoint Energy electric customer. Advocate for review of savings for early replacement of ECM furnace fans as part of the upcoming Indiana TRM update process to provide guidance for adding this measure to the Residential Prescriptive Program.

Clothes Washer Gas Savings

CenterPoint Energy could claim gas savings for the impact of clothes washers on water heater and clothes dryer gas consumption. A high-efficiency clothes washer also reduces water heater and clothes dryer energy consumption. The Illinois TRM V9.0 was used to determine evaluated savings for this measure. This TRM accounts for electric savings associated with water heaters and dryers, and these

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8 Regulations.gov. May 18, 2017. "2017-01-18 Energy Conservation Program: Conservation Standards for Dedicated-Purpose Pool Pumps; Direct final rule." https://www.regulations.gov/document?D=EERE-2015-BT-STD-0008-0109

9 Robledo, R. May 24, 2017. "Federal Pump Rule Established." *Pool and Spa News.* https://www.poolspanews.com/business/legal-regulatory/federal-pump-rule-established_o

savings are included in the evaluated savings. However, for some customers, this equipment may be gas-powered, so gas savings could be claimed, though they are not currently. Collecting fuel type for clothes dryers and water heaters on the rebate application would help capture these indirect energy savings. For this evaluation, Cadmus incorporated savings associated with electric dryers and water heaters into the evaluated electric savings results. Savings associated with gas dryers and gas water heaters were estimated to be 1.7 and 0.8 therms, respectively, per average clothes washer.

Recommendation: On the clothes washer rebate application, collect clothes dryer and water heater fuel type to claim the appropriate electric or gas savings associated with these additional end uses.

Online Marketplace Refinement

There is customer interest to support growing the Online Marketplace, but CenterPoint Energy needs to address the verification process before expanding this channel. Customers are satisfied with the Online Marketplace and all components of the channel. However, product selection received the lowest satisfaction rating; 52% of respondents were *very satisfied* with the product selection compared with 69% to 74% of respondents who were *very satisfied* with other aspects. Respondents also commented that they would like to see more products available through the Online Marketplace, indicating there is customer interest to support expanding this channel.

Online Marketplace channel data, however, suggest that some incentivized measures should not receive as much or any savings. Where data was available, Cadmus considered an installation eligible for savings only if it included eligible service territory information. The Online Marketplace data also included several customers who purchased certain measures in large quantities. For example, one customer purchased 99 packs of weatherstripping, with each pack containing 17 feet of weatherstripping. It is unlikely all packs of weatherstripping were installed. For this evaluation year, Cadmus assigned savings for installations with higher quantities.

Recommendation: The implementer should validate customer eligibility to receive incentives in the Online Marketplace, which will ensure CenterPoint Energy achieves accurate savings for measures it promotes through this channel. For each measure, consider limiting the quantity per customer to a reasonable amount for single-family home use.

Impact Evaluation Overview

Table 7 lists the evaluated savings summary for the Residential Prescriptive Program.

Table 7. 2021 Residential Prescriptive Program Electric Savings

Component	Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rates	NTG Ratio	Evaluated Net Savings
		Reported	Audited	Verified				
Standard	Total kWh	2,311,659[1]	2,311,659	2,269,923	2,315,664	100%	61%	1,419,944
	Total kW	1,374	1,738	1,724	1,500	109%	61%	917
Online Marketplace	Total kWh	340,554	421,937	404,405	401,764	118%	62%	249,834
	Total kW	623	782	753	14	2%[2]	59%	8
Midstream	Total kWh	713,876[1]	713,876	713,876	654,435	92%	44%	285,985
	Total kW	132	132	132	145	109%	44%	68
Total[3]	Total kWh	3,366,090	3,447,472	3,447,472	3,371,863	100%	58%	1,955,763
	Total kW	2,129	2,652	2,609	1,658	78%	60%	993

[1] CenterPoint Energy's 2021 Electric DSM Scorecard reported 2,222,320 kWh in Standard channel measures and 803,215 kWh in Midstream measures. These values are based on the program tracking data.
[2] CenterPoint Energy's 2021 Electric DSM Scorecard reported an average, per-unit kW savings across all program measures. Online Marketplace measures in particular save less demand on a per-unit basis compared with measures in other channels. Therefore, the evaluated kW savings for Online Marketplace measures were much lower than the reported kW savings.
[3] Totals do not represent sum of the parts due to rounding.

Cadmus evaluated savings for each measure in the tracking database using savings analyses derived primarily from the 2015 Indiana TRM v2.2 and participant survey data. Additional details regarding the calculations and assumptions used to estimate gross savings are provided in *Appendix A. Impact Evaluation Methodology*. Table 8 provides per-unit annual gross savings for each program measure.

Table 8. 2021 Residential Prescriptive Program Per-Unit Gross Savings

Program Component	Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
		Reported	Evaluated	Reported[1]	Evaluated
Standard	AC Tune Up	100.2	108.1	0.291	0.172
	Air Purifier	539.7	220.1	0.291	0.025
	Air Source HP 16 SEER	969.6	753.6	0.291	0.418
	Air Source HP 18 SEER	1,783.7	1,640.0	0.291	0.389
	Attic Insulation (Electric)	3,456.8	5,480.8	0.291	0.566
	Attic Insulation (Dual Fuel)	433.0	421.1	0.291	0.354
	Central Air Conditioner 16 SEER	486.2	404.3	0.291	0.497
	Central Air Conditioner 18 SEER	774.3	789.2	0.291	0.641
	Clothes Dryer	160.0	161.9	0.291	0.022
	Clothes Washer	202.0	170.8	0.291	0.024
	Dehumidifier	273.0	95.1	0.291	0.009
	Air Source HP 16 SEER (Dual Fuel)	835.0	561.0	0.291	0.433
	Duct Sealing Electric Heat Pump	694.0	698.7	0.291	0.378
	Ductless HP 19 SEER 9.5 HSPF	2,887.3	3,212.7	0.291	0.357
	HP Tune Up	280.9	342.0	0.291	0.160
	HP Water Heater	2,376.0	2,415.7	0.291	0.330
	Pool Heater COP >=6	1,254.5	1,362.8	0.291	-
	Pool Heater COP 5.5-5.9	899.9	1,027.4	0.291	-
	Smart Programmable Thermostat - South (Dual)	304.9	277.7	0.291	-
	Smart Programmable Thermostat - South (Electric)	844.4	985.6	0.291	-
	Variable Speed Pool Pump	1,172.6	1,828.0	0.291	1.716
	Wall Insulation - All Electric	776.6	941.2	0.291	0.076
	Wall Insulation - Dual Fuel	87.5	97.6	0.291	0.094
	Wi-Fi Thermostat - South (Dual)	279.2	290.4	0.291	-
	Wi-Fi Thermostat - South (Electric)	418.5	489.6	0.291	-
Online Marketplace	Air Purifier	681.1	80.6	0.291	0.009
	Aerator (Dual)	0.0	44.2	0.291	0.620
	LED Reflector	49.1	43.7	0.291	0.007
	LED Specialty	34.1	42.8	0.291	0.005
	Smart Power Strips	25.8	24.6	0.291	0.002
	Thermostat (Dual)	299.4	371.1	0.291	-
	Thermostat (Electric)	740.3	683.2	0.291	-
Midstream	Air Source HP 16 SEER	969.6	683.7	0.291	0.303
	Air Source HP 18 SEER	1,783.7	1,445.2	0.291	0.303
	Ductless HP 19 SEER 9.5 HSPF	2,887.3	2,997.7	0.291	0.346
	Ductless HP 21 SEER 10 HSPF	2,546.8	3,020.0	0.291	0.364
	Ductless HP 23 SEER 10 HSPF	1,962.9	2,377.6	0.291	0.364

[1] CenterPoint Energy's 2021 Electric DSM Scorecard reported an averaged, per-unit kW savings value.

CenterPoint Energy's *ex ante* savings for the Standard and Midstream channels are derived primarily from evaluated savings for the 2019 program. For most measures, Cadmus' 2021 evaluation used the same methodology as in 2019, so differences between *ex ante* and *ex post* are largely due to differences in participant survey results and program tracking data.[10] Online Marketplace *ex ante* savings were based primarily on 2018 and 2019 evaluated savings from various CenterPoint Energy programs.

The following discusses the measures with substantial differences between *ex post* and *ex ante* savings by program channel.

Residential Prescriptive – Standard

The following are the notable assumption differences between *ex ante* and *ex post* savings:

- **Air purifier.** In 2020, a new ENERGY STAR specification came into effect. Cadmus relied on the Illinois TRM V9.0 rather than the ENERGY STAR calculator because the former is based on the most recent ENERGY STAR specification. The ENERGY STAR calculator, which CenterPoint Energy used to determine *ex ante* savings, assumed a baseline clean air delivery rate (CADR) of 1.0, whereas the Illinois TRM V9.0 assumes a more efficient baseline with a CADR of 1.9. This updated baseline assumption came from the Air Cleaner Data Package released by ENERGY STAR to supplement the new specification update.[11]
- **Air source heat pump/central air conditioner/dual fuel air source heat pump.** For some measures, baseline equipment efficiencies are different for installations replaced on burnout than for those retired early.
    - Replace-on-burnout installations have more efficient baselines than early retirement installations. Because the equipment requires replacement, the two alternatives are the current federal standard or a high-efficiency unit. Choosing a high-efficiency unit for a replace-on-burnout installation generates more savings than the federal standard alternative.
    - Early retirement installations often have less efficient baselines than replace-on-burnout installations because the equipment that is currently installed, though probably more efficient than a burned out unit (because it is probably not as old), is less efficient than the federal standard. This currently installed equipment is the baseline, because it is assumed that, without the program incentive to install a high-efficiency unit, this (probably) below-standard equipment would continue to operate. Each evaluation year, the percentage of all early retirement installations is determined based on program and/or survey data. In the 2019 evaluation, from which CenterPoint Energy established the program's 2021 *ex ante*

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[10] Changes in year-to-year program tracking data include installed equipment efficiencies, equipment age, home square footage, installation location, baseline information (i.e., programmable thermostat prevalence and usage patterns), percentage of installations considered to be early replacements, etc.

[11] ENERGY STAR. "ENERGY STAR® Room Air Cleaner Data and Analysis." Version 2.0. https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20V2%20Room%20Air%20Cleaners%20Data%20Package.xlsx

savings, 37% of installations were considered early retirement. This decreased to 21% in the 2021 evaluation, meaning installations overall had more efficient baseline alternatives, which in turn reduced savings.

- **Dehumidifier.** This measure was new to the program in 2021. Cadmus based its savings methodology primarily on the 2019 federal standard for dehumidifiers and the associated Notice of Proposed Rulemaking Technical Support Document (NOPR TSD),[12] whereas *ex ante* savings were derived using the Illinois TRM V7.0, which used baseline assumptions from an earlier dehumidifier federal standard. Updating these baseline assumptions to align with the most recent federal standard was the main cause of differences in reported and evaluated savings.
- **Heat pump tune-up.** *Ex ante* heat pump efficiency metrics were from averages of efficient heat pumps installed in 2019. In the 2021 evaluation, Cadmus used efficiency metrics from the Illinois TRM V9.0, which more accurately captures the market average heat pump to which a tune-up would be applied.
- **Insulation and thermostat.** Differences in reported and evaluated savings for insulation and thermostat measures were primarily due to shifts in equipment saturations based on participant surveys. In 2019, the basis for *ex ante* savings, saturations were 3% for heat pumps and 4% for electric furnaces. In 2021, these saturations changed to 2% and 6%, respectively (the remaining 92% of saturation was for natural gas heating), resulting in higher overall savings for measures whose evaluated savings depend on these HVAC equipment saturations. Electric resistance heating is less efficient than heat pump heating, so savings are greater when more homes are estimated to be heated using electric resistance equipment.
- **Pool heater.** The same approach was applied to determine *ex ante* and *ex post* savings. However, *ex ante* savings assumptions relied on conservative coefficient of performance (COP) estimates. Actual program data revealed that most pool heater measures were on the higher end of the allowable COP range, resulting in higher per-unit evaluated savings.
- **Variable speed pool pump.** The 2021 program data included a new field for recording the operating days per year. On average, this value was higher than the *ex ante* assumption, which used the 2015 Indiana TRM V2.2, resulting in higher per-unit evaluated savings.

Residential Prescriptive – Online Marketplace

The Online Marketplace channel was offered for the first time in 2021, so *ex ante* savings were sourced primarily from past evaluated savings of similar measures in other CenterPoint Energy programs. Programs may have different program-specific considerations and measure granularity, so measure savings may be specific to items such as housing segment or installation location. Differences in these

12 Regulations.gov. "2015-05 NOPR Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment; Residential Dehumidifiers." May 17, 2015. https://www.regulations.gov/document?D=EERE-2012-BT-STD-0027-0030

assumptions drove some of the changes from *ex ante* to *ex post* savings for Online Marketplace measures.

Program data recorded details that Cadmus used to inform which installations received savings. These resulted in differences between reported and evaluated measure quantities and savings.

- **Air purifier.** Differences in air purifier *ex ante* and *ex post* savings are explained by the same reasoning as discussed in the Standard section above.
- **Aerator.** *Ex ante* savings for this measure appear to be a weighted average of the Multifamily Direct Install (MFDI) Program's 2019 evaluated savings for bathroom and kitchen aerators. The Online Marketplace measure is not specific to a bathroom or a kitchen, so Cadmus weighted variables specific to a bathroom or a kitchen (such as outlet temperature) together. Moreover, the 2019 MFDI savings used MFDI survey data to inform variables such as people per home or faucets per home, but these variables are specific to multifamily. The Online Marketplace aerator is not specific to a particular housing segment, so Cadmus pulled household metrics from the 2015 Residential Energy Consumption Survey (RECS) and weighted values for single-family and multifamily segments together.
- **Lighting.** CenterPoint Energy based 2021 *ex ante* savings on the 2018 Residential Lighting Program evaluation by averaging per-unit savings for reflectors and specialty lighting measures across their many types, baselines, and efficient wattages. Cadmus used program data to inform these inputs on a per-installation basis. Given the simplicity of lighting savings algorithms, differences from *ex ante* to *ex post* savings were primarily from differences in assumptions for wattage or hours of use.
- **Thermostat.** Differences in *ex ante* and *ex post* savings for Online Marketplace thermostat measures were mainly driven by the determination of heating system type.

Residential Prescriptive – Midstream

The Midstream channel was offered for the first time in 2021, so *ex ante* savings were based on the Residential Prescriptive Program's 2018 and 2019 evaluated savings. Cadmus applied single average values across multiple years of Residential Prescriptive Program data for efficiency metrics, capacities, and early retirement percentages for each measure to every installation. Differences in program design and assumptions between Standard and Midstream channels drove some of the differences between *ex ante* and *ex post* savings.

- **Air source heat pump.** Differences in reported and evaluated savings were caused by differences in efficient equipment and baseline specifications.[13] *Ex ante* savings were based on the 2019 Residential Prescriptive Program's evaluated savings, which were an average of savings

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[13] The program data for the Midstream channel did not record equipment specifications for each installation. To inform the savings analysis, historical data from the 2019, 2020, and 2021 Residential Prescriptive Program's Standard channel were averaged to determine efficiency metrics and capacity values for each Midstream measure. This same process was used to determine the percentage of early replacement for each fuel type. This sets a comprehensive baseline for the Midstream channel as it continues to be developed and evaluated.

across installations that varied by capacity and seasonal energy efficiency rating (SEER). In general, 2019 air source heat pumps had higher capacity values and older baseline units compared with 2020 and 2021 program data. This means 2019 evaluated, per-unit savings were higher than 2021 evaluated, per-unit savings.

- **Ductless heat pump.** Similar to air source heat pumps, differences in 2021 savings were due to differences in efficiency metrics and capacity from historical evaluations, especially for capacity.

Residential New Construction Program

Through the ***Residential New Construction Program,*** CenterPoint Energy provides incentives to builders who construct homes that receive a Home Energy Rating System (HERS) score of 62 or lower.[14] All builders constructing high-efficiency homes in CenterPoint Energy's service territory can participate in the program.

HERS raters measure and verify participating home performance. In 2021, CenterPoint Energy provided three incentive tiers: one for Gold Star homes (rating 61 to 62), one for Platinum Star homes (rating 60 or less), and one for Platinum Star Plus homes (rating 60 or less, including installation of a natural gas tankless water heater).

The program was discontinued at the end of 2021 because adoption of the 2020 Indiana Residential Code in early December 2019 resulted in a higher efficiency baseline and thus lower potential for savings. Builders will be encouraged to continue using energy-efficient building practices with incentives through the Residential Prescriptive Program.

Code Baseline

The 2020 Indiana Residential Code (IRC) increased the efficiency of the baseline for the Residential New Construction program, resulting in lower program energy savings. The energy and demand realization rates for the program dropped to 39% in 2021. As a result of the lower potential for savings, the program was discontinued at the end of 2021, except where carryover rebates are paid in 2022 for projects completed in 2021.

Impact Evaluation Overview

Table 9 lists the evaluated savings summary for the Residential New Construction Program.

Table 9. 2021 Residential New Construction Program Electric Savings

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rates	NTG Ratio	Evaluated Net Savings
	Reported	Audited	Verified				
Total kWh	373,827	373,827	373,827	144,301	39%	57%	82,251
Total kW	148	181	181	57	39%	57%	33

[14] Under HERS, the lower the score the higher the efficiency.

Table 10 provides per-unit annual gross savings for each program measure.

Table 10. 2021 Residential New Construction Program Per-Unit Gross Savings

Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
	Reported	Evaluated	Reported[1]	Evaluated
Gold Star (Electric)	4,540.1	1,648.3	0.577	0.094
Gold Star (Dual Fuel)	981.4	356.3	0.577	0.094
Platinum Plus (Electric)	9,956.3	4,026.8	0.577	1.061
Platinum Plus (Dual Fuel)	1,458.4	565.4	0.577	0.250
Platinum Star (Dual Fuel)	1,458.4	589.8	0.577	0.267

[1] CenterPoint Energy's 2021 Electric DSM Scorecard reported an averaged, per-unit kW savings value.

In late 2019, Indiana adopted the 2018 International Residential Code (referred to as the 2020 Indiana Residential Code [IRC]) as the default into its residential building code. The IRC increases required insulation levels, building envelope air tightness, and lighting efficiency. In the Residential New Construction Program, builders were given a grace period to adopt the new code requirements. Any homes permitted in 2019 (even if construction had not started) could be completed under the old or the new code, whereas any homes permitted on January 1, 2020, or later were required to be completed under the new code.

Since the HERS rating period occurs at the end of construction and the average construction period is 10.7 months from permit date to completion, Cadmus evaluated the energy impact of the code change starting in the 2021 program year. All program tiers underwent decreases from reported to evaluated energy savings and demand reduction.

Income Qualified Weatherization Program

Through the ***Income Qualified Weatherization Program*** (IQW), CenterPoint Energy offers its low-income customers (up to 200% of the federal poverty level) a walk-through home energy audit that includes full diagnostic testing for the home. Auditors recommend weatherization measures or upgrades that facilitate the installation of energy-saving measures at no cost to the customer.

Gross Savings

The IQW Program exceeded its savings and participation goals, but per-household savings declined over the previous year. After underperforming during 2020 because of the COVID-19 pandemic, the IQW Program rebounded in 2021 and exceeded all planning goals. The program achieved 130% of its participation goals. Program savings kept pace with participation, achieving 115% of its gross kWh and 130% of its gross kW savings goals. Savings per home, however, decreased from 503 kWh in 2020 to 346 kWh in 2021, largely driven by the removal of savings from general service LEDs from the program.

Whole home IQW electric savings were much lower than reported. The implementer provided a summary to identify the measures included in each Whole Home IQW project; however, the measures lacked detailed descriptions that would provide more context for which measure category's savings should be used.

- Five Whole Home IQW project measures included duct sealing or air sealing with attic insulation but no documentation of baseline and efficient measure conditions. Cadmus used a program average savings from other duct sealing, air sealing, and attic insulation measures, which may have understated savings.
- Three Whole Home IQW project measures were either furnace repair or replacement that did not describe baseline and efficient measure conditions, and two of these were for electric furnaces. Furnace tune-up and replacement for electric furnaces has no basis for savings since electric resistance efficiency does not change; however, for the electric furnace repair measure, the implementer reported the presence of a heat pump in addition to the electric furnace. Cadmus used a program average therms savings for the one natural gas furnace measure, used program average heat pump tune-up electric savings for the electric furnace repair measure, and zero electric savings for the electric furnace replacement measure.
- Several Whole Home IQW projects included measures that were accounted for under another applicable measure group. For example, a whole home measure was reported to have an air conditioner repair, but the same household also received savings for an air conditioner tune-up. Air conditioner repair falls within the air conditioner tune-up measure efficient condition and should not be counted in both.
- One Whole Home IQW project included an electric package unit furnace and air conditioner replacement measure but had a duplicate project with the same savings. Cadmus assigned zero electric savings for the duplicate project. Consistent with the approach for other Whole Home IQW measures, Cadmus assigned zero savings for the electric furnace replacement but applied program-averaged electric savings to the air conditioner replacement.

Recommendation: To increase the accuracy of savings for Whole Home IQW projects, the implementer should provide more thorough documentation and descriptions of each project.

Impact Evaluation Overview

Table 11 lists the evaluated savings summary for the IQW Program.

Table 11. 2021 Income Qualified Weatherization Program Electric Savings

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rates	NTG Ratio	Evaluated Net Savings
	Reported	Audited	Verified				
Total kWh	434,820	435,558	433,279	374,823	86%	100%	374,823
Total kW	145	67	67	56	39%	100%	56

Table 12 provides per-unit annual gross savings for each program measure.

Table 12. 2021 Income Qualified Weatherization Per-Unit Gross Savings

Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
	Reported[1]	Evaluated	Reported[2]	Evaluated
AC Tune Up	150.0	90.2	0.019	0.147
Air Sealing 20% Infil. Reduction - (Dual Fuel)	136.0	244.5	0.019	0.359
Air Source Heat Pump 16 SEER	744.1	257.6	0.019	0.301
Attic Insulation (Dual Fuel)	485.8	491.4	0.019	0.462
Audit Fee MF (Dual Fuel)	16.7	13.3	0.019	0.001
Audit Fee MF (Electric)	53.0	46.5	0.019	0.002
Audit Fee SF (Dual Fuel)	90.4	74.6	0.019	0.002
Audit Fee SF (Electric)	112.3	102.2	0.019	0.002
Bathroom Aerator MF (Electric)	27.2	26.8	0.019	0.003
Bathroom Aerator SF (Electric)	35.6	30.0	0.019	0.003
Central Air Conditioner 16 SEER	276.9	290.0	0.019	0.412
Duct 10% Leakage Reduction (Dual Fuel)	151.7	211.9	0.019	0.345
Exterior LED Lamps	99.0	91.6	0.019	0.000
Furnace Tune Up	7.6	0.0	0.019	0.000
HP Tune UP	155.1	265.7	0.019	0.118
IQW Whole Home (Dual Fuel)	1,316.4	186.8	0.019	0.000
IQW Whole Home (Electric Only)	1,987.2	96.7	0.019	0.000
Kitchen Flip Aerator - Electric MF	111.0	131.7	0.019	0.007
Kitchen Flip Aerator - Electric SF	141.3	115.7	0.019	0.007
LED 5W Bulb IQW MFDI	20.0	19.3	0.019	0.002
LED 5W Bulb SFH	19.2	18.5	0.019	0.002
LED 5W Candelabra	23.6	22.7	0.019	0.003
LED Nightlight	13.1	13.1	0.019	0.000
LED R30 Bulb IQW MFDI	57.1	55.0	0.019	0.007
LED R30 Bulb SFH	36.0	52.8	0.019	0.007
Low Flow Showerhead - Electric MF	247.3	256.6	0.019	0.015
Low Flow Showerhead - Electric SF	335.2	267.3	0.019	0.015
Refrigerator Replacement	474.0	388.4	0.019	0.057
Smart Power Strips	24.4	24.3	0.019	0.002
Smart Thermostat MF (Dual Fuel)	241.8	191.2	0.019	0.000
Smart Thermostat MF (Electric)	746.9	643.0	0.019	0.000
Smart Thermostat SF (Dual Fuel)	324.1	255.1	0.019	0.000
Wall Insulation - (Dual Fuel)	99.5	65.6	0.019	0.071

[1]CenterPoint Energy's 2021 DSM Scorecard did not have kWh savings at the measure level. These per-unit savings reflect audited savings from the 2021 program tracking data.
[2] CenterPoint Energy's 2021 Electric DSM Scorecard reported an averaged, per-unit kW savings value.

Reported savings for single-family homes are primarily based on 2019 evaluated findings. To estimate savings for multifamily measures, introduced in 2019, reported savings multiplied single-family savings by an adjustment factor. The following caused discrepancies from reported to evaluated 2021 savings.

Appliance and plug load reduction. Refrigerator replacement per-unit savings are updated yearly with an analysis based on the existing and installed model numbers reported in the tracking data. Evaluated savings for refrigerator replacement resulted in an average per-unit savings of 388 kWh in 2021, compared with the average of 474 kWh calculated in 2019.

Audit education. The audit education measures vary from year to year depending on how many surveyed participants say they have taken energy-saving actions. In 2021, 43% of respondents reported taking shorter showers compared with 37% in 2019, and 68% reported turning off the lights while not in use compared with 65% in 2019. However, no respondents in 2021 reported installing additional weatherization measures, compared with 8% in 2019, and therefore, overall, evaluated 2021 energy savings for this measure were less than reported energy savings.

HVAC measures. Differences in savings varied by measure:

- **Air conditioner tune-ups** had substantially lower evaluated savings than reported savings while **heat pump tune-ups** had substantially higher evaluated savings than reported savings. The heat pump tune-up measure was not offered prior to 2019, so reported savings were not based on previous evaluation findings. Cadmus used the average capacity of program-installed central air conditioners and air source heat pumps as an input into the 2015 Indiana TRM v2.2 algorithm to determine energy and demand savings. Reported savings were from an unknown source and used the same deemed savings for both air conditioners and heat pumps. The planning methodology may have differed from the TRM for this measure.[15]
- **Furnace tune-up for electric furnaces** has no basis for savings, as it is impossible to tune up an electric furnace since electric resistance efficiency does not change. There were five electric furnace tune-ups reported.
- **Air source heat pumps** had much lower evaluated savings than reported savings because the three measures in 2021 had lower capacities compared with the one measure in 2019, which had a larger capacity.
- **Central air conditioner** had greater evaluated savings than reported savings due to higher cooling capacities in 2021, with an average capacity of 33,513 BTUH, compared with an average of 32,000 BTUH in 2019.

Lighting. Realization rates were around 100% for all bulb types except the LED R30 bulb in single-family homes. The relatively high evaluated savings were due to a calculation error in reported savings. Cadmus found that reported savings did not account for a quantity of greater than one bulb installed for 6.6% of these measures.

15 CenterPoint did not provide *ex ante* assumptions for this measure.

Thermostats. Smart thermostats had lower savings than reported savings because the programmable thermostat baseline saturation increased in 2021. Forty-three percent of the respondents to the 2021 IQW Program survey reported owning a programmable thermostat prior to installing a smart thermostat, compared with 11% in the 2019 IQW Program survey.

Water-saving devices. Differences in savings for water-saving devices were due to differences in survey inputs, such as people per home, showers per home, and bathroom faucets per home, from year to year. For example, people per single-family home was two in 2021 compared with 2.44 in 2019. There were no multifamily responses in the 2021 IQW survey data, so Cadmus determined inputs, such as faucets per home, people per home, and showers per home, using survey data from the 2020 Multifamily Direct Install Program.[16]

Weatherization. Reported and evaluated savings for weatherization measures differed widely because each installation had site-specific data that affected the amount of savings given each home.

- **Air sealing** had higher evaluated savings primarily due to higher infiltration reduction in 2021 compared with 2019. The average difference in pre- and post-installation air flow was 1,328 cfm in 2021, compared with 874 cfm in 2019.
- **Attic and wall insulation** per-unit savings differences were the result of different values for installed square footage between 2019 and 2021. Reported per-unit savings for wall insulation was derived from an unknown source in 2021 and did not match the 2019 evaluated per-unit savings.
- **Duct sealing** had higher savings than reported due to a difference in the central air conditioning cooling capacity input. This input is based on the program year average and was greater in 2021 than in 2019.
- **Whole Home IQW** measures received low evaluated savings compared with reported savings due to a variety of factors. Each Whole Home IQW project is unique; however, reported per-project savings was derived from an unknown source in 2021 and 2020 when the measure was first introduced. Forty-six percent of Whole Home IQW projects included measures for which savings were already accounted under another measure group. Cadmus assigned zero savings to a household that had any Whole Home IQW measures already accounted for in another measure group. The following describes findings for nine Whole Home IQW projects:
  - Five Whole Home IQW project measures were either duct sealing or air sealing with attic insulation but had no documentation of baseline and efficient measure conditions. Cadmus used a program average for these measures, all of which were less than reported.
  - Three Whole Home IQW project measures were either furnace repair or replacement, two of which were for electric furnaces, that also had no descriptions of baseline and efficient measure conditions. Furnace tune-up and replacement for electric furnaces has no basis for savings since electric resistance efficiency does not change; however, for the electric furnace repair measure, the implementer reported the presence of a heat pump in addition

16 *2020 Vectren DSM Portfolio Natural Gas Impacts Evaluation.*

to the electric furnace. Cadmus used a program average therms savings for the one natural gas furnace measure, used program average heat pump tune-up electric savings for the electric furnace repair measure, and zero electric savings for the electric furnace replacement measure.

- One Whole Home IQW project included an electric package unit furnace and air conditioner replacement measure but had a duplicate project with the same savings. Cadmus removed the duplicate project and used a program average electric savings from other replacement air conditioning measures. Cadmus assigned zero savings for the electric resistance furnace replacement, consistent with other electric furnace measures in this evaluation.

Residential Behavioral Savings Program

Since 2012, the ***Residential Behavioral Savings (RBS) Program*** has been sending customers home energy reports (HERs), which provide energy consumption information and encourage the adoption of energy-saving behaviors and home improvements. These reports contain the household's energy use data, a similar neighbor comparison on energy use, and energy-saving tips. The program also provides energy usage information to all residential CenterPoint Energy customers on the customer's online utility account webpage. Oracle is the program implementer.

The RBS Program uses an experimental design called a randomized control trial wherein customers are randomly assigned to either a treatment group (recipients of HERs) or a control group (nonrecipients). Treatment group customers are mailed print HERs, and those with valid email addresses also receive the reports via email. Control group customers do not receive the HERs; the control group's consumption provides a baseline for measuring the program's energy savings.

Treatment and control group customers are further segmented into "waves" according to their CenterPoint Energy fuel service (electric only or dual fuel) and the year in which they started or would have started receiving the HERs. For several years, CenterPoint Energy operated the program with two waves—one electric only and one dual fuel—as Wave 1.

In 2020, CenterPoint Energy launched a second dual fuel wave—as Wave 2—to address customer attrition. Attrition occurs when customers close their CenterPoint Energy accounts. Long-running programs like CenterPoint Energy's can lose a large portion of the originally randomized customers as the program ages, and this loss can compromise the experimental design and reduce the likelihood of detecting a significant treatment effect (energy savings).

Savings & Uplift

Savings for both Wave 1 treatment groups (electric only and dual fuel) dropped from 2020 to 2021. Wave 2 (dual fuel) continued to ramp up savings in the first 18 months, consistent with Wave 1. Although the implementer indicated savings were not impacted by changes to the content and design of the HERs, Cadmus observed that, from 2020 to 2021, Wave 1 electric only savings fell from 2% to 1.3% and Wave 1 dual fuel savings fell from 2% to 1.5%.

Wave 1 dual fuel savings were consistent with prior program years, and the drop in savings can be attributed to more temperate weather and normalizing to typical savings.

Wave 1 electric only savings, however, fell to the lowest since program launch. In particular, from May 2021 to October 2021 Wave 1 electric only had 0.39% in savings, compared with an average of 1.52% over the same months in all prior years since program launch. Part of the decrease can be explained by more temperate weather in 2021, but temperate weather is unlikely to be the sole driver. Savings for Wave 1 electric only appeared to begin bouncing back in November as temperatures got colder.

Wave 2 had savings of 0.83% savings in 2021, comparable to the savings achieved by Wave 1 dual fuel in the second year of treatment (0.98% savings).

Recommendation: Savings for the electric only wave should be monitored to see if the unusually low savings were a random occurrence or could be due to some other factor, including the new report design.

The RBS Program is encouraging cross-program participation. RBS Program uplift savings were positive and higher than previous program years, achieving 70,900 kWh in energy savings and 64.46 kW in demand savings. All three electric waves—Wave 1 electric only, Wave 1 dual fuel, and Wave 2—demonstrated positive uplift savings. This is in contrast to prior years where uplift savings for Wave 1 were often negative. This indicates that the report design changes may have been successful in increasing participation in CenterPoint Energy's other efficiency programs.

Low-Income Customer Identification

The low-to-moderate participant income analysis conducted at the household level will help assess and improve identification and engagement. The program implementer ran a low-to-moderate (LMI) analysis for CenterPoint Energy to understand how to better serve these customers. Data on household energy burden, U.S. Census Ability to Pay Index, Ability to Pay income buckets, county unemployment changes, Household Energy Affordability Score, and HERs treatment/control status will be finalized in 2022.

Recommendation: Utilize results from LMI analysis to more effectively promote CenterPoint Energy's efficiency programs and other initiatives to this customer segment.

Cadmus could not identify differences in savings between low-income and standard-income customers for the Wave 2. Cadmus could not identify savings differences between low-income and standard-income customers because there was not an equivalent segmentation for the control group. To estimate income-specific savings, Cadmus would need to compare the changes in energy use for the low-income treatment customers to the corresponding low-income customers in the control group.

Recommendation: Consider calculating differences in low-income and non-low-income savings to inform and update program design and planning. To do this it will be necessary to identify which control group customers are low-income in the same way treatment group customers are identified.

Impact Evaluation Overview

Table 13 lists the evaluated savings summary for the Residential Behavioral Savings Program. The 2021 evaluation resulted in a 92% energy savings realization rate and a 106% demand realization rate. Cadmus deducted 70,900 kWh and 64.46 kW in uplift savings to avoid double-counting savings claimed in other CenterPoint Energy programs.

Table 13. 2021 Residential Behavioral Savings Program Electric Savings[1]

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rates	NTG Ratio	Evaluated Net Savings
	Reported	Audited	Verified				
Total kWh	7,718,618	7,718,618	7,718,618	7,089,988	92%	N/A	7,089,988
Total kW	1,350	1,350	1,350	1,431	106%	N/A	1,431

[1] Evaluated savings have been adjusted for uplift.

Table 14 and Table 15 show the 2021 reported and evaluated program net energy and demand savings and the realization rates for the RBS Program.[17] The reported energy and demand savings are within Cadmus' 90% confidence interval for evaluated *ex post* savings, suggesting that reported and evaluated savings are not statistically different. Savings in these tables do not include the uplift findings.

Table 14. 2021 RBS Program Energy Savings

Customer Segment	Annual Net Electricity Savings (MWh/yr)		90% Confidence Interval		Relative Precision	Realization Rate
	Reported	Evaluated[1]	Lower Bound	Upper Bound		
Wave 1 Electric Only (2012)	N/A	1,993	183	3,803	±91%	N/A
Wave 1 Dual Fuel (2013)	N/A	3,995	996	6,994	±75%	N/A
Wave 2 Dual Fuel (2020)	N/A	1,173	497	1,850	±58%	N/A
Total	**7,719**	**7,161**	**3,594**	**10,728**	**±50%**	**93%**

[1] Evaluated savings have not been adjusted for uplift.

Table 15. 2021 RBS Program Demand Savings

Customer Segment	Annual Net Electricity Savings (MW/yr)[1]		90% Confidence Interval		Relative Precision	Realization Rate
	Reported	Evaluated	Lower Bound	Upper Bound		
Wave 1 Electric Only (2012)	N/A	0.42	-0.03	0.86	±107%	N/A
Wave 1 Dual Fuel (2013)	N/A	0.83	0.10	1.57	±88%	N/A
Wave 2 Dual Fuel (2020)	N/A	0.24	0.08	0.41	±68%	N/A
Total	**1.35**	**1.50**	**0.99**	**2.00**	**±37%**	**111%**

[1] Evaluated savings have not been adjusted for uplift.

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[17] Because the experimental design uses a control group as the savings baseline, the regression analysis produces only net savings estimates (no gross estimates).

Table 16 lists the evaluated average daily savings per home (kWh/day) relative to control group consumption, for each customer segment (wave) in the program.

Table 16. RBS Program Historical Daily Savings per Customer

Program Year	Wave 1 Electric Only		Wave 1 Dual Fuel		Wave 2 Dual Fuel	
	kWh/day [1]	Percentage [2]	kWh/day [1]	Percentage [2]	kWh/day [1]	Percentage [2]
2012	0.424 (0.093) ***	1.08%	0.215 (0.083) ***	0.66%	N/A	N/A
2013	0.644 (0.14) ***	1.52%	0.304 (0.099) ***	0.98%	N/A	N/A
2014	0.734 (0.176) ***	1.67%	0.424 (0.118) ***	1.38%	N/A	N/A
2015	0.696 (0.175) ***	1.68%	0.464 (0.126) ***	1.52%	N/A	N/A
2016	0.674 (0.188) ***	1.64%	0.428 (0.143) ***	1.37%	N/A	N/A
2017	0.745 (0.197) ***	1.88%	0.391 (0.149) ***	1.31%	N/A	N/A
2018	0.812 (0.244) ***	1.84%	0.292 (0.169) *	0.92%	N/A	N/A
2019	0.673 (0.251) ***	1.60%	0.479 (0.18) ***	1.59%	N/A	N/A
2020	0.799 (0.265) ***	2.00%	0.584 (0.187) ***	2.01%	0.181 (0.098) *	0.51%
2021	0.52 (0.287) *	1.28%	0.432 (0.197) **	1.48%	0.277 (0.097) ***	0.83%

[1] Standard errors clustered on customers are presented after the estimated treatment effect in parentheses (*** Significant at 1%; ** Significant at 5%; * Significant at 10%). The treatment effects represent the average daily savings per treatment group customer.
[2] Percentage savings are relative to control group consumption in the same time period.

In 2021, savings decreased for both Wave 1 segments, from 2% to 1.28% for the electric only and 2.01% to 1.48% for the dual fuel. The Wave 1 dual fuel savings fell back to the typical percentage savings experienced prior to 2020, likely driven by more temperate weather and normalizing to the typical savings. Wave 1 electric only savings fell to the lowest percentage and absolute savings since program launch. Part of this decrease is likely attributable to more temperate weather; however, weather is not likely to be the sole driver.

When examining the monthly savings for Wave 1 electric only, it appeared savings fell unusually between May and October of 2021, averaging 0.39% savings during those months. During the same months in all other program years, average savings were 1.52%. The cause for this specific decrease was not clear with only the billing and weather data and is unlikely to be driven solely based on weather.

Wave 2 had savings of 0.277 kWh per day equivalent to 0.83% of baseline consumption. Monthly savings in the first 18 months of treatment appeared to be ramping upward similar to Wave 1 dual fuel. Cadmus was unable to get reliable savings estimates by low-income status for Wave 2.[18] Cadmus observed that annual pretreatment usage for low-income participants was significantly lower than for standard-income participants, as shown in Table 17. This indicates a not unexpected systematic difference between the two customer segments. Because the control group was not similarly segmented in the data, Cadmus was unable to compare pre- to post-usage changes for the low-income treatment customers compared with corresponding low-income control customers.

18 Wave 2 includes a segment of low-income customers.

Table 17. Pretreatment Usage by Income Status

Wave	Annual Pretreatment Usage		p-value
	Standard-Income Participant	Low-Income Participant	
Wave 2 - Dual-Electric	13,865	9,643	<0.001

Table 18 and Table 19 show annual uplift savings per treated home and total uplift savings by program and wave. All waves exhibited positive uplift savings in 2021, indicating that in 2021 the HERs drove increased savings in other CenterPoint Energy programs. This may be attributable to the change in the report design. Wave 1 dual fuel had the largest amount of savings uplift, accounting for 75% of the energy uplift and 60% of the demand uplift. At a program level, the residential prescriptive program accounted for 67% of the energy savings uplift and 88% of the demand uplift. Because all waves achieved positive uplift savings, Cadmus adjusted all of the wave-level savings to avoid double-counting.

Table 18. 2021 RBS Program Electricity Savings from Uplift

Program	Wave 1 Electric Only		Wave 1 Dual Fuel		Wave 2 Dual Fuel		Total Uplift Savings (kWh/yr)
	Annual Uplift Savings per Home (kWh/yr)	Total Uplift Savings (kWh/yr)	Annual Uplift Savings per Home (kWh/yr)	Total Uplift Savings (kWh/yr)	Annual Uplift Savings per Home (kWh/yr)	Total Uplift Savings (kWh/yr)	
Appliance Recycling	0.26	2,794	-0.16	-4,088	0.22	2,751	1,457
Income Qualified Weatherization	-0.08	-852	1.00	25,962	-0.25	-3,091	22,019
Residential Prescriptive - Marketplace	0.07	806	0.18	4,569	0.04	482	5,857
Residential Prescriptive - Midstream	-0.07	-717	0.08	2,208	0.00	-60	1,431
Residential Prescriptive - Standard	0.57	6,164	0.83	21,648	0.99	12,262	40,074
Smart Cycle	-0.13	-1,403	0.11	2,855	-0.11	-1,391	61
Total	0.63	6,793	2.04	53,154	0.88	10,953	70,900

Table 19. 2021 RBS Program Demand Savings from Uplift

Program	Wave 1 Electric Only		Wave 1 Dual Fuel		Wave 2 Dual Fuel		Total Uplift Savings (kW)
	Uplift Savings per Home (kW)	Total Uplift Savings (kW)	Uplift Savings per Home (kW)	Total Uplift Savings (kW)	Uplift Savings per Home (kW)	Total Uplift Savings (kW)	
Appliance Recycling	0.0002	2.50	0.0000	-1.22	0.0002	2.01	3.29
Income Qualified Weatherization	-0.0001	-0.80	0.0003	7.48	-0.0002	-2.48	4.20
Residential Prescriptive - Marketplace	0.0000	0.04	0.0000	0.50	0.0000	-0.01	0.53
Residential Prescriptive - Midstream	-0.0001	-1.27	0.0001	2.07	0.0000	0.20	0.99
Residential Prescriptive - Standard	0.0008	9.04	0.0012	30.00	0.0013	16.42	55.45
Smart Cycle	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.00
Total	0.0009	9.51	0.0015	38.82	0.0013	16.14	64.46

Appliance Recycling Program

Through the ***Appliance Recycling Program***, CenterPoint Energy provides removal and recycling services for operable refrigerators, freezers, and room air conditioners to prevent older appliances from remaining in service at a participant's premise or elsewhere in CenterPoint Energy's service territory. The program implementer, ARCA Recycling Inc., operates a recycling facility that follows U.S. Environmental Protection Agency best practices and recycles close to 100% of each unit picked up.

In 2021, customers could recycle up to two working refrigerators or freezers, sized 10 to 30 cubic feet, by scheduling a pick-up of the units through the program implementer. CenterPoint Energy provides a $50 incentive to customers for each qualifying refrigerator or freezer unit picked up. Free pick-up of room air conditioners with any qualifying refrigerator or freezer is allowed.

Gross Savings Review

Per-unit savings are decreasing as the program recycles newer refrigerators and freezers over time. In 2021, evaluated per-unit gross kWh savings were 4% lower for refrigerators and 9% lower for freezers compared with CenterPoint Energy's reported savings, which were based on the results of the 2019 evaluation. The main reasons were fewer recycled units manufactured before 1990 and a decrease in average age for recycled units, compared with 2019. Both reasons will remain a challenge over time. In response, CenterPoint Energy marketed a promotion for an Oldest Fridge Contest to encourage customers' oldest appliances to be recycled and awarded a 75-year-old refrigerator as the contest winner.

Recommendation: Though savings will inevitably decline over time, monitor the effects of promotions like the Oldest Fridge Contest on participation from customers with older appliances.

Program Implementation and Delivery

A hybrid pick-up delivery model offers options for customer participation. The implementer reported that many customers appreciated the contactless pick-up option initiated during the COVID-19 pandemic, but some customer segments preferred to have or required assistance with the removal of appliances from their home. The hybrid pick-up model consisted of 70% no contact and 30% in-person contact pick-ups. The implementer said older customers greatly benefited from in-person appliance pick-up, and as a result, CenterPoint Energy will maintain the hybrid pick-up methods for the foreseeable future.

Impact Evaluation Overview

Table 20 lists the evaluated savings summary for the Appliance Recycling Program.

Table 20. 2021 Appliance Recycling Program Electric Savings

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rates	NTG Ratio	Evaluated Net Savings
	Reported	Audited	Verified				
Total kWh	1,438,561	1,438,561	1,438,561	1,376,142	96%	52%	710,771
Total kW	151	151	151	214	141%	54%	116

Table 21 provides per-unit annual gross savings for each program measure.

Table 21. 2021 Appliance Recycling Program Per-Unit Gross Savings

Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
	Reported	Evaluated	Reported[1]	Evaluated
Freezer	709.0	648.0	0.101	0.095
Refrigerator	1,041.0	1,000.0	0.101	0.147
Room Air Conditioner	304.0	304.0	0.101	0.205

[1] CenterPoint Energy's 2021 Electric DSM Scorecard reported an averaged, per-unit kW savings value.

For 2021, Cadmus found a 4% decrease in per-unit evaluated gross energy savings for refrigerators compared with reported savings (which are based on 2019 evaluated savings), primarily due to the following:

- 18 percentage point decrease in the number of refrigerators manufactured before 1990[19]
- 11% decrease in the average age of refrigerators

These two factors are key drivers in how much energy a refrigerator consumes, and the mix of refrigerators collected will drive the per-unit savings up and down.

For freezers, Cadmus found a 9% decrease in per-unit gross energy savings compared with the reported savings, primarily due to the following:

- 6 percentage point decrease in the proportion of the year that the freezers were being used (part-use factor)
- 25 percentage point decrease in freezers manufactured before 1990
- 16% decrease in the average age of freezers

Smart Cycle Program

Through the ***Smart Cycle Program***, CenterPoint Energy direct installs smart thermostats in residential homes to call load control events during the summer peak season. The program targets demand reductions during peak summer hours, but it also achieves energy savings from the smart thermostats throughout the year. CenterPoint Energy recruits participants from the long-running Summer Cycler Program to transition to the Smart Cycle Program.[20] Summer Cycler participants receive complimentary removal of their load control switches, a Nest or ecobee thermostat installed by a technician at no additional cost, and automatic enrollment into the Smart Cycle Program. CenterPoint Energy contracted

[19] The U.S. Department of Energy's energy conservation standards for consumer refrigerators and freezers started in 1990.

[20] The Summer Cycler Program is another CenterPoint Energy program designed to reduce residential and small commercial air-conditioning and water-heating electricity loads during summer peak hours. Through this program, customers receive bill credits for allowing CenterPoint Energy to use radio communication equipment and load control switches to cycle off selected appliances during the summer.

with a local HVAC company, A+Derr, to schedule and perform the removal of the Summer Cycler load control switches and replace them with Nest or ecobee thermostats.

The 2021 Smart Cycle Program evaluation focused only on savings derived from normal use of the Nest and ecobee thermostats that were direct-installed during the 2021 program year. [21]

Program Administration and Delivery

CenterPoint Energy could not deliver the Smart Cycle Program as planned because of the COVID-19 pandemic. Prior to the pandemic, the program was operating successfully. As a result of not meeting the goal of 1,000 installations in 2020, the goal was reduced to 500 units for 2021. Though support through the thermostat vendor's EnergyHub website strengthened Bring Your Own Thermostat (BYOT) participation, this did not impact direct install participation. The COVID-19 pandemic impacted the program implementer's ability to install thermostats, which resulted in the program missing its 500-unit participation goal for 2021.

Recommendation: Increase focus on the BYOT program vendor's EnergyHub to further encourage participation across BYOT and Smart Cycle programs. Increase the variety of creative and engaging marketing campaigns such as "Be Smart, Be a Genius" to promote program awareness and participation.

Peak Demand Savings for Smart Thermostats

There are not enough data to support applying peak demand savings for smart thermostats aside from savings achieved through load control events. The 2015 Indiana TRM v2.2 assumes no coincident peak demand reduction for smart thermostats, and Cadmus could derive no consensus from researching other TRMs or studies. Peak definitions are highly dependent on climate and region, so it is best to rely on peak demand factors from local TRMs. There are conflicting approaches in the industry, so this topic warrants further discussion during the update of the Indiana TRM. The 2021 Smart Cycle evaluation focused only on savings from normal use of the smart thermostats; therefore, this conclusion does not speak to the demand response impacts from Smart Cycle load control events during 2021.

Recommendation: For planning purposes, assume no coincident peak demand savings for normal use of smart thermostats until the new Indiana TRM is released and provides updated guidance. During the Indiana TRM update process, encourage discussion of peak demand savings for smart thermostats.

Impact Evaluation Overview

Table 22 lists the evaluated savings summary for the Smart Cycle Program.

Table 22. 2021 Smart Cycle Program Electric Savings

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rates	NTG Ratio	Evaluated Net Savings
	Reported	Audited	Verified				
Total kWh	89,391	88,409	87,348	90,238	101%	94%	85,073
Total kW	200	198	196	-	-	94%	-

[21] Cadmus evaluates the demand response impacts of this program under a separate evaluation.

Table 23 provides per-unit annual gross savings for each program measure.

Table 23. 2021 Smart Cycle Program Per-Unit Gross Savings

Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
	Reported[1]	Evaluated	Reported[1]	Evaluated
Smart Cycle Thermostat - Dual Fuel	491	310	1.100	-
Smart Cycle Thermostat - Electric	491	958	1.100	-

[1] CenterPoint Energy's 2021 DSM Scorecard did not have kWh or kW savings at the measure level. These per-unit savings reflect an averaged, per-unit reported savings value.

The differences between reported and evaluated kWh savings appear to be caused primarily by the granularity of the reporting measure names. Dual fuel thermostats have non-electric heating systems and central cooling systems; evaluated electric savings for dual fuel thermostats capture central cooling savings only. Electric thermostats have electric heating systems (either electric furnaces or heat pumps) and central cooling systems; evaluated electric savings for electric thermostats capture heating and cooling savings, making savings for these thermostats higher than those of dual fuel thermostats.

Ex ante savings seem to be a weighting of the evaluated savings for these two thermostat measures from the 2019 Smart Cycle evaluation based on installation counts. Weighting the 2021 evaluation results for these two thermostat measures by installation counts in this same way generates a savings of 507 kWh, much more similar to the *ex ante* savings. The remaining differences are due to small changes in correct use rates and heating equipment capacity in the 2021 evaluation compared with the 2019 evaluation. [22] These two variables are updated each year according to the Residential Prescriptive Program's participant survey.

The 2015 Indiana TRM v2.2 does not assign coincident peak demand savings for smart thermostats, so Cadmus assigned 0 kW from normal use of the smart thermostats.

Community Based LED Specialty Bulb Distribution Program

Through the ***Community Based LED Specialty Bulb Distribution Program,*** CenterPoint Energy partners with food banks, trustee offices, and other community events in its electric service territory to give away LED bulbs and LED nightlights at no cost to recipients. Due to modifications to the effective useful life (EUL) baseline for general service LEDs (GSLs), CenterPoint Energy distributed specialty LED bulbs (4-watt candelabras) instead of 9-watt GSLs through the program. In 2021, CenterPoint Energy also began distributing LED nightlights.

Program Design

Low postcard response rates, paired with returned postcards with evaluation survey opt-out requests, limit the ability to verify in-service rate, savings, leakage, and other key evaluation findings. The overall postcard response rate was 2% (n=14,689), or 355, through the end of 2021. Of those 355

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[22] Correct use rate is the percentage of homeowners who use their basic programmable or non-learning Wi-Fi thermostat in an energy-saving manner (i.e., by turning the setpoint down in the winter or up in the summer).

postcards, 337 (95%) were received in time to be sampled for the evaluation survey fielded in mid-December 2021.

Postcard respondents are asked to provide their phone number and willingness to answer additional survey questions; respondents who decline are considered opt-outs and are removed from the evaluation survey sample frame. This year, opt-outs made up 42% of the 337 postcards received in time for the evaluation survey. At the request of the implementer, Cadmus removed another 16% that were probably from students who received bulbs at a school drop-off event. Cadmus also removed postcards with invalid phone numbers. Of the remaining 129 postcard respondents, only 22 completed the evaluation survey, a response rate of 17%.

The evaluation team acknowledges the work the implementer does to bolster postcard response rates, such as offering a financial incentive for the return of the postcard (a drawing for a $25 Walmart gift card) and educating staff at giveaway events to promote postcard returns. Before the onset of the COVID-19 pandemic, these efforts were successful at generating enough postcard responses to reach the target of 70 evaluation survey completes. In 2020, due to the pandemic, fewer giveaway event staff were available to remind individuals to return the postcard and to prominently display postcard drop-off boxes. Given that postcard response rates were again low in 2021, additional changes may be needed to the postcard and to the survey methodology to gather enough customer data to support the evaluation.

Recommendation: Consider revising the survey administration process to prominently display a quick response (QR) code and survey link directly on the giveaway packaging so participants can take the survey immediately, rather than submitting a postcard to take a survey later. CenterPoint Energy and its implementer are already exploring opportunities for updates.

Recommendation: If CenterPoint Energy continues to collect participant contact information for the survey via a postcard, consider requesting the participant's email address as well as the phone number. Update survey messaging to promote the financial incentive of being entered in a drawing for a $100 VISA gift card. In addition, since the customer is already providing responses to a few questions from the implementer via the postcard, consider removing the opt-out option to allow for a more robust evaluation survey population.

Community events that specifically targeted the income-qualified population served this population much better than did community events that were open to the general population. There were six community events in 2021. Of three community events specifically targeted to serve income-qualified customers, savings attributed to income-qualified customers ranged from 75% to 100%. Of three community events targeted to the general population, savings attributed to income-qualified customers ranged from 14% to 25%.

Recommendation: To optimize net savings and for the larger benefit and engagement of income-qualified customers, focus on hosting community events with organizations such as community action agencies that serve the income-qualified population. For such agencies that host a giveaway, perhaps along with an energy education event, Cadmus would assume the population of that event would all be income-qualified, and the NTG would be 100%.

Reported Savings

CenterPoint Energy used its 2020 *ex post* per-unit value for a 9-watt GSL as a proxy for its 4-watt candelabra measure, which affected program realization rates. The per-unit savings of the 2021 program candelabras were 6% greater than the program GSLs in 2020. It would have been more appropriate to estimate savings based on a 4-watt candelabra, as was done for the LED nightlights.

Recommendation: To improve realization rates, consider estimating reported savings for any new measures, in this case, for LED bulbs with different wattages. For 4-watt candelabras, assume gross, per-unit savings of 31.36 kWh and 0.0043 kW. Cadmus could assist with forecasting savings for future measures.

In-Service Rates

The in-service rates for the specialty LED bulbs in 2021 were less than the in-service rates of historical GSLs, and this trend will probably continue. In the 2020 Residential Lighting Program, specialty bulbs comprised 18% of the verified program LED bulbs, and GSLs comprised 61% of the verified program bulbs. The 2021 participant survey identified a specialty bulb in-service rate of 72%, compared with 84% for GSLs in the 2019 survey (the most recent survey for which Cadmus had enough responses). In 2021, five of 16 survey respondents said that no bulbs outside of traditional, general-purpose bulbs would be useful in their home. Since specialty LED bulbs comprise a smaller share of overall bulbs, it is inherently difficult to obtain an in-service rate for specialty bulbs equivalent to in-service rates for GSLs in a similar program. However, six of the 16 survey respondents said candelabras would be the most useful non-general-purpose bulb; therefore, candelabras may be a good specialty bulb choice for CenterPoint Energy to offer its customers.

Recommendation: For program planning purposes, assume that the in-service rates for specialty LED bulbs will be about 72%, as determined in this evaluation, rather than about 84%, as in 2019.

LED Nightlights – Quantity

Distributing two LED nightlights through the program worked well. The program began distributing LED nightlights in 2021, which made up 22% of gross savings, with an in-service rate was of 83%. Note that in-service rates can decline quickly when more units are added, so two is likely the ideal number of LED nightlights per household.

Impact Evaluation Overview

Table 24 lists the evaluated savings summary for the Community Based LED Specialty Bulb Distribution Program. The realization rate for energy savings is 71%, mainly due to the 72% in-service rate. The realization rate for demand savings is 52% because reported savings assumed there were demand savings for LED nightlights; however, the 2015 Indiana TRM v2.2 specifies there are no demand savings for LED nightlights.

Table 24. 2021 Community Based LED Specialty Bulb Distribution Program Electric Savings

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rates	NTG Ratio	Evaluated Net Savings
	Reported	Audited	Verified				
Total kWh	1,997,113	1,997,113	1,342,714	1,410,282	71%	91%	1,278,861
Total kW	322	321	221	167	52%	91%	153

Table 25 provides per-unit annual gross savings for each program measure and program component. Food bank events refer to giveaways completed at 17 food banks in CenterPoint Energy's territory. Community events are giveaways hosted at venues that are not food banks, such as schools, zoos, and street fairs.

Table 25. 2021 Community Based LED Specialty Bulb Distribution Program Per-Unit Gross Savings

Program Component	Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW) [1]	
		Reported	Evaluated	Reported[2]	Evaluated
Food Bank Events	4W Candelabra	29.6	31.4	0.0041	0.0043
Food Bank Events	LED Nightlight	13.1	13.1	0.0041	-
Community Events	4W Candelabra	29.6	31.4	0.0041	0.0043
Community Events	LED Nightlight	13.1	13.1	0.0041	-

[1] Results presented at the fourth decimal place to show difference between reported and evaluated
[2] CenterPoint Energy's 2021 Electric DSM Scorecard reported an averaged, per-unit kW savings value.

Food bank events are assumed to have all of their savings attributed to income-qualified customers, but savings for community events vary.

If the community event was hosted at a school, then the percentage of income-qualified was equal to the percentage of students who qualify for free or reduced lunch. If the community event was hosted by a community action agency that specifically serves the income-qualified community, then 100% of the savings were assumed to be attributed to income-qualified customers. If a community event was open to everyone, Cadmus estimated the proportion of income-qualified customers based on the American Community Survey (ACS) data for the zip code of the event.

Gross savings for 4-watt candelabras differed from reported savings because reported savings used the *ex post* savings of a 9-watt general purpose LED from 2020. Though the hours of use assumption and waste heat factors are the same for these bulb types, their baseline and efficient wattages differ.

For LED nightlights, the reported and evaluated savings followed the 2015 Indiana TRM v2.2, using the actual wattage, and therefore no difference in gross per-unit energy savings. For the demand savings, reported per-unit savings assumed there were demand savings; however, the 2015 Indiana TRM v2.2 specifies there are no demand savings for LED nightlights.

Commercial and Industrial Programs

Commercial and Industrial Prescriptive Program

Through the ***Commercial and Industrial (C&I) Prescriptive Program,*** CenterPoint Energy provides prescriptive rebates to facilities, based on the installation of energy-efficient equipment and system improvements. Rebates address lighting, variable frequency drives, HVAC, refrigeration, compressed air, and through a midstream delivery channel, commercial kitchen appliances. The program implementer, Resource Innovations, formerly Nexant, processes program paperwork and, with the help of trade allies, promotes the program to CenterPoint Energy customers.

Program Design

The implementer's trade ally engagement strategy supports program delivery. In 2021, 34% of participants (n=32) learned about the program through trade allies. Program awareness relies heavily on engaging contractors to promote and deliver the program. The implementer enhanced its contractor search engine, contractor enrollment process, and online platform resources for contractors in 2021. It also extended the Mobile Assessment Tool application beyond the small business customer segment, which helped bridge the application process across the Small Business Energy Solutions (SBES) and C&I Prescriptive programs. Though the number of actively participating contractors declined to 120 in 2021 from 128 in 2020, 11% of the 2021 contractors participated in multiple C&I programs, compared with 6% in 2020. Most surveyed participants were very satisfied with the C&I Prescriptive Program overall (88%, n=32) and are very likely to recommend it to another business (87%, n=31). Of the participants who worked with a contractor on their project, 91% (n=21) were highly satisfied with their contractor.

Lighting Calculation Differences

Lighting realization rates shift year-over-year and that is very likely due to differences in reported waste heat factor and coincident factors. The 2015 Indiana TRM v2.2 does not have a centralized building type list for lighting hours, waste heat factors, and coincidence factors, which results in challenges in matching reported building types to TRM inputs and varying year-over-year realization rates. This year's lighting realization rate was 103%, compared with 91% in 2019 and 96% in 2020. Explicitly reporting the sources for lighting inputs and working with Cadmus to agree on the overall building type mapping scheme will improve the accuracy of the *ex ante* savings.

Recommendation: The implementer and Cadmus should agree on a building type mapping for reporting lighting savings. Also, consider specifying the building type mapping or other source (i.e., the application) for the lighting hours, waste heat factors, and coincidence factors in the database.

Chiller Baseline Values

Baseline efficiency for chillers is increasing due to market transformation. In 2021, chillers and chiller tune-ups made up 21% of electric *ex post* energy savings. The Indiana commercial building energy efficiency code, last updated in 2010, states the minimum efficiency for chillers must follow ASHRAE 90.1-2007. However, many portions of the North American market (and especially the most populous states) follow the more efficient IECC 2015, IECC 2018, or a more efficient iteration of the ASHRAE building energy efficiency code,[23] and CenterPoint Energy should expect an updated version of commercial energy efficiency code in the near future, similar to the recent update to the residential energy efficiency code.[24]

Recommendation: Monitor potential changes to the commercial energy efficiency code to inform future program design. Advocate for the review of the measure as part of the upcoming Indiana TRM update process. CenterPoint Energy should also conduct market research to determine whether manufacturers are exclusively producing equipment to meet code requirements in most states and, therefore, this equipment is more efficient than the minimum required in Indiana.

Impact Evaluation Overview

Table 26 lists the evaluated savings summary for the C&I Prescriptive Program.

Table 26. 2021 Commercial and Industrial Prescriptive Program Electric Savings

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rates	NTG Ratio	Evaluated Net Savings
	Reported	Audited	Verified				
Total kWh	12,714,310	12,714,310	12,714,310	13,038,378	103%	76%	9,909,167
Total kW	2,541	2,541	2,541	3,757	148%	76%	2,856

The C&I Prescriptive Program had an energy realization of 103% and a demand realization rate of 148%, primarily from aligning lighting measure inputs in accordance with the 2015 Indiana TRM v2.2 and by building type. Lighting comprised 68% of the *ex post* energy savings and 75% of the *ex post* demand savings; therefore, any changes to lighting drove the overall program realization rates. Cadmus found that waste heat factors and coincidence factors for lighting were generally applied incorrectly and correcting these increased the energy and demand savings.

Table 27 provides per-unit annual gross savings for each program measure.

23 Office of Energy Efficiency & Renewable Energy. "Status of State Energy Code Adoption – Commercial." Last updated January 13, 2022. https://www.energycodes.gov/status/commercial.

24 2020 Indiana Residential Code. 675 IAC 14-4.4. Effective December 26, 2019. https://www.in.gov/dhs/fire-and-building-safety/fpbsc-rules/.

Table 27. 2021 Commercial and Industrial Prescriptive Program Per-Unit Gross Savings

Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
	Reported[1]	Evaluated	Reported[1]	Evaluated
Chillers	47,793.6	48,106.2	16.074	15.028
Clothes Washer	541.5	748.4	-	-
Compressed Air Systems	100,239.6	97,369.3	13.724	6.404
Controls	1,611.8	1,611.8	-	-
Heat Pump Water Heater	664.5	664.5	0.100	0.095
HVAC	725.5	702.6	0.147	0.248
Kitchen Equipment	3,188.6	3,259.7	0.300	0.459
Lighting	279.1	287.5	0.048	0.092
Refrigeration	2,911.5	662.8	0.330	0.076
Thermostat	1,754.7	1,754.7	-	-
VFD/Motor	2,913.4	3,832.2	0.150	0.144

[1] CenterPoint Energy's 2021 DSM Scorecard did not include per-unit kWh or kW savings value. Cadmus used available information to provide the averaged, per-unit reported savings value.

Table 28 summarizes the primary reasons for differences from reported to evaluated per-unit energy and demand savings by measure.

Table 28. 2021 Commercial and Industrial Prescriptive Program Summary of Differences in Per-Unit Savings by Measure

Measure	Updated Federal Baseline Standards	Updates for Early Replacement Baseline	Corrected Algorithm Inputs	No Difference in Reported/ Evaluated Savings
Chillers		✓	✓	
Clothes Washer			✓	
Compressed Air Systems			✓	
Controls				✓
Heat Pump Water Heater				✓
HVAC		✓	✓	
Kitchen Equipment			✓	
Lighting		✓	✓	
Refrigeration	✓			
Thermostat				✓
VFD/Motor			✓	

For chillers, compressed air systems, controls, heat pump water heaters, HVAC, kitchen equipment, lighting (energy savings only), and thermostats, the difference in reported and evaluated per-unit savings was under 5% or there was no difference at all, and the corrected algorithm inputs were generally minor. However, because lighting makes up a majority of energy savings for the C&I Prescriptive Program, any differences in reported and evaluated savings have a large effect.

In 2021, evaluated per-unit energy savings were greater than reported by 28% for clothes washers and 24% for VFD/motors. Evaluated per-unit energy savings were lower than reported by 339% for refrigeration. For the one clothes washer measure, Cadmus used the residential-duty clothes washer measure type in the Illinois TRM V9.0 to align with program tracking data instead of using the commercial clothes washer measure in the 2015 Indiana TRM v2.2 as was reported. For VFD/motor measures, Cadmus adjusted the total horsepower for motors from the incorrect sizing in the reported savings. As in recent years, refrigeration had the most notable difference because Cadmus used the updated federal standards rather than the baseline from the 2015 Indiana TRM v2.2.

For demand savings, the reasons for differences in per-unit savings are the same as for energy savings, as shown in Table 28 above, but the effects of the incorrectly applied waste heat factors and coincidence factors on lighting measures were greater than for energy savings.

Commercial and Industrial Custom Program

Through the ***Commercial and Industrial (C&I) Custom Program,*** CenterPoint Energy focuses on energy-saving projects unique to the commercial participant's facility. Customers and/or their trade allies submit engineering analyses showing first-year savings to qualify for program incentives. CenterPoint Energy calculates program incentive levels on a basis of estimated first-year, amount-of-energy saved ($0.10 per kWh saved and $1.00 per therm saved). Incentives cannot exceed 50% of total project costs and must have a maximum of up to $100,000 for qualified projects. Projects achieving a simple payback of one year or less do not qualify for the program.

The C&I Custom Program includes multiple subcomponents, as described in Figure 2.

Figure 2. 2021 C&I Custom Program Subcomponents

CenterPoint Energy administers the program. Resource Innovations, formerly Nexant, acts as program implementer. The program implementer is also subcontracted with Willdan, which engages design teams for the new construction component of the program. Trade allies, including design firms and installation contractors, promote the program and execute custom energy efficiency measures.

Program Delivery

The C&I Custom Program exceeded its therm savings goal but did not reach its electric savings or demand goals. The program achieved 31% of *ex ante* gross electric savings, 55% of *ex ante* gross demand, and 279% of the *ex ante* gross therm savings goal. In 2021, program participation was 26%, compared with 70% in 2020. Although the number of projects in the New Construction Program decreased slightly, most of the electric savings came through installation of C&I Custom Program measures.

CenterPoint Energy used trade allies who were effective at both recruitment and program implementation. The six survey participants reported high satisfaction with the program as well as with the contractors who installed their equipment. Three of the respondents said they learned about the program through trade allies. A key asset of the program is to use fully engaged and high-performing contractors to deliver savings.

Specific Savings Criteria

The building tune-up program subcomponent remains a small percentage of the C&I Custom Program electric savings. In 2021, for the third year in a row, building tune-ups comprised approximately 3% of C&I Custom Program savings and contributed 66% less kWh savings than in 2020. Of facilities that received a building tune-up in 2021, one was an office building and one was a civic center. There were no facilities that deliver healthcare services. In general, health care facilities have robust building management systems and significant tune-up opportunities, and they are underrepresented in the C&I Custom Program; however, they have probably been focused on overcoming the challenges of delivering services during the COVID-19 pandemic.

Recommendation: Though building tune-ups are targeted to buildings between 50,000 and 150,000 square feet, consider specifically targeting hospital and health care facilities. Only one hospital participated in the C&I Custom Program by implementing a single measure.

Impact Evaluation Overview

Table 29 lists the evaluated savings summary for the C&I Custom Program.

Table 29. 2021 Commercial and Industrial Custom Program Electric Savings

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rates	NTG Ratio	Evaluated Net Savings
	Reported[1]	Audited	Verified				
Total kWh	1,714,556	1,714,556	1,714,556	1,714,556	100%	93%	1,594,537
Total kW	376	376	376	376	100%	93%	349

[1] CenterPoint Energy's 2021 DSM Scorecard did not have kW or kWh savings at the application level. These reported savings reflect audited savings from the 2021 program tracking data. Reported total kW differs from the scorecard due to rounding.

Table 30 provides per-unit annual gross savings for each of the 17 program measures (application identifiers [IDs]). An application ID is associated with an organization and may include one or multiple, unique measure IDs.

Table 30. 2021 Commercial and Industrial Custom Program Per-Unit Gross Savings

Measure (Application ID)	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
	Reported[1]	Evaluated	Reported[1]	Evaluated
3210	164,364.0	164,364.0	20.140	20.140
3216	44,307.3	44,307.3	3.040	3.040
3575	86,924.5	86,924.5	36.310	36.310
3796	11,751.6	11,751.6	2.880	2.880
3804	247,141.9	247,141.9	0.000	0.000
4016	19,123.1	19,123.1	46.680	46.680
4020	664,750.1	664,750.1	86.560	86.560
4021	27,635.0	27,635.0	100.220	100.220
4242	134,657.8	134,657.8	9.900	9.900
4310	71,676.6	71,676.6	14.120	14.120
4358	1,969.5	1,969.5	0.000	0.000
4619	105,309.3	105,309.3	0.000	0.000
4629	39,578.2	39,578.2	0.271	0.271
4647	59,200.4	59,200.4	48.910	48.910
4673	10,306.3	10,306.3	2.000	2.000
4674	9,734.4	9,734.4	1.870	1.870
4675	16,126.7	16,126.7	2.770	2.770

[1] CenterPoint Energy's 2021 DSM Scorecard did not have kW or kWh savings at the application level. These reported savings reflect audited savings from the 2021 program tracking data.

In 2021, 59 electric energy-saving measures were installed at 15 buildings under the 17 application IDs through the C&I Custom Program:[25]

- 13 lighting upgrades
- 1 building envelope upgrade
- 1 compressed air upgrade
- 3 commercial kitchen equipment
- 30 HVAC control-related upgrades
- 8 HVAC equipment upgrades
- 2 industrial process upgrades
- 1 laundry equipment upgrade

Cadmus performed desk reviews on 42 measures, which made up 99% of the *ex ante* energy savings. For the remaining measures, Cadmus ensured that the underlying methodology was consistent with the other projects in the program and found no clerical issues for nonqualifying products and no double-counting of savings. Evaluated savings aligned with CenterPoint Energy's reported savings, and Cadmus made no adjustments.

Cadmus found that several measures had zero coincident peak demand savings because there was either no reduction in demand or the reduction occurred outside of peak demand hours (e.g., exterior

[25] 2021 natural gas energy-saving projects are evaluated in the *2021 CenterPoint Energy Demand-Side Management Portfolio Natural Gas Evaluation Key Findings, Conclusions, and Recommendations Memo.*

lighting where the demand reduction is at night). Additional details for measure savings can be found in *Appendix A. Impact Evaluation Methodology*.

Small Business Energy Solutions Program

Through the ***Small Business Energy Solutions (SBES) Program,*** CenterPoint Energy helps qualifying businesses identify savings opportunities by providing free on-site energy assessments, installation of energy-efficient measures, and low-cost pricing for energy-efficient measures recommended in the assessments. To participate, a customer's business must be in CenterPoint Energy's service territory and have a peak electric demand of 400 kW or less over the past 12 months. Resource Innovations, previously Nexant, is the program implementer, while participating trade allies are responsible for customer outreach, conducting on-site energy assessments, and installing no-cost and low-cost direct install measures.

Program Experience

Participants are highly satisfied with program equipment and are seeking further savings. Survey participants expressed high satisfaction with their installed equipment. A few survey respondents requested that CenterPoint Energy provide additional measures through the program, including thermostats and water-saving devices, which are already offered as no-cost measures through the SBES Program. When asked why they did not install a thermostat or water-saving device, respondents said they were not offered one.

Recommendation: Update no-cost measures, such as thermostats, to low-cost measures, requiring a co-pay to incentivize trade allies to install these measures.

Gross Savings

Program tracking data discrepancies resulted in underestimated savings. Tracking data reported four projects with differences in reported savings (representing 25% of total Wi-Fi and programmable thermostats). The eQuest model uses six different tracking data inputs to find appropriate heating therm savings, cooling kWh savings, heating multipliers, fan kWh savings (heating), and fan kWh savings (cooling) based on the model.

Recommendation: Ensure that the building heating type, heating and cooling setback details, and business hours of operation, including days closed, in the tracking data are also correctly tracked in the eQuest model.

Impact Evaluation Overview

Table 31 lists the evaluated savings summary for the SBES Program.

Table 31. 2021 Small Business Energy Solutions Program Electric Savings

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rates	NTG Ratio	Evaluated Net Savings
	Reported	Audited	Verified				
Total kWh	5,196,177	5,196,177	5,196,177	5,426,531	104%	88%	4,775,347
Total kW	632	1,189	1,189	1,225	194%	88%	1,078

Table 32 provides per-unit annual gross savings for each program measure.

Table 32. 2021 Small Business Energy Solutions Program Per-Unit Gross Savings

Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
	Reported[1]	Evaluated	Reported[1]	Evaluated
Lighting - Controls	141.3	136.9	0.030	0.032
Lighting - Exit Signs	85.4	87.4	0.030	0.011
Lighting - Exterior	878.1	889.3	0.030	0.000
Lighting - Interior	182.1	193.1	0.030	0.066
Lighting - Refrigerated Cases	218.7	218.7	0.030	0.032
Vending Machine Occupancy Sensors	1,547.4	1,611.8	0.000	0.000
Wi-Fi and Programmable Thermostats	1,863.0	2,047.5	0.030	0.000

[1] CenterPoint Energy's 2021 DSM Scorecard did not have kWh or kW savings at the measure level. Per-unit kWh savings reflect audited savings from the 2021 program tracking data, and per-unit kW savings reflect an averaged value based on the 2021 program tracking data.

In 2021, most differences between reported and evaluated savings were due to differences in input values for installation location for lighting measures, which in turn led to differences in the applied *ex post* waste heat factors and coincidence factors. The following four measures had large deviations between reported and evaluated savings:

- **Lighting – exterior.** Exterior lighting did not receive evaluated demand savings because Cadmus determined these measures were installed in unconditioned locations. Cadmus used hours of use and baseline wattages as reported in the tracking database and a coincidence factor of 0%, as stated in the 2015 Indiana TRM v2.2. Lighting installed in unconditioned spaces does not have any interactive effects with HVAC equipment, so no waste heat factors were applied to the exterior lighting measures.
- **Lighting controls.** Evaluated savings aligned well with the tracking database, with the exception of four records (22% of lighting control records). One project had an incorrect baseline equipment size. Three records used a different energy waste heat factor; all were installations at religious worship sites but used different building types. Inputs for *ex ante* savings use the "Religious" building type; however there is no record of this type of building in the 2015 Indiana TRM v2.2. Ex *post* savings used the "Public Assembly" building type, which followed the building description in the TRM.
- **Interior lighting.** In the tracking data, 102 projects (8% of interior lighting records) had no reported kWh savings or energy demand, and 142 records (11% of interior lighting records) used a different energy waste heat factor in the *ex ante* and *ex post* calculations.
- **Wi-Fi and programmable thermostats.** Thermostats had an energy savings realization rate of 110%. The deviation from 100% is mainly because five projects (31% of installed smart thermostats) with electric resistance heating systems reported inconsistent energy savings and energy demand, derived from the eQuest thermostat model. Heating multipliers vary according to the building's heating system and should be properly tracked to avoid differences in the realization rate.

Appendices

Appendix A. Impact Evaluation Methodology

As a part of the impact evaluation, Cadmus reviewed gross savings, verified measure installation, and determined freeridership and spillover to calculate a net-to-gross (NTG) ratio and estimated realized program savings. The impact evaluation reports the following metrics:

- **Reported *ex ante* savings.** Annual gross savings for the evaluation period, as reported by CenterPoint Energy in the 2021 Electric DSM Scorecard.
- **Audited savings.** Annual gross savings after CenterPoint Energy's per-unit calculations and measure counts were confirmed by Cadmus (using 2021 program tracking data).
- **Verified savings.** Annual gross savings adjusted for an in-service rate.
- **Evaluated *ex post* savings.** Annual gross savings adjusted for an in-service rate and savings adjustments resulting from the gross savings review.
- **Realization rate (percentage).** The percentage of savings the program actually realized, calculated as follows:

$$Realization\ Rate = \frac{Ex\ Post\ Savings}{Ex\ Ante\ Savings}$$

- **Evaluated net savings.** Evaluated *ex post* savings, adjusted for NTG (i.e., freeridership and spillover).

A.1 Gross Savings Review

Cadmus calculated electric energy savings and demand reduction for all programs. This appendix details the specific methodology Cadmus used to determine per-unit gross savings. Table A-1 lists the evaluation activities Cadmus performed for each program, including these:

- ***Engineering analysis.*** To assess CenterPoint Energy's claimed energy savings and coincident peak demand reduction, Cadmus conducted an engineering desk review for most of CenterPoint Energy's 2021 demand-side management (DSM) programs. Cadmus used assumptions from technical reference manuals (TRMs) from Indiana and other states and industry studies to determine inputs to the savings estimates, which were calibrated with survey results and program tracking data where possible. Cadmus also determined if any additional savings were generated from the early replacement of measures installed through the residential and commercial and industrial (C&I) prescriptive programs, based on program data and survey results.
- ***REM/Rate analysis.*** Cadmus conducted a REM/Rate analysis for the Residential New Construction Program, which entailed modeling a baseline home, which Cadmus compared with participant homes that received program incentives. Cadmus relied on the Home Energy Rating System (HERS) certificates for the key data inputs that modeled home savings.
- ***Regression/billing analysis.*** Through billing analyses, Cadmus modeled savings by comparing the consumption of program participants to nonparticipants while controlling for exogenous factors such as weather.

Table A-1. Gross Savings Review Task by Program

Program	Engineering Analysis	REM/Rate Analysis	Regression/ Billing Analysis
Residential Programs			
Residential Specialty Lighting	✓		
Residential Prescriptive	✓		
Midstream Pilot	✓		
Residential New Construction	✓	✓	
Income Qualified Weatherization	✓		
Energy Efficient Schools	✓		
Residential Behavioral Savings			✓
Appliance Recycling	✓		✓
Smart Cycle	✓		
Community Based LED Specialty Bulb Distribution	✓		
Commercial and Industrial Programs			
C&I Prescriptive	✓		
C&I Custom	✓		
Small Business Energy Solutions	✓		

A.1.1 Measure Verification

Cadmus reviewed tracking data to audit measure installations for all programs. As shown in Table A-2, for most programs, Cadmus relied on surveys with program participants, along with program application documentation, to confirm customer participation status, the number and type of measures that received program incentives, and the persistence of installations. Cadmus used this equation to calculate the in-service rate for each program:

$$In - Service\ \text{Rate} = \frac{\text{Verified Installations}}{\text{Reported Installations}}$$

Table A-2. Measure Verification Method by Program

Program	Program Data Review	Participant Surveys	Deemed Value 2019/2020[1]	Secondary Resource[2]
Residential Programs				
Residential Specialty Lighting	✓			✓
Residential Prescriptive – Standard and Marketplace	✓	✓		
Residential Prescriptive - Midstream	✓			
Residential New Construction	✓		✓	
Income Qualified Weatherization	✓	✓		
Energy Efficient Schools	✓		✓	
Residential Behavioral Savings	✓			
Appliance Recycling	✓	✓		
Smart Cycle	✓		✓	
Community Based LED Specialty Bulb Distribution	✓	✓		

Program	Program Data Review	Participant Surveys	Deemed Value 2019/2020[1]	Secondary Resource[2]
Commercial and Industrial Programs				
Commercial and Industrial Prescriptive	✓	✓		
Commercial and Industrial Custom	✓	✓		
Small Business Energy Solutions	✓	✓		

[1] Cadmus applied in-service rates and fuel shares from surveys conducted as part of the program's 2019 and 2020 evaluation.
[2] Cadmus used the discounted future savings approach from the Uniform Methods Project to account for lifetime in-service rates and savings for installations in future years.

A.2 Residential Specialty Lighting Program

Cadmus' impact evaluation of the Residential Specialty Lighting program included two categories of measures with attributable electric saving:

- LED reflector
- Specialty LED (candelabra or globe)

A.2.1 LED Lighting

To determine the program's *ex post* gross savings, Cadmus applied the deemed values in the 2015 Indiana TRM v2.2 for hours of use (HOU), waste heat factor (WHF), and coincidence factor (CF) to determine the *ex post* savings for each lamp's stock keeping unit (SKU) in the program's tracking database.[26] Cadmus then totaled the savings by each specific lamp type. The 2015 Indiana TRM v2.2 uses the following equations for determining energy savings and demand reductions for residential lighting:

$$\Delta kWh = \left(\frac{watts_{BASE} - watts_{EFF}}{1000}\right) * ISR * HOURS * (1 + WHF_E)$$

$$\Delta kW = \left(\frac{watts_{BASE} - watts_{EFF}}{1000}\right) * CF * HOURS * (1 + WHF_D)$$

To determine baseline watts for all program bulbs, ($watts_{base}$), Cadmus used the ENERGY STAR® lumens equivalence method specified in the most recent version of the Uniform Methods Project.[27] After carefully reviewing the delta watts multiplier approach recommended by the 2015 Indiana TRM v2.2, Cadmus determined that the specific values in the delta watts multiplier approach were out of date.

[26] Stock keeping unit (SKU) is the standard retail categorization that identifies each individual product a particular retailer sells. Cadmus used SKU as a unique identifier for each lamp for which the Residential Lighting Program provided incentives through each participating retailer.

[27] Dimetrosky, S., K. Parkinson, and N. Lieb. October 2017. *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.* "Chapter 6: Residential Lighting Evaluation Protocol." https://www.nrel.gov/docs/fy17osti/68562.pdf

When the delta watts multiplier for LEDs was generated for the 2015 Indiana TRM v2.2, LEDs produced, on average, around 50 lumens per watt. For 2021 data, the average LED produced closer to 86 lumens per watt. This means that, as the technology improves, the continued use of the current TRM multiplier will probably significantly understate the savings potential of LED bulbs.

Cadmus used specified values for hours of use, waste heat factor for energy and demand, and coincidence factor for demand from the 2015 Indiana TRM v2.2. These values are listed in Table A-3.

Table A-3. Residential Lighting Program Deemed Inputs Used to Determine *Ex Post* Gross Savings

Input	Deemed Input
Hours of Use[1]	902
Coincidence Factor[2]	0.11
Waste Heat Factor Energy[3]	-0.034
Waste Heat Factor Demand[3]	0.092
In-Service Rate	89%

[1] TecMarket Works, et al. *Indiana Core Lighting Logger Hours of Use (HOU) Study*. July 29, 2013. Annual hours of use for specialty bulbs and multifamily common areas are from 2015 Illinois TRM, Version 4.0.
[2] Nexus Market Research, RLW Analytics, and GDS Associates. January 20, 2009. *New England Residential Lighting Markdown Impact Evaluation.*
[3] Based on weighted average waste heat factor for Evansville Indiana. 2015 Indiana TRM v2.2.

A.2.2 Lighting Measure Verification

For the Residential Specialty Lighting program, Cadmus calculated verified savings by applying an in-service rate to program-sponsored bulbs by lamp type. Retailers participating in upstream lighting programs do not track installation of program-sponsored bulbs, so Cadmus could not determine how many bulbs customers installed after purchase. Therefore, Cadmus calculated in-service rates based on the discounted future savings approach from the Uniform Methods Project to account for lifetime in-service rates and savings for installations in future years.[28] Table A-4 lists the in-service rates for each program measure.

Table A-4. 2021 Residential Lighting Program Measure Verification Results – In-Service Rates

Measure Category	Installations			In-Service Rate[1]
	Reported	Audited	Verified	
LED Reflector	84,854	84,854	75,520	89%
LED Specialty	87,251	87,251	77,653	89%
Total	**172,105**	**172,105**	**153,173**	**89%**

[1] ISRs are adjusted to include savings for lamps installed through the end of 2022.

[28] Dimetrosky, S., K. Parkinson, and N. Lieb. October 2017. “Chapter 6: Residential Lighting Evaluation Protocol.” *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.* p. 22. http://www.energy.gov/eere/about-us/ump-protocols

In-service rates account for the delayed installation of lamps and upcoming changes to baseline lamp definitions. In Indiana, 86% of LED lamps are expected to be installed in the first year after purchase.[29] In subsequent years, additional lamps are installed. The Uniform Methods Project states that approximately 24% of stored lamps are installed in the first year following purchase, and 24% of stored lamps are installed in the second year after purchase, and so on.[30] Cadmus used the program savings discounting method and, after accounting for the assumption that LEDs will not get savings credit following the application of updated EISA baselines in 2023, applied an in-service rate of 89% to all specialty and reflector LEDs in 2021. This is consistent with a year and a half of carryover savings.

A.3 Residential Prescriptive Program

Cadmus' impact evaluation of the Residential Prescriptive Program included measures with attributable electric savings, including these:

HVAC measures:

- Air conditioner and heat pump tune-ups
- Air source heat pumps
- Central air conditioners
- Ductless heat pumps

Thermostats:

- Smart programmable thermostats
- Wi-Fi thermostats

Weatherization measures:

- Attic and wall insulation
- Duct sealing

Other:

- Air purifiers
- Clothes dryers
- Clothes washers
- Dehumidifiers
- Faucet aerators
- Heat pump water heaters
- Lighting
- Pool heaters
- Smart power strips
- Variable speed pool pumps

A.3.1 HVAC Measures

Air Conditioner and Heat Pump Tune-Up

Cadmus started with the 2015 Indiana TRM v2.2 methodology, which used this formula to calculate savings per air conditioner and heat pump tune-up:

$$\Delta kWh_{CAC} = EFLH_{Cool} * Btuh_{Cool} * \frac{1}{SEER_{CAC} * 1{,}000} * MF_E$$

[29] Cadmus applied first-year in-service rates, derived through the *2014 Market Effects Study* from Opinion Dynamics (2015), the most current research available from Indiana. More recent studies in Maryland (86%, 2016) and New Hampshire (87%, 2016) have similar first year LED ISRs. ISRs for LEDs typically range between 74% (Wyoming, 2016) and 97% (New Hampshire, 2016).

[30] Dimetrosky, S., K. Parkinson, and N. Lieb. October 2017. "Chapter 6: Residential Lighting Evaluation Protocol." *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.* p. 22. http://www.energy.gov/eere/about-us/ump-protocols

$$\Delta kWh_{ASHP} = \left(EFLH_{Cool} * Btuh_{Cool} * \left(\frac{1}{SEER_{ASHP}}\right) + EFLH_{Heat} * Btuh_{Heat} * \left(\frac{1}{HSPF_{ASHP}}\right)\right) * \frac{MF_E}{1{,}000}$$

$$\Delta kW = Btuh_{Cool} * \frac{1}{EER * 1{,}000} * MF_D * CF$$

Where:

$EFLH_{Cool}$	=	Equivalent full load cooling hours
$BTUH_{Cool}$	=	Cooling capacity of equipment in BTUH
$SEER_{CAc}$	=	SEER efficiency of existing central air conditioning unit receiving maintenance
MF_E	=	Maintenance energy savings factor
$SEER_{ASHP}$	=	SEER efficiency of existing air-source heat pump unit receiving maintenance
$EFLH_{Heat}$	=	Equivalent full load heating hours
$BTUH_{Heat}$	=	Heating capacity of equipment in BTUH
HSPFBase	=	Heating season performance factor of existing air-source heat pump unit receiving maintenance
EER	=	EER efficiency of existing unit receiving maintenance
MFD	=	Maintenance demand reduction factor
CF	=	Summer peak coincidence factor

To determine equivalent full load hours (EFLH), each installation was matched to its nearest 2015 Indiana TRM v2.2 reference city using the installation location's zip code. The FLH associated with that reference city was then used in the savings calculation for the installation. Table A-5 shows the other variables used in this evaluation.

Table A-5. Residential Prescriptive Program Air Conditioner and Heat Pump Tune-Up Calculation Variables

Variable	Value	Units	Source
$BTUH_{Cool}$	AC 36,048 HP 33,465	BTUH	2021 Residential Prescriptive Program tracking data
$SEER_{CAC}$	10	BTUH/Watt-hr	Illinois TRM V9.0
MF_E	5%	%	2015 Indiana TRM v2.2
$SEER_{ASHP}$	10	BTUH/Watt-hr	Illinois TRM V9.0
$BTUH_{Heat}$	33,465	BTUH	2021 program tracking data
$HSPF_{Base}$	6.8	BTUH/Watt-hr	Illinois TRM V9.0
EER	AC 9.2 HP 9.2	BTUH/Watt-hr	Illinois TRM V9.0
MF_D	5%	%	2015 Indiana TRM v2.2
CF	88%	%	2015 Indiana TRM v2.2
Conversion	1,000	BTUH/therm	Constant

Air Source Heat Pump, Dual Fuel Heat Pump, and Central Air Conditioner

Cadmus used these equations from the 2015 Indiana TRM v2.2 to calculate savings per heat pump installed (excluding ISR):

$$Annual\ kWh\ Savings = [((FLHcool \times BTUH \times (1/SEERbase - 1/SEERnew)))/1000 + ((FLHheat \times BTUH \times (1/HSPFbase - 1/HSPFnew)))/1000]$$

$$Demand\ kW\ Savings = [BTUH \times (1/EERbase - 1/EERnew))/1000 \times CF]$$

Cadmus calculated central air conditioner savings using the following equation:

$$Annual\ kWh\ Savings = [(FLHcool \times BTUH \times (1/SEERbase - 1/SEERnew))/1000]$$

$$Demand\ kW\ Savings = [BTUH \times (1/EERbase - 1/EERnew))/1000 \times CF]$$

To determine FLH, each installation was matched to its nearest 2015 Indiana TRM v2.2 reference city using the installation location's zip code. The FLH associated with that reference city was then used in the savings calculation for the installation. Table A-6 shows the other inputs Cadmus used to evaluate impacts for these measures.

Table A-6. Residential Prescriptive Program Heat Pump and Central Air Conditioner Inputs Variables

Variable	Value	Units	Source
$SEERbase$	14 ASHP 13 CAC	Btu/Watt-hr	Federal standard for ASHPs and CACs
$EERbase$	11 Replacement	Btu/Watt-hr	Federal standard for ASHPs and CACs
$HSPFbase$	8.2 Replacement	Btu/Watt-hr	Federal standard for ASHPs
CF	0.88	decimal	2015 Indiana TRM v2.2
$FLHheat$	633	hours	This was a corrected *FLHheat* value for heat pumps installed at a property with gas heating. The assumption was that gas heat will be used as a supplemental heat source; therefore, the heat pump can qualify only for a portion of heating savings.

To calculate savings for each installation, Cadmus used output capacity (BTUH), SEER (SEERnew), EER (EERnew), and HSPF (HSPFnew) values of installed equipment from the Standard channel data to calculate savings for each installation. For the remaining systems with missing data, Cadmus used average values by measure. These values were not provided in the Midstream channel installation data. Cadmus used averages of these variables from the Standard channel from 2019, 2020, and 2021 to calculate savings for each installation under the Midstream channel.

Cadmus assumed that dual fuel air source heat pumps have gas furnaces that supply supplemental heat when outside temperatures fall below 38°F. Therefore, all electric only heat pumps received heating and cooling savings while dual fuel heat pumps received all cooling savings and partial electric heating savings. To calculate heating savings for dual fuel air source heat pumps, Cadmus ran a bin analysis to adjust the 2015 Indiana TRM v2.2 from 982 FLH to 633 FLH to correct the heat pump run time hours where supplemental gas heat was available.

Early Replacement Savings

The Standard channel tracking data did distinguish early replacement units, but the field was not consistently populated. Therefore, Cadmus determined an early replacement proportion using installation data across all air source heat pump and central air conditioner measures. Cadmus further vetted these data by including only installations with data entries for "existing unit age" and "condition of existing unit." Cadmus considered any installation in this final group with an equipment age less than 18 years for central air conditioners and 15 years for air source heat pumps and an operable condition to be an early replacement installation. Using this approach, in 2021, 21% of air source heat pump and central air conditioner installations qualified as early replacement.

The Midstream channel tracking data did not distinguish early replacement units. Therefore, Cadmus determined an early replacement proportion of 27% using Standard channel installation data from 2019, 2020, and 2021 across all air source heat pump measures.

Efficiency metrics of baseline equipment in early replacement cases were based on appropriate federal standard values for HSPF and SEER. These values are shown in Table A-7.

Table A-7. Residential Prescriptive Program Mechanical System Efficiency by Age

Mechanical Systems	Units	1993-2006	2006-2015	2015-present
Air Source Heat Pump	HSPF	6.8	7.7	8.2
Air Source Heat Pump	SEER	10	13	14
Central Air Conditioner	SEER			13

Using the table above in conjunction with equipment age information from installation data, Cadmus determined the baseline SEER and HSPF values. For installations missing input in this data field, Cadmus applied the average equipment age of the other installations for which the equipment age was less than the EUL of the measure. To determine baseline EER values for early replacement cases, the following equation was used according to the 2015 Indiana TRM v2.2:

$$EERbase = 0.9 * SEERbase$$

Ductless Heat Pump

The 2015 Indiana TRM v2.2 does not include ductless heat pumps. For the 2021 evaluation, Cadmus used the Illinois TRM V9.0 method. Cadmus calculated ductless heat pump savings using these equations (excluding ISR):

$$Annual\ \mathrm{kWh\ Savings} = \Delta\mathrm{kWh}_{\mathrm{HEATING}} + \Delta\mathrm{kWh}_{\mathrm{COOLING}}$$

$$\Delta kW\mathrm{h}_{\mathrm{HEATING}} = \mathrm{Elec}_{\mathrm{Heat}} * \mathrm{Capacity}_{\mathrm{Heat}} * \mathrm{FLH}_{\mathrm{Heat}} * \mathrm{DHP}_{\mathrm{HeatFLH}\,\mathrm{Adjustment}} * (1/(\mathrm{HSPF\_base}) - 1/(\mathrm{HSPF\_ee}))$$

$$\Delta kW\mathrm{h}_{\mathrm{Cooling}} = \mathrm{Capacity}_{\mathrm{cool}} * \mathrm{FLH}_{\mathrm{Cool}} * \mathrm{DHP}_{\mathrm{CoolFLH}\,\mathrm{Adjustment}} * \left(\frac{1}{\mathrm{SEER}_{\mathrm{base}}} - \frac{1}{\mathrm{SEER}_{\mathrm{ee}}}\right)$$

$$Demand\ kW\ Savings = \mathrm{Capacity}_{\mathrm{Cool}} \times \frac{\left(\frac{1}{EER_{base}} - \frac{1}{EER_{ee}}\right)}{1000} \times CF$$

To determine FLH, each installation was matched to its nearest 2015 Indiana TRM v2.2 reference city using the installation location's zip code. The FLH associated with that reference city was then used in the savings calculation for the installation. Table A-8 shows other inputs Cadmus used to evaluate impacts for this measure. Cadmus used output capacity ($\text{Capacity}_{\text{cool}}$ and $\text{Capacity}_{\text{heat}}$), SEER (SEERee), EER (EERee), and HSPF (HSPFee) values of installed equipment from the program data on a per-installation basis. These values are not provided in the Midstream channel installation data. Similar to other HVAC measures, Cadmus used averages of these variables from the Standard channel from 2019, 2020, and 2021 to calculate savings for each installation under the Midstream channel.

Table A-8. Residential Prescriptive Program Ductless Heat Pump Input Variables

Variable	Value	Units	Source
$\text{Elec}_{\text{Heat}}$	1	-	Illinois TRM V9.0
$\text{DHP}_{\text{HeatFLH}_{\text{Adjustment}}}$	0.77	-	This adjustment is necessary to accurately calculate the savings for DHP measures using Indiana 2015 Indiana TRM v2.2 FLHs. The Illinois TRM V9.0 has FLHs specific to DHP, which are lower than the FLHs for ASHPs. This adjustment factor is the DHP FLHs divided by the ASHP FLHs from the Illinois TRM V9.0. Cadmus applied this factor to the Indiana FLHs to get Indiana DHP FLHs.
$\text{DHP}_{\text{CoolFLH}_{\text{Adjustment}}}$	0.61	-	This adjustment is necessary to accurately calculate the savings for DHP measures using 2015 Indiana TRM v2.2 FLHs. The Illinois TRM V9.0 has FLHs specific to DHP, which are lower than the FLHs for ASHPs. This adjustment factor is the DHP FLHs divided by the ASHP FLHs from the Illinois TRM V9.0. Cadmus applied this factor to the Indiana FLHs to get Indiana DHP FLHs.
Factor of 3.412	3.412	kBtu/kWh	Illinois TRM V9.0
HSPFbase	3.412	Btu/Watt-hr	Assume electric baseboard heat as baseline
SEERbase	11.3	Btu/Watt-hr	2016 Pennsylvania TRM
EERbase	9.8	Btu/Watt-hr	2016 Pennsylvania TRM
CF	0.88	-	2015 Indiana TRM v2.2

A.3.2 Thermostat Measures

Smart Programmable (Learning) and Wi-Fi Thermostats (Non-Learning)

The Residential Prescriptive Program offers two types of thermostat measures:

- Smart thermostats (mostly learning) [31]
- Wi-Fi thermostats (mostly non-learning)

[31] Examples of learning thermostats are all Nest thermostats and ecobee3, which all have advanced features that can attribute to higher savings. These features include occupancy detection, heat pump lockout temperature control, upstaging and downstaging, optimal humidity/humidity control/air conditioner overcool, fan dissipation, behavioral features, and free cooling/economizer capability.

Cadmus calculated smart and Wi-Fi thermostat savings using the following equations (excluding ISR).

$$Annual\ kWh\ Savings = \Delta kWh_{HEATING} + \Delta kWh_{COOLING}$$

$$\Delta kWh_{HEATING} = FLH_{HEAT} * BTUH_{HEAT} * ESF_{AdjustedBaseline_{HEAT}} * \left(\frac{\%_{HEAT\ PUMP}}{\eta_{HEAT\ PUMP} * 3412} + \frac{\%_{ER}}{\eta_{ER} * 3412}\right) * TStat\_Type_{Adjustment}$$

$$\Delta kWh_{Cooling} = \Delta Cooling_{AdjustedBaseline} * TStat_{Type_{COOLING_{DiscountRate}}} * \%AC$$

Cadmus used the same savings methodology for both categories of thermostats, though savings differ significantly because of differences in the proportion of learning and non-learning thermostats in each category.[32] Table A-9 shows the inputs Cadmus used to evaluate impacts for this measure.

Table A-9. Residential Prescriptive Program Thermostat Input Variables

Variable	Value	Units	Source
$\eta_{HEAT\ PUMP}$	2.40	-	Federal standard
η_{ER}	1.0	-	2015 Indiana TRM v2.2
$BTUH_{HEAT}$	33,465	BTUH	Average of 2021 CenterPoint Energy Residential Prescriptive heat pump tracking data capacities
$\%_{HEAT\ PUMP}$	2%	%	2021 Residential Prescriptive Program participant survey
$\%_{GAS}$	92%	%	2021 Residential Prescriptive Program participant survey
$\%_{ER}$	6%	%	2021 Residential Prescriptive Program participant survey
Manual thermostat saturation	17%	%	2021 Residential Prescriptive Program participant survey
Programmable thermostat saturation	83%	%	2021 Residential Prescriptive Program participant survey
$TStat\_\mathrm{Type}_{\mathrm{DiscountRate}}$	31% non-learning 100% learning	%	The 2013-2014 Thermostat Evaluation indicates that heating savings are highly dependent on thermostat technology and that cooling savings are not.
$TStat\_Type_{COOLING_{DiscountRate}}$	100%	%	No cooling savings adjustment can be directly derived from the comparative study of smart Wi-Fi thermostats. Cadmus is not comfortable discounting products without direct supporting evidence. The 2013-2014 Thermostat Evaluation indicates that heating savings are highly dependent on thermostat technology and that cooling savings are not.
$ESF_{AdjustedBaseline_{HEAT}}$	9.9%	%	Calculated, example below
$\%AC$	95%	%	2021 Residential Prescriptive Program participant survey
$\Delta Cooling_{AdjustedBaseline}$	267	kWh	Calculated, example below

Cadmus applied savings to installations with defined heating or cooling equipment for that equipment type. For installations with no defined equipment type, Cadmus applied partial electric and gas savings based on the equipment saturations of existing heating equipment reported in Table A-9. Cadmus used the average heat pump capacity from the tracking database for the BTUH capacity in the electric heating savings calculation. Cadmus used a heat pump efficiency of 2.40 based on the federal standard and an

32 Cadmus reviewed thermostat capabilities using model numbers to determine if the thermostat was learning or non-learning.

electric resistance efficiency of 1.0 from the 2015 Indiana TRM v2.2. To determine EFLH, each installation was matched to its nearest 2015 Indiana TRM v2.2 reference city using the installation location's zip code. The FLH associated with that reference city was then used in the savings calculation for the installation.

Program data for Online Marketplace measures included fields describing service territory, water heater fuel type, and heating system fuel type. Cadmus used these fields to determine which installations should receive savings and for which fuel type.

2013-2014 Thermostat Evaluation and Adjusted Baseline

Cadmus' analysis of smart thermostat savings used the results of a separate Cadmus evaluation of programmable and Nest Wi-Fi thermostats in CenterPoint Energy South territory.[33] This evaluation reports household cooling energy savings of 332 kWh and a household heating energy saving factor (ESF) of 5% for programmable thermostats. It reports household cooling energy savings of 429 kWh and a household heating ESF of 12.5% for Nest Wi-Fi thermostats. This study used a 100% manual thermostat baseline for both programmable and Nest Wi-Fi thermostats.

The 2021 Residential Prescriptive Program participant survey indicated that the saturation was 17% for manual thermostats and 83% for programmable thermostats.

Cadmus used the reported household cooling and heating savings for programmable thermostats from the 2013-2014 Cadmus thermostat study and a weighted average to adjust the savings for Nest thermostats from a manual thermostat baseline to a mixed manual and programmable thermostat baseline. Cadmus used the following equations:[34]

$$\Delta Cooling_{AdjustedBaseline} = [17\% * 429 + 83\% * (429 - 177.8)] * 95\% = 267\ kWh$$

$$\mathrm{ESF}_{\mathrm{AdjustedBaseline}_{\mathrm{HEAT}}} = 17\% * 12.5\% + 83\% * (12.5\% - 3.15\%) = 9.9\%$$

In the $\Delta Cooling_{AdjustedBaseline}$ calculation, the 177.8 represents the cooling savings (332 kWh multiplied by 54% correct use factor) for programmable thermostats.[35] Cadmus did equivalent calculations to obtain adjusted baseline values for ESF-heat. The 2013-2014 thermostat evaluation investigated only homes with gas heating, so Cadmus assumed that the percentage of gas savings from that evaluation apply to electric heat as well.

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33 Cadmus. January 29, 2015. *Evaluation of the 2013-2014 Programmable and Smart Thermostat Program.*

34 Ibid.

35 Correct use rate is the percentage of homeowners who use their basic programmable or non-learning Wi-Fi thermostat in an energy-saving manner (i.e., by turning the setpoint down in the winter or up in the summer).

Learning and Non-Learning Wi-Fi Thermostats

Cadmus' 2013-2014 evaluation concerned Nest Wi-Fi thermostats only. In 2021, the Residential Prescriptive Program's tracking data recorded many more models of smart and Wi-Fi-enabled thermostats.

According to a study Cadmus conducted for a Midwest utility thermostat program in 2015,[36] there is a significant difference in savings between Nest Wi-Fi thermostats and other Wi-Fi thermostats; this study yielded a heating savings discount rate of 31% for non-Nest Wi-Fi thermostats, which means non-learning thermostats save 31% as much heating energy as learning thermostats.[37] The results of Cadmus' evaluation of the 2016 Vectren Smart Thermostat Pilot supported this conclusion.[38] However, no cooling savings adjustment can be directly derived from the comparative study conducted for a Midwest utility in 2015 because the result was not statistically different from 0%.

The 2013-2014 evaluation indicates that heating savings are highly dependent on thermostat technology and that cooling savings are not. Heating savings are 5% for programmable thermostats and 12.5% for smart Wi-Fi thermostats, and cooling savings are 13.1% for programmable thermostats and 13.9% for smart Wi-Fi thermostats.

Cadmus did not discount specific name brands without direct supporting evidence and instead took a features-based approach. Cadmus determined if each thermostat in the tracking data exhibited learning features. For the 2021 evaluation, Cadmus applied the 31% discount rate to the heating savings of all non-learning thermostat installations.

CenterPoint Energy's thermostat offerings for 2021 align with this evaluation approach by segmenting Wi-Fi-enabled thermostats into two separate measures: smart and Wi-Fi thermostats. Cadmus found that thermostats rebated through the smart thermostats measure were overwhelmingly learning thermostats, which meant applying the 31% discount to only a handful of thermostats determined to be non-learning for this measure. Cadmus found that thermostats rebated through the Wi-Fi thermostats measure were overwhelmingly non-learning, which meant applying the 31% to all but a handful of thermostats for this measure. All differences in savings between these thermostat measures are because of the proportion of learning thermostats in each.

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36 Cadmus conducted an evaluation of thermostats for a Midwest utility, but the report is not publicly available.

37 Examples of learning Wi-Fi enabled thermostats are all Nest thermostats and ecobee3, which have advanced features that Cadmus believes are attributable to higher savings. These features include occupancy detection, heat pump lockout temperature control, upstaging and downstaging, optimal humidity/humidity control/air conditioner overcool, fan dissipation, behavioral features, and free cooling/economizer capability.

38 Cadmus. August 8, 2017. *Vectren Residential Smart Thermostat Program 2016 Energy Savings Analysis.*

A.3.3 Weatherization Measures

Attic and Wall Insulation

This algorithm from the 2015 Indiana TRM v2.2 served as the basis to calculate and verify energy saving (excluding ISR):

$$Annual\ (Energy\ or\ Demand)\ Savings = kSF\ x\ \frac{(Energy\ or\ Demand)\ Savings}{kSF}$$

Where:

kSF	=	Area of installed insulation (1,000 square feet)
	=	Actual installed
$\frac{(Energy\ or\ Demand)\ Savings}{kSF}$	=	Unit energy or demand savings per 1,000 square feet of insulation. Dependent on recorded pre- and post R-value conditions, kWh/kSF or kW/kSF.

Energy and demand savings (kWh/kSF, kW/kSF) differed based on heating, cooling, and measure type using a series of look-up tables in the 2015 Indiana TRM v2.2. Table A-10 shows savings scenarios by measure and equipment type.

Table A-10. Residential Prescriptive Program Equipment Scenarios by Measure

Measure	Equipment Scenarios
Attic Insulation (All Electric)	Heat Pump
	Electric Heat with Air Conditioner
	Electric Heat without Air Conditioner
Attic Insulation (Dual Fuel)	Gas furnace with Air Conditioner
Wall Insulation (All Electric)	Heat Pump
	Electric Heat with Air Conditioner
	Electric Heat without Air Conditioner
Wall Insulation (Dual Fuel)	Gas furnace with Air Conditioner

Energy savings per installation depended on pre- and post-retrofit insulation R-values, which Cadmus calculated using a three-step process. For the few cases where these R-values were not recorded in the tracking database, Cadmus used the average pre- and post-retrofit value for calculating savings. These are the three steps:

1. Determine variables to use for insulation compression, R_{ratio}, and void factors
2. Calculate adjusted pre- and post-retrofit R-values using the inputs from step one
3. Interpolate the 2015 Indiana TRM v2.2 tables to calculate savings using the adjusted R-values from step two

Variables to Use for Insulation Compression, Rratio, and Void Factors

Cadmus adjusted R-values to account for compression, void factors, and surrounding building material. To calculate these adjusted pre- and post-retrofit R-values, Cadmus used this formula:

$$R\ value\ Adjusted = R_{nominal}\ x\ F_{compression}\ x\ F_{void}$$

Where:

- $R_{nominal}$ = Actual pre- and post-retrofit R-values per manufacturing specifications.
- $F_{compression}$ = Compression factor dependent on the percentage of insulation compression. Cadmus assumed a value of 1 at 0% compression for the evaluation.
- F_{void} = Void factor, which accounted for insulation coverage and was dependent on installation grade level, pre- and post-retrofit R-values and compression effects.

This equation determined F_{void}:

$$R_{ratio} = (R_{nominal}\ x\ F_{compression})x\ ((R_{nominal}\ x\ R_{framing\ and\ air\ space}))$$

Where:

- $R_{nominal}$ = As stated above.
- $F_{compression}$ = As stated above.
- $R_{framing/airspace}$ = R-value for material, framing, and air space of the installed insulation's surrounding area. Cadmus used R-5 for this evaluation, as recommended in the 2015 Indiana TRM v2.2.

Table A-11 lists the void factor based on the calculated R_{ratio}. Cadmus used 2% as a conservative assumption since this information was unknown.

Table A-11. 2015 Indiana TRM v2.2: Insulation Void Factors

Rratio	Void Factor	
	2% Void (Grade II)	5% Void (Grade III)
0.5	0.96	0.9
0.55	0.96	0.9
0.6	0.95	0.88
0.65	0.94	0.87
0.7	0.94	0.85
0.75	0.92	0.83
0.8	0.91	0.79
0.85	0.88	0.74
0.9	0.83	0.66
0.95	0.71	0.49
0.99	0.33	0.16

Adjusted R-values

Applying the formula above (R_{value} Adjusted), Cadmus used the inputs defined in step one to calculate R-adjusted values for pre- and post-installation and calculated adjusted R-values for every insulation installation in the database.

Interpolate 2015 Indiana TRM v2.2 Tables

Cadmus used the pre- and post-installation adjusted R-values from step two to interpolate energy and demand for every 2021 insulation installation. Appendix C of the 2015 Indiana TRM v2.2 defines energy and demand savings for insulation measures by heating and cooling equipment.

Cadmus based its assumptions on data collected in the 2021 Residential Prescriptive Program participant survey, which found that the saturation of central cooling equipment was 95%, of heat pumps was 31%, of electric furnaces was 67%, and of electric baseboard was 2%.[39] Cadmus adjusted the ducted savings by a duct efficiency of 76% for electric resistance furnaces because the 2015 Indiana TRM v2.2 savings are representative of electric baseboard heating, which has no duct losses. Cadmus also calculated demand savings using a 0.88 coincidence factor from the 2015 Indiana TRM v2.2 for central air conditioners and cooling heat pumps.

Duct Sealing

In 2021, CenterPoint Energy's Residential Prescriptive Program had duct sealing measures for heat pumps. Cadmus calculated savings for the duct sealing measures using the following equations (excluding ISR):

$$Annual\ Cooling\ kWh\ Savings = \frac{DE_{AFTER} - DE_{BEFORE}}{DE_{AFTER}} * EFLH_{COOL} * \frac{Btuh_{COOL}}{SEER * 1{,}000}$$

$$Annual\ Heating\ kWh\ Savings = \frac{DE_{AFTER} - DE_{BEFORE}}{DE_{AFTER}} * EFLH_{HEAT} * \frac{Btuh_{HEAT}}{3{,}412\ * \ \eta_{HEAT}}$$

$$Demand\ kW\ Savings = \frac{DEPK_{AFTER} - DEPK_{BEFORE}}{DEPK_{AFTER}} * \frac{Btuh_{COOL}}{EER * 1{,}000} * CF$$

Because program-specific information was not available regarding pre-existing conditions, Cadmus used the average distribution efficiency for cases between no observable leaks and catastrophic leaks as a conservative assumption to determine DE_{before}. Cadmus used the 2015 Indiana TRM v2.2 to determine the $\mathrm{DEPK_{BEFORE}}$ and $\mathrm{DEPK_{AFTER}}$values for the appropriate DE_{before} and DE_{after} values.

Cadmus used program data to determine average heating and cooling system capacities. To determine EFLH, each installation was matched to its nearest 2015 Indiana TRM v2.2 reference city using the installation location's zip code. The FLH associated with that reference city was then used in the savings

39 Cadmus normalized electric heating saturations to sum to 100% (excluding gas heating) for the all-electric insulation measures.

calculation for the installation. Table A-12 shows the other inputs Cadmus used to evaluate impacts for this measure.

Table A-12. Residential Prescriptive Program Duct Sealing Input Variables

Variable	Value	Units	Source
DE_{AFTER}	87%	%	Used the following reference (listed in the 2015 Indiana TRM v2.2): http://www.bpi.org/files/pdf/DistributionEfficiencyTable-BlueSheet.pdf Percentage of ducts within conditioned space was unknown. Assumed the average of all potential values under "Connections Sealed with Mastic." Distribution efficiency of ductwork after dealing sealing
DE_{BEFORE}	76%	%	Used the following reference (listed in the 2015 Indiana TRM v2.2): http://www.bpi.org/files/pdf/DistributionEfficiencyTable-BlueSheet.pdf Percentage of ducts within conditioned space was unknown. Assumed the average of all potential values under "No Observational Leaks," "Some Observed Leaks," "Significant Leaks," and "Catastrophic Leaks." Distribution efficiency of ductwork before dealing sealing
$DEPK_{AFTER}$	85%	%	2015 Indiana TRM v2.2, DE for use in peak demand savings
$DEPK_{BEFORE}$	73%	%	2015 Indiana TRM v2.2, DE for use in peak demand savings
$Btuh_{COOL}$	33,465	BTUH	2021 program tracking data
SEER	14	BTUH/Watt-hr	2021 program tracking data
EER	11	BTUH/Watt-hr	2021 program tracking data

A.3.4 Other Measures

Air Purifier

Cadmus calculated air purifier savings using the following equations (excluding ISR) referenced in the Illinois TRM V9.0 method:

$$Annual\ kWh\ Savings = kWh_{Deemed}$$

$$Demand\ kW\ Savings = \frac{Annual\ kWh\ Savings}{Hours} * CF$$

Table A-13 shows the inputs Cadmus used to evaluate impacts for this measure.

Table A-13. Residential Prescriptive Program Air Purifier Input Variables

Variable	Value	Units	Source
CF	66.7%	%	Illinois TRM V9.0
Hours	5,844	Hours	Illinois TRM V9.0

The Indiana 2015 TRM v2.2 does not have an air purifier measure, so Cadmus used the Illinois TRM V9.0. This method assigns deemed kWh savings to an air purifier according to its smoke clean air delivery rate (CADR). The tracking data did not include equipment CADR, so Cadmus researched CADR values for each installation based on the installations reported equipment model number.

The program data for Online Marketplace measures included fields describing service territory. Cadmus used this field to determine which installations should receive savings.

Clothes Dryer

Cadmus calculated clothes dryer savings using the following equations referenced in the Illinois TRM V9.0 (excluding ISR):

$$Annual\ kWh\ Savings = \left(\frac{Load}{CEF_{base}} - \frac{Load}{CEF_{eff}}\right) * N_{cycles} * \%Electric$$

$$Demand\ kW\ Savings = \frac{Annual\ kWh\ Savings}{Hours} * CF$$

Table A-14 shows the inputs Cadmus used to evaluate impacts for this measure.

Table A-14. Residential Prescriptive Program Clothes Dryer Input Variables

Variable	Value	Units	Source
Load	Varies by dryer size	lbs	Illinois TRM V9.0
CEF_{base}	Varies by dryer class	lbs/kWh	Illinois TRM V9.0
CEF_{eff}	Varies by install	lbs/kWh	ENERGY STAR QPL
N_{cycles}	283	Cycles/year	Illinois TRM V9.0
%Electric	100%	%	Program design only targets electric dryers
Hours	283	Hours/year	Illinois TRM V9.0
CF	3.8%	-	Illinois TRM V9.0

The Indiana 2015 TRM v2.2 does not have a clothes dryer measure, so Cadmus used the Illinois TRM V9.0. The tracking data did not include information about dryer size, dryer class, or combined energy factor (CEF), so Cadmus matched each measure's manufacturer and model number to the ENERGY STAR qualified product list (QPL) to pull these values. For the few dryers without matches on the ENERGY STAR QPL, Cadmus found these values from online retailers using the installations' reported equipment manufacturer and model number.

Clothes Washer

Cadmus calculated clothes washer savings using the following equations (excluding ISR): [40]

$$\begin{aligned} &Annual\ kWh\ Savings \\ &\quad = Capacity * N_{cycles} \\ &\quad * \left(\left(\frac{1}{IMEF_{base}} * Consumption\ \%_{base}\right) - \left(\frac{1}{IMEF_{eff}} ** Consumption\ \%_{eff}\right)\right) \end{aligned}$$

$$Consumption\ \%_{base} = \left(\%CW_{base} + (\%Electric_{DHW} * \%DHW_{base}) + \left(\%Dryer_{base} * \%Electric_{dryer}\right)\right)$$

40 These equations are referenced in the Illinois TRM V9.0 available online at https://www.ilsag.info/technical-reference-manual/il-trm-version-9/

$$Consumption\ \%_{eff} = \left(\%CW_{eff} + \left(\%Electric_{DHW} * \%DHW_{eff}\right) + \left(\%Dryer_{eff} * \%Electric_{dryer}\right)\right)$$

$$Demand\ kW\ Savings = \frac{Annual\ kWh\ Savings}{Hours} * CF$$

$$Water\ Savings = Capacity * N_{cycles} * (IWF_{base} - IWF_{eff})$$

Table A-15 shows the inputs Cadmus used to evaluate impacts for this measure.

Table A-15. Residential Prescriptive Program Clothes Washer Input Variables

Variable	Value	Units	Source
Capacity	Varies by install	Cubic feet	ENERGY STAR QPL
$IMEF_{base}$	1.75	lbs/kWh	Illinois TRM V9.0
$IMEF_{eff}$	Varies by install	lbs/kWh	ENERGY STAR QPL
N_{cycles}	320	Cycles/year	Illinois TRM V9.0
$\%Electric_{DHW}$	27%	Fuel share % of electric DHW systems	Illinois TRM V9.0
$\%Electric_{dryer}$	66%	Fuel share % of electric dryers	Illinois TRM V9.0
$\%Gas_{DHW}$	63%	Fuel share % of gas DHW systems	Illinois TRM V9.0
$\%Gas_{dryer}$	34%	Fuel share % of gas dryers	Illinois TRM V9.0
$\%CW_{base}$	8.1%	% of total baseline energy per wash used by washer	Illinois TRM V9.0
$\%DHW_{base}$	26.5%	% of total baseline energy per wash used by hot water system	Illinois TRM V9.0
$\%Dryer_{base}$	65.4%	% of total baseline energy per wash used by dryer	Illinois TRM V9.0
$\%CW_{eff}$	5.8%	% of total efficient case energy per wash used by washer	Illinois TRM V9.0
$\%DHW_{eff}$	31.2%	% of total efficient case energy per wash used by hot water system	Illinois TRM V9.0
$\%Dryer_{eff}$	63.0%	% of total efficient case energy per wash used by dryer	Illinois TRM V9.0
Hours	320	Hours/year	Illinois TRM V9.0
CF	4.5%	-	Illinois TRM V9.0
IWF_{base}	5.29	Gallons	Illinois TRM V9.0
IWF_{eff}	Varies by install	Gallons	ENERGY STAR QPL

The Indiana 2015 TRM v2.2 does not have a clothes dryer measure, so Cadmus used the Illinois TRM V9.0. The tracking data did not include information about integrated modified energy factor (IMEF), integrated water factor (IWF), or capacity, so Cadmus matched each installation's manufacturer and model number to the ENERGY STAR QPL to determine these values. For the few washers without matches on the ENERGY STAR QPL, Cadmus found these values from online retailers using the installations' reported equipment manufacturer and model number.

Therms savings were also calculated for clothes washer installation locations with gas accounts for cost-effectiveness inputs. These therms savings reflect the savings associated with a clothes washer upgrade's impact on a gas hot water system and gas dryer. Additional water savings benefits were also calculated for all clothes washer installations for cost-effectiveness inputs.

Dehumidifier

Cadmus calculated dehumidifier savings based on the 2015 Indiana TRM v2.2 methodology:

$$Annual\ kWh\ Savings = X_{Dehum} * Capacity * \frac{0.473}{24} * Hours * \left(\frac{1}{\frac{L}{kWh_{base}}} - \frac{1}{\frac{L}{kWh_{eff}}}\right)$$

$$Demand\ kW\ Savings = \frac{Annual\ kWh\ Savings}{Hours} * CF$$

Table A-16 shows the inputs Cadmus used to evaluate impacts for this measure.

Table A-16. Residential Prescriptive Program Dehumidifier Input Variables

Variable	Value	Units	Source
Capacity	Varies by install	Pints/day	ENERGY STAR QPL
Pints to Liters	0.473	Liters/pint	Constant
Hours	3,799	Hours/year	2015 NOPR TSD; Table 7.4.2
Hours per Day	24	Hours/day	Constant
$\frac{L}{kWh_{base}}$	Varies by install	L/kWh	2019 Federal Standard
$\frac{L}{kWh_{eff}}$	Varies by install	L/kWh	ENERGY STAR QPL
X_{Dehum}	35.3%	% of operating hours dehumidifier is running (as opposed to fan and standby operations)	2015 NOPR TSD; Table 7.4.2
CF	0.37%	-	2015 Indiana TRM v2.2

The tracking data did not include information about capacity or L/kWh, so Cadmus matched each install's manufacturer and model number to the ENERGY STAR QPL to determine these values. For the few dehumidifiers that did not align with a model on the ENERGY STAR QPL, Cadmus found these values from online retailers using the reported equipment manufacturer and model number or used the averaged values of the other dehumidifier installations.

Faucet Aerator

Cadmus calculated faucet aerator savings using the following equations (excluding ISR):[41]

$$Annual\ kWh\ Savings = (GPM_{base} - GPM_{low}) * MPD * \frac{PH}{FH} * DR * 8.3 * (T_{mix} - T_{in}) * Days * \frac{1}{RE * 3{,}412}$$

$$Demand\ kW\ Savings = \frac{Annual\ kWh\ Savings}{\left(MPD * \frac{PH}{FH} * Days\right)} * CF * 60$$

$$Water\ Savings = (GPM_{base} - GPM_{low}) * MPD * \frac{PH}{FH} * DR * Days$$

[41] These equations are referenced in the 2015 Indiana TRM V2.2 and adjusted using the 2015 NOPR TSD https://www.regulations.gov/document?D=EERE-2012-BT-STD-0027-0030

Table A-17 shows the inputs Cadmus used to evaluate impacts for this measure.

Table A-17. Residential Prescriptive Program Faucet Aerator Input Variables

Variable	Value	Units	Source
MPD	2.6	Faucet minutes per day	2015 Indiana TRM V2.2, weighting kitchen and bathroom aerators together using data from RECS 2015
GPM_{base}	2.09	Gallons per minute	2015 Indiana TRM V2.2, weighting kitchen and bathroom aerators together using data from RECS 2015
GPM_{low}	Varies by install	Gallons per minute	Research of online retailers
PH	2.5	People per household	2021 Residential Prescriptive Participant Survey
FH	2.89	Faucets per household	RECS 2015
DR	63%	%	2015 Indiana TRM V2.2, weighting kitchen and bathroom aerators together using data from RECS 2015
Specific Heat of Water	8.3	Btu/lbF	Constant
T_{mix}	88	F	2015 Indiana TRM V2.2, weighting kitchen and bathroom aerators together using data from RECS 2015
T_{in}	Varies by install	F	2015 Indiana TRM V2.2
Days	365	Days/year	Constant
RE	Gas 76% Electric 98%	%	2015 Indiana TRM V2.2
Factor of 3,412	3,412	Btu/kWh	Constant
CF	19.3%	%	2015 Indiana TRM V2.2, weighting kitchen and bathroom aerators together using data from RECS 2015

The tracking data did not include information about gallons per minute (gpm), so Cadmus found these values from online retailers using each installations' reported equipment manufacturer and model number in the tracking data. To determine water inlet temperature, Cadmus matched each installation to its nearest 2015 Indiana TRM v2.2 reference city using the instalhtalation location's zip code then used the water inlet temperature associated with that reference city in the savings calculation for the installation.

The program data for Online Marketplace measures included fields describing service territory, water heater fuel type, and heating system fuel type. Cadmus used these fields to determine which installations should receive savings and for which fuel type.

Heat Pump Water Heater

Cadmus calculated heat pump water heater (HPWH) savings using the following equations referenced in the 2015 Indiana TRM v2.2 (excluding ISR):

$$Annual\ kWh\ Savings$$
$$= kWh_{BASE} * \frac{COP_{NEW} - COP_{Base}}{COP_{New}} + (kWh_{COOLING} - kWh_{HEATING})$$
$$* \%\_Units\_In\_Conditioned\_Space$$

$$kWh_{HEATING} = kWh_{ER} * Saturation_{ER} + kWh_{HP} * Saturation_{HP} + kWh_{GAS} * Saturation_{GAS}$$

$$Demand\ kW\ Savings = \frac{Annual\ kWh\ Savings}{Hours} * CF$$

Table A-18 shows the inputs Cadmus used to evaluate impacts for this measure.

Table A-18. Residential Prescriptive Program Heat Pump Water Heater Input Variables

Variable	Value	Units	Source
kWh_BASE	3,460	kWh	2015 Indiana TRM v2.2
COP_BASE	0.945	-	Federal standard
kWh_COOLING	180	kWh	2015 Indiana TRM v2.2
CF	34.6%	-	2015 Indiana TRM v2.2
Hours	2,533	Hours	2015 Indiana TRM v2.2
kWh_ER	1,577	kWh	2015 Indiana TRM v2.2
kWh_HP	779	kWh	2015 Indiana TRM v2.2
kWh_GAS	0	kWh	2015 Indiana TRM v2.2
Saturation_HP	2%	%	2021 Residential Prescriptive participant survey
Saturation_GAS	92%	%	2021 Residential Prescriptive participant survey
Saturation_ER	6%	%	2021 Residential Prescriptive participant survey
%_Units_In_Conditioned_Space	27%	%	2021 Residential Prescriptive participant survey
kWh_HEATING	106	kWh	Weighted average calculation

Cadmus obtained the unit energy savings for heat pump water heaters by calculating the savings for each installation in the tracking database and averaging the results. Cadmus used assumptions from the 2015 Indiana TRM v2.2 for all values except $\mathrm{COP}_{\mathrm{NEW}}$ and $\mathrm{kWh}_{\mathrm{HEATING}}$. Cadmus also used the TRM for heat pump water heaters model specifications for $\mathrm{COP}_{\mathrm{NEW}}$ provided in program data and a weighted average of heating equipment saturations and deemed kWh savings to determine $\mathrm{kWh}_{\mathrm{HEATING}}$.

Cadmus used the federal standard coefficient of performance (COP) for <55 gallon electric storage water heaters because the storage capacity of heat pump water heaters is larger for the same water heating load than for non-heat pump water heaters. Cadmus assumed the baseline was a 50-gallon water heater to represent the typical electric storage water heater load, regardless of the heat pump water heater tank size.

In addition, Cadmus did not consider early replacement for heat pump water heaters. Due to the low number of installations for this measure, Cadmus was unable to gather sufficient data to break out replace-on-burnout and early replacement units.

Lighting

Cadmus calculated reflector and specialty lighting savings using the following equations referenced in the 2015 Indiana TRM v2.2 (excluding ISR):

$$Annual\ kWh\ Savings = \frac{Watts_{base} - Watts_{eff}}{1{,}000} * Hours * (1 + WHF_e)$$

$$Annual\ therms\ Savings = Watts_{base} - Watts_{eff} * .00003412 * Hours * WHF_e$$

$$Demand\ kW\ Savings = \frac{Annual\ kWh\ Savings}{Hours} * CF$$

Table A-19 shows the inputs Cadmus used to evaluate impacts for this measure.

Table A-19. Residential Prescriptive Program Lighting Input Variables

Variable	Value	Units	Source
$Watts_{base}$	Varies by install	W	ENERGY STAR lumens bins approach specified in the UMP applied in the Mid-Atlantic TRM V10[1]
$Watts_{eff}$	Varies by install	W	Research of online retailers and measure descriptions
W/kW	1,000	W/kW	Constant
Therms/W	0.00003412	W/therm	Constant
WHF_e	Varies by install	%	2015 Indiana TRM V2.2
WHF_g	Varies by install	%	2015 Indiana TRM V2.2
WHF_d	Varies by install	%	2015 Indiana TRM V2.2
Hours	902	Hours/year	2015 Indiana TRM V2.2
CF	11%	%	2015 Indiana TRM V2.2

[1] Dimetrosky, S., K. Parkinson, and N. Lieb. October 2017. "Chapter 6: Residential Lighting Evaluation Protocol." *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.* https://www.nrel.gov/docs/fy17osti/68562.pdf

To determine waste heat factors, each installation was matched to its nearest 2015 Indiana TRM v2.2 reference city using the installation location's zip code. The waste heat factors associated with that reference city and that installation's heating system fuel type was then used in the savings calculation. Waste heat factors across HVAC configurations were weighted together into waste heat factors specific to electric and natural gas using counts of homes by HVAC configurations found in Appendix B of the 2015 Indiana TRM V2.2.

The program data for Online Marketplace measures included fields describing service territory, water heater fuel type, and heating system fuel type. Cadmus used these fields to determine which installations should receive savings and for which fuel type (for lighting, heating system fuel type informed which installations received savings associated with lighting HVAC interactive effects).

Pool Heater

Pool heater measures are broken into two efficiency bins in the Residential Prescriptive Program:

- Pool heater COP >=6
- Pool heater COP 5.5-5.9

Cadmus used the following equations to calculate savings per pool heater installed (excluding ISR):

$$Annual\ kWh\ Savings = \left(kWh\ Consumption * \frac{COP_{Assumed}}{COP_{base}} - kWh\ Consumption * \frac{COP_{Assumed}}{COP_{ee}}\right) * \left(\frac{Hrs_{Evansville}}{Hrs_{Chicago}}\right)$$

$$kWh\ Consumption = \frac{Cost_{OPERATION}}{Year} * Price_{ELECTRICITY}$$

$$Annual\ kW\ Savings = There\ are\ no\ peak\ demand\ savings\ for\ this\ measure$$

Table A-20 shows the inputs Cadmus used to evaluate impacts for this measure.

Table A-20. Residential Prescriptive Program Pool Heater Input Variables

Variable	Value	Units	Source
COP_Assumed	5.0	unitless	Energy.gov. “Heat Pump Swimming Pool Heaters.” http://energy.gov/energysaver/heat-pump-swimming-pool-heaters
COP_base	5.2	unitless	Engineering assumption, based on available models in Air Conditioning, Heating, & Refrigeration Institute (AHRI) catalogue
COP_ee	Varies	unitless	Based on model number research for each install
kWh Consumption	12,176	kWh/yr	Calculated from equation, above
Hrs_Chicago: Hrs June-Sep temp below 80F	1,884	Hours	Typical Meteorological Year 3 (TMY3) bin data
Hrs_Evansville/: Hrs June-Sep temp below 80F	1,514	Hours	Typical Meteorological Year 3 (TMY3) bin data
(Cost_OPERATION)/Year: Cost to operate a pool in Chicago per year	1,035	$/yr	Energy.gov. “Heat Pump Swimming Pool Heaters.” http://energy.gov/energysaver/heat-pump-swimming-pool-heaters
Price_ELECTRICITY	0.085	$/kWh	Energy.gov. “Heat Pump Swimming Pool Heaters.” http://energy.gov/energysaver/heat-pump-swimming-pool-heaters

Cadmus used heat pump pool heater calculations from the U.S. Department of Energy to derive the average heating energy consumption for a residential pool in Chicago.[42] Cadmus adjusted this value for weather in Evansville, Indiana, using the ratio of the number of hours every June through September (assuming pools are operated for 100 days[43]) that the outside air temperature is below 80°F in Evansville compared with Chicago.[44] This ratio is 80% (1,514 hours divided by 1,884 hours). Cadmus' calculations assumed a $COP_{Assumed}$ of 5.0, a pool area of 1,000 square feet, a temperature setpoint of 80°F, and a cost of 0.085 $/kWh.

42 The U.S. Department of Energy provides values only for large cities, and Chicago is the closest city to CenterPoint's Indiana territory. ENERGY STAR. “Heat Pump Swimming Pool Heaters.” http://energy.gov/energysaver/heat-pump-swimming-pool-heaters

43 The 2015 Indiana TRM v2.2 assumes pool operation from Memorial Day to Labor Day.

44 TMY3 bin data for Chicago, Illinois, and Evansville, Indiana.

Smart Power Strips

Cadmus calculated smart power strip savings using the following equations referenced in the 2015 Indiana TRM V2.2 (excluding ISR):

$$Annual\ kWh\ Savings = \frac{Hours}{1000} * (1 + WHF_e) * \sum(W_{standby} * F_{homes} * F_{control})$$

$$Annual\ therms\ Savings = Hours * 0.00003412 * WHF_g * \sum(W_{standby} * F_{homes} * F_{control})$$

$$Demand\ kW\ Savings = \frac{1}{1000} * (1 + WHF_d) * \sum(W_{standby} * F_{homes} * F_{control}) * CF$$

Table A-21 shows the inputs Cadmus used to evaluate impacts for this measure.

Table A-21. Residential Prescriptive Program Smart Power Strip Input Variables

Variable	Value	Units	Source
$W_{standby}$	Varies by peripheral	W	2015 Indiana TRM V2.2
F_{homes}	Varies by peripheral	%	2015 Indiana TRM V2.2
$F_{control}$	Varies by peripheral	%	2015 Indiana TRM V2.2
W/kW	1,000	W/kW	Constant
Therms/W	0.00003412	W/therm	Constant
WHF_e	Varies by install	%	2015 Indiana TRM V2.2
WHF_g	Varies by install	%	2015 Indiana TRM V2.2
WHF_d	Varies by install	%	2015 Indiana TRM V2.2
Hours	Computer 7,474 TV 6,784	Hours/year	2015 Indiana TRM V2.2
CF	50%	%	2015 Indiana TRM V2.2

To determine waste heat factors, each installation was matched to its nearest 2015 Indiana TRM v2.2 reference city using the installation location's zip code. The waste heat factors associated with that reference city and that installation's heating system fuel type was then used in the savings calculation for the installation. Waste heat factors across HVAC configurations were weighted together into waste heat factors specific to electric and natural gas using counts of homes by HVAC configurations found in Appendix B of the 2015 Indiana TRM V2.2.

The program data for Online Marketplace measures included fields describing service territory, water heater fuel type, and heating system fuel type. Cadmus used these fields to determine which installations should receive savings and for which fuel type (for smart power strips, heating system fuel type informed which installations received savings associated with waste heat factors).

Variable Speed Pool Pump

Cadmus used these equations to calculate savings per variable speed pool pump installed referenced in the 2015 Indiana TRM v2.2 (excluding ISR):

$$Annual\ kWh\ Savings = HP * LF * \frac{0.746}{\eta Pump} * \frac{Hrs}{day} * \frac{Days}{yr} * ESF$$

$$Annual\ kW\ Savings = HP * LF * \frac{0.746}{\eta Pump} * CF * DSF$$

Table A-22 shows the inputs Cadmus used to evaluate impacts for this measure.

Table A-22. Residential Prescriptive Program Variable Speed Pool Pump Input Variables

Variable	Value	Units	Source
HP – Horsepower	1.5	hp	Default baseline horsepower from the 2015 Indiana TRM v2.2
LF – Load factor	0.66	Decimal	2015 Indiana TRM v2.2; First Energy, Residential Swimming Pool Pumps memo
ηPump	0.325	Decimal	2015 Indiana TRM v2.2; First Energy; Residential Swimming Pool Pumps memo
Hrs/day	6	Hrs/day	2015 Indiana TRM v2.2; Consortium for Energy Efficiency; Pool Pump Exploration Memo, June 2009
Days/yr	Varies by install	Days/yr	2021 Residential Prescriptive Program Data
ESF (energy savings factor)	86%	%	2015 Indiana TRM v2.2; First Energy; Residential Swimming Pool Pumps memo
CF	83%	%	2015 Indiana TRM v2.2; Efficiency Vermont, TRM August 9, 2013. Coincidence factor based on market feedback about typical run pattern for pool pumps, which revealed that most people run pump during the day and set timer to turn pump off during the night.
DSF (demand savings factor)	91%	%	2015 Indiana TRM v2.2; First Energy, Residential Swimming Pool Pumps memo

The 2021 program tracking data's pool pump annual operating hours field was updated to help customers more realistically estimate their pool pump operating schedule. Rather than recording annual operating hours, this field now describes operating days per year. Cadmus used this data field to inform the days per year input to the savings algorithm above. If an installation did not have data in this field, it was given the 2015 Indiana TRM V2.2's default value of 100 days per year.

A federal standard requiring that pool pumps be variable speed came into effect July 18, 2021. Savings for variable speed pool pumps persisted throughout 2021 as vendors sold through their stock of models manufactured before the standard took effect. Savings for this measure will not be available beyond 2021.

A.4 Residential New Construction Program

Cadmus' impact evaluation of the Residential New Construction Program included measures with attributable electric savings, including these:

- Gold Star (electric)
- Gold Star (dual fuel)
- Platinum Plus (electric)
- Platinum Plus (dual fuel)
- Platinum Star (dual fuel)

A.4.1 New Construction Homes

Cadmus evaluated gross savings for Residential New Construction Program homes by drawing a random sample of builder applications from 2021 participants and recording critical home data, such as square footage, insulation levels, and HVAC efficiencies from Home Energy Rating System (HERS) certificates. Cadmus developed energy models using REM/Rate V16.0.6 to evaluate the electric savings of the homes built under program requirements.[45]

In 2021, program homes had an average HERS score of 59.2—approximately three points better than the program requirement of 62—which builders achieved through high-efficiency furnaces and air conditioners, tight building envelopes, improved wall insulation, sealed duct systems, efficient domestic water heaters, and efficient windows.[46]

Energy Model Development

Cadmus reviewed 62 random REM/Rate and Ekotrope-generated HERS reports.[47] Based on these reports, Cadmus compiled the homes' characteristics, such as insulation levels and square footage, into a database for energy modeling. Table A-23 shows the sample of the 2021 homes.

Table A-23. 2021 Residential New Construction Program Homes Sample

Measure	2021 Participants	Sample
Gold Star (Electric)	3	0
Gold Star (Dual Fuel)	54	31
Platinum Star (Electric)	2	0
Platinum Star (Dual Fuel)	169	18
Platinum Star Plus (Dual Fuel)	28	14

Table A-24 presents the average home characteristics from 2016 to 2021, as well as sample sizes and precision estimates. Though values for typical characteristics differ year over year, in general, program homes have become more energy-efficient since 2016. In 2021, home size increased and duct tightness also improved compared with 2020. Heating and cooling equipment has varied across program years, with cooling system efficiency trending lower from 2018 through 2021 and heating system efficiency trending upward since 2016. For several home characteristics, such as insulation for ceilings, above ground walls, and basement walls, program homes were more efficient in 2021 than in 2018. Home tightness has also improved each year since 2019.

45 REM/Rate V16.0.6 was released in January 2021.

46 The lower the HERS score, the higher the efficiency of the home.

47 Home energy raters used either the Ekotrope and REM/Rate software to generate HERS scores. Cadmus requested 63 HERS certificates, but one could not be reviewed because the certificate was illegible.

Table A-24. 2016-2021 Residential New Construction Program Home Characteristics

Home Characteristic	Program Year						Changes in Program Home Characteristics from 2020
	2016	2017	2018	2019	2020	2021	
Sample Size	30	46	52	62	39	62	Larger Sample
Participants	128	171	145	194	245	256	Similar Population
Precision at 90% Confidence[2]	13%	11%	10%	9%	12%	9%	Higher Precision
Home Size	3,191	2,279	2,268	2,236	2,226	2,996	Higher
Ceiling R Value	40.0	39.0	38.0	38.9	37.5	39.6	Higher
Walls R Value	15.0	15.3	14.8	14.9	14.8	15.8	Higher
Basement Wall R Value	11.0	N/A	10.2	13.1	10.2	10.7	Higher
Crawlspace Wall R Value	11.0	12.0	11.0	10.6	11.1	11.0	Lower
Windows U Factor[3]	0.3	0.3	0.3	0.30	0.31	0.31	No Change
Home Tightness ACH50[3]	3.4	3.1	3.0	3.5	3.4	3.2	Higher
Duct Tightness CFM25/100 sq. ft.[3]	2.8	2.3	2.7	3.8	3.4	2.2	Lower (more efficient)
Furnace AFUE	93.0	94.0	94.0	93.8	94.1	94.4	Higher
Air Conditioner SEER	13.5	14.4	14.4	14.3	14.3	13.9	Lower
Percentage High-Efficiency Lighting	81.0%	76.0%	86.0%	99.5%	99.3%	99.5%	No Change
Gas Water Heat Energy Factor	0.87	0.85	0.88	0.92	0.81	0.87	Higher
Electric Water Heat Energy Factor	0.95	0.95	N/A4	0.93	0.93	0.93	No Change

To evaluate electric savings for the participating homes, Cadmus developed 10 prototype energy models,[48] shown in Table A-25, using the characteristics of the homes documented in the HERS certificates (Table A-24). The models represented typical characteristics of the sampled participants.

Table A-25. Residential New Construction Program Prototype Model Iterations

Foundation Type	Water Heating Type	Weather Location
Conditioned Basement	Nat Gas Tankless	Evansville
Slab on Grade	Nat Gas Tankless	Evansville
Conditioned Basement	Elec Tank	Indianapolis
Conditioned Basement	Nat Gas Tank	Indianapolis
Conditioned Basement	Nat Gas Tankless	Indianapolis
Slab on Grade	Elec Tank	Indianapolis
Slab on Grade	Nat Gas Tank	Indianapolis
Slab on Grade	Nat Gas Tankless	Indianapolis
Slab on Grade	Elec Tank	Fort Wayne
Conditioned Basement	Nat Gas Tankless	Evansville

48 Prototype energy models represent simulated program homes. Because the no homes in the sample had heat pumps, the prototypes did not include heating and cooling system iterations.

Cadmus calculated electric energy and demand savings as the savings between the baseline energy code model and the modeled home for each of the 10 prototypes. Cadmus applied the 2020 Indiana Residential Code (IRC) and current federal standards to establish characteristics of the baseline models. Adoption of the IRC increased the baseline condition for the sampled program homes, which reduced 2021-evaluated savings.

Cadmus calculated program realization rates as the evaluated savings divided by the reported savings of the modeled homes. Realization rates were weighted by program tier and applied to the program population. Realization rates for energy savings were between 36% and 40%, depending on the home tier, and demand reductions were between 32% and 61%, as shown in Table A-26.

Table A-26. 2021 Residential New Construction Program Modeled Prototypes Realization Rates

Annual Gross Savings Type	Reported Sample (n=62)	Evaluated Sample (n=62)	Realization Rate
Gold Star kWh (n=31)	30,424	11,046	36%
Platinum Star kWh (n=18)	26,250	10,617	40%
Platinum Plus kWh (n=14)	20,417	7,915	39%
Gold Star Coincident Peak kW (n=31)	9.1	2.9	32%
Platinum Star Coincident Peak kW(n=18)	7.9	4.8	61%
Platinum Plus Coincident Peak kW (n=14)	9.5	3.5	37%
Total, kWh			**39%**
Total, Coincident Peak kW			**39%**

A.5 Income Qualified Weatherization Program

Cadmus' impact evaluation of the Income Qualified Weatherization (IQW) Program included measures with attributable electric savings, including these:

Audit education

- Audit

Appliance and plug load reduction

- Refrigerator replacement
- Smart power strips

Lighting

- Exterior LED lamp
- LED 5W globe
- LED 5W candelabra
- LED R30 dimmable
- LED night light

Water-saving devices

- Bathroom aerator
- Kitchen aerator
- Efficient showerhead

HVAC

- AC tune-up
- Central air conditioner
- HP tune-up
- Furnace tune-up

Thermostats

- Smart thermostat

Weatherization measures

- Air sealing
- Attic insulation
- Duct sealing
- Wall Insulation
- Whole Home IQW

A.5.1 Audit Education

Energy auditors gave IQW Program participants home audit reports that identified additional energy-efficient actions they could take to further reduce energy consumption. The ex *post* audit savings were specific to participants and based on survey response data from 47 IQW Program participants. Of these respondents, 73% said they had implemented one or more recommendations from the home audit report. Home audit reports had two types of recommended measures:

- **Behavioral measures** that required homeowners to modify how they used energy in their homes. Cadmus evaluated behavioral savings for the following energy-savings actions:
  - Turning off lights when not in use
  - Unplugging unused appliances
  - Taking shorter showers
  - Programming your thermostat with efficient settings
- **Installation measures** that required purchases and installations of equipment

Table A-27 shows household percentages for each recommended action that IQW Program participants reported engaging in after receiving an on-site energy assessment.

Table A-27. 20120 IQW Household Percentages and Average Savings per Recommended Measure

Recommendation	Percentage of Households that Reportedly Took Action	Average Per-unit Evaluated Savings for Action (kWh)
Behavioral Measures		
Turn off lights when not in use	68%	9
Unplug appliances when not in use	55%	12
Take shorter showers	43%	11
Program thermostat with efficient settings (excludes recipients of smart thermostats through program)	55%	88
Installation Measures		
Air sealing/weather-stripping	0%	NA

Table A-28 shows the assumptions that went into the evaluated savings for each component. For all energy-saving actions, Cadmus adjusted savings to account for any efficient equipment that was installed. For turning off the lights and showerheads, this meant adjusting the baseline usage to account for the installed efficient equipment. For unplugging appliances and programming thermostats correctly, this meant not evaluating savings for participants who received smart strips or smart thermostats, respectively.

Table A-28. 2021 IQW Audit Education Savings Assumptions

Recommendation	Assumption	Source
Behavioral Measures		
Turn off lights when not in use	20% reduction in hours of use per day.	CPUC. *PY2006-2008 Indirect Impact Evaluation of the Statewide Marketing and Outreach Programs.* Vol II. 2009.
Unplug appliances when not in use	21.3 kWh	CPUC. *PY2006-2008 Indirect Impact Evaluation of the Statewide Marketing and Outreach Programs.* Vol II. 2009.
Take shorter showers	5% reduction in time spent in shower. Household showerhead usage was adjusted to account for efficient showerheads installed	Engineering judgment
Program thermostat with efficient settings (excludes recipients of smart thermostats through program)	Savings are equivalent to the savings from installing a new programmable thermostat (incorporating a proper usage factor)	Evaluation of the 2013-2014 Programmable and Smart Thermostat Program
Installation Measures		
Air sealing/weather-stripping	Additional air sealing and weather-stripping will achieve 50% of evaluated air sealing savings.	Engineering judgment

A.5.2 Lighting

LED Bulbs

Cadmus used the following equations from the 2015 Indiana TRM v2.2 to calculate gross savings per LED bulb installed (excluding ISR):

$$kWh\ Savings = \left(\frac{watts_{BASE} - watts_{EFF}}{1{,}000} * HOURS\right) * (1 + WHF_E)$$

$$kW\ Savings = \left(\frac{watts_{BASE} - watts_{EFF}}{1{,}000} * HOURS\right) * (1 + WHF_D) * CF$$

Cadmus used baseline wattage values based on methodology from the Uniform Methods Project, which specifies baseline wattages based on lumen output and style of the installed bulbs.

Cadmus used the 2015 Indiana TRM v2.2 assumption of 902 as the hours of use (HOU) per year for direct install measures. Cadmus also applied a waste heat factor (WHF), representing the portion of annual lighting energy producing an interactive effect (lost or gained) with heating and cooling equipment. The heating and cooling factor were taken from the Indiana TRM v2.2 for the city of Evansville, Indiana, and were dependent on the heating and cooling type of each different site.

The assumption of 902 hours of use applied only to lighting installed indoors, so Cadmus used 2,475 hours from the Illinois TRM V8.0, which specifically applies to exterior bulbs. Exterior bulbs also did not have a waste heat factor because there are no interactive effects on bulbs installed outdoors.

The savings inputs Cadmus used for its *ex post* calculations are shown in Table A-29.

Table A-29. Lighting Savings Inputs

Input	Assumption	Source
Baseline wattage for equivalent incandescent bulb (5W LED globe) (WattsBase)	25	DOE Uniform Methods Project, Chapter 21 Residential Lighting Evaluation Protocol for EISA-exempt 525 lumen LED globe
Baseline wattage for equivalent halogen bulb (9W LED) (WattsBase)[2]	43	DOE Uniform Methods Project, Chapter 21 Residential Lighting Evaluation Protocol for post-EISA 800 lumen A-line LED
Baseline wattage for equivalent halogen bulb (R30 Dimmable LED) (WattsBase)	65	2016 Pennsylvania TRM[1]
Baseline wattage for equivalent incandescent bulb (exterior bulb 13W PAR30 LED) (WattsBase)	50	2016 Pennsylvania TRM[1]
Hours of use per year (HOURS)	902 (interior) 2,475 (exterior)	2015 Indiana TRM v2.2 (interior) Illinois TRM V8.0 (exterior)
Summer peak coincidence factor (CF)	0.11	2015 Indiana TRM v2.2
Waste heat factor for energy (WHFe)	Dependent on heating and cooling type	2015 Indiana TRM v2.2 appendix with 2021 heating and cooling for each lighting participant
Waste heat factor for demand (WHFd)	Dependent on heating and cooling type	2015 Indiana TRM v2.2 appendix with 2021 heating and cooling for each lighting participant

[1] The Uniform Methods Project does not include lumen bins for reflector bulbs. Since these bulbs are exempt from current EISA regulations, Cadmus used lumen bins for reflector bulbs in the 2016 Pennsylvania TRM. This TRM closely follows the Uniform Methods Project approach but has additional lumen bins for non-exempt bulbs like reflectors.

[2] Aligning with *ex ante*, no savings are assigned for 9-watt bulb installations in 2021.

LED Night Lights

Cadmus used the following 2015 Indiana TRM v2.2 equation to calculate gross savings per night light installed (excluding ISR):

$$kWh\ Savings = \left(\frac{watts_{BASE} - watts_{EFF}}{1{,}000} * HOURS\right)$$

The savings inputs Cadmus used for its *ex post* calculations are shown in Table A-30.

Table A-30. LED Night Light Savings Inputs

Input	Assumption	Source
Baseline wattage for equivalent incandescent night light (WattsBase)	5.00	2015 Indiana TRM v2.2
Wattage of LED night light (WattsEff)	0.5	Provided by CenterPoint
Hours of use per year (Hours)	2,920	2015 Indiana TRM v2.2

A.5.3 Water-Saving Devices

Faucet Aerators

Cadmus used the following 2015 Indiana TRM v2.2 equations to calculate savings per faucet aerator installed (excluding ISR):

$$kWh\ Savings = (GPM_{BASE} - GPM_{LOW}) * MPD * \frac{PH}{SH} * DR * 8.3 * (T_{MIX} - T_{IN}) * \frac{365}{RE * 3{,}412}$$

$$kW\ Savings = (GPM_{BASE} - GPM_{LOW}) * 60 * DR * 8.3 * \frac{(T_{MIX} - T_{IN})}{RE * 3{,}412} * CF$$

The savings inputs Cadmus used for its *ex post* calculations are shown in Table A-31.

Table A-31. Faucet Aerator Savings Inputs

Input	Assumption		Source
	Kitchen Faucet	Bathroom Faucet	
Faucet usage (minutes/day/person) (MPD)	4.5	1.6	2015 Indiana TRM v2.2
Number of faucets per home (FH) – Single-Family	1	1.41	2021 IQW Participant survey data for bathroom. 2015 Indiana TRM v2.2 for kitchen
Number of faucets per home (FH) – Multifamily	1	1.80	2020 MFDI Participant survey data,[1] 2015 Indiana TRM v2.2 for kitchen
Average household size (participants/household, PH) – Single-Family	2.00	2.00	2021 IQW participant survey
Average household size (participants/household, PH) – Multifamily	2.28	2.28	2020 MFDI Participant survey[1]
Input water temperature to house (°F) (°F, Tin)	62.8	62.8	2015 Indiana TRM v2.2 for Evansville, Indiana, cold water temperature entering the DWH system
Temperature of water at faucet (°F) (°F, Tmix)	93	86	2015 Indiana TRM v2.2
Percent of water flowing down drain (DR)	0.5	0.7	2015 Indiana TRM v2.2
Gallons per minute of baseline faucet aerator (GPMbase)	2.44	1.9	2015 Indiana TRM v2.2
Gallons per minute of low-flow faucet aerator (GPMlow)	1.5	1.0	2021 program tracking data
Electric water heater recovery efficiency (RE)	0.98	0.98	2015 Indiana TRM v2.2
Summertime peak coincidence factor (CF)	0.0033	0.0033	2015 Indiana TRM v2.2

[1] Cadmus used MFDI survey data because there were no multifamily-specific responses in the IQW survey data

Efficient Showerhead

Cadmus used the following 2015 Indiana TRM v2.2 equations to calculate savings per efficient showerhead installed (excluding ISR):

$$kWh\ Savings = (GPM_{BASE} - GPM_{LOW}) * MS * SPD * \frac{PH}{SH} * 8.3 * (T_{MIX} - T_{IN}) * \frac{365}{RE * 3{,}412}$$

$$kW\ Savings = (GPM_{BASE} - GPM_{LOW}) * 60 * 8.3 * \frac{(T_{MIX} - T_{IN})}{RE * 3{,}412} * CF$$

The savings inputs Cadmus used for its *ex post* calculations are shown in Table A-32.

Table A-32. Efficient Showerhead Savings Inputs

Input	Assumption	Source
Average shower length in minutes (MS)	7.8	2015 Indiana TRM v2.2
Average household size (participants/household, PH) – Single-Family	2.00	2021 IQW participant survey data
Average household size (participants/household, PH) – Multifamily	2.28	2020 MFDI participant survey data[1]
Number of showerheads per home (SH) – Single-Family	1.37	2021 IQW participant survey data
Number of showerheads per home (SH) – Multifamily	1.62	2020 MFDI participant survey data[1]
Number of showers per day per person (SPD)	0.6	2015 Indiana TRM v2.2
Input water temperature to house (°F, Tin)	62.8	2015 Indiana TRM v2.2 for Evansville cold water temperature entering the DWH system
Water temperature at showerhead (°F, Tmix)	101	2015 Indiana TRM v2.2, average mixed temperature of water used for shower
Gallons per minute of baseline showerhead (GPMbase)	2.63	2015 Indiana TRM v2.2
Gallons per minute of low-flow showerhead (GPMlow)	1.50	2021 program tracking data
Electric recovery efficiency of hot water heater (RE)	0.98	2015 Indiana TRM v2.2
Summer peak coincidence factor (CF)	0.0023	2015 Indiana TRM v2.2

[1] Cadmus used MFDI survey data because there were no multifamily-specific responses in the IQW survey data

A.5.4 HVAC

Air Conditioner & Heat Pump Tune-Up

Cadmus used these equations to calculate savings per air conditioner and heat pump tune-up (excluding ISR):

$$\Delta kWh_{CAC} = EFLH_{Cool} * Btuh_{Cool} * \frac{1}{SEER_{CAC} * 1{,}000} * MF_E$$

$$\Delta kWh_{ASHP} = \left(EFLH_{Cool} * Btuh_{Cool} * \frac{1}{SEER_{ASHP} * 1{,}000} + EFLH_{HEAT} * Btuh_{HEAT} * \frac{1}{HSPF_{ASHP} * 1{,}000}\right) * \frac{MF_E}{1{,}000}$$

$$\Delta kW = Btuh_{Cool} * \frac{1}{EER * 1{,}000} * MF_D * CF$$

Where:

$EFLH_{Cool}$ = Equivalent full load cooling hours

$EFLH_{HEAT}$ = Equivalent full load heating hours

$Btuh_{Cool}$ = Cooling capacity of equipment in BTUH

$Btuh_{HEAT}$ = Heating capacity of equipment in BTUH

$SEER_{CAC}$ = SEER efficiency of existing central air conditioning unit receiving maintenance

$SEER_{ASHP}$ = SEER efficiency of existing air source heat pump unit receiving maintenance

$HSPF_{BASE}$ = Heating season performance factor of existing air source heat pump unit receiving maintenance

MF_E = Maintenance energy savings factor

EER = EER efficiency of existing unit receiving maintenance

MF_D = Maintenance demand reduction factor

CF = Summer peak coincidence factor

Cadmus calculated savings for air conditioner tune-ups implemented through the IQW Program using the savings inputs used for its *ex post* calculations are shown in Table A-33.

Table A-33. IQW Program Air Conditioner Tune-Up Savings Inputs

Variable	Value	Units	Source
$Btuh_{CoolCAC}$	33,512.5	Btuh	2021 IQW Central Air Conditioner tracking data
$Btuh_{CoolHP}$	27,000	Btuh	2021 IQW Central ASHP tracking data
$Btuh_{HEAT}$	26,733.3	Btuh	2021 IQW Central ASHP tracking data
SEER	11.2	Btuh/Watt-hr	2015 Indiana TRM v2.2
MF_E	5%	%	2015 Indiana TRM v2.2
EER	10	Btuh/Watt-hr	Used 2015 Indiana TRM v2.2 calculation to determine EER from SEER (EER=SEER * 0.9) for AC.
MF_D	5%	%	2015 Indiana TRM v2.2
CF	88%	%	2015 Indiana TRM v2.2

Central Air Conditioner

Cadmus used these equations to calculate savings per air conditioner replacement (excluding ISR):

$$Annual\ kWh\ Savings = FLH_{COOL} * Btuh * \left(\frac{1}{SEER_{Base}} - \frac{1}{SEER_{Eff}}\right) * \frac{1}{1000}$$

$$Demand\ kW\ Savings = \ Btuh * \left(\frac{1}{EER_{Base}} - \frac{1}{EER_{Eff}}\right) * \frac{1}{1000} * CF$$

Savings inputs Cadmus used its *ex post* calculations are shown in Table A-34.

Table A-34. IQW Program Central Air Conditioner Savings Inputs

Description	Assumption	Source
Efficient SEER	Varies	2021 program tracking data
Efficient EER	Varies	2021 program tracking data
Baseline SEER	13	Federal Standard SEER Rating, 2015 Indiana TRM v2.2
Baseline EER	11	Federal Standard EER Rating, 2015 Indiana TRM v2.2
CAC Btuh	Varies	2021 program tracking data
FLHcool – Evansville	600	2015 Indiana TRM v2.2
CF	88%	2015 Indiana TRM v2.2

Air Source Heat Pump

Cadmus used these equations to calculate savings per heat pump replacement (excluding ISR):

$$Annual\ kWh\ Savings =$$

$$FLH_{COOL} * Btuh_{COOL} * \left(\frac{1}{SEER_{Base}} - \frac{1}{SEER_{Eff}}\right) * \frac{1}{1000} + FLH_{HEAT} * Btuh_{HEAT} * \left(\frac{1}{HSPF_{Base}} - \frac{1}{HSPF_{Eff}}\right) * \frac{1}{1000}$$

$$Demand\ kW\ Savings = Btuh * \left(\frac{1}{EER_{Base}} - \frac{1}{EER_{Eff}}\right) * \frac{1}{1000} * CF$$

Savings inputs Cadmus used for its *ex post* calculations are shown in Table A-35.

Table A-35. IQW Program Air Source Heat Pump Savings Inputs

Description	Assumption	Source
Efficient SEER	Actual	2021 program tracking data
Efficient EER	Actual	2021 program tracking data
Efficient HSPF	Actual	2021 program tracking data
Baseline SEER	14	Federal standard SEER rating for heat pumps
Baseline EER	11	Federal standard EER rating, 2015 Indiana TRM v2.2
Baseline HSPF	8.2	Federal standard HSPF rating for heat pumps
Btuh cool	Actual	2021 program tracking data
Btuh heat	Actual	2021 program tracking data
FLHcool – Evansville	600	2015 Indiana TRM v2.2
FLHheat – Evansville	600	2015 Indiana TRM v2.2
CF	88%	2015 Indiana TRM v2.2

A.5.5 Thermostats

Smart Thermostats

Cadmus calculated smart thermostat savings using the following equation (excluding ISR).

$$Annual\ kWh\ Savings = (\Delta kWh_{HEATING} + \Delta kWh_{COOLING}) * \ SqFt_{Adjust}$$

$$\Delta kWh_{HEATING} = FLH_{HEAT} * BTUH_{HEAT} * ESF_{AdjustedBaseline_{HEAT}} * \left(\frac{1}{\eta_{HEAT} \ * 3412}\right)$$

$$\Delta kWh_{Cooling} = \Delta Cooling_{AdjustedBaseline}$$

The savings inputs Cadmus used for its *ex post* calculations are shown in Table A-36. These inputs were primarily derived from results of a 2013-2014 evaluation of programmable and smart thermostats in CenterPoint South territory.[49] Because smart thermostats have a learning function, it was assumed that 100% were auto-adjusting temperature appropriately.

Table A-36. Smart Thermostat Savings Inputs

Variable	Value	Units	Source
FLH_{HEAT}	982	Hours	2015 Indiana TRM v2.2; Evansville, Indiana
$BTUH_{HEAT}$	32,000	BTUH	2016 Pennsylvania TRM
η_{HEAT}	2.0/1.0	-	2015 Indiana TRM v2.2 – 2.0 used for Heat Pumps. 1.0 used for Electric Resistance Heat
Manual thermostat saturation	57%	%	2021 IQW Program participant survey
Programmable thermostat saturation	43%	%	2021 IQW Program participant survey
$ESF_{AdjustedBaseline_{HEAT}}$	10.87%	%	Calculated, example below. Based on Evaluation of the 2013-2014 Programmable and Smart Thermostat Program
$\Delta Cooling_{AdjustedBaseline}$	377	kWh	Calculated, example below. Based on Evaluation of the 2013-2014 Programmable and Smart Thermostat Program
Square Footage Adjustment for MF	45%	%	2009 RECS square footage by building type

In 2021, smart thermostats were installed in homes with gas heating and central air conditioning as well as homes with electric furnaces and central air conditioning. Cadmus calculated electric heating savings for all thermostats installed in electrically heated homes.

2013-2014 Thermostat Evaluation and Adjusted Baseline

Cadmus' analysis of smart programmable thermostat savings used the results of Cadmus' 2013-2014 evaluation of programmable and Nest Wi-Fi thermostats in CenterPoint South territory.[50] This evaluation reports household cooling energy savings of 332 kWh and a household heating energy saving

[49] Cadmus. January 29, 2015. *Evaluation of the 2013-2014 Programmable and Smart Thermostat Program*.

[50] Ibid.

factor (ESF) of 5% for programmable thermostats. It reports a household cooling energy savings of 429 kWh and a household heating ESF of 12.5% for Nest Wi-Fi thermostats.

This study used a 100% manual thermostat baseline for both programmable and Nest Wi-Fi thermostats. However, in 2021, the Income Qualified Weatherization Program participant survey indicated that the saturation was 57% for manual thermostats and 43% for programmable thermostats (n=9).

Cadmus used the reported household cooling and heating savings for programmable thermostats from its 2013-2014 evaluation and a weighted average to adjust the savings for Nest thermostats from a manual thermostat baseline to a mixed manual and programmable thermostat baseline.

Cadmus used these equations:[51]

$$\Delta Cooling_{AdjustedBaseline} = [57\% * 429 + 53\% * (429 - 252)] = 321\ kWh$$

$$\mathrm{ESF}_{\mathrm{AdjustedBaseline}_{\mathrm{HEAT}}} = 57\% * 12.5\% + 43\% * (12.5\% - 3.8\%) = 10.87\%$$

In the $\Delta Cooling_{AdjustedBaseline}$ calculation, the 252 represents the cooling savings (332 kWh multiplied by 76% correct use factor) for replaced programmable thermostats. Cadmus did equivalent calculations to obtain adjusted baseline values for ESF-heat. The 2013-2014 thermostat evaluation investigated only homes with gas heating, so Cadmus assumed that the percentage of gas savings from that evaluation applies to electric heat as well.

Home Type Adjustment

The 2013-2014 thermostat evaluation from which savings are derived was based on single-family homes. To account for savings differences by home type due to reduced heating and cooling load for multifamily homes compared with single-family homes, Cadmus applied a square footage adjustment.

A.5.6 Appliance and Plug Load Reduction

Refrigerator Replacement

Cadmus used the following equation from the 2015 Indiana TRM v2.2 to calculate savings for replaced refrigerators (excludes ISR). The regression coefficients used were coefficient findings from the 2013 Appliance Recycling Program evaluation.

$$kWh\ Savings = [(UEC_{RETIRED} * F_{RUNTIME}) - UEC_{NEW}] * \left(\frac{RUL_{RECYCLED}}{EUL_{NEW}}\right) + [(UEC_{STANDARD} - UEC_{NEW}) * (\frac{(EUL_{new} - RUL_{RECYCLED})}{EUL_{NEW}})]$$

[51] Cadmus. January 29, 2015. *Evaluation of the 2013-2014 Programmable and Smart Thermostat Program*.

$$UEC_{existing} = 365.25 * \left[0.81 + (0.02 * Age) + \left(1.04 * F_{before1990}\right) + (0.06 * Size) + \left(-1.75 * F_{singledoor}\right) + \left(1.12 * F_{side-by-side}\right) + \left(0.56 * F_{primary}\right) + (-0.04 * HDD * F_{outdoor}) + (0.03 * CDD * F_{outdoor})\right]$$

$$kW\ Savings = \frac{\Delta kWh}{8{,}760} * TAF * LSAF$$

Cadmus calculated savings for each refrigerator replaced using the following sources:

- 2015 Indiana TRM v2.2 methodology for refrigerator recycling to establish the unit energy consumption (UEC) of the retired refrigerators, using algorithm coefficients from the 2013 Appliance Recycling Program evaluation results
- ENERGY STAR database to determine the UEC of the new refrigerator units based on make and model numbers
- 2021 program tracking data for recycled and new refrigerator characteristics for each participant

Cadmus determined a weighted average energy savings for two baseline scenarios over the life of the new refrigerator unit, obtaining remaining useful life and effective useful life values from the 2015 Indiana TRM v2.2:

- Recycled old refrigerator with a remaining useful life of eight years
- New standard refrigerator baseline for the remaining duration of the life of the new refrigerator (9 years=$EUL_{new\ refrigerator} - RUL_{recycled\ unit}$)

Savings inputs are shown in Table A-37.

Table A-37. IQW Program Refrigerator Replacement Savings Inputs

Description	Assumption	Source
UEC_new (kWh)	393	2021 program tracking data, ENERGY STAR database
UEC_retired (kWh)	1,210	2013 program tracking data, appliance recycling program coefficients
UEC_standard baseline (kWh)	401	2015 Indiana TRM v2.2, averaged by program data configuration
F_run time	1.000	2015 Indiana TRM v2.2
TAF	1.21	2015 Indiana TRM v2.2
LSAF_old	1.063	2015 Indiana TRM v2.2, refrigerator recycling
LSAF_new	1.124	2015 Indiana TRM v2.2, time-of-sale refrigerator
Remaining useful life of old unit (years)	8	2015 Indiana TRM v2.2
EUL of new refrigerator (years)	17	2015 Indiana TRM v2.2

Smart Strips

Cadmus used deemed savings from the 2015 Indiana TRM v2.2 to evaluate savings for smart strips (excludes ISR):

$$Energy\ Savings = \sum^{Peripherals} W_{standby} * F_{homes} * F_{control} * H * \frac{1 + WHF_E}{1000}$$

$$Demand\ Savings = \sum^{Peripherals} W_{standby} * F_{homes} * F_{control} * CF * \frac{1 + WHF_D}{1000}$$

The end usage of the smart strip is unknown, so Cadmus used the default weighting from the 2015 Indiana TRM v2.2 where 50% are installed with TV systems and 50% are installed with computer systems. The heating and cooling factor were taken from the Indiana TRM v2.2 for the city of Evansville and were dependent on the heating and cooling type of each participant home. The savings inputs Cadmus used for its *ex post* calculations are shown in Table A-38.

Table A-38. IQW Smart Strip Savings Inputs

Input	Assumption	Source
Power use in standby mode (Wstandby)	Varies from 0.3 watts to 18 watts depending on home computer or TV system peripheral device, per tables in the 2015 Indiana TRM v2.2 Smart Power Strip section	2015 Indiana TRM v2.2
Percentage of homes with peripherals (Fhomes)	Varies from 0.3% to 69% depending on home computer or TV system peripheral device, per tables in the 2015 Indiana TRM v2.2 Smart Power Strip section	2015 Indiana TRM v2.2
Percentage of peripherals controlled (Fcontrol)	Varies from 57% to 100% depending on home computer or TV system peripheral device, per tables in the 2015 Indiana TRM v2.2 Smart Power Strip section	2015 Indiana TRM v2.2
Number of hours per year peripherals are controlled (computers) (H)	7,474	2015 Indiana TRM v2.2
Number of hours per year peripherals are controlled (televisions) (H)	6,784	2015 Indiana TRM v2.2
Coincident factor (CF)	0.50	2015 Indiana TRM v2.2
Waste heat factor for energy (WHFe)	Dependent on heating and cooling type	2015 Indiana TRM v2.2 appendix with 2021 heating and cooling for each lighting participant
Waste heat factor for demand (WHFd)	Dependent on heating and cooling type	2015 Indiana TRM v2.2 appendix with 2021 heating and cooling for each lighting participant

A.5.7 Weatherization Measures

Air Sealing/Infiltration Reduction

Cadmus used these equations from the 2015 Indiana TRM v2.2 to calculate savings for each infiltration reduction retrofit (excludes ISR):

$$kWh\ Savings\ = \frac{CFM50_{EXIST} - CFM50_{NEW}}{N - factor} * \frac{kWh}{CFM}$$

$$kW\ Savings = \frac{CFM50_{EXIST} - CFM50_{NEW}}{N - factor} * \frac{\Delta kW}{CFM} * CF$$

Each site was calculated on an individual basis with different blower door measurements and heating and cooling types. The savings inputs Cadmus used for its *ex post* calculations are shown in Table A-39.

Table A-39. IQW Program Air Sealing Savings Inputs

Description	Assumption	Source
Leakage rate before installation (CFM50_exist)	Actual	2021 program tracking data
Leakage rate after installation (CFM50_new)	Actual	2021 program tracking data
N-Factor	16.3	2015 Indiana TRM v2.2
Summer peak coincidence factor (CF)	0.88	2015 Indiana TRM v2.2
kWh/CFM – Electric, CAC (kWh/CFM)	40.30	2015 Indiana TRM v2.2
kW/CFM – Electric, CAC (kW/CFM)	0.01	2015 Indiana TRM v2.2
kWh/CFM – Heat Pump (kWh/CFM)	20.50	2015 Indiana TRM v2.2
kW/CFM – Heat Pump (kW/CFM)	0.01	2015 Indiana TRM v2.2
kWh/CFM – Electric, NO AC (kWh/CFM)	36.90	2015 Indiana TRM v2.2
kW/CFM – Electric, NO AC (kW/CFM)	0.00	2015 Indiana TRM v2.2
kWh/CFM – Gas Furnace, CAC (kWh/CFM)	3.00	2015 Indiana TRM v2.2
kW/CFM – Gas Furnace, CAC (kW/CFM)	0.01	2015 Indiana TRM v2.2

Insulation (Attic and Wall)

Cadmus applied this algorithm from the 2015 Indiana TRM v2.2 to calculate and verify energy saving (excludes ISR):

$$Annual\ (Energy\ or\ Demand)\ Savings = kSF\ x\ \frac{(Energy\ or\ Demand)\ Savings}{kSF}$$

Table A-40. IQW Program Attic Insultation Savings Inputs

Description	Assumption	Source
Area of installed insulation (kSF)	Actual	2021 program tracking data
Energy Savings	Dependent on recorded pre and post R-values	2021 program tracking data

Energy savings (kWh/kSF) differed by heating type and measure and are in a series of look-up tables in the 2015 Indiana TRM v2.2. Energy savings by installation depended on pre- and post-retrofit insulation R-values, which Cadmus calculated using a three-step process:

1. Determine variables to use for insulation compression, R_{ratio}, and void factors
2. Calculate adjusted pre- and post-retrofit R-values using the inputs from step one
3. Interpolate the 2015 Indiana TRM v2.2 tables to calculate savings using the adjusted R-values from step two

Variables to Use for Insulation Compression, Rratio, and Void Factors

Cadmus adjusted R-values to account for compression, void factors, and surrounding building material, using this formula:

$$R\ value\ Adjusted = R_{nominal}\ x\ F_{compression}\ x\ F_{void}$$

The following equation determined F_{void}:

$$R_{ratio} = (R_{nominal}\ x\ F_{compression})x\ ((R_{nominal}\ x\ R_{framing\ and\ air\ space}))$$

The inputs used for these formulas are shown in Table A-41.

Table A-41. Attic Insulation Compression, Rratio, and Void Factors

Description	Assumption	Source
Actual pre- and post-R-values per manufacturing specifications (Rnominal)	Actual	2021 IQW Program data
Compression factor dependent on the percentage of insulation compression (Fcompression)	1	Cadmus assumed a value of 1 at 0% compression for the evaluation
Void Factor (Fvoid)	Varied	Void factors accounted for insulation coverage and were dependent on installation grade level, pre- and post-R-values and compression effects
R-value for material (Rfarming and air space)	5	2015 Indiana TRM v2.2
Area of installed insulation in thousand square feet (kSF)	Varies by participant	2021 program tracking data for heating/cooling combination for each participant

Table A-42 lists the void factor based on the calculated R_{ratio}. Cadmus used a 2% void for the evaluation because this information was unknown, and 2% is common in most households.

Table A-42. Indiana TRM v2.2: Insulation Void Factors

R_{ratio}	Void Factor	
	2% Void (Grade II)	5% Void (Grade III)
0.5	0.96	0.9
0.55	0.96	0.9
0.6	0.95	0.88
0.65	0.94	0.87
0.7	0.94	0.85
0.75	0.92	0.83
0.8	0.91	0.79
0.85	0.88	0.74
0.9	0.83	0.66
0.95	0.71	0.49
0.99	0.33	0.16

Adjusted R-Values

Applying the formula above (R_{value} Adjusted), Cadmus used the inputs defined in step one to calculate adjusted R-values for pre- and post-installation and calculated adjusted R-values for every installation in the database.

Interpolate Indiana TRM v2.2 Tables

Cadmus used the pre- and post-adjusted R-values from step two to interpolate energy and demand for every 2019 installation based on the reported heating and cooling types. Appendix C of the 2015 Indiana TRM v2.2 defines energy and demand savings for insulation measures by heating and cooling equipment.

Duct Sealing

Cadmus used these equations to calculate savings per duct sealing retrofit (excludes ISR):

$$Annual\ Cooling\ kWh\ Savings = \frac{DE_{AFTER} - DE_{BEFORE}}{DE_{AFTER}} * EFLH_{COOL} * \frac{Btuh_{COOL}}{SEER * 1{,}000}$$

$$Annual\ Heating\ kWh\ Savings = \frac{DE_{AFTER} - DE_{BEFORE}}{DE_{AFTER}} * EFLH_{HEAT} * \frac{Btuh_{HEAT}}{3{,}412\ *\ \eta_{HEAT}}$$

$$Demand\ kW\ Savings = \frac{DEPK_{AFTER} -\ DEPK_{BEFORE}}{DEPK_{AFTER}} * \frac{Btuh_{COOL}}{EER * 1{,}000} * CF$$

Cadmus calculated savings for duct sealing jobs implemented through the IQW Program using the savings inputs used for its *ex post* calculations are shown in Table A-43.

Table A-43. IQW Program Duct Sealing Savings Inputs

Description	Assumption	Source
Distribution efficiency of ductwork after dealing sealing (DE_{AFTER})	87%	Used the following reference (listed in the 2015 Indiana TRM v2.2): http://www.bpi.org/files/pdf/DistributionEfficiencyTable-BlueSheet.pdf Percentage of ducts within conditioned space was unknown. Assumed the average of all potential values under: “Connections Sealed with Mastic.”
Distribution efficiency of ductwork before dealing sealing (DE_{BEFORE})	76%	Used the following reference (listed in the 2015 Indiana TRM v2.2): http://www.bpi.org/files/pdf/DistributionEfficiencyTable-BlueSheet.pdf Percentage of ducts within conditioned space was unknown. Assumed the average of all potential values under: “No Observational Leaks,” “Some Observed Leaks,” “Significant Leaks,” and “Catastrophic Leaks.”
DE for use in peak demand savings ($DEPK_{AFTER}$)	85%	2015 Indiana TRM v2.2
DE for use in peak demand savings ($DEPK_{BEFORE}$)	73%	2015 Indiana TRM v2.2
Full-load heating hours ($EFLH_{HEAT}$)	1,341; 982	2015 Indiana TRM v2.2 for Indianapolis and Evansville
Full-load cooling hours ($EFLH_{COOL}$)	600	2015 Indiana TRM v2.2 for Evansville
Heating system capacity – electric furnace ($Btuh_{HEAT}$)	32,000 BTUH	2016 Pennsylvania TRM[52]
Cooling system capacity ($Btuh_{COOL}$)	33,513 BTUH	2021 IQW CAC Installation Data
Efficiency of heating system – electric furnace (η_{HEAT})	HSPF=3.412	2015 Indiana TRM v2.2
Efficiency of cooling system (SEER)	13	2015 Indiana TRM v2.2: 13 SEER reflects new federal efficiency standard for baseline equipment
Efficiency of cooling system (EER)	11	2015 Indiana TRM v2.2: 11 EER reflects new federal efficiency standard for baseline equipment

Whole Home IQW

CenterPoint provided measure categories under which each Whole Home IQW project could fall. These included water heater repair, water heater replacement, furnace repair, furnace replacement, venting correction, miscellaneous electrical, air conditioner replacement, refrigerator, preparation before replacement, and healthier homes. Additional notes specified what was included in preparation for replacement, which could include duct sealing and air sealing with attic insulation.

52 Electric heating system capacity assumptions were not available in the 2015 Indiana TRM v2.2.

Furnace tune-up and replacement for electric furnaces has no basis for savings since electric resistance efficiency does not change; however, for the electric furnace repair measure, the implementer reported the presence of a heat pump in addition to the electric furnace. Therefore, Cadmus used a program average heat pump tune-up electric savings for the electric furnace repair measure, and zero electric savings for the electric furnace replacement measure.

Cadmus also used program average savings for duct sealing, air sealing, attic insulation, non-electric furnace replacement, and air conditioner replacement. If the household had a similar measure in both Whole Home IQW and other measure groups as part of the IQW Program, Cadmus assigned zero electric savings to the IQW whole home measure.

A.6 Residential Behavioral Savings Program

Cadmus' impact evaluation of the Residential Behavioral Savings (RBS) Program included a billing analysis to evaluate the effect of home energy reports on the behavior of treated customers. The evaluation of the RBS Program savings and efficiency program uplift consisted of these six tasks:

- Billing data collection, review, and preparation
- Equivalency checks on treatment and control groups
- Billing analysis
- Energy-savings estimations
- Energy efficiency program channeling analysis (uplift)
- Demand savings analysis

A.6.1 Data Collection, Review, and Preparation

CenterPoint Energy provided data from monthly utility bills for electric only and dual fuel homes for treatment and control group customers between January 2011 and January 2022 (approximately 13 months of bills prior to the beginning of the RBS Program in 2012 and 120 months of bills after the program began). Billing data included energy use during the monthly billing cycle, the last day of the billing cycle, and these fields:

- Customer segment (electric only or dual fuel and launch date/wave)
- Assignment to treatment or control groups
- First report date
- Opt-out date for customers choosing not to participate in the program
- Move-out date for customers who have moved
- Electric and gas account numbers for linking to billing data

Cadmus collected National Oceanic and Atmospheric Administration (NOAA) daily temperature data from the municipal airport weather stations near Henderson, Kentucky, Lawrenceville, Illinois, and Evansville, Indiana, the three stations nearest to all RBS Program treatment and control homes.

CenterPoint Energy provided participation and measure savings data for its 2021 DSM programs. For each program and measure, these data included the account number, the number and description of measures installed, measure installation dates, and verified savings. Cadmus used these data to estimate the RBS Program's participation and savings effects on other efficiency programs (uplift).

Data Preparation

Cadmus worked with CenterPoint Energy and the program implementer to acquire the data necessary for the RBS Program evaluation in 2021. Major data preparation steps included cleaning and compiling the program tracking data, billing consumption and weather data, and testing for significant differences in annual pretreatment consumption between treatment and control customers, by customer segment. This section describes the steps Cadmus took to process the data and verify customers in the tracking and billing data.

Program Tracking Data

Cadmus received RBS Program tracking data from the program implementer at the close of 2021. These data included treatment group customers who received home energy reports in the current or a previous year and control group customers tracked since the program's inception. Because the RBS Program was implemented as a randomized control trial, Cadmus included all of the possible customers in its evaluation, adopting a "once in, always in" policy for customers originally randomized into either the treatment or control group prior to the launch of the home energy reports.

Table A-44 shows customer attrition through 2021, by treatment and control groups, by customer segment, and as originally randomized and active at the beginning of treatment in 2021. The attrition process captures customers whose accounts closed (became inactive) since the launch of the program.

Table A-44. 2021 RBS Program Customer Attrition

Customer Segment	Originally Randomized		Active at the Beginning of Treatment in 2021	
	Treatment	Control	Treatment	Control
Wave 1 Electric Only (2012)	25,746	6,098	10,786	2,589
Wave 1 Dual Fuel (2013)	51,496	5,590	26,003	2,915
Wave 2 Dual Fuel (2020)	13,693	10,000	12,439	9,055
Program Total	**90,935**	**21,688**	**49,228**	**14,559**

Billing Data

Cadmus collected customer billing data for each customer segment from the program implementer. To clean the billing data, Cadmus followed these steps:

1. Drop customers whose accounts went inactive before the delivery of the first energy reports
2. Clean and calendarize bills, which included dropping bills that covered more than 100 days (about three months), dropping bills with negative consumption, dropping bills earlier than one year prior to the delivery of the first energy reports, and truing up bills with estimated reads
3. Drop customers with less than six months of pretreatment bills (six months of pretreatment bills was used as a cutoff to preserve sample sizes and be consistent across waves)

Table A-45 provides the attrition in the 2021 analysis sample from data cleaning steps. The final modeling sample included customers in Cadmus' final tracking data who were not dropped during the billing data cleaning process and were included in the billing analysis. These customers were not necessarily active at the beginning of treatment in 2021.

Table A-45. 2021 RBS Program Analysis Sample

Step in Attrition	Wave 1 Electric Only[1]		Wave 1 Dual Fuel[1]		Wave 2 Dual Fuel[1]	
	Treatment	Control	Treatment	Control	Treatment	Control
Originally Randomized Customers	25,746 (100%)	6,098 (100%)	51,496 (100%)	5,590 (100%)	13,693 (100%)	10,000 (100%)
Included in Billing Data	25,677 (100%)	6,082 (100%)	51,393 (100%)	5,580 (100%)	13,693 (100%)	10,000 (100%)
Active at Program Launch	25,171 (98%)	5,963 (98%)	50,822 (99%)	5,530 (99%)	13,645 (100%)	9,968 (100%)
Less than 6 Months of Pretreatment Data	23,717 (92%)	5,594 (92%)	49,632 (96%)	5,390 (96%)	13,186 (96%)	9,611 (96%)
Final Modeling Sample	**23,717 (92%)**	**5,594 (92%)**	**49,632 (96%)**	**5,390 (96%)**	**13,186 (96%)**	**9,611 (96%)**

[1] The billing data analysis sample includes customers who were randomized into the program and active when treatment began in 2012. These customers were not necessarily active in 2021.

Weather Data

Cadmus collected weather data from the weather station closest to each home and estimated the heating degree days (HDDs) and cooling degree days (CDDs) for each customer billing cycle. After merging the weather and billing data, Cadmus allocated the billing cycle electricity consumption, HDDs, and CDDs to calendar months.

Verification of Balanced Treatment and Control Groups

Cadmus verified that subjects in the treatment and control groups in the final analysis sample were equivalent in their annual pretreatment energy consumption. Cadmus verified the equivalence of waves using the cleaned billing data, comparing preprogram average annual consumption from before the launch of the program.

Table A-46 provides the 2021 results of the tests for significant differences in treatment and control group pretreatment consumption. Cadmus found that all waves were balanced. No statistically significant differences existed between the pretreatment consumption of treatment and control groups in any customer segment.

Table A-46. 2021 RBS Program Analysis Sample

Customer Segment	Average Annual Electricity Use per Customer (kWh/yr)			p-value[1]
	Treatment Group	Control Group	Difference	
Wave 1 Electric Only (2012)	14,772	14,647	-125	0.28
Wave 1 Dual Fuel (2013)	12,024	11,937	-87	0.30
Wave 2 Dual Fuel (2020)	11,785	11,811	26	0.74

[1] A p-value >0.05 indicates an insignificant difference at the 5% significance level.

A.6.2 Regression Analysis

Cadmus used regression analyses of monthly billing data from customers in the treatment and control groups to estimate the RBS Program's energy savings. The billing analysis conformed to IPMVP Option C, whole facility,[53] and the approach described in the Uniform Methods Project.[54,55]

More specifically, Cadmus used a multivariate regression to analyze the energy use of customers who had been randomly assigned to treatment and control groups. Cadmus tested and compared two general model specifications to check the robustness of savings results:

- The ***post-only*** model regresses customer average daily consumption on a treatment indicator variable and includes as regressors customers' pretreatment energy use, month-by-year fixed effects and weather.[56] The model is estimated only with posttreatment customer bills.
- The ***difference-in-differences (D-in-D) fixed effects*** model regresses average daily consumption on a treatment indicator variable, month-by-year fixed effects, customer fixed effects, and weather. The model is estimated with pretreatment and posttreatment customer bills.

Both models yielded savings estimates that were within each other's confidence intervals, meaning that their results were not statistically different. In 2021, Cadmus reported the results of the post-only model, consistent with previous program years.

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53 Efficiency Valuation Organization. January 2012. *International Performance Measurement and Verification Protocol, Concepts and Options for Determining Energy and Water Savings, Volume 1.* Page 25. (EVO 10000 – 1:2012) http://www.evo-world.org/

54 Agnew, K., and M. Goldberg. April 2013. *Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol.* U.S. Department of Energy, National Renewable Energy Laboratory. (NREL/SR-7A30-53827) http://www1.eere.energy.gov/office_eere/de_ump_protocols.html

55 Stewart, J., and A. Todd. August 2014. *Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, Chapter 17: Residential Behavior Protocol.* U.S. Department of Energy, National Renewable Energy Laboratory. (NREL/SR-7A40-62497) http://www1.eere.energy.gov/office_eere/de_ump_protocols.html

56 Allcott, H., and T. Rogers. 2014. "The Short-Run and Long-Run Effects of Behavioral Interventions: Experimental Evidence from Energy Conservation." *American Economic Review* 104 (10), 3003-3037.

The error terms of the post-only model and D-in-D fixed effects model should be uncorrelated with program participation ($PART_i$) and other observable variables because of the random assignment of homes to treatment and control groups, and therefore ordinary least squares (OLS) regression should result in an unbiased estimate of the average daily savings per customer. Cadmus clustered the standard errors on customers to account for arbitrary correlation in customer consumption over the analysis period.

Post-Only Model

Cadmus specified the post-only model assuming the average daily consumption (ADC_{it}) of electricity of home 'i' in month 't' as given by the following equation:

$$ADC_{it} = \sum_{t=1}^{T} \beta_{1t} PART_i * PY_t + \sum_{m=1}^{M} \beta_2 Pre\text{–} ADC_{im} \times M_m + W'\gamma + \ \tau_t + \varepsilon_{it}$$

Where:

β_1	=	Coefficient representing the conditional average treatment effect of the program on electricity consumption (kWh per customer per day).
$PART_i$	=	Indicator variable for program participation (which equals 1 if customer 'i' was in the treatment group and 0 otherwise).
PY_t	=	Indicator variable for each program year (which equals 1 if the month 't' was in the program year and 0 otherwise).
β_2	=	Coefficient representing the conditional average effect of pretreatment electricity consumption on posttreatment average daily consumption (kWh per customer per day).
$Pre\text{–} ADC_{im}$	=	Mean household energy consumption of customer 'i' in month 'm' in the pretreatment period.
M_m	=	Variable indicating the month of the calendar year for months $m = 1,2, \dots ,12$.
W	=	Vector using both HDD and CDD variables to control for weather impacts on energy use.
γ	=	Vector of coefficients representing the average impact of weather variables on energy use.
τ_t	=	Average energy use in month 't reflecting unobservable factors specific to the month. The analysis controls for these effects with month-by-year fixed effects.
ε_{it}	=	Error term for customer 'i' in month 't.'

D-in-D Fixed Effects Model

The D-in-D fixed effects model was specified, assuming average daily consumption (ADC_{it}) of electricity of customer 'i' in month 't', as given by the following equation:

$$ADC_{it} = \alpha_i + \tau_t + W'\gamma + \beta_1 PART_i \times POST_t + \epsilon_{it}$$

Where:

β_1	=	Coefficient representing the program's conditional average treatment effect on electricity use (kWh per customer per day).
$PART_i$	=	Indicator variable for program participation (which equals 1 if customer 'i' was in the treatment group and 0 otherwise).
$POST_t$	=	Indicator variable for whether month 't' is pre- or posttreatment (which equals 1 if month 't' was in the treatment period and 0 otherwise).
W	=	Vector using HDD and CDD variables to control for weather impacts on energy use.
γ	=	Vector of coefficients representing the average impact of weather variables on energy use.
α_i	=	Average energy use in customer 'i' reflecting unobservable, non-weather-sensitive, and time-invariant factors specific to the customer. The analysis controlled for these effects with customer fixed effects.
τ_t	=	Average energy use in month 't' reflecting unobservable factors specific to the month. The analysis controlled for these effects with month-by-year fixed effects.
ϵ_{it}	=	Error term for customer 'i' in month 't'

Regression Analysis Estimates

Cadmus estimated separate treatment effects for each customer segment and program year. Table A-47 shows both the post-only and D-in-D fixed effects model estimates of average daily savings per customer, by segment and program year. All of the models were estimated by OLS, and Huber-White robust clustered standard errors were adjusted for correlation over time in a customer's consumption. The post-only and D-in-D fixed effects models produce statistically indistinguishable results each year, showing that estimated treatment effects are robust.

Table A-47. RBS Program Historical Model Comparison of Savings

Treatment Year	Wave 1 Electric Only[1]		Wave 1 Dual Fuel[1]		Wave 2 Dual Fuel[1]	
	Post-Only (Standard Error)	D-in-D Fixed Effects (Standard Error)	Post-Only (Standard Error)	D-in-D Fixed Effects (Standard Error)	Post-Only (Standard Error)	D-in-D Fixed Effects (Standard Error)
2012	0.424 (0.093) ***	0.352 (0.092) ***	0.215 (0.083) ***	0.171 (0.072) **	N/A	N/A
2013	0.644 (0.14) ***	0.61 (0.126) ***	0.304 (0.099) ***	0.274 (0.095) ***	N/A	N/A
2014	0.734 (0.176) ***	0.674 (0.162) ***	0.424 (0.118) ***	0.417 (0.116) ***	N/A	N/A
2015	0.696 (0.175) ***	0.626 (0.171) ***	0.464 (0.126) ***	0.442 (0.127) ***	N/A	N/A
2016	0.674 (0.188) ***	0.646 (0.189) ***	0.428 (0.143) ***	0.412 (0.144) ***	N/A	N/A
2017	0.745 (0.197) ***	0.677 (0.204) ***	0.391 (0.149) ***	0.404 (0.154) ***	N/A	N/A

Treatment Year	Wave 1 Electric Only[1]		Wave 1 Dual Fuel[1]		Wave 2 Dual Fuel[1]	
	Post-Only (Standard Error)	D-in-D Fixed Effects (Standard Error)	Post-Only (Standard Error)	D-in-D Fixed Effects (Standard Error)	Post-Only (Standard Error)	D-in-D Fixed Effects (Standard Error)
2018	0.812 (0.244) ***	0.738 (0.236) ***	0.292 (0.169) *	0.332 (0.17) *	N/A	N/A
2019	0.673 (0.251) ***	0.582 (0.249) **	0.479 (0.18) ***	0.492 (0.184) ***	N/A	N/A
2020	0.799 (0.265) ***	0.701 (0.267) ***	0.584 (0.187) ***	0.606 (0.193) ***	0.181 (0.098) *	0.176 (0.083) **
2021	0.52 (0.287) *	0.403 (0.286)	0.432 (0.197) **	0.444 (0.203) **	0.277 (0.097) ***	0.31 (0.097) ***

[1]Standard errors clustered on customers are presented below the estimated treatment effect in parentheses (*** Significant at 1%; ** Significant at 5%; * Significant at 10%). The treatment effects represent the average daily savings per treatment group customer.

A.6.3 Program Total Savings Estimation

Cadmus estimated program savings in 2021 for each wave's population of treated customers as the product of average daily savings per participant and the number of days these customers were treated in 2021, as shown below. Cadmus assumed that the program implementer intended to treat all eligible customers at least once in 2021 and included treatment days for customers who should have received treatment in 2021 (i.e., those who were still active and randomized as a treatment customer), even when customers were not explicitly flagged as receiving 2021 treatment.

$$Savings_h = -\hat{\beta}_{1,h} * \sum_{i=1}^{N} Treatment\ Days_{i,h}$$

Where:

$\hat{\beta}_{1,h}$ = Average daily savings (kWh) per treatment group customer in wave 'h', estimated from the post-only regression model.

$Treatment\ Days_{i,h}$ = The number of days customer 'i' in wave 'h'was treated in 2021.

Cadmus estimated realization rates for each wave as the ratio of verified program savings to reported program savings (estimated by the program implementor).

A.6.4 Energy Efficiency Program Channel (Uplift) Analysis

Analysis of efficiency program uplift proved important for two reasons:

- CenterPoint Energy sought to learn whether and to what extent the RBS Program caused participation in CenterPoint Energy's other programs.
- To the extent the RBS Program caused participation in other efficiency programs, energy savings resulting from this participation would be counted twice—once in the regression estimate of RBS Program savings and once in the other programs' savings. (Thus, CenterPoint Energy should subtract the double-counted savings from the DSM portfolio savings.)

The uplift analysis yielded estimates of the percentage of the RBS Program's effect on other efficiency program participation and on the double-counted savings. Cadmus limited the analysis, however, to program measures that CenterPoint Energy tracked at the customer level. Cadmus performed participation and savings uplift analyses for these residential efficiency programs:

- Appliance Recycling Program
- Income Qualified Weatherization (IQW) Program
- Residential Prescriptive Program (all delivery channels)
- Smart Cycle Program

Cadmus did not perform channeling analyses for these residential efficiency programs:

- The Energy Efficient Schools Program targeted school children and their families. Participation was not voluntary.
- For the Residential Specialty Lighting Program, although the RBS Program may have influenced purchases of LEDs and other high-efficiency lighting, such purchases were tracked at the store level rather than the customer level.
- The Residential New Construction Program targeted builders of new homes, which the RBS Program did not target.

As with the energy-savings analysis, the uplift analysis followed the logic of the program's experimental design. Cadmus collected efficiency program participation and savings data in 2021, matching the data to RBS Program treatment and control homes, and applied a simple differences analysis to each customer segment. Because customers in the treatment and control groups are expected to be identical, except for having participated in the RBS Program, the difference between these groups in other efficiency program participation would equal the RBS Program uplift.

In homes matching the 2021 efficiency program data, Cadmus excluded measures installed after an account became inactive or measures installed before the start of the evaluation year. When calculating energy uplift, Cadmus pro-rated a measure's savings based on the installation date, so that a measure installed halfway through the year was only credited half a year of savings. In addition, Cadmus prorated a measure's savings based on weather sensitivity. For demand uplift, Cadmus included full demand savings for any measure installed prior to the end of September 2021.

Let ρ_m be the participation rate (defined as the number of participants to the number of potential participants) in a program in 2021 for group m (as before, m=1, for treated homes, and m=0 for control homes) in period t (t in {0,1}), as illustrated in this equation:

$$\textit{Participation uplift} = \rho_1 - \rho_0$$

Cadmus used this method to express participation uplift relative to the participation rate of control homes in 2021, which yielded an estimate of the percentage uplift, as in this equation:

$$\textit{\%Participation Uplift} = \textit{Program Uplift}/\rho_0$$

Cadmus estimated RBS Program savings from participation in other efficiency programs the same way, by replacing the program participation rate with the program net savings per home, as illustrated in this equation:

$$\textit{Net savings per home from participation uplift} = \sigma_1 - \sigma_0$$ [57]

Multiplying net savings per home by the number of program homes yielded an estimate for a customer segment of total RBS net savings counted in CenterPoint Energy's other efficiency programs.

A.6.5 Demand Savings Analysis

Cadmus estimated the peak-coincident demand savings with Integral Analytics' DSMore software using a load shape for a typical CenterPoint Energy home and the evaluated net program energy savings as inputs. This is the same software that CenterPoint Energy uses to assess program cost-effectiveness, which helps maintain alignment. This methodology is a reasonable approach for programs that evaluate savings using billing analysis, in the absence of an hourly analysis of treatment and control AMI data. These approaches and validities are further outlined in the Uniform Methods Project.[58] Reported demand savings were based on per-household estimates that do not take into account year-to-year differences in energy savings.

The Calibrated DSMore Load-Shape Differences (CLSD) approach uses CenterPoint Energy-specific residential load shapes built into DSMore and calibrates the load shapes to match the verified annual consumption of the treatment group to equal the annual kWh savings. It then identifies and reports the demand reductions during the coincident peak for the utility. Cadmus performed separate demand savings analyses for dual fuel and electric only customers using load shapes specific to each customer segment.

The CLSD approach follows six specific steps:

1. Conduct a pre-post D-in-D (experimental design with randomized control group) billing analysis to identify average participant and program-wide energy (kWh) savings achieved. (This is described in more detail above in the *A.6.2 Regression Analysis* section in this appendix.)
2. Calibrate CenterPoint Energy-specific residential DSMore load shapes to match the kWh consumption levels of the treatment group.
3. Adjust the load shape so that the annual savings identified in the billing analysis are reflected on that load shape. Maintain the same shape, while reducing the amplification of that shape.[59]

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57 Cadmus obtained net savings by multiplying measure-verified gross savings by the estimated measure NTG ratio.

58 Stern, Frank, and Justin Spencer. October 2017. "Chapter 10: Peak Demand and Time-Differentiated Energy Savings Cross-Cutting Protocol." *Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.* https://www.nrel.gov/docs/fy17osti/68566.pdf

59 This load-shape adjustment accounted for the fact that delivery of the first home energy reports occurred in late January and early February of 2012.

4. Record the coincident load reduction on the calibrated DSMore load shape for the peak period defined by CenterPoint Energy.
5. Report the number determined in step four as the coincident kW reduction.
6. Multiply the peak reduction determined in step five by the number of active treatment customers to report program kW impacts.

The CLSD approach provides a reasonable estimate of the per household and program-wide peak kW reduction given the available data.

A.7 Appliance Recycling Program

Cadmus' impact evaluation of the Appliance Recycling Program included measures with attributable electric savings—recycled refrigerators, freezers, and room air conditioners.

A.7.1 Refrigerator and Freezer Models

Cadmus used a regression model specified in the U.S. Department of Energy's Uniform Methods Project (UMP) to estimate consumption for refrigerators.[60] Because the UMP does not have specifications for freezers, Cadmus created an analogous freezer model from an aggregated dataset of freezers metered by Cadmus in Wisconsin and Michigan. The coefficient for each independent variable indicated the influence of that variable on daily consumption. Holding all other variables constant, a positive coefficient indicated an upward influence on consumption, and a negative coefficient indicated a downward effect on consumption.

Table A-48 shows the model specification Cadmus used to estimate a refrigerator's annual unit energy consumption (UEC) and its estimated parameters. The coefficient indicated the marginal impact on the UEC of a one-point increase in the independent variable. For example, an increase of one cubic foot in the size of a refrigerator will result in a 0.06 kWh increase in daily consumption. For dummy variables, the coefficient value represented the difference in consumption if the given condition proved true. For example, Cadmus' refrigerator model used a coefficient of 0.56 for the variable indicating whether a refrigerator was a primary unit; thus, with all else equal, a primary refrigerator consumed 0.56 kWh per day more than a secondary unit.

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[60] U.S. Department of Energy. October 2017. *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.* https://www.energy.gov/eere/about-us/ump-protocols

Table A-48. Refrigerator UEC Regression Model Estimates

(Dependent Variable=Average Daily kWh, R2=0.30)

Independent Variables	Coefficient	p-Value
Intercept	0.81	0.13
Age (years)	0.021	0.04
Dummy: Unit manufactured pre 1990s	1.04	<.0001
Size (cu. Ft.)	0.06	0.02
Dummy: Single Door	-1.75	<.0001
Dummy: Side-by-Side	1.12	<.0001
Dummy: Primary	0.56	0.003
Interaction: Unconditioned Space x HDDs[1]	-0.04	<.0001
Interaction: Unconditioned Space x CDDs[2]	0.03	0.19

[1] Heating degree day
[2] Cooling degree day

Table A-49 shows the final model specifications Cadmus used to estimate annual energy consumption of participating freezers and their estimated parameters.

Table A-49. Freezer UEC Regression Model Estimates

(Dependent Variable=Average Daily kWh, R2=0.45)

Independent Variables	Coefficient	p-Value
Intercept	-0.96	0.54
Age (years)	0.045	0.12
Dummy: Unit Manufactured Pre-1990	0.54	0.24
Size (cu. Ft.)	0.12	0.09
Dummy: Chest Freezer	0.30	0.07
Interaction: Unconditioned Space x HDDs[1]	-0.03	0.54
Interaction: Unconditioned Space x CDDs[1]	0.08	0.07

[1] CDDs and HDDs derive from the weighted average CDDs and HDDs from TMY3 data for weather stations mapped to participating appliance zip codes. TMY3 is a typical meteorological year, using median daily values for a variety of weather data collected from 1991–2005.

Cadmus analyzed the corresponding characteristics (i.e., the independent variables) for the participating appliances (captured by ARCA, the program implementer, in the 2021 program tracking database). Table A-50 lists program averages or proportions for each independent variable. Cooling degree days (CDDs) equal the weighted average CDDs from typical meteorological year 3 (TMY3) data for weather stations mapped to participating appliance ZIP codes.[61]

[61] TMY3 used median daily values for a variety of weather data collected from 1991 to 2005.

Table A-50. 2021 Appliance Recycling Program Participant Mean Explanatory Variables and Model Coefficients

Measure	Independent Variables	2021 Mean Value	2021 Model Coefficient
Refrigerator	Intercept	1.00	0.81
	Age (years)	19.59	0.021
	Dummy: Manufactured pre 1990s	0.09	1.04
	Size (cu. Ft.)	19.33	0.06
	Dummy: Single Door	0.04	-1.75
	Dummy: Side-by-Side	0.36	1.12
	Dummy: Primary	0.48	0.56
	Interaction: Unconditioned Space x HDDs[1]	5.27	-0.04
	Interaction: Unconditioned Space x CDDs[1]	1.59	0.03
Freezer	Intercept	1.00	-0.96
	Age (years)	21.98	0.045
	Dummy: Unit Manufactured Pre-1990	0.21	0.54
	Size (cu. Ft.)	15.25	0.12
	Dummy: Chest Freezer	0.44	0.30
	Interaction: Unconditioned Space x HDDs[1]	7.11	-0.03
	Interaction: Unconditioned Space x CDDs[1]	2.15	0.08

[1] CDDs and HDDs derive from the weighted average CDDs and HDDs from TMY3 data for weather stations mapped to participating appliance zip codes. TMY3 is a typical meteorological year, using median daily values for a variety of weather data collected from 1991–2005.

Unit Energy Consumption

To determine annual and average daily per-unit energy consumption using UEC models and 2021 Appliance Recycling Program tracking data, Cadmus applied average participant refrigerator and freezer characteristics to regression model coefficients. This approach ensured that the resulting UEC was based on specific units recycled through CenterPoint Energy's program in 2021 rather than on a secondary data source.

Table A-51 shows the average per-unit UEC for refrigerators and freezers recycled during 2021 and 2020 (for comparison). In 2021, refrigerators and freezers had a lower UEC than in 2020. Note that the average per-unit UEC shown in the table does not include the part-use adjustment factor.

Table A-51. 2021 and 2020 Appliance Recycling Program – Refrigerator and Freezer Average UEC

Measure	2020 Average Unit Energy Consumption (kWh/Year)	2021 Average Unit Energy Consumption (kWh/Year)	2021 Relative Precision (90% Confidence)
Refrigerator	1,077	1,064	11%
Freezer	785	754	27%

Using values from Table A-50 above, Cadmus calculated the estimated annual UEC for 2021 freezers using the following equation:

$$\text{2021 Freezer UEC} = 365.25\, days * (-0.96 + 0.045 * [21.98\, years\ old] + 0.54 * [21\%\ units\ manufactured\ pre - 1990] + 0.12 * [15.25\, ft.^3\,] + 0.30 * [44\%\ units\ that\ are\ chest\ freezers] + 0.08 * [2.15\ Unconditioned\ CDDs] - 0.03 * [7.11\ Unconditioned\ HDDs]) = 754\, kWh/year$$

Compared with 2020, the change in the refrigerator UEC is primarily because of a 4% decrease in the number of recycled refrigerators that were being used as primary units. The independent variables for primary refrigerators has a positive coefficient in the gross savings model, which means a unit with this characteristic uses more energy compared with a unit without the characteristic, holding all else equal.

The decrease in the freezer UEC is primarily because of a 9% decrease in the number of recycled freezers that were manufactured before 1990 and a 4% decrease in the average age of recycled freezers compared with 2020.

Table A-52 shows a direct comparison of average values for 2020 and 2021 for all model variables.

Table A-52. Appliance Recycling Program
Participant Mean Explanatory Variables 2021 and 2020 Comparison

Measure	Independent Variables	2021 Mean Value	2020 Mean Value
Refrigerator	Age (years)	19.59	19.36
	Dummy: Manufactured pre 1990s	0.09	0.09
	Size (cubic feet)	19.33	19.96
	Dummy: Single Door	0.04	0.03
	Dummy: Side-by-Side	0.36	0.32
	Dummy: Primary	0.48	0.50
	Interaction: Unconditioned Space x HDDs[1]	5.27	4.71
	Interaction: Unconditioned Space x CDDs[1]	1.59	1.42
Freezer	Age (years)	21.98	23.01
	Dummy: Unit Manufactured Pre-1990	0.21	0.23
	Size (cubic feet)	15.25	15.54
	Dummy: Chest Freezer	0.44	0.41
	Interaction: Unconditioned Space x HDDs[1]	7.11	6.60
	Interaction: Unconditioned Space x CDDs[1]	2.15	1.98

[1] CDDs and HDDs derive from the weighted average CDDs and HDDs from TMY3 data for weather stations mapped to participating appliance zip codes. TMY3 is a typical meteorological year, using median daily values for a variety of weather data collected from 1991–2005.

Part-Use

Part-use is an adjustment factor specific to appliance recycling that is used to convert the UEC into an average per-unit gross savings. The UEC itself is not equal to the gross savings because the UEC model yields an estimate of annual consumption, and not all recycled refrigerators would have operated year-round had they not been decommissioned through the program.

The part-use methodology relies on information from surveyed customers regarding their pre-program appliance use patterns. The final estimate of part-use reflects how appliances were likely to operate had they not been recycled (rather than how they previously operated). For example, a primary refrigerator, operated year-round, could have become a secondary appliance, operating part-time in a situation where the participant bought a new refrigerator for the kitchen.

The methodology accounts for these possible shifts in usage types. Specifically, Cadmus calculated part-use using a weighted average of these prospective part-use categories and factors:

- Appliances that would have run full-time (part-use=1.0)
- Appliances that would not have run at all (part-use=0.0)
- Appliances that would have operated a portion of the year (part-use is between 0.0 and 1.0)

Using information gathered through the 2021 Appliance Recycling Program participant survey, Cadmus used this multistep process to determine part-use:

- First, Cadmus determined whether a recycled refrigerator served as a primary or secondary unit (with all stand-alone freezers considered secondary units).
- If participants said they recycled a secondary refrigerator, Cadmus asked whether the refrigerator remained unplugged, operated year-round, or operated for a portion of the preceding year (assuming all primary units operated year-round). Cadmus asked the same question for all participants recycling a freezer.
- If participants said their secondary refrigerator or freezer operated for only a portion of the preceding year, respondents estimated the total number of months that the appliance was plugged in. (In 2021, responses from this participant subset resulted in secondary refrigerators operating an average of 5.1 months and secondary freezers operating an average of 6.8 months.)
- Cadmus divided each value by 12 to calculate the annual part-use factor for all secondary refrigerators and freezers operated for only a portion of the year. (In 2021, the average secondary refrigerator had a part-use factor of 0.43, and the average secondary freezer had a part-use factor of 0.56.)
- If participants said they would have kept their unit, Cadmus then asked if they would have moved the unit to a new location or would have kept the unit in the same location. If participants said they would have kept their refrigerators in the kitchen, Cadmus assumed these participants would have continued to use the refrigerator as a primary appliance and assigned them a part-use factor of 1. For all other responses, Cadmus assumed the appliance would have been used as a secondary appliance and applied the weighted average part-use factor for secondary appliances (0.90 for refrigerators and 0.86 for freezers, as shown in Table A-53).
- If participants said they would have discarded their appliance independent of the Appliance Recycling Program, Cadmus did not follow up about that appliance's future use because those actions would be determined by another customer. Therefore, because the future use of discarded refrigerators remains unknown, Cadmus applied the weighted part-use average (0.95)

of all refrigerator units (primary and secondary, as shown in Table A-53) to this subset of refrigerators. Cadmus acknowledges that the discarded appliances might be used as either primary or secondary units in the would-be recipient's home.

Table A-53 lists the resulting part-use factor results by category.

Table A-53. 2021 Appliance Recycling Program Part-Use Factor by Category

Usage Type and Part-Use Category	Refrigerators			Freezers		
	Percentage of Recycled Units[1]	Part-Use Factor	Per-Unit Energy Savings (kWh/Yr)	Percentage of Recycled Units[1]	Part-Use Factor	Per-Unit Energy Savings (kWh/Yr)
Secondary Units Only	n=69			N/A		
Not in Use	4%	0.00	-			
Used Part-Time	10%	0.43	456			
Used Full-Time	86%	1.00	1,064			
Weighted Average	**100%**	**0.90**	**956**			
All Units (Primary and Secondary)	n=136			n=35		
Not in Use	2%	0.00	-	9%	0.00	-
Used Part-Time	5%	0.43	456	11%	0.56	424
Used Full-Time	93%	1.00	1,064	80%	1.00	754
Weighted Average	**100%**	**0.95**	**1,009**	**100%**	**0.86**	**652**

[1] All freezer units are considered to be secondary.

Combining the part-use factors in Table A-53 with participants' self-reported likely actions in the absence of the program resulted in the distribution of future-use scenarios and corresponding part-use estimates for refrigerators shown in Table A-54. This table shows that the weighted average of these future scenarios produces final part-use factor for refrigerators of 0.94 for the 2021 Appliance Recycling Program. The final part-use estimate of 0.86 for freezers comes from Table A-53, as all freezer units are considered secondary units and no additional weighting is needed.

Table A-54. 2021 Appliance Recycling Program Refrigerator Weighted Average Part-Use

Use Prior to Recycling	Likely Use Independent of Recycling	Refrigerators	
		Part-Use Factor	Percentage of Participants
Secondary	Kept	0.90	18%
	Discarded	0.95	34%
Primary	Kept (as primary unit)	1.00	3%
	Kept (as secondary unit)	0.90	2%
	Discarded	0.95	43%
Overall		**0.94**	**100%**

In 2021, the part-use factor for refrigerators was 0.94, the same as in 2020, while freezers decreased to 0.86 in 2021 from 0.92 in 2020. Table A-55 compares CenterPoint Energy's part-use factors to previous evaluation years. Part-use factors can vary every year because they are based on survey results.

Table A-55. Appliance Recycling Program Historical Part-Use

Program Year	Refrigerators	Freezers
2012	0.97	0.92
2013	0.97	0.96
2014	0.93	0.90
2015	0.91	0.79
2016	0.88	0.79
2017	0.90	0.86
2018	0.93	0.80
2019	0.89	0.81
2020	0.94	0.92
2021	**0.94**	**0.86**

A.7.2 Room Air Conditioner

Cadmus used the following equations from the 2015 Indiana TRM v2.2 to calculate *ex post,* per-measure energy savings and demand reduction for recycled room (window) air conditioners:

$$kWh\ savings = \frac{EFLH_{clg} * \text{BTUh}}{1{,}000} * \left(\frac{1}{EER_{exist}} - \frac{\%_{replaced}}{EER_{new}}\right)$$

$$kW\ reduction = \frac{BTUh * CF}{1{,}000} * \left(\frac{1}{EER_{exist}} - \frac{\%_{replaced}}{EER_{new}}\right)$$

Where:

$EFLH_{clg}$ = Equivalent full-load hours to satisfy the cooling requirements for residents in Evansville, Indiana

BTUh = Actual size of the recycled room air conditioner in BTUh units (where 1 ton = 12,000 BTUh)

EER_{exist} = Energy efficiency rating of the recycled room air conditioner

% Replaced = Average percentage of recycled room air conditioners replaced with a new room air conditioner

EER_{new} = Energy efficiency rating of the newly installed room air conditioner

CF = Coincidence factor, a number between 0 and 1 indicating how many room air conditioners are expected to be in use and saving energy during the peak summer demand period

Table A-56 summarizes the recycled room air conditioners' savings assumptions and identifies each assumption's source.

Table A-56. Appliance Recycling Program Variable Assumptions for Recycled Room Air Conditioners

Variable	Room Air Conditioner Value	Source
Equivalent Full-Load Hours (EFLHclg)	445	2015 Indiana TRM v2.2
BTUh	11,357	
Energy Efficiency Rating-Existing(EERexist)	7.7	
% Replaced	76%	
Energy Efficiency Rating-New (EERnew)	10.9	
Coincidence Factor (CF)	0.30	

A.8 Smart Cycle Program

Cadmus' impact evaluation of the Smart Cycle Program focused on smart thermostats with attributable electric savings.

A.8.1 Smart Thermostats

Using the same savings methodology for the Smart Cycle Program as used to calculate smart thermostat savings in the 2021 Residential Prescriptive Program, Cadmus calculated smart (learning) thermostat savings using the following equations (excluding ISR):

$$Annual\ kWh\ Savings = \Delta kWh_{HEATING} + \Delta kWh_{COOLING}$$

$$\Delta kWh_{HEATING} = FLH_{HEAT} * BTUH_{HEAT} * ESF_{AdjustedBaseline_{HEAT}} * \left(\frac{1}{\eta_{HEAT\ PUMP} * 3412}\right) * TStat\_Type_{DiscountRate}$$

$$\Delta kWh_{Cooling} = \Delta Cooling_{AdjustedBaseline} * TStat_{Type_{COOLING_{DiscountRate}}} * \%AC$$

Table A-57 shows the inputs Cadmus used to evaluate impacts for the smart (learning) thermostats. The Smart Cycle Program tracking database does not have information on home heating equipment capacity, so Cadmus used the average heat pump capacity from the 2021 Residential Prescriptive Program tracking data to determine the BTUH capacity for the electric heating savings calculation.

Table A-57. 2020 Smart Cycle Per-Unit Savings Inputs

Variable	Value	Units	Source
$\eta_{HEAT\ PUMP}$	2.40	N/A	Federal standard (COP)
η_{ER}	1.0	N/A	2015 Indiana TRM v2.2 (COP)
$BTUH_{HEAT}$	33,465	BTUH	Average of 2021 Residential Prescriptive Program heat pump tracking data capacities
$\%_{HEAT\ PUMP}$	18% for program; 59% for electric only	%	2019 Smart Cycle participant survey
$\%_{GAS}$	68% for program; 98% for dual fuel	%	2019 Smart Cycle participant survey
$\%_{PROPANE}$	1% for program; 2% for dual fuel	%	2019 Smart Cycle participant survey
$\%_{ELECTRIC\ FURNACE}$	13% for program; 41% for electric only	%	2019 Smart Cycle participant survey
Manual thermostat saturation	38%	%	2019 Smart Cycle participant survey
Programmable thermostat saturation	62%	%	2019 Smart Cycle participant survey
$TStat\_Type_{\mathrm{DiscountRate}}$	31% non-learning 100% learning	%	The 2013–2014 Programmable and Smart Thermostat Evaluation indicates that heating savings are highly dependent on thermostat technology (learning vs. non-learning) and that cooling savings are not. All Nest thermostats are learning thermostats, so this value is 100% for this program.
$TStat\_Type_{COOLING\ Disco}$	100%	%	The 2013–2014 Thermostat Evaluation indicates that heating savings are highly dependent on thermostat technology and that cooling savings are not. No cooling savings adjustment can be directly derived from the comparative study of smart Wi-Fi thermostats to programmable thermostats.
$ESF_{AdjustedBaseline_{HEAT}}$	10.6%	%	Calculated, example below
$\%AC$	100%	%	Program design assumption; all Smart Cycle participants much have central air conditioning to participate in the program
$\Delta Cooling_{AdjustedBaselin}$	319	kWh	Calculated, example below

Cadmus used a heat pump efficiency of 2.40 coefficient of performance (COP) based on the federal standard. To determine full load hours (FLH), each installation was matched to its nearest 2015 Indiana TRM v2.2 reference city using the installation location's zip code. The full load hours associated with that reference city were then used in the savings calculation for the installation. Cadmus applied additional assumptions from the 2019 Smart Cycle Program participant survey. Cadmus did not conduct a participant survey for the 2021 or 2020 Smart Cycle Program due to the low population size.

2013–2014 Thermostat Evaluation and Adjusted Baseline

Cadmus' analysis of the thermostat savings for the 2021 Smart Cycle Program used the results of a separate Cadmus evaluation of programmable and Nest Wi-Fi thermostats in CenterPoint Energy South territory in 2013 and 2014.[62] This evaluation reports household cooling energy savings of 332 kWh and a household heating energy saving factor (ESF) of 5% for programmable thermostats. It reports household cooling energy savings of 429 kWh and a household heating ESF of 12.5% for Nest Wi-Fi thermostats.

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62 Cadmus. January 29, 2015. *Evaluation of the 2013–2014 Programmable and Smart Thermostat Program.*

This study uses a 100% manual thermostat baseline for both programmable and Nest Wi-Fi thermostats. However, the 2021 Smart Cycle Program includes participants regardless of their existing thermostat type. Therefore, Cadmus used results from the 2019 Smart Cycle Program participant survey to inform methodology inputs. Survey data indicated a saturation of 38% for manual thermostats and 62% for programmable thermostats.

Cadmus used the reported household cooling and heating savings for programmable thermostats from its thermostat study for the 2013-2014 program and a weighted average to adjust the savings for learning thermostats from a manual thermostat baseline to a mixed manual and programmable thermostat baseline. Cadmus used these equations:[63,64]

$$\Delta Cooling_{AdjustedBaseline} = [38\% * 429 + 62\% * (429 - 177.8)] * 100\% = 319\ kWh$$

$$\mathrm{ESF}_{\mathrm{AdjustedBaseline}_{\mathrm{HEAT}}} = 38\% * 12.5\% + 62\% * (12.5\% - 3.15\%) = 10.6\%$$

Cadmus performed equivalent calculations to obtain adjusted baseline values for the heating energy saving factor. The 2013-2014 thermostat evaluation investigated only homes with gas heating, so Cadmus assumed that the percentage of gas savings from that evaluation apply to electric heating as well.

A.9 Community Based LED Specialty Bulb Distribution

Cadmus' impact evaluation of the Community Based LED Specialty Bulb Distribution included measures with attributable electric savings, including these:

- 4-watt candelabra
- LED nightlight

A.9.1 4W Candelabra

Cadmus applied the savings algorithm in the Residential ENERGY STAR Lighting (CFL and LED) section of the 2015 Indiana TRM v2.2. Cadmus used the lumen equivalence method to determine the baseline bulb wattage. Cadmus used these equations to calculate savings per LED bulb installed:

$$kWh\ Savings = \left(\frac{Watts_{BASE} - Watts_{EFF}}{1{,}000}\right) * HOURS\ * (1 + WHF_E)$$

$$kW\ Savings = \left(\frac{Watts_{BASE} - Watts_{EFF}}{1{,}000}\right) * (1 + WHF_D) * CF$$

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63 Cadmus. January 29, 2015. *Evaluation of the 2013–2014 Programmable and Smart Thermostat Program.*

64 In the ΔCooling_AdjustedBaseline calculation, the 177.8 represents the cooling savings (332 kWh multiplied by 54% correct use factor) for programmable thermostats. The 54% cooling correct use factor is from the 2021 Residential Prescriptive Program participant survey, which asks homeowners with programmable thermostats about their thermostat usage habits related to cooling.

Table A-58 shows the input values and the source for each value

Table A-58. Community Based LED Specialty Bulb Distribution 4-Watt Candelabra Per-Unit Gross Savings

HOURS – Hours of use per year	902	2015 Indiana TRM v2.2[1]
$Watts_{BASE}$ – Equivalent baseline wattage of program bulb	40	Program bulb's lumens were 325 – used methodology in the Uniform Methods Project, Chapter 6 Residential Lighting to find equivalent bulb[2]
$Watts_{EFF}$ – Wattage of program bulbs	4	Spec sheets of program bulb
WHF_E – Waste heat factor to account for cooling and heating savings	-0.034	2015 Indiana TRM v2.2—weighted average of weighted average heating types. Cities were Evansville (98%) and Indianapolis (2%), based on 2019-2021 survey data.[3]
WHF_D – waste heat factor for demand to account for cooling kW	0.092	
WHF_G – Waste heat factor to account for gas impacts	-0.002	
CF – Coincidence factor	0.11	2015 Indiana TRM v2.2

[1] Cadmus et al. July 28, 2015. *Indiana Technical Reference Manual, Version 2.2.*
[2] Dimetrosky, S., K. Parkinson, and N. Lieb. October 2017. "Chapter 6: Residential Lighting Evaluation Protocol." *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.* https://www.nrel.gov/docs/fy17osti/68562.pdf
[3] 2021 survey sample was too small to generate adequate precision. Cadmus used the cumulative results from 2019 to 2021 to estimate weather city weights.

A.9.2 LED Nightlight

Cadmus applied the savings algorithm in the LED Night Lights section of the 2015 Indiana TRM v2.2. Cadmus used these equations to calculate savings per LED bulb installed:

$$kWh\ Savings = \left(\frac{Watts_{BASE} - Watts_{EFF}}{1{,}000}\right) * HOURS$$

$$kW\ Savings = 0$$

Table A-59 shows the input values and the source for each value.

Table A-59. Community Based LED Specialty Bulb Distribution LED Nightlight Per-Unit Gross Savings

Cadmus Assumptions	Inputs	Source
HOURS – Hours of use per year	2,920	2015 Indiana TRM v2.2[1]
$Watts_{BASE}$ – Equivalent baseline wattage of program bulb	5	
$Watts_{EFF}$ – Wattage of program bulbs	0.5	Spec sheets of program bulb
Deemed kW savings	0	2015 Indiana TRM v2.2[1]

[1] Cadmus et al. July 28, 2015. *Indiana Technical Reference Manual, Version 2.2.*

A.9.3 Measure Verification

Cadmus verified measure installations in 2021 by using the estimated in-service rate and leakage from the 2021 participant survey, which Cadmus designed to follow the Residential Lighting Evaluation Protocol in the Uniform Methods Project.[65]

Cadmus conducted a phone survey with 2021 bulb recipients and received 22 responses, a response rate of 2% of the postcard population and 17% of those who opted into the survey. With that sample size, Cadmus did not achieve 90% confidence with 10% precision around the in-service rate portion of the survey. Nevertheless, Cadmus used these results for the following reasons:

- The 4-watt candelabras and LED nightlights are new measures, and Cadmus has no historical program data to reference.
- The confidence and precision results around the individual measure ISRs are not unreasonable when compared with the sampling design of programs in other jurisdictions. CenterPoint Energy standards are robust—requiring 90% confidence with ±10% precision—but sometimes it is not possible or is exceedingly difficult to gather enough responses to reach this level of rigor. Cadmus relies upon participants to mail back postcards with their contact information to use as a sample frame. This can be a large barrier for collecting a suitable sample frame for an income-qualified population.
- The in-service rates for this program did reach 85% confidence with ±15% precision, a reasonable, albeit less robust, standard across many jurisdictions.

Table A-60 shows the overall measure verification of the Community Based LED Specialty Bulb Program. Adjustments for in-service rate are grouped by program component but distilled by measure.[66] For leakage, Cadmus grouped program components and measures to simplify the survey for respondents.

[65] Dimetrosky, S., K. Parkinson, and N. Lieb. October 2017. “Chapter 6: Residential Lighting Evaluation Protocol.” *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.* https://www.nrel.gov/docs/fy17osti/68562.pdf

[66] There were not enough responses to distill measures by program component to reach 85% confidence at ±15% precision.

Table A-60. 2021 Community Based LED Specialty Bulb Measure Verification Results – In-Service Rates

Program Component	Measure Group	Measure	Installations[1]				Adjustments		
			Reported	Audited	Verified (ISR)	Verified (ISR and Leakage)	ISR	Leakage[2]	Total (ISR and Leakage)[3]
Food Bank Events	Lighting	4W Candelabra	57,346	57,346	41,212	37,778	72%	8%	66%
Food Bank Events	Lighting	LED Nightlight	18,900	18,900	15,750	14,438	83%	8%	76%
Community Events	Lighting	4W Candelabra	1,400	1,400	1,006	922	72%	8%	66%
Community Events	Lighting	LED Nightlight	700	700	583	535	83%	8%	76%
Total			**78,346**	**78,346**	**57,801**	**52,984**	**75%**	**8%**	**69%**

[1] When applying in-service rate and leakage, total installations may not sum due to rounding.
[2] The percentage of bulbs that stayed in the service territory is 92%.
[3] Total adjustment rate equals ISR multiplied by (1-leakage rate).

Table A-61 shows the absolute precision at different confidence levels for the program's ISRs.

Table A-61. 2021 Community Based LED Specialty Bulb Distribution Comparison of Absolute Precision at Different Confidence Levels

Program Component	Measure Group	Measure	ISR	Absolute Precision	
				(90/10)	(85/15)
Food Bank Events	Lighting	4W Candelabra	72%	17%	15%
Food Bank Events	Lighting	LED Nightlight	83%	17%	15%
Community Events	Lighting	4W Candelabra	72%	17%	15%
Community Events	Lighting	LED Nightlight	83%	17%	15%

Leakage Calculation

To estimate leakage—that is, bulbs distributed to non-CenterPoint Energy customers—Cadmus asked survey respondents who installed at least one program bulb if CenterPoint Energy provides their electricity service. Table A-62 lists the electric utility, number of program bulbs installed, and number of survey respondents (included for context).

Note that leakage is calculated from the number of bulbs installed, not the number of recipients. Of the 48 specialty LED bulbs installed, 44 were installed inside CenterPoint Energy's territory, for a leakage rate of 8%. Cadmus applied this rate to the LED nightlights as well to simplify the survey for participants.

Table A-62. 2021 LED Distribution Leakage Summary

Utility/Co-op	4W Candelabra LED Bulbs Installed	Survey Respondents
	2021 Survey Results	
CenterPoint Energy	44	12
IPL	-	-
Duke Energy	1	1
Indiana Michigan	-	-
NIPSCO	-	-
WIN Energy	3	1
Total[1]	**48**	**14**
Percentage Outside of CenterPoint Energy's Electric Territory	**8%**	**14%**

[1] Participants who did not know their utility, how many bulbs they installed, or installed zero bulbs were excluded from the totals.

A.9.4 Estimation of Income-Qualified Population in General Population

Reasoning

For community events that were not hosted by organizations that serve income-qualified folks or schools in income-qualified areas, Cadmus had to estimate the proportion of gross and net savings attributed to the non-income-qualified population and the income-qualified population attending community events. Cadmus was not able to collect enough survey data to estimate different in-service and leakage rates between the community and food bank events, so the in-service and leakage rates estimates group these program components together. However, for net savings, Cadmus applied different net-to-gross assumptions to the different populations.

Methodology and Results

Cadmus used the most recent American Community Survey (ACS) five-year estimates (2014-2019) to estimate the proportion of the income-qualified population in CenterPoint's zip codes.[67] The ACS data do not report the proportion of the population at 150% of the federal poverty level (FPL)—only at or below the FPL—so Cadmus estimated it based on the linear interpolated rate of income levels relative to different poverty levels, see Table A-63 and Table A-64.

[67] U.S. Census Bureau. American Community Survey 5-year estimates (2014-2019). Census - Table Results.

Table A-63. ACS Survey Data Inputs

Indiana Zip Code in ACS Data	Below Poverty Level (%)	Total Population				Total Population
		w/ Income Below 50%	w/ Income Below 125%	w/ Income Below 150%	w/ Income Below 185%	
	ACS Data Inputs					
45053	1%	52	96	266	431	3,780
46001	20%	543	2,103	2,776	3,174	9,993
46011	11%	476	2,582	3,058	4,084	17,069
…	…	…	…	…	…	…
47997	19%	12	27	34	54	134

Table A-64. Cadmus Outputs of ACS Survey Data Inputs

Indiana Zip Code in ACS Data	Population Rate of Income				Estimated Rate of Income at 100% of FPL	Estimated Population at 150% Poverty Level
	50% of FPL	125% of FPL	150% of FPL	185% of FPL		
	Total Population at Specific Income Level Divided by Total Population				Linear Interpolated Income at 100%	Percent Below Poverty Level Multiplied by Rate of Income at 150% Divided by Estimate Rate of Income at 100%
	Cadmus Outputs					
45053	1%	3%	7%	11%	4%	3%
46001	5%	21%	28%	32%	16%	34%
46011	3%	15%	18%	24%	11%	18%
…	…	…	…	…	…	…
47997	9%	20%	25%	40%	18%	27%

Cadmus then used the zip codes of respondents from 2019-2021 to come up with a weighted average of those in the total surrounding area who are 150% at or below the federal poverty level, as shown in Table A-65.

Table A-65. CenterPoint Zip Codes and 150% Poverty Level Outputs

CenterPoint Zip Code	Respondents in 2019-2021 Survey	Percent of Zip Code at 150% FPL	Population	Population Weighted by Survey Responses
	Cadmus Surveys	Cadmus Estimate Based on ACS Data	ACS Data	Calculated
47011	1	12%	788	788
47523	1	15%	3,346	3,346
47601	7	14%	13,854	96,978
47610	2	21%	5,444	10,888
47615	1	17%	1,832	1,832
47620	6	20%	13,129	78,774
47630	10	9%	36,182	361,820
47633	1	12%	2,384	2,384
47635	3	21%	5,432	16,296
47637	1	14%	1,294	1,294
47638	1	9%	3,514	3,514
47710	9	43%	18,869	169,821
47711	13	21%	32,612	423,956
47712	3	22%	26,764	80,292
47713	4	60%	10,108	40,432
47714	15	37%	34,447	516,705
47715	5	20%	26,196	130,980
47720	1	16%	17,763	17,763

The weighted average rate of 150% of the federal poverty level in CenterPoint Community Based LED Specialty Bulb Distribution Program event territory is 25%. Thus, Cadmus assumed that 25% of the participants at the community events meant for the general population were at or below 150% of the federal poverty level. The remaining 75% were non-income-qualified. For community events more focused on locals from a specific county, Cadmus used only the zip codes in each county to estimate the rate of the population at or below 150% of the federal poverty level.

Table A-66 shows the percentage of the income-qualified customers assumed to be served by each community event.

Table A-66. 2021 LED Distribution—Percentage Income-Qualified at Community Events

Community Event	Measures Distributed	Income-Qualified (%)	Non Income-Qualified (%)	Source
525 Foundation	4,160	100%	0%	Income-qualified targeted community organization
Franklin Street Events Association	6,836	25%	75%	2014-2019 ACS Survey Data Analysis for Vanderburg County zip codes
Glenwood Leadership Academy	3,000	84%	16%	Implementer indicated that 84% of students qualify for free or reduced lunch
Mesker Park Zoo	2,100	25%	75%	2014-2019 ACS Survey Data Analysis for surrounding areas
Warrick Parks Foundation	6,572	14%	86%	2014-2019 ACS Survey Data Analysis for Warrick County zip codes
Washington Middle School	2,120	75%	25%	Implementer indicated that 75% of students qualify for free or reduced lunch

Limitations of Approach

Cadmus' approach estimates only the proportion of the population in each zip code that are income-qualified. It does not estimate the percentage of the population at each community event that were income-qualified, because Cadmus was not able to gather enough survey data to determine that. Instead, Cadmus assumed that on the day of each community event meant for the general population, the proportion of the event that was income-qualified matched the proportions from Cadmus' ACS survey estimates.

A.10 Commercial and Industrial Prescriptive Program

Cadmus' impact evaluation of the Commercial and Industrial Prescriptive Program included measures with attributable electric savings, including these:

- Chillers
- Clothes Washer
- Compressed air systems
- Controls
- Heat Pump Water Heater
- HVAC
- Kitchen equipment
- Lighting
- Refrigeration
- Thermostats
- VFDs/motors

A.10.1 Chillers

Equation and assumptions for each measure.

Chiller Replacements

Cadmus used the 2015 Indiana TRM v2.2 algorithms for chiller replacements:

$$\Delta kWh = TONS \times \left(\frac{3.516}{IPLV_{BASE}} - \frac{3.516}{IPLV_{EE}}\right) \times EFLH$$

$$\Delta kW = TONS \times \left(\frac{3.516}{COP_{BASE}} - \frac{3.516}{COP_{EE}}\right) \times CF$$

Where, in the kWh equation:

TONS	=	New chiller's size in tons
$IPLV_{EE}$	=	New chiller's integrated part-load value
3.516	=	Conversion factor to IPLV in kW/ton
$IPLV_{BASE}$	=	Assumed baseline IPLV that depends on the chiller type and size and is derived from the ASHRAE 90.1–2007 standard
EFLH	=	Estimated full-load hours selected based upon city, building type, and chiller type

The kW equation uses coefficient of performance (COP) instead of integrated part load value (IPLV) because COP is an instantaneous efficiency, rather than a seasonal average efficiency like IPLV. The coincidence factor, CF, is assumed to be 74%.

For early replacement savings, Cadmus assumed that the $IPLV_{BASE}$ and COP_{BASE} values came from IECC 2006 standards.

Chiller Tune-Ups

Cadmus used the 2015 Indiana TRM v2.2 algorithms for chiller tune-ups:

$$\Delta kWh = TONS \times \frac{3.516}{IPLV_{BASE}} \times EFLH \times ESF$$

$$\Delta kW = TONS \times \frac{3.516}{COP_{BASE}} \times DSF \times CF$$

Where, in the kWh equation:

TONS	=	Existing chiller's size in tons
$IPLV_{BASE}$	=	Assumed baseline IPLV that depends on the chiller type and size and is derived from the ASHRAE 90.1–2007 standard
3.516	=	Conversion factor to IPLV in kW/ton
COP_{BASE}	=	Assumed baseline COP that depends on the chiller type and size and is derived from the ASHRAE 90.1–2007 standard
EFLH	=	Estimated full-load hours selected based upon city, building type, and chiller type
ESF	=	Energy savings factor, 8%

The kW equation uses coefficient of performance (COP) instead of integrated part load value (IPLV) because COP is an instantaneous efficiency, rather than a seasonal average efficiency like IPLV. The coincidence factor, CF, is assumed to be 74%. The demand savings factor (DSF) is 8%.

A.10.2 Clothes Washer

The single clothes washer in the 2021 program was a residential-duty clothes washer in a commercial setting. The residential-duty clothes washers section in the 2015 Indiana TRM v2.2 is outdated in terms of baseline efficiencies and calculation methodology. Therefore, Cadmus used the equations in the IL TRM V9.0,[68] with some slight adjustments for Indiana and commercial settings:

$$\Delta kWh = Capacity \times \left(\frac{1}{IMEF_{base}} - \frac{1}{IMEF_{eff}}\right) \times N_{cycles}$$

$$\Delta kW = 0$$

Where, in the kWh equation:

Capacity	=	Capacity of the clothes washer in cubic feet, actual from program
$IMEF_{base}$	=	Integrated modified energy factor of baseline unit, based on federal standards
$IMEF_{eff}$	=	Integrated modified energy factor of efficient unit, actual from program
N_{Cycles}	=	Number of cycles for commercial loads, from the Indiana TRM, assumed to be 950

Cadmus assumed that the peak demand savings were zero, consistent with 2015 Indiana TRM v2.2.

A.10.3 Compressed Air Systems

Efficient Air Compressors

Cadmus used the 2015 Indiana TRM v2.2 algorithms for the efficient air compressor project (manufacturing process application):

$$\Delta kWh = Bhp * \frac{0.746}{\eta_{motor}} * HOURS * ESF$$

$$\Delta kWh = \frac{\Delta kWh}{HOURS} * CF$$

Where Bhp is the full load brake horsepower, η_{motor} is the motor efficiency, and ESF is the energy savings factor based on the load control type—an ESF of 10% for no load, 17% for variable displacement, and 26% for variable frequency drive Compressed Air Audits

68 Illinois Energy Efficiency Stakeholder Advisory Group. Final September 25, 2020; effective January 1, 2021. *2021 Illinois Statewide Technical Reference Manual for Energy Efficiency. Version 9.0, Section 5.1.2.* https://www.ilsag.info/technical-reference-manual/il-trm-version-9/.

For compressed air audits, Cadmus used the algorithms in the 2021 Wisconsin Focus on Energy TRM:[69]

$$\Delta kWh = CFM\ Reduction / \left(\frac{CFM}{BHP}\right) \times 0.746 \times HOURS/Eff$$

$$\Delta kWh = \frac{\Delta kWh}{HOURS} * CF$$

Where:

CFM Reduction	=	Total CFM reduction in entire compressed air system, actual from program
CFM/BHP	=	Average amount of CFM per brake horsepower, 4.2
0.746	=	Motor brake horsepower to kilowatt conversion factor
HOURS	=	Average annual compressor run hours, actual from program
Eff	=	Air compressor deemed motor efficiency, 90%
CF	=	Peak coincident factor of air compressor systems, 38%, from the Indiana TRM

A.10.4 Controls

Beverage Machine Controls

For beverage machine controls, Cadmus followed the algorithm in the 2015 Indiana TRM v2.2:

$$\Delta kWh = \frac{Watts_{Base}}{1000} \times Hours \times ESF$$

$$\Delta kW = 0$$

Here, $Watts_{Base}$, Hours, and ESF are deemed values based on the equipment type from the 2015 Indiana TRM v2.2.

A.10.5 Heat Pump Water Heater

For heat pump water heaters, Cadmus used the algorithm in the Illinois TRM V9.0:[70]

$$\Delta kWh = \frac{(T_{out} - T_{in}) \times HotWaterUse_{Gal} \times \gamma Water\ \times 1 \times \left(\frac{1}{UEF_{base}} - \frac{1}{UEF_{eff}}\right)}{3412}$$

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69 Public Service Commission of Wisconsin. *Wisconsin Focus on Energy 2021 Technical Reference Manual, Section, "Compressed Air System Leak Survey and Repair."* https://www.focusonenergy.com/sites/default/files/inline-files/Focus%20on%20Energy%202021%20TRM.pdf.

70 Illinois Energy Efficiency Stakeholder Advisory Group. Final September 25, 2020; effective January 1, 2021. *2021 Illinois Statewide Technical Reference Manual for Energy Efficiency. Version 9.0, Section 4.3.1.* https://www.ilsag.info/technical-reference-manual/il-trm-version-9/.

$$\Delta kW = \frac{\Delta kWh}{Hours} \times CF$$

Where:

T_{out}	=	Tank temperature, program data
T_{in}	=	Groundwater temperature, from Indiana TRM
$HotWaterUse_{Gal}$	=	Total hot water use based on building type, from IL TRM
γWater	=	Specific weight capacity of water, 8.33
1	=	Specific heat of water, 1
UEF_{base}	=	Uniform energy factor of baseline unit, based on federal standards
UEF_{eff}	=	Uniform energy factor of efficient unit, based on program data
3412	=	Conversion from Btu to kWh
Hours	=	Full load hours of water heater, 6461
CF	=	Summer peak coincident factor, 0.925 from IL TRM

A.10.6 HVAC

Air Conditioners and Heat Pumps

For unitary or split air conditioning units and heat pumps, Cadmus followed the algorithm in the 2015 Indiana TRM v2.2 for time-of-sale measures (or replace-on-burnout) and early replacement measures:

$$\Delta kWh = kBTU \times \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{ee}}\right) \times EFLH_{Cool} + kBTU \times \left(\frac{1}{HSPF_{base}} - \frac{1}{HSPF_{ee}}\right) \times EFLH_{Heat}$$

$$\Delta kW = kBTU \times \left(\frac{1}{EER_{base}} - \frac{1}{EER_{ee}}\right) \times CF$$

Here, kBtu, $SEER_{ee}$, and EER_{ee} are the capacity and efficiency specifications of the installed cooling equipment or heat pump equipment. For heat pump systems, there is also $HSPF_{ee}$, which is the heating efficiency of the heat pump. The heating and cooling hours are denoted by $EFLH_{Cool}$ and $EFLH_{Heat}$, which come from the 2015 Indiana TRM v2.2. Baseline efficiency terms are equal to the current federal baseline based on equipment size. The early replacement savings assume IECC 2006 standards as the baseline.

A.10.7 Kitchen Equipment

The kitchen equipment measure category contains a variety of commercial appliances including convection ovens, dishwashers, griddles, and ice machines, some of which are not included in the 2015 Indiana TRM v2.2.

Convection Ovens

For convection ovens, Cadmus used the following 2015 Indiana TRM v2.2 equations:

$$\Delta kWh = kWh_{base} - kWh_{EFF}$$

$$kWh_{base} = \left(\frac{LB * E_{food}}{EFF_{Base}} + \frac{IDLE_{Base}}{1{,}000} * \left(HOURS_{DAY} - \frac{LB}{PC_{Base}} - \frac{PRE_{TIME}}{60}\right) + PRE_{ENERGY,B}\right) * DAYS$$

$$kWh_{EFF} = \left(\frac{LB * E_{food}}{EFF_{EFF}} + \frac{IDLE_{EFF}}{1{,}000} * \left(HOURS_{DAY} - \frac{LB}{PC_{EFF}} - \frac{PRE_{TIME}}{60}\right) + PRE_{ENERGY,EFF}\right) * DAYS$$

Where:

LB	=	Pounds of food cooked per day (= 100 lb/day)
E_{Food}	=	ASTM Energy to Food; the amount of energy absorbed by the food during cooking (= 0.00732 kWh/lb)
Eff_{base}	=	Heavy load cooking energy efficiency of baseline oven (= 65%)
Eff_{ES}	=	Heavy load cooking energy efficiency of ENERGY STAR oven (= 74%)
$IDLE_{Base}$	=	Idle energy rate of baseline model (= 2 kW)
$IDLE_{EFF}$	=	Idle energy rate of ENERGY STAR model (= 1.3 kW)
$HOURS_{DAY}$	=	Daily operating hours (= 12)
PC_{BASE}	=	Production capacity of baseline oven (= 70 lb/hr)
PC_{EFF}	=	Production capacity of ENERGY STAR oven (= 80 lb/hr)
PRE_{TIME}	=	Preheat time to reach operating temperature (= 15 min/day)
$PRE_{ENERGY,B}$	=	Baseline preheat energy (= 1.5 kWh)
$PRE_{ENERGY,EFF}$	=	ENERGY STAR preheat energy (= 1 kWh)
DAYS	=	Operating days per year (= 365)

Dishwashers

For dishwashers, Cadmus used the electric deemed savings provided in the Illinois TRM V9.0, as shown in Table A-67.

Table A-67. 2021 Commercial and Industrial Prescriptive Program Dishwasher Deemed Savings

Temperature	Dishwasher Type	Base kWh	ENERGY STAR kWh	ΔkWh
Electric Building and Electric Booster Water Heating				
Low Temp	Under Counter	10,972	8,431	2,541
Low Temp	Stationary Single Tank Door	39,306	23,142	16,164
Low Temp	Single Tank Conveyor	42,230	28,594	13,636
Low Temp	Multi Tank Conveyor	50,112	31,288	18,824
High Temp	Under Counter	12,363	9,191	3,173
High Temp	Stationary Single Tank Door	39,852	27,981	11,871
High Temp	Single Tank Conveyor	45,593	36,375	9,218
High Temp	Multi Tank Conveyor	72,523	45,096	27,426
High Temp	Pot, Pan, and Utensil	21,079	17,766	3,313
Electric Building and Natural Gas Booster Water Heating				
Low Temp	Under Counter	10,972	8,431	2,541
Low Temp	Stationary Single Tank Door	39,306	23,142	16,164
Low Temp	Single Tank Conveyor	42,230	28,594	13,636
Low Temp	Multi Tank Conveyor	50,112	31,288	18,824
High Temp	Under Counter	9,432	6,878	2,554
High Temp	Stationary Single Tank Door	26,901	19,046	7,856
High Temp	Single Tank Conveyor	33,115	26,335	6,780
High Temp	Multi Tank Conveyor	51,655	33,479	18,176
High Temp	Pot, Pan, and Utensil	14,052	11,943	2,108
Natural Gas Building and Electric Booster Water Heating				
Low Temp	Under Counter	2,831	2,831	0
Low Temp	Stationary Single Tank Door	2,411	2,411	0
Low Temp	Single Tank Conveyor	9,350	8,766	584
Low Temp	Multi Tank Conveyor	10,958	10,958	0
High Temp	Under Counter	7,234	5,143	2,090
High Temp	Stationary Single Tank Door	17,188	12,344	4,844
High Temp	Single Tank Conveyor	23,757	18,806	4,951
High Temp	Multi Tank Conveyor	36,004	24,766	11,238
High Temp	Pot, Pan, and Utensil	8,781	7,576	1,205

Ice Machines

Cadmus used the following formulas to determine energy savings and demand reduction from the 2015 Indiana TRM v2.2:

$$\Delta kWh = \frac{kWh_{base} - kWh\_EE}{100} * DC * H * 365$$

$$\Delta kW = \frac{\Delta kWh}{HOURS * DC} * CF$$

Where:

kWh_{base}	=	baseline kWh consumption per 100 pounds of ice, using 2018 Federal Standards[71]
kWh_{EE}	=	ENERGY STAR kWh consumption per 100 pounds of ice, (= actual)
100	=	Conversion factor from 100 lbs of ice to per pound of ice
DC	=	Duty cycle of ice machine (= 0.57)
H	=	Harvest rate of ice machine (= actual)
365	=	Days per year
Hours	=	Hours per year (= 8,760 hours)
CF	=	Summer peak coincident factor (= 0.772)

A.10.8 Lighting

Retrofits

Retrofits were the predominant type of lighting measure, and the basic algorithm is the same regardless of the replaced or efficient lighting technology (LED panels, high output T8 fixtures, refrigerated LEDs, etc.). Cadmus evaluated all retrofit lighting measures using this 2015 Indiana TRM v2.2 algorithm:

$$\Delta kWh = (WATTS_{BASE} - WATTS_{EE}) \times Hours \times \frac{(1 + WHF_E)}{1000}$$

$$\Delta kW = (WATTS_{BASE} - WATTS_{EE}) \times CF \times \frac{(1 + WHF_D)}{1000}$$

In these equations:

$WATTS_{ee}$	=	Wattage of the new lighting
$WATTS_{base}$	=	Wattage being replaced
Hours	=	Hours the lights are on per year
CF	=	Peak demand coincidence factor
WHF_E	=	Waste heat factors for energy
WHF_D	=	Waste heat factor for demand

[71] Code of Federal Regulations. Automatic Commercial Ice Makers: 10 CFR §431.136(c). "Energy conservation standards and their effective dates." https://www.ecfr.gov/cgi-bin/text-idx?SID=a25116a0785a0c488243d01bddb84f90&mc=true&node=se10.3.431_1136&rgn=div8.

Program tracking data reported savings and new and replaced wattages for each lighting project. In accordance with the 2015 Indiana TRM v2.2, Cadmus used actual wattages (from the program tracking data) for $WATTS_{ee}$ and $WATTS_{base}$.

New Construction

The program also offered a number of new construction lighting measures, which Cadmus evaluated using the lighting power density reduction method described in the 2015 Indiana TRM v2.2:

$$\Delta kWh = (LPD_{BASE} - LPD_{EE}) \times AREA \times Hours \times \frac{(1 + WHF_E)}{1000}$$

$$\Delta kW = (LPD_{BASE} - LPD_{EE}) \times AREA \times CF \times \frac{(1 + WHF_D)}{1000}$$

In these equations:

LPD	=	Lighting power density (lighting wattage per square foot)
AREA	=	Area (in square feet) that has its lighting power density reduced
LPD_{BASE}	=	Minimum lighting power density required by the ASHRAE 90.1–2007 standard
LPD_{ee}	=	Final lighting power density after fixture removal, efficient lighting installation, and/or other methods have been applied to the area

The difference between LPD_{BASE} and LPD_{EE} multiplied by the area produces a reduction in overall wattage.

Occupancy Sensors

Cadmus categorized occupancy sensors as a lighting measure for the purposes of the evaluation and used the 2015 Indiana TRM v2.2 to evaluate savings:

$$\Delta kWh = kW_{CONTROLLED} \times Hours \times (1 + WHF_E) \times ESF$$

$$\Delta kW = kW_{CONTROLLED} \times (1 + WHF_D) \times CF$$

Here, $kW_{CONTROLLED}$ is the amount of lighting wattage controlled by the occupancy sensor, ESF is an energy savings factor that depends on the type of occupancy sensor, and CF is a coincidence factor that also depends on the type of occupancy sensor.

A.10.9 Refrigeration

The predominant measure upgrade for refrigeration was upgrading commercial freezers and/or refrigerators to an ENERGY STAR model. Cadmus based evaluated savings on the 2015 Indiana TRM v2.2 equations:

$$\Delta kWh = (kWh_{BASE} - kWh_{EE}) * 365$$

$$\Delta kW = \frac{\Delta kWh}{HOURS} \times CF$$

However, Cadmus used the updated federal standards as the baseline and pulled the daily energy consumption of the efficient unit (kWh_{EE}) from the ENERGY STAR Qualified Products List. For the equation, kWh terms are available in the 2015 Indiana TRM v2.2 based on the size of the unit. Hours equal 8,760, and coincidence factor equals 1.

A.10.10 Thermostats

The program implementer currently uses an energy modeling tool to determine savings for Wi-Fi and programmable thermostat measures because the 2015 Indiana TRM v2.2 does not provide savings algorithms for thermostats in commercial applications. In 2021, as in the previous five program years, the implementer used energy savings intensity factors (which estimate energy savings per square foot of building served by the thermostat) based on an eQuest model of a 15,000-square-foot office building. The eQuest model simulates the heating, cooling, and ventilation savings for 360 different thermostat configurations for two different weather locations: Indianapolis and Evansville. Configurations vary by degree heating/cooling setback, hours of setback per day, and days the business was closed per week. Savings are assigned on a project-by-project basis according to the project’s reported thermostat setback schedule and facility square footage.

Cadmus performed an in-depth review of the implementer’s model as part of the 2017 and 2018 evaluations. Cadmus determined that the implementer’s approach was reasonable for thermostats, considering the available data, and found no reason to adjust thermostat savings based on the *ex ante* model.

A.10.11 VFD/Motors

Variable frequency drive (VFD) controls added to HVAC fans, pumps, and cooling towers were the predominant measure type in this measure category. Cadmus evaluated savings using the Illinois TRM V9.0.[72] The 2015 Indiana TRM v2.2 had limited building types.

Pumps and Cooling Tower Fans

Cadmus used the following equations to determine savings:

$$\Delta kWh = \frac{BHP}{Eff_i} * Hours * ESF$$

$$\Delta kW = \frac{BHP}{Eff_i} * DSF$$

72 Sections 4.4.17 for pumps and cooling tower fans and 4.4.26 for supply and return fans. Illinois Energy Efficiency Stakeholder Advisory Group. Final September 25, 2020; effective January 1, 2021. *2021 Illinois Statewide Technical Reference Manual for Energy Efficiency.* https://www.ilsag.info/technical-reference-manual/il-trm-version-9/

Where:

BHP	=	System brake horsepower (= nominal motor HP * load factor [65%])
Eff_i	=	Motor efficiency installed (= 93%)
Hours	=	Operating hours, varies by building type and equipment type
ESF	=	Energy savings factor, varies by equipment type
DSF	=	Demand savings factor, varies by equipment type

Supply and Return Fans

Cadmus used the following equations to determine savings:

$$\Delta kWh = \Delta kWh_{fan} * \left(1 + IE_{Energy}\right)$$

$$\Delta kWh_{fan} = kWh_{base} - kWh_{retrofit}$$

$$kWh_{base} = \left(0.746 * HP * \frac{LF}{\eta_{motor}}\right) * RHRS_{base} * \sum_{0\%}^{100\%} (\%FF * PLR_{Base})$$

$$kWh_{Retrofit} = \left(0.746 * HP * \frac{LF}{\eta_{motor}}\right) * RHRS_{base} * \sum_{0\%}^{100\%} (\%FF * PLR_{Retrofit})$$

$$\Delta kW = \Delta kW_{fan} * (1 + IE_{Demand})$$

$$\Delta kW_{fan} = kW_{base} - kW_{Retrofit}$$

$$kW_{base} = \left(0.746 * HP * \frac{LF}{\eta_{motor}}\right) * PLR_{base,FFpeak}$$

$$kW_{Retrofit} = \left(0.746 * HP * \frac{LF}{\eta_{motor}}\right) * PLR_{RF,FFpeak}$$

Where:

0.746	=	Conversion from HP to kWh
HP	=	Nominal horsepower of controlled motor (= actual)
LF	=	Load factor of motor (= 65%)
η_{motor}	=	Installed motor efficiency (= default NEMA premium efficiency, ODP, 4-pole, 1800 RPM fan motor at nominal horsepower)
$RHRS_{Base}$	=	Annual operating hours based on building type
%FF	=	Percentage of run-time spent within a given flow fraction
PLR_{Base}	=	Part load ratio for a given flow fraction range based on the baseline flow control type
$PLR_{Retrofit}$	=	Part load ratio for a given flow fraction range based on the retrofit flow control type

IE_{Energy} = HVAC interactive effects factor for energy (= 15.7%)

$PLR_{base,FFpeak}$ = The part load ratio for the average flow fraction between the peak daytime hours during the weekday peak time period based on the baseline flow control type (default average flow fraction during peak period = 100%)

$PLR_{,RF,FFpeak}$ = The part load ratio for the average flow fraction between the peak daytime hours during the weekday peak time period based on the retrofit flow control type (default average flow fraction during peak period = 90%)

IE_{Demand} = HVAC interactive effects factor for demand (= 15.7%)

ECMs for Freezers and Coolers

For ECMs for freezers and coolers, Cadmus used the methodology and assumptions from the IL TRM V9.0:[73]

$$\Delta kWh = Savings\ per\ motor\ \times motors$$

$$\Delta kW = \frac{\Delta kWh}{Hours} \times CF$$

Where:

Savings per motor = Deemed savings per motor based on size in IL TRM

motors = Number of rebated motors

Hours = Hours per year, 8,760

CF = Peak coincident factor, 1.0

A.11 Commercial and Industrial Custom Program

Cadmus' impact evaluation of the Commercial and Industrial (C&I) Custom Program included measures with attributable electric savings from three of the four program subcomponents:

- New construction
- Building tune-up
- Custom incentives

Each customer (or participating contractor) provided initial documentation of the project's energy savings and demand reduction, which the program implementer then reviewed, adjusted where necessary, and finalized. To evaluate the reasonableness of the savings calculations, Cadmus reviewed

[73] Illinois Energy Efficiency Stakeholder Advisory Group. Final September 25, 2020; effective January 1, 2021. *2021 Illinois Statewide Technical Reference Manual for Energy Efficiency. Version 9.0, Section 4.6.4.* https://www.ilsag.info/technical-reference-manual/il-trm-version-9/.

all project documentation, including invoices, technical specifications, and verification reports (if applicable) supplied by the program implementer.

Cadmus then reviewed each project's analysis workbook (supplied by the program implementer), upon which each project's incentives were based, to verify these items:

- Calculation assumptions matched equipment specifications and supporting project documentation (including verification reports)
- Reported savings calculations follow accepted engineering methodologies
- All assumed baselines are appropriate for project type (new construction, retrofit, etc.)
- All calculation assumptions were reasonable, justified, and properly cited
- Reported savings fell within a reasonable range given the project's scope

Cadmus performed desk reviews (no on-site verification) on 17 C&I Custom Program measures (electric application IDs), which accounted for 99% of the program's electric savings in 2021. Cadmus determined that no measures required a savings adjustment.

A.11.1 New Construction

Projects in the new construction subcomponent used computer software to develop energy models of the baseline condition and potential energy efficiency measures. The program implementer used standard and custom calculators to determine savings for the individual measures. Cadmus reviewed all the available documentation and checked calculations to determine the evaluated savings for each measure.

In 2021, 22 new construction electric energy-saving measures were installed at two buildings under three application IDs through the C&I Custom Program:[74,75]

- 8 lighting upgrades
- 1 building envelope upgrades
- 3 commercial kitchen equipment
- 1 HVAC control-related upgrades
- 8 HVAC equipment upgrades
- 1 laundry equipment upgrade

The combined savings of the new construction measures accounted for 12% of the C&I Custom Program electric savings.

A.11.2 Building Tune-up

The building tune-up measure group used data analytics software to analyze building management system trend data and identify energy efficiency opportunities. The program implementer used custom calculators to determine savings for the individual measures that were installed. Cadmus reviewed all

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[74] An application ID is associated with an organization and may include one or multiple unique measure IDs.

[75] 2021 natural gas energy-saving projects are evaluated in the *2021 CenterPoint Energy Demand-Side Management Portfolio Natural Gas Evaluation Key Findings, Conclusions, and Recommendations Memo.*

the available documentation and checked calculations to determine the evaluated savings for each application ID.

In 2021, 12 building tune-up measures were installed at two buildings under two application IDs through the C&I Custom Program. All included upgrading and optimizing the building control systems. The combined savings of the building tune-up measures accounted for 3% of the C&I Custom Program electric savings.

A.11.3 Custom

The program implementer used standard and custom calculators to determine savings for the individual measures that were installed. Cadmus reviewed all available documentation and checked calculations to determine the evaluated savings for each application ID.

In 2021, 25 Custom electric energy-saving measures were installed at 12 buildings under 13 application IDs through the C&I Custom Program:

- 5 lighting upgrades
- 1 compressed air
- 17 HVAC control upgrades
- 2 Industrial equipment upgrades

The combined savings of the custom measures accounted for 85% of the C&I Custom Program electric savings.

A.12 Small Business Energy Solutions Program

A.12.1 Lighting – Controls

Cadmus adhered to the 2015 Indiana TRM v2.2 guidelines for evaluating savings for occupancy sensors. Savings for this measure are largely a reflection of the total connected wattage controlled by each sensor. The evaluated savings align well with the tracking database with the exception of four records (22% of total lighting control projects). One project included an incorrect baseline equipment size in the tracking data. The remaining three records used a different energy waste heat factor for building type for religious worship. For *ex ante* savings, these projects are classified as “Religious building.” However, no building type in the Indiana 2015 Indiana TRM v2.2 fits this description, so hours of use, waste heat factor, and coincidence factor are inaccurate. Cadmus used a “Public Assembly” building type to inform *ex post* inputs which matches the 2015 Indiana TRM v2.2 building description.

A.12.2 Lighting – Exit Signs

Cadmus identified differences between *ex ante* and evaluated calculations in three records (approximately 16% of exit sign records), where program tracking data used a different waste heat factor than assigned by Cadmus.

Cadmus adhered to the 2015 Indiana TRM v2.2 guidelines for evaluating savings for LED exit signs but used a coincidence factor of 100%, which aligns with the annual operating hours of 8,760 hours. As in previous years, Cadmus used an in-service rate of 100% rather than the 98% in-service rate stipulated in the TRM because the program is direct install and should be claiming savings for equipment directly installed by the implementer.

A.12.3 Lighting – Exterior

Cadmus used the hours of use and baseline wattages as reported in the tracking database and a coincidence factor of 0% as stated in the 2015 Indiana TRM v2.2. Lighting installed in unconditioned spaces does not have any interactive effects with HVAC equipment, so no waste heat factors were applied to the exterior lighting measures. There were also 19 projects (7% of lighting exterior records) with no reported kWh savings in the tracking data.

A.12.4 Lighting – Interior

Cadmus applied waste heat factors and coincidence factors in accordance with Appendix B of the 2015 Indiana TRM v2.2. Cadmus looked up waste heat factors for the type of HVAC equipment serving the facility and the facility type and looked up coincidence factors for the building type. There were 102 projects (8% of interior lighting records) with no reported kWh savings or energy demand in the tracking data, and 142 records (11% of interior lighting records) used a different energy waste heat factor in the *ex ante* and *ex post* calculations.

A.12.5 Lighting – Refrigerated Cases

Savings for LED case lighting are a result of the installed lamp length as well as the installation location. Cadmus evaluated savings in accordance with the 2015 Indiana TRM v2.2.

A.12.6 Wi-Fi and Programmable Thermostats

The program implementer currently uses an energy modeling tool for determining savings for thermostat measures because the 2015 Indiana TRM v2.2 does not provide savings algorithms for Wi-Fi or programmable thermostats in commercial applications. [76] In 2021, as in previous program years, the implementer used energy savings intensity factors (which estimate energy savings per square foot of building served by the thermostat) based on an eQuest model of a 15,000-square-foot office building. The eQuest model simulates the heating, cooling, and ventilation savings for 360 different thermostat configurations for two different weather locations: Indianapolis and Evansville. Configurations varied by degree heating/cooling setback, hours of setback per day, and days the business was closed per week. Savings are assigned on a project-by-project basis according to the project’s reported thermostat setback schedule and facility square footage.

Thermostats had an energy savings realization rate of 110%. The deviation from 100% is mainly because five projects (31% of installed smart thermostats) with electric resistance heating systems reported inconsistent energy savings and energy demand, derived from the eQuest thermostat model. Heating

[76] The same eQuest model is used for both programmable and smart Wi-Fi thermostats. Approximately 31% of the thermostats rebated in 2021 were programmable and the balance (69%) were smart Wi-Fi thermostats.

multipliers vary according to the building's heating system and should be properly tracked to avoid differences in the realization rate.

A.12.7 Vending Machine Occupancy Sensors

Cadmus relied on the 2015 Indiana TRM v2.2 to determine evaluated savings for vending machine occupancy sensors. The evaluated savings matched the per-unit deemed kWh savings as reported.

Appendix B. Net-to-Gross Detailed Findings

Cadmus calculated the savings that were directly attributable to CenterPoint Energy's programs (net savings) by estimating program-specific (or measure-specific, where applicable) net-to-gross (NTG) ratios. The NTG ratios were used to adjust the verified gross savings estimates to account for freeridership and spillover.

For CenterPoint Energy's portfolio of programs, Cadmus used three methods for determining NTG ratios:

- ***Self-report surveys*** use survey results to derive net savings by adjusting *ex post* gross savings to account for an NTG ratio. To mitigate self-report bias, Cadmus used a battery of freeridership questions that collect data on each participant's *intention* and factors that might have had *influence*. The *intention* and *influence* scores contributed equally to the total freeridership score. Cadmus computed a freeridership score for each participant by calculating the arithmetic mean of the intention and influence scores.
  - ***Participant spillover*** is the program's influence on customers' decisions to invest in additional energy efficiency measures for which they did not receive any CenterPoint Energy incentives. Cadmus gathered the necessary data from the self-report surveys to calculate participant spillover. Cadmus included measures that are program-eligible (known as like spillover) as well as any non-program-eligible measures (known as non-like spillover) for which Cadmus could provide a reasonable savings documentation.
  - ***Nonparticipant spillover (NPSO)*** is created by CenterPoint Energy's marketing and education efforts among residential customers who did not participate in any program.
- ***Deemed NTG*** is applied to programs where the participant is unlikely to have taken energy-saving action without program intervention (for example, programs targeting low-income and student households). Cadmus also applied deemed NTG ratios from the 2019 or 2020 impact evaluation for programs for which a participant survey was not conducted in 2020 or 2021 or if the 2021 survey did not generate a significant response (given small program population).
- ***Benchmarking*** using publicly available historical evaluation results and NTG calculations for similar residential upstream lighting measures in other jurisdictions to determine an appropriate benchmark for Residential Specialty Lighting Program net savings.
- ***Control group*** comparison generates inherently net savings. Cadmus used billing/regression analysis to estimate net impacts for the Residential Behavioral Savings Program. In this method, Cadmus calculated net savings by developing a comparison (control) group, which isolates the program impacts from exogenous effects.

Table B-1 lists the NTG approach Cadmus used for each program. This appendix further details the specific methodology Cadmus used to determine each program's NTG ratio.

Table B-1. Net-to-Gross Method by Program

Program	Self-Report Surveys	Deemed NTG	Benchmarking	Control Group
Residential Programs				
Residential Specialty Lighting			✓	
Residential Prescriptive	✓			
Residential Midstream Pilot	✓			
Residential New Construction	✓			
Income Qualified Weatherization		✓		
Energy Efficient Schools		✓		
Residential Behavioral Savings				✓
Appliance Recycling	✓			
Smart Cycle		✓[1]		
Community Based LED Specialty Bulb Distribution		✓		
Commercial and Industrial Programs				
Commercial and Industrial Prescriptive	✓			
Commercial and Industrial Custom	✓			
Small Business Energy Services	✓			

[1] Cadmus used 2019 survey data to calculate NTG for Smart Cycle.

B.1 Residential Specialty Lighting Program

Cadmus calculated NTG for the Residential Specialty Lighting program as the average of seven different utilities using findings from a benchmarking study (details below). The program resulted in a 35% NTG ratio. Table B-2 lists the presents the NTG results for the program.

Table B-2. Residential Specialty Lighting Program Net-to-Gross Ratio

Measure	Freeridership	Spillover	NTG Ratio
LED Reflector	69%	0%	31%
LED Specialty	58%	0%	42%
Total Program	**65%**	**0%**	**35%**

B.1.1 Benchmarking Specialty Lighting NTG

Table B-3 details the historical NTG values used for the evaluation of CenterPoint Energy's Residential Lighting Program, which until 2021 included general service lamps. Where available, Cadmus provides historical NTG values specific to specialty and/or reflector lamps.

For the 2015 evaluation, Cadmus benchmarked 16 demand elasticity modeling (DEM) analyses conducted for electric utilities across the United States between 2011 and 2015. Cadmus determined the 2015 NTG ratio by weighting these studies by average net-of-freeridership value based on three unique factors: study age, program size, and census region.

For the 2016-2019 evaluations, Cadmus developed a DEM using program tracking data to determine the program's NTG ratio. CenterPoint Energy removed general service LEDs from its portfolio in 2021;

therefore, Cadmus did not use demand elasticity modeling in 2020 to update NTG for the program. Instead, Cadmus applied the NTG estimated as part of the 2019 Residential Lighting Program impact evaluation to the 2020 gross savings.

Table B-3. CenterPoint Energy Residential Lighting Program Historical Net-to-Gross Ratios

Year	Measure	NTG	Source
2015	Overall Program	67%	Benchmarked
2016	Specialty	84%	DEM
	Reflector	84%	
	Overall Program	79%	
2017	Specialty	65%	
	Reflector	72%	
	Overall Program	72%	
2018	Specialty	23%	
	Reflector	39%	
	Overall Program	58%	
2019	Specialty	59%	
	Reflector	54%	
	Overall Program	53%	
2020	Specialty	59%	2019 DEM results
	Reflector	54%	
	Overall Program	53%	

NTG Among Benchmarked Utilities

For 2021, Cadmus reviewed publicly available evaluation results to identify the NTG values used by 15 utilities across the United States (including AES Indiana, NIPSCO, and CNP), collecting the most recent data available to most accurately capture current market conditions for LEDs. Cadmus started with evaluation results that were applied to residential upstream lighting evaluation results between 2019 and 2021. Cadmus removed results from several of the surveyed utilities from the benchmarking for CenterPoint Energy for two main reasons.

Cadmus first removed utilities whose studies entailed sales data modeling with market effects. The Indiana framework does not allow utilities to claim market effects. Cadmus was not able to collect NTG estimates for three utilities that reported NTG ratios with market effects included. Because the market effects were not reported separately from other net savings metrics, Cadmus could not determine how much market effects contributed to the NTG ratio, so they were eliminated from the population.

Market conditions changed dramatically between 2019 and 2020, with LEDs becoming the dominant technology among all common residential bulb styles, particularly reflectors.[77] Studies published analyzing 2020 lighting sales data showed LED market shares largely converged and showed little difference between states with long-running utility-sponsored programs and states with no history of

77 Cadmus. December 2020. *General Service Lamps: Stocking and Shelving Survey.* Final Report | Report Number 21-20 | December 2020. Prepared for New York State Energy Research and Development Authority. https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Other-Technical-Reports/21-20-General-Service-Lamps--Stocking-and-Shelving-Survey.pdf

utility-sponsored programs.[78] Therefore, Cadmus also removed studies known to include data collected prior to 2019, unless the studies included trend adjustments. Trend adjustments are prospective applications that use historic data but that apply values for future years that consider market trends. This step eliminated five utilities from the population, including the three Indiana utilities.

Figure B-1 is an attrition diagram illustrating Cadmus' methodology.

Figure B-1. Benchmarked Utility Attrition Diagram

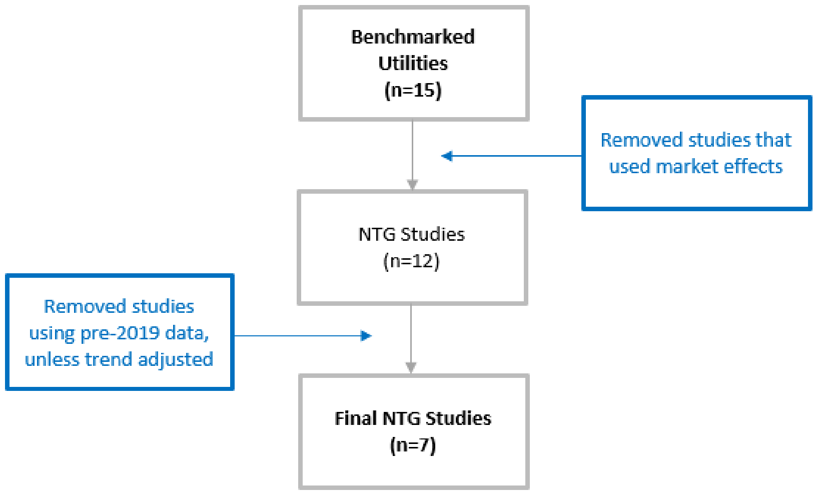


Table B-4 lists the remaining utilities and NTG values that Cadmus used in calculating NTG averages for each LED lamp type. Cadmus applied the average NTG to CenterPoint Energy's program sales data for 2021.

[78] Cadmus. May 2021. Focus on Energy Calendar Year 2020 Evaluation Report VOLUME III APPENDICES. Available online: https://www.focusonenergy.com/sites/default/files/inline-files/Evaluation_Report-2020-Volume_III.pdf

Table B-4. NTG Averages by Lamp Type

List of Surveyed Utilities	Reflector	Globe/Candelabra	Methodology
Mid-Atlantic	0.19	0.19	Sales data modeling
Midwest 1	N/A	0.59	Sales data modeling
Midwest 2	N/A	0.50	Multiple methods, including sales data modeling
Midwest 3	0.02	0.31	Sales data modeling
Northeast 1	0.33	0.33	Sales data modeling and consensus panel
Northeast 2	0.35	0.35	Benchmarking
Northeast 3	0.68	0.68	Multiple methods, including sales data modeling
Average	**0.31**	**0.42**	

The NTG estimates reflect broad market acceptance of LEDs among all bulb styles and expectations that halogens will likely be phased out of the market in 2023 due to the implementation of revised EISA regulations currently in progress. The exact timing of EISA regulations being implemented is unknown but is likely to occur some time in 2023.

B.2 Residential Prescriptive Program

Cadmus calculated NTG for the Residential Prescriptive Program using findings from surveys conducted with program participants. Cadmus calculated NTG for the Residential Prescriptive Program using findings from surveys conducted with 1,365 Standard and Online Marketplace channel program participants, seven Midstream channel participating distributors and 10 Midstream channel participating contractors. Table B-5 summarizes the freeridership, spillover, and NTG estimates by program channel. The overall program NTG ratio of 61% is weighted by the combination of electric and gas gross evaluated program population savings.

Table B-5. 2021 Residential Prescriptive Net-to-Gross Ratio by Program Channel

Measure Category	Freeridership	Spillover	NTG Ratio	Total Program *Ex Post* MMBTU Savings
Standard and Online Marketplace	39%	0%	61%	150,516
Midstream	56%	0%	44%	6,713
Total Program	**39%**[1]	**0%**[1]	**61%**[1]	**157,229**
Electric-Specific NTG			**58%**	**11,324**
Demand-Specific NTG			**60%**	**5.63**[1]
Gas-Specific NTG			**61%**	**145,905**

[1] Weighted by evaluated *ex post* program population MMBtu savings
[2] MMBTU/hour savings

B.2.1 Standard and Online Marketplace

Cadmus calculated NTG for the Residential Prescriptive Program Standard and Online Marketplace channels using findings from a survey of 1,365 program participants (customers); 1,025 answered the freeridership questions and 788 program participants answered the spillover questions. Table B-6 summarizes the freeridership, spillover, and NTG estimates by measure category. The overall program NTG ratio of 62% is weighted by the combination of electric and gas gross evaluated program population savings.

The electric-specific NTG ratio of 61% is weighted specifically to electric savings due to the application of measure category-level NTG estimates. The overall program NTG ratio is heavily weighted toward the gas-specific NTG estimate of 62% because *ex post* gross gas savings account for 94% of the total 2021 energy savings in the Standard and Online Marketplace channels.

Table B-6. 2021 Residential Prescriptive Program Standard and Online Marketplace Net-to-Gross Ratio

Measure Category	Freeridership	Spillover	NTG Ratio	Total Program *Ex Post* MMBTU Savings
Furnace/Boiler (n=356 for FR, 328 for SO)	**38%**	**0%**	**62%**	**104,145**
Heat Pump/CAC (n=67 for FR, 47 for SO)	**39%**	**1%**	**62%**	**3,423**
Wi-Fi Thermostat (n=347 for FR, 221 for SO)	**39%**	**2%**	**63%**	**30,709**
Weatherization (n=30 for FR, 16 for SO)	**42%**	**0%**	**58%**	**6,438**
Other (n=225 for FR, 176 for SO)	**41%**	**0%**	**59%**	**5,801**
Total Program (n=1,365)[1]	**38%[2]**	**0%[2]**	**62%[2]**	**150,516**
Electric-Specific NTG			**61%**	**9,093**
Demand-Specific NTG			**61%**	**5.14[3]**
Gas-Specific NTG			**62%**	**141,424**

[1] Through all survey efforts, 1,025 respondents answered freeridership questions and 788 respondents answered spillover questions. 1,365 unique participants answered either the freeridership questions or spillover questions. 448 answered freeridership and spillover questions. 577 answered only freeridership questions. 340 answered only spillover questions. Not all respondents surveyed answered the freeridership and spillover questions.
[2] Weighted by evaluated *ex post* program population MMBtu savings
[3] MMBTU/hour savings

B.2.2 Detailed Freeridership Findings

Cadmus estimated freeridership by combining the standard self-report intention method and the intention/influence method.[79] Cadmus calculated the arithmetic mean of the savings weighted *intention* and *influence* freeridership components to estimate measure category freeridership estimates,[80] as shown in this equation:

$$\text{Final Freeridership \%} = \frac{Intention\ \text{FR Score(0\% to 100\%)} + Influence\ \text{FR Score(0\% to 100\%)}}{2}$$

[79] *Intention* and *influence* freeridership scores both have a maximum of 100%.

[80] *Ex post* gross program savings.

Intention Freeridership Score

Cadmus estimated *intention* freeridership scores for all participants based on their responses to *intention*-focused freeridership questions. As part of past CenterPoint Energy evaluations, Cadmus developed a transparent, straightforward matrix approach to assign a single score to each participant based on their objective responses. Determining *intention* freeridership estimates from a series of questions rather than using a single question helps form a picture of the program's influence on the participant. Use of multiple questions also checks consistency.

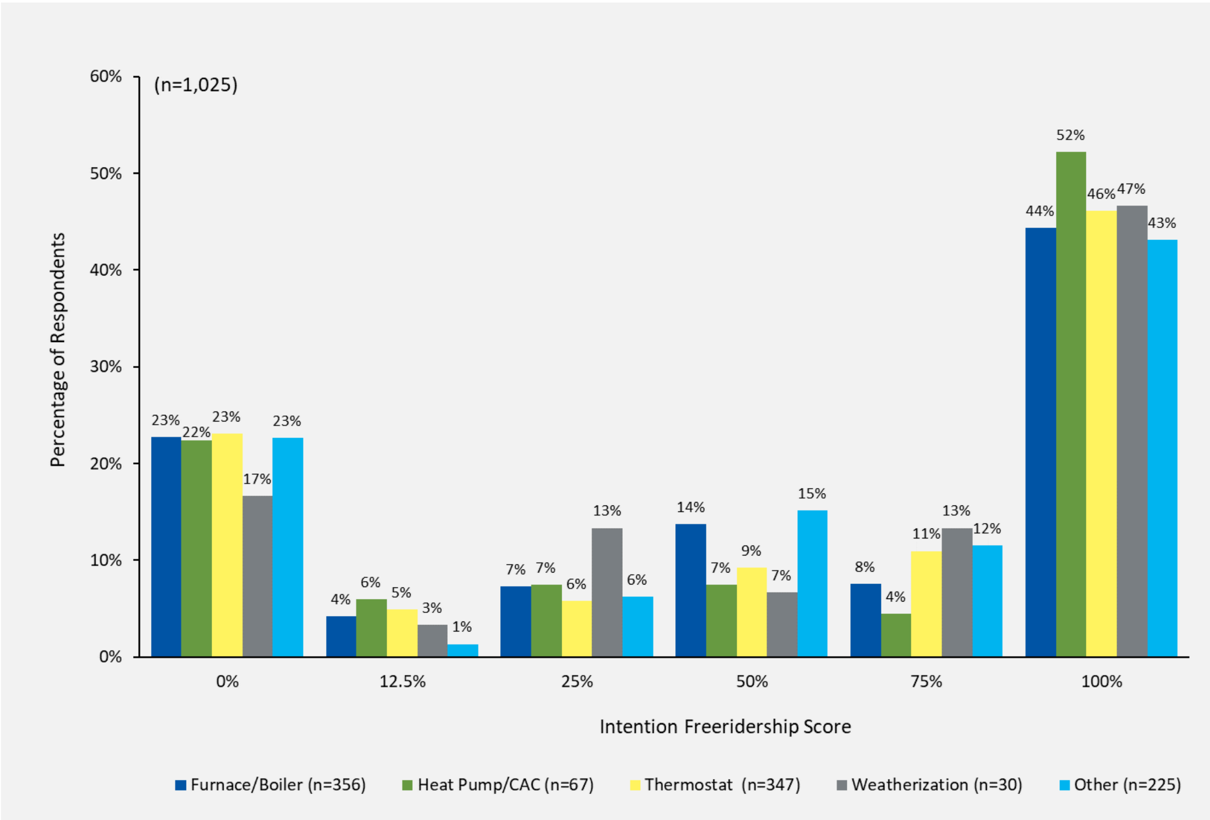
Table B-7 illustrates how initial responses are translated into whether the response is "yes," "no," or "partially" indicative of freeridership (in parentheses). The value in brackets is the scoring decrement associated with each response option. Each participant freeridership score starts with 100%, which Cadmus then decrements based on their responses to the questions.

Table B-7. Raw Survey Responses Translation to *Intention* Freeridership Scoring Matrix Terminology Residential Prescriptive Program and Scoring

BEFORE you heard about the CenterPoint Energy Residential Efficient Products Rebate Program, had you already PLANNED [If purchase: purchase the/if tune-up: schedule a tune-up or annual check-up of your] [MEASURE 1]?	Before you heard anything about the CenterPoint Energy Residential Rebate program, had you already had you already [If purchase: purchased or installed/if tune-up: scheduled the tune-up or annual check-up of] [MEASURE 1]?	To confirm, you [If purchase: installed your new/if tune-up: scheduled a tune-up for your] [MEASURE 1] before you heard anything about the CenterPoint Energy Residential Efficient Products Rebate Program, correct?	[If purchase] Would you have installed the same [MEASURE 1] without the rebate from CenterPoint Energy? [If tune-up] Would you have scheduled a [MEASURE_1] tune-up without the rebate from CenterPoint Energy?	[If purchase] Would you have installed a different type of [MEASURE_1] without the CenterPoint Energy rebate or would you have decided not to purchase it?	[If purchase] Without the rebate from CenterPoint Energy, would you have purchased and installed a [MEASURE_1] that was just as efficient, less efficient or more efficient than what you purchased?	Without the rebate from CenterPoint Energy, what kind of thermostat would you have installed?	[If purchase] Would you have installed the same quantity of [MEASURE_1]s without the incentive from CenterPoint Energy?	Thinking about timing, without the CenterPoint Energy rebate, when would you have [If purchase: installed/if tune-up: scheduled a tune-up for] the [MEASURE_1]?...
Yes (Yes) [-0%]	Yes (Yes) [-0%]	Yes, that is correct (Yes) [100% FR Assigned]	Yes (Yes) [-0%]	I would have installed a different MEASURE_1 (Yes) [-0%]	Just as efficient (Yes) [-0%]	A smart or learning thermostat (Yes) [-0%]	Yes, the same quantity (No) [-0%]	At the same time (No) [-0%]
No (No) [-50%]	No (No) [-0%]	No, that's not correct (No) [-0%]	No (No) [-25%]	I would have decided not to replace it (No) [-25%]	Less efficient (No) [-100%]	A Wi-Fi thermostat (non-learning) (Yes) [-0%]	No, would have installed fewer (Partial2) [-50%]	Within the same year (Partial2) [-50%]
DK/RF (Partial) [-25%]	DK/RF (No) [-0%]	DK/RF (No) [-0%]	DK/RF (Partial) [-0%]	DK/RF (Partial) [-25%]	More efficient (Yes) [-0%]	A programmable thermostat (No) [-100%]	No, would have installed more (No) [-0%]	One to two years out (No) [-100%]
					DK/RF (Partial) [-25%]	A manual thermostat (Yes) [-100%]	DK/RF (Partial) [-25%]	More than two years out (No) [-100%]
						Would not have installed a new thermostat (Yes) [-100%]		Never (No) [-100%]
						DK/RF (Partial) [-25%]		DK/RF (Partial) [-25%]

Figure B-2 shows the distribution of *intention* freeridership estimates Cadmus assigned to participant responses to the pure intention-based freeridership method.

Figure B-2. Residential Prescriptive Program Self-Report *Intention* Freeridership Distribution by Estimate



Influence Freeridership Score

Table B-8 shows the distribution of responses to the question: "Please rate the influence of the following program elements on your decision to purchase and install [the product]. Please use a scale from 1, meaning *not at all influential*, to 4, meaning the item was *very influential* to your decisions." Cadmus assessed influence freeridership from participants' ratings to how important various program elements were in their decision to purchase energy-efficient products.

Table B-8. Residential Prescriptive Program Freeridership *Influence* Responses by Measure Category (n=1,025)

Response Options	Influence Score	Information about the program from your contractor					Rebates for the equipment					Information about energy efficiency that CenterPoint Energy provided					Previous participation in a CenterPoint Energy efficiency program				
		Furnace/Boiler	Heat Pump/CAC	Thermostat	Weatherization	Other	Furnace/Boiler	Heat Pump/CAC	Thermostat	Weatherization	Other	Furnace/Boiler	Heat Pump/CAC	Thermostat	Weatherization	Other	Furnace/Boiler	Heat Pump/CAC	Thermostat	Weatherization	Other
1 - Not at all influential	100%	17	2	25	2	11	23	3	29	2	17	23	3	29	2	17	23	3	29	2	17
2 - Not too influential	75%	9	0	10	1	4	13	1	11	1	9	13	1	11	1	9	13	1	11	1	9
3 - Somewhat influential	25%	52	9	56	6	42	79	12	77	8	56	79	12	77	8	56	79	12	77	8	56
4 - Very influential	0%	167	36	150	16	97	234	49	225	19	142	234	49	225	19	142	234	49	225	19	142
Not Applicable	50%	6	1	5	0	1	7	2	5	0	1	7	2	5	0	1	7	2	5	0	1
Average Rating		**3.5**	**3.7**	**3.4**	**3.4**	**3.5**	**3.5**	**3.6**	**3.7**	**3.5**	**3.4**	**3.5**	**3.6**	**3.5**	**3.5**	**3.4**	**3.5**	**3.6**	**3.5**	**3.5**	**3.4**

Cadmus used the maximum rating given by each participant for any factor in Table B-8 to determine the participant's influence score, presented in Table B-9. Cadmus weighted individual influence scores by their respective total survey sample *ex post* gross savings to arrive at savings-weighted average influence scores by measure category.

Table B-9. Residential Prescriptive Program Influence Freeridership Score (n=1,025)

Maximum Influence Rating	Influence Score	Furnace/Boiler	Heat Pump/CAC	Thermostat	Weatherization	Other
1 – Not at all influential	100%	23	3	29	2	7
2 – Not too influential	75%	13	1	11	1	8
3 – Somewhat influential	25%	79	12	77	8	32
4 – Very influential	0%	234	49	225	19	87
Not Applicable	50%	7	2	5	0	2
Average Maximum Influence Rating - Simple Average		**3.5**	**3.6**	**3.5**	**3.5**	**3.4**
Average Influence Score - Weighted by *Ex Post* Savings		**16%**	**14%**	**17%**	**18%**	**19%**

Cadmus then calculated the arithmetic mean of the intention and influence freeridership components to estimate final freeridership by measure category, weighted by *ex post* gross program savings. The higher the freeridership score, the more savings are deducted from the gross savings estimates. Table B-10 summarizes the intention, influence, and overall freeridership scores for each measure category.

Table B-10. Residential Prescriptive Program Intention, Influence and Overall Freeridership Scores by Measure Category

Measure Category	n	Intention Score	Influence Score	Freeridership Score
Furnace/Boiler	356	60%	16%	38%
Heat Pump/CAC	67	64%	14%	39%
Thermostat	347	60%	17%	39%
Weatherization	30	65%	18%	42%
Other	225	62%	19%	41%

B.2.3 Detailed Spillover Findings

Sixteen participants reported installing a total of 21 high-efficiency measures after participating in the program. These respondents did not receive an incentive and said participation in the program was very influential on their decision to install additional measures. Cadmus attributed spillover savings to measures including high-efficiency ENERGY STAR clothes washers, dishwashers, an air purifier, dehumidifier, room air conditioner, water heaters, duct sealing, and a smart thermostat

Cadmus used *ex post* savings estimated for the 2021 Residential Prescriptive Program evaluation in combination with the 2015 Indiana TRM v2.2 to estimate savings for all spillover measures attributed to the program. Cadmus divided the total survey sample spillover savings for each measure category by the gross program savings from the survey sample to obtain the measure category spillover estimates in Table B-11.

Table B-11. Residential Prescriptive Standard and Online Marketplace Spillover Estimates by Measure Category

Measure Category	Survey Sample Spillover MMBtu Savings	Survey Sample Program MMBtu Savings	Percentage Spillover Estimate
Furnace/Boiler	5.1	4,830.6	0%
Heat Pump/CAC	4.7	530.2	1%
Thermostat	29.9	1,522.8	2%
Weatherization	0.0	365.2	0%
Water Heater	2.8	371.3	1%
Other	3.8	1,375.2	0%

B.2.4 Midstream

For each measure category incented through the Midstream channel, Cadmus used a distributor and contractor causal pathway NTG methodology. This approach is based on methods used in California and other states for similar upstream/midstream offerings, most recently described in detail in the 2017 California Public Utilities Commission (CPUC) HVAC Impact Evaluation Report.[81]

The recommended methodology establishes program attribution by considering the pathways distributors and contractors take when selling high-efficiency equipment and the related pathways end users take when purchasing equipment. The term "causal pathway" is used to represent how the program is intended to influence the final purchase decisions of end users. This approach is used to integrate survey responses into freeridership and NTG values.

In this methodology, three main causal pathways of influence can impact distributors and equipment end users, two of which also apply to contractors:

- The program influences distributors to **stock** high-efficiency units, and what is in stock influences what end users purchase when their units fail. This causal pathway is driven by the assumption that when end users replace existing equipment in a pressing situation, the equipment kept in stock by distributors has a strong influence on their purchasing decisions.

81 *See* CPUC Impact Evaluation Report – Final – HVAC – Program Year 2017 EM&V. 2019. Appendix G. 6.12.1.1 https://pda.energydataweb.com/api/view/2167/CPUC%20Group%20A%202017%20HVAC%20Impact%20Evaluation%20-%20Final%20Report.pdf

- The program encourages distributors and contractors to **upsell** high-efficiency units, and promotional efforts influence end users to purchase high-efficiency units rather than standard-efficiency units.
- The program encourages distributors and contractors to reduce the **price** of high-efficiency units or pass along rebates to end users, and end users are influenced by the lower prices to purchase high-efficiency units rather than standard-efficiency units.

Table B-12 presents the question themes associated with the three causal pathways for distributors and contractors.

Table B-12. Question Themes Associated with the Three Causal Pathways

Causal Pathways	Distributor/Contractor Question Theme
Stocking	What was the program influence on distributor stock?
Upselling	What was the program influence on encouraging the distributor/contractor to promote or upsell the units?
Price	Did the distributor/contractor pass on some or all of the incentive to buyers?

Each causal pathway is dependent on the distributor's change in behavior in response to the program and on the influence of that change in behavior on the decisions made by contractors. Each causal pathway is independently based on the assumption that if the program failed to show attribution through the distributors or contractors, then the program did not affect the equipment sale on that particular causal path. This does not mean the program had no influence on the sale, only that any influence it had was not through this pathway. If another causal pathway did show program influence, then the sale would be at least partially attributable to the program.

Table B-13 shows the distributor causal pathway attribution scoring approach for HVAC equipment incented through the CenterPoint Energy Midstream channel.

Table B-13. Distributor Causal Pathway Attribution Scoring Approach

Distributor Causal Pathways	General Question Series Logic	Attribution Scoring
Stocking	**Has the program influenced stocking patterns of high-efficiency units?** D5. For all [EQUIPMENT TYPE] approximately how many [EQUIPMENT TYPE] does your company normally keep available in stock? D6. Of those, how many are high efficiency [EQUIPMENT TYPE] units that qualify for the Midstream HVAC program? D7. If the program weren't available, how many of these high-efficiency [EQUIPMENT TYPE] would you stock?	$\frac{(D6\ response - D7\ response)}{D6\ response}$ = Distributor Attribution$_{Stock}$

Distributor Causal Pathways	General Question Series Logic	Attribution Scoring
Upselling	**Has the program influenced any upselling or promoting of high-efficiency units?** D14. In situations where you are selling [EQUIPMENT TYPE], about what percent of the time are you currently recommending the high-efficiency equipment? D15. For [EQUIPMENT TYPE] equipment, what percent of the time would you have recommended the high-efficiency equipment had the program not existed in 2021?	$\frac{(D14\ response - D15\ response)}{D14\ response}$ = Distributor Attribution$_{Upsell}$
Price	**Does any of the incentive get passed on to the buyer?** D20. On average, what percent of the rebate is passed on to the buyer for the [EQUIPMENT TYPE], either directly or indirectly?	$D20\ Response$ = Distributor Attribution $_{Price}$

Table B-14 shows the contractor causal pathway attribution scoring approach for HVAC equipment incented through the CenterPoint Energy Midstream channel. This section is comparable to the same section for distributors.

Table B-14. Contractor Causal Pathway Attribution Scoring Approach

Contractor Causal Pathways	General Question Series Logic	Attribution Scoring
Upselling	**Has the program influenced any upselling or promoting of high-efficiency units?** D16. In situations where you are selling [EQUIPMENT TYPE], about what percent of the time are you currently recommending the high-efficiency equipment? D17. For [MEASURE CATEGORY] equipment, what percent of the time would you have recommended the high-efficiency [EQUIPMENT TYPE] equipment had the program not existed in 2021?	$\frac{(D16\ response - D17\ response)}{D16\ response}$ = Contractor Attribution$_{Upsell}$
Price	**Does any of the incentive get passed on to the end-use buyer?** D22. On average, what percent of the rebate is passed on to the buyer for the [EQUIPMENT TYPE], either directly or indirectly?	$D22\ Response$ = Contractor Attribution $_{Price}$

Note: Though Cadmus asks contractors general questions about whether they keep a supply of equipment in stock and if the CenterPoint Energy program influenced their stocking practices, HVAC contractors typically do not stock a significant amount of equipment; therefore, a separate contractor stocking attribution score is not applicable.

B.3 Residential New Construction Program

Cadmus analyzed NTG for the 2021 Residential New Construction Program through interviews with eight participating builders.[82] Cadmus estimated freeridership using the intention/influence freeridership method.[83] Table B-15 presents the freeridership, spillover, and NTG results for the 2021 program.

Table B-15. 2021 Residential New Construction Program Net-to-Gross Ratio

Measure	Freeridership	Spillover	NTG Ratio
New Construction Incentives	43%[1]	0%	57%

[1] Weighted by evaluated *ex post* program MMBtu savings.

B.3.1 Detailed Freeridership Findings

Intention Method

The initial intention freeridership questions and answers are shown in Table B-16. The table also contains the analysis of responses to the follow-up questions associated with each response option (which Cadmus used to determine each builder's final intention score). To calculate intention-based freerider savings, Cadmus multiplied each builder's intention score by the respondent's respective verified gross program savings. The sum of the intention score MMBtu savings divided by the evaluated *ex post* MMBtu savings of the total survey sample produces a weighted MMBtu savings intention score of 35%.

82 Cadmus was unable to match 1 of the 9 interviewed builders back to the 2021 program data and therefore excluded this builder from these results.

83 The intention score and influence score each have maximum values of 50%. They are then added to arrive at the final freeridership score. Other CenterPoint energy programs use a maximum value of 100% for the intention score and influence score, which are then averaged to arrive at the final freeridership score.

Table B-16. 2021 Residential New Construction Program Evaluated Net Savings

Intention Question / Response Options Thinking about the CenterPoint Energy Residential New Construction program homes you built in 2021, which of the following would have happened if you had not received incentives and assistance from CenterPoint Energy?	Intention Score	Count	Total Survey Sample *Ex Post* MMBtu Savings	Intention Score MMBtu Savings
Adopted some of the Residential New Construction Program building practices but not enough to meet the HERS 63 standards. **Just to confirm, would your company have adopted most, some or a few of the building practices required to meet the HERS 62 standards?**				
Most	37.5%	0	0	0
Some	25%	0	0	0
A few	12.5%	0	0	0
Continued with current practices, which were not Residential New Construction Program standards. **Would your company have adopted some of the CenterPoint Energy Residential New Construction Program building practices in the last 12 months?**				
Yes, within the last 12 months	25%	0	0	0
No, but within one to two years	0%	0	0	0
No, not in the near future	0%	0	0	0
Don't know	12.5%	0	0	0
Continued with current practices, which were a mix of Residential New Construction Program standards and less efficient than the program standards. **Would your firm have continued to build some of your homes to the CenterPoint Energy New Construction Program standards of at least a HERS 62 without any incentives or assistance from CenterPoint Energy?**				
Yes, would have adopted 100% of New Construction Program standards for some homes within the last 12 months	29%	2	4,444	1,296
Yes, would have adopted 100% of New Construction Program standards for some homes within one to two years	25%	0	0	0
No, not in the near future for any homes	0%	0	0	0
Don't know	12.5%	0	0	0
Continued with current practices, the Residential New Construction program standards are my standard practices and I build to HERS 62 and below. **Would your firm have built all of your homes to the HERS 62 standards without the incentives or assistance from CenterPoint Energy?**				
Yes	50%	6	1,747	873
No	0%	0	0	0
Total		**8**	**6,191**	**2,170**
Intention Score - Weighted by *Ex Post* MMBtu Savings (Intention Score MMBtu Savings Divided by Total Survey Sample *Ex Post* MMBtu Savings)	**35%**			

Influence Method

Table B-17 shows the distribution of responses to the influence question: "Please rate each item on how influential it was to your decision to build homes to CenterPoint Energy RNC Program standards of at least a HERS 62 or below. Please use a scale from 1, meaning *not influential*, to 4, meaning the item was *very influential* to your decisions."

Cadmus assessed influence freeridership from builders' ratings to determine how important various program elements were in their decision to build program qualifying homes. Table B-17 shows the program elements that participants rated for influence, along with a count and average rating for each factor.

Table B-17. 2021 Residential New Construction Program Freeridership Influence Responses (n=8)

Response Options	Influence Score	CenterPoint Energy Program Incentives	CenterPoint Energy Program Marketing	Information about energy-efficient building practices that CenterPoint Energy provided	Obtaining information from HERS rater who rates homes	Previous participation in a CenterPoint Energy efficiency program
1 - Not at all influential	50%	1	3	0	1	1
2 – Not too influential	37.5%	1	3	3	0	1
3 – Somewhat influential	12.5%	3	1	3	1	3
4 – Very influential	0%	3	1	1	5	3
Don't Know	25%	0	0	1	1	0
Average		**3.0**	**2.0**	**2.7**	**3.4**	**3.0**

Cadmus used the maximum rating given by each builder for any factor in Table B-17 to determine their influence score, which is presented in Table B-18. The counts refer to the number of responses for each factor/influence score response option. Cadmus weighted individuals' influence scores by their respective total survey sample *ex post* gross savings to arrive at a savings-weighted average influence score of 8% for the Residential New Construction Program.

Table B-18. 2021 Residential New Construction Program Influence Freeridership Score (n=8)

Maximum Influence Rating	Influence Score	Count	Total Survey Sample *Ex Post* MMBtu Savings	Influence Score MMBtu Savings
1 - Not at all influential	50%	0	0	0
2 – Not too influential	37.5%	0	0	0
3 – Somewhat influential	12.5%	2	3,773	472
4 – Very influential	0%	6	2,418	0
Average Maximum Influence Rating - Simple Average		**3.8**		
Average Influence Score - Weighted by *Ex Post* MMBtu Savings		**8%**		

Next, Cadmus summed the intention and influence components to estimate the total intention/ influence method freeridership score of 43%, weighted by *ex post* gross program savings. The higher the freeridership score, the more savings are deducted from the gross savings estimates.

B.3.2 Detailed Spillover Findings

The 2021 Residential New Construction Program spillover estimate is 0%. None of the surveyed builders reported voluntarily raising the energy efficiency standard of the appliances or materials they used to build homes that were not eligible for the CenterPoint Energy program.

B.4 Appliance Recycling Program

Appliance recycling programs generate net savings only when the recycled appliance would have continued to operate absent program intervention (either in the participating customer's home or at the home of another utility customer).

Cadmus employed a decision-tree approach to calculate net program savings and used a weighted average of these scenarios to calculate the net savings attributable to the Appliance Recycling Program. The decision tree—populated by the responses of 175 surveyed 2021 participants—presents all of the program's possible savings scenarios.[84]

The decision tree accounts not only for what the participating household would have done independent of the program but also for the possibility that the unit would have been transferred to another household *and* whether the would-be acquirer of that refrigerator would have found an alternate unit instead.

Table B-19 lists the NTG results for the program. Cadmus assumed NTG of 100% for room air conditioners because these participants must recycle a refrigerator or freezer to have the room air conditioner recycled. Room air conditioners represented only 1.6% of gross program population savings.

Table B-19. 2021 Appliance Recycling Program Net-to-Gross Ratio

Measure	Freeridership	Spillover	NTG Ratio
Refrigerator	50%	0%	50%
Freezer	41%	0%	59%
Room Air Conditioner	0%	0%	100%
Total Program[1]	**48% kWh, 46% kW**	**0%**	**52% kWh, 54% kW**

[1]Program-level estimates are weighted by each measure's *ex post* gross evaluated population energy savings and demand savings.

Cadmus calculated the final verified per-unit net savings using the following equation:

$$\begin{aligned} &Net\ Program\ Savings\ (kWh\ per\ year) \\ &\qquad = Gross\ Program\ Savings - FR\ and\ SMI\ - Induced\ Consumption + Spillover \end{aligned}$$

Table B-20 lists the per-unit net impacts and overall NTG ratio by appliance type.

[84] 175 participants answered the NTG questions.

Table B-20. 2021 Appliance Recycling Program NTG by Appliance Type

Measure	Gross Per-Unit Savings (kWh/Year)	Freeridership and Secondary Market Impacts (kWh)	Additional kWh Savings (Spillover)	Net kWh	NTG[1]	Absolute Precision (90% Confidence)
Refrigerator	1,000	501	0	499	50%	±7%
Freezer	648	265	0	383	59%	±15%

[1]Cadmus assumed 100% NTG for room air conditioners.

B.4.1 Detailed Freeridership Findings

In general, independent of program intervention, participant refrigerators and freezers are subject to one of three scenarios:

- **Scenario 1.** The participant keeps the refrigerator.
- **Scenario 2.** The participant discards the refrigerator by a method that transfers it to another customer for continued use.
- **Scenario 3.** The participant discards the refrigerator by a method that removes the unit from service.

Cadmus applies freeridership only under Scenario 3 because the unit has been removed from the grid and destroyed, even if it has not been recycled through the program. As a result, the program cannot claim energy savings generated by recycling this appliance.

To determine the percentage of participants in each of the scenarios and to assess freeridership, Cadmus asked each surveyed participant which of the following would have occurred to the appliance had it not been recycled by CenterPoint Energy:

- Sold it to someone directly
- Sold it to a used appliance dealer
- Given it away to someone for free
- Given it away to charity organization
- Left it on the curb with a free sign
- Had it removed by the dealer you got your new appliance
- Hauled it to the dump yourself [or with help from a friend or family member.
- Hauled it to a recycling center yourself [or with help from a friend or family member]
- Hired someone to haul it away for junking or dumping

To ensure the highest quality of responses possible and to mitigate a socially responsible response bias, Cadmus asked some participants follow-up questions to test the reliability of their initial responses. For example, through interviews it has conducted with market actors for other evaluations, Cadmus has determined that used appliance dealers usually do not purchase appliances more than 15 years old. Therefore, Cadmus asked any participants with an appliance more than 15 years old, who indicated they would have sold their unit to a used appliance dealer, what they would have done had they been unable to carry through with their plans.

Upon determining the final assessments of participants' actions independent of the Appliance Recycling Program, Cadmus calculated the percentage of refrigerators and freezers that would have been kept or discarded. As shown in Table B-21, 75% of respondents would not have kept their refrigerator.

Of those disposing the refrigerator, 46% would have discarded it through one of the following means:

- Had it removed by the dealer from which they purchased the new or replacement appliance
- Took it to a dump or recycling center themselves (or with help from a friend or family member)
- Had someone take it to a dump or recycling center (for example, a handyman or local waste management company)

Table B-21. 2021 Appliance Recycling Program Final Distribution of Kept and Discarded Appliances

Stated Action Absent Program	Indicative of Freeridership	Refrigerators (n=133)[1]	Freezers (n=36)[1]
Kept	No	25%	42%
Discarded	Varies by discard method	75%	58%
Total Program		**100%**	**100%**

[1] Does not include *don't know* responses and refusals.

As shown in Table B-22, fewer 2021 participants said they would have kept their refrigerators in the absence of the Appliance Recycling Program than in 2020. This decrease is the main factor contributing to a lower NTG estimate in 2021 than in 2020.

Table B-22. CenterPoint Energy Historical Appliance Recycling Program Kept and Discarded Scenarios

Program Year	Percentage Likely to Have Been Kept Independent of Program	
	Refrigerators	Freezers
2012	35%	67%
2013	37%	49%
2014	38%	43%
2015	42%	31%
2016	54%	63%
2017	30%	54%
2018	46%	49%
2019	51%	62%
2020	41%	39%
2021	**25%**	**42%**

Having the retailer pick up the appliance was not necessarily indicative of freeridership. Rather, this depended on the retailer's decision whether or not to resell the unit. Not all appliances would be viable for resale. Cadmus used age as a proxy for secondary market viability, assuming a retailer would be unlikely to resell appliances over 15 years old. Together, these actions resulted in a 35% reduction in gross savings due to refrigerator freeridership.[85]

Freeridership for freezer recyclers took a similar route. Of 58% of respondents who would not have kept their freezers, 48% would have taken one of the three actions listed above, leading to the appliance's removal from the grid, for a 28% freeridership for freezers.

Secondary Market Impacts

After determining whether a participant would have directly or indirectly (i.e., through a market actor) transferred the unit to another customer on the grid,[86] Cadmus addressed what that would-be acquirer would have done if the recycled unit was unavailable. There are three possible scenarios:

- **Scenario 1: None of the would-be acquirers would find another unit.** That is, program participation would result in a one-for-one reduction in the total number of refrigerators operating on the grid. In this case, the total energy consumption of avoided transfers (participating appliances that otherwise would have been used by another customer) should be credited as savings to the program. This position is consistent with the theory that participating appliances are essentially convenience goods for would-be acquirers. That is, the would-be acquirer would have accepted the refrigerator had it been readily available but, since the refrigerator was not a necessity, would not have sought out an alternate unit.
- **Scenario 2: All of the would-be acquirers would find another unit.** Thus, program participation has no effect on the total number of refrigerators operating on the grid. This position is consistent with the notion that participating appliances are necessities and that customers will always seek alternative units when participating appliances are unavailable.
- **Scenario 3: Some of the would-be acquirers would find another unit, while others would not.** This scenario reflects the awareness that some acquirers were in the market for an appliance and would acquire another unit, while others were not and would have taken the unit only opportunistically.

Cadmus assumed one-half of would-be acquirers of avoided transfers would have found an alternate unit, an assumption consistent with the UMP.

The next issue Cadmus addressed was the likelihood that the alternate unit would be another used appliance (similar to those recycled through the program) or—with fewer used appliances presumably available in the market due to program activity—the customer would acquire a new standard-efficiency unit. Even if a would-be acquirer could select a new ENERGY STAR unit, Cadmus assumed it was likely that a customer in the market for a used appliance would upgrade to the next-lowest price point.

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85 Reduction in gross savings due to refrigerator freeridership is calculated as 75% of respondents not keeping their appliance * 46% of respondents reporting one of the three actions leading to freeridership = 35% freeridership. For freezers, 58% * 48% = 28%.

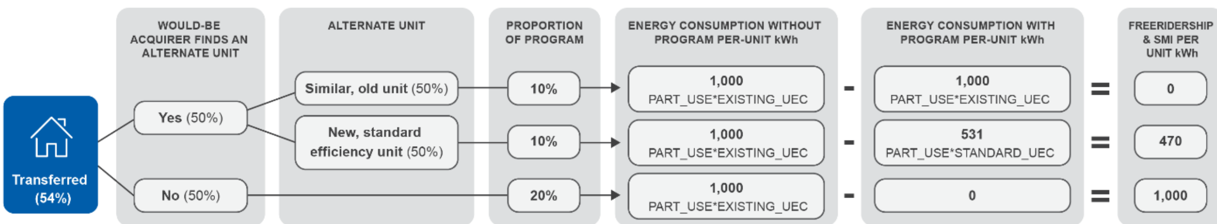
86 Forty-one percent of refrigerator 2021 survey respondents and 31% of freezer 2021 survey respondents would have directly or indirectly transferred their unit to another customer on the grid.

Cadmus applied a midpoint approach, with one-half of would-be acquirers of program units finding a similar used appliance and one-half acquiring a new standard-efficiency unit.[87]

Figure B-3 explains the methodology used for assessing the program's impact on the secondary refrigerator market and the application of the recommended midpoint assumptions (when primary data were unavailable). As shown, accounting for market impacts resulted in three savings scenarios:

- Full savings (i.e., per-unit gross savings)
- No savings (i.e., the difference in energy consumption of the program unit and a similar, old unit)
- Partial savings (i.e., the difference between the energy consumption of the program unit and that of the new, standard-efficiency appliance acquired)

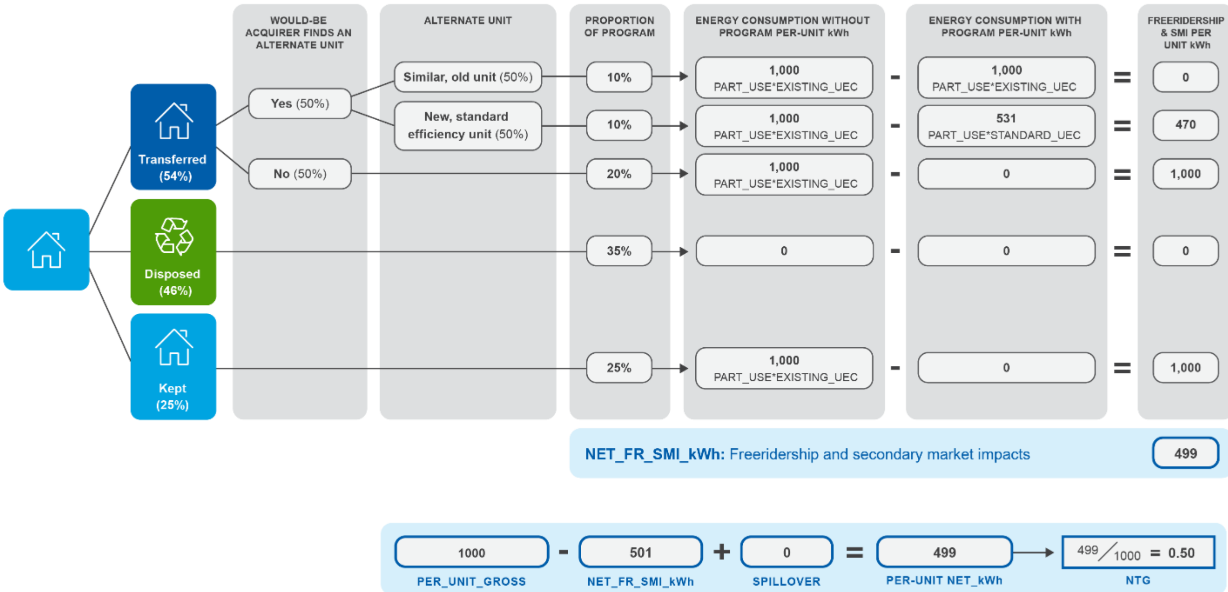
Figure B-3. Secondary Market Impacts—Refrigerators



After estimating the parameters of the freeridership impacts and secondary market impacts, Cadmus used the UMP decision tree to calculate average per-unit program savings, net of their combined effect. Figure B-4 shows how these values integrated into a combined savings estimate, net of freeridership and secondary market impacts.

[87] Cadmus calculated the energy consumption of a new, standard-efficiency appliance using the ENERGY STAR website, taking the average energy consumption of new, comparably sized, and standard-efficiency appliances with similar configurations as the program units. U.S. Environmental Protection Agency. ENERGY STAR. "Refrigerator Retirement Savings Calculator." Accessed February 2018: http://www.energystar.gov/index.cfm?fuseaction=refrig.calculator

Figure B-4. Savings Net of Freeridership and Secondary Market Impacts—Refrigerators



B.4.2 Detailed Spillover Findings

As recommended in the UMP, Cadmus did not include spillover in net savings estimates for the Appliance Recycling Program in 2021. The UMP suggests, that although appliance recycling programs promote enrollment in other energy efficiency programs, spillover of unrelated measures is unlikely to occur.

B.5 Community Based LED Specialty Bulb Distribution

Cadmus calculated NTG ratios for the Community Based LED Specialty Bulb Distribution Program by program component (food bank or community events) and by population of each component (income- or non-income-qualified). The community events program component rolls up two of the population groups, as shown in Table B-23.

Table B-23. Community Based LED Specialty Bulb Distribution Net-to-Gross Ratio – Population

Program Component	Measure Group	Measure	Population Group	Proportion of Population Group
Food Bank Events	Lighting	4W Candelabra	Income-qualified	100%
Food Bank Events	Lighting	LED Nightlight	Income-qualified	
Community Events	Lighting	4W Candelabra	Income-qualified	25%
Community Events	Lighting	LED Nightlight	Income-qualified	
Community Events	Lighting	4W Candelabra	Non-income-qualified	75%
Community Events	Lighting	LED Nightlight	Non-income-qualified	

For the food bank event program component, where it is assumed that 100% of the population is income-qualified, Cadmus applied a 100% NTG ratio, consistent with long-standing evaluation assumptions that income-qualified participants would not have purchased program measures without the intervention of the program. For the non-income-qualified proportion of the community event participant population, Cadmus applied a 59% NTG ratio from the 2019 Residential Lighting Program evaluation of specialty lighting measures.

Table B-24 lists the population proportions of each program component and their respective NTG results.

Table B-24. Community Based LED Specialty Bulb Distribution Net-to-Gross Ratio – Population

Program Component	Measure Group	Measure	Population Group	Proportion of Population Group	Freeridership	Spillover
Food Bank Events	Lighting	4W Candelabra	Income-qualified	100%	0%	0%
Food Bank Events	Lighting	LED Nightlight	Income-qualified	100%	0%	0%
Community Events	Lighting	4W Candelabra	Income-qualified	25%	0%	0%
Community Events	Lighting	LED Nightlight	Income-qualified	25%	0%	0%
Community Events	Lighting	4W Candelabra	Non-income-qualified	75%	41%	0%
Community Events	Lighting	LED Nightlight	Non-income-qualified	75%	41%	0%

Table B-25 lists the rolled-up NTG results by program component and for the entire program.

Table B-25. Community Based LED Specialty Bulb Distribution Net-to-Gross Ratio – Program Component

Program Component	Measure Group	Measure	Proportion of Bulbs Distributed	Weighted Average Freeridership by Population Group	Weighted Average Spillover by Population Group	Weighted Average NTG by Population Group
Food Bank Events	Lighting	4W Candelabra	73%	0%	0%	100%
Food Bank Events	Lighting	LED Nightlight	24%	0%	0%	100%
Community Events	Lighting	4W Candelabra	2%	31%	0%	69%
Community Events	Lighting	LED Nightlight	1%	31%	0%	69%
Total Program (Weighted by Bulbs Distributed)				**1%**	**0%**	**99%**

B.6 Commercial and Industrial Prescriptive Program

Cadmus calculated freeridership and spillover for the C&I Prescriptive Program using findings from a survey conducted with 30 program participants. After including spillover, the program resulted in a 76% NTG ratio. Table B-26 lists the presents the NTG results for the program.

Table B-26. Commercial and Industrial Prescriptive Program Net-to-Gross Ratio

Measure	Freeridership	Spillover	NTG Ratio
Total Program	24%[1]	0%	76%

[1] Weighted by evaluated *ex post* program MMBtu savings.

B.6.1 Detailed Freeridership Findings

Intention Freeridership Score

Cadmus estimated *intention* freeridership scores for all participants based on their responses to the *intention*-focused freeridership questions. Table B-27 illustrates how initial responses are translated into whether the response is "yes," "no," or "partially" indicative of freeridership (in parentheses). The value in brackets is the scoring decrement associated with each response option. Each participant freeridership score starts with 100%, which Cadmus then decrements based on their responses to the nine questions.

Figure B-5 shows the distribution of *intention* freeridership estimates Cadmus assigned to participant responses to the pure intention-based freeridership method.

Figure B-5. 2021 Commercial and Industrial Prescriptive Program Self-Report *Intention* Freeridership Distribution by Estimate

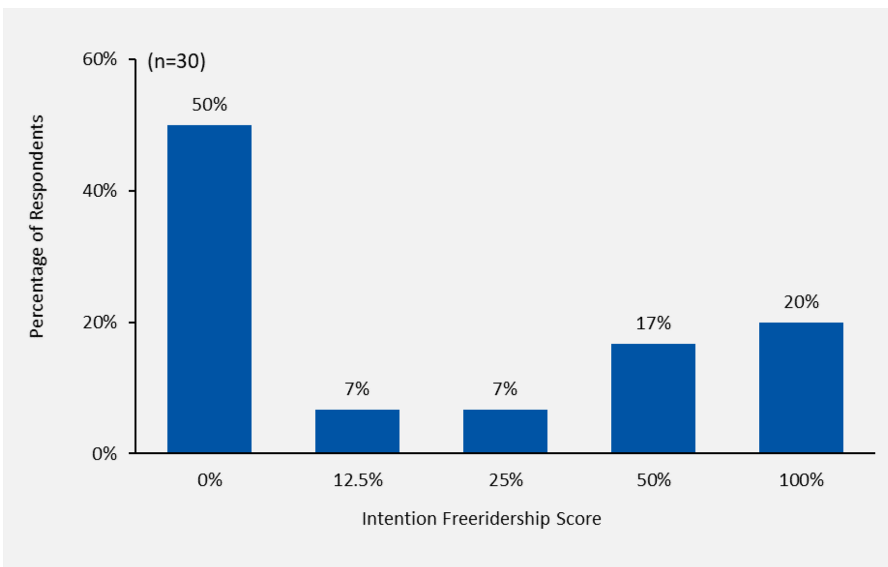


Table B-27. 2021 Raw Survey Responses Translation to *Intention* Freeridership Scoring Matrix Terminology Commercial and Industrial Prescriptive Program and Scoring

First, did your organization have specific plans to install the [MEASURE] before learning about CenterPoint Energy's Business Rebate Program?	Had you already purchased or installed the new [MEASURE] before you learned about the program?	Just to be clear, you installed the [MEASURE] before you heard anything about the CenterPoint Energy program, correct?	Would you have installed a [MEASURE] that (was/were) just as energy-efficient without the CenterPoint Energy program and rebates?	And would you have installed the same quantity of [MEASURE] in absence of the CenterPoint Energy program and rebates?	Without the CenterPoint Energy program and rebates, when would you have installed the [MEASURE]?	Did the incentive help the [MEASURE] project receive implementation approval from your organization?	Prior to participating in the Business Rebate Program, was the purchase and installation of the [MEASURE] included in your organization's capital budget?
Yes (Yes) [-0%]	Yes (Yes) [-0%]	Yes, that is correct (Yes) [100% FR Assigned]	Yes, just as energy-efficient (Yes) [-0%]	Yes, same quantity (Yes) [-0%]	Within the same year? (Yes) [-0%]	Yes (No) [-50%]	Yes (No) [-50%]
No (No) [-50%]	No (No) [-0%]	No, that's not correct (No) [-0%]	No, less energy efficient (No) [-50%]	No, I would have installed less (Partial2) [-50%]	Within one to two years? (Partial2) [-50%]	No (Yes) [-0%]	No (Yes) [-0%]
DK/RF (Partial) [-25%]	DK/RF (No) [-0%]	DK/RF (No) [-0%]	No, more energy efficient (Yes) [-0%]	No, I would have installed more (Yes) [-0%]	Within three to five years? (No) [-100%]	DK/RF (Partial) [-25%]	DK/RF (Partial) [-25%]
				Would not have installed anything at all (No) [-100%]	In more than five years? (No) [-100%]		
				DK/RF (Partial) [-25%]	Never (No) [-100%]		
					DK/RF (Partial) [-25%]		

Influence Freeridership Score

Table B-28 shows the distribution of responses to the influence question: "Please rate each item on how important it was to your decision to complete the [MEASURE] project the way it was done. Please use a scale from 1, meaning *not at all important*, to 4, meaning the item was *very important* to your decisions." Cadmus assessed influence freeridership from participants' ratings to the relative importance of various program elements in their purchasing decisions, as shown in Table B-28.

Table B-28. 2021 Commercial and Industrial Prescriptive Program Freeridership Influence Responses (n=30)

Response Options	Influence Score	CenterPoint Energy or Resource Innovations staff	Rebates for the equipment	Information about energy efficiency provided by CenterPoint Energy	Information about energy efficiency from my contractor	Previous participation in a CenterPoint Energy efficiency program
1 – Not at all important	100%	8	4	3	5	8
2 – Not too important	75%	4	1	4	3	1
3 – Somewhat important	25%	6	8	17	10	4
4 - Very important	0%	4	16	4	8	12
Don't Know	50%	1	0	0	0	0
Not Applicable	50%	7	1	2	4	5
Average		**2.3**	**3.2**	**2.8**	**2.8**	**2.8**

Cadmus used the maximum rating given by each participant for any factor in Table B-28 to determine the participant's influence score presented in Table B-29. Cadmus weighted individual influence scores by each participant's respective total survey sample *ex post* gross savings to arrive at a savings-weighted average influence score of 12% for C&I Prescriptive Program participants.

Table B-29. 2021 Commercial and Industrial Prescriptive Program Influence Freeridership Score (n=30)

Maximum Influence Rating	Influence Score	Count[1]	Total Survey Sample *Ex Post* MMBtu Savings	Influence Score MMBtu Savings
1 – Not at all important	100%	3	184	184
2 – Not too important	75%	1	19	14
3 – Somewhat important	25%	6	416	104
4 - Very important	0%	20	1,929	0
Average Maximum Influence Rating - Simple Average		**3.4**		
Average Influence Score - Weighted by *Ex Post* Savings			**12%**	

[1] Refers to the number of responses for each factor/influence score response option.

Final Freeridership Score

Cadmus calculated the arithmetic mean of the intention and influence freeridership components to estimate a final freeridership value of 24%, weighted by *ex post* gross program savings. The higher the freeridership score, the more savings are deducted from the gross savings estimates. Table B-30 presents the intention, influence, and freeridership scores for the C&I Prescriptive Program.

Table B-30. 2021 Commercial and Industrial Prescriptive Program Intention/Influence Freeridership Score

n	Intention Score	Influence Score	Freeridership Score
30	35%	12%	24%

B.6.2 Detailed Spillover Findings

None of the interviewed participants reported that, after participating in the program, they had installed additional high-efficiency equipment for which they did not receive an incentive and that participation in the program was very important in their decision. Therefore, no spillover is attributed to the program.

B.7 Commercial and Industrial Custom Program

Cadmus calculated freeridership and spillover for the C&I Custom Program using findings from a survey conducted with six program participants. After including spillover, the program resulted in a 93% NTG ratio. Table B-31 lists the presents the NTG results for the program.

Table B-31. C&I Custom Program Net-to-Gross Ratio

Measure	Freeridership	Spillover	NTG Ratio
Total Program	7%[1]	0%	93%

[1] Weighted by evaluated *ex post* program MMBtu savings

B.7.1 Detailed Freeridership Findings

Intention Freeridership Score

Cadmus estimated *intention* freeridership scores for the program based on surveyed participants' responses to the *intention*-focused freeridership questions. Table B-32 illustrates how initial responses are translated into whether the response is "yes," "no," or "partially" indicative of freeridership (in parentheses). The value in brackets is the scoring decrement associated with each response option. Each participant freeridership score starts with 100%, which Cadmus then decrements based on responses to the questions. After assigning an *intention* freeridership score to every survey respondent, Cadmus calculated a savings-weighted average *intention* freerider score of 13% for the program.

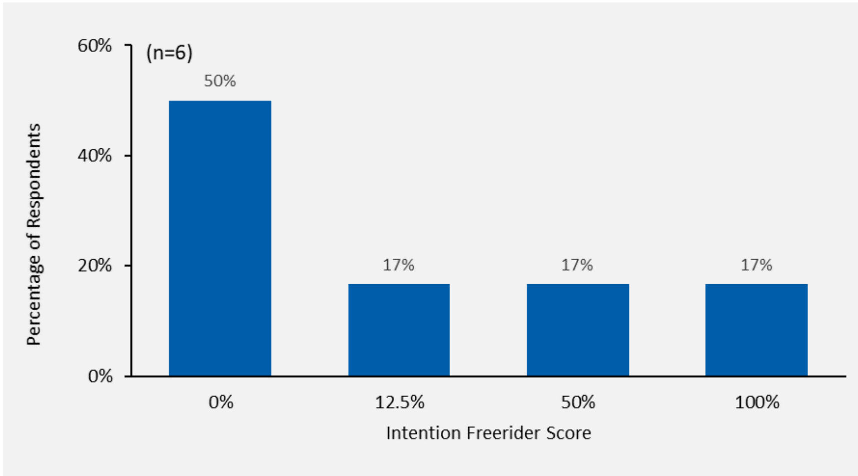
Figure B-6 shows the distribution of *intention* freeridership estimates Cadmus assigned to participant responses using the pure intention-based freeridership method.

Table B-32. 2021 Raw Survey Responses Translation to *Intention* Freeridership Scoring Matrix Terminology C&I Custom Program and Scoring

First, did your organization have specific plans to install the [MEASURE] BEFORE learning about CenterPoint Energy's Commercial Custom Program rebate?	Had you already purchased or installed the new [MEASURE] before you learned about the program?	Just to be clear, you installed the [MEASURE] before you heard anything about the CenterPoint Energy program, correct?	Would you have installed a [MEASURE] that (was/were) just as energy-efficient without the CenterPoint Energy program and rebates? [READ LIST IF NECESSARY]	And would you have installed the same quantity of [MEASURE] in absence of the CenterPoint Energy program and rebates? [READ LIST IF NECESSARY]	Without the CenterPoint Energy program and rebates, would you have installed the [MEASURE] … [READ LIST]?	Did the incentive help the [MEASURE] project receive implementation approval from your organization?	Prior to participating in the Commercial Custom Program, was the purchase and installation of the [MEASURE] included in your organization's capital budget?
Yes (Yes) [-0%]	Yes (Yes) [-0%]	Yes, that is correct (Yes) [100% freerider Assigned]	Yes, just as energy-efficient (Yes) [-0%]	Yes, same quantity (Yes) [-0%]	Within the same year? (Yes) [-0%]	Yes (No) [-50%]	Yes (Yes) [-0%]
No (No) [-50%]	No (No) [-0%]	No, that's not correct (No) [-0%]	No, less energy efficient (No) [-100%]	No, I would have installed less (No) [-50%]	Within one to two years? (Partial) [-25%]	No (Yes) [-0%]	No (No) [-50%]
DK/NA (Partial) [-25%]	DK/NA (No) [-0%]	DK/NA (No) [-0%]	No, more energy efficient (Yes) [-0%]	No, I would have installed more (Yes) [-0%]	Within three to five years? (No) [-100%]	DK/NA (Partial) [-25%]	DK/NA (Partial) [-25%]
			DK/NA (Partial) [-25%]	DK/NA (Partial) [-25%]	In more than five years? (No) [-100%]		
					DK/NA (Partial) [-25%]		

DK = don't know; RF = refused

Figure B-6. 2021 C&I Custom Program Self-Report *Intention* Freeridership Distribution by Estimate



Influence Freeridership Score

Table B-33 shows the distribution of responses to the influence question: "Please rate each item on how influential it was to your decision to complete the project the way it was done. Please use a scale from 1, meaning 'not at all influential', to 4, meaning the item was 'very influential' to your decisions." Cadmus assessed influence freeridership from participants' ratings to the relative importance of various program elements in their purchasing decisions, as shown in Table B-33.

Table B-33. 2021 C&I Custom Program Freeridership Influence Responses (n=6)

Question Response Options	Influence Score	CenterPoint Energy or program implementer staff	Rebates for the equipment	Information about energy efficiency provided by CenterPoint Energy	Information about energy efficiency from program staff or my contractor provided	Previous participation in a CenterPoint Energy efficiency program
1 – Not at all influential	100%	0	0	0	0	0
2 – Not too influential	75%	0	0	1	0	0
3 – Somewhat influential	25%	3	0	2	2	2
4 - Very influential	0%	3	6	3	3	1
Don't Know	50%	0	0	0	1	3
Not Applicable	50%	0	0	0	0	0
Average		**3.5**	**4.0**	**3.3**	**3.6**	**3.3**

Cadmus used the maximum rating given by each participant for any factor in Table B-33 to determine the participant's influence score presented in Table B-34. Cadmus weighted individual influence scores by each participant's respective *ex post* gross savings associated with the total survey sample to arrive at a savings-weighted average influence score of 0% for C&I Custom Program participants.

Table B-34. 2021 C&I Custom Program Influence Freeridership Score (n=6)

Maximum Influence Rating	Influence Score	Count[1]	Total Survey Sample *Ex post* MMBtu Savings	Influence Score MMBtu Savings
1 – Not at all influential	100%	0	0	0
2 – Not too influential	75%	0	0	0
3 – Somewhat influential	25%	0	0	0
4 - Very influential	0%	6	12,308	0
Average Maximum Influence Rating - Simple Average		**4.0**		
Average Influence Score - Weighted by *Ex Post* Savings			**0%**	
[1] Refers to the number of responses for each factor/influence score response option.				

Final Freeridership Score

Cadmus calculated the arithmetic mean of the intention and influence freeridership components to estimate a final freeridership value of 7%, weighted by *ex post* gross program savings. The higher the freeridership score, the more savings are deducted from the gross savings estimates. Table B-35 presents the intention, influence, and freeridership scores for the C&I Custom Program.

Table B-35. 2021 C&I Custom Program Intention/Influence Freeridership Score

n	Intention Score	Influence Score	Freeridership Score
6	13%	0%	7%

B.7.2 Detailed Spillover Findings

None of the surveyed participants reported that, after participating in the program, they had installed additional high-efficiency equipment for which they did not receive an incentive and that participation in the program was very important in their decision. Therefore, no spillover is attributed to the program.

B.8 Small Business Energy Solutions Program

Cadmus calculated freeridership and spillover for the Small Business Energy Solutions (SBES) Program using findings from a survey conducted with 16 program participants.[88] Table B-36 lists the NTG results for the program.

Table B-36. Small Business Energy Solutions Net-to-Gross Ratio

Measure	Freeridership	Spillover	NTG Ratio
Total Program	12%	0%	88%

[88] 16 participants answered the NTG questions.

B.8.1 Detailed Freeridership Findings

Cadmus estimated freeridership by combining two methods used in prior evaluations—the standard self-report intention method and the intention/influence method.[89] Cadmus calculated the arithmetic mean of the savings weighted *intention* and *influence* freeridership components to estimate measure category freeridership,[90] as shown in this equation:

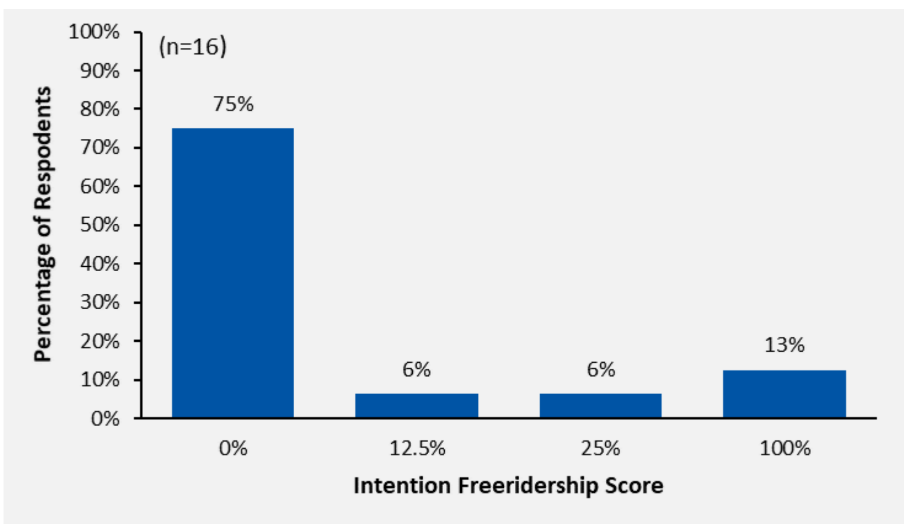
$$\text{Final Freeridership \%} = \frac{\mathit{Intention}\text{ FR Score}(0\% \text{ to } 100\%) + \mathit{Influence}\text{ FR Score}(0\% \text{ to } 100\%)}{2}$$

Intention Freeridership Score

Cadmus estimated *intention* freeridership scores for all participants based on their responses to *intention*-focused freeridership questions. Table B-37 illustrates how initial responses are translated into whether the response is "yes," "no," or "partially" indicative of freeridership (in parentheses). The value in brackets is the scoring decrement associated with each response option. Each participant freeridership score starts with 100%, which Cadmus then decrements based on the participant's response to the questions.

Figure B-7 shows the distribution of *intention* freeridership estimates Cadmus assigned to participant responses to the pure intention-based freeridership method.

Figure B-7. 2021 Small Business Energy Solutions Program Self-Report *Intention* Freeridership Distribution by Estimate



[89] *Intention* and *influence* freeridership scores both have a maximum of 100%.

[90] *Ex post* gross program savings.

Table B-37. 2021 Raw Survey Responses Translation to *Intention* Freeridership Scoring Matrix Terminology Small Business Energy Solutions Program and Scoring

Did your organization have specific plans to install the [MEASURE](s) BEFORE learning about the CenterPoint Energy Small Business Solutions program?	Would you have installed the same [MEASURE] if the equipment had not been recommended to you in the Small Business Energy Solutions assessment report?	Would you have installed the same [MEASURE](s) without the CenterPoint Energy program and instant discounts?	Would you have installed equipment that was just as energy efficient without the CenterPoint Energy program and instant discount?	Would you have installed the same quantity of [MEASURE]s in absence of the CenterPoint Energy program and instance discounts?	Without the CenterPoint Energy program and instant discounts, when would you have installed the [MEASURE](s)?	Prior to participating in this program, was the purchase and installation of the [MEASURE] included in your organization's most recent capital budget?
Yes (Yes) [-0%]	Yes (Yes) [-0%]	Yes (Yes) [-0%]	Yes, just as energy efficient (Yes) [-0%]	Yes, same quantity (Yes) [-0%]	At the same time (Yes) [-0%]	Yes (Yes) [-0%]
No (No) [-50%]	No (No) [-25%]	No (No) [-25%]	No, less energy efficient (No) [-100%]	No, I would have installed less (Partial2) [-50%]	Later but within the same year (Partial2) [-50%]	No (No) [-50%]
DK/RF (Partial) [-25%]	DK/RF (No) [-0%]	DK/RF (No) [-0%]	No, more energy efficient (Yes) [-0%]	No, I would have installed more (Yes) [-0%]	Within one to two years (No) [-100%]	DK/RF (Partial) [-25%]
			DK/RF (Partial) [-25%]	Would not have installed anything at all (No) [-100%]	Within three to five years (No) [-100%]	
				DK/RF (Partial) [-25%]	In more than five years (No) [-100%]	
					Never (No) [-100%]	
					DK/RF (Partial) [-25%]	

DK = don't know; RF = refused

Influence Freeridership Score

Table B-38 shows the distribution of responses to the influence freeridership question: "Please rate each item on how influential it was to your decision to complete the project the way it was done. Please use a scale from 1, meaning *not at all influential*, to 4, meaning the item was *very influential* to your decisions." Cadmus assessed influence freeridership from participants' ratings to the relative importance of various program elements in their purchasing decisions.

Table B-38. 2021 Small Business Energy Solutions Program Freeridership Influence Responses (n=16)

Response Options	Influence Score	CenterPoint Energy staff or contractor	Instant discounts for the equipment	Information about energy efficiency that CenterPoint Energy provided	The recommendations or information provided during the free energy assessment	Previous participation in a CenterPoint Energy efficiency program
1 – Not at all influential	100%	1	0	2	1	1
2 – Not too influential	75%	2	0	1	0	0
3 – Somewhat influential	25%	5	5	3	2	3
4 – Very influential	0%	7	10	9	9	6
Don't Know	50%	0	0	0	0	1
Not Applicable	50%	1	1	1	4	5
Average		**3.2**	**3.7**	**3.3**	**3.6**	**3.4**

Cadmus used the maximum rating given by each participant for any factor in Table B-38 to determine their influence freeridership score presented in Table B-39. The counts refer to the number of responses for each factor/influence freeridership score response option. Cadmus weighted individual influence freeridership scores by their respective total survey sample *ex post* gross savings to arrive at a savings-weighted average influence freeridership score of 9% for SBES Program participants.

Table B-39. 2021 Small Business Energy Solutions Program Influence Freeridership Score (n=16)

Maximum Influence Rating	Influence Score	Count	Total Survey Sample *Ex Post* MMBtu Savings	Influence Score MMBtu Savings
1 – Not at all influential	100%	0	0	0
2 – Not too influential	75%	0	0	0
3 – Somewhat influential	25%	3	25	6
4 – Very influential	0%	12	296	0
Not Applicable	50%	1	51	26
Average Maximum Influence Rating - Simple Average	**3.8**			
Average Influence Score - Weighted by *Ex Post* Savings	**9%**			

Final Freeridership Score

Cadmus calculated the arithmetic mean of the intention and influence freeridership components to estimate a final freeridership value of 12%, weighted by *ex post* gross program savings. The higher the freeridership score, the more savings are deducted from the gross savings estimates. Table B-40 summarizes the intention, influence, and freeridership scores for the SBES Program.

Table B-40. 2021 Small Business Energy Solutions Program Intention/Influence Freeridership Score

n	Intention Score	Influence Score	Freeridership Score
16	16%	9%	12%

B.8.2 Detailed Spillover Findings

No viable spillover activity was reported by 2021 survey participants, resulting in zero spillover savings.

Appendix C. Market Performance Indicators

The primary objective of the market performance indicators evaluation was to assess changes and trends from 2011 to 2021 in the activities and key performance indicators (KPIs) for the demand-side management (DSM) programs in CenterPoint Energy's Indiana territory. During interviews and surveys, Cadmus asked program staff, trade allies, and participants about fundamental shifts in the energy marketplace (market transformation) and current market practices and compared these responses with the KPIs and findings from previous evaluation years. Their responses to the market performance indicator questions informed updates to program logic models.

The main objective of updating the logic models was to develop an understanding of each program and define its underlying theory and assumptions. The logic models include market actors, market barriers uncovered by the evaluation, current and expected intervention strategies and activities, and the expected outcomes if current program intervention strategies were implemented.

Cadmus assessed market performance indicators for most CenterPoint Energy electric only and integrated dual fuel DSM programs with available longitudinal data.

C.1 Residential Specialty Lighting Program

RESIDENTIAL SPECIALTY LIGHTING PROGRAM

Market Actor: End-Use Customer | Lighting Product Purchasers

Market Barriers

- Higher cost of efficient lighting products
- Customer preference for the familiar
- Skepticism of true energy savings
- Lack of program awareness
- Lack of energy efficiency awareness
- Negative associations with energy-efficient lighting
- Lighting products do not match customer's aesthetic preferences (e.g., shape, color)
- Low penetration in hard to reach communities (i.e. income-qualified)

Intervention Strategies / Activities

- Lighting product discounts at point of purchase
- Target retailers in hard to reach communities
- In-store program signage
- Lighting product discounts for multiple specialty bulbs and reflector
- Recruit wide variety of retailers (superstore, discount, wholesale, hardware, and general)
- Digital and broadcast media promotion of the program
- Information on CenterPoint Energy website
- Increased number of participating retailers

Outcomes

- Increased awareness
- Increased participation
- Increased customer satisfaction
- Increased participation among income-qualified customers
- Improved customer perception of efficient lighting
- Increased energy savings
- Increased penetration of efficient lighting technologies

Key Indicators

- Efficient lighting saturation/penetration in CenterPoint Energy's territory
- Percentage of income-qualified customers purchasing discounted bulbs
- Product satisfaction ratings
- Achievement of program participation and savings goals
- Number of participating retailers

Market Actor: Trade Allies | Retail Store Staff

Market Barriers

- Lack of program awareness
- COVID-19 creates health/safety concern for in-store staff
- Lack of understanding of efficient lighting benefits

Intervention Strategies / Activities

- In-store program signage
- Retail staff training on the program and efficient lighting
- Implementer providing retail personnel with lighting brochures
- Flexibility in point of purchase material distribution and in-store event scheduling

Outcomes

- Increased awareness
- Increased participation
- Increased energy savings
- Increased retailer participation

Key Indicators

- Efficient lighting saturation/penetration in CenterPoint Energy's territory
- Achievement of program participation and savings goals
- Number of participating retailers

C.2 Residential Prescriptive Program – Standard and Marketplace

RESIDENTIAL PRESCRIPTIVE PROGRAM

STANDARD, ONLINE MARKETPLACE, INSTANT REBATES CHANNELS

Market Actor	End-Use Customer	Residential Customers
Market Barriers	• Higher upfront costs for efficient equipment • Energy-efficiency home upgrades are low priority • Customer perception of application process as a hassle	• Lack of customer knowledge about efficiency of existing equipment • Lack of awareness about monetary benefits of high-efficiency equipment • Lack of program awareness • Customer uncertainty about which energy efficiency claims to trust
Intervention Strategies / Activities	• Program information, eligibility requirements, and educational content available on CenterPoint Energy's website and Online Marketplace • Program marketing (mailings and digital) • Trade ally option to provide rebate as a direct discount to customers at time of purchase (trade allies apply for rebate)	• Incentives for equipment tune-up provide a low-cost option to increase efficiency and receive expert assessment of existing equipment • Online Marketplace and Instant Rebates coupon apply discount at time of purchase • Multiple methods available for rebate submission, including mail and online applications • Marketing campaigns coordinated with trade allies • Rebates for energy-efficient products • Program sets clear equipment eligibility criteria
Outcomes	• Increased program awareness • Increased participation • Increased installations of high-efficiency equipment	• Increased availability of high-efficiency equipment through distribution and retail channels • Increased customer satisfaction • Reduced energy use
Key Indicators		• Likelihood to recommend rating • Achievement of program participation and savings goals • Customer familiarity with marketing materials • Program satisfaction rating

Market Actor	Trade Allies	Retailers and Installation Contractors
Market Barriers	• Trade ally perception of application process is a hassle • Perceived risk of carrying upfront cost of instant discount	• Perceived difficulty selling high-efficiency equipment with higher upfront cost
Intervention Strategies / Activities	• Multiple methods available for rebate submission, including mail and online applications • Rebates used as a sales tool	• Experienced program implementer who continually works with trade allies to promote program's success • Program support with rebate applications • Reliable and timely rebate payment • Marketing material and messages for contractors to use with customers
Outcomes	• Increased sales of high-efficiency equipment • Increased number of trade allies participating in program	• Increased trade ally satisfaction with program
Key Indicators	• Percentage of participants learning about the program through a contractor or retailer • Achievement of program participation and savings goals	• Number of trade allies participating in program • Trade ally satisfaction with program

C.3 Residential Prescriptive Program – Midstream

RESIDENTIAL PRESCRIPTIVE PROGRAM
MIDSTREAM CHANNEL

Market Actor	Market Barriers	Intervention Strategies / Activities	Outcomes	Key Indicators
End-Use Customer Homeowners	• Lack of program awareness • Lack of understanding of benefits of energy-efficient HVAC/water heating equipment • Upfront cost of energy-efficient HVAC/water heating equipment • Lack of availability of efficient HVAC/water heating equipment	• Program promotion via contractors and participating distributors • Follow-up notice to thank homeowners for participating • Incentives to distributors/contractors to sell energy-efficient HVAC/water heating equipment • Incentives to help offset increased costs passed on to homeowner	• Increased awareness of energy-efficient HVAC/water heating equipment • Increased demand for energy-efficient HVAC/water heating equipment • Increased energy savings • Increased program participation	• Achievement of program participation and savings goals • Number of participating homeowners
Trade Allies Distributors	• Lack of program awareness • Lack of understanding of benefits of energy-efficient HVAC/water heating equipment • Low demand for high-efficiency HVAC/water heating equipment • Lack of understanding of how to use program portal • Perceived administrative burden of participation	• Outreach to qualified distributors to encourage program enrollment • Program information and materials that highlight energy-efficient equipment and program benefits • Trainings on how to use program portal • Distributors encourage contractors to promote instant rebate and benefits of energy-efficient HVAC/water heating equipment • Program promotion via CenterPoint Energy website • Program staff assist with rebate processing issues	• Increased program awareness • Increased program satisfaction • Increased program participation and uptake per distributor • Increased stocking and sales of energy-efficient HVAC/water heating equipment • Increased energy savings	• Achievement of program participation and savings goals • Number of participating distributors • Distributor satisfaction with program • Percentage of stocked program-qualified HVAC/water heating equipment • Market share of program-qualified equipment
Trade Allies Contractors	• Lack of program awareness • Lack of understanding of benefits of energy-efficient HVAC/water heating equipment • Lack of availability of energy-efficient HVAC/water heating equipment • Lack of ability to provide needed customer information	• Incentives to help lower cost of equipment purchase • Participating distributors stock qualified equipment • Contractors promote instant rebate and benefits of energy-efficient HVAC/water heating equipment • Outreach to trade ally network to drive program awareness	• Reduced administrative burden from simplified rebate applications • Increased contractor participation • Increased sales of energy-efficient HVAC/water heating equipment	• Achievement of program participation and savings goals • Contractor satisfaction with the program • Number of participating contractors • Percentage of program-qualified HVAC/water heating equipment sales

C.4 Residential New Construction Program

RESIDENTIAL NEW CONSTRUCTION PROGRAM

Market Actor	Market Barriers	Intervention Strategies / Activities	Outcomes	Key Indicators
End-Use Customer Homebuyers	• Lack of program awareness • Upfront cost of high-efficiency construction and equipment • Low prioritization of energy efficiency when buying a home • Difficulty locating participating builders • Long lead times for construction due to shortage of high-efficiency equipment and qualified labor • Low demand for HERS-rated homes particularly with overall increased demand for new construction homes • Lack of program access among income-qualified homebuyers • Lack of understanding about benefits of energy-efficient home construction	• Incentives to builders to construct and market efficient homes • "Parade of Homes" and other outreach events to increase awareness among customers • Trainings to builders on energy-efficient homes, e.g., building practices and marketing strategies • Incentives help offset increased costs passed on to homebuyer • CenterPoint Energy outreach to local builders and HERS raters	• Increased awareness of energy-efficient building practices • Increased demand for energy-efficient homes • Increased availability of energy-efficient homes • Increased program participation • Increased energy savings • Increased engagement with income-qualified homeowners	• Achievement of participation and savings goals • Percentage of homebuyers seeking energy-efficient homes • Saturation of homes more efficient than Indiana residential energy code • Average HERS rating of homes built through the program • Number of participating builders
Trade Allies Builders	• Lack of program awareness • Higher construction costs • Lack of understanding of energy-efficient building practices • Time constraints, lengthy paperwork and certification process before rebate is received and home can go on market • Upfront cost of HERS certification • Low demand for HERS-rated homes particularly with overall increased demand for new construction homes • Low customer awareness of home efficiency, HERS ratings, etc. • Project delays due to shortage of high-efficiency equipment and qualified labor	• Builder incentives to offset higher construction costs and cost of HERS rating • Program promotion through homebuilders' association and other industry groups • Quarterly e-mail reminder of upcoming application deadlines • Program information and material readily available on CenterPoint Energy website • Trainings to builders on energy-efficient building practices and marketing strategies • Platinum Plus tier with bonus incentives for water heating equipment • Builders encouraged to use low HERS rating as selling point • Program staff assist with paperwork; streamlined application for multiple submissions • Yearly kickoff meeting with builders to review program changes • Midstream Pilot encourages distributors to carry inventory of energy-efficient equipment	• Increased program awareness • Increased program satisfaction • Increased energy efficiency within homes • Increased program participation and uptake (lower HERS rating, additional high-efficiency measures installed, etc.) per builder • Increased energy savings • Increased builder participation • Increased familiarity with energy-efficient equipment	• Number of builders participating • Number of builders constructing ≤60 HERS-rated homes • Percent of ≤60 HERS-rated homes in program • Home builder attendance at outreach events • Builder satisfaction with the program ratings • Achievement of participation and savings goals • Average number of homes per builder • Number of homes in Platinum Plus Tier
HERS Raters	• Lack of program awareness	• Outreach and education direct to HERS raters	• Increased HERS rater participation • Increased builder satisfaction with the program	• Builder satisfaction with the program

C.5 Income Qualified Weatherization Program

INCOME QUALIFIED WEATHERIZATION PROGRAM

Market Actor	Market Barriers	Intervention Strategies / Activities	Outcomes	Key Indicators
End-Use Customer Income-Qualified Customers	• Lack of program awareness • Lack of disposable income to make home improvements • Lack of energy efficiency awareness • Health and safety issues that prevent efficient product installation • Skepticism of true energy savings • Lack of time available for assessments and installation process	• Program marketing (direct mail, bill inserts, email, events, door-to-door canvassing) • Information on CenterPoint Energy website • Direct installation of products at no cost to the customer • Energy education provided during in-home assessment • Budget for health and safety improvements • Turnkey installation services • Easy-to-use online scheduling tool • Customer appointment reminders	• Increased awareness • Increased participation • Increased customer satisfaction • Improved customer perception of energy efficiency • Increased energy savings • Increased adoption of energy efficiency measures • Increased adoption of energy-saving behaviors • Increased health and safety of the home • Increased savings per home • Fewer appointment cancellations	• Achievement of program participation and savings goals • Number of participating homes • Number of measures installed • Persistence of measures • Measure satisfaction ratings • Program satisfaction ratings • Number of participant-adopted energy-saving behaviors • Ease of participation rating • Average kWh per household
Program Implementer Assessors	• Inability to reach eligible customers • Health and safety issues that prevent product installation • Participant concerns about assessors entering home	• RFPs to attract qualified program implementer • Open communication with participants to address concerns • Budget for health and safety improvements • Requirement to wear personal protective equipment during in-home visits	• Increased program awareness • Increased participation • Assurance of quality work • Increased customer satisfaction • Increased savings per home • Continuation of program services	• Achievement of program participation and savings goals • Number of participating homes • Program satisfaction ratings • Average kWh per household
Trade Allies Installers	• Participant uncertainty about installer qualifications • Participant concerns about installation staff entering home	• Interviews to hire qualified pool of installers • Open communication with participants to address concerns • Requirement to wear personal protective equipment during in-home visits	• Assurance of quality work • Increased customer satisfaction • Continuation of program services	• Program satisfaction ratings • Achievement of program participation and savings goals

C.6 Residential Behavioral Savings Program

RESIDENTIAL BEHAVIORAL SAVINGS PROGRAM

Market Actor: End-Use Customer — Residential Home Energy Report Recipients (Treatment Group Customers)

Market Barriers

- Lack of engagement with home energy reports
- Lack of engagement with online energy efficiency resources
- Lack of home energy use benchmark
- Lack of understanding of how home uses energy
- Lack of awareness of energy efficiency options
- Lack of energy education among hard to reach customers (e.g., income-qualified)

Intervention Strategies / Activities

- Print reports mailed 4 times per year and online reports emailed monthly
- Home energy use comparison to a group of similar homes included in report
- Embed energy usage widget within customer's CenterPoint Energy's online account
- Historical energy use data shown in the reports and available in online widget
- Incorporation of income-qualified customers in treatment wave
- Energy-saving tips included in reports and online widget
- Cross-promotion of other CenterPoint Energy DSM programs

Outcomes

- Increased adoption of energy-saving behaviors
- Increased participation in other CenterPoint Energy DSM programs
- Reduced per-customer energy use and demand
- Increased readership of reports
- Increased customer understanding of energy efficiency actions
- Increased engagement with online energy efficiency resources
- Increased energy education among income-qualified customers

Key Indicators

- Percentage of customers who read the reports
- Annual logins to the online widget
- Program uplift
- Average energy savings per treatment home
- Achievement of program participation and savings goal
- Percentage of customers adopting energy-saving behaviors
- Percentage of income-qualified customers adopting energy-saving behaviors

Market Actor: Program Implementer — Home Energy Reports Distributor

Market Barriers

- Delivering the same content and design of the reports/widget disengages customers
- Lack of detailed energy use data make it difficult to deliver accurate, disaggregated reports
- Lack of customer information make it difficult to incorporate personalized tips

Intervention Strategies / Activities

- Integrate AMI data and home energy analysis survey data for more accurate, detailed, and personalized reports
- Update content and look of the reports/widget
- With CenterPoint Energy, regularly review and update tips library

Outcomes

- An effective, well-designed report/widget that delivers strong and reliable energy savings

Key Indicators

- Achievement of program participation and savings goals
- High realization rate

C.7 Appliance Recycling Program

APPLIANCE RECYCLING PROGRAM

Market Actor	End-Use Customer	Residential Customers	
Market Barriers	• Lack of program awareness • Health/safety concerns with pick-up process due to COVID-19	• Customer perception of scheduling process as a hassle • Physical limitations preventing self removal of an inefficient appliance	• Lack of awareness of monetary and environmental benefits of removing an inefficient appliance • Skepticism of true energy savings
Intervention Strategies / Activities	• Multiple marketing channels • Cross-promotion through other CenterPoint Energy programs • Program information and eligibility requirements available on CenterPoint Energy website, bill inserts, and in retail stores	• Incentives for removal of working appliances • Enhanced scheduling process with multiple options (phone, online, and mobile) and resolution specialists and improved customer service software to resolve issues	• Pick-up of appliances within two to three weeks of initial customer contact • Text alerts to notify customers that pick-up staff are on their way • Pick-up staff deliver appliances to recycling center • Contactless pickup option
Outcomes	• Increased program awareness • Increased program participation • Increased customer satisfaction with program	• Increased customer understanding of energy efficiency benefits • Fewer inefficient appliances available on the secondary market • Reduced energy use	• Environmentally responsible disposal of waste materials from recycled appliances • Increased customer satisfaction with scheduling and pickup processess
Key Indicators	• Achievement of program participation and savings goals • Program satisfaction ratings • Appliance pick-up experience satisfaction ratings	• Likelihood to recommend ratings • Saturation of used appliances on the secondary market • Ease of scheduling ratings	

Market Actor	Program Implementer	Appliance Pick-Up Staff	
Market Barriers		• Insufficient pick-up staff qualifications • COVID-19 creates health/safety concern for appliance pick-up staff	• Participant concerns about pick-up staff entering home
Intervention Strategies / Activities	• Route optimization and tracking software	• RFPs to attract qualified program implementer • Open communication with participants to address concerns • Option for contactless pick-up	• Checklist followed by pick-up staff upon arrival at every home • Strict safety measures, sanitation procedures, and personal protective equipment in response to COVID-19
Outcomes	• Assurance of quality work • Increased program participation	• Increased customer satisfaction with pick-up experience	• Fewer inefficient appliances in operation
Key Indicators	• Achievement of program participation and savings goals		• Appliance pick-up experience satisfaction ratings

C.8 Community Based LED Specialty Bulb Distribution Program

COMMUNITY BASED LED SPECIALTY BULB DISTRIBUTION PROGRAM

Market Actor	End-Use Customer	Bulb Recipients	
Market Barriers		• Lack of program awareness • Higher cost of efficient specialty LEDs • Lack of energy efficiency education • Low brand awareness of CenterPoint Energy	• Skepticism of true energy savings • Negative associations with energy-efficient lighting • COVID-19 creates concern about social distancing when receiving bulbs
Intervention Strategies / Activities	• Specialty LEDs offered to customers at no cost • Program signage prominent at giveaway event locations • CenterPoint Energy branding on bulb box	• Income-Qualified Weatherization Program information on bulb box • ENERGY STAR-certified bulbs to ensure quality	• Contactless option for bulb pickup
Outcomes	• Increased participation • Increased customer satisfaction • Increased awareness	• Increased energy savings • Improved customer perception of efficient lighting technologies • Continuation of program services	• Increased saturation of efficient lighting technologies • Increased awareness of Center-Point Energy efficiency programs
Key Indicators	• Achievement of program participation and savings goals • Installation rate • Persistence of measures		• Efficient lighting saturation in CenterPoint Energy territory • Conversion to other CenterPoint Energy energy efficiency programs • Bulb satisfaction ratings

Market Actor	Trade Allies	Community Event, Food Bank, and Trustee Office Staff	
Market Barriers	• Lack of program understanding • COVID-19 creates health/safety concern for distribution staff	• Inability to encourage postcard return	• Lack of understanding of benefits of efficient lighting
Intervention Strategies / Activities	• Program implementer trains event staff how to deliver program • Contactless option for bulb pickup		• Incentive for returned postcards • Program signage prominent at giveaway event locations
Outcomes	• Bulbs effectively distributed to customers • Ability to contact bulb recipients to confirm installation of products	• Increased saturation of energy efficient lighting • Continuation of program services	• Increased program understanding
Key Indicators	• Achievement of program participation and savings goals • Number of bulbs distributed • Installation rate	• Efficient lighting saturation in CenterPoint Energy's territory • Postcard response rate	

C.9 Commercial and Industrial Prescriptive Program

C&I PRESCRIPTIVE PROGRAM

Market Actor	End-Use Customer — C&I Customers		
Market Barriers	• Lack of program awareness or knowledge of energy conservation benefits	• Large out-of-pocket expenses • Time commitment • Large customers opt out of programs	• Perception that project is not cost-effective for business or that business does not need improvements
Intervention Strategies / Activities	• Participation in industry associations and events, program handouts, and ongoing communication with customers • Word-of-mouth and one-on-one marketing	• Workshops and incentve bonuses targetng large, opt-out eligible customers • Energy manager dedicated to large customers, and implementer staff support studies and projects	• Program incentives for efficient technologies to offset initial upfront cost • Participating trade ally base to make installation timely and convenient
Outcomes	• Increased program awareness and participation • Improved customer perception of energy efficiency programs	• Increased market saturation of energy-efficient measures • Increased energy savings	
Key Indicators		• Likelihood to recommend ratings • Achievement of program participation and savings goals	• Participant satisfaction with the program

Market Actor	Trade Allies — Installation Contractors		
Market Barriers		• Administrative burden such as program eligibility and paperwork requirements	• Lack of program awareness
Intervention Strategies / Activities	• Program outreach staff train and communicate with trade allies about program offerings • Contractor network portal simplifies access to marketng materials to promote program to customers	• Program outreach staff cross-promote prescriptive and custom programs to deliver project assistance through a single procedure	• Provide project-level assistance to encourage trade ally engagement and adoption
Outcomes	• Increased contractor awareness of program offerings • Increased and sustained contractor participation with program	• Streamlined program participation for customers • Increased number of participating contractors	• Increased number of contractors promoting multiple C&I programs • Increased number of projects per contractor
Key Indicators	• Contractor satisfaction with the program • Number of contractors participating in multiple C&I programs • Achievement of program participation and savings goals	• Number of contractors participating in multiple years • Number of actively participating contractors • Average number of projects per contractor	

C.10 Commercial and Industrial Custom Program

C&I CUSTOM PROGRAM

Market Actor	End-Use Customer | C&I Customers		
Market Barriers	• Lack of program awareness • Lack of knowledge of energy conservation benefits • Lack of knowledge of energy audit benefits	• Large out-of-pocket expenses • Perception that project is not cost-effective for business or that business does not need improvements • Large customers opt out of programs	• Lack of knowledge about project eligibility • Concern with the complexity of project and time taken from business operations
Intervention Strategies / Activities	• Participation in industry associations and events, program handouts, and ongoing communication with customers • Energy manager and workshops dedicated to large customers	• Incentives up to 50% of qualified project cost • Explanation of total amount customer responsible for and calculation of payback period	• Participating trade ally base to make installation timely and convenient • Provide savings values, sample applications, and rebate process charts
Outcomes	• Increased program awareness • Increased participation • Incentive contribution allows energy efficiency customization to be viable option to C&I customers	• Increased market saturation of energy-efficient measures • Increased energy savings • Improved customer perception of energy efficiency programs	
Key Indicators		• Program satisfaction ratings • Average kWh per project	• Likelihood to recommend ratings • Achievement of participation and savings goals

Market Actor	Trade Allies | Installation Contractors		
Market Barriers	• Lack of program awareness • Inability to communicate directly with decision-maker	• Lack of customer awareness • Perception that design team engagement will slow down new construction project schedule	• Perception that time spent promoting program and helping customer with application is burdensome
Intervention Strategies / Activities	• Advertisement through trade associations and events • Facilitate trade ally relationships with decision-maker through account managers and energy manager • Partner with reputable firm to support new construction projects at the design stage		• Group and individual training sessions detailing program operations and requirements, application forms, and invoicing requirements • Contractor network portal simplifies access to marketing materials to promote program to customers
Outcomes	• Increased program awareness • Increased energy savings • Increased engagement with new construction design firms and architects	• Streamlined project communication and implementation • Faster application processing times due to reduced errors	• Trade allies exposed to greater number of potential customers, thus increasing overall revenue and customer relationship
Key Indicators	• Number of contractors participating in multiple years • Number of actively participating contractors	• Number of new construction projects • Application processing time • Contractor satisfaction ratings	

C.11 Small Business Energy Solutions Program

SMALL BUSINESS ENERGY SOLUTIONS PROGRAM

Market Actor	End-Use Customer | Small Business Customers		
Market Barriers	• Time constraints, difficulty dedicating time to an energy efficiency project	• Lack of program awareness • Upfront costs affiliated with purchase and installation of efficient measures	• Lack of understanding of benefits of program-recommended energy-efficient products
Intervention Strategies / Activities	• Information on CenterPoint Energy website • Discounts for lighting, refrigeration, furnace tune-ups, steam trap replacements, thermostats, and water-saving devices		• Efficient product discounts at point of purchase • Trade ally network promoting benefits of energy-efficient products through energy assessments
Outcomes	• Increased awareness • Increased participation • Increased customer satisfaction	• Improved customer perception of efficient products • Increased energy savings	• Increased penetration of efficient technologies
Key Indicators	• Achievement of program participation and savings goals • Number of participating small businesses	• Measure satisfaction ratings	

Market Actor	Trade Allies | Installation Contractors		
Market Barriers		• Lack of program understanding • Lack of contractor engagement	• Concern that the program is not profitable enough to offset the time involved in delivering it
Intervention Strategies / Activities	• Group and individual training sessions detailing program operations and requirements, application forms, invoicing requirements, and sales strategies	• Trade allies required to complete a minimum number of assessments per year • Referrals to potential customers who are interested in participating in the program	• Program incentives and detailed energy assessment reports that entice customers to install low-cost measures • Online contractor network portal provides program resources and simplifies program adoption
Outcomes	• Increased program awareness • Increased participation • Deeper savings per project	• Increased energy savings • Increased market penetration of energy-efficient measures	• Increased sales volume per trade ally • Increased program satisfaction
Key Indicators	• Achievement of program participation and savings goals • Number of participating trade allies • Average number of recruited participants per trade ally • Average kWh per project		• Trade ally reported impact of program on sales • Conversion rate of energy assessments to low-cost measure installations • Program satisfaction ratings

Appendix D. Process Evaluation

For the process evaluation of the 2021 CenterPoint Energy demand-side management (DSM) portfolio, Cadmus assessed program strengths, areas for improvement, and best practices to optimize the customer experience.

Table D-1 lists the process evaluation research topics by data collection activity. In addition to interviews and surveys, Cadmus reviewed status reports and other program materials to obtain a complete understanding of all activities conducted to reach program goals.

Table D-1. Process Evaluation Topics by Research Activity

Process Evaluation Research Activity	Research Topics	
In-Depth Program Staff Interviews	• Implemented and proposed program changes • Program design and delivery • Program administration	• Quality control • Marketing strategies and effectiveness • Target audiences and program participation
Trade Ally Interviews	• Program awareness • Reasons for participation • Aspects of program delivery and program process effectiveness • Interactions with program staff	• Program satisfaction and value • Changes in business practices or performance as a result of program participation • Program strengths and suggestions for improvement
Participant Surveys	• Program awareness • Reasons for participation and installation of specific measures • Customer experience including program satisfaction and likelihood to recommend	• Trade ally experience • Freeridership and spillover • Verification of measure installation • Program strengths and suggestions for improvement

Table D-2 shows the number of interviews and surveys Cadmus completed for the 2021 CenterPoint Energy DSM portfolio evaluation.[91]

[91] Cadmus conducted telephone customer surveys for the Community LED Distribution and C&I Custom programs. All other customer surveys were conducted online.

Table D-2. Survey Respondent Groups by Program

Respondent Group	Population[1]	Included in Sample Frame[2]	Target Completes	Achieved Completes
Residential Programs				
Residential Specialty Lighting				
CenterPoint Energy Staff	1	1	1	1
CLEAResult Staff	1	1	1	1
Residential Prescriptive – Standard and Marketplace				
CenterPoint Energy Staff	1	1	1	1
CLEAResult Staff	1	1	1	1
Participating Customers (Quarterly Freeridership and Customer Experience Surveys)	10,192	7,182	1,000 (70 per measure category)	1,044
Participating Customers (Annual Spillover Surveys)	10,192	2,716	300 (50 per measure category)	788
Residential Prescriptive - Midstream				
CenterPoint Energy Staff	1	1	1	1
CLEAResult Staff	1	1	1	1
Participating Distributors	17	17	10	7
Participating Contractors	58	53	10	10
Residential New Construction				
CenterPoint Energy Staff	1	1	1	1
CLEAResult Staff	1	1	1	1
Participating Builders	51	51	10	9
Income Qualified Weatherization				
CenterPoint Energy Staff	1	1	1	1
CLEAResult Staff	1	1	1	1
Participating Customers	456	288	70	49
Residential Behavioral Savings				
CenterPoint Energy Staff	1	1	1	1
Oracle Staff	1	1	1	1
Appliance Recycling				
CenterPoint Energy Staff	1	1	1	1
ARCA Staff	1	1	1	1
Participating Customers	1,497	958	120	178
Smart Cycle				
CenterPoint Energy Staff	1	1	1	1
A+Derr Staff[3]	1	1	1	0
Community Based LED Specialty Bulb Distribution				
CenterPoint Energy Staff	1	1	1	1
CLEAResult Staff	1	1	1	1
Participating Customers	355	129	70	22

Respondent Group	Population[1]	Included in Sample Frame[2]	Target Completes	Achieved Completes
Commercial and Industrial Programs				
C&I Prescriptive				
CenterPoint Energy Staff	N/A	1	1	1
Resource Innovations Staff	N/A	1	1	1
Participating Customers	152	138	70	33
C&I Custom				
CenterPoint Energy Staff	N/A	1	1	1
Resource Innovations Staff	N/A	1	1	1
Participating Customers	27	26	Census	6
Small Business Energy Solutions				
CenterPoint Energy Staff	N/A	1	1	1
Resource Innovations Staff	N/A	1	1	1
Participating Customers	119	110	70	15

[1] Population includes both electric and gas participants.
[2] Cadmus removed customers from the sample frames if they were contacted about their participation in another program, they had been recently surveyed through another evaluation effort, or they had missing contact information.
[3] Cadmus made repeated attempts to contact A+Derr but was unable to schedule an interview.

D.1 Residential Specialty Lighting Program

RESIDENTIAL SPECIALTY LIGHTING PROGRAM

2021 Process Analysis Activities

1 CenterPoint Energy staff interview

1 CLEAResult® staff interview

2021 Program Changes

CenterPoint Energy: Discontinued general service lighting offerings

Increased incentives at Sam's Club to help achieve program savings goal

Retailers remained open, but health and safety regulations due to COVID-19 affected CLEAResult's in-store marketing efforts. A temporary suspension barred CLEAResult staff from conducting in-store events

2 in-store events took place, compared to 0 in 2020 and 12 in 2019

2022 Planned Program Changes

CenterPoint Energy plans to:

Expand offerings to include smart bulb technologies that fall within the reflector and specialty lighting categories

Remove general service lighting references and emphasize specialty lighting and reflector offerings in marketing content

Key Process Evaluation Findings

Consistent with 2020, big box retailers with dedicated lighting departments were influential in bringing customer attention to program offerings; these retailers tend to have a higher level of understanding about the program and its products

Additional EISA legislation in 2022 likely to impact opportunity to capture savings from specialty bulbs in future years

D.2 Residential Prescriptive Program – Standard and Marketplace

RESIDENTIAL PRESCRIPTIVE PROGRAM

STANDARD, ONLINE MARKETPLACE, INSTANT REBATES CHANNELS

2021 Process Analysis Activities

1 CenterPoint Energy staff interview

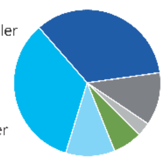
1 CLEAResult® staff interview

1,372 quarterly online participant customer surveys

- 917 Standard participants
- 127 Online Marketplace participants

1,044 customer experience responses

- 358 Furnace/boiler participants
- 353 Thermostat participants
- 115 Water heater participants
- 67 Heat pump/central AC participants
- 30 Weatherization participants
- 121 Other participants



788 spillover responses

2021 Program Changes

New Measures:
Clothes Washers
Clothes Dryers
Dehumidifiers

Measures moved to **Residential Midstream** channel:

January 2021: ductless and air source heat pumps

Mid-2021: heat pump water heaters

CenterPoint launched the **Online Marketplace** in June (air purifiers, smart thermostats, smart power strips, specialty LEDs, water-saving aerators, and showerheads)

2022 Planned Program Changes

Discontinue pool pumps due to federal standards changes

Launch **Instant Rebates** channel (air purifiers, smart thermostats, heat pump water heaters), delayed from planned 2021 launch

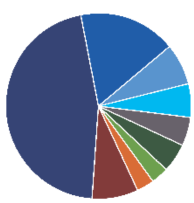
Reduce saving goal by 1.5 million kWh

- Reset to reflect market conditions
- Supply chain and trade ally staffing challenges

Key Process Evaluation Findings

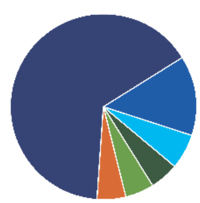
45% (n=900) of **Standard** participants learned about program from **contractors**

- 46% Contractor
- 17% CenterPoint Energy Website
- 7% Word of Mouth
- 6% CenterPoint Energy Email
- 5% Internet Search
- 5% Retail/Store
- 3% CenterPoint Energy Mail
- 3% Bill Insert
- 8% Other



63% (n=124) of **Online Marketplace** participants learned about program from an **email**

- 65% CenterPoint Energy Email
- 14% CenterPoint Energy Website
- 6% Word of Mouth
- 5% CenterPoint Energy Mail
- 5% Bill Insert
- 5% Other



	Standard Participants	Online Marketplace Participants
Satisfied with program overall	97% (n=880)	89% (n=122)
Satisfied with measure	99% (n=881)	88% (n=123)
Likely to recommend program	95% (n=877)	85% (n=123)

Online Marketplace Participant Experience
(very satisfied)

- **75%** (n=120) discount amount
- **74%** (n=118) order completion process
- **69%** (n=114) navigating the online store
- **61%** (n=119) time for shipping and delivery
- **52%** (n=110) product selection

99% (n=727) **Standard** participants who worked with a contractor were **very satisfied** with their contractor

D.3 Residential Prescriptive Program – Midstream

RESIDENTIAL PRESCRIPTIVE PROGRAM
MIDSTREAM CHANNEL

2021 Process Analysis Activities

1 CenterPoint Energy staff interview

1 CLEAResult® staff interview

10 contractor interviews

7 distributor interviews

2021 Program Overview

Launched in **mid-2020**, with **full ramp-up in 2021**

Provides instant discounts to contractors and customers purchasing qualifying equipment from participating distributors

Focuses on high-efficiency HVAC equipment

air source heat pumps | furnaces | ductless and ducted heat pumps

2022 Planned Program Changes

Planning to revamp program marketing, including:

Emails/newsletters to Trade Allies

&

Re-launching Counter Day events for CLEAResult staff to promote program at participating distributor locations

Key Process Evaluation Findings

Distributor Interview Results:

7/7 satisfied with the program

5/5 satisfied with program setup process (two distributors not involved)

4/5 said effort level was minimal

6/7 interested in a commercial midstream program

Contractor preference between two program types:

7/10 **prefer Residential Rebates** because they do not rely on the distributor for the incentive and the process is familiar

2/10 **prefer Midstream** because it requires less paperwork

(1 contractor unsure)

ALL distributors and contractors saw COVID-19 pandemic impacts:

6/7 distributors and 8/10 contractors had supply chain issues

4/7 distributors and 3/10 contractors saw increased demand

2/7 distributors and 2/10 contractors had staffing issues

D.4 Residential New Construction Program

RESIDENTIAL NEW CONSTRUCTION PROGRAM

2021 Process Analysis Activities

- 1 CenterPoint Energy staff interview
- 1 CLEAResult® staff interview
- 9 builder interviews

2021 Program Changes

Lowered HERS rating requirements for Gold Star tier from 61-63 to 61-62 to encourage more efficient building practices

61-63 → 61-62

Discontinued Habitat for Humanity kits because builders were not directly installing kit measures as required

2022 Planned Program Changes

- Program discontinued December 31, 2021 due to increases in minimum efficiency levels in the Indiana residential building code
- Builders will be encouraged to participate in Residential Prescriptive program to continue efficient building practices

Key Process Evaluation Findings

Builder Interview Results:

9/9
satisfied with overall program experience

9/9
satisfied with the HERS rating process

8/9
satisfied with application process
- Dissatisfied builder said application was "tedious and repetitive"

4/9
very likely to take advantage of Residential Prescriptive rebates in 2022

3/9
said the program closing will have a moderate financial impact on their business
- **5/9** said little to no impact
- **1/9** unsure

ALL
experienced project disruptions due to COVID-19 and expect these disruptions to continue in 2022:
- **8/9** Equipment sourcing delays
- **5/9** Increased pricing for raw materials
- **4/9** Crew scheduling difficulties

D.5 Income Qualified Weatherization Program

INCOME QUALIFIED WEATHERIZATION PROGRAM

2021 Process Analysis Activities

1 CenterPoint Energy staff interview

1 CLEAResult staff interview

49 online participant customer surveys

2021 Program Changes

"Healthier Homes" initiative piloted to fund air quality improvement measures in homes at risk of high medical bill burdens

2022 Planned Program Changes

Continue COVID-19 safety protocols as needed

CenterPoint Energy exploring ways to increase participation through additional marketing and outreach

Key Process Evaluation Findings

89% (n=46) satisfied with the program overall

3/4 dissatisfied participants felt they did not receive sufficient services
1/4 did not believe their insulation contractor was professional

Participant satisfaction with program measures:

Satisfaction	n	Measure
100%	(n=39)	LED Lighting
100%	(n=32)	Smart strip
100%	(n=13)	Bathroom faucet aerator(s)
100%	(n=12)	Kitchen faucet aerator(s)
100%	(n=6)	Attic insulation
100%	(n=5)	Furnace tune up
100%	(n=2)	Air sealing
100%	(n=3)	Exterior LED light bulb(s)
100%	(n=1)	Duct sealing
100%	(n=1)	Water heater setback
100%	(n=1)	Furnace
100%	(n=1)	Water heater
100%	(n=1)	Air conditioner tune up
97%	(n=36)	LED night light
88%	(n=8)	Thermostat
83%	(n=6)	High-efficiency showerhead(s)

73% (n=41) took action on recommended energy-saving behaviors

D.6 Residential Behavioral Savings Program

RESIDENTIAL BEHAVIORAL SAVINGS PROGRAM

2021 Process Analysis Activities

1 CenterPoint Energy staff interview

1 ORACLE staff interview

2021 Program Changes

Oracle launched its new HER 3.0, changing the home energy reports' design and content

CenterPoint Energy cross-promoted

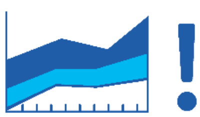
Appliance Recycling *and* Smart Cycle

programs in 2021 home energy reports

2022 Planned Program Changes

Oracle will:

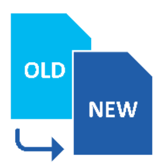
Send participants combined bill forecasting alerts, which will encourage customers to lower their usage before the bill period ends by giving them a better picture of their full energy usage



Begin sending hourly AMI participant usage reports to CenterPoint Energy weekly

Key Process Evaluation Findings

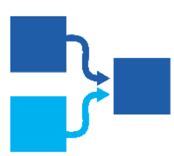
Oracle reported that the changes to the Home Energy Report did not impact customer savings or experience



Oracle conducted a household-level analysis of tier 2 low-to-moderate income participants to assess and improve identification and engagement. Next steps include:

Finalizing and delivering additional participant data from research

Understanding how to utilize segmentation attributes to promote CenterPoint Energy's efficiency programs and other initiatives



D.7 Appliance Recycling Program

APPLIANCE RECYCLING PROGRAM

2021 Process Analysis Activities

1 CenterPoint Energy staff interview

1 ARCA Recycling staff interview

178 online participant customer surveys

142 refrigerator participants

36 freezer participants

2021 Program Changes

Discontinued $25 bonus incentive for room air conditioners

CenterPoint Energy initiated **Oldest Fridge Contest** to encourage recycling older models
Winner was **75 years old**

ARCA:

zendesk — Added Zendesk software to assist in quickly resolving customer disputes

DispatchTrack — Added DispatchTrack software to allow for better appliance pick-up staff and vehicle tracking

2022 Planned Program Changes

ARCA to explore creating their own transportation network of in-house drivers and pick-up vehicles

ARCA to explore adding **mini refrigerators** to the program

Key Process Evaluation Findings

Participant Survey Results

- **99%** (n=167) satisfied with program
- **99%** (n=97) satisfied with contactless pick-up service
- **98%** (n=139) likely to recommend program
- **98%** (n=167) said scheduling process was easy
- **96%** (n=139) satisfied with length of time between scheduled appointment and pick-up
- **96%** (n=139) satisfied with variety of energy efficiency programs offered by CenterPoint Energy
- **89%** (n=147) said CenterPoint Energy's suggestions to reduce energy use were useful
- **88%** (n=137) satisfied with CenterPoint Energy's efforts to help customers manage monthly energy usage

D.8 Smart Cycle Program

SMART CYCLE

2021 Process Analysis Activities

1 CenterPoint Energy staff interview

2021 Program Changes

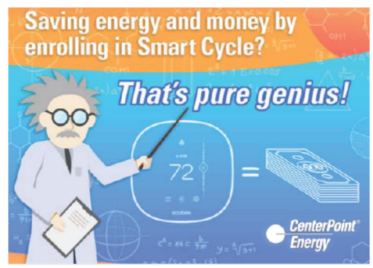
Ecobee thermostats added to customer offerings in addition to Nest

70 + 70

CenterPoint decreased installation goal from

1,000 to **500**

CenterPoint promoted the program through new "Be Smart, Be a Genius" recruitment messaging



2022 Planned Program Changes

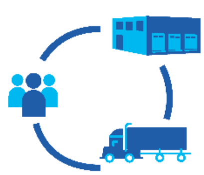
CenterPoint hired Threshold, a new implementer, to conduct installations for the Smart Cycle program

Key Process Evaluation Findings

Through the Bring Your Own Thermostat (BYOT) program, Energy Hub improved Smart Cycle program enrollment

Energy Hub's marketing app, which messages Nest and Ecobee users to sign up for the BYOT program, resulted in a boost to Smart Cycle program participation

Installations slowed due to COVID-19 and supply chain issues, which delayed thermostat delivery and installations.



CenterPoint did not meet its reduced 2021 installation goal (36%)

D.9 Community Based LED Specialty Bulb Distribution Program

COMMUNITY BASED LED SPECIALTY BULB DISTRIBUTION PROGRAM

2021 Process Analysis Activities

1 CenterPoint Energy staff interview

1 CLEAResult® staff interview

22 phone surveys with bulb recipients

4 surveys from non-low-income community events

18 surveys from low-income events

17% of postcard responses

2021 Program Changes

Bulb packs now contain:

4 candelabras and

2 nightlights

instead of 4 traditional LED bulbs

Bulb drops now include community events (such as themed zoo days) or targeted school drops in addition to food bank and trustee office drops that target low-income households

ZOO

2022 Planned Program Changes

CenterPoint Energy exploring adding other measures such as smart strips as a distribution item

CLEAResult planning to replace postcard used to collect information for evaluation survey with a web link on bulb packaging

Key Process Evaluation Findings

Participant Survey Results:

8/18 were aware CenterPoint Energy sponsored the program

17/17 satisfied with LED candelabras

9/9 satisfied with LED nightlights

5/9 had **not** installed LEDs in their home prior to the program

5/16 no particularly useful bulbs for their households outside of traditional, A-Line bulbs, however:

- 6/16 said candelabras would be most useful
- 3/16 said 3-way bulbs would be most useful

2/18 participated in CenterPoint Energy's Income Qualified Weatherization program as a result of this program

Bulb Recipient Housing (n=18)

- Single-Family Home **12**
- Multifamily Home **4**
- Manufactured Home **2**

5/17 were renters

16/17 found CenterPoint Energy's suggestions to reduce energy usage useful

15/16 satisfied with CenterPoint Energy's efforts to help them manage their monthly usage

14/15 satisfied with variety of programs offered by CenterPoint Energy

D.10 Commercial and Industrial Prescriptive Program

C&I PRESCRIPTIVE PROGRAM

2021 Process Analysis Activities

1 CenterPoint Energy staff interview

1 resource innovations staff interview

33 online surveys with participating customers

24% response rate

2021 Program Changes

CenterPoint Energy

- Launched rebates for compressed air studies for customers who fix 60% of their identified leaks. Resource Innovations conducted outreach with compressed air contractors, refining the rebate offers midyear. **3 customers participated in 2021**
- Decreased lighting incentives in response to evolving market conditions, but to boost program savings, introduced **50% lighting bonus** in September 2021
- Introduced a 20% food service equipment bonus
- Revised boiler tune-up rebates to encourage larger boiler projects
  - Average per tune-up savings were 855 therms in 2021, compared to 576 in 2020

resource innovations

Promoted Contractor Network and updated Trade Ally Connect portal contents

- Added document center within website
- Streamlined network enrollment application process
- Upgraded Find a Contractor tool

Expanded its Mobile Assessment Tool application beyond small business customers to streamline application process for more customers and contractors

2022 Planned Program Changes

- No planned program changes for 2022

Key Process Evaluation Findings

88% (n=32) of participants were **very satisfied** with the program overall

87% (n=31) were **very likely to** recommend the program to another business

6% (n=31) had installation delays due to COVID-19 pandemic

compared to 4% in 2020 (n=68)

71% (n=31) of participants visited **CenterPointEnergy.com**

90% (n=21) had no issues navigating the website

67% (n=33) worked with a contractor on their project

91% (n=22) of those were **very satisfied** with their **contractor**

D.11 Commercial and Industrial Custom Program

C&I CUSTOM PROGRAM

2021 Process Analysis Activities

1 CenterPoint Energy staff interview

1 resource innovations staff interview

6 phone surveys with participating customers

23% response rate

2021 Program Changes

CenterPoint Energy promoted advanced rooftop controls through email and direct mailers to businesses with rooftop units

Conducted workshop with opt-out eligible customers, highlighting **compressed air system** and **power factor correction** offers that appeal to large customers

10% bonus incentive for all attendees, effective for one year

One participant utilized this bonus in 2021

2022 Planned Program Changes

Continue monitoring market conditions for baseline adjustments to rack unit equipment

Key Process Evaluation Findings

3/6 participants learned about rebates through **contractors**

2/6 learned about rebates through **CenterPoint Energy staff**

5/6 participants were **very satisfied** with the program

5/5 participants who worked with a contractor were **very satisfied** with their **contractor**

3/6 **very likely** to recommend the program to another business

3/6 encountered delays in project completion due to COVID-19 pandemic

3/6 visited CenterPointEnergy.com

2/3 had no issues navigating the website

Program continues to capture primarily HVAC and lighting projects

Building tune-ups, though in its 3rd year, captured just 3% of the program's savings

D.12 Small Business Energy Solutions Program

SMALL BUSINESS ENERGY SOLUTIONS PROGRAM

2021 Process Analysis Activities

1 CenterPoint Energy staff interview

1 resource innovations staff interview

15 online surveys with participating customers

14% response rate

2021 Program Changes

CenterPoint Energy introduced a **25% bonus** on small business projects in July

resource innovations

Promoted Contractor Network and updated Trade Ally Connect portal contents

- Document center within site
- Streamlined network enrollment application process
- Upgraded Find a Contractor tool

Upgraded its Find a Contractor search engine with additional contractor business details and analytics to track number of customer visits

2022 Planned Program Changes

- No planned program changes for 2022

Key Process Evaluation Findings

Participant Survey Results:

14/15 learned about rebates from **contractors**, the remaining 1 learned from **CenterPoint staff**

6/8 received a **bonus incentive** from CenterPoint Energy

4/6 said the bonus was **very significant** in their decision to proceed with the project

2/15 visited the CenterPoint Energy website

Both users rated the website as **somewhat user-friendly**

13/15 were **very satisfied** with the contractor who conducted the on-site assessment and installed their equipment

12/15 **very satisfied** with the program

12/15 **very likely** to recommend the program to another business

11/15 were **very satisfied** with the usefulness of the energy assessment report that they received as part of this program

Recommended Program Improvements:

3/15 Provide additional measures: thermostats, water-saving devices, other ways to save within the program

1/15 Use better contractors

1/15 Provide monthly savings reports