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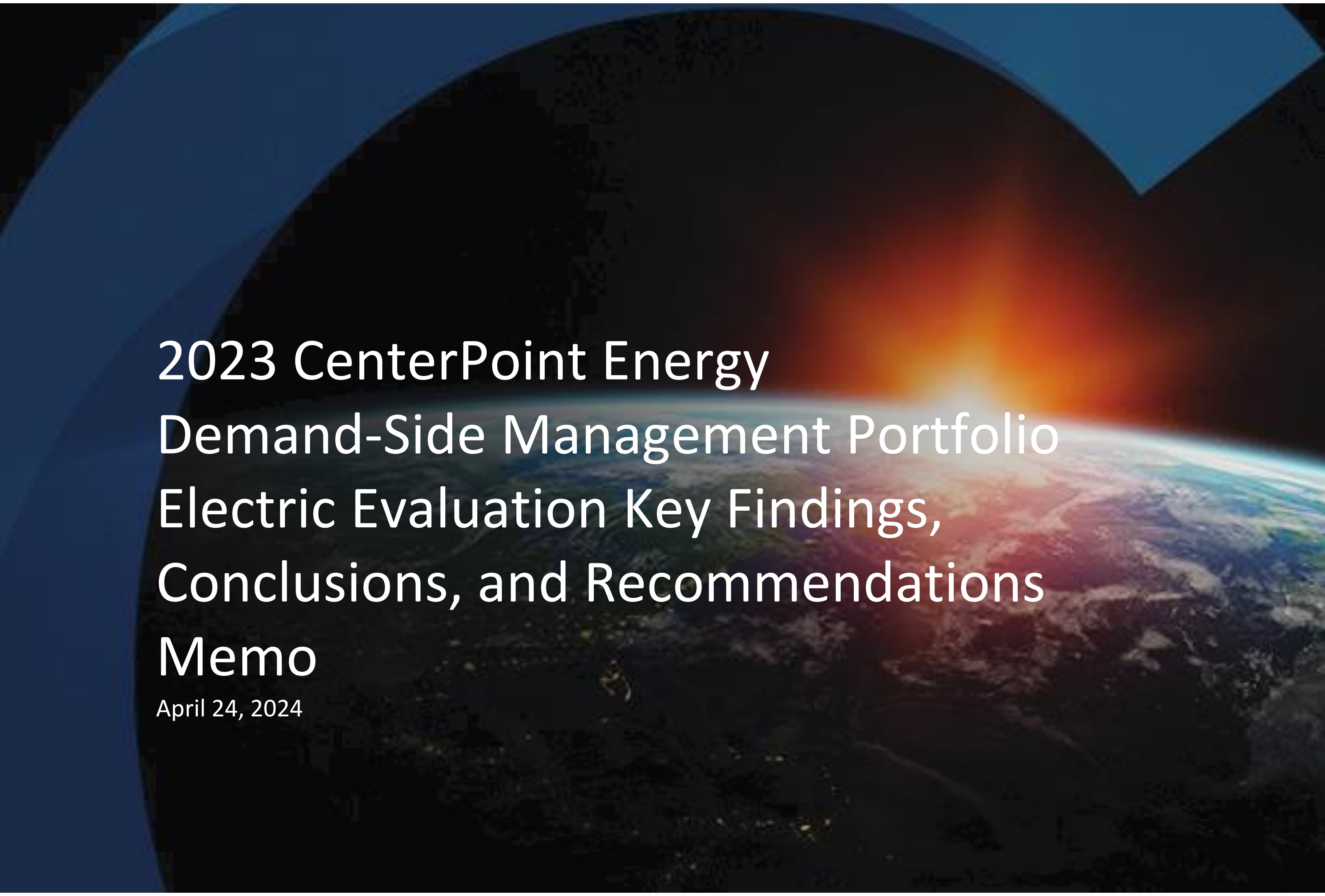

2023 CenterPoint Energy Demand-Side Management Portfolio Electric Evaluation Key Findings, Conclusions, and Recommendations Memo

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Prepared for:

CenterPoint Energy Delivery of Indiana
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Evansville, Indiana

CenterPoint Energy Electric Evaluation Dashboard

Acronyms

Acronym	Definition	Acronym	Definition
AFUE	Annual fuel utilization efficiency	HOU	Hours of use
AMI	Advanced metering infrastructure	hp	Horsepower
BTUH	British thermal units per hour	HSPF	Heating seasonal performance factor
C&I	Commercial and industrial	IQW Program	Income Qualified Weatherization Program
CAC	Central air conditioner	IPLV	Integrated part load value
CDD	Cooling degree days	ISR	In-service rate
CEF	Combined energy factor	kBtu	Kilowatt per British thermal unit
CF	Coincidence factor	kBtuh	Kilowatt per British thermal unit per hour
CFM	Cubic feet per minute	KPI	Key performance indicator
COP	Coefficient of performance	kSF	Thousand square feet
CVR	Conservation voltage reduction	Kw	Kilowatt
DHP	Ductless heat pump	kWh	Kilowatt per hour
DHW	Domestic hot water	LED	Light-emitting diode
DK/RF	Don’t know/refused	MMBTU	One million British thermal units
DOE	U.S. Department of Energy	MFDI Program	Multifamily Direct Install Program
DSF	Demand savings factor	NEF	National Energy Foundation
DSM	Demand-side management	NTG	Net to gross
ECM	Electronically commutated motor	OLS	Ordinary least square
EER	Energy efficiency ratio	RBS Program	Residential Behavioral Savings Program
EFLH	Equivalent full load hours	RECS	Residential Energy Consumption Survey
EISA	Energy Security and Independence Act of 2007	RNC Program	Residential New Construction Program
ERI	Energy Rating Index	SBES Program	Small Business Energy Solutions Program
ESF	Energy saving factor	SEER	Seasonal energy efficiency ratio
EUL	Effective useful life	SKU	Stock keeping unit
FLH	Full load hours	TMY3	Typical meteorological year
FPL	Federal poverty level	TRM	Technical reference manual
HDD	Heating degree days	UMP	Uniform Methods Project
HER	Home energy report	VFD	Variable frequency drive
HERS	Home Energy Rating System	WHF	Waste heat factor
HEW	Home Energy Worksheet		

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Executive Summary

CenterPoint Energy in Indiana has a demand-side management (DSM) portfolio containing 15 programs, 12 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 2023 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).

This memo provides the key findings, conclusions, and recommendations of Cadmus' evaluation of CenterPoint Energy's 2023 DSM electric portfolio.[2] Full impact evaluation results are contained in the online CenterPoint Energy evaluation dashboard.

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

[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 *2023 CenterPoint Energy Demand-Side Management Portfolio Natural Gas Evaluation Key Findings, Conclusions, and Recommendations Memo.*

Table 1. 2023 Evaluation Tasks by Program

Program	Impact Evaluation	Process Evaluation	Market Performance Indicators
Residential Programs			
Residential Specialty Lighting	✓		
Residential Prescriptive [a]	✓	✓	✓
Residential New Construction	✓	✓	✓
Income Qualified Weatherization	✓	✓	✓
Community Connections	✓	✓	✓
Residential Behavioral Savings	✓	✓	✓
Appliance Recycling	✓	✓	✓
Smart Cycle [b]	✓	✓	
Commercial and Industrial Programs			
C&I Prescriptive	✓	✓	✓
C&I Custom [c]	✓	✓	✓
Small Business Energy Solutions	✓	✓	✓
Cross-Sector Program			
Conservation Voltage Reduction	✓		

[a] CenterPoint Energy's Residential Prescriptive Program includes Standard, Midstream, Online Marketplace, and Instant Rebates delivery channels.
[b] For this evaluation, Cadmus estimated savings for year-round use of Smart Cycle direct install thermostats; Cadmus estimated savings from summer peak load control events in a separate evaluation.
[c] CenterPoint Energy's C&I Custom program includes Commercial New Construction, Building Tune-Up, and Strategic Energy Management as program subcomponents.

Portfolio-Level Impacts

Table 2 and Table 3 present the electric savings and demand reduction achieved by the 2023 CenterPoint Energy DSM Portfolio.[3] Overall, the portfolio achieved 36,226,983 kWh of evaluated, net electric savings and 6,971 kW evaluated, net demand reduction.

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[3] Reported *ex ante* electric and demand savings are derived from CenterPoint Energy's 2023 Electric DSM scorecard.

Table 2. 2023 CenterPoint Energy DSM Program Portfolio Electric Savings

Program	*Ex Ante* Savings (kWh)			Evaluated *Ex Post* Savings (kWh)	Realization Rate (kWh)	NTG Ratio	Evaluated Net Savings (kWh)	Net Savings Goal (kWh)	Percentage Net Savings Goal Achieved
	Reported	Audited	Verified						
Residential Programs									
Residential Specialty Lighting	407,688	407,688	350,612	351,536	86%	34%	121,100	0	0%
Residential Prescriptive	3,123,939	3,125,813	2,994,691	2,487,187	80%	62%	1,535,114	4,022,177	38%
Residential New Construction	46,589	46,589	45,999	110,977	238%	57%	63,257	27,160	233%
Income Qualified Weatherization	177,704	167,002	161,085	140,348	79%	100%	140,348	279,724	50%
Residential Behavioral Savings	4,972,242	4,972,242	4,972,242	3,853,205	77%	100%	3,853,205	6,790,000	57%
Appliance Recycling	874,503	830,815	830,815	852,139	97%	52%	440,719	630,853	70%
Smart Cycle	26,988	26,988	25,247	23,505	87%	94%	22,154	259,484	9%
Community Connections	675,303	675,303	409,624	800,442	119%	100%	800,442	591,172	135%
Commercial and Industrial Programs									
C&I Prescriptive	17,164,188	17,292,532	17,292,532	17,954,357	105%	85%	15,261,204	11,400,000	134%
C&I Custom	3,016,872	3,016,872	3,016,872	3,007,699	100%	97%	2,917,468	4,650,000	63%
Small Business Energy Solutions	6,320,172	6,320,172	6,320,172	6,448,471	102%	95%	6,126,047	5,720,000	107%
Cross-Sector Program									
Conservation Voltage Reduction	2,228,830	2,228,830	2,228,830	3,008,921	135%	100%	3,008,921	1,972,581	153%
Flex Funding									
GAP Initiative - Community Connections	1,035,716	1,035,716	451,400	362,721	35%	100%	362,721	0	0%
GAP Initiative - Motel DI	812,544	812,539	812,539	584,856	72%	95%	555,613	0	0%
GAP Initiative - Cold Storage	557,946	557,947	557,947	629,598	113%	95%	598,118	0	0%
Total	**41,441,225**	**41,517,049**	**40,470,607**	**40,615,962**	**98%**	**88%**	**35,806,431**	**36,343,151**	**99%**
Nonparticipant Spillover[a]	N/A	N/A	N/A	N/A	N/A	5%	348,817	N/A	N/A
Total Adjusted Portfolio	**41,441,225**	**41,517,049**	**40,470,607**	**40,615,962**	**98%**	**89%**	**36,155,248**	**36,343,151**	**99%**

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

Table 3. 2023 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)	NTG Ratio	Evaluated Net Savings (Coincident Peak kW)	Net Savings Goal (Coincident Peak kW)	Percentage Net Savings Goal Achieved
	Reported	Audited	Verified						
Residential Programs[a]									
Residential Specialty Lighting	0	56	48	48	0%	34%	17	0	0%
Residential Prescriptive	1,028	1,028	1,027	798	78%	54%	428	416	103%
Residential New Construction	20	21	30	51	254%	57%	29	29	100%
Income Qualified Weatherization	30	27	27	54	178%	100%	54	83	65%
Residential Behavioral Savings	2,025	2,025	2,025	769	38%	100%	769	1,340	57%
Appliance Recycling	134	127	127	130	97%	54%	70	194	36%
Smart Cycle	57	57	0	0	0%	0%	0	550	0%
Community Connections	18	18	15	20	108%	100%	20	18	111%
Commercial and Industrial Programs									
C&I Prescriptive	3,530	3,579	3,579	3,579	101%	85%	3,042	2,567	118%
C&I Custom	420	420	420	233	55%	97%	226	671	34%
Small Business Energy Solutions	1,328	1,328	1,328	1,329	100%	95%	1,262	471	268%
Cross-Sector Program									
Conservation Voltage Reduction	396	396	396	944	238%	100%	944	396	238%
Total	**8,987**	**9,083**	**9,022**	**7,955**	**89%**	**86%**	**6,860**	**6,735**	**102%**
Nonparticipant Spillover	N/A	N/A	N/A	N/A	N/A	5%	69	N/A	N/A
Total Adjusted Portfolio	**8,987**	**9,083**	**9,022**	**7,955**	**89%**	**87%**	**6,929**	**6,735**	**103%**

[a] 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 2023 evaluation, Cadmus proposed several recommendations to enhance CenterPoint Energy's DSM portfolio (Table 4).

Table 4. 2023 Program Recommendations

Program	Recommendations
Residential Programs	
Residential Specialty Lighting	None
Residential Prescriptive	None
Residential New Construction	None
Income Qualified Weatherization	Explore other measure opportunities to replace lighting and increase claimed electric savings in participant homes. Whenever possible, prioritize homes with electric resistance heat for weatherization measures such as attic insulation. Consider conducting additional research to identify high electric energy using customers that could be targeted by the program. In addition to increasing marketing efforts in 2024 through canvassing and attending community events to add to the number of interactions with low-income community members and targeting customers who receive LIHEAP payments, tailor recruitment approaches to address customers' motivation to reduce energy costs. Continue revising the data collection process to include more-robust quality control to limit tracking errors in future program years. Specifically, target measures that appear to be duplicates or those with reported equipment specifications that don't match the measure configuration.
Community Connections	None
Residential Behavioral Savings	None
Appliance Recycling	None
Smart Cycle	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.
Commercial and Industrial Programs	
C&I Prescriptive	Tailor marketing materials and communication to potential customers that may be looking to replace broken or old equipment. Inform trade allies, who are a vital pathway to program involvement, that equipment replacement is a top motivation for program participants. Leverage the competitive advantage of being able to offer incentives in future trade ally network outreach.
C&I Custom	Revise the demand savings algorithm to calculate demand savings as the average demand reduction during the coincident summer peak period of 1 p.m. to 5 p.m. Central Prevailing Time on non-holiday weekdays from June through August.

Program	Recommendations
Small Business Energy Solutions	None
Cross-Sector Program	
Conservation Voltage Reduction	Ensure data submitted for evaluation includes cycling from July through September to support robust baseline model estimates. Earlier installation will ensure that savings for higher demand months are captured, and that future modeling efforts will have more representative data and can better capture relationships between hotter temperatures and higher energy peaks.

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 2023, the program was discontinued in response to new EISA regulations prohibiting the sale of incandescent or halogen lamps. All bulbs included in the 2023 tracking database are bulbs that were sold at the end of 2022 but were not processed in time to be included in the 2022 evaluation period.

Impact Evaluation Overview

Table 5 lists evaluated savings for the Residential Specialty Lighting Program. Cadmus reviewed the 2023 program tracking database to check savings estimates and calculations against CenterPoint Energy's reported savings from the 2023 Electric DSM Scorecard and to confirm the accurate application of the savings assumptions. Cadmus exactly matched energy savings and total program lamps in the tracking data to the DSM scorecard but found that the scorecard did not report demand savings despite the presence of these savings in the tracking data.

Table 5. 2023 Residential Specialty Lighting Program Electric Savings

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rate	NTG Ratio	Evaluated Net Savings
	Reported	Audited	Verified				
Total kWh	407,688	407,688	350,612	351,536	86%	34%	121,100
Total kW	0	56	48	48	N/A	34%	17

Variance in realization rates is largely because of differences in *ex post* and *ex ante* savings. To determine *ex ante* savings, CenterPoint Energy applied fixed per-unit kWh and kW for each bulb category based on 2020 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.[4]

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

Table 6. 2023 Residential Specialty Lighting Program Per-Unit Gross Savings

Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
	Reported	Evaluated	Reported[a]	Evaluated
LED Reflector	49.5	48.2	0.000	0.007
LED Specialty	29.0	31.4	0.000	0.004

[a] CenterPoint Energy's 2023 Electric DSM Scorecard did not report demand savings.

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: ***Standard***, ***Residential Midstream, Online Marketplace***, and ***Instant Rebates***. 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 was the implementer for the Online Marketplace and Instant Rebates channels until 2023.

The following describes the four channels:

- Through the ***Standard*** channel, CenterPoint Energy offers downstream prescriptive rebates for a variety of measures, such as smart thermostats, HVAC equipment, appliances, and insulation. Projects are eligible for a rebate after a customer installs qualifying equipment. CenterPoint Energy provides the rebate either directly to the customer or to the project contractor if authorized to do so by the customer. To receive the rebate directly, customers complete and submit a rebate application through an online portal, by email, or by mail. Some contractors give customers the option of including the rebate as a discount in their project cost. In these cases, the customer authorizes the contractor to submit the rebate application and receive the rebate payment.
- Launched in mid-2020, the ***Residential Midstream*** channel provides incentives directly to distributors for qualifying HVAC equipment sales. Participating distributors collect the required information directly from their customers, which allows them to confirm eligibility and provide an instant discount on eligible equipment. Distributors are then reimbursed by CenterPoint

[4] 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

Energy for the incentive amount. Distributors are required to pass at least some of the incentive onto their customers (typically contractors, but occasionally end users) and inform them of their rebate from CenterPoint Energy. The channel focuses primarily on higher-efficiency HVAC equipment models than those available in the Standard channel. In 2023, the program implementer introduced a hybrid approach. If determined eligible, high-sales contractors can stock their own equipment and were able to receive program incentives/rebates directly, rather than partnering with a participating distributor

- CenterPoint Energy launched the ***Online Marketplace*** channel in 2021. Through this channel, customers can purchase measures including specialty LEDs, smart thermostats, and advanced power strips online to receive an instant discount.
- CenterPoint Energy launched its ***Instant Rebates*** channel in 2022. The channel offered customers a point-of-sale discount when they used a rebate coupon. The coupon was accessible online through a portal that verified customers eligibility. The verification process happened quickly, giving customers the option to access the coupon through a smartphone while in the store. The Instant Rebates channel will not be offered in 2024 due to implementer onboarding issues that made the channel's initial extension funding more effective in other high achieving programs/channels..

Customer Satisfaction

The program achieved high customer satisfaction from participants in the Standard and Online Marketplace channels. From customer surveys, 97% of Standard respondents and 96% of Online Marketplace respondents were satisfied with the program overall. Online marketplace respondents also gave high satisfaction ratings across all categories (94% and above). These categories included navigating the store to find products, completing the order, the selection of products, the time it took for shipping/delivery and the amount of the discount.

Midstream Data

Midstream Trade Ally contact data were inconsistent and included duplicates and missing details. The data provided included duplicate trade ally contact information within each contractor and distributor list. Additionally data had out-of-date trade ally contact information such as names, emails, and phone numbers. Finally, certain trade allies were listed as both a distributor and a contractor. These data issues affected the number of accurate contacts Cadmus was able to interview.

Recommendation: Consider requesting that the implementer, CLEAResult, revise and update trade ally contact data to ensure that there are no duplicates and contact information is as up-to-date and complete as possible.

Recommendation: Request that CLEAResult add a more formal flag to trade allies who are contractors, yet utilize the "Hybrid Approach" similar to a distributor so that evaluation findings are accurate and NTG results can be accurately calculated. Consider asking trade allies for two points of contact in case of staff turnover throughout the year.

Midstream Trade Ally Satisfaction

The Midstream channel successfully offers an easy path of participation for both contractors and distributors. Four of the five contractors commented that they were satisfied that they were able to submit rebates themselves and quickly received the rebates. Four of the five contractors also preferred the channel compared to the standard channel. The Midstream channel is also successful with distributors as five of the seven distributors were very satisfied with the program and two noted that it drives them to stock more efficient equipment.

Midstream

Midstream data contained missing and inconsistent model numbers. The tracking data for Air Source Heat Pump and Ductless Heat Pump measures often either were missing model numbers or contained baseline model numbers that did include enough information to confirm model details within the Air Conditioning, Heating and Refrigeration Institute (AHRI). For example, in one of eight records almost 90% of the Ductless Heat Pump 17 SEER 9.5 HSPF = 17 SEER2 8.6 HSPF2 measure did not contain make or model information. For these measures Cadmus used the average of available models in the AHRI catalogue, based on SEER level and available models. These records account for 14% of total ductless heat pump records. The majority of records provided both make and model details to search the AHRI catalogue.

Recommendation: Although applying averages from records containing make and model details to records missing this information is generally acceptable for evaluating savings, requiring contractors and distributors to input make and model information will increase the accuracy of evaluated savings and could also inform reported savings.

Marketplace

Some Online Marketplace data were ineligible for savings. In the Online Marketplace data, about 15% contained customers with a heating system fuel and water heater fuel that was not within CenterPoint’s service area. For example, in one thermostat record, while CenterPoint only provided electricity, the thermostat used gas as the heating fuel. Since CenterPoint did not provide the heating fuel used by the thermostat, it cannot be claimed as savings for CenterPoint. This discrepancy was especially prevalent with Marketplace thermostats. Cadmus removes the records that include savings outside of CenterPoint’s service area, however *ex ante* and *ex post* savings would be more aligned if the implementers increased their screening process to exclude these records as well.

Recommendation: Consider working with implementers to enhance qualification logic on the Online Marketplace to identify purchases with heating system and water heater fuels that are not provided by CenterPoint and are ineligible to claim for savings.

Online Marketplace data were inconsistent and missing details. About 53% of the Marketplace program data did not contain either heating system fuel and water heater fuel. There was missing data particularly in the thermostat measures and water-saving devices, such as the showerhead and aerator measures.

Recommendation: Although applying fuel share averages from records with this information to records in which fuel is not specified is generally acceptable for evaluating savings, consider working with implementers to change the heating system fuel and water heater fuel fields to required fields, possibly using drop-down functionality that requires users to choose from a list of options.

Thermostat Electric Savings

Thermostat data for the Standard, Online Marketplace, and Instant Rebates channels should contain data for learning or non-learning capabilities. Savings for thermostats are highly varied depending on whether the thermostats are learning and non-learning. In this evaluation, Cadmus assigns savings based on a thermostat's learning or non-learning capabilities, typically by researching each new model included in the raw data. This evaluation year there were over 250 new thermostats to categorize for learning capabilities. If the implementers created a new category in the raw data that defined whether each thermostat had learning or non-learning capabilities, this would increase the efficiency of the evaluation and create more consistency between reported and evaluated savings.

Recommendation: To improve performance tracking in thermostats, consider requesting implementers begin requiring a field distinguishing between learning and non-learning thermostats. Consider asking implementers to include the learning capabilities within the tracking data to create a more efficient savings calculations process and more consistent *ex ante* and *ex post* savings.

Impact Evaluation Overview

Table 7 lists the evaluated savings summary for the Residential Prescriptive Program. 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. *Appendix A Impact Evaluation Methodology* provides additional details for the calculations and assumptions used to estimate gross savings.

Table 7. Residential Prescriptive Program Electric Savings

Component	Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rate	NTG Ratio	Evaluated Net Savings
		Reported	Audited	Verified				
Standard	Total kWh	704,868	705,289	649,905	563,056	80%	76%	430,162
	Total kW	93	93	93	156	167%	65%	102
Online Marketplace	Total kWh	667,321	664,355	589,915	630,942	95%	82%	518,969
	Total kW	20	20	19	23	117%	80%	19
Midstream	Total kWh	1,737,959	1,738,296	1,738,296	1,276,513	73%	45%	574,105
	Total kW	914	914	914	618	68%	50%	306
Instant Rebates	Total kWh	13,791	17,873	16,574	16,676	121%	71%	11,878
	Total kW	1	1	1	1	161%	60%	1
Total[a]	**Total kWh**	**3,123,939**	**3,125,813**	**2,994,691**	**2,487,187**	**80%**	**62%**	**1,535,114**
	Total kW	**1,028**	**1,028**	**1,027**	**798**	**78%**	**54%**	**428**

[a] Totals do not represent sum of the parts due to rounding.

CenterPoint Energy's *ex ante* savings for the Standard, Midstream, Online Marketplace, and Instant Rebates channels are derived primarily from 2022 program-evaluated savings. For most measures, Cadmus' 2023 evaluation used the same methodology as in 2022, so differences between *ex ante* and *ex post* are largely due to differences in participant survey results and program tracking data.[5]

Table 8 through Table 11 provide annual gross savings for each program measure by channel.

Table 8. 2023 Residential Prescriptive Program Gross Savings – Standard Channel

Measure Group	Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
		Reported	Evaluated	Reported	Evaluated
HVAC	AC Tune Up	26,278.7	24,498.7	41.5	39.1
Appliance and Plug Load Reduction	Air Purifier	10,787.0	9,336.6	1.2	1.1
HVAC	HP Tune Up	4,788.4	4,677.4	2.2	2.2
Weatherization	Attic Insulation (Electric)	65,769.1	54,016.4	6.8	5.8
Weatherization	Attic Insulation (Dual Fuel)	29,900.0	37,925.3	25.1	31.7
HVAC	Central Air Conditioner 16 SEER	48,161.7	36,632.8	0.0	43.5
HVAC	Central Air Conditioner 18 SEER	17,363.3	19,060.6	0.0	15.1
Appliance and Plug Load Reduction	Clothes Dryer	40,799.7	39,422.5	5.5	5.3
Appliance and Plug Load Reduction	Clothes Washer	56,380.1	57,228.7	7.9	8.0
Appliance and Plug Load Reduction	Dehumidifier	4,756.8	4,526.4	0.5	0.4
Other	HP Water Heater	16,909.7	17,080.0	2.3	2.3
Other	Pool Heater COP 5.5-5.9	4,109.8	3,875.1	0.0	0.0
Other	Pool Heater COP >= 6	4,088.3	4,609.3	0.0	0.0
Thermostats	Smart Programmable Thermostat - South (Dual)	114,698.0	85,399.3	0.0	0.0
Thermostats	Smart Programmable Thermostat - South (Electric)	93,632.9	36,312.4	0.0	0.0
Weatherization	Wall Insulation - Dual Fuel	976.3	1,057.0	0.0	1.0
Weatherization	Wall Insulation - All EL	1,737.5	2,385.7	0.0	0.2
Thermostats	Wifi Thermostat - South (Dual)	119,663.9	90,953.7	0.0	0.0
Thermostats	Wifi Thermostat - South (Electric)	44,067.1	34,058.3	0.0	0.0

[5] 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 installs considered to be early replacements, etc.

Table 9. 2023 Residential Prescriptive Program Gross Savings – Midstream Channel

Measure Group	Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
		Reported	Evaluated	Reported	Evaluated
Other	Air Source HP 15 SEER	42,157.3	26,580.6	0.0	8.1
HVAC	Air Source HP 16 SEER	100,986.4	79,388.5	56.1	33.6
Other	Air Source HP 17 SEER	57,581.5	44,965.0	32.0	5.6
HVAC	Air Source HP 18 SEER	249,283.0	136,693.5	59.1	17.1
Other	Central Air Conditioner 15 SEER	52,012.8	49,401.7	0.0	60.4
HVAC	Central Air Conditioner 16 SEER	283,969.5	199,959.1	338.2	244.4
Other	Central Air Conditioner 17 SEER	118,077.5	59,050.2	152.8	72.3
HVAC	Central Air Conditioner 18 SEER	240,774.2	88,805.4	193.7	108.6
Other	Ductless HP 17 SEER 9.5 HSPF	29,844.0	32,616.6	1.3	4.9
Other	Ductless HP 18 SEER 9.5 HSPF	76,874.6	86,140.7	6.0	3.4
HVAC	Ductless HP 19 SEER 9.5 HSPF	37,709.2	47,963.0	5.7	5.5
Other	Ductless HP 20 SEER 10 HSPF	145,147.9	152,556.2	24.5	16.5
HVAC	Ductless HP 21 SEER 10 HSPF	92,428.0	84,558.7	11.0	10.2
Other	Ductless HP 22 SEER 10 HSPF	49,045.0	40,419.9	11.4	5.9
HVAC	Ductless HP 23 SEER 10 HSPF	162,068.0	147,413.8	22.2	21.5

Table 10. 2023 Residential Prescriptive Program Gross Savings – Online Marketplace Channel

Measure Group	Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
		Reported	Evaluated	Reported	Evaluated
Appliance and Plug Load Reduction	Air Purifier	13,428.7	4,740.6	1.5	0.5
Water-Saving Devices	Kitchen Aerator	115.7	34.6	0.0	0.5
Water-Saving Devices	Bathroom Aerator	929.7	170.4	0.1	2.4
Appliance and Plug Load Reduction	Dehumidifier	95.1	82.6	0.0	0.0
Water-Saving Devices	Showerhead	1,336.4	68.1	0.1	0.0
Other	LED Exterior Fixtures	0.0	0.0	0.0	0.0
Other	LED Interior Fixtures	0.0	0.0	0.0	0.0
Lighting	LED Reflector	54,480.5	51,340.2	8.5	8.1
Lighting	LED Specialty	88,779.5	98,777.5	9.7	11.8
Lighting	LED Nightlight	446.8	466.6	0.0	0.0
Appliance and Plug Load Reduction	Smart Power Strips	270.2	260.2	0.0	0.0
Thermostats	Smart Programmable Thermostat - South (Dual)	226,341.1	277,099.7	0.0	0.0
Thermostats	Smart Programmable Thermostat - South (Electric)	277,941.9	197,585.8	0.0	0.0
Weatherization	Weatherstripping	3,155.3	315.5	0.0	0.0
Thermostats	Wifi Thermostat - South (Dual)	0.0	0.0	0.0	0.0
Thermostats	Wifi Thermostat - South (Electric)	0.0	0.0	0.0	0.0

Table 11. 2023 Residential Prescriptive Program Gross Savings – Instant Rebates Channel

Measure Group	Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
		Reported	Evaluated	Reported	Evaluated
Appliance and Plug Load Reduction	Air Purifier	440.3	13.6	0.1	0.0
Appliance and Plug Load Reduction	Dehumidifier	1,522.2	1,321.8	0.0	0.1
Other	HP Water Heater	4,831.4	7,397.0	0.7	1.0
Lighting	LED Reflector	0.0	0.0	0.0	0.0
Lighting	LED Specialty	0.0	0.0	0.0	0.0
Appliance and Plug Load Reduction	Smart Power Strips	0.0	0.0	0.0	0.0
Thermostats	Smart Programmable Thermostat - South (Dual)	3,054.9	6,430.6	0.0	0.0
Thermostats	Smart Programmable Thermostat - South (Electric)	3,942.4	1,513.1	0.0	0.0

The following describes 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:

Thermostats. CenterPoint Energy appears to have used the ASHP average capacity from Cadmus' 2022 evaluation to determine savings. Cadmus used 2023 program data to calculate the average capacity, so the differences between *ex ante* and *ex post* are largely due to differences in participant survey results and program tracking data.

Insulation. Differences in reported-to-evaluated savings for insulation measures are primarily due to shifts in HVAC equipment saturations based on participant surveys. In 2021 and 2022, the basis for *ex ante* savings, saturations were 2% for heat pumps and 6% for electric furnaces. In 2023, these saturations changed to 3% for heat pumps and 6% for electric furnaces (the remaining 91% of saturation was for natural gas heating). This increase in the amount of heat pumps in the service territory resulted 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.

Residential Prescriptive – Midstream

The majority of the Midstream channel's *ex ante* savings were based on evaluated savings for similar measures in the 2022 evaluation. Notable assumption differences between *ex ante* and *ex post* savings are these:

- **Central Air Conditioners.** The savings differences in central air conditioners were due to differences in efficiency metrics and especially in capacity values from evaluated savings in 2022 compared to installed measures in 2023.

Residential Prescriptive – Online Marketplace

The majority of the Online Marketplace channel's *ex ante* savings were based on evaluated savings for similar measures in the 2022 evaluation. Notable assumption differences between *ex ante* and *ex post* savings are these:

- **Weatherstripping.** The *ex ante* kWh savings were much higher than the evaluated kWh savings, resulting in a very low realization rate.

- **Showerhead.** Differences in ex ante and ex post savings for Online Marketplace showerheads were mainly driven by the determination of heating system type and a very low realization rate.

Residential Prescriptive – Instant Rebates

This was the second year for the Instant Rebates channel. The *ex ante* savings were based on the last evaluations, which primarily sourced from past evaluated savings of similar measures in other CenterPoint Energy programs. Different programs have different program-specific considerations and measure granularity. Some program measure savings may be specific to fuel type, housing segment, or installation location. Differences in these assumptions drive some of the differences in *ex ante to ex post* savings for Instant Rebates measures. The program data included fields for service territory and equipment fuel type, which Cadmus used to inform which installations received savings and for which fuel type. All of these considerations resulted in differences between reported and evaluated measure quantities and savings.

Air purifier. 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 that came into effect in 2020. The ENERGY STAR calculator, which CenterPoint Energy used to determine *ex ante* savings, assumes 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.

- **Thermostats**. CenterPoint Energy appears to have used the ASHP average capacity from Cadmus' 2022 evaluation to determine savings. Cadmus used 2023 program data to calculate the average capacity, so the differences between *ex ante* and *ex post* are largely due to differences in participant survey results and program tracking data.

Residential New Construction Program

Through the ***Residential New Construction Program,*** CenterPoint Energy provides incentives to builders who include energy efficient measures in their newly constructed homes. All builders constructing high-efficiency homes in CenterPoint Energy's service territory are eligible for the program.

The program originally provided incentives to builders who constructed homes that received a Home Energy Rating System (HERS) score of 62 or lower.[6] This version of the program was discontinued at the

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

end of 2021, except where carryover rebates were paid prior to the discontinuation of the program for projects completed in 2021. The program then relaunched in 2023 with a new approach.

The 2023 incentives structure includes individual measures that are referred to as *a la carte* measures, or several measure bundles that are referred to as Builder Option Packages or BOPs (see *Appendix A* for the full list). The BOP measures have two tiers and a similar structure. BOP1 measures include meeting certain HVAC and DHW equipment efficiency criteria and installing smart thermostat controls. Additionally, BOP2 measures typically have higher equipment efficiency criteria than BOP1, installing smart thermostat controls, and achieving 4.5 ACH50 or below air tightness. Furthermore, the program provides a bonus incentive for homes that achieve a HERS score of 52 or lower.

Program Promotion

Promoting the Residential New Construction program through the Southwest Indiana Builders Association (SIBA) has been a successful way of gaining program participation. Out of nine interview respondents, five of them reported that they learned about the program through a SIBA event. Additionally, three builders reported that they participated in a CenterPoint sponsored event, and all three said the event was very useful. In an interview, one builder specifically stated that CenterPoint's involvement in SIBA was very influential in their decision to participate in the program and that they would like to see CenterPoint continue to be a part of SIBA in future years.

Incentive Structure

The new measure-based incentive structure was well received by builders during the first year of implementation. All the interviewed builders said that they were very satisfied or somewhat satisfied with the incentive structure, and seven of eight said they would be very likely to recommend the program to other builders. When asked which incentive path they used the most often between the HERS scores and individual measures, 3 of 8 builders said they used the Individual Measures path most often and 1 said they used both paths. The program was also very successful in terms of participation. In 2023 the program hit the highest level of participation for home and measures that it has had on record. It is very possible the program will continue to see this level of participation continue, as the implementer said during their interview that some of the biggest participating builders have already reached out about participating in the program again in 2024.

Impact Evaluation Overview

For the 2023 evaluation, Cadmus evaluated projects using program documents and TRM-based calculations. The realization rates for the Residential New Construction Program were 238% for energy and 254% for demand. Differences in verified measure quantities and TRM-based savings approach contributed to very high electric realization rates. For instance, reported savings used TRM default values (Illinois) and evaluated savings used program data (i.e. home location/zip code) to derive weather dependent variable values such as full load heating and cooling hours of various equipment types. Many programs use historical evaluated savings as the basis for reported savings, which often minimizes differences between reported and evaluated savings. However, because the program relaunched in 2023 with new measure bundles, historical savings that used a whole-home simulation modeling approach to estimate savings are not an appropriate comparison. Table 12 lists the evaluated savings summary for the Residential New Construction Program.

Table 12. 2023 Residential New Construction Program Electric Savings

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rate	NTG Ratio	Evaluated Net Savings
	Reported	Audited	Verified				
Total kWh	46,589	46,589	45,999	110,977	238%	57%	63,257
Total kW	20	21	30	51	254%	57%	29

Table 13 provides per-unit annual gross savings for each program measure (incentive type).

Table 13. 2023 Residential New Construction Program Per-Unit Gross Savings

Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
	Reported	Evaluated	Reported[a]	Evaluated
Central AC (14+ SEER/13.4 + SEER2)	96	575	0.2578	0.2720
Heat Pump - Tier 1 (13+ SEER or 12.4 SEER2)	2,016	1,587	0.0000	0.2639
Heat Pump - Tier 2 (14+ SEER or 13.4 SEER2)	8,504	9,410	0.3867	0.2639
BOP1 Electric	1,653	0	0.0000	0.0000
BOP2 Electric	0	0	0.0000	0.0000
BOP1 Gas/Electric	23,400	39,073	0.0000	0.2800
BOP2 Gas/Electric	4,680	8,044	0.0000	0.2800
HERS 52 Electric	0	0	0.0000	0.0000
HERS 52 Gas/Electric	0	0	0.0000	0.0000

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

Income Qualified Weatherization Program

Through the ***Income Qualified Weatherization (IQW) Program***, 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.

CenterPoint Energy sponsors the program. CLEAResult, as the program implementer, is responsible for scheduling appointments and completing initial assessments with its trained auditors. Auditors recommend weatherization measures or upgrades that facilitate the installation of energy-saving measures at no cost to the customer. Auditors help participants schedule follow-up installation appointments with trade allies if professional contractor work is needed.

Gross Savings

Lack of installation of attic insulation measures in electric only (electric heating and cooling) homes and the loss of electric savings attributed to lighting led to a decrease in per home savings in 2023 compared with 2022. Savings per home decreased to 170 kWh in 2023 from 384 kWh in 2022. This decrease was largely driven by the lack of homes with electric resistance heat that received attic insulation measures and the inability to claim lighting savings. These two measures accounted for 28% of all electric energy savings in 2022. No homes with electric resistance heat received attic insulation measures in 2023. The program implementer plans to adjust scheduling in 2024 to boost attic insulation and air sealing adoption by making those measures more available during the first appointment so customers are not discouraged by needing to make a second appointment to install those measures.

Recommendation: Explore other measure opportunities to replace lighting and increase claimed electric savings in participant homes. Whenever possible, prioritize homes with electric resistance heat for weatherization measures such as attic insulation. Consider conducting additional research to identify high electric energy using customers that could be targeted by the program.

Participation in the IQW Program increased between 2022 and 2023, but the program did not reach its goals. The program was closer to reaching its participation goal in 2023 than in 2022 (74% of 760 versus 55% of 760, respectively), but it still did not meet its 2023 participation and savings goals. In August 2023, CLEAResult hired a full-time Market Outreach Specialist to increase canvassing efforts and CNP presence at low-income community events, which bolstered participation for the latter half of 2023. Because of this, CLEAResult is optimistic that the program will experience increased participation in 2024. When exploring customer motivations for participating, 89% of the 55 evaluation participant survey respondents reported that saving on energy bills/reducing energy costs was their main reason for participating in the IQW program.

Recommendation: In addition to increasing marketing efforts in 2024 through canvassing and attending community events to add to the number of interactions with low-income community members and targeting customers who receive LIHEAP payments, tailor recruitment approaches to address customers' motivation to reduce energy costs.

Data tracking errors were identified. In 2023, Cadmus identified errors related to recorded duplicates and incorrect measure configurations, which the implementer confirmed. Although 2023 was a transition year for the data tracking tool which caused some of the tracking errors Cadmus identified, these errors have persisted. Cadmus corrected these errors during a data review which resulted in 308 fewer units than reported and audited savings 10,701 kWh and 3.29 kW less than reported in 2023.

Recommendation: Continue revising the data collection process to include more-robust quality control to limit tracking errors in future program years. Specifically, target measures that appear to be duplicates or those with reported equipment specifications that don't match the measure configuration.

Impact Evaluation Overview

Table 14 lists the evaluated savings summary for the IQW Program data.

Table 14. 2023 Income Qualified Weatherization Electric Savings

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rate	NTG Ratio	Evaluated Net Savings
	Reported	Audited	Verified				
Total kWh	177,704	167,002	161,085	140,348	79%	100%	140,348
Total kW	30	27	27	54	178%	100%	54

Table 15 provides per-unit annual gross savings for each program measure.

Table 15. 2023 Income Qualified Weatherization Per-Unit Gross Savings

Measure	Annual Gross Savings (kWh)[a]		Annual Gross Savings (Coincident Peak kW)[b]	
	Reported	Evaluated	Audited	Evaluated
AC Tune-Up	125	85	0.147	0.138
Air Sealing 20% Infil. Reduction (Dual Fuel)	244	88	0.030	0.129
Air Sealing 20% Infil. Reduction (Electric)	1132	1738	0.000	0.342
Attic Insulation (Dual Fuel)	491	413	0.118	0.400
Audit Fee MF (Dual Fuel)	13	54	0.001	0.009
Audit Fee MF (Electric Only)	46	54	0.001	0.010
Audit Fee SF (Dual Fuel)	75	68	0.002	0.015
Audit Fee SF (Electric Measures)	102	82	0.002	0.015
Bathroom Aerator SF (Electric)	32	31	0.003	0.003
Central Air Conditioner 16 SEER	290	272	0.056	0.387
Exterior LED Lamps	0	0	0.000	0.000
Furnace Tune-Up	0	1	0.000	0.000
IQW MFDI Door and Window Weatherstripping	7	36	0.000	0.000
IQW MFDI Door Sweep	103	26	0.000	0.000
IQW MFDI Site Visit and DI - dual (Gas)	13	13	0.002	0.002
IQW Whole Home (Dual Fuel)	187	48	0.000	0.055
Kitchen Flip Aerator - Electric MF	132	132	0.007	0.007
Kitchen Flip Aerator - Electric SF	116	127	0.006	0.007
LED 5W Bulb IQW MFDI	0	0	0.000	0.000
LED 5W Bulb SFH	0	0	0.000	0.000
LED 5W Candelabra	0	0	0.000	0.000
LED 9W Bulb SFH	0	0	0.000	0.000
LED Nightlight	0	0	0.000	0.000
LED Nightlight MF	0	0	0.000	0.000
LED R30 Bulb SFH	0	0	0.000	0.000
Low Flow Showerhead - Electric SF	244	315	0.013	0.015
Pipe Wrap - Electric DHW (per home)	89	96	0.010	0.011
Refrigerator Replacement	388	343	0.057	0.050
Smart Power Strips	24	24	0.001	0.002
Smart Thermostat SF (Dual Fuel)	255	249	0.000	0.000
Smart Thermostat SF (Electric)	1364	317	0.000	0.000
Wall Insulation (Dual Fuel)	66	97	0.071	0.105

[a] CenterPoint Energy's 2023 DSM Scorecard did not have kWh savings at the measure level. These per-unit savings reflect audited savings from the 2023 program tracking data.
[b] CenterPoint Energy's 2023 Electric DSM Scorecard reported an averaged, per-unit kW savings value.

Appliance and plug load reduction. Refrigerator replacement per-unit savings are updated yearly with an analysis based on appliance recycling program findings, the existing refrigerator's age and model, and installed efficient refrigerator model numbers reported in the tracking data. Due to a lack of available existing refrigerator data, the analysis assumed average existing equipment age and size from the 2022 evaluation and added the 2023 reported efficient refrigerator equipment to the average assumed baseline energy consumption. The average baseline energy consumption of the installed efficient refrigerators was 411 kWh in 2022 and 2023 compared with 401 in 2021, the evaluation that 2023 reported savings are based on. The difference between average baseline energy consumption of the installed efficient refrigerators are the biggest drivers in determining refrigerator replacement per-unit savings. Evaluated savings for refrigerator replacement resulted in an average per-unit savings of 343 kWh in 2023, compared with388 kWh in 2021.

Audit education. The audit education measures vary from year to year depending on how many survey respondents say they have taken energy-saving actions. An IQW Program survey was conducted in 2023, which resulted in 2023 audit measures being updated with new survey data. In 2023, 62% of respondents reported taking shorter showers compared with 43% in 2021, 79% reported turning off the lights while not in use compared with 68% in 2021, and 18% reported installing additional weatherization measures compared with no respondents in 2021.

Evaluated savings are also dependent on whether a household installed a smart strip, smart thermostat, or both; if either of these items was installed, that household is ineligible for savings associated with unplugging appliances or programming the thermostat correctly. In 2023, a significantly larger percentage of audit participants installed additional smart strips than in 2021. Therefore, in 2023, evaluated energy savings for these measures were less than reported energy savings.

HVAC measures. Differences in savings varied by measure:

- **Air conditioner tune-ups** had evaluated savings that were substantially lower than reported savings. To determine energy and demand savings, Cadmus used the average capacity of 2023 program-installed central air conditioners as an input to the 2015 Indiana TRM v2.2 algorithm. Reported savings used a mix of deemed savings that reflect air conditioner tune-up 2021 evaluated savings and an unknown deemed savings value that was used by reported savings in 2020, 2021, and 2022, so the planning methodology may have differed from the TRM for some air conditioner tune-ups.[7] For the reported savings that used the 2021 evaluated savings, the average air conditioner capacity in 2021 was slightly higher than in 2023, resulting in evaluated savings that were slightly lower than reported for those cases.
- **Central air conditioner** had lower evaluated savings than reported savings due to lower cooling capacities in 2023, with an average capacity of 31,481 BTUH compared with an average capacity of 33,513 BTUH in 2021.

Water-saving devices. Differences in savings for water-saving devices were due to differences in the survey inputs for a single-family home, such as people per home, showers per home, in-service rates (ISRs), and bathroom faucets per home, from year to year. An IQW Program survey was conducted in 2023, which informed these survey inputs. For kitchen aerators, ISRs increased from 91.7% in 2021 to

[7] CenterPoint Energy did not provide *ex ante* assumptions for air conditioner and heat pump tune-ups.

95.2% in 2023 resulting in evaluated savings slightly higher than reported. For showerheads, a difference in verified ISRs resulted in lower evaluated savings with an ISR in the 2021 IQW Program survey of 100% compared with 71.4% in 2023.

Weatherization. Reported and evaluated savings for weatherization measures differed widely because each installation had site-specific data that affected the savings attributed to each home:

- **Air sealing** had substantially lower evaluated savings primarily because of lower average infiltration reduction in 2023 than in 2021. The average difference in pre- and post-installation airflow was 496 cfm in 2023 compared with 1,328 cfm in 2021.
- **Attic and wall insulation** per-unit savings differences were the result of different average installed square footage and R-values in 2021 and 2023.
- **Whole Home IQW measures** showed lower evaluated savings than reported savings for a variety of factors. For the reported Whole Home IQW measures, evaluated savings used notes provided in the health and safety recap to assign applicable program average deemed savings for measures that could not be accounted for elsewhere in the program. These measures included water heater replacement, air sealing, duct sealing, air conditioner tune-up, furnace tune-up, furnace replacement, and air conditioner replacement. Average per-household electric energy savings were less in 2023 than in 2021 due to fewer home improvements warranting savings, such as bathroom attic fans and collection box repair, and measures that were already accounted for elsewhere in the program. There were also cases in which there was no documentation for the work conducted, so no savings were attributed to those households.

MFDI weatherstripping and door sweeps. Reported and evaluated savings both pulled from the 2023 Illinois TRM V11 for MFDI weatherstripping and door sweep measures but used different assumptions that resulted in evaluated savings significantly higher or lower than reported savings.

- **Weatherstripping.** For weatherstripping measures, it appears reported savings were determined by simple averaging the deemed kWh/ft for both electric resistance and heat pump installations in the 2023 Illinois TRM V11. However, these reported savings did not account for the total kWh savings by multiplying this average by the length of the weatherstripping. Additionally, the reported savings assumed that measures were installed in a location with both natural gas and electric heating and used an even split of heat pump and electric furnace installations for electric savings, attributing the full electric and therm savings to both. Evaluated savings were calculated by applying a weighted average of electric heating fuel and equipment saturation rates based on Indiana Residential Energy Consumption Survey data to the deemed kWh/ft provided in the 2023 Illinois TRM V11. This was multiplied by the length of weatherstripping installed, resulting in evaluated savings that were greater than the reported savings.

- **Door sweeps.** Similar to weatherstripping, reported savings took a simple average of the deemed savings per door sweep for electric resistance and heat pump heating and assumed the full therm savings per door sweep for natural gas heating. Evaluated savings were calculated by applying a weighted average of electric heating fuel and equipment saturation rates based on Indiana Residential Energy Consumption Survey data to the deemed kWh/sweep provided in the 2023 Illinois TRM V11. The application of these fuel and equipment saturations resulted in evaluated savings that were less than the reported savings.

Demand savings. Evaluated demand savings were significantly higher than reported because of a tracking data error in reported demand savings where there was no reported demand savings for some central air conditioner, attic insulation, audit, and air sealing measures. Specifically, reported savings claimed demand savings for only three out of 22 possible central air conditioners, six out of 35 possible attic insulation measures, 457 out of 534 audit measures where other reported savings were claimed, and one out of 13 air sealing measures. Evaluated savings claimed demand savings for each central air conditioner installation, all audit measures for which other reported savings were claimed, and applicable air sealing and attic insulation measures, depending on fuel types.

Duplicate measures. During a tracking database review Cadmus identified 158 measures (across 46 participants) that were suspected to be duplicates or incorrect measure configurations. Cadmus confirmed which of the measures were duplicates, and corrected the measure configurations for others, and reflected final totals in audited savings. Ultimately this resulted in 308 fewer units than reported and audited savings 10,701 kWh and 3.29 kW less than reported in 2023.

Community Connections Program

Through the ***Community Connections Program,*** CenterPoint Energy partners with food banks and trustee offices in its electric service territory to give away energy efficient kits (which included LED nightlights, smart power strips, and door and window weatherstripping in 2023) at no cost to recipients. Though the program changed its offerings in previous years as federal regulations such as EISA limited opportunities to claim savings from LED lightbulbs, the shift to kits with multiple kinds of measures (instead of just bulbs) is significant for the program. To better reflect the current and future state of the program, and to emphasize the program’s overall purpose, it has been renamed ***Community Connections***.

Participant Trends

Increasing the variety of measures offered helped the Community Connections program achieve significant savings and maintain high customer satisfaction. The program’s historically high satisfaction levels have continued into 2023, with 87% (n=30) of survey participants reporting satisfaction with the program overall. After years of distributing LED bulbs, the trend toward LED adoption and updated federal standards resulted in LED bulbs being removed from the program and replaced with smart power strips and weatherstripping. According to implementers, trustees and food bank partners provided very positive feedback on these changes, stating that customers were excited about the new measures and that refreshing the program offerings increased demand for and popularity of the program. The program implementer plans to adjust the measures in the kit next year to ensure returning participant satisfaction.

Awareness of CenterPoint Energy's sponsorship of the program increased. In 2023, 53% (n=30) of survey respondents were aware that CenterPoint Energy sponsored the Community Connections Program, an increase from 2022, when only 21% of respondents (n=28) were aware. Cadmus can continue to track awareness to see if this upward trend continues.

Impact Evaluation Overview

Table 16 lists the evaluated savings summary for the Community Connections Program. CenterPoint Energy realized 68% of reported annual energy savings and 108% of reported demand savings. Evaluated savings were lower than reported savings because of differences in ISRs and assumptions used for weatherstripping savings.

Table 16. 2023 Community Connections Program Electric Savings

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rate	NTG Ratio	Evaluated Net Savings
	Reported	Audited	Verified				
Total kWh	1,711,019	1,711,019	861,023	1,163,162	68%	100%	1,163,162
Total kW	18	18	15	20	108%	100%	20

Table 17 provides per-unit annual gross savings for each program measure.

Table 17. 2023 Community Connections Program Per-Unit Gross Savings

Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
	Reported	Evaluated	Reported	Evaluated
LED Night Light	13.1	13.1	0	0
Smart Power Strips	24.6	22.6	0.0017	0.0018
Door and Window Weatherstripping	22.7	35.8	0	0
GAP-LED Nightlight	12.7	13.1	0	0
GAP-Weatherstripping (Door and Window)	117.3	35.8	0	0
GAP-Outlet Gaskets	10.8	5.2	0	0
GAP-Door Sweep	103.4	26.0	0	0

For LED night lights, evaluated savings were lower than reported savings because of the application of ISRs from a Community Connections Program participant phone survey conducted for the 2023 evaluation. Evaluated savings aligned with the 2015 Indiana TRM v2.2 methodology, which assumes savings for LED nightlights that replace existing incandescent nightlights. Of participants surveyed, 100% installed the nightlights they received; however, only 44% of those installations replaced an existing nightlight. Of the existing nightlights replaced, 90% were incandescent resulting in an ISR of 36%.

For weatherstripping, outlet gaskets, and door sweeps measures, it appears that the difference between reported and evaluated savings is likely the result of heating fuel saturations, heating type saturations, and ISRs assumed. Evaluated savings assume an ISR for weatherstripping based on 2023 participant survey data and ISRs from the Illinois TRM V11 for other weatherization measures. Evaluated savings also assumes fuel and heating equipment saturations from 2020 Indiana residential energy consumption survey (RECS) data. The equipment saturations based on Indiana RECS data were used to calculate a weighted average deemed energy savings value from the deemed savings provided for heating and cooling equipment in the Illinois TRM V11. For weatherstripping, the ISR was based on whether participants installed the measure, whether they installed all 17 linear feet of weatherstripping, and if not, what percentage of tape was installed. These responses resulted in an ISR of 52%, and the combination of these factors resulted in lower evaluated savings than reported savings.

For smart strips, the main driver for the difference between evaluated and reported savings was the ISR assumed. Evaluated savings assumed an ISR of 82% based on the responses in the 2023 participant survey, which resulted in lower evaluated savings than reported savings.

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 energy 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. CenterPoint Energy operated the 2023 program with three waves: the 2013 dual-fuel wave, the 2020 dual-fuel wave, and a new 2023 electric-only wave. The program retired the 2012 electric-only wave and replaced it with a rolling enrollment wave where customers who would like to receive an HER can opt in and are randomized into treatment and control groups on an ongoing monthly basis.

Savings and Uplift

Savings for both dual fuel waves dropped from 2021 to 2023. Wave 1 (electric only) increased in savings from 2021 to 2023. Cadmus observed that from 2021 to 2023, Wave 1 electric-only savings increased from 1.20% to 1.32%. Wave 1 dual-fuel savings fell from 1.53% to 1.06%, and Wave 2 dual-fuel savings fell from 0.88% to 0.71%.

Wave 1 electric savings were still lower than in prior program years; the drop in savings can be attributed to more temperate weather and normalizing to typical savings.

Wave 1 dual-fuel savings fell to the lowest levels in the last four years. In particular, from May 2023 to October 2023, Wave 1 dual fuel had 1.04% in savings, compared with an average of 1.33% over the same months in all other years since program launch.

Wave 2 had savings of 0.71% savings. The slight decrease in savings from 2021 may be due to the decrease in savings from May to October 2023. Savings during these months averaged 0.49%, similar to the 0.41% average savings in 2020, but lower than the 0.92% in 2021.

Recommendation: Work with the implementer to determine if savings for the dual-fuel waves could be increased with different messaging or targeted recommendations in 2023.

The RBS Program is encouraging cross-program participation. In 2021, across all three electric waves—Wave 1 electric only, Wave 1 dual fuel, and Wave 2— and across all programs, uplift savings were positive. In 2023, Wave 1 electric only had negative uplift savings across all programs while Wave 1 dual fuel and Wave 2 remained positive across all programs.

In 2023, the HERs specifically promoted appliance recycling and low-income efficiency kits. RBS Program uplift savings were positive for two waves, both Wave 1 electric only and Wave 1 dual fuel. Wave 1 electric only achieved 2,305 kWh in energy savings between the two promoted programs, while other programs had negative uplift savings. Wave 1 dual fuel achieved a combined 20,922 kWh in energy savings from the Appliance Recycling and Income Qualified Weatherization programs. While combined uplift for the appliance recycling program increased from 2021, total uplift savings across all programs and waves decreased from 70,900 kWh in 2021 to 18,231 in 2023.

Impact Evaluation Overview

Table 18 lists the evaluated savings summary for the Residential Behavioral Savings Program. The 2023 evaluation resulted in a 77% energy savings realization rate and a 38% demand realization rate. Cadmus deducted 26,276 kWh and 8.61 kW uplift savings to avoid double-counting savings claimed in other CenterPoint Energy programs. The deductions are only from waves with positive savings. For energy savings, the deduction was for both dual-fuel waves. For demand, uplift savings occurred only in Wave 1 dual fuel. For waves where uplift savings were negative, no adjustments were made because savings are not being double-counted in other programs.

Table 18. 2023 Residential Behavioral Electric Savings

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rate	NTG Ratio	Evaluated Net Savings
	Reported	Audited	Verified				
Total kWh	4,972,242	4,972,242	4,972,242	3,853,205	77%	N/A	3,853,205
Total kW	2,025	2,025	2,025	769	38%	N/A	769

Note: Evaluated savings have been adjusted for uplift.

Table 19 and Table 20 show the 2023 reported and evaluated program net energy and demand savings and the realization rates for the RBS Program.[8] The reported energy and demand savings are within Cadmus' 90% confidence interval for evaluated *ex post* savings. The confidence interval defines the range of values that are likely (specifically, 90% likely defined by the confidence level) to contain the true *ex post* savings. If the *ex ante* savings are also within this range then there is no statistical difference between *ex ante* and *ex post*. Savings in these tables do not include the uplift findings.

Table 19. 2023 RBS Program Electric 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 Dual Fuel (2013)	N/A	3,218	224	6,213	±93%	N/A
Wave 2 Dual Fuel (2020)	N/A	637	-219	1,493	±134%	N/A
Wave 3 Dual Fuel (2022)	N/A	12	-45	69	±84%	N/A
Wave 4 Electric (2023)[a]	N/A	0	N/A	N/A	N/A	N/A
Total	**3,948**	**3,876**	**1,793**	**8,499**	**±65%**	**78%**

[a] Wave 4 savings were not statistically significant, with zero being in the 90% confidence interval and modeled savings being slightly negative. No savings were counted for this wave.
[1] Note: Evaluated savings have **not** been adjusted for uplift.

Table 20. 2023 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 Dual Fuel (2013)	N/A	0.65	0.05	1.26	±93%	N/A
Wave 2 Dual Fuel (2020)	N/A	0.12	-0.04	0.29	±134%	N/A
Wave 3 Dual Fuel (2022)	N/A	0.002	-9.47	-9.47	±491%	N/A
Wave 4 Electric (2023)[a]	N/A	0	N/A	N/A	N/A	N/A
Total	**2.03**	**0.78**	**0.15**	**1.41**	**±81%**	**38%**

[a] Wave 4 savings were not statistically significant, with zero being in the 90% confidence interval and modeled savings being slightly negative. No savings were counted for this wave.
[1] Note: Evaluated savings have **not** been adjusted for uplift.

Table 21 shows the reported historical daily savings for all waves of the program.

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

Table 21. 2023 RBS Program Historical Daily Electric Savings per Customer

Program Year	Wave 1 Dual Fuel		Wave 2 Dual Fuel		Wave 3 Dual Fuel		Wave 4 Electric	
	kWh/day[a]	Percentage[b]	kWh/day[a]	Percentage[b]	kWh/day[a]	Percentage[b]	kWh/day[a]	Percentage[b]
2012	0.211 (0.086)**	0.64%	N/A	N/A	N/A	N/A	N/A	N/A
2013	0.299 (0.101)***	0.96%	N/A	N/A	N/A	N/A	N/A	N/A
2014	0.43 (0.119)***	1.40%	N/A	N/A	N/A	N/A	N/A	N/A
2015	0.465 (0.127)***	1.52%	N/A	N/A	N/A	N/A	N/A	N/A
2016	0.443 (0.143)***	1.41%	N/A	N/A	N/A	N/A	N/A	N/A
2017	0.4 (0.149)***	1.34%	N/A	N/A	N/A	N/A	N/A	N/A
2018	0.301 (0.169)*	0.95%	N/A	N/A	N/A	N/A	N/A	N/A
2019	0.476 (0.179)***	1.58%	N/A	N/A	N/A	N/A	N/A	N/A
2020	0.587 (0.186)***	2.02%	0.367 (0.208)*	1.36%	N/A	N/A	N/A	N/A
2021	0.448 (0.196)**	1.54%	0.176 (0.1)*	0.50%	N/A	N/A	N/A	N/A
2022	0.301 (0.208)	1.05%	0.288 (0.099)***	0.87%	0.122 (0.477)	0.41%	N/A	N/A
2023	0.367 (0.208)*	1.36%	0.231 (0.124)*	0.69%	0.004 (0.294)	0.01%	-0.013 (0.087)	-0.04%

[a] 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.
[b] Percentage savings are relative to control group consumption in the same time period.

In 2023, electric savings increased for Wave 1 dual fuel from 1.05% in 2022 to 1.36%. Wave 2 dual fuel decreased slightly from 0.87% in 2022 to 0.69% in 2023.

Wave 2 had savings of 0.231 kWh per day, equivalent to 0.69% of baseline consumption, which is a slight decrease from 0.87% in 2022.

The program administrator described the customers added starting in October 2022 as backfilling Wave 1, the 2012 dual fuel wave. Cadmus did not consider these customers part of Wave 1 because they were not part of the initial experimental design for Wave 1. Additionally, these customers would not have had the same treatment effect as the original Wave 1 customers because the length of time these newly added customers were exposed to treatment is significantly shorter than the length of time the original customers were exposed. Instead, Cadmus modeled savings for these customers as a new, rolling monthly wave—Wave 3.

The new electric-only wave, Wave 4, did not produce any significant savings in 2023 and did not contribute to the program total savings.

Table 22 and Table 23 shows annual uplift savings per treated home and total uplift savings by program and wave. Both dual-fuel waves exhibited positive uplift savings in 2023, indicating that the HERs drove increased savings in other CenterPoint Energy programs. Appliance Recycling and Income Qualified Weatherization were both promoted by CenterPoint in the 2023 HER reports.

Wave 1 dual fuel had the largest savings uplift for both energy and demand. Wave 2 dual fuel had negative savings for both energy and demand. At a program level, Residential Prescriptive – Online Marketplace and Midstream accounted for 96% of the energy savings uplift and Midstream alone accounted for 93% of the demand uplift savings across all waves. Because waves achieved both positive and negative uplift savings, Cadmus adjusted only the positive wave-level savings to avoid double-counting. The electric only wave launched in 2023 was not adjusted for uplift because this wave generated no evaluated energy or demand savings for 2023, so there was no risk of double-counting.

As discussed in previous evaluations, negative uplift savings may be caused by a greater number of control participants who were not encouraged early on to participate in other CenterPoint programs. Wave 1 dual fuel had more treatment group participants than control group participants per 1,000 households.

Table 22. 2023 RBS Program Electricity Savings from Uplift

Program	Wave 1 Dual Fuel		Wave 2 Dual Fuel		Wave 3 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	0.04	1,049	0.09	839	-0.09	-1,568	320
Income Qualified Weatherization	-0.06	-1,490	-0.14	-1,311	0.17	2,843	42
Residential Prescriptive - Marketplace	0.54	12,657	-1.27	-12,193	0.38	6,550	7,014
Residential Prescriptive - Midstream	0.35	8,097	0.20	1,898	-0.23	-3,939	6,057
Residential Prescriptive - Standard	-0.08	-1,879	-0.06	-601	0.24	4,170	1,690
Smart Cycle	-0.06	-1,458	0.00	0	0.00	0	-1,458
Total	**0.75**	**16,976**	**-1.17**	**-11,368**	**0.51**	**8,056**	**13,664**

Table 23. 2023 RBS Program Demand Savings from Uplift

Program	Wave 1 Dual Fuel		Wave 2 Dual Fuel		Wave 3 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	0.0000	0.48	0.0000	-0.08	0.0000	-0.43	-0.03
Income Qualified Weatherization	-0.0001	-3.09	-0.0002	-1.49	0.0002	4.00	-0.57
Residential Prescriptive - Marketplace	0.0000	0.09	0.0000	0.03	0.0000	0.02	0.14
Residential Prescriptive - Midstream	0.0002	5.29	0.0000	0.02	0.0001	2.11	7.42
Residential Prescriptive - Standard	0.0000	0.56	0.0000	0.01	0.0000	0.41	0.99
Smart Cycle	0.0000	0.00	0.0000	0.00	0.0000	0.00	0.00
Total	**0.0001**	**3.33**	**0.00**	**-1.50**	**0.00**	**6.11**	**7.95**

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 implementers worked with CenterPoint Energy to deliver the program. In 2023, the Appliance Recycling Program transitioned implementers: ARCA went out of business in August of 2023 and CLEAResult was brought on to the program in October 2023. The implementers operated a recycling facility that follows U.S. Environmental Protection Agency best practices and recycles close to 100% of each unit picked up.

In 2023, customers could recycle up to two working refrigerators or freezers from 10 to 30 cubic feet by scheduling a pickup of the units through the program implementer. CenterPoint Energy provides a $50 incentive to customers for each qualifying refrigerator or freezer unit picked up and a $25 incentive to customers for a room air conditioner.

Program Participation

Over the past three years, program participation has decreased. Since 2020, program participation has steadily decreased from 1,703 participants in 2020 to 958 participants in 2023. In interviews, implementers noted that participation has decreased as baseline efficiencies have increased, and older units are less prominent in the appliance market. Although most appliances in the market are considered to be energy-efficient, other factors that contributed to the changes in market trends and impacted program participation include increasing inflation rates, which lessen the appeal of purchasing new, energy-efficient appliances, and market expectations that encourage consumers who are considering purchasing a new appliance to wait for the newest model. Furthermore, the need to replace appliances has decreased, resulting in fewer customers that are eligible to participate.

Program Implementation and Delivery

Changing implementers led to higher program costs, further decreasing the program's cost-effectiveness. CenterPoint staff indicated that transitioning to a new implementer for the Appliance Recycling Program was a was challenging to find a cost-effective implementer to replace ARCA. When CLEAResult became the implementer in October of 2023, its responsibilities included only scheduling and picking up appliances, while CenterPoint was responsible for providing program participant contact information, all program marketing materials, and issued the incentive check to the participants. Along with the steady decrease in program participation and difficulty meeting its savings goals, CenterPoint staff reported that the Appliance Recycling program was no longer forecasted to be a cost-effective program.

Gross Savings Review

Evaluated per-unit savings gross kWh savings were higher than *ex ante* per-unit gross kWh savings for refrigerators and freezers, because of changes in recycled appliance characteristics from the 2021 evaluation on which *ex ante* gross savings are based. In 2023, evaluated per-unit gross kWh savings were 2% higher for refrigerators and 8% higher for freezers than CenterPoint Energy's reported savings, which were based on the results of the 2021 evaluation. The modest increase in refrigerator savings from 2021 to 2023 was primarily due to recycling fewer refrigerators with a single-door configuration (three percentage points) and a 7% increase in the average size of refrigerators. For freezers, evaluated savings were 8% higher than reported primarily due to a 4% increase in average size and a 5% increase in average age.

Impact Evaluation Overview

Table 24 lists the evaluated savings summary for the Appliance Recycling Program.

Table 24. 2023 Appliance Recycling Program Electric Savings

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rate	NTG Ratio	Evaluated Net Savings
	Reported	Audited	Verified				
Total kWh	874,503	830,815	830,815	852,139	97%	52%	440,719
Total kW	134	127	127	130	97%	54%	70

Table 25 provides per-unit annual gross savings for each program measure.

Table 25. 2023 Appliance Recycling Program Per-Unit Gross Savings

Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
	Reported	Evaluated	Reported	Evaluated
Freezer	648	697	0.095	0.102
Refrigerator	1,000	1,019	0.147	0.150
Room Air Conditioner	304	304	0.205	0.205

For 2023, Cadmus found per-unit evaluated gross energy savings for refrigerators to be 2% higher than reported savings (which are based on 2021 evaluated savings), primarily due to the following:

- 3 percentage point decrease in the number of refrigerators with a single-door configuration
- 7% increase in the average age of refrigerators

The configuration is a key driver of the amount of energy a refrigerator consumes, and the mix of recycled refrigerators will drive the per-unit savings up or down.

For freezers, Cadmus found per-unit gross energy savings to be 8% higher than reported savings, primarily due to the following:

- 4% increase in average size of freezers
- 5% increase in the average age of freezers
- 10 percentage point increase in number of freezers with a chest configuration

Smart Cycle Program

Through the ***Smart Cycle Program***, CenterPoint Energy direct installs ecobee smart thermostats in residential homes to call load control events during the summer peak season. Although the program targets demand reductions during peak summer hours, it also achieves energy savings from the smart thermostats throughout the year.

Each year, CenterPoint Energy recruits participants from the long-running Summer Cycler Program to transition to the Smart Cycle Program.[9] Summer Cycler participants receive complimentary removal of their load control switches, an ecobee thermostat installed by a technician at no additional cost, and automatic enrollment into the Smart Cycle Program.

For the 2023 program year, CenterPoint Energy contracted with Schneider Electric to schedule and perform the removal of the Summer Cycler load control switches and replace them with ecobee thermostats. The 2023 Smart Cycle Program evaluation focused only on savings derived from normal use of the ecobee thermostats that were direct installed during the 2023 program year. [10]

Program Administration and Delivery

Though the Smart Cycle Program did not meet its participation goal for 2023, the program's future participation looks promising with the onboarding of an experienced installation contractor. The 2023 program completed 52 installations, well below the target of 500, due to operating most of the year without an installation contractor. In August 2023, CenterPoint Energy brought on Schneider Electric as the installation contractor and began installations in mid Q3. Schneider Electric had worked on installing switches for the Summer Cycler program and smart thermostats for the Smart Cycle pilot. The installation contractor's previous experience working with CenterPoint Energy should help the program catch up on installations in 2024.

Peak Demand Savings for Smart Thermostats

There are not enough data to support the application of 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 development of the updated Indiana TRM. The 2023 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 2023.

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.

Impact Evaluation Overview

Table 26 lists the evaluated savings summary for the Smart Cycle Program.

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9 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.

10 Cadmus evaluates the demand response impacts of the Smart Cycle Program under a separate evaluation.

Table 26. 2023 Smart Cycle Program Electric Savings

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rate	NTG Ratio	Evaluated Net Savings
	Reported	Audited	Verified				
Total kWh	26,988	26,988	25,247	23,505	87%	94%	22,154
Total kW	57	57	-	-	-	-	-

Table 27 provides per-unit annual gross savings for the Smart Cycle Program.

Table 27. 2023 Smart Cycle Program Per-Unit Gross Savings

Program Component	Measure Group	Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
			Reported	Evaluated	Reported	Evaluated
Standard	Thermostats	Smart Cycle Thermostat - Dual Fuel	519	290.79	1.10	0
Standard	Thermostats	Smart Cycle Thermostat - Electric	519	931.02	1.10	0

The difference between reported and evaluated kWh savings is probably due to differences in *ex ante* and *ex post* assumptions of home heating fuel. Cadmus was unable to verify the exact assumptions, but comparison with the 2022 *ex ante* savings indicated that a higher share of electric heating was assumed for 2023 *ex ante* savings. In the 2019 evaluation, 17.9% of surveyed participants had heat pumps and 12.5% had electric furnaces. No survey was conducted from 2020 through 2023 because the participant population was small, so Cadmus applied these 2019 survey results for home heating fuel to the 2022 and 2023 evaluations.

The 2015 Indiana TRM v2.2 does not assign coincident peak demand savings for smart thermostats. Additional details for measure-level savings can be found in *Appendix A. Impact Evaluation Methodology*.

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 for installing 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, processes program paperwork and with the help of trade allies promotes the program to CenterPoint Energy customers.

Customer Satisfaction

The program continues to achieve high customer satisfaction, likely due to positive experiences with trade allies. Of the 2023 program participants who completed the survey, 24 of 33 respondents (73%) said they were *very satisfied* and seven of 33 respondents (21%) said they were *somewhat satisfied* with the C&I Prescriptive Program. Three percent (n=24) of program respondents reported being *very* *satisfied* with their contractor or vendor. Contact through a trade ally was the most frequently cited source of awareness for the Prescriptive program (36%, n=33).

Customer Insights

Replacing equipment is a driving motivation for program involvement. When asked what condition their existing equipment was in before purchasing the new energy-efficient equipment, 39% (n=25) of respondents reported that their equipment was running but in need of repair, and 15% of respondents reported that their equipment was non-operational. 42% (n=33) of respondents listed the replacement of broken or old but functioning equipment as *the most important* factor in their company's decision to purchase the energy-efficient equipment for which they received a rebate.

Recommendation: Tailor marketing materials and communication to potential customers that may be looking to replace broken or old equipment. Inform trade allies, who are a vital pathway to program involvement, that equipment replacement is a top motivation for program participants.

Trade Ally Findings

The Midstream Channel benefitted contractors' businesses by enabling them to offer incentives. Nine contractor respondents (n=11) reported that being able to offer incentives is a top motivator for participating in the program, followed by receiving incentives (4 respondents) and energy efficiency goals (4 respondents). Nine contractor respondents reported that being able to offer incentives is the main benefit their company gets from participating in the Commercial Electric Midstream Program, followed by improved customer satisfaction (5 respondents), receiving incentives (4 respondents), and meeting energy efficiency goals (4 respondents).

Recommendation: Leverage the competitive advantage of being able to offer incentives in future trade ally network outreach.

Participating trade allies value the education that the Midstream Channel provides. Seven contractor respondents (n=11) and the one distributor respondent reported that their level of knowledge had changed since the program started. Respondents reported learning more about program benefits; the benefits of energy efficiency, lighting controls, and other incentives offered by CenterPoint Energy; and the importance of rebates to customers. Six contractor respondents, of the seven contractor respondents who reported that their level of knowledge changed since the program started, and the distributor respondent see this increased knowledge as a benefit to their business

Evaluated *Ex Post* Savings Performance

Cadmus found that the reported calculations and inputs appropriately match the savings algorithms from the Illinois and Indiana TRMs. In 2023, the Prescriptive program realized 105% of annual reported electric savings and 101% of reported demand savings. Few discrepancies were found through impact evaluation activities.

Impact Evaluation Overview

Table 28 lists the evaluated savings summary for the C&I Prescriptive Program.

Table 28. 2023 Commercial and Industrial Prescriptive Program Electric Savings

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rate	NTG Ratio	Evaluated Net Savings
	Reported	Audited	Verified				
Total kWh	17,164,188	17,292,532	17,292,532	17,954,357	105%	85%	15,261,204
Total kW	3,530	3,579	3,579	3,579	101%	85%	3,042

The C&I Prescriptive Program realized 105% of reported energy savings and 101% of reported demand savings. Like prior years, more than 57% of reported electric energy savings in 2023 are from lighting measures, 37% are from chiller and compressed air measures, and 6% are from six measure categories: HVAC, kitchen equipment, refrigeration, thermostats, VFD/motors, and other.

Table 29 provides per-unit annual gross savings for each program measure.

Table 29. 2023 Commercial and Industrial Prescriptive Program Per-Unit Gross Savings

Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
	Reported[a]	Evaluated	Reported[a]	Evaluated
Chillers	3,403,988	3,522,952	1,306.0	1,255.1
Compressed Air Systems	2,982,484	3,019,377	414.9	426.2
HVAC	608,657	572,970	61.8	89.2
Kitchen Equipment	46,665	26,373	4.9	4.5
Lighting	9,788,675	10,255,438	1,715.2	1,722.6
Refrigeration	10,135	10,400	2.1	0.7
Thermostat	62,456	62,456	0.0	0.0
Other	4,208	4,128	0.7	0.7
VFD/Motor	256,920	480,265	24.8	79.9

[a] CenterPoint Energy's 2023 DSM Scorecard did not include per-unit kWh or kW savings. Cadmus used available information to provide the averaged, per-unit reported savings.

Similar to reported savings in 2022, three measure types account for over 90% of reported savings: Chillers, Compressed Air Systems, and Lighting. Cadmus found minor discrepancies between evaluated and reported energy savings for these three measure types. One measure type, VFD/Motor, realized 191% of reported energy savings. Findings associated with these three measures are described below.

- **Chillers** account for 20% of total reported energy savings for the C&I Prescriptive Program. Over 94% of the reported energy savings within the Chillers measure category are due to chiller tune-ups. Seventy-six chiller tune-up measures were implemented in 2023. Cadmus found minor discrepancies between the reported calculation inputs for measures in this category resulting in a 104% realization rate for chiller tune-up measures.
- **Compressed air measures** account for 17% of total reported electric energy savings for the program. These include high-efficiency air compressors, compressed air no-loss condensate drains, compressed air setpoint reductions, and compressed air leak audits. Compressed air leak audits account for 92% of electric energy savings in this measure category. Savings derive from reduced compressor energy use after identifying and eliminating leaks in a compressed air

system. Cadmus found that evaluated energy savings closely matched reported energy savings for all compressed air measures resulting in a 101% realization rate for these measures.

- **Lighting** accounted for 57% of reported energy savings for the program, and lighting measures realized 105% of reported electric energy savings. Cadmus found discrepancies resulting from differences in waste heat factors attributed to building types that accounted for the greatest impact on 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 energy savings to qualify for program incentives. CenterPoint Energy calculates program incentive levels on a basis of $0.14 per kWh saved and $1.00 per therm saved. Incentives cannot exceed 50% of total project costs. 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 Table 30.

CenterPoint Energy administers the program and contracts with Resource Innovations to implement the program and with Willdan to engage design teams for the new construction component. Trade allies, including design firms and installation contractors, promote the program and execute custom energy efficiency measures.

Table 30. 2023 C&I Custom Program Subcomponents

Custom Incentives	Commercial New Construction and Energy Design Assistance	Building Tune-Up	Strategic Energy Management	Refrigeration Tune-Up
Support the implementation of non-prescriptive, high-efficiency projects.	Promotes the implementation of energy-efficient, new building designs that exceed the Indiana building code.	Provides retro-commissioning support to encourage operational and captial improvements in small-to-midsize businesses.	Provides building audits and long-term technical support to encourage large businesses to undergo process improvements.	Implements energy efficiency into buildings with refrigeration systems by providing a fully incentivized system study and no- and low-cost measures.

Gross Savings

CenterPoint Energy realized higher annual electric energy savings and lower electric demand savings in 2023 than in prior years. In 2023, the C&I Custom Program produced realization rates of 99.7% for annual electric energy and 55.4% for electric demand savings. Eighteen of the 27 projects realized 100% of annual energy and electric demand savings. Evaluated annual electric energy savings were found to be very close to reported savings with minimal discrepancies. Evaluated demand savings were lower than reported on most retro-commissioning projects due to reported calculation methodology of HVAC scheduling energy conservation measures. During peak periods, HVAC systems will operate without interruption resulting in no reduction in demand load.

Recommendation: Revise the demand savings algorithm to calculate demand savings as the average demand reduction during the coincident summer peak period of 1 p.m. to 5 p.m. Central Prevailing Time on non-holiday weekdays from June through August.

Impact Evaluation Overview

Table 31 lists the evaluated savings summary for the C&I Custom Program.

Table 31. 2023 Commercial and Industrial (C&I) Custom Program Electric Savings

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rate	NTG Ratio	Evaluated Net Savings
	Reported	Audited	Verified				
Total kWh	3,016,872	3,016,872	3,016,872	3,007,699	100%	97%	2,917,468
Total kW	420	420	420	233	55%	97%	226

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

Table 32. 2023 Commercial and Industrial (C&I) Custom Program Per-Unit Gross Savings

Measure (Application ID)	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)		Measure Description
	Reported	Evaluated	Reported	Evaluated	
31	184,422	184,422.20	28.23	10.10	Retro-Commissioning
142	86,453	86,453.00	-	-	Retro-Commissioning
152	165,047	165,047.22	16.71	16.71	LED Lighting
226	210,741	210,740.00	25.47	25.50	Refrigeration
355	90,983	90,983.10	13.85	13.85	LED Lighting
523	8,973	8,973.40	7.35	7.35	Air Conditioners
560	42,210	42,209.86	40.59	40.59	Other
744	329,020	329,020.00	37.65	-	Retro-Commissioning
745	688,382	688,382.10	78.77	-	Retro-Commissioning
746	240,410	240,410.00	27.92	-	Retro-Commissioning
826	143,158	143,157.65	17.85	17.85	Controls Optimization
870	12,106	12,106.45	12.39	12.39	Air Conditioners
1026	5,402	5,402	1.00	1.00	LED Lighting
1202	76,491	76,491.00	8.69	-	Retro-Commissioning
1208	57,273	57,272.88	6.54	6.54	High-Bay LED Lighting
1268	6,384	6,384	1.18	1.18	LED Lighting
1385	111,271	111,271.00	12.65	-	Retro-Commissioning
1416	13,591	13,591.20	-	-	Controls Optimization
1550	12,470	13,591.20	-	-	Controls Optimization
1858	101,199	101,199.45	17.97	17.96	Other
2425	54,973	44,678.00	9.48	6.10	Other
2541	35,835	35,835.00	-	-	Controls Optimization
2771	221,608	221,608.38	54.91	54.91	High-Bay LED Fixtures
2820	10,697	10,697.06	-	-	Retro-Commissioning
2857	5,243	5,243.00	-	-	Refrigeration
2873	25,941	25,941.00	0.50	0.50	Other
2876	76,588	76,588.00	-	-	Window Upgrades

In 2023, 105 electric energy-saving measures were installed in 27 buildings under 27 application IDs through the C&I Custom Program. Cadmus performed desk reviews on all 105 measures:

- 23 of 27 projects realized 100% of reported annual energy savings.
- 11 of 20 projects realized 100% of reported demand savings.
- 2 projects realized less than 10% of reported annual electric energy savings.

Seven retro-commissioning projects reported demand savings from energy conservation measures that involved adjusting operation schedules of air handling units (AHUs). Generally, AHUs operated continuously, 24 hours a day prior to the retro-commissioning process. The retro-commissioning provider implemented an occupied/unoccupied scheduling control change that commanded the AHU to stop running during unoccupied mode, except to maintain space temperature at an unoccupied space temperature setpoint. Although this measure will typically generate substantial annual electric energy savings, the operation of AHUs during peak periods (defined as 1 p.m. to 5 p.m. Central Prevailing Time on non-holiday weekdays from June through August[11]) are unchanged unless the unoccupied mode starts within the peak period hours. As such, no demand savings were realized for this measure in these seven projects.

One project reported electric energy and demand savings through the renewal of an annual maintenance agreement. However, the Illinois TRM AC Tune-up measure requires that equipment not have a maintenance process for the previous 36 months. The AHUs involved in this project have not degraded as maintenance has been maintained prior to the incentive. Because of this, no savings are achieved or have been incentivized through the program.

For the remaining projects, 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. Additional details for measure savings can be found in *Appendix A. Impact Evaluation Methodology.*

Small Business Energy Solutions

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 is the program implementer. Participating trade allies are responsible for customer outreach, conducting on-site energy assessments, and installing no-cost and low-cost direct install measures.

Project Conversion Rates

Project conversion rates increased from 2022 to 2023. Program conversion rates (the rate at which people complete post-audit recommendations in the same calendar year as their audit) were at 52% in 2022 and increased to 73% in 2023**.** Similar to previous years, the program ran a 25% bonus for project same-year conversions in 2023. However, unlike in previous years, customers were required to complete the project by 11/30/2023 in order to receive the bonus (rather than a grace period allowing

[11] The Indiana TRM does not provide a clear definition of peak demand period. However, the Illinois TRM V12 defines peak demand as the average demand reduction during the coincident summer peak period of 1 p.m. to 5 p.m. Central Prevailing Time on non-holiday weekdays from June through August. This peak demand period definition aligns with PJM interconnection. CenterPoint Energy's service territory is within the Midcontinent Independent System Operator (MISO), and in corporation with PJM, the two organizations developed a Joint and Common Market (JCM) to align market rules between them.

completion into early the following year). This hard cutoff date may have contributed to the increased project conversion rates in 2023.

Program Satisfaction

The Small Business Energy Assessment program received high satisfaction scores in 2023. Participants reported very high overall satisfaction, with 21 out of 24 reporting that they were satisfied with the program overall. Out of the 24 total respondents, 23 reported being very satisfied with the program contractor and 22 reported being very satisfied with the program equipment. Participants were slightly less satisfied, but still very high, with the Energy Assessment Report where 12 of 24 reported being very satisfied and 8 of 24 reported being somewhat satisfied.

Impact Evaluation Overview

Table 33 lists the evaluated savings summary for the SBES Program.

Table 33. 2023 Small Business Energy Solutions Electric Savings

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rate	NTG Ratio	Evaluated Net Savings
	Reported	Audited	Verified				
Total kWh	6,320,172	6,320,172	6,320,172	6,448,471	102.0%	95%	6,126,047
Total kW	1,328	1,328	1,328	1,329	100.0%	95%	1,262

Table 34 provides per-unit annual gross savings for each program measure.

Table 34. 2023 Small Business Energy Solutions Per-Unit Gross Savings

Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
	Reported[a]	Evaluated	Reported[a]	Evaluated
Lighting – Interior	173.3	177.3	0.046	0.046
Lighting - Controls	159.3	184.8	0.040	0.040
Lighting - Exterior	1,193.4	1,193.4	0.000	0.000
Lighting – Exit Signs	80.4	82.1	0.010	0.010
Wi-Fi and Programmable Thermostats	612.2	607.8	0.000	0.000
Vending Machine Occupancy Sensors	1,611.8	1,611.8	0.000	0.000
Lighting – Refrigerated Cases	218.7	218.7	0.032	0.032

[a] CenterPoint Energy's 2023 DSM Scorecard did not have kWh or kW savings at the measure level. Per-unit kWh savings reflect audited savings from the 2023 program tracking data, and per-unit kW savings reflect an averaged value based on the 2023 program tracking data.

In 2023, differences between reported and evaluated savings were small. Interior Lighting measures accounted for 77.2% of all reported electric energy savings. These measures realized 100.1% of demand savings and 102.3% of annual electric energy savings. The remaining measure types accounted for 22.8% of all reported savings. The measures realized 103.1% of demand savings and 100.9% of reported annual electric savings. Similar to interior lighting measures, the majority of discrepancies were related to differences in the application of waste heat factors to energy savings calculations. Minor discrepancies were found from the use of Waste Heat Factors based on the building type and HVAC system type.

Discrepancies were not systematic and do not warrant recommendations to changes in program implementation

Conservation Voltage Reduction

The Conservation Voltage Reduction (CVR) Program achieves residential and commercial end-user energy and demand savings by reducing the voltage on distribution feeders while ensuring that delivered voltage remains above the allowable minimum voltage of 114 V (allowable maximum is 126 V) set by the American National Standards Institute (ANSI). The CVR Program reduces end-user energy consumption without the end user having to alter behavior or equipment—that is, savings are generated without a noticeable impact on customers. In 2023, CenterPoint Energy implemented the CVR Program at its Tekoppel substation in Evansville, Indiana, by installing voltage monitors and automated control systems on the electric distribution system. CenterPoint Energy had previously implemented the CVR Program at its Buckwood substation in 2017 and 2018, and at its East Side substation in 2020.

CenterPoint Energy partnered with Utilidata to implement the CVR Program and provide analytic support to adjust voltage levels. Utilidata installed the CVR system on two load tap changing transformers (LTCs) at the Tekoppel substation.[12] Each LTC controls voltage on two distribution feeders (total of four feeders) that serve a mix of residential and commercial electric customers.

Impact Evaluation Overview

By implementing CVR at the Tekoppel substation, CenterPoint Energy expanded the program beyond the initial installation at the Buckwood substation in 2017 and the East Side substation in 2020. Same as the East Side substation, the CVR Program at the Tekoppel substation uses three-day on/off cycling instead of one-day or varying cycling used in 2017. In previous evaluations, the LTCs were installed so that cycling could begin July 1 and run through September 30 to provide sufficient observations of high-voltage, high-temperature hours both when the controls are active and when controls are off. This provides sufficient data to train a statistical model to predict power and voltage had the controls not been turned on in order to estimate savings.

In 2023, the controls were not installed until late August and early September because of equipment delays. This provided an insufficient number of observations for Cadmus to train a reliable model.

Due to the late installation of voltage monitors and automated control systems, Cadmus applied the historical energy savings rate (defined as the evaluated energy savings as a share of total annual load) from the 2020 analysis of the East Side Substation to the full annual load of the Tekoppel substation to estimate energy savings. Demand savings were estimated by taking the ratio of evaluated peak demand savings to evaluated energy savings for the East Side substation from the 2020 evaluation.

[12] Load tap changers regulate voltage by discretely changing the “tap” position of a transformer.

Table 35 shows CenterPoint Energy's *ex ante* claimed savings from CVR and implementation costs for 2023.

Table 35. 2023 Conservation Voltage Reduction Goals and Achievements

Unit	2023 Actual[1]	2023 Planning Goal[1]	Percentage of Goal
Residential Sector			
Gross kWh Savings	805,226	805,226	100%
Gross kW Savings	-	-	-
Participants (meters affected)	4,491	4,491	100%
Program Expenditures	$242,512	$252,941	96%
Commercial and Industrial Sector			
Gross kWh Savings	1,423,604	1,423,604	100%
Gross kW Savings	396	396	100%
Participants (meters affected)	560	560	100%
Program Expenditures	$261,539	$300,854	87%

[1] Goals and achievements from CenterPoint Energy's 2023 DSM Scorecard. Actuals represent *ex ante* reported values.

Table 36 lists the evaluation savings summary for the CVR Program. The program achieved annual energy savings of 3,008,921 kWh and demand savings of 944 kW. These savings represent realization rates of 135% and 238%, respectively, due to the utilization of 2020 East Side substation's percent savings because of unrepresentative data for modeling.

Table 36. 2023 Conservation Voltage Reduction Electric Savings

Energy Savings Unit	*Ex Ante* Savings			Evaluated *Ex Post* Savings	Realization Rates	NTG Ratio	Evaluated Net Savings
	Reported	Audited	Verified				
Total kWh	2,228,830	2,228,830	2,228,830	3,008,921	135%	100%	3,008,921
Total kW	396	396	396	944	238%	100%	944

Recommendation: CenterPoint Energy should ensure data submitted for evaluation includes cycling from July through September to support robust baseline model estimates. Earlier installation will ensure that savings for higher demand months are captured, and that future modeling efforts will have more representative data and can better capture relationships between hotter temperatures and higher energy peaks.

Impact Evaluation Methods and Findings

The CVR impact evaluation included multiple data collection efforts and analysis tasks:

- Compile dataset of grid-level voltages and power consumption, CVR operational state, and local weather data
- Model demand as a response to temporal and meteorological independent variables for cases when CVR is and is not operational

- Apply models to predict counterfactual power consumption when the CVR system was not operational to estimate realized savings.

Due to insufficient data modeling efforts did not produce reliable results. Thus, for the 2023 analysis Cadmus in agreement with CenterPoint finalized the analysis with the following tasks:

- Compile monthly Tekoppel substation demand data for 2019
- Apply 2020 energy savings rate from the East Side evaluation to Tekoppel feeders to estimate evaluated energy savings for 2023
- Calculate the ratio of evaluated 2020 peak demand to evaluated 2020 energy savings and apply the ratio to evaluated energy savings in 2023.

Gross Savings Review

CenterPoint Energy claimed almost 2,229 MWh savings for the CVR Program for 2023 for the Tekoppel substation. Cadmus estimated savings of 3,008 MWh and peak coincident demand savings of 944 kW. Table 37 provides per-unit annual gross savings for the Tekoppel substation.[13] Due to the absence of the vital summer months data, the 2023 model did not offer an accurate depiction of savings (further details are included in the Appendix). Savings were evaluated on a substation basis using 2020 evaluated percent savings for the East Side substation.[14] Peak coincident demand savings were calculated using the coincidence factor from the 2020 evaluation of East Side Substation.[15] Additionally, Cadmus did not receive site-specific data for residential or commercial and industrial (C&I) customers.

Table 37. 2023 Conservation Voltage Reduction Per-Unit Gross Savings

Program	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
	Reported	Evaluated	Reported	Evaluated
Tekoppel Substation CVR	2,228,830	3,008,921	396	944

CenterPoint Energy's CVR system are assumed to have achieved approximately 2.7% energy savings while active during the 2023 program year after applying historical savings rates.

Table 38. 2023 Conservation Voltage Reduction Energy Savings

Feeder	Energy Savings (kWh)	Percentage of Energy Savings	Demand Savings (kW)
Total	3,008,921	2.7%	944

[13] 2023 CVR evaluation is only conducted on the substation basis.

[14] Cadmus did apply feeder-level savings rates since the load for each feeder varies by substation.

[15] Coincidence factor is the proportion of annual savings that overlap with coincident peak savings. Cadmus calculates this as total 2020 demand savings / total 2020 energy savings. The coincident factor for this analysis is 0.000314

Table 39 lists CVR savings by program year. Savings have been relatively consistent over time, and 2023 savings for the Tekoppel substation are comparable to prior savings for the East Side substation.

Table 39. Conservation Voltage Reduction Historical Percentage of Energy Savings

Measure	Evaluated Percentage of Energy Savings (kWh)				
	2017	2018	2019	2020	2023
Total Program CVR	3%[1]	2.2%[1]	N/A[2]	2.7%[3]	2.7%[4]

[1] Buckwood substation.
[2] CenterPoint Energy did not implement CVR in 2019.
[3] East Side substation.
[4] Tekoppel substation.

Net-to-Gross Analysis

CVR does not experience freeridership because reducing line voltage can be done only by CenterPoint Energy and would not be achieved in the absence of the program. CVR also does not experience spillover because it does not exert a noticeable effect on participants that could influence their behavior.

Evaluated Net Savings Adjustments

Table 40 and Table 41 list evaluated net savings for the CVR. The program achieved net savings of 3,008,921 kWh and 944 coincident kW demand reduction.

Table 40. 2023 Conservation Voltage Reduction Electric Savings (kWh)

Energy Savings Unit	*Ex Ante* Savings (kWh)			Evaluated *Ex Post* Savings (kWh)	Realization Rate (kWh)	NTG Ratio	Evaluated Net Savings (kWh)
	Reported	Audited	Verified				
Tekoppel Substation CVR	2,228,830	2,228,830	2,228,830	3,008,921	135%	1	3,008,921
Total	**2,228,830**	**2,228,830**	**2,228,830**	**3,008,921**	**135%**	**1**	**3,008,921**

Table 41. 2023 Conservation Voltage Reduction Demand Reduction (Coincident Peak kW)

Energy Savings Unit	*Ex Ante* Savings (Coincident Peak kW)			Evaluated *Ex Post* Savings (Coincident Peak kW)	Realization Rate (Coincident Peak kW)	NTG Ratio	Evaluated Net Savings (Coincident Peak kW)
	Reported	Audited	Verified				
Tekoppel Substation CVR	396	396	396	944	238%	N/A	944
Total	**396**	**396**	**396**	**944**	**238%**	**N/A**	944

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 2023 Electric DSM Scorecard.
- **Audited savings.** Annual gross savings after CenterPoint Energy's per-unit calculations and measure counts were confirmed by Cadmus (using 2023 program tracking data).
- **Verified savings.** Annual gross savings adjusted for ISR.
- **Evaluated *ex post* savings.** Annual gross savings adjusted for ISR 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).

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 2023 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.
- ***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	Regression/ Billing Analysis
Residential Programs		
Residential Specialty Lighting	✓	
Residential Prescriptive	✓	
Residential New Construction	✓	
Income Qualified Weatherization	✓	
Community Connections	✓	
Residential Behavioral Savings		✓
Appliance Recycling	✓	✓
Smart Cycle	✓	
Commercial and Industrial Programs		
C&I Prescriptive	✓	
C&I Custom	✓	
Small Business Energy Solutions	✓	
Cross-Sector Program		
Conservation Voltage Reduction		✓

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 ISR 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	Secondary Resource
Residential Programs				
Residential Specialty Lighting	✓			✓[b]
Residential Prescriptive	✓	✓		
Residential New Construction	✓		✓	
Income Qualified Weatherization	✓		✓	
Community Connections	✓		✓	
Residential Behavioral Savings	✓			
Appliance Recycling	✓		✓	
Smart Cycle	✓		✓	

Program	Program Data Review	Participant Surveys	Deemed Value	Secondary Resource
Commercial and Industrial Programs				
Commercial and Industrial Prescriptive	✓	✓		
Commercial and Industrial Custom	✓	✓		
Small Business Energy Solutions	✓	✓		
Cross-Sector Program				
Conservation Voltage Reduction	✓			

Residential Specialty Lighting Program

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

- Reflector LED
- Specialty LED (candelabra or globe)

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.[16] 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:

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

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

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.[17] 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.

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16 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.

17 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 2023 data, the average LED produced closer to 83 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 HOU, WHF for energy and demand, and CF 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[a]	902
Coincidence Factor[b]	0.11
Waste Heat Factor Energy[c]	-0.034
Waste Heat Factor Demand[c]	0.092
In-Service Rate	86%

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

Lighting Measure Verification

For the Residential Specialty Lighting Program, Cadmus calculated verified savings by applying an ISR to program-sponsored bulbs. In Indiana, 86% of LED lamps are expected to be installed in the first year after purchase.[18] Historically, ISRs have accounted for the delayed installation of lamps allowing for savings to carry over to future program years.

Cadmus is no longer attributing carryover savings to account for the assumption that LEDs will not get savings credit following the application of updated EISA baselines in 2023 and instead applied an ISR of 86% to all specialty and reflector LEDs.

Table A-4 shows reported, audited, and verified installations and the ISRs for reflector and specialty LEDs.

18 Cadmus applied first-year ISRs, 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).

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

Measure Category	Installations			In-Service Rate[a]
	Reported	Audited	Verified	
LED Reflector	6,064	6,064	5,215	86%
LED Specialty	3,715	3,715	3,195	86%
Total	**9,779**	**9,779**	**8,410**	**86%**

[a] ISRs are not adjusted to include savings for lamps installed after the end of 2023.

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-up
- Air source heat pumps
- Central air conditioners
- Ductless heat pumps

Thermostats:

- Smart programmable thermostats
- Wi-Fi thermostats

Weatherization measures:

- Attic and wall insulation
- Weatherstripping

Other:

- Air purifiers
- Clothes dryers
- Clothes washers
- Dehumidifiers
- Kitchen and bathroom aerators
- Heat pump water heaters
- Lighting
- Pool heaters
- Smart power strips
- Showerhead

Table A-5 through Table A-8 provide per-unit annual gross savings for each program measure by channel.

Table A-5. 2023 Residential Prescriptive Program Per-Unit Savings – Standard Channel

Measure Group	Measure	Annual Per-Unit Savings (kWh)		Annual Per-Unit Savings (Coincident Peak kW)	
		Reported	Evaluated	Reported	Evaluated
HVAC	AC Tune Up	108.14	100.82	0.17	0.16
Appliance and Plug Load Reduction	Air Purifier	220.14	197.71	0.03	0.02
HVAC	HP Tune Up	342.03	334.10	0.16	0.16
Weatherization	Attic Insulation (Electric)	5,480.76	4,501.37	0.57	0.48
Weatherization	Attic Insulation (Dual Fuel)	421.13	526.74	0.35	0.44
HVAC	Central Air Conditioner 16 SEER	411.64	313.10	0.00	0.37
HVAC	Central Air Conditioner 18 SEER	789.24	866.39	0.00	0.69
Appliance and Plug Load Reduction	Clothes Dryer	161.90	162.33	0.02	0.02
Appliance and Plug Load Reduction	Clothes Washer	170.85	179.95	0.02	0.03
Appliance and Plug Load Reduction	Dehumidifier	95.14	93.93	0.01	0.01
Other	HP Water Heater	2,415.68	2,454.35	0.33	0.34
Other	Pool Heater COP 5.5-5.9	1,027.45	1,005.24	0.00	0.00
Other	Pool Heater COP >= 6	1,362.77	1,594.26	0.00	0.00
Thermostats	Smart Programmable Thermostat - South (Dual)	277.72	239.55	0.00	0.00
Thermostats	Smart Programmable Thermostat - South (Electric)	985.61	442.81	0.00	0.00
Weatherization	Wall Insulation - Dual Fuel	97.63	105.70	0.00	0.10
Weatherization	Wall Insulation - All EL	868.76	1,192.86	0.00	0.10
Thermostats	Wifi Thermostat - South (Dual)	290.45	255.75	0.00	0.00
Thermostats	Wifi Thermostat - South (Electric)	489.63	438.40	0.00	0.00

Table A-6. 2023 Residential Prescriptive Program Per-Unit Gross Savings – Midstream Channel

Measure Group	Measure	Annual Per-Unit Savings (kWh)		Annual Per-Unit Savings (Coincident Peak kW)	
		Reported	Evaluated	Reported	Evaluated
Other	Air Source HP 15 SEER	780.69	492.23	0.00	0.15
HVAC	Air Source HP 16 SEER	753.63	588.06	0.42	0.25
Other	Air Source HP 17 SEER	1,151.63	899.30	0.64	0.11
HVAC	Air Source HP 18 SEER	1,640.02	899.30	0.39	0.11
Other	Central Air Conditioner 15 SEER	309.60	294.06	0.00	0.36
HVAC	Central Air Conditioner 16 SEER	416.99	294.06	0.50	0.36
Other	Central Air Conditioner 17 SEER	587.45	293.78	0.76	0.36
HVAC	Central Air Conditioner 18 SEER	797.27	294.06	0.64	0.36
Other	Ductless HP 17 SEER 9.5 HSPF	3,316.00	3,624.06	0.14	0.54
Other	Ductless HP 18 SEER 9.5 HSPF	3,203.11	3,589.20	0.25	0.14
HVAC	Ductless HP 19 SEER 9.5 HSPF	2,356.82	2,997.69	0.36	0.35
Other	Ductless HP 20 SEER 10 HSPF	2,962.20	3,113.39	0.50	0.34
HVAC	Ductless HP 21 SEER 10 HSPF	3,301.00	3,019.95	0.39	0.36
Other	Ductless HP 22 SEER 10 HSPF	2,885.00	2,377.64	0.67	0.35
HVAC	Ductless HP 23 SEER 10 HSPF	2,614.00	2,377.64	0.36	0.35

Table A-7, 2023 Residential Prescriptive Program Per-Unit Gross Savings – Online Marketplace Channel

Measure Group	Measure	Annual Per-Unit Savings (kWh)		Annual Per-Unit Savings (Coincident Peak kW)	
		Reported	Evaluated	Reported	Evaluated
Appliance and Plug Load Reduction	Air Purifier	220.14	80.64	0.03	0.01
Water-Saving Devices	Kitchen Aerator	115.74	34.64	0.01	0.50
Water-Saving Devices	Bathroom Aerator	29.99	44.21	0.00	0.62
Appliance and Plug Load Reduction	Dehumidifier	95.14	82.61	0.01	0.01
Water-Saving Devices	Showerhead	267.28	13.62	0.01	0.00
Other	LED Exterior Fixtures	0.00	0.00	0.00	0.00
Other	LED Interior Fixtures	0.00	0.00	0.00	0.00
Lighting	LED Reflector	43.72	42.75	0.01	0.01
Lighting	LED Specialty	42.81	49.75	0.00	0.01
Lighting	LED Nightlight	13.14	13.72	0.00	0.00
Appliance and Plug Load Reduction	Smart Power Strips	24.56	24.54	0.00	0.00
Thermostats	Smart Programmable Thermostat - South (Dual)	277.72	393.40	0.00	0.00
Thermostats	Smart Programmable Thermostat - South (Electric)	985.61	817.50	0.00	0.00
Weatherization	Weatherstripping	22.70	2.18	0.00	0.00
Thermostats	Wifi Thermostat - South (Dual)	0.00	0.00	0.00	0.00
Thermostats	Wifi Thermostat - South (Electric)	0.00	0.00	0.00	0.00

Table A-8. 2023 Residential Prescriptive Program Per-Unit Gross Savings – Instant Rebates Channel

Measure Group	Measure	Annual Per-Unit Savings (kWh)		Annual Per-Unit Savings (Coincident Peak kW)	
		Reported	Evaluated	Reported	Evaluated
Appliance and Plug Load Reduction	Air Purifier	220.14	7.06	0.03	0.00
Appliance and Plug Load Reduction	Dehumidifier	95.14	85.72	0.00	0.01
Other	HP Water Heater	2,415.68	2,480.17	0.33	0.34
Lighting	LED Reflector	0.00	0.00	0.01	0.00
Lighting	LED Specialty	0.00	0.00	0.01	0.00
Appliance and Plug Load Reduction	Smart Power Strips	0.00	0.00	0.00	0.00
Thermostats	Smart Programmable Thermostat - South (Dual)	277.72	438.22	0.00	0.00
Thermostats	Smart Programmable Thermostat - South (Electric)	985.61	438.22	0.00	0.00

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:

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

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

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

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 effective 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-9 shows the other variables used in this evaluation.

Table A-9. 2023 Residential Prescriptive Program Air Conditioner and Heat Pump Tune-Up Calculation Variables

Variable	Value	Units	Source
$BTUH_{Heat}$	HP 32,689	BTUH	2023 Residential Prescriptive Program tracking data
$SEER_{CAC}$	10	BTUH/Watt-hr	Illinois TRM V11
MF_E	5%	%	2015 Indiana TRM v2.2
$SEER_{ASHP}$	10	BTUH/Watt-hr	Illinois TRM V11
$BTUH_{Cool}$	AC 33,606 HP 32,689	BTUH	Assuming the same as heating capacity
$HSPF_{Base}$	6.8	BTUH/Watt-hr	Illinois TRM V11
EER	AC 9.2 HP 9.2	BTUH/Watt-hr	Illinois TRM V11
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 to calculate savings per heat pump installed (excluding ISR):[19]

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

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

Cadmus calculated central air conditioner savings using the following equation:

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

19 These equations are referenced in the 2015 Indiana TRM v2.2. https://www.ilsag.info/technical-reference-manual/il-trm-version-9/

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

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-10 shows the other inputs Cadmus used to evaluate impacts for these measures.

Table A-10. 2023 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
$EFLHheat$	982	hours	2015 Indiana TRM v2.2
$EFLHcool$	600	hours	2015 Indiana TRM v2.2

The Midstream channel data did not provide capacity (BTUH), SEER (SEERnew), or EER (EERnew in the installation data. Cadmus used averages of these variables from the non-Midstream Residential Prescriptive program data from 2019, 2020, and 2021 to calculate savings for each installation. For the systems with new qualifications that were not in historical data, Cadmus used average values by measure from the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) directory.[20] Table A-11 contains the average values and sources used in the evaluation when the capacity, SEER, or EER were not provided in the tracking data.

Table A-11. 2023 Residential Prescriptive Program Air-Source Heat Pump and Dual-Fuel Heat Pump Average Inputs

Equipment	SEER	EER	HSPF	Capacity	Source of the Average Inputs
ASHP 15 SEER	15.672544	12.17551	9.0215524	31,800	AHRI
ASHP 16 SEER	16.092338	12.69065	9.1641204	32,604	Res Rx Historical Tracking Data
ASHP 17 SEER	17.64819	11.97998	9.775455	31,936	AHRI
ASHP 18 SEER	18.56176	12.41699	10.23176	38895.686	Res Rx Historical Tracking Data
DHP 17 SEER	17	13.5	10	22,000	AHRI
DHP 18 SEER	-	-	-	22,157	AHRI
DHP 19 SEER	20.00294	12.49908	11.14471	17,827	Res Rx Historical Tracking Data
DHP 20 SEER	20.2	12.3	10	18540	AHRI
DHP 21 SEER	21.85179	12.68036	11.09717	17826.429	Res Rx Historical Tracking Data
DHP 22 SEER	20.7	12.4	9.8	25230	AHRI
DHP 23 SEER	24.57255	13.62157	11.28039	13794.118	Res Rx Historical Tracking Data

20 AHRI directory used for SEER, HSPF, and EER input values by measure model number. AHRI Certification Directory (ahridirectory.org)

Early Replacement Savings

The non-Midstream 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 ASHPs and an operable condition to be an early replacement installation.

The Midstream channel tracking data did not distinguish early replacement units. Therefore, Cadmus determined an early replacement proportion of 27% using historical Residential Prescriptive 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-12.

Table A-12. 2023 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			

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 V11 method. Cadmus calculated ductless heat pump savings using these equations (excluding ISR):

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

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

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

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

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-13 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. The Midstream channel data did not provide output capacity ($\text{Capacity}_{\text{cool}}$ and $\text{Capacity}_{\text{heat}}$), SEER (SEERee), EER (EERee), or HSPF (HSPFee) in the installation data. Similar to the HVAC measures, Cadmus used averages of these variables from the Standard channel Residential Prescriptive program data from 2019, 2020, and 2021 to calculate savings for each installation, as noted in Table A-11

Table A-13. 2023 Residential Prescriptive Program Ductless Heat Pump Input Variables

Variable	Value	Units	Source
$\text{Elec}_{\text{Heat}}$	1	-	Illinois TRM V11
$\text{DHP}_{\text{HeatFLH}\,\text{Adjustment}}$	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 V11 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 V11. 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 V11 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 V11. Cadmus applied this factor to the Indiana FLHs to get Indiana DHP FLHs.
Factor of 3.412	3.412	kBtu/kWh	Illinois TRM V11
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

Thermostat Measures

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

CenterPoint Energy's Residential Prescriptive Program has two types of thermostat measures:

- Smart thermostats (mostly learning) [21]
- Wi-Fi thermostats (mostly non-learning)

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

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

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

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

Each thermostat category has two measures, one for dual fuel and one for electric. 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.[22] Table A-14 shows the inputs Cadmus used to evaluate impacts for this measure.

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-14. 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 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.

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.

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21 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.

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

Table A-14. 2023 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
$BTUH_{HEAT}$	32,683	BTUH	Average of 2023 CenterPoint Energy Residential Prescriptive heat pump tracking data capacities
$\%_{HEAT\ PUMP}$	3%	%	2023 Residential Prescriptive Program participant survey
$\%_{GAS}$	91%	%	2023 Residential Prescriptive Program participant survey
$\%_{ER}$	6%	%	2023 Residential Prescriptive Program participant survey
Manual thermostat saturation	16%	%	2023 Residential Prescriptive Program participant survey
Programmable thermostat saturation	84%	%	2023 Residential Prescriptive Program participant survey
$TStat\_Type_{\mathrm{DiscountRate}}$	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.
$ESF_{AdjustedBaseline_{HEAT}}$	9.7%	%	Calculated, example below
$\%AC$	93%	%	2023 Residential Prescriptive Program participant survey
$\Delta Cooling_{AdjustedBaseline}$	235	kWh	Calculated, example below

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.[23] 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. However, 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.

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

Cadmus used the following equations:[24]

$$\Delta Cooling_{AdjustedBaseline} = [16\% * 429 + 84\% * (429 - 210.4)] * 93\% = 235\ kWh$$

$$\mathrm{ESF}_{\mathrm{AdjustedBaseline}_{\mathrm{HEAT}}} = 16\% * 12.5\% + 84\% * (12.5\% - 3.3\%) = 9.7\%$$

In the $\Delta Cooling_{AdjustedBaseline}$ calculation, the 210.4 represents the cooling savings (332 kWh multiplied by 63% correct use factor) for programmable thermostats.[25] 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.

Learning and Non-Learning Wi-Fi Thermostats

The 2014 thermostat evaluation concerned Nest Wi-Fi thermostats only. In 2023, the Residential Prescriptive Program's tracking data recorded many more models of smart and Wi-Fi-enabled thermostats. According to a later study Cadmus study conducted in 2015 for a Midwest utility thermostat program,[26] 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. This means non-learning thermostats save 31% as much heating energy as learning thermostats.[27] The results of Cadmus' evaluation of the 2016 Vectren Smart Thermostat Pilot supported this conclusion.[28] However, no cooling savings adjustment can be directly derived from the comparative study conducted in 2015 for a Midwest utility because the result was not statistically different from 0%.

The Vectren 2013-2014 Programmable and Smart Thermostat Program 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 2023 evaluation, Cadmus applied the 31% discount rate to the heating savings of all non-learning thermostat installations.

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

25 The correct use rate is the percentage of homeowners that 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).

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

27 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.

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

CenterPoint Energy's thermostat offerings for 2023 align with this evaluation approach, segmenting Wi-Fi-enabled thermostats into two separate thermostat measures: smart and Wi-Fi thermostats. In 2022, Cadmus found that thermostats rebated through the smart thermostats measure category 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. In 2023, due to time constraints from data delivery, Cadmus was unable to verify each thermostat as learning or non-learning. In the 2023 evaluation, Cadmus assumed the 2022 percentages of learning to non-learning thermostats, providing only a handful of thermostats with the 31% discount. All differences in savings between these thermostat variants are because of the proportion of learning thermostats in each thermostat measure.

Weatherization Measures

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-15 shows savings scenarios by measure and equipment type.

Table A-15. 2023 Residential Prescriptive Program Equipment Scenarios by Measure

Measure	Equipment Scenarios
Attic Insulation (All Electric)	Heat pump
	Electric heat with air conditioning
	Electric heat without air conditioning
Attic Insulation (Dual Fuel)	Gas furnace with air conditioning
Wall Insulation (All Electric)	Heat pump
	Electric heat with air conditioning
	Electric heat without air conditioning
Wall Insulation (Dual Fuel)	Gas furnace with air conditioning

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, following these 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-16 lists the void factor based on the calculated R_{ratio}. Cadmus used 2% as a conservative assumption since this information was unknown.

Table A-16. 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 2023 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 2023 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%.[29] Cadmus adjusted the ducted savings by a duct efficiency of 76% for electric resistance furnaces because the TRM 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.

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

Weatherstripping

Cadmus referred to the Connecticut TRM methodology (as there was no applicable savings methodology in the 2015 Indiana TRM v2.2), which used this formula to calculate savings for weatherstripping:[30]

$$\Delta Therms \ = \ Feet * Therms\ Savings\ per\ Foot * \frac{HLH_{IN}}{HLH_{CT}}$$

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

Table A-17. Residential Prescriptive Program Weatherstripping Calculation Variables

Variable	Value	Units	Source
Feet	Varies by install	Feet	2023 program tracking data and feedback from program staff
Therms Savings per Foot	0.44	Therms	CT TRM Section 4.4.13
HLH_{CT}	2,878	Hours	CT TRM Section 4.4.13
HLH_{IN}	Indianapolis 2,250 Evansville 2,067	Hours	TMY3 Data

Cadmus determined feet on a per-installation basis. Cadmus assigned feet to each installation according to model number. If the model number was missing from the data, Cadmus used the description to determine the length.

The climate in Connecticut is not the same as in Indiana, so Cadmus adjusted the heating load hours (HLH) found in the Connecticut TRM. Using TMY3 weather data, Cadmus generated ratios between HDDs in Indiana to HDDs in Connecticut. This ratio was used to discount the HLH hours according to installation location.

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.

Other Measures

Air Purifier

Cadmus calculated air purifier savings based using the following equations (excluding ISR):[31]

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

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

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

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30 Energize Connecticut. October 31, 2016. *Connecticut Program Savings Document.* Section 4.4.13. https://www.puc.nh.gov/EESE%20Board/EERS_WG/ct_trm.pdf

31 These equations are referenced in the Illinois TRM V11.

Table A-18. 2023 Residential Prescriptive Program Air Purifier Input Variables

Variable	Value	Units	Source
CF	66.7%	%	Illinois TRM V11
Hours	5,844	Hours	Illinois TRM V11

The Indiana 2015 TRM v2.2 does not have an air purifier measure, so Cadmus used the Illinois TRM V11.[32] This method assigns deemed kWh savings to an air purifier according to it's 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. All installations where the fuel type did not align with a CenterPoint Energy fuel account were assigned no savings.

Clothes Dryer

Cadmus calculated clothes dryer savings using the following equations (excluding ISR):[33]

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

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

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

Table A-19. 2023 Residential Prescriptive Program Clothes Dryer Input Variables

Variable	Value	Units	Source
Load	Varies by dryer size	lbs	Illinois TRM V11
CEF_{base}	Varies by dryer class	lbs/kWh	Illinois TRM V11
CEF_{eff}	Varies by install	lbs/kWh	ENERGY STAR QPL
N_{cycles}	283	Cycles/year	Illinois TRM V11
%Electric	100%	%	Program design only targets electric dryers
Hours	283	Hours/year	Illinois TRM V11
CF	3.8%	-	Illinois TRM V11

The Indiana 2015 TRM v2.2 does not have a clothes dryer measure, so Cadmus used the Illinois TRM V11. The tracking data did not include information about dryer size, dryer class, or combined energy factor (CEF), so Cadmus matched each install'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

32 These equations are referenced in the Illinois TRM V11.

33 Ibid.

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):[34]

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

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

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

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

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

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

The Indiana 2015 TRM v2.2 does not have a clothes dryer measure, so Cadmus used the Illinois TRM V11. The tracking data did not include information about the integrated modified energy factor (IMEF), integrated water factor (IWF), or capacity, so Cadmus matched each install'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 installs for cost-effectiveness inputs.

[34] These equations are referenced in the Illinois TRM V11.

Table A-20. 2023 Residential Prescriptive Program Clothes Washer Input Variables

Variable	Value	Units	Source
Capacity	Varies by install	Cubic feet	ENERGY STAR QPL
$IMEF_{base}$	1.71	lbs/kWh	Illinois TRM V11
$IMEF_{eff}$	Varies by install	lbs/kWh	ENERGY STAR QPL
N_{cycles}	320	Cycles/year	Illinois TRM V11
$\%Electric_{DHW}$	27%	Fuel share % of electric DHW systems	Illinois TRM V11
$\%Electric_{dryer}$	66%	Fuel share % of electric dryers	Illinois TRM V11
$\%Gas_{DHW}$	63%	Fuel share % of gas DHW systems	Illinois TRM V11
$\%Gas_{dryer}$	34%	Fuel share % of gas dryers	Illinois TRM V11
$\%CW_{base}$	6.7%	% of total baseline energy per wash used by washer	Illinois TRM V11
$\%DHW_{base}$	15.8%	% of total baseline energy per wash used by hot water system	Illinois TRM V11
$\%Dryer_{base}$	77.5%	% of total baseline energy per wash used by dryer	Illinois TRM V11
$\%CW_{eff}$	6.6%	% of total efficient case energy per wash used by washer	Illinois TRM V11
$\%DHW_{eff}$	13%	% of total efficient case energy per wash used by hot water system	Illinois TRM V11
$\%Dryer_{eff}$	80.4%	% of total efficient case energy per wash used by dryer	Illinois TRM V11
Hours	320	Hours/year	Illinois TRM V11
CF	4.5%	-	Illinois TRM V11
IWF_{base}	5.59	Gallons	Illinois TRM V11
IWF_{eff}	Varies by install	Gallons	ENERGY STAR QPL

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

Table A-21. 2023 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 liters per kilowatt hours (L/kWh), so Cadmus matched each installation'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.

In the scorecard, there were dehumidifier measures in the Standard and Online Marketplace channels, but the program data Cadmus received also included a dehumidifier in the Instant Rebates channel. Therefore, Cadmus included this Instant Rebates dehumidifier in the calculations.

Kitchen and Bathroom Faucet Aerator

Cadmus calculated kitchen and bathroom aerator savings using the following equations (excluding ISR): [35]

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

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

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

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

[35] These equations are referenced in the 2015 Indiana TRM v2.2 and adjusted using federal guideline for residential humidifiers. Regulations.gov. 2015 Notice of Proposed Rulemaking (NOPR). "2015-05 NOPR Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Residential Dehumidifiers."https://www.regulations.gov/document?D=EERE-2012-BT-STD-0027-0030

Table A-22. 2023 Residential Prescriptive Program Faucet Aerator Input Variables

Variable	Value	Units	Source
MPD	2.6	Faucet minutes per person 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	Res Rx 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	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 GPM, so Cadmus found these values from online retailers using the product manufacturer and model number in the tracking data. To determine water inlet temperature, each installation was matched to its nearest 2015 Indiana TRM v2.2 reference city using the installation location's zip code. The water inlet temperature associated with that reference city was then used 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. The discrepancies between reported and evaluated savings can be explained by the difference in distribution of fuel types between this and last year and the discrepancy between scorecard and tracking data quantities. In the 2022 report, aerators were distributed between natural gas and electric fuel based on the duel aerator measures. In 2023, there were no dual aerator measures so Cadmus distributed the savings to either electric or natural gas.

Heat Pump Water Heater

Cadmus calculated heat pump water heater (HPWH) savings using the following equations (excluding ISR): [36]

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

36 These equations are referenced in the 2015 Indiana TRM v2.2

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

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

Table A-23 shows the inputs Cadmus used to evaluate impacts for this measure.

Table A-23. 2023 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%	%	2023 Residential Prescriptive participant survey
Saturation_GAS	92%	%	2023 Residential Prescriptive participant survey
Saturation_ER	6%	%	2023 Residential Prescriptive participant survey
%_Units_In_Conditioned_Space	28%	%	2023 Residential Prescriptive participant survey
kWh_HEATING	108.75	kWh	Weighted average calculation

Cadmus obtained the unit energy savings for HPWHs 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 $\mathrm{COP_{NEW}}$ and $\mathrm{kWh_{HEATING}}$. Cadmus used HPWH model specifications for $\mathrm{COP_{NEW}}$ provided in program data and a weighted average of heating equipment saturations and deemed kWh savings to determine $\mathrm{kWh_{HEATING}}$ using the 2015 Indiana TRM v2.2.

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

In addition, Cadmus did not consider early replacement for HPWHs. Due to the low number of installations for this measure, Cadmus was unable to gather sufficient data to support a breakout between replace-on-burnout and early replacement for this measure.

Lighting

Cadmus calculated reflector and specialty lighting savings using the following equations (excluding ISR):[37]

[37] These equations are referenced in the 2015 Indiana TRM v2.2

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

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

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

Table A-24 shows the inputs Cadmus used to evaluate impacts for this measure.

Table A-24. 2023 Residential Prescriptive Program Lighting Input Variables

Variable	Value	Units	Source
$Watts_{base}$	Varies by install	W	2015 Indiana TRM v2.2
$Watts_{eff}$	Varies by install	W	Research of online retailers
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

The tracking data did not include information about wattages, so Cadmus found these values from online retailers using the product manufacturer and model number in the program tracking data. 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 install'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 electric and natural gas specific waster heat factors 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 interaction 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-25 shows the inputs Cadmus used to evaluate impacts for this measure.

Table A-25. 2023 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 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.[38] 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,[39] and assuming the outside air temperature is below 80°F in Evansville compared to Chicago.[40] 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.

38 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

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

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

Smart Power Strips

Cadmus calculated smart power strip savings using the following equations (excluding ISR):[41]

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

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

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

Table A-26 shows the inputs Cadmus used to evaluate impacts for this measure.

Table A-26. 2023 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 install'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 electric and natural gas specific waster heat factors 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). The differences between the reported and evaluated savings can be explained by the difference in program data from year to year. In 2021, significantly more homes used fossil fuel heat; in 2022, many more homes had all electric heat, and in 2023 there was in increase in homes using other types of heating. This change in the data can explain discrepancies between reported and evaluated values.

[41] These equations are referenced in the 2015 Indiana TRM v2.2.

Showerhead

Cadmus calculated showerhead savings using the following equations (excluding ISR):[42]

$$Annual\ therms\ Savings = (GPM_{base} - GPM_{low}) * MS * \frac{PH}{SH} * SPD * 8.3 * (T_{mix} - T_{in}) * Days * \frac{1}{RE * 100{,}000}$$

$$Water\ Savings = (GPM_{base} - GPM_{low}) * MS * \frac{PH}{SH} * SPD * Days$$

Table A-27 shows the inputs Cadmus used to evaluate impacts for this measure.

Table A-27. Residential Prescriptive Program Showerhead Input Variables

Variable	Value	Units	Source
MS	7.8	Shower minutes per day	2015 Indiana TRM v2.2
GPM_{base}	2.63	Gallons per minute	2015 Indiana TRM v2.2
GPM_{low}	Varies by install	Gallons per minute	Research of online retailers
PH	2.5	People per household	Res Rx Participant Survey
SH	1.56	Showers per household	RECS 2015
SPD	0.6	Showers per person per day	2015 Indiana TRM v2.2
Specific Heat of Water	8.3	Btu/lbF	Constant
T_{mix}	101	F	2015 Indiana TRM v2.2
T_{in}	Varies by install	F	2015 Indiana TRM v2.2
Days	365	Days/year	Constant
RE	Electric 98%	%	2015 Indiana TRM v2.2
Factor of 100,000	100,000	Btu/therms	Constant

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

Residential New Construction Program

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

[42] These equations are referenced in the 2015 Indiana TRM v2.2.

Table A-28. 2023 Residential New Construction Program Electric Measures

*A la Carte**	BOP1 Requirements**	BOP2 Requirements**	HERS Bonus
• Central AC: 14 SEER (13.4 SEER2) • Heat pump - Tier 1: 13 SEER (12.4 SEER2) • Heat pump - Tier 2: 14 SEER (13.4 SEER2)	• Cooling: 14+ SEER AC or heat pumps with 8.5 HSPF and 13.0 SEER • Smart thermostat control • DHW: Electric storage tank with 0.90 UEF minimum, or heat pump water heater	• Cooling: 14+ SEER AC or heat pumps with 9.0 HSPF and 14.0 SEER • Smart thermostat control • DHW: Heat pump water heater • Air sealing: 4.5 ACH50 or below	• HERS score of 52 or lower

* *A la carte* measures show individual measures.

** BOP Requirements list all the requirements to qualify for each tier. BOP incentives for gas/electric homes have the same electric efficiency requirements listed and additional gas efficiency requirements.

New Construction Homes

The Residential New Construction Program was reinstated in 2023 using a new program design. The new program design uses a flexible approach for participants based on several high-efficiency measure options. This approach allows the program to meet participant demand by measure type and allow for future changes to keep the program cost-effective.

In 2023, the program used three individual *a la carte* electric incentives, combined measures in BOP incentives, and a bonus incentive for achieving a HERS score of 52 or lower.

Cadmus calculated program realization rates as the evaluated savings divided by the reported savings of the program year. Realization rates were calculated for each measure and aggregated across all program measures. Realization rates for energy savings were between 0% and 834%, depending on the measure, and demand reductions were between 77% and 147% for measures with reported savings greater than zero, as shown in Table A-29.

Table A-29. 2023 Residential New Construction Program Realization Rates

Annual Gross Savings Type	2023 *Ex Ante* Savings	2023 *Ex Post* Savings	2023 Realization Rate
Central AC	6,336	52,863	834%
Heat Pump- Tier 1	2,016	1,587	79%
Heat Pump- Tier 2	8,504	9,410	111%
BOP1 Electric	1,653	0	0%
BOP1 Gas/Electric	23,400	39,073	167%
BOP2 Electric	0	0	N/A
BOP2 Gas/Electric	4,680	8,044	172%
HERS Bonus	0	0	N/A
Total kWh	**46,589.00**	**110,977**	**238%**
Total Coincident Peak kW	**20.1**	**51.2**	**254%**

The following factors contributed to the high variation in electric realization rates:

Smartsheet/tracking data: The impact analysis relied on the Smartsheet workbook (Excel) to perform the impact analysis in 2023 due to issues with the tracking database. The Smartsheet workbook contained multiple tabs for *a la carte* measure saving calculations and a program summary tab named "RNC Smartsheet" that listed builder details, project location, HERS certificate details, mechanical system types and efficiencies (heating, cooling, and water heating), house tightness meeting a 4.5 ACH50 threshold, and smart thermostat installation. These inputs determined incentive amounts for each project location. The RNC Smartsheet inconsistently used hard-coded values instead of the logic-based formulas to determine incentive amounts and contained one duplicate home address and four duplicate Cadmus Account Keys. Cadmus overwrote the hard-coded values by applying the logic-based formulas consistently to the incentive calculation columns. Cadmus also used the RNC Smartsheet tab to determine measure quantities, calculate average equipment efficiencies, and determine location-based TRM parameters (e.g., heating and cooling full load hours weighted averages) to evaluate per-unit measure savings.

Central AC: higher evaluated quantity and per unit savings than reported drove realization rates. The electric scorecard reported 66 Central AC *a la carte* measures; Cadmus found 92 in the Smartsheet workbook. Both reported savings and the evaluation team used the following algorithm in the Illinois TRM to calculate kWh savings (this algorithm remained unchanged from Illinois TRM V9, which was used for program year 2021 in the Smartsheet, to TRM v11, which was used for the 2023 evaluation):

$$\Delta kWH = (FLHcool * Capacity * (1/(SEERbase * (1 - DeratingCoolBase)) - 1/(SEERee * SEERadj * (1 - DeratingCoolEff)))/1{,}000$$

Reported savings totaled 207.34 kWh/unit; Cadmus' savings calculation totaled 574.60 kWh/unit because of the use of different input values for some parameters:

$FLHcool$	Reported savings used the Illinois TRM V9 default value of 629 FLHcool (statewide average); Cadmus used 1,035 FLH, based on a Smartsheet-weighted average calculation for all Central AC 14+ SEER *a la carte* measures. Cadmus mapped project location from the Smartsheet data to the equivalent Illinois reference city to calculate the weighted average for FLHcool.
$SEERee$	Reported savings used the measure requirement of 14 SEER; Cadmus used 15.12 SEER based on the Smartsheet average for all Central AC 14+ SEER *a la carte* measures.
$Capacity$	Reported savings used an assumed 30,000 Btuh cooling capacity; Cadmus used the Illinois TRM V11 default value of 33,600 Btuh cooling for single-family homes.

The net effect of higher evaluated measure quantities and higher per-unit savings increased the realization rate significantly for this measure to 834%.

BOP1 Gas/Electric and BOP2 Gas/Electric: Lower evaluated quantities offset evaluated per unit savings that were higher than reported values, resulting in higher realization rates. The electric scorecard reported 75 BOP1 Gas/Electric and 15 BOP2 Gas/Electric projects; Cadmus found 68 BOP1 Gas/Electric and 14 BOP2 Gas/Electric projects in the Smartsheet workbook. Reported savings used the Central AC 14+ SEER savings value of 207.34 kWh/unit; Cadmus used 574.60 kWh/unit as described previously[43] The net effect of lower evaluated measure quantities and higher per-unit savings increased the realization rates for these measures to 167% and 172% for BOP1 and BOP2, respectively.

Tier 1 and Tier2 Heat Pumps: Realization rates differed due to factors similar to those described in the Central AC measure above. However, realization rates for Tier 1 and Tier 2 heat pumps have less impact on the overall kWh realization rate because of their relatively low quantities.

Both reported savings and Cadmus used the following Illinois TRM V9 algorithm to calculate kWh savings for heat pumps (the TRM v11 algorithm has some changes to the parameter format but is similar to the v9 algorithm).[44]

$$\Delta kWh = (FLH\_cooling * Capacity\_cooling * (1/(SEER\_base * (1 - DeratingCoolBase)) - 1/(SEER\_ee * SEERadj * (1 - DeratingCoolEff))) / 1{,}000) + ((FLH\_heat * Capacity\_heating * (1/(HSPF\_base * (1 - DeratingHeatBase)) - 1/(HSPF\_ee * HSPFadj * (1 - DeratingHeatEff)))) / 1{,}000)$$

The factors that impacted realization rates include the following:

Heat Pump – Tier 1: The evaluated quantity matched the reported value, but reported per unit savings were greater than evaluated (781.81 kWh/unit and 528.98 kWh/unit respectively). The lower evaluated savings were due to using different input values for some parameters:

$FLH\_cooling$ Reported savings mistakenly used the Illinois TRM V9 default value of 692 FLHheat for weatherized multifamily statewide average (instead of single-family full load cooling hours); Cadmus used 1,035 FLH based on a Smartsheet weighted average calculation for all Heat Pump – Tier 1 measures. Cadmus mapped project location from the Smartsheet data to the equivalent Illinois reference city to calculate the weighted average for FLH_cooling.

$Capacity\_cooling$ Reported savings used an assumed 30,000 Btuh cooling; Cadmus used the Illinois TRM V11 default value of 33,600 Btuh cooling capacity if unknown.

$SEERee$ Reported savings used the Central AC 14+ SEER measure requirement value of 14 SEER; Cadmus used 13.0 SEER based on the Smartsheet average for all Heat Pump – Tier 1 measures (thus removing evaluated cooling savings because SEERbase equals SEERee).

43 Cadmus did not evaluate heat pump savings calculations, because heat pumps were not in any BOP1/BOP2 Gas/Electric measures in 2023.

44 The Illinois TRM V11 algorithm multiplies full load hours and capacity for the HeatingLoad and CoolingLoad parameters and uses HSPF_ClimateAdj parameter, which Cadmus assumed to be 1.0 for the 2023 evaluation.

FLH_heat	Reported savings used the Illinois TRM V9 default value of 1,821 FLH_heat (statewide average); Cadmus used 1,288 FLH_heat based on a Smartsheet weighted average calculation for all Heat Pump – Tier 1 measures. Cadmus mapped project location from the Smartsheet data to the equivalent Illinois reference city to calculate the weighted average for FLH_heat.
Capacity_heating	Reported savings used an assumed 30,000 Btuh heating capacity; Cadmus used the Illinois TRM V11 default value of 33,600 Btuh cooling capacity for ASHP heating capacity (the Illinois TRM V11 does not specify a default heating capacity if unknown).

Both the evaluated and reported savings calculations used 8.5 HSPF (the Illinois TRM V9 and V11 default) because the actual ratings could not be derived from the Smartsheet workbook. The net effect of these parameter inputs lowered the kWh realization rate for the Heat Pump – Tier 1 measure to 79%.

Heat Pump – Tier 2: The evaluated quantity and the evaluated per unit savings were greater than reported. The electric scorecard reported eight Heat Pump – Tier 2 measures; Cadmus found nine in the Smartsheet workbook. The reported per unit savings were greater than evaluated (1,138.87 kWh/unit and 1,045.54 kWh/unit respectively). The higher evaluated savings were due to using different input values for some parameters:

FLH_cooling	Reported savings mistakenly used the Illinois TRM v9 default value of 692 FLHheat for weatherized multifamily statewide average (instead of single family full load cooling hours); Cadmus used 1,035 FLH based on a Smartsheet weighted average calculation for all Heat Pump – Tier 1 measures. Cadmus mapped project location from the Smartsheet data to the equivalent IL reference city to calculate the weighted average for FLH_cooling.
SEERee	Reported savings used the Central AC 14+ SEER measure requirement value of 14 SEER, while Cadmus used 16.1 SEER based on Smartsheet average for all Heat Pump – Tier 2 measures.
Capacity_cooling	Reported savings used an assumed 30,000 Btuh cooling; Cadmus used the TRM v11 default value of 33,600 Btuh cooling capacity if unknown.
FLH_heat	Reported savings used the Illinois TRM V9 default value of 1,821 FLH_heat (statewide average); Cadmus used 1,288 FLH_heat based on a Smartsheet weighted average calculation for all Heat Pump – Tier 2 measures. Cadmus mapped project location from the Smartsheet data to the equivalent Illinois reference city to calculate the weighted average for FLH_heat.
Capacity_heating	Reported savings used an assumed 30,000 Btuh heating capacity; Cadmus used the TRM default value of 33,600 Btuh cooling capacity for ASHP heating capacity (the TRM v11 does not specify a default heating capacity).

Both the evaluated and reported savings calculations used 8.5 HSPF (TRM default if unknown) since the actual ratings could not be derived from the Smartsheet workbook. The net effect of these parameter inputs increased the kWh realization rate for the Heat Pump – Tier 2 measure to 111%.

The Residential New Construction Program used a new program design in 2023. The 2023 program year had more participants than in 2018 and almost the same as in 2019, but fewer than in 2020 and 2021. The 2023 program achieved less electric kWh and demand savings than in prior years, but was closest to the 2021 program year (Residential energy code changes took affect for the second half of 2021, which reduced program savings when comparing to 2018-20 program years).

Table A-30 compares the 2023 program year to prior years going back to 2018 (program year 2022 is excluded, because the program was suspended and only processed carry-over projects from 2021).

Table A-30. Residential New Construction Program History

RNC Program History	Program Year				
	2018	2019	2020	2021	2023
Participants	145	194	245	256	186
Evaluated *Ex Post* Gross kWh Savings	162,407	259,578	364,825	144,301	110,977
Evaluated *Ex Post* Gross kW Savings	62	90	99	57	51

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

Water-saving devices

- Bathroom aerator
- Kitchen aerator
- Efficient showerhead

HVAC

- Air conditioner tune-up
- Central air conditioner

Thermostats

- Smart thermostat

Weatherization measures

- Air sealing
- Attic insulation
- Wall Insulation
- Whole Home IQW
- MFDI weatherstripping
- MFDI door sweeps
- Pipe wrap

Audit Education

Energy auditors gave IQW Program participants home audit reports that recommended additional energy-efficient actions they could take to further reduce energy consumption. *Ex post* savings were specific to participants, using survey response data from 47 IQW Program participants in 2023. Of these respondents, 81% said they had implemented one or more recommendations from the home audit report.

Home audit reports have two types of recommended measures:

- **Behavioral measures** that require homeowners to modify how they use 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 the thermostat with efficient settings
- **Installation measures** that required purchases and installations of equipment

Table A-31 shows the percentage of households that participated in each recommended action that IQW Program participants reported engaging in after receiving an on-site energy assessment.

Table A-31. 2023 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	79%	19
Unplug appliances when not in use	57%	12
Take shorter showers	62%	8
Program thermostat with efficient settings (excludes recipients of smart thermostats through program)	60%	96
Installation Measures		
Air sealing/weather-stripping	18%	20

Table A-32 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-32. 2023 IQW Audit Education Savings Assumptions

Recommendation	Assumption	Source
Behavioral Measures		
Turn off lights when not in use	20% reduction in HOU 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/weatherstripping	Additional air sealing and weatherstripping will achieve 50% of evaluated air sealing savings.	Engineering judgment

Water-Saving Devices

Faucet Aerators

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

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

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

The savings inputs Cadmus used for its *ex post* calculations are shown in Table A-33.

Table A-33. 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	1.49	2023 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,[a] 2015 Indiana TRM v2.2 for kitchen
Average household size (participants/household, PH) – Single-Family	2.19	2.19	2023 IQW participant survey
Average household size (participants/household, PH) – Multifamily	2.28	2.28	2020 MFDI participant survey[a]
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
Percentage 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	2023 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	0.0012	2015 Indiana TRM v2.2

[a] Cadmus used Multifamily Direct Install Program survey data because there were no multifamily-specific responses in the IQW Program 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-34.

Table A-34. 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	2.19	2023 IQW participant survey data
Average household size (participants/household, PH) – Multifamily	2.28	2020 MFDI participant survey data[a]
Number of showerheads per home (SH) – Single-Family	1.27	2023 IQW participant survey data
Number of showerheads per home (SH) – Multifamily	1.62	2020 MFDI participant survey data[a]
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	2023 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

[a] Cadmus used Multifamily Direct Install (MFDI) Program survey data because there were no multifamily-specific responses in the IQW Program survey data

HVAC and Water Heating

Air Conditioner Tune-Up

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

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

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

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
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-35.

Table A-35. IQW Program Air Conditioner Tune-Up Savings Inputs

Variable	Value	Units	Source
$Btuh_{CoolCAC}$	31,481.8	BTUH	2023 IQW Central Air Conditioner 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-36.

Table A-36. IQW Program Central Air Conditioner Savings Inputs

Description	Assumption	Source
Efficient SEER	Varies	2023 program tracking data
Efficient EER	Varies	2023 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	2023 program tracking data
FLHcool – Evansville	600	2015 Indiana TRM v2.2
CF	88%	2015 Indiana TRM v2.2

Pipe Wrap

Cadmus used the following equation to calculate savings per water heater with pipe wrap (excluding ISR):

$$kWh\ Savings = ESF * GPD * 8.3 * 365 * (T_{set} - T_{in})/(RE * 3{,}412)$$

$$kW\ Savings = kWh\ Savings/8{,}760$$

Cadmus did not use the 2015 Indiana TRM v2.2 methodology because this methodology assumed that the average temperature difference between water supplied by the water heater and ambient air temperature was constant for every foot of pipe. However, hot water does not flow constantly in most domestic residential water heating systems, so this TRM approach likely overestimates energy savings from pipe wrap. Cadmus assumed insulating water heater pipes saved an average 3% of annual hot water energy consumption, based on ACEEE Report Number E093.[45] The savings inputs Cadmus used for its *ex post* calculations are shown in Table A-37.

Table A-37. 2022 Targeted Income Program Pipe Wrap savings Inputs

Input	Assumption	Source
Energy savings factor (ESF)	3%	ACEEE Report Number E093, assumption used in CL&P and UI PSD 2013
Gallons of water used per day (GPD)	48.7	Calculated using average home size from 2023 IQW Program survey data to interpolate daily usage, based on the relationship between gallons of water per day, per household vs. the number of people. 2015 Indiana TRM v2.2
Water heater temperature set point (°F, Tsetpoint)	135 / 120	Illinois TRM V10 default value or 120 if the participant received a water heater setback
Input water temperature to house (°F, Tin)	Varies	2015 Indiana TRM v2.2; Based on location
Conversion from Btu to kWh	3412	Conversion factor
Electric water heater recovery efficiency (RE)	98%	2015 Indiana TRM v2.2
Hours/Year	8,760	2015 Indiana TRM v2.2

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-38. These inputs were primarily derived from results of a 2013-2014 evaluation of programmable and smart thermostats in CenterPoint South territory.[46] Because smart thermostats have a learning function, it was assumed that 100% were auto-adjusting temperature appropriately.

45 American Council for an Energy-Efficient Economy. April 2009. ACEEE Report Number E093. *Potential for Energy Efficiency, Demand Response, and Onsite Solar Energy in Pennsylvania.*

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

Table A-38. 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	40%	%	2023 IQW Program participant survey
Programmable thermostat saturation	50%	%	2023 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 2023, 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.[47] This evaluation reports household cooling energy savings of 332 kWh and a household heating 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 2023, the IQW Program participant survey indicated that the saturation was 40% for manual thermostats and 50% for programmable thermostats (n=10).

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:[48]

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

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

In the $\Delta Cooling_{AdjustedBaseline}$ calculation, the 252 represents the cooling savings (332 kWh multiplied by 82% 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

47 Ibid

48 Ibid.

homes with gas heating; 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.

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 (excluding ISR). The regression coefficients used were coefficient findings from the 2013 Appliance Recycling Program evaluation.

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

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

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

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
- 2023 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-39.

Table A-39. IQW Program Refrigerator Replacement Savings Inputs

Description	Assumption	Source
UEC_new (kWh)	405	2023 program tracking data, ENERGY STAR database
UEC_retired (kWh)	1,128	2023 program tracking data, appliance recycling program coefficients
UEC_standard baseline (kWh)	411	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 (excluding 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-40.

Table A-40. 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

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 (excluding 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-41.

Table A-41. IQW Program Air Sealing Savings Inputs

Description	Assumption	Source
Leakage rate before installation (CFM50_exist)	Actual	2023 program tracking data
Leakage rate after installation (CFM50_new)	Actual	2023 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 (excluding ISR):

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

The inputs used for these formulas are shown in Table A-42.

Table A-42. IQW Program Attic and Wall Insultation Savings Inputs

Description	Assumption	Source
Area of installed insulation (kSF)	Actual	2023 program tracking data
Energy Savings	Dependent on recorded pre- and post-retrofit R-values	2023 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. Cadmus calculated savings 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-43.

Table A-43. Attic Insulation Compression, Rratio, and Void Factors

Description	Assumption	Source
Actual pre- and post-R-values per manufacturing specifications (Rnominal)	Actual	2023 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 (Rframing and air space)	5	2015 Indiana TRM v2.2
Area of installed insulation in thousand square feet (kSF)	Varies by participant	2023 program tracking data for heating/cooling combination for each participant

Table A-44 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-44. 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 pre- and post-installation R-values for and calculated adjusted R-values for every installation in the database.

Interpolate 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 2023 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.

Whole Home IQW

CenterPoint Energy provided notes in the health and safety recap under which each IQW Whole Home claimed savings could fall. Evaluated savings used these notes to assign applicable program average deemed savings for measures that could not be accounted for elsewhere in the program. These measures included water heater replacement, air sealing, duct sealing, air conditioner tune-up, furnace tune-up, furnace replacement, and air conditioner replacement.

MFDI Door Sweeps

Cadmus applied this algorithm and inputs from the Illinois TRM V11 and Residential Energy Consumption Survey (RECS) to calculate and verify energy saving (excluding ISR):

$$kWh\ Savings = (\Delta kWh_{sweep,HP} * \%HP + \Delta kWh_{sweep,ER} * \%ER) * ADJ_{RxAirsealing} * \%ElectricHeat$$

The inputs used for these formulas are shown in Table A-45.

Table A-45. IQW Program Door Sweep Savings Inputs

Description	Assumption	Source
ΔkWh sweep,HP (Marion)	68.9	2023 Illinois TRM V11
n_sweep	Varies	2023 IQW Program Tracking Data
%HP (Homes with heat pumps out of homes with electric heat)	0.2	2020 Indiana RECS Data
ΔkWh sweep,ER (Marion)	137.9	2023 Illinois TRM V11
%ER (Homes with electric resistance out of homes with electric heat)	0.8	2020 Indiana RECS Data
ADJ_RxAirsealing	0.8	2023 Illinois TRM V11
%ElectricHeat	0.26	2020 Indiana RECS Data

MFDI Weatherstripping

Cadmus applied this algorithm and inputs from the 2023 Illinois TRM V11, Indiana TRM v2.2, and Residential Energy Consumption Survey (RECS) to calculate and verify energy saving (excluding ISR):

$$kWh\ Savings = \left(\Delta kWh_{wx,HP} * \%HP + \Delta kWh_{wx,ER} * \%ER\right) * ADJ_{RxAirsealing} * \%ElectricHeat + \%Cool * \frac{\left(\left(\frac{\Delta CFM50_{wx}}{N_{cool}}\right) * 60 * 24 * CDD * DUA * 0.018\right)}{1{,}000 * \eta Cool} * LM$$

The inputs used for these formulas are shown in Table A-46.

Table A-46. IQW Program Weather Stripping Savings Inputs

Description	Assumption	Source
ΔkWh wx,HP (Marion)	4.6	2023 Illinois TRM V11
Lf_weatherstripping	17	2023 IQW Program Tracking Data
%HP (Homes with heat pumps out of homes with electric heat)	0.2	2020 Indiana RECS Data
ΔkWh wx,ER (Marion)	9.2	2023 Illinois TRM V11
%ER (Homes with electric resistance out of homes with electric heat)	0.8	2020 Indiana RECS Data
ADJ_RxAirsealing	0.8	2023 Illinois TRM V11
%ElectricHeat	0.26	2020 Indiana RECS Data
%Cool	0.94	2020 Indiana RECS Data
ΔCFM50_wx	0.639	2023 Illinois TRM V11, average weatherstripping reduction
N_cool	16.3	2015 Indiana TRM v2.2
CDD	1570	2023 Illinois TRM V11; Belleville
DUA	0.75	2023 Illinois TRM V11
ηCool	10.5	2023 Illinois TRM V11
LM	3.5	2023 Illinois TRM V11

Community Connections Measure Distribution

Cadmus' impact evaluation of the Community Connections Program included two measures with attributable electric savings:

- LED Night Light
- Door and Window Weatherstripping
- Smart Power Strips
- GAP Initiative Outlet Gaskets
- GAP Initiative Door Sweeps

LED Night Light

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-47 shows the input values and the source for each value.

Table A-47. Community Connections LED Nightlight Per-Unit Gross Savings

Cadmus Assumptions	Inputs	Source
HOURS – Hours of use per year	2,920	2015 Indiana TRM v2.2[a]
$Watts_{BASE}$ – 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[a]

Smart Strips

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

$$Energy\ Savings = \sum^{Peripherals} W_{standby} * F_{homes} * F_{control} * H * \frac{1 + WHF_E}{1{,}000}$$

$$Demand\ Savings = \sum^{Peripherals} W_{standby} * F_{homes} * F_{control} * CF * \frac{1 + WHF_D}{1{,}000}$$

The end use of the smart strip is unknown, so Cadmus used the default weighting from the 2015 Indiana TRM v2.2 in which 50% are installed with TV systems and 50% are installed with computer systems. The heating and cooling factors were taken from the Indiana TRM v2.2 for the city of Evansville and were dependent on the heating and cooling types of each participant home. The savings inputs Cadmus used for its *ex post* calculations are shown in Table A-48.

Table A-48. Community Connections 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	2015 Indiana TRM v2.2, per tables in the 2015 Indiana TRM v2.2 Smart Power Strip section
Percentage of homes with peripherals (Fhomes)	Varies from 0.3% to 69% depending on home computer or TV system peripheral device	2015 Indiana TRM v2.2, per tables in the 2015 Indiana TRM v2.2 Smart Power Strip section
Percentage of peripherals controlled (Fcontrol)	Varies from 57% to 100% depending on home computer or TV system peripheral device	2015 Indiana TRM v2.2, per tables in the 2015 Indiana TRM v2.2 Smart Power Strip section
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 (TVs) (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

Weatherstripping

Cadmus applied this algorithm and inputs from the 2023 Illinois TRM V11, Indiana TRM v2.2, and Residential Energy Consumption Survey (RECS) to calculate and verify energy saving (excluding ISR):

$$kWh\ Savings = \left(\Delta kWh_{wx,HP} * \%HP + \Delta kWh_{wx,ER} * \%ER\right) * ADJ_{RxAirsealing} * \%ElectricHeat + \%Cool * \frac{\left(\left(\frac{\Delta CFM50_{wx}}{N_{cool}}\right) * 60 * 24 * CDD * DUA * 0.018\right)}{1{,}000 * \eta Cool} * LM$$

The inputs used for these formulas are shown in Table A-49.

Table A-49. Community Connections Program Weatherstripping Savings Inputs

Description	Assumption	Source
ΔkWh sweep,HP (Marion)	68.9	2023 Illinois TRM V11
n_sweep	Varies	2023 IQW Program Tracking Data
%HP (Homes with heat pumps out of homes with electric heat)	0.2	2020 Indiana RECS Data
ΔkWh sweep,ER (Marion)	137.9	2023 Illinois TRM V11
%ER (Homes with electric resistance out of homes with electric heat)	0.8	2020 Indiana RECS Data
ADJ_RxAirsealing	0.8	2023 Illinois TRM V11
%ElectricHeat	0.26	2020 Indiana RECS Data
%Cool	0.94	2020 Indiana RECS Data

Description	Assumption	Source
ΔCFM50_wx	0.639	2023 Illinois TRM V11, average weatherstripping reduction
N_cool	16.3	2015 Indiana TRM v2.2
CDD	1,570	2023 Illinois TRM V11; Belleville
DUA	0.75	2023 Illinois TRM V11
ηCool	10.5	2023 Illinois TRM V11
LM	3.5	2023 Illinois TRM V11

Door Sweeps

Cadmus applied this algorithm and inputs from the Illinois TRM V11 and Residential Energy Consumption Survey (RECS) to calculate and verify energy saving (excluding ISR):

$$kWh\ Savings = (\Delta kWh_{sweep,HP} * \%HP + \Delta kWh_{sweep,ER} * \%ER) * ADJ_{RxAirsealing} * \%ElectricHeat$$

The inputs used for these formulas are shown in Table A-50.

Table A-50. Community Connections GAP Initiative Door Sweep Savings Inputs

Description	Assumption	Source
ΔkWh sweep,HP (Marion)	68.9	2023 Illinois TRM V11
n_sweep	Varies	2023 IQW Program Tracking Data
%HP (Homes with heat pumps out of homes with electric heat)	0.2	2020 Indiana RECS Data
ΔkWh sweep,ER (Marion)	137.9	2023 Illinois TRM V11
%ER (Homes with electric resistance out of homes with electric heat)	0.8	2020 Indiana RECS Data
ADJ_RxAirsealing	0.8	2023 Illinois TRM V11
%ElectricHeat	0.26	2020 Indiana RECS Data

Gaskets

Cadmus applied this algorithm and inputs from the 2023 Illinois TRM V11, Indiana TRM v2.2, and Residential Energy Consumption Survey (RECS) to calculate and verify per unit energy saving (excluding ISR):

$$kWh\ Savings = \left(\Delta kWh_{gaskets,HP} * \%HP + \Delta kWh_{gaskets,ER} * \%ER\right) * ADJ_{RxAirsealing} * \%ElectricHeat + \%Cool * \frac{\left(\left(\frac{\Delta CFM50_{gaskets}}{N_{cool}}\right) * 60 * 24 * CDD * DUA * 0.018\right)}{1{,}000 * \eta Cool} * LM$$

The inputs used for these formulas are shown in Table A-51.

Table A-51. Community Connections GAP Initiative Gaskets Savings Inputs

Description	Assumption	Source
ΔkWh gaskets,HP (Marion)	3.6	2023 Illinois TRM V11
N_gaskets	Varies	2023 IQW Program Tracking Data
%HP (Homes with heat pumps out of homes with electric heat)	0.2	2020 Indiana RECS Data
ΔkWh gaskets,ER (Marion)	7.2	2023 Illinois TRM V11
%ER (Homes with electric resistance out of homes with electric heat)	0.8	2020 Indiana RECS Data
ADJ_RxAirsealing	0.8	2023 Illinois TRM V11
%ElectricHeat	0.26	2020 Indiana RECS Data
%Cool	0.94	2020 Indiana RECS Data
ΔCFM50_gaskets	6.49	2023 Illinois TRM V11, average gasket reduction
N_cool	16.3	2015 Indiana TRM v2.2
CDD	1570	2023 Illinois TRM V11 ; Belleville
DUA	0.75	2023 Illinois TRM V11
ηCool	10.5	2023 Illinois TRM V11
LM	3.5	2023 Illinois TRM V11

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 (HERs) 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

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 December 2023 (approximately 13 months of bills prior to the beginning of the RBS Program in 2012 and 148 months of bills after the program began). Billing data included these fields:

- Energy use during the monthly billing cycle
- The last day of the billing cycle
- 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 2023 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 2023. 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 2023. These data included treatment group customers who received HERs 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 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 HERs.

Table A-52 shows customer attrition through 2023 by treatment and control groups, by customer segment, and as originally randomized and active at the beginning of treatment in 2023. The attrition process captures customers whose accounts closed (became inactive) since the launch of the program.

Table A-52. 2023 RBS Program Customer Attrition

Customer Segment	Originally Randomized		Active at the Beginning of Treatment in 2023[a]	
	Treatment	Control	Treatment	Control
Wave 1 Dual Fuel (2013)	51,393	5,580	23,305	2,610
Wave 2 Dual Fuel (2020)	13,696	10,000	9,543	7,014
Wave 3 Dual Fuel (2022)[a]	5,745	624	6,423	701
Wave 4 Electric (2023)	9,580	9,601	9,580	9,601
Program Total	80,414	25,805	48,851	19,926

[a]The 2022 wave has had ongoing enrollment; customers continued to join since its beginning in 2022 through 2023.

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 became 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 was used as a cutoff to preserve sample sizes and be consistent across waves)

Table A-53 provides the attrition in the 2023 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 2023. Wave 3 is excluded from this table because of ongoing enrollment.

Table A-53. 2023 RBS Program Analysis Sample

Step in Attrition	Wave 1 Dual Fuel[a]		Wave 2 Dual Fuel[a]		Wave 4 Electric[a]	
	Treatment	Control	Treatment	Control	Treatment	Control
Originally Randomized Customers	51,496 (100%)	5,590 (100%)	13,693 (100%)	10,000 (100%)	9,998 (100%)	9,999 (100%)
Included in Billing Data	50,856 (99%)	5,580 (100%)	13,696 (100%)	10,000 (100%)	9,998 (39%)	10,000 (164%)
Active at Program Launch	50,856 (99%)	5,531 (99%)	13,648 (100%)	9,970 (100%)	9,938 (39%)	9,941 (163%)
Less than Six Months of Pretreatment Data	50,018 (97%)	5,442 (97%)	13,381 (98%)	9,757 (98%)	9,580 (37%)	9,601 (157%)
Final Modeling Sample	**50,018 (97%)**	**5,442 (97%)**	**13,381 (98%)**	**9,757 (98%)**	**9,580 (37%)**	**9,601 (157%)**

[a] The billing data analysis sample includes customers who were randomized into the program and active when treatment began in 2023. These customers were not necessarily active in 2023.

Table A-54 shows enrollment accrual for Wave 3, which experienced ongoing monthly enrollment starting at its launch in October 2022.

Table A-54. 2023 RBS Program Rolling Monthly Wave Analysis Sample

Wave 3 Enrollment Accrual	Included in Billing Data		At Least Six Months of Pretreatment Data	
	Treatment	Control	Treatment	Control
2022-10	5,745	624	5,242	571
2022-11	6,153	664	5,326	577
2022-12	6,332	688	5,319	579
2023-01	6,423	701	5,303	576
2023-02	6,508	716	5,342	580
2023-03	6,569	715	5,339	576
2023-04	6,597	716	5,312	572
2023-05	6,501	709	5,238	565
2023-06	6,361	704	5,149	561
2023-07	9,938	1,084	8,473	912
2023-08	9,803	1,061	8,349	892
2023-09	11,183	1,215	9,223	995
2023-10	13,515	1,462	11,255	1,204
2023-11	15,153	1,640	12,518	1,342
2023-12	15,349	1,673	12,564	1,357

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

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,[49] and the approach described in the Uniform Methods Project.[50,51]

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.[52] 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 pre- and post-treatment customer bills.

Both models yielded savings estimates that were within each other's confidence intervals, meaning that their results were not statistically different. In 2023, Cadmus reported the results of the post-treatment only model, consistent with previous program years.

The error terms of the post-only model and D-in-D fixed effects model should be uncorrelated with program participation 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.

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49 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/

50 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

51 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

52 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.

Post-treatment Only Model

Cadmus specified the post-treatment 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, besides Wave 3 which is reported separately due to rolling enrollment. Table A-55 shows both the post-treatment 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-treatment only and D-in-D fixed effects models produce statistically indistinguishable results each year, showing that estimated treatment effects are robust.

Table A-55. RBS Program Historical Model Comparison of Savings

Treatment Year	Wave 1 Dual Fuel[a]		Wave 2 Dual Fuel[a]		Wave 4 Electric[a]	
	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	0.211 (0.086) **	0.167 (0.073) **	N/A	N/A	N/A	N/A
2013	0.299 (0.101) ***	0.275 (0.095) ***	N/A	N/A	N/A	N/A
2014	0.43 (0.119) ***	0.429 (0.116) ***	N/A	N/A	N/A	N/A
2015	0.465 (0.127) ***	0.444 (0.127) ***	N/A	N/A	N/A	N/A
2016	0.443 (0.143) ***	0.429 (0.144) ***	N/A	N/A	N/A	N/A
2017	0.4 (0.149) ***	0.411 (0.154) ***	N/A	N/A	N/A	N/A
2018	0.301 (0.169) *	0.343 (0.169) **	N/A	N/A	N/A	N/A
2019	0.476 (0.179) ***	0.501 (0.184) ***	N/A	N/A	N/A	N/A
2020	0.587 (0.186) ***	0.615 (0.192) ***	0.367 (0.208) *	0.378 (0.218) *	N/A	N/A
2021	0.448 (0.196) **	0.468 (0.202) **	0.176 (0.1) *	0.161 (0.084) *	N/A	N/A
2022	0.301 (0.208)	0.313 (0.214)	0.288 (0.099) ***	0.315 (0.097) ***	N/A	N/A
2023	0.367 (0.208) *	0.378 (0.218) *	0.231 (0.124) *	0.309 (0.123) **	-0.013 (0.087)	-0.02 (0.089)

Rolling Wave Post-Treatment Only Model

For the 2022 rolling enrollment wave, Cadmus specified a monthly post-treatment only model assuming the average daily consumption (ADC_{it}) of electricity of home 'i' in month 't' as given by the following equation:

$$ADC_{it} = \sum_{t=1}^{T} \beta_{1t} PART_i * length_t + \beta_2 Pre\text{–}ADC_{it} + W'\gamma + \varepsilon_{it}$$

Where:

β_1	=	Coefficient representing the conditional average treatment effect of the program on electricity consumption in month 't' in the post-treatment period (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)
$length_t$	=	The length customer 'i' has been participating in the program, in months, starting at 1 for customers in their first month
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 't' in the pretreatment period
W	=	Vector using both HDD and CDD variables to control for weather impacts on energy use. For months October through March, this vector only includes HDD; for months May through September, this vector only includes CDD
γ	=	Vector of coefficients representing the average impact of weather variables on energy use
ε_{it}	=	Error term for customer 'i' in month 't'

Regression Analysis Estimates

Cadmus estimated separate treatment effects for Wave 3 for each month of rolling enrollment. Table A-56 shows the post-treatment only model estimates of average daily savings per customer, by month. 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.

Table A-56. RBS Program Rolling Wave Model Savings by Month

Wave 4 Dual-Fuel – Treatment Month	Post-Only (Standard Error)
2022-10	0.267 (0.448)
2022-11	-0.098 (0.224)
2022-12	0.201 (0.181)
2023-01	0.582 (0.137) ***
2023-02	0.655 (0.094) ***
2023-03	0.698 (0.066) ***
2023-04	0.572 (0.047) ***
2023-05	0.973 (0.049) ***
2023-06	1.21 (0.049) ***
2023-07	-0.588 (0.03) ***
2023-08	-0.776 (0.029) ***
2023-09	-0.243 (0.024) ***
2023-10	1.059 (0.021) ***
2023-11	-0.602 (0.016) ***
2023-12	-1.191 (0.019) ***

Program Total Savings Estimation

Cadmus estimated program savings in 2023 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 2023, as shown below. Cadmus assumed that the program implementer intended to treat all eligible customers at least once in 2023 and included treatment days for customers who should have received treatment in 2023 (i.e., those who were still active and randomized as a treatment customer), even when customers were not explicitly flagged as receiving 2023 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 2023 [53]

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

[53] For the rolling wave, average daily savings was multiplied by the number of treatment days for each customer within each month, rather than by a given customer's total treatment days for 2023.

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, which meant that 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 2023, matching the data to RBS Program treatment and control homes, and applied a simple differences analysis to each customer segment and wave. 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 2023 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 prorated a measure's savings based on the installation date, so 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 2023.

Cadmus set ρ_m as the participation rate (defined as the number of participants to the number of potential participants) in a program in 2023 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 2023, 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:

$$\textit{Net savings per home from participation uplift} = \sigma_1 - \sigma_0$$ [54]

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.

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.[55] 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.

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

55 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

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 *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 [56]
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.

Appliance Recycling Program

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

Refrigerator and Freezer Models

To evaluate CenterPoint Energy's 2023 Appliance Recycling Program, Cadmus used a regression model specified in the U.S. Department of Energy's Uniform Methods Project (UMP) to estimate consumption for refrigerators.[57] 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 indicates the influence of that variable on daily consumption. Holding all other variables constant, a positive coefficient indicates an upward influence on consumption, and a negative coefficient indicates a downward effect on consumption.

Table A-57 shows the model specification Cadmus used to estimate a refrigerator's annual unit energy consumption (UEC) and its estimated parameters. The coefficient indicates the marginal impact on the UEC of a one-point increase in the independent variable. For example, an increase in refrigerator size of one cubic foot will result in a 0.06 kWh increase in daily energy consumption. For dummy variables, the coefficient value represents the difference in consumption if the given condition proves true. For example, Cadmus' refrigerator model uses a coefficient of 0.56 for the variable indicating whether a

[56] 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.

[57] 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

refrigerator is a primary unit; thus, with all else equal, a primary refrigerator consumes 0.56 kWh per day more than a secondary unit.

Table A-57. 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[a]	-0.04	<.0001
Interaction: Unconditioned Space x CDDs[b]	0.03	0.24

[a] Heating degree day
[b] Cooling degree day

Table A-58 shows the final model specifications Cadmus used to estimate annual energy consumption of participating freezers and their estimated parameters.

Table A-58. Freezer UEC Regression Model Estimates (Dependent Variable=Average Daily kWh, R2=0.45)

Independent Variables	Coefficient	p-Value
Intercept	-0.96	0.24
Age (years)	0.045	0.01
Dummy: Unit Manufactured Pre-1990	0.54	0.20
Size (cu. Ft.)	0.12	0.001
Dummy: Chest Freezer	0.30	0.27
Interaction: Unconditioned Space x HDDs[a]	-0.03	0.04
Interaction: Unconditioned Space x CDDs[a]	0.08	0.08

[a] 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 to 2005.

Cadmus analyzed the corresponding characteristics (i.e., the independent variables) for the participating appliances (captured by ARCA, the program implementer, in the 2023 program tracking database). Table A-59 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 ZIP codes of participating appliances.[58]

Table A-59. 2023 Appliance Recycling Program Participant Mean Explanatory Variables and Model Coefficients

Measure	Independent Variables	2023 Mean Value	2023 Model Coefficient
Refrigerator	Intercept	1.00	0.81
	Age (years)	21.00	0.021
	Dummy: Manufactured pre 1990s	0.09	1.04
	Size (cu. ft.)	18.67	0.06
	Dummy: Single Door	0.01	-1.75
	Dummy: Side-by-Side	0.37	1.12
	Dummy: Primary	0.48	0.56
	Interaction: Unconditioned Space x HDDs[a]	5.27	-0.04
	Interaction: Unconditioned Space x CDDs[a]	1.59	0.03
Freezer	Intercept	1.00	-0.96
	Age (years)	23.10	0.045
	Dummy: Unit Manufactured Pre-1990	0.22	0.54
	Size (cu. ft.)	15.83	0.12
	Dummy: Chest Freezer	0.54	0.30
	Interaction: Unconditioned Space x HDDs[a]	7.13	-0.03
	Interaction: Unconditioned Space x CDDs[a]	2.14	0.08

[a] 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 to 2005.

Unit Energy Consumption

To determine annual and average daily per-unit energy consumption using UEC models and 2023 Appliance Recycling Program tracking data, Cadmus applied average participating 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 2023 rather than on a secondary data source.

Table A-60 shows the average per-unit UEC for refrigerators and freezers recycled during 2023 and 2022 (for comparison). In 2023, refrigerators and freezers had a higher UEC than in 2022. Note that the average per-unit UEC shown in the table does not include the part-use adjustment factor.

58 Typical meteorological year 3 (TMY3) uses median daily values for a variety of weather data collected from 1991 to 2005.

Table A-60. 2023 and 2022 Appliance Recycling Program – Refrigerator and Freezer Average UEC

Measure	2022 Average Unit Energy Consumption (kWh/Year)	2023 Average Unit Energy Consumption (kWh/Year)	2023 Relative Precision (90% Confidence)
Refrigerator	1,086	1,084	12%
Freezer	771	810	28%

Using values from Table A-59 above, Cadmus calculated the estimated annual UEC for 2023 freezers using the following equation:

$$\text{2023 Freezer UEC} = 365.25\ days * (-0.96 + 0.045 * [23.10\ years\ old] + 0.54 * [22\%\ units\ manufactured\ pre - 1990] + 0.12 * [15.83\ ft.^3\ ] + 0.30 * [54\%\ units\ that\ are\ chest\ freezers] + 0.08 * [2.14\ Unconditioned\ CDDs] - 0.03 * [7.13\ Unconditioned\ HDDs]) = 810\ kWh/year$$

Compared with 2022, the decrease in the refrigerator UEC is primarily because of a 6% increase in the average size of recycled refrigerators. The independent variable for average size has a positive coefficient in the gross savings model, which means a larger-size unit uses more energy than a smaller unit, holding all else equal.

The increase in the freezer UEC is primarily because of a 4% increase in the average size of recycled freezers from the average size in 2022.

Table A-61 shows a direct comparison of average values for 2022 and 2023 for all model variables.

Table A-61. Appliance Recycling Program
Participant Mean Explanatory Variables 2023 and 2022 Comparison

Measure	Independent Variables	2023 Mean Value	2022 Mean Value
Refrigerator	Age (years)	21.00	18.88
	Dummy: Manufactured pre 1990s	0.09	0.08
	Size (cu. ft.)	18.67	19.80
	Dummy: Single Door	0.01	0.02
	Dummy: Side-by-Side	0.37	0.38
	Dummy: Primary	0.48	0.48
	Interaction: Unconditioned Space x HDDs[a]	5.27	5.27
	Interaction: Unconditioned Space x CDDs[a]	1.59	1.59
Freezer	Age (years)	23.10	23.02
	Dummy: Unit Manufactured Pre-1990	0.22	0.19
	Size (cu. ft.)	15.83	15.24
	Dummy: Chest Freezer	0.54	0.48
	Interaction: Unconditioned Space x HDDs[a]	7.13	7.11
	Interaction: Unconditioned Space x CDDs[a]	2.14	2.15

[a] 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 to 2005.

Demand Reduction Impacts

The team used adjustment factors shown in Table A-62, drawn from the Indiana TRM v2.2, to calculate per-measure demand reduction separately for refrigerators and freezers, using the following equation:

$$kW\ reduction = \frac{Average\ per\ Measure\ kWh\ Savings}{8{,}760} * TAF * LSAF$$

Where:

TAF = Temperature adjustment factor

LSAF = Load shape adjustment factor

Table A-62. 2023 Appliance Recycling Program Demand Reduction Assumptions for Recycled Refrigerators and Freezers

Variable	Recycled Appliance Value
Temperature Adjustment Factor	1.21
Load Shape Adjustment Factor	1.06

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 in which the participant bought a new refrigerator for the kitchen. No survey was conducted in 2023, so Cadmus used the part-use estimates from the 2021 survey for the 2023 evaluation.

Cadmus applied the part-use factors calculated for the 2021 survey to the modeled annual consumption and demand reduction for 2023 from Table A-60 above. Table A-63 shows average per-unit gross annual energy savings and demand reduction, part-use factors and the part-use adjusted per-unit gross energy savings, and peak demand reduction used as final *ex post* gross per-unit savings for 2023.

Table A-63. 2023 Appliance Recycling Program *Ex Post* Per-Unit Energy Savings and Demand Reduction

Measure	Average Unit Energy Consumption (kWh/Year)	Average Unit Energy Consumption (kW/Year)	Part-Use Factor	*Ex Post* Per-Unit Gross Unit Energy Consumption (kWh/Year)	*Ex Post* Per-Unit Gross Unit Energy Consumption (kWh/Year)
Refrigerator	1,084	0.16	0.94	1,019	0.15
Freezer[a]	810	0.12	0.86	697	0.10

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

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-64 summarizes the recycled room air conditioners' savings assumptions and identifies each assumption's source.

Table A-64. 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	

Smart Cycle Program

Cadmus' impact evaluation of the Smart Cycle Program focused on smart thermostats with attributable electric savings. Table A-65 provides per-unit annual gross savings. The 2015 Indiana TRM v2.2 does not assign coincident peak demand savings for smart thermostats, so Cadmus did not assign coincident peak demand savings from normal use of the smart thermostats.

Table A-65. Smart Cycle Program Per-Unit Gross Savings

Program Component	Measure Group	Measure	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
			Reported	Evaluated	Reported	Evaluated
Standard	Thermostats	Smart Cycle Thermostat - Dual Fuel	519	290.79	1.10	0
Standard	Thermostats	Smart Cycle Thermostat - Electric	519	931.02	1.10	0

Smart Thermostats

Using the same savings methodology used to calculate smart thermostat savings in the 2023 Residential Prescriptive Program, Cadmus calculated ecobee 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-66 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 2022 Residential Prescriptive Program tracking database for the BTUH capacity in the electric heating savings calculation. Delayed data delivery made it challenging to calculate the capacities in the 2023 database. However, because this measure includes heat pump controls instead of installation, the 2022 database is likely more representative than the 2023 database of heat pump capacity.

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 FLH associated with that reference city was then used in the savings calculation for the installation. Cadmus applied additional assumptions from the 2019 participant survey. Cadmus did not conduct a participant survey for the 2022 or 2023 Smart Cycle Program due to the small population size.

Table A-66. 2023 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)
$BTUH_{HEAT}$	33,407	BTUH	Average of 2023 Residential Prescriptive Program heat pump tracking data capacities
$\%_{HEAT\ PUMP}$	18% for program; 59% for electric only	%	2019 participant survey
$\%_{GAS}$	68% for program; 98% for dual fuel	%	2019 participant survey
$\%_{PROPANE}$	1% for program; 2% for dual fuel	%	2019 participant survey
$\%_{ELECTRIC\ FURNACE}$	13% for program; 41% for electric only	%	2019 participant survey
Manual thermostat saturation	38%	%	2019 participant survey
Programmable thermostat saturation	62%	%	2019 participant survey
$TStat\_\text{Type}_{\text{DiscountRate}}$	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 ecobee thermostats are learning thermostats, so this value is 100% for this program.
$TStat\_Type_{COOLING\ DiscountRate}$	100%	%	The 2013-2014 Programmable and Smart 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.
$ESF_{AdjustedBaseline_{HEAT}}$	10.45%	%	Calculated, example below
$\%AC$	100%	%	Program design assumption; all Smart Cycle participants much have central air conditioning to participate in the program
$\Delta Cooling_{AdjustedBaseline}$	299	kWh	Calculated, example below in 2013-2014 Thermostat Evaluation and Adjusted Baseline section

2013-2014 Thermostat Evaluation and Adjusted Baseline

Cadmus' analysis of the thermostat savings for the 2023 Smart Cycle Program used the results of a separate Cadmus evaluation of programmable and Nest Wi-Fi thermostats in Vectren's Indiana South territory in 2013 and 2014.[59] The 2013 and 2014 evaluation reports household cooling energy savings of 332 kWh and a household heating energy saving factor (ESF) of 5% for programmable thermostats. The evaluation reports household cooling energy savings of 429 kWh and a household heating ESF of 12.5% for Nest Wi-Fi thermostats.

The 2013 and 2014 study used a 100% manual thermostat baseline for both programmable and Nest Wi-Fi thermostats. However, the 2023 Smart Cycle Program includes participants regardless of their existing thermostat type. Therefore, Cadmus used results from the 2019 Smart Cycle Program participant survey

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

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:[60,61,62]

$$\Delta Cooling_{AdjustedBaseline} = [38\% * 429 + 62\% * (429 - 210.4)] * 100\% = 299\ kWh$$

$$\mathrm{ESF}_{\mathrm{AdjustedBaseline}_{\mathrm{HEAT}}} = 38\% * 12.5\% + 62\% * (12.5\% - 3.33\%) = 10.45\%$$

In the ΔCooling_AdjustedBaseline calculation, the 213.1 represents the cooling savings (332 kWh multiplied by 63% correct use factor) for programmable thermostats. The 63% cooling correct use factor is from the 2023 Residential Prescriptive Program participant survey, which asks homeowners with programmable thermostats about their thermostat usage habits related to cooling. 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.

Commercial and Industrial Prescriptive Program

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

- Chillers
- Compressed air systems
- Controls
- HVAC
- Kitchen equipment
- Lighting
- Refrigeration
- Thermostats
- Other
- VFDs/motors

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

61 In the ΔCooling_AdjustedBaseline calculation, the 210.4 represents the cooling savings (332 kWh multiplied by 63% correct use factor) for programmable thermostats. The 63% cooling correct use factor is from the 2023 Residential Prescriptive Program participant survey, which asks homeowners with programmable thermostats about their thermostat usage habits related to cooling.

62 In the ESF AdjustedBaselineHEAT calculation, the 3.33 represents heating savings (ESF Heat of 12.5% multiplied by 67% correct use factor) for programmable thermostats. The 67% Heating correct use factor is from the 2023 Residential Prescriptive Program participant survey, which asks homeowners with programmable thermostats about their thermostat usage habits related to heating.

Chillers

Following are equations and assumptions used for each type of chiller 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%.

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. ESF is 10% for no load, 17% for variable displacement, and 26% for variable frequency drive compressed air audits.

For compressed air audits, Cadmus used the algorithms in the 2021 Wisconsin Focus on Energy TRM:[63]

$$\Delta kWh = CFM\ Reduction / \left(\frac{CFM}{BHP}\right) \times 0.746 \times HOURS/Eff$$

$$\Delta kWh = \frac{\Delta kWh}{HOURS} * CF$$

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

63 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.

Compressed Air No-Loss Condensate Drains

Cadmus used the Illinois TRM V11 algorithms for the no-loss condensate drains:

$$\Delta kWh = CFM_{reduced} * kW_{cfm} * Hours$$

Where:

$CFM_{reduced}$ = Reduced air consumption (CFM) per drain, 3 CFM.

kW_{cfm} = System power reduction per reduced air demand (kW/CFM) depending on the type of compressor control

Hours = Compressed air system pressurized hours, 6,136 hours.

Summer peak demand savings were calculated as:

$$\Delta kW = \Delta kWh/Hours * CF$$

Where:

CF = Peak coincident factor of air compressor systems, 95%

Compressed Air Leak Audit

Cadmus used the Wisconsin Focus on Energy Compressed Air System Leak Survey and Repair measure algorithm for the compressed air leak audits:

$$\Delta kWh = \frac{CFM_{reduced}/CFM}{BHP}.746 * \ Hours/Eff$$

Where:

$\mathrm{CFM_{reduced}}$ = Total CFM reduction in entire compressed air system (directly from the leak log survey)

CFM/BHP = Average amount of CFM per brake horsepower (= 4.2)

-.746 = Motor brake horsepower to kilowatt conversion factor

$Hours$ = Average annual compressor run hours

Eff = Air compressor deemed motor efficiency (= 90%)

Reduce Compressed Air Setpoint

Cadmus used the Illinois TRM V11 algorithm for reduced compressed air setpoint measures:

$$\Delta kWh = CFM_{reduced} * kW_{typical} * dP * SF * \frac{Hours}{hp_{typical}} * hp_{real}$$

Where:

$kW_{typical}$ = adjusted compressor power (kW) based on typical compressor loading and operating profile

dP = reduction in pressure differential between efficient and base case (psi)

SF = % reduction in power per 2 psi reduction in system pressure equal to 0.5% reduction per 1 psi, or Savings Factor of 0.005

$Hours$ = compressor total hours of operation depending on shift

hp_{real} = total hp of real compressors distributing air through filter

Controls

Boiler Tune-Up

Cadmus used the energy savings algorithms in the 2015 Indiana TRM v2.2 for boiler tune-ups:

$$\Delta Therms = CAP \times EFLH_H \times ESF$$

Here, CAP is the capacity of the boiler in therms, EFLH is the estimated full-load hours (which depend on the building type and location recorded in the program tracking data and confirmed in the participant survey), and ESF is a 2% energy savings factor.

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.

Advanced Rooftop Controls

Cadmus followed the energy savings algorithms in the Illinois TRM V11 for Advanced Rooftop Controls measures:

$$\Delta kWh = (Capacity_{cool} * Normalized\ Electric\ Cooling\ Energy\ Savings) + (Capacity_{heat} * Normalized\ Electric\ Heating\ Energy\ Savings)$$

Where:

$Capacity_{cool}$ = capacity of the cooling equipment in tons (nominal tonnage may be used)

$Normalized\ Electric\ Cooling\ Energy\ Savings$ = kWh/ton savings for the appropriate combination of building type, climate zone, and measure scenario

Furnace

Cadmus used this evaluated savings algorithm from the 2015 Indiana TRM v2.2 for efficient furnaces installed with electronically commutated motor (ECM) fans and adjusted it due to the new federal standard furnace fan requirement:

$$\Delta kWh = CAP \times EFLH_H * \left(10 * \frac{n_{EE}}{n_{BASE}} - 5\right)$$

$$\Delta Therms = CAP \times EFLH_H \times \left(\frac{n_{BASE}}{n_{EE}} - 1\right)/100\ - Therms_{ECM}$$

$$Therms_{ECM} = 0.019 \times CAP \times EFLH_H \times \frac{n_{BASE}}{n_{EE}}/100 \times AdjRatio$$

Where:

CAP = Heating input capacity of installed equipment in kBtuh

$EFLH_H$ = Equivalent full load heating hours selected based upon city and building type

10 = Non-ECM kWh per MMBtu of heating fuel consumption

5 = ECM kWh per MMBtu of heating fuel consumption

n_{EE} = Installed equipment efficiency, in units of AFUE

n_{BASE} = Baseline equipment efficiency, in AFUE

1 = Constant, based on algebraic manipulation of efficiency ratios

100 = Conversion to therms

$Therms_{ECM}$ = Increased heating fuel consumption due to fan motor waste heat, if no ECM, set to 0

0.019 = Conversion factor

12% = Ratio of the deemed residential-sized furnace fan savings from the 2021 Wisconsin Focus on Energy TRM of 70 kWh to the average savings of the previous standard of 583 kWh. There is less of a therms penalty because the furnace fan requirement adjusts the baseline. Cadmus assumes the baseline shifts occur linearly.

The tracking database provided Cadmus with the capacity, installed efficiency, and if an ECM fan was present. The baseline annual fuel utilization efficiency (AFUE), n_{BASE}, was the federal standard of 80%.

The existing AFUE was 64.4%, which Cadmus used when project documentation indicated replacement of working equipment.[64]

Air Conditioner Tune-Ups

Cadmus followed the energy savings algorithms in the Illinois TRM V11 for Air Conditioner Tune-Up measures:

$$\Delta kWh = \frac{kbtu}{hr} * \left(\left(\frac{1}{EER_{before}} \right) - \left(\frac{1}{EER_{after}} \right) \right) * EFLH$$

Where:

$\frac{kbtu}{hr}$	=	capacity of the cooling equipment actually installed in kBtu per hour
$\mathrm{EER_{before}}$	=	Energy Efficiency Ratio of the baseline equipment prior to tune-up
EER_{after}	=	Energy Efficiency Ratio of the baseline equipment after tune-up
$EFLH$	=	Equivalent Full Load Hours for cooling in Existing Buildings

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, Combination Ovens, and Electric Griddles

For convection ovens, combination ovens and electric griddles, 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:

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[64] Illinois Commerce Commission. September 25, 2020. *2021 Illinois Statewide Technical Reference Manual for Energy Efficiency Version 9.0—Volume 2: Commercial and Industrial Measures*. https://ilsag.s3.amazonaws.com/IL-TRM_Effective_0-10-120_v8.0_Vol_2_C_and_I_10-17-19_Final.pdf.

LB = Pounds of food cooked per day (Combination Oven = 200 lb./day, Convection Oven/Griddle = 100 lb/day)

E_{Food} = ASTM Energy to Food; amount of energy absorbed by the food during cooking (= 0.00732 kWh/lb)

Eff_{base} = Heavy load cooking energy efficiency of baseline oven (Combination Oven = 44%, Convection Oven = 65%, Electric Griddle = 60%)

Eff_{ES} = Heavy load cooking energy efficiency of ENERGY STAR oven (Combination Oven = 60%, Convection Oven = 74%, Electric Griddle = 75%)

$IDLE_{Base}$ = Idle energy rate of baseline model (Combination Oven = 7.5 kW, Convection Oven = 2 kW, Electric Griddle = 2.4 kW)

$IDLE_{EFF}$ = Idle energy rate of ENERGY STAR model (Combination Oven = 3.0 kW, Convection Oven = 1.3 kW, Electric Griddle = 0.05 kW)

$HOURS_{DAY}$ = Daily operating hours (= 12)

PC_{BASE} = Production capacity of baseline oven (Combination Oven = 80 lb/hr, Convection Oven = 70 lb/hr, Electric Griddle = 35 lb/hr)

PC_{EFF} = Production capacity of ENERGY STAR oven (Combination Oven = 100 lb/hr, Convection Oven = 80 lb/hr, Electric Griddle = 51 lb/hr)

PRE_{TIME} = Preheat time to reach operating temperature (= 15 min/day)

$PRE_{ENERGY,B}$ = Baseline preheat energy (Combination Oven = 3.0 kWh, Convection Oven = 1.5 kWh, Electric Griddle = 4 kWh)

$PRE_{ENERGY,EFF}$ = ENERGY STAR preheat energy (Combination Oven = 1.5 kWh, Convection Oven = 1 kWh, Electric Griddle = 2 kWh)

DAYS = Operating days per year (= 365)

Hot Food Holding Cabinets

For convection ovens, Cadmus used the following Illinois TRM V11 equations:

$$\Delta kWh = HFHCBaselinekWh - HFHCENERGYSTARkWh$$

$$\Delta kW = \frac{\Delta kWh}{HOURS} * CF$$

$$HFHCBaselinekWh = PowerBaseline * HOURSday * Days/1000$$

$$HFHCENERGYSTARkWh = PowerENERGYSTAR * HOURSday * Days/1000$$

Where:

PowerBaseline = Full Size HFHC = 2,500 W, ¾ Size HFHC = 1,200 W, ½ Size HFHC = 800 W

PowerENERGYSTAR = Full Size HFHC = 800 W, ¾ Size HFHC = 480 W, ½ Size HFHC = 320 W

HOURS = Average Daily Operation (= 15)

DAYS = Operating days per year (= 365.25)

CF = Summer peak coincidence factor

Freezers and Refrigerators

For freezers and refrigerators, Cadmus used the following 2015 Indiana TRM v2.2 equations:

$$\Delta kWh = (kWh_{base} - kWh_{EFF}) * 365$$

$$\Delta kW = \frac{\Delta kWh}{HOURS} * CF$$

Where:

kWh_{base} = Baseline maximum daily energy consumption in kilowatt hours

kWh_{EFF} = Efficient maximum daily energy consumption in kilowatt hours

$HOURS$ = Number of hours equipment is operating (= 8,760)

CF = Summer peak coincidence factor (= 1.0)

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[65]

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)

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65 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.

365	=	Days per year
$Hours$	=	Hours per year (= 8,760 hours)
CF	=	Summer peak coincident factor (= 0.772)

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, and so on). Cadmus evaluated all retrofit lighting measures using these 2015 Indiana TRM v2.2 algorithms:

$$\Delta kWh = (WATTS_{BASE} - WATTS_{EE}) \times Hours \times \frac{(1 + WHF_E)}{1{,}000}$$

$$\Delta kW = (WATTS_{BASE} - WATTS_{EE}) \times CF \times \frac{(1 + WHF_D)}{1{,}000}$$

In these equations:

$WATTS_{ee}$	=	Wattage of the new lighting
$WATTS_{base}$	=	Wattage of the lighting 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

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:

$$\Delta kWh = (LPD_{BASE} - LPD_{EE}) \times AREA \times Hours \times \frac{(1 + WHF_E)}{1{,}000}$$

$$\Delta kW = (LPD_{BASE} - LPD_{EE}) \times AREA \times CF \times \frac{(1 + WHF_D)}{1{,}000}$$

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 equals the 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.

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.

Anti-Sweat Heater Controls

For anti-sweat door heater controls, Cadmus used the following equation from the door heater controls for cooler or freezer measure from the 2015 Indiana TRM v2.2:

$$\Delta kWh = kW_{base} * NUM_{doors} * ESF * BF * 8{,}760$$

Where:

kW_{base}	=	Connected load kilowatts for typical reach-in refrigerator or freezer door and frame with a heater (= actual; otherwise assume 0.195 kW for freezers and 0.092 kW for coolers)
NUM_{doors}	=	Number of reach-in refrigerator or freezer doors controlled by sensor (= actual)
ESF	=	Energy savings factor (= 55% for humidity based controls, = 70% for conductivity based controls)
BF	=	Bonus factor (= 1.36 for low-temperature applications, = 1.22 for medium temperature applications, = 1.15 for high-temperature applications)

Electronically Commutated (EC) Motor – Walk-In Freezers and Refrigerators

For EC Motors serving evaporator fans on walk-in freezers and refrigerators, Cadmus used the following Illinois TRM V11 equations for the measure Electronically Commutated Motors (ECM) for Walk-in and Reach-in Coolers / Freezers:

$$\Delta kWh = Savings\ per\ motor * motors$$

The Illinois TRM V11 specifies the annual kWh savings for each of the ECM ratings as shown in Table A-67:

Table A-67. Annual kWh Savings for Each ECM Rating

Evaporator Fan Motor Rating (of ECM)	Annual kWh Savings/motor
16W	652
1/15-120 hp	1,586
1/5 hp	2,320
1/3 hp	3,380
1/2 hp	4,481
3/4 hp	5,293

Thermostats

Wifi-Enabled and Programmable 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 2023, as in the previous six 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.

To evaluate savings, Cadmus used the following equations from the Illinois TRM V11 for the measure Small Commercial Thermostats:

$$\Delta kWh = \left(\%ElecHeat * \frac{kBtu}{hr_{heat}} * \frac{1}{HSPF} * EFLH_{heat} * Heating_{Reduction} * BAF\right) + (dTherms * F_e * 29.3) + (\frac{kBtu}{hr_{cool}} * \frac{1}{SEER} * EFLH_{cool} * Cooling_{Reduction} * BAF)$$

Where:

$\%ElecHeat$	= Percentage of heating savings assumed to be electric.
$kBtu/hr_{heat}$	= capacity of the heating equipment in kBtu per hour
$HSPFbase$	= Heating Seasonal Performance Factor of the baseline equipment
$EFLH_{heat}$	= heating mode equivalent full load hours in Existing Buildings
$Heating_{reduction}$	= Assumed percentage reduction in total building heating energy consumption due to thermostat (8.8%)
$dTherms$	= Therm savings in Natural Gas heating system
F_e	= Furnace Fan energy consumption as a percentage of annual fuel consumption (7.7%)
29.3	= kWh per therm
$kBtu/hr_{cool}$	= Capacity of the cooling equipment actually installed in kBtu per hour
$EFLH_{cool}$	= Equivalent Full Load Hours for cooling in Existing Buildings
$Cooling_{Reduction}$	= Average percentage reduction in total building cooling energy consumption due to installation of thermostat (17.7%)

Other

Window Film

For window film measures, Cadmus used the following equations from the 2015 Indiana TRM v2.2 to determine savings:

$$\Delta kWh = \frac{SF}{100} * \Delta kWh_{100sf}$$

$$\Delta kW = \frac{SF}{100} * \Delta kW_{100sf} * CF$$

Where:

SF = Glazing surface area of installed window film in square feet

ΔkWh_{100sf} = Unit energy savings per 100 square feet of window film

ΔkW_{100sf} = Unit demand reduction per 100 square feet of window film

CF = Summer peak coincident factor (= 0.74)

Heat Pump Water Heater

For heat pump water heater measures, Cadmus used the following equations from the 2015 Indiana TRM v2.2 to determine savings:

$$\Delta kWh = \frac{GPD * 365 * 8.3 * (T_{out} - T_{in})}{3{,}412} * (\frac{1}{EF_{base}} - \frac{1}{EF_{ee}})$$

Where:

GPD = Average daily gallons of hot water consumption

365 = Days of operation per year

8.3 = Specific weight of water multiplied by the specific heat of water

T_{out} = Water heater set point (130F)

T_{in} = Cold water temperature entering the DWH system (58.1)

3,412 = Conversion Factor (Btu/kWh)

EF_{base} = Baseline water heater energy factor

EF_{ee} = Energy factor of HPWH system

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 V11.[66] The 2015 Indiana TRM v2.2 had limited building types.

VFDs for HVAC applications

Cadmus used the following equations to determine savings:

$$\Delta kWh = \frac{BHP}{Eff_i} * Hours * ESF$$

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66 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/

$$\Delta kW = \frac{BHP}{Eff_i} * DSF$$

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

Commercial and Industrial Custom Program

Cadmus' impact evaluation of the Commercial and Industrial (C&I) Custom Program included measures with attributable electric savings from eight end-use types, as shown in Table A-68.

Table A-68. 2023 Commercial and Industrial (C&I) Custom Program Measures

End Use	Quantity of Measures	Reported Annual Energy Savings (kWh)	Reported Demand Savings (kW)
Air-Conditioners	15	21,080	19.74
Controls Optimization	37	306,253	35.82
Lighting	28	546,698	94.19
Other	4	144,739	41.09
Refrigeration	2	215,984	25.47
Retro-Commissioning	16	1,727,145	193.91
VFDs	3	54,973	9.48

Each customer (or participating contractor) provided initial documentation of the project's energy savings and demand reduction, which the program implementer reviewed, adjusted where necessary, and finalized. To evaluate the reasonableness of the savings calculations, Cadmus reviewed 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 followed accepted engineering methodologies
- All assumed baselines were 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 (not on-site verification) for all 27 C&I Custom Program projects (electric application IDs), which accounted for all of the program's electric savings in 2023. Cadmus determined that seven measures required a savings adjustment, as shown in Table A-69.

Table A-69. 2023 Commercial and Industrial (C&I) Custom Program Measures

Application ID	Project Description	Annual Energy Savings (kWh)		Demand Savings (kW)		Adjustments
		Reported	Evaluated	Reported	Evaluated	
31	Retro-Commissioning	184,422	84,422	28.23	10.10	Removed demand savings from AHU schedule optimization measure. AHU continues to operate during peak period after retro-commissioning process.
744	Retro-Commissioning	329,020	329,020	37.65	-	Removed demand savings from AHU schedule optimization measure. AHUs continue to operate during peak period after retro-commissioning process.
745	Retro-Commissioning	688,382	688,382	78.77	-	Removed demand savings from AHU schedule optimization measure. AHUs continue to operate during peak period after retro-commissioning process.
746	Retro-Commissioning	240,410	240,410	27.92	-	Removed demand savings from AHU schedule optimization measure. AHUs continue to operate during peak period after retro-commissioning process.
1202	Retro-Commissioning	76,491	76,491	8.69	-	Removed demand savings from AHU schedule optimization measure. AHUs continue to operate during peak period after retro-commissioning process.
1385	Retro-Commissioning	111,271	111,271	12.65	-	Removed demand savings from AHU schedule optimization measure. AHUs continue to operate during peak period after retro-commissioning process.
2425	Other	54,973	44,678	9.48	6.10	Removed savings associated with AC Tune-up measure due to existing maintenance agreement with the vendor

Small Business Energy Solutions

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. Cadmus found 24 of 41 measures did not report values for waste heat factors in the tracking database. Because of this, evaluated savings differed from reported savings for each of these measures resulting in measure level realization rates of 96.6% for demand and 116.0% for electric energy savings.

Lighting – Exit Signs

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 ISR of 100% rather than the 98% ISR stipulated in the TRM because the program is direct-install and should be claiming savings for equipment directly installed by the contractor.

Lighting – Exterior

Cadmus used the HOU 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 – 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 facility type and looked up coincidence factors for the building type. Cadmus found that 36 records (1% of interior lighting records) used a different coincident factor in the *ex ante* calculations.

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. Evaluated savings aligned with the tracking database.

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.[67]

In 2023, 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 vary by degree heating/cooling setback, hours of setback per day, and days the business is 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.

[67] The same eQuest model is used for both programmable and smart Wi-Fi thermostats.

Cadmus evaluated thermostat measures based on the methodologies outlined in measure "4.4.48 Small Commercial Thermostats" from the Illinois TRM V10. Cadmus found the measures realized 99.3% of *ex ante* annual electric energy savings.

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.

Conservation Voltage Reduction

The 2023 evaluation for the Tekoppel substation required a departure from previous methodology due to insufficient observations of cycling during the summer of 2023. Savings for 2023 result from applying historical savings rates from the 2020 East Side station evaluation to the 2019 Tekoppel annual load.

Table A-70 lists the reported and evaluated savings for the 2023 Conservation Voltage Reduction (CVR) Program.

Table A-70. 2023 Conservation Voltage Reduction Per-Unit Gross Savings

Program	Annual Gross Savings (kWh)		Annual Gross Savings (Coincident Peak kW)	
	Reported	Evaluated	Reported	Evaluated
Tekoppel Substation CVR	2,228,830	3,008,921	396	944

Data Sources

Cadmus analyzed feeder-level data for each of the four feeders at CenterPoint's Tekoppel substation between August 20 and November 2nd, 2023. These data were exported from AdaptiVolt, Utilidata's volt/VAR optimization (VVO) software, which records multiple measurements for each feeder at 15-second intervals that can be used for modeling. Cadmus retrieved the data from CenterPoint's SFTP site. In its analysis of each feeder, Cadmus used specific measurements—start and end of line voltage, demand, three-phase power, and CVR system status (on or off). Given the limited time frame of this feeder-level data, Cadmus also collected monthly feeder-level data for all four Tekoppel feeders from 2019.

Cadmus also collected local climatological data from the National Oceanic and Atmospheric Administration (NOAA) for the weather station at the Evansville Regional Airport. This data contains hourly, historical records of temperature and relative humidity that coincide with the supplied power distribution data.

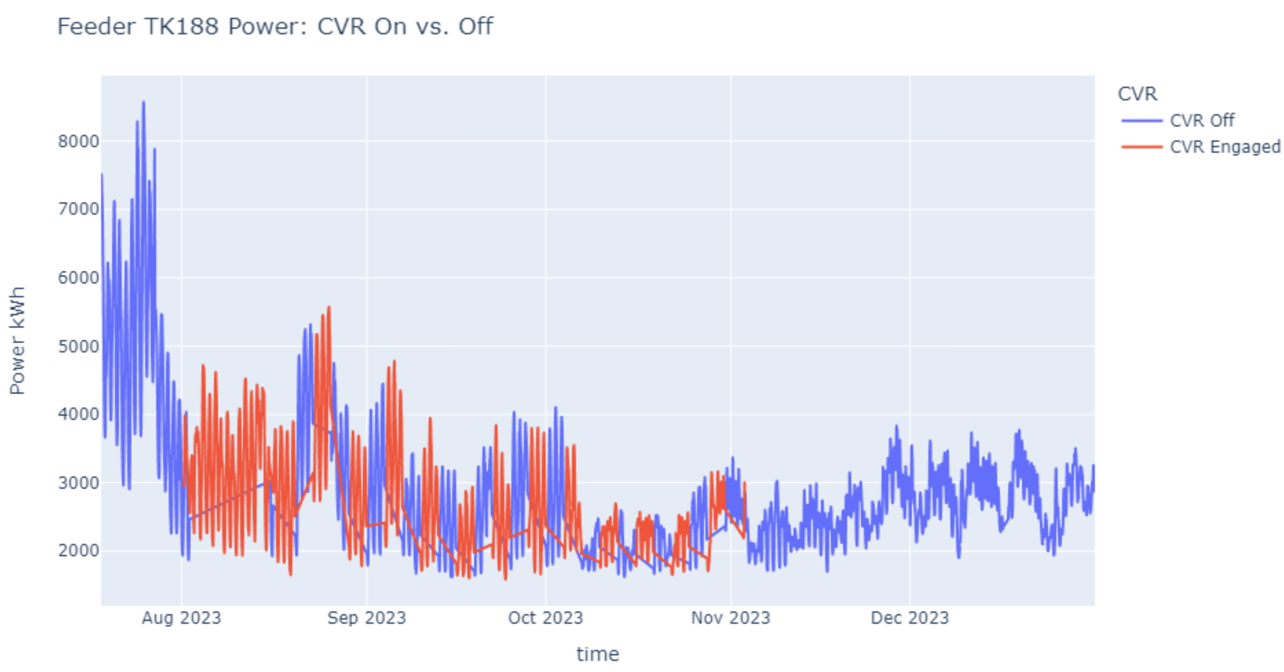
Savings Analysis

Cadmus used statistical modeling to develop estimates of energy and demand savings. This technique empirically quantifies savings by modeling feeder-level power demand as a response to local meteorological and temporal variables. These models are used to predict what a feeder's power demand would have been in the absence of an operating CVR system. The savings attributed to this period are calculated as the difference between these counterfactual predictions of power demand and the actual measurements recorded during that time. Energy savings are calculated by summing demand savings over time.

The first step in developing a model is to select the data from the periods of time when a feeder's CVR system was not engaged. These periods are referred to as the baseline period, and a model fit to these data is called a baseline model.

The periods when a feeder's CVR system was turned on are referred to as event periods, and savings estimates are reported for these hours. When designating event and baseline periods, days that did not follow the predetermined schedule of three days on and three days off, for CVR engagement, were excluded. This resulted in different time spans for the four feeders. Feeders TK188 and TK288 had data spanning August 20 – November 2, 2023, while feeders TK388 and TK488 had data spanning September 1 – October 26, 2023. This date range excludes a majority of the summer season, where CVR can benefit. This limited date range presented several challenges in the analysis and required a different methodology. Figure A-1 illustrates a single feeder's power for when the CVR system was on and off. As depicted in the figure potential summer savings were not available for the modeling due to the late installation. Furthermore, correct cycling of the CVR system began on August 20th, further reducing the available data for modeling.

Figure A-1. Example Activation of Conservation Voltage Reduction for Single Feeder, 2023



As a first method, Cadmus used random forest regression to fit baseline models of demand for each feeder to outdoor air temperature and relative humidity, the hour of the day, and the day of the week.[68]

However, because the model was trained on limited data it is unable to generalize to unseen days, and capture the large savings expected for July. To test the functionality of the model, Cadmus conducted a linear fixed-effects regression to estimate whether the impact of CVR engagement on power was statistically significant. For this regression model, fixed effects of weather and month were included to isolate the treatment effect. For two of the feeders, there was a negative statistically significant effect; however, for the remaining two feeders there was no statistically significant relationship. This confirms that due to the limited unrepresentative data, the random forest model cannot be used to generate results. Thus, Cadmus applied percent savings from the 2020 analysis of East Side Substation to the Tekoppel substation's total 2019 kWh.

[68] Random forest regression is an ensemble machine learning method that fits many decision trees on subsamples of data.

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 2021 impact evaluation for programs for which a participant survey was not conducted in 2023 or if the 2023 survey did not generate a significant response (given small program population or analysis sample).
- ***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	✓	✓[a]		
Residential New Construction		✓[b]		
Income Qualified Weatherization		✓		
Community Connections		✓		
Residential Behavioral Savings				✓
Appliance Recycling		✓[c]		
Smart Cycle		✓[d]		
Commercial and Industrial Programs				
Commercial and Industrial Prescriptive	✓			
Commercial and Industrial Custom	✓			
Small Business Energy Services		✓[e]		

[a] Cadmus used 2021 survey data based NTG results to calculate NTG for Residential Prescriptive Midstream program channel.
[b] Cadmus used 2021 survey data based NTG results to calculate NTG for Residential New Construction.
[c] Cadmus used 2021 survey data based NTG results to calculate NTG for Appliance Recycling.
[d] Cadmus used 2019 survey data based NTG results to calculate NTG for Smart Cycle.
[e] Cadmus used 2021 survey data based NTG results to calculate NTG for Small Business Energy Services.

The individual, program-specific methodologies are detailed below.

Residential Specialty Lighting Program

Cadmus calculated NTG for the Residential Specialty Lighting program as the average of NTG values from seven different utilities using findings from a benchmarking study conducted in 2021 (details are in the 2021 Electric Memo appendix). The program resulted in a 34% NTG ratio.

Table B-2 lists the NTG results applied to residential specialty lighting for the 2023 program year.

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	**66%**	**0%**	**34%**

Residential Prescriptive Program

Cadmus calculated NTG for the Residential Prescriptive Program using findings from surveys conducted with 1,030 Standard and Online Marketplace channel program participants and the 2021 Midstream NTG results.[69] Table B-3 summarizes the freeridership, spillover, and NTG estimates by program channel. The overall program NTG ratio of 60% is weighted by the combination of electric and natural gas gross evaluated program population savings.

Table B-3. 2023 Residential Prescriptive Net-to-Gross Ratio by Program Channel

Program Channel	Freeridership	Spillover	NTG Ratio	Total Program *Ex Post* MMBTU Savings
Standard and Online Marketplace	39%	0%	61%	90,443
Midstream	55%	0%	45%	4,605
Total Program	**40%[1]**	**0%**	**60%**	**95,048**
Electric-Specific NTG			**62%**	**8,487**
Demand-Specific NTG			**54%**	**2.72[b]**
Natural Gas-Specific NTG			**60%**	**86,561**

[a] Weighted by evaluated *ex post* program population MMBtu savings

[b] MMBTU/hour savings

Standard and Online Marketplace

Cadmus calculated NTG for the Residential Prescriptive Program Standard and Online Marketplace channels using findings from a survey conducted with 1,030 program participants; 806 answered the freeridership questions and 429 program participants answered the spillover questions. Table B-4 summarizes the freeridership, spillover, and NTG estimates by measure category. The overall program NTG ratio of 60% is weighted by the combination of electric and gas gross evaluated program population savings.

The electric-specific NTG ratio of 62% presented in Table B-4 is weighted specifically to electric savings due to the application of measure category level NTG estimates. The overall NTG ratio is heavily weighted toward the natural gas-specific NTG estimate of 60% because *ex post* gross gas savings account for 95% of the total 2023 energy savings in the Standard and Online Marketplace channels.

69 For the 2023 Residential Prescriptive Program Midstream program channel, Cadmus applied 2021 Midstream NTG results due to insufficient response rates to the NTG questions by participating distributors and contractors in 2023.

Table B-4. 2023 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=210 for FR, 94 for SO)	46%	0%	54%	62,788
Heat Pump/CAC (n=34 for FR, 19 for SO)	39%	0%	61%	290
Thermostat (n=358 for FR, 222 for SO)	18%	1%	83%	18,058
Water Heater (n=81 for FR, 42 for SO)	43%	0%	57%	4,014
Weatherization (n=17 for FR, 4 for SO)	28%	0%	72%	4,335
Other (n=106 for FR, 48 for SO)	26%	6%	80%	958
Total Program (n=1,030)[a]	**39%[b]**	**0%[b]**	**61%[b]**	**90,443**
Electric-Specific NTG			**79%**	**4,131**
Demand-Specific NTG			**68%**	**0.61[c]**
Natural Gas-Specific NTG			**60%**	**86,312**

[a] Through all survey efforts, 806 respondents answered freeridership questions and 429 respondents answered spillover questions. 1,030 unique participants answered either the freeridership questions or spillover questions. 205 answered freeridership and spillover questions. 577 answered only freeridership questions. 224 answered only spillover questions. Not all respondents surveyed answered the freeridership and spillover questions.
[b] Weighted by evaluated *ex post* program population MMBtu savings
[c] MMBTU/hour savings

Detailed Freeridership Findings

Cadmus estimated freeridership by combining the standard self-report *intention* method and the *intention*/*influence* method.[70] Cadmus calculated the arithmetic mean of the savings weighted *intention* and *influence* freeridership components to estimate measure category freeridership estimates,[71] as shown in this equation:

$$\text{Final Freeridership \%} = \frac{\textit{Intention}\text{ FR Score}(0\%\text{ to }100\%) + \textit{Influence}\text{ FR Score}(0\%\text{ to }100\%)}{2}$$

Intention Freeridership Score

Cadmus estimated *intention* freeridership scores for all participants based on their responses to *intention*-focused freeridership questions. As part of previous 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 to form a picture of the program's influence on the participant. Use of multiple questions also checks consistency.

Table B-5 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

70 *Intention* and *influence* freeridership scores both have a maximum of 100%.

71 *Ex post* gross program savings.

associated with each response option. Each participant freeridership score starts with 100%, which Cadmus then decrements based on their responses to the questions.

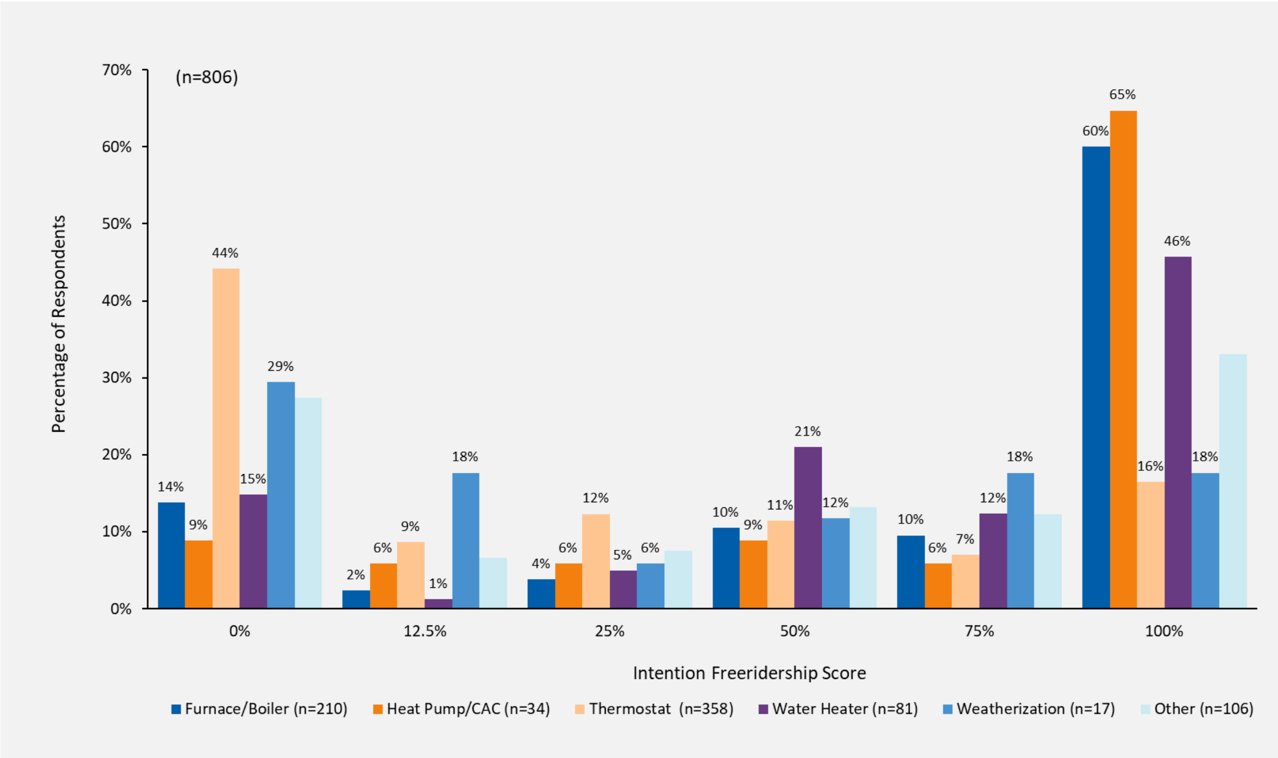
Table B-5. Raw Survey Responses Translation to *Intention* Freeridership Scoring Matrix Terminology Residential Prescriptive Program and Scoring

Before you heard about the CenterPoint Energy [If OnlineMarketplace <>yes: Residential Rebate Program/ If OnlineMarketplace =yes: Online Marketplace], had you already planned to [If purchase: purchase the/if tune-up: schedule a tune-up or annual check-up of your] [MEASURE]?	[If OnlineMarketplace≠yes] Before you heard anything about the CenterPoint Energy Residential Rebate Program, had you ALREADY [If purchase: purchased or installed/if tune-up: scheduled the tune-up or annual check-up of] your [MEASURE]?	[If OnlineMarketplace≠yes] Just to be clear, is it correct that you [If purchase: purchased your new/if tune-up: scheduled a tune-up for your] [MEASURE] before you heard anything about the CenterPoint Energy Residential Rebate Program, correct?	[If purchase] Would you most likely have purchased and installed the same type of [MEASURE] without the rebate or discount from CenterPoint Energy? [If tune-up] Would you most likely have scheduled a [MEASURE] tune-up without the rebate or discount from CenterPoint Energy?	[If purchase] Would you most likely have purchased and installed a different type of [MEASURE] without the CenterPoint Energy rebate or discount or would you most likely have decided not to purchase it?	[If purchase] This next question is going to ask you about the efficiency of your [MEASURE]. In this case, efficiency refers to the energy savings associated with your [MEASURE]. More efficient means that the [MEASURE] reduces your energy usage and less efficient means that the [MEASURE] increases your energy usage. Without the rebate or discount from CenterPoint Energy, would you most likely have purchased and installed [If MEASURE≠LED lighting: a] [MEASURE] that was just as energy efficient, less energy efficient or more energy efficient than what you purchased?	Without the rebate or discount from CenterPoint Energy, what kind of thermostat would you most likely have purchased and installed?	[If purchase] Would you most likely have purchased and installed the same quantity of [MEASURE][If MEASURE≠LED lighting:s] without the incentive from CenterPoint Energy?	Thinking about timing, without the CenterPoint Energy rebate or discount, when would you most likely have [If purchase: purchased and installed/if tune-up: scheduled a tune-up for] the [MEASURE]?
Yes (Yes) [-0%]	Yes (Yes) [-0%]	Yes, that is correct (Yes) [100% FR Assigned]	Yes (Yes) [-0%]	I would have installed a different MEASURE (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) [-100%]	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		Never (No) [-100%]

Before you heard about the CenterPoint Energy [If OnlineMarketplace <>yes: Residential Rebate Program/ If OnlineMarketplace =yes: Online Marketplace], had you already planned to [If purchase: purchase the/if tune-up: schedule a tune-up or annual check-up of your] [MEASURE]?	[If OnlineMarketplace≠yes] Before you heard anything about the CenterPoint Energy Residential Rebate Program, had you ALREADY [If purchase: purchased or installed/if tune-up: scheduled the tune-up or annual check-up of] your [MEASURE]?	[If OnlineMarketplace≠yes] Just to be clear, is it correct that you [If purchase: purchased your new/if tune-up: scheduled a tune-up for your] [MEASURE] before you heard anything about the CenterPoint Energy Residential Rebate Program, correct?	[If purchase] Would you most likely have purchased and installed the same type of [MEASURE] without the rebate or discount from CenterPoint Energy? [If tune-up] Would you most likely have scheduled a [MEASURE] tune-up without the rebate or discount from CenterPoint Energy?	[If purchase] Would you most likely have purchased and installed a different type of [MEASURE] without the CenterPoint Energy rebate or discount or would you most likely have decided not to purchase it?	[If purchase] This next question is going to ask you about the efficiency of your [MEASURE]. In this case, efficiency refers to the energy savings associated with your [MEASURE]. More efficient means that the [MEASURE] reduces your energy usage and less efficient means that the [MEASURE] increases your energy usage. Without the rebate or discount from CenterPoint Energy, would you most likely have purchased and installed [If MEASURE≠LED lighting: a] [MEASURE] that was just as energy efficient, less energy efficient or more energy efficient than what you purchased?	Without the rebate or discount from CenterPoint Energy, what kind of thermostat would you most likely have purchased and installed?	[If purchase] Would you most likely have purchased and installed the same quantity of [MEASURE][If MEASURE≠LED lighting:s] without the incentive from CenterPoint Energy?	Thinking about timing, without the CenterPoint Energy rebate or discount, when would you most likely have [If purchase: purchased and installed/if tune-up: scheduled a tune-up for] the [MEASURE]?
						thermostat (Yes) [-100%]		
						DK/RF (Partial) [-25%]		DK/RF (Partial) [-25%]

Figure B-1 shows the distribution of *intention* freeridership estimates Cadmus assigned to participant responses to the pure intention-based freeridership method.

Figure B-1. Residential Prescriptive Program Self-Report *Intention* Freeridership Distribution by Estimate



Influence Freeridership Score

Table B-6 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-6. Residential Prescriptive Program Freeridership *Influence* Responses by Measure Category (n=806)

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	Water Heater	Weatherization	Other	Furnace/Boiler	Heat Pump/CAC	Thermostat	Water Heater	Weatherization	Other	Furnace/Boiler	Heat Pump/CAC	Thermostat	Water Heater	Weatherization	Other	Furnace/Boiler	Heat Pump/CAC	Thermostat	Water Heater	Weatherization	Other
1 - Not at all influential	100%	21	1	3	5	1	1	21	1	8	7	1	5	21	1	8	7	1	5	21	1	8	7	1	5
2 - Not too influential	75%	6	0	3	2	1	4	7	0	7	3	1	8	7	0	7	3	1	8	7	0	7	3	1	8
3 - Somewhat influential	25%	47	13	19	20	2	11	47	13	50	20	2	29	47	13	50	20	2	29	47	13	50	20	2	29
4 - Very influential	0%	129	19	103	40	13	13	129	19	292	49	13	63	129	19	292	49	13	63	129	19	292	49	13	63
Not Applicable	50%	6	1	0	2	0	1	6	1	1	2	0	1	6	1	1	2	0	1	6	1	1	2	0	1
Average Rating		**3.4**	**3.5**	**3.7**	**3.4**	**3.6**	**3.2**	**3.4**	**3.5**	**3.8**	**3.4**	**3.6**	**3.4**	**3.4**	**3.5**	**3.8**	**3.4**	**3.6**	**3.4**	**3.4**	**3.5**	**3.8**	**3.4**	**3.6**	**3.4**

Cadmus used the maximum rating given by each participant for any factor in Table B-6 to determine the participant's *influence* score, presented in Table B-7. 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-7. Residential Prescriptive Program Influence Freeridership Score (n=806)

Maximum *Influence* Rating	*Influence* Score	Furnace/Boiler	Heat Pump/CAC	Thermostat	Water Heater	Weatherization	Other
1 – Not at all influential	100%	21	1	8	7	1	5
2 – Not too influential	75%	7	0	7	3	1	8
3 – Somewhat influential	25%	47	13	50	20	2	29
4 – Very influential	0%	129	19	292	49	13	63
Not Applicable	50%	6	1	1	2	0	1
Average Maximum *Influence* Rating - Simple Average		**3.4**	**3.5**	**3.8**	**3.4**	**3.6**	**3.4**
Average *Influence* Score - Weighted by *Ex Post* Savings		**19%**	**13%**	**6%**	**19%**	**16%**	**10%**

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-8 summarizes the *intention*, *influence*, and overall freeridership scores for each measure category.

Table B-8. Residential Prescriptive Program *Intention*, *Influence* and Overall Freeridership Scores by Measure Category

Measure Category	n	*Intention* Score	*Influence* Score	Freeridership Score
Furnace/Boiler	210	72%	19%	46%
Heat Pump/CAC	34	65%	13%	39%
Thermostat	358	30%	6%	18%
Water Heater	81	67%	19%	43%
Weatherization	17	39%	16%	28%
Other	106	41%	10%	26%

Detailed Spillover Findings

Nine reported installing a total of 11 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, refrigerators, air purifiers, dehumidifiers, a VSP pool pump, a central air conditioner, and gas water heater.

Cadmus used *ex post* savings estimated for the 2023 Residential Prescriptive Program evaluation in combination with the 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-9.

Table B-9. 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	1.4	1,178.2	0%
Heat Pump/CAC	0.0	21.8	0%
Thermostat	6.7	969.6	1%
Water Heater	0.0	199.4	0%
Weatherization	0.0	60.3	0%
Other	8.4	135.3	6%

Commercial and Industrial Prescriptive Program

Cadmus calculated freeridership and spillover for the C&I Prescriptive Program using findings from a survey conducted with 33 program participants. After including spillover, the program's NTG ratio was 85%. Table B-10 presents the freeridership, spillover, and NTG results for the 2023 C&I Prescriptive Program.

Table B-10. 2023 Commercial and Industrial Prescriptive Program Net-to-Gross Ratio

Measure	Freeridership	Spillover	NTG Ratio
Total Program	15%[a]	0%	85%

[a] Weighted by evaluated *ex post* program MMBtu savings.

Detailed Freeridership Findings

Intention Freeridership Score

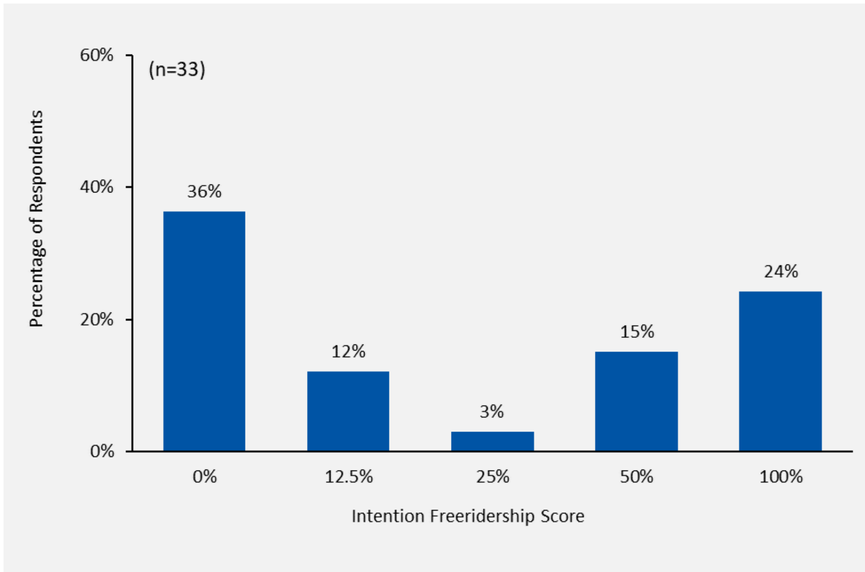
Cadmus estimated *intention* freeridership scores for all participants based on their responses to the intention-focused freeridership questions. Table B-11 illustrates how initial responses were translated into "yes," "no," or "partially" to indicate freeridership (in parentheses). The value in brackets is the scoring decrement associated with each response option. Each participant's freeridership score starts at 100%, which Cadmus then decrements based on the responses to the questions. After assigning an *intention* freeridership score to every survey respondent, Cadmus calculated a savings-weighted average *intention* freeridership score of 24% for the program.

Table B-11. 2023 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 energy efficient [] over a less efficient option 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, is it correct that you installed the [MEASURE] before you heard anything about the CenterPoint Energy program?	Without the rebate and information or education from CenterPoint Energy, would you have installed a [MEASURE] that (was/were) just as energy-efficient, less energy efficient, or more energy efficient than what you purchased??	Would you most likely have [IF SERVICE=0, "installed", else "completed"] the same amount of [MEASURE](s) without the rebates and information and education from CenterPoint Energy?	Without the rebate and information or education from CenterPoint Energy, when would you most likely have installed the [MEASURE]?	Did the rebate from CenterPoint Energy help the [MEASURE] project receive implementation approval from your organization?	Prior to learning about 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, lower amount (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, higher amount (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%]		

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. 2023 Commercial and Industrial Prescriptive Program Self-Report *Intention* Freeridership Distribution by Estimate



Influence Freeridership Score

Table B-12 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-12.

Table B-12. 2023 Commercial and Industrial Prescriptive Program Freeridership *Influence* Responses (n=33)

Response Options	*Influence* Score	CenterPoint Energy or Implementer 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%	9	6	3	3	1
2 – Not too important	75%	8	3	8	2	1
3 – Somewhat important	25%	0	4	2	8	7
4 - Very important	0%	0	15	8	11	5
Don't Know	50%	0	2	7	7	14
Not Applicable	50%	6	3	5	2	5
Average		**1.5**	**3.0**	**2.7**	**3.1**	**3.1**

Cadmus used the maximum rating given by each participant for any factor in Table B-12 to determine the participant's *influence* score presented in Table B-13. 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 6% for C&I Prescriptive Program participants.

Table B-13. 2023 Commercial and Industrial Prescriptive Program Influence Freeridership Score (n=33)

Maximum *Influence* Rating	*Influence* Score	Count[a]	Total Survey Sample *Ex Post* MMBtu Savings	*Influence* Score MMBtu Savings
1 – Not at all important	100%	1	21	21
2 – Not too important	75%	2	43	32
3 – Somewhat important	25%	7	277	69
4 - Very important	0%	21	2,756	0
Don't Know	50%	2	134	67
Average Maximum *Influence* Rating - Simple Average		**3.5**		
Average *Influence* Score - Weighted by *Ex Post* Savings			**6%**	

[a] 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 15%, weighted by *ex post* gross program savings. The higher the freeridership score, the more savings are deducted from the gross savings estimates. Table B-14 presents the *intention*, *influence*, and freeridership scores for the C&I Prescriptive Program.

Table B-14. 2023 Commercial and Industrial Prescriptive Program *Intention/Influence* Freeridership Score

n	*Intention* Score	*Influence* Score	Freeridership Score
33	24%	6%	15%

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.

Commercial and Industrial Custom Program

Cadmus calculated freeridership and spillover for the C&I Custom Program as a whole using findings from a survey conducted with five program participants. After including spillover, the program resulted in a 97% NTG ratio.

Table B-15 presents the freeridership, spillover, and NTG results for the 2023 C&I Custom Program.

Table B-15. 2023 Commercial and Industrial Custom Program Net-to-Gross Ratio

Measure	Freeridership	Spillover	NTG Ratio
Total Program	3%[a]	0%	97%

[a] Weighted by evaluated *ex post* program MMBtu savings

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-16 illustrates how initial responses are translated into "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* freeridership score of 5% for the program.

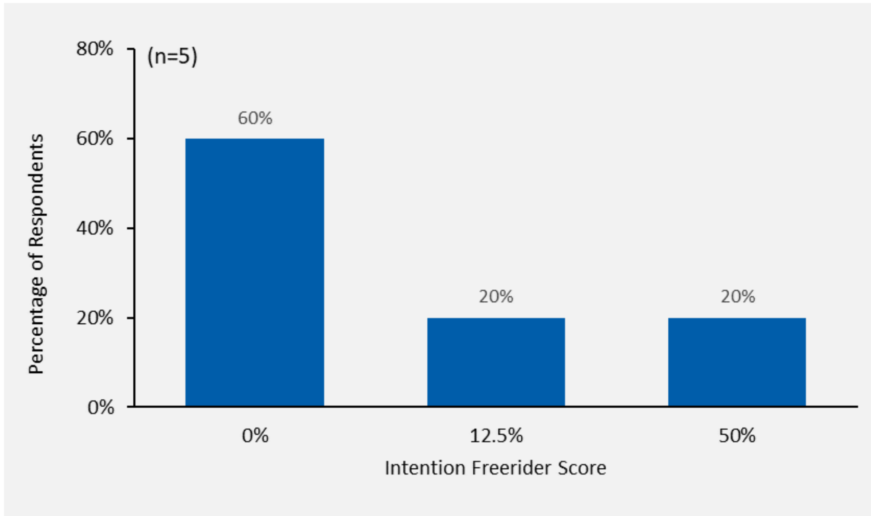
Table B-16. 2023 Raw Survey Responses Translation to *Intention* Freeridership Scoring Matrix Terminology C&I Custom Program and Scoring

First, did your organization have specific plans to install the [MEASURE_FINAL] BEFORE learning about CenterPoint Energy's Commercial Custom Program rebate?	Had you already purchased or installed the new [MEASURE_FINAL] before you learned about the program?	Just to be clear, you installed the [MEASURE_FINAL] before you heard anything about the CenterPoint Energy program, correct?	Would you have installed a [MEASURE_FINAL] that (was/were) just as energy-efficient without the CenterPoint Energy program and rebates?	And would you have installed the same quantity of [MEASURE_FINAL] in absence of the CenterPoint Energy program and rebates?	Without the CenterPoint Energy program and rebates, would you have installed the [MEASURE_FINAL]	Did the incentive help the [MEASURE_FINAL] project receive implementation approval from your organization?	Prior to participating in the Commercial Custom Program, was the purchase and installation of the [MEASURE_FINAL] included in your organization's capital budget?
Yes (Yes) [-0%]	Yes (Yes) [-0%]	Yes, that is correct (Yes) [100% freerider Assigned]	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%]	Less energy efficient (No) [-100%]	No, I would have installed less (partial2) [-50%]	Within one to two years? (Partial2) [-25%]	No (Yes) [-0%]	No (No) [-50%]
DK/NA (Partial) [-25%]	DK/NA (No) [-0%]	DK/NA (No) [-0%]	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%]	Would not have installed anything at all (no) [-100%]	In more than five years? (No) [-100%]		
				DK/NA (Partial) [-25%]	DK/NA (Partial) [-25%]		

DK = don't know; RF = refused

Figure B-3 shows the distribution of *intention* freeridership estimates Cadmus assigned to participant responses using the pure intention-based freeridership method.

Figure B-3. 2023 C&I Custom Program Self-Report *Intention* Freeridership Distribution by Estimate



Influence Freeridership Score

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 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 of the relative importance of various program elements in their purchasing decisions, as shown in Table B-17.

Table B-17. 2023 C&I Custom Program Freeridership *Influence* Responses (n=5)

Question F9 Response Options	*Influence* Score	CenterPoint Energy or implementer 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 energy efficiency program
1 – Not at all influential	100%	0	0	0	0	0
2 – Not too influential	75%	2	1	2	0	0
3 – Somewhat influential	25%	1	1	2	1	3
4 - Very influential	0%	2	3	1	4	2
Don't Know	50%	0	0	0	0	0
Not Applicable	50%	0	0	0	0	0
Average		**3.0**	**3.4**	**2.8**	**3.8**	**3.4**

Cadmus used the maximum rating given by each participant for any factor in Table B-17 to determine the participant's *influence* score presented in Table B-18. 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 1% for C&I Custom Program participants.

Table B-18. 2023 C&I Custom Program *Influence* Freeridership Score (n=5)

Maximum *Influence* Rating	*Influence* Score	Count[a]	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%	1	195	49
4 - Very influential	0%	4	6,160	0
Average Maximum *Influence* Rating - Simple Average		**3.8**		
Average *Influence* Score - Weighted by *Ex Post* Savings		**1%**		

[a] 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 3%, weighted by *ex post* gross program savings. The higher the freeridership score, the more savings are deducted from the gross savings estimates. Table B-19 presents the *intention*, *influence*, and freeridership scores for the C&I Custom Program.

Table B-19. 2023 C&I Custom Program *Intention*/*Influence* Freeridership Score

n	*Intention* Score	*Influence* Score	Freeridership Score
5	5%	1%	3%

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.

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 24 program participants. Table B-20 lists the presents the NTG results for the program.

Table B-20. 2023 Small Business Energy Solutions Net-to-Gross Ratio

Measure	Freeridership	Spillover	NTG Ratio
Total Program	5%	0%	95%

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.[72] Cadmus calculated the arithmetic mean of the savings weighted *intention* and *influence* freeridership components to estimate measure category freeridership,[73] as shown in this equation:

$$\text{Final Freeridership \%} = \frac{Intention\text{ FR Score}(0\% \text{ to } 100\%) + Influence\text{ FR Score}(0\% \text{ to } 100\%)}{2}$$

Intention Freeridership Score

Cadmus estimated *intention* freeridership scores for all participants based on their responses to *intention*-focused freeridership questions. Table B-21 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.

72 *Intention* and *influence* freeridership scores both have a maximum of 100%.

73 *Ex post* gross program savings.

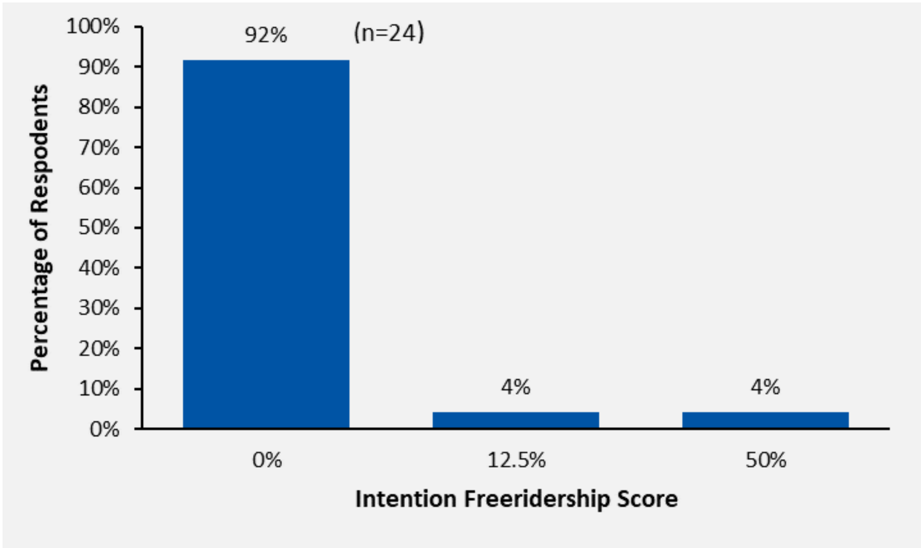
Table B-21. 2023 Raw Survey Responses Translation to *Intention* Freeridership Scoring Matrix Terminology Small Business Energy Solutions Program and Scoring

Did your organization have specific plans to install energy-efficient [MEASURE] over a less efficient option BEFORE learning about the Small Business Energy 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] without the instant discount?	Without the Small Business Energy Solutions program, would you have installed [MEASURE] equipment to at least the same level of efficiency?	Without the Small Business Energy Solutions program, would you have installed the same quantity of [MEASURE]?	Without the Small Business Energy Solutions program, would you have installed the [MEASURE]?	Prior to learning about the Small Business Energy Solutions 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%]	DK/RF (Partial) [-25%]	Within three to five years (No) [-100%]	
					In more than five years (No) [-100%]	
					DK/RF (Partial) [-25%]	

DK = don't know; RF = refused

Table B-22 shows the distribution of *intention* freeridership estimates Cadmus assigned to participant responses to the pure intention-based freeridership method.

Table B-22. 2023 Small Business Energy Solutions Program Self-Report *Intention* Freeridership Distribution by Estimate



Influence Freeridership Score

Table B-23 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-23. 2023 Small Business Energy Solutions Program Freeridership *Influence* Responses (n=24)

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 energy efficiency program
1 – Not at all influential	100%	2	0	0	0	1
2 – Not too influential	75%	1	0	7	2	3
3 – Somewhat influential	25%	1	2	3	6	1
4 – Very influential	0%	18	21	10	13	6
Don't Know	50%	2	1	2	2	2
Not Applicable	50%	0	0	2	1	11
Average		**3.6**	**3.9**	**3.2**	**3.5**	**3.1**

Cadmus used the maximum rating given by each participant for any factor in Table B-23 to determine their *influence* freeridership score presented in Table B-24. 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 7% for SBES Program participants.

Table B-24. 2023 Small Business Energy Solutions Program *Influence* Freeridership Score (n=24)

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%	0	0	0
4 – Very influential	0%	23	347	0
Not Applicable	50%	1	54	27
Average Maximum *Influence* Rating - Simple Average	**4.0**			
Average *Influence* Score - Weighted by *Ex Post* Savings	**7%**			

Final Freeridership Score

Cadmus calculated the arithmetic mean of the *intention* and *influence* freeridership components to estimate a final freeridership value of 5%, weighted by *ex post* gross program savings. The higher the freeridership score, the more savings are deducted from the gross savings estimates. Table B-25 summarizes the *intention*, *influence*, and freeridership scores for the SBES Program.

Table B-25. 2023 Small Business Energy Solutions Program *Intention*/*Influence* Freeridership Score

n	*Intention* Score	*Influence* Score	Freeridership Score
24	3%	7%	5%

Detailed Spillover Findings

No viable spillover activity was reported by 2023 survey participants, resulting in zero spillover savings.

Appendix C. Market Performance Indicators

The primary objective of the market performance indicators was to assess changes 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. 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.

Residential Prescriptive

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 and other 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) • Midstream channel provides rebates as a direct discount to customers at time of purchase (trade allies apply for rebate)	• Rebates for energy-efficient products • 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 offer discount at time of purchase	• Multiple methods available for rebate submission, including mail and online applications • Marketing campaigns coordinated with trade allies • 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 knowledge of benefits of high-efficiency equipment	• 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 as a hassle • Perceived risk of carrying upfront cost of instant discount	• Perceived difficulty selling high-efficiency equipment with higher upfront cost	• Perceived difficulty with staying competitive during the bid process when promoting more expensive equipment
Intervention Strategies / Activities	• Multiple methods available for rebate submission, including mail and online applications through a streamlined trade ally portal • Rebates used as a sales tool	• Experienced program implementer who continually works with trade allies to promote program's success • Dedicated implementation team that maintains trade ally network	• Program support with rebate applications • Reliable and timely rebate payment • Pre-designed 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

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 equipment • Upfront cost of energy-efficient HVAC equipment • Lack of available, energy-efficient HVAC equipment	• Program promotion via contractors and participating distributors • Follow-up notice to thank homeowners for participating • Incentives provided directly to distributors/contractors to sell energy-efficient HVAC equipment • Incentives to help offset increased costs passed on to homeowner • Direct incentives to the distributor/contractor allows for seamless participation that does not require applications from homeowners	• Increased knowledge of the benefits of energy-efficient HVAC equipment • Increased awareness of energy-efficient HVAC equipment • Increased demand for energy-efficient HVAC equipment • Increased energy savings • Increase overall participation in the Residential Prescriptive Program	• 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 equipment • Low demand for high-efficiency HVAC 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 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 equipment • Increased energy savings • Increased consistency and satisfaction for rebate application processing	• Achievement of program participation and savings goals • Number of participating distributors • Distributor satisfaction with program • Percentage of stocked program-qualified HVAC equipment • Market share of program-qualified equipment
Trade Allies Contractors	• Lack of program awareness • Lack of understanding of benefits of energy-efficient HVAC equipment • Lack of available, energy-efficient HVAC equipment • Lack of ability to provide needed customer information • Perceived administrative burden of participation	• Incentives to help lower cost of equipment purchase • Participating distributors stock qualified equipment • Contractors promote instant rebate and benefits of energy-efficient HVAC equipment • Outreach to trade ally network to drive program awareness • Program staff assist with rebate processing concerns and provide program materials	• Reduced administrative burden from simplified rebate applications • Increased contractor participation • Increased sales of energy-efficient HVAC equipment	• Achievement of program participation and savings goals • Contractor satisfaction with the program • Number of participating contractors • Percentage of program-qualified HVAC equipment sales

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 high efficiency (including 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 offered directly to builders to construct and market efficient homes • Outreach events to increase awareness of Residential New Construction program 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 and HERS Raters	• Lack of program awareness • Increasing construction costs • Lack of understanding of energy-efficient building practices • Time constraints; perceived lengthy paperwork and application process, which delays rebate delivery and home going to market • High upfront costs for builders who pursue HERS certification • Low demand for HERS rated and energy efficient homes, particularly with an 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	• Measure-level incentives for builders to offset higher equipment costs and upfront costs for HERS ratings. Incentive bundle options available to increase the number of high efficiency measures installed in a home • Program promotion through homebuilders' association and other industry groups • Program information and material readily available on CenterPoint Energy website • Required in-depth trainings for builders on energy-efficient building practices and marketing strategies • Builders encouraged to use high efficiency equipment and/or low HERS ratings as selling points • Program staff assist with paperwork; streamlined application for multiple submissions • Yearly kickoff meeting with builders to review program changes	• 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 • Increased number of high efficiency measures used in new builds	• Number of builders participating • Number of builders constructing homes with high-efficiency equipment and/or <= 60 HERS ratings • Higher market saturation of home with high efficiency measures • Home builder attendance at outreach events • Builder program satisfaction ratings • Achievement of participation and savings goals • Average number of homes per builder

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 no-cost products and true energy savings • Lack of time available for assessments and installation process	• Program marketing (direct mail, bill inserts, email, events, door-to-door canvassing, leave-behind referral materials) • Addition of full-time Market Outreach Specialist • 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 • Expanded appointment time offerings	• 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	• RFPs to attract qualified program implementer • Open communication with participants to address concerns • Budget for health and safety improvements, including the addition of the Healthy Homes Initiative	• 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	• Interviews to hire qualified pool of installers • Open communication with participants to address concerns	• Assurance of quality work • Increased customer satisfaction • Continuation of program services	• Program satisfaction ratings • Achievement of program participation and savings goals

Community Connections Program

COMMUNITY CONNECTIONS PROGRAM

Market Actor	End-Use Customer	Kit Recipients	
Market Barriers	• Saturation of LED lighting in many homes	• Lack of program awareness • Higher cost of efficient measures • Lack of energy efficiency education • Low brand awareness of CenterPoint Energy	• Skepticism of no-cost measures and true energy savings • Negative associations with energy efficient measures
Intervention Strategies / Activities	• Remove LED candelabra bulbs from kit and add smart power strips and door and window weatherstripping	• CenterPoint Energy logo, website, and program information on measure kit box	• Specialty energy efficiency measures offered to customers at no cost • Prominent program signage at giveaway location
Outcomes	• Increased participation • Increased customer satisfaction • Increased awareness	• Increased energy savings • Improved customer perception of energy efficient technologies • Continuation of program services	• Increased saturation of energy efficient technologies • Increased awareness of CenterPoint Energy energy efficiency programs
Key Indicators	• Achievement of program participation and savings goals • Installation rate • Persistence of measures		• Efficient measure saturation in CenterPoint Energy territory • Conversion to other CenterPoint Energy energy efficiency programs • Measure satisfaction ratings

Market Actor	Trade Allies	Food Bank and Trustee Office Staff	
Market Barriers	• Lack of program understanding	• Inability to encourage survey participation • Labor constraints and supply-chain delays	• Lack of understanding of benefits of energy efficiency measures
Intervention Strategies / Activities	• Program implementer trains event staff on how to deliver program		• Incentive for survey participation • Program signage prominent at giveaway event locations
Outcomes	• Measures effectively distributed to customers • Ability to confirm product installations	• Increased saturation of energy efficient lighting • Continuation of program services	• Increased program understanding
Key Indicators	• Achievement of program participation and savings goals • Number of measures distributed • Installation rate	• Efficient measure saturation in CenterPoint Energy territory • Survey response rate	

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 awareness of home energy use benchmarks
- Lack of understanding of how one's 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 at least 5 times a year and send 12 emails per year (monthly)
- Home energy use comparison to a group of similar homes included in report
- High bill alerts and combined bill forecasting reports sent to customers throughout the year
- Embed energy usage widget within customers' CenterPoint Energy online account
- Historical energy use data shown in the reports and available in online widget
- Incorporation of income-qualified customers in treatment wave
- Customer segment-targeted 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 weekly data and home energy analysis survey data for more accurate, detailed, and personalized reports
- Send targeted messages and content to segments of treatment customers
- Periodic updates to content and look of the reports/widget
- Regularly review and update tips library with CenterPoint Energy
- Cross-promote other CenterPoint Energy programs through in-report modules as applicable

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
- Percentage of customers who read the reports

Appliance Recycling Program

APPLIANCE RECYCLING PROGRAM

Market Actor	End-Use Customer: Residential Customers		
Market Barriers	• Lack of program awareness	• 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), resolution specialists, and improved customer service software to address 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 level of used appliances on the secondary market • Ease of scheduling ratings	

Market Actor	Program Implementer: Appliance Pick-Up Staff		
Market Barriers		• Transitioned implementers in the middle of the program year • Increased cost of drivers and transportation resources	• Participant concerns about pick-up staff entering home • Decline in appliance purchases
Intervention Strategies / Activities	• Route optimization and tracking software	• Timely 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 • Offer bonus incentives to boost participation • In-house transportation network to improve resource availability
Outcomes	• Assurance of quality work	• 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&I 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 • Lack of time to participate in the program and/or apply for rebates • Large customers opt-out of programs	• Perception that project is not cost-effective for business • Perception that business does not need energy efficiency 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 incentive bonuses targeting large, opt-out eligible customers • Energy manager dedicated to large customers • Implementation 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 program • Achievement of program participation and savings goals	• Participant satisfaction with the program

Market Actor	Trade Allies	Installation Contractors and Distributors	
Market Barriers		• Administrative burdens such as determining 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 provides easy-access marketing materials for trade allies to promote the program	• Midstream intervention at the contractor and distributor level with rebates for energy efficient lighting, HVAC, and kitchen equipment • Program outreach staff cross-promote prescriptive and custom programs to deliver coordinated project assistance	• Provide project-level assistance to encourage trade ally engagement and adoption
Outcomes	• Increased trade ally awareness of program offerings • Increased and sustained trade ally participation with the program	• Streamlined program participation for customers • Increased number of participating trade allies	• Increased number of trade allies promoting multiple C&I programs • Increased number of projects per contractor
Key Indicators	• Trade ally satisfaction with the program • Number of contractors and distributors participating in the program • Achievement of program participation and savings goals	• Number of trade allies participating in multiple years • Number of actively participating trade alliess • Average number of projects per contractor	

C&I Custom Program

C&I CUSTOM PROGRAM

Market Actor	End-Use Customer — C&I Customers		
Market Barriers	• Customers with diverse and niche needs require customized interventions and considerations • 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	• Four intervention pathways that capture the diverse and niche needs of customers: Custom Incentives, Commercial New Construction, Building Tune Up, and Strategic Energy Management (SEM). • 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 projects and cost shares on facility energy assessments that will cover up to 100% of assessment costs	• Explanation of customer's payment responsibility and calculation of payback period • Established trade ally network to make installation timely and convenient • Provide savings values, sample applications, and rebate process charts
Outcomes	• Increased program awareness • Increased participation • Increased market saturation of energy-efficient measures	• Increased project viability for C&I customers to customize energy efficiency through the incentive contribution	• 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 trade ally program awareness • Inability to communicate directly with customer decision-maker who can approve projects	• Lack of customer awareness • Contractor 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 C&I customer decision maker through account managers and energy manager • Outreach representatives dedicated to new construction and HVAC participation, recruiting trade allies, and promoting the Contractor Network		• Individual and group training sessions detailing program operations and requirements, application forms, and invoicing • 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 • New customer relationships	• Increased overall revenue due to growing number of potential customers • Increased quality of existing customer relationships
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

Small Business Energy Solutions

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 • Saturation of lighting measures and projects in the program mix
Intervention Strategies / Activities	• Information on CenterPoint Energy website • Discounts for lighting, refrigeration, furnace tune-ups, steam trap replacements, thermostats, and water-saving devices	• Direct installation of products at no cost to the business • Energy education provided during in-business energy assessment • Launched HVAC check-ups focused on low cost, preventative maintenance measures, and/or quick install of applicable energy efficiency measures	• Efficient product discounts at point of purchase • Contractor 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 electric and gas energy savings	• Increased penetration of efficient technologies
Key Indicators	• Achievement of program participation and savings goals • Number of participating small businesses	• Program and 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 • Increased implementer staff focused on outreach to trade allies	• 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 2023 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

Data Collection Activity	Research Topics	
Program Staff Interviews	• Evaluation goals and research questions • Program goals and objectives • Implemented and proposed program changes • Program design, delivery, and administration • Quality control	• Marketing strategies and effectiveness • Program tracking and key performance indicators (KPIs) • Market barriers and reasons for nonparticipation • Target audiences and program participation
Trade Ally and Market Actor Interviews	• Program awareness and motivations • Freeridership and spillover, if applicable • Aspects of program delivery and effectiveness • Interactions with program staff • Market barriers and reasons for nonparticipation (among trade allies and customers)	• Program satisfaction and value • Effectiveness of marketing materials/channels • 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, if applicable • Verification of measure installation • Program strengths and suggestions for improvement

Table D-2 shows the number of interviews and surveys Cadmus completed for the 2023 CenterPoint Energy DSM portfolio evaluation. Cadmus conducted telephone surveys and interviews with the Residential Prescriptive program's midstream trade allies, Residential New Construction's builders, C&I Prescriptive program's midstream trade allies, C&I Custom's participants, and C&I Small Business Energy Solutions' participants. All other programs' surveys were conducted online.

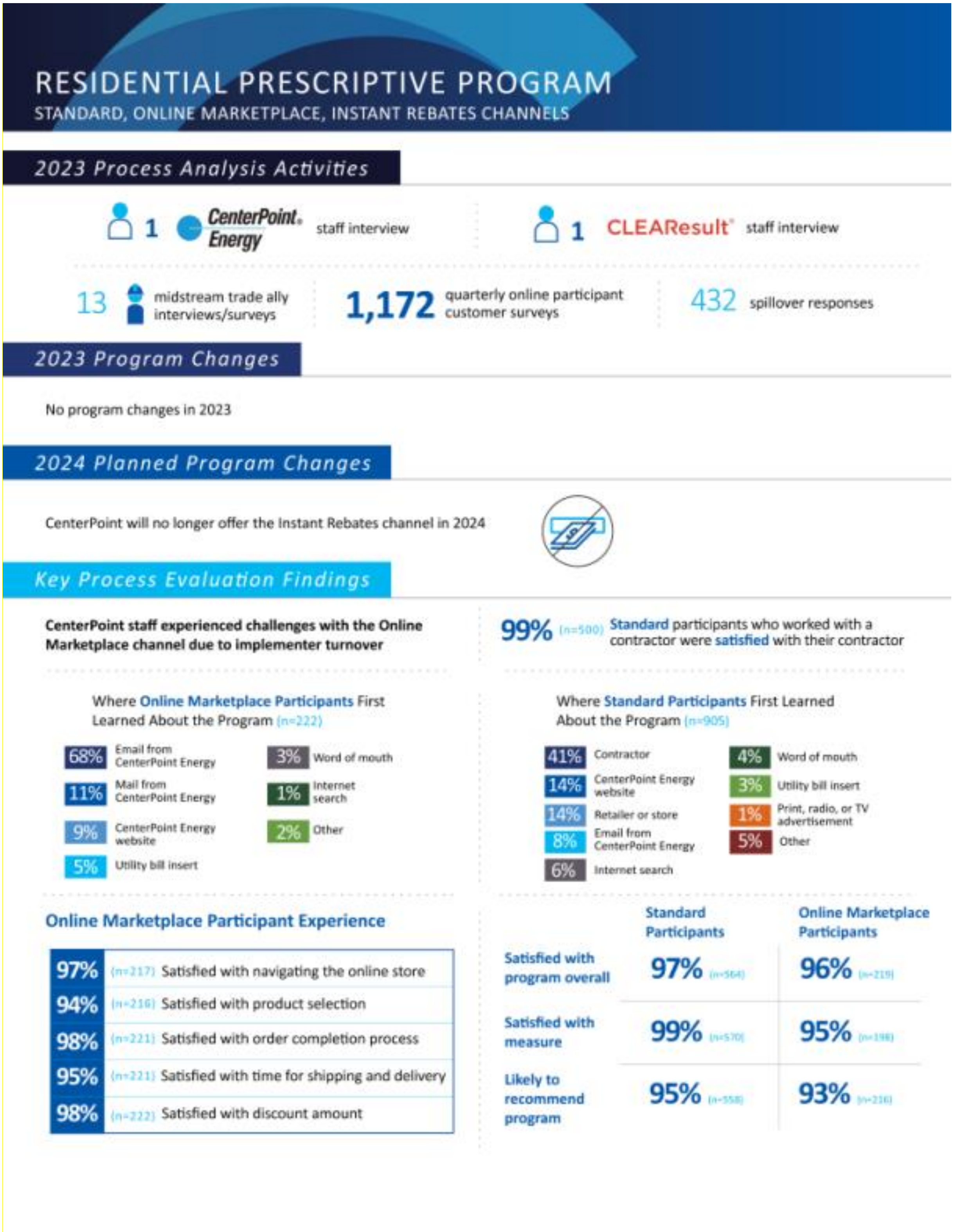
Table D-2. Interviews and Surveys by Program

Respondent Group	Population[a]	Included in Sample Frame[b]	Target Completes	Achieved Completes
Residential Programs				
Residential Specialty Lighting				
CenterPoint Energy 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)	9,692	7,102	1,000 (70 per measure category)	1,172
Participating Customers (Annual Spillover Surveys)	9,692	9,436	300 (50 per measure category)	432
Residential Prescriptive - Midstream				
CenterPoint Energy Staff	1	1	1	1
CLEAResult Staff	1	1	1	1
Participating Distributors	33	33	10	7
Participating Contractors	34	34	10	6
Residential New Construction				
CenterPoint Energy Staff	1	1	1	1
CLEAResult Staff	1	1	1	1
Participating Builders	37	36	8	8
Income Qualified Weatherization				
CenterPoint Energy Staff	1	1	1	1
CLEAResult Staff	1	1	1	1
Participating Customers	405	248	70	55
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
CLEAResult Staff	1	1	1	1
Smart Cycle				
CenterPoint Energy Staff	1	1	1	1
Community Connections				
CenterPoint Energy Staff	1	1	1	1
CLEAResult Staff	1	1	1	1
Participating Customers	11,196	82	70	31
Commercial and Industrial Programs				
C&I Prescriptive				
CenterPoint Energy Staff	1	1	1	1
Resource Innovations Staff	1	1	1	1

Respondent Group	Population[a]	Included in Sample Frame[b]	Target Completes	Achieved Completes
Participating Customers	139	125	20+	33
C&I Prescriptive – Midstream				
Participating Distributors	85	81	5-10	1
Participating Contractors	85	81	5-10	17
C&I Custom				
CenterPoint Energy Staff	1	1	1	1
Resource Innovations Staff	1	1	1	1
Participating Customers	35	33	10+	5
Small Business Energy Solutions				
CenterPoint Energy Staff	1	1	1	1
Resource Innovations Staff	1	1	1	1
Participating Customers	112	112	35+	24

[a] Population includes both electric and gas participants.
[b] 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.

Residential Prescriptive Program



RESIDENTIAL PRESCRIPTIVE PROGRAM

MIDSTREAM CHANNEL

2023 Process Analysis Activities

1 CenterPoint Energy staff interview

1 CLEAResult staff interview

6 contractor interviews

7 distributor interviews

2023 Program Changes

Electric-only program in 2023 due to limited gas measure participation in 2022

Introduction of a **hybrid approach:** if determined eligible, high-sales contractors can stock their own equipment and are now able to receive program incentives/rebates **directly**, rather than partnering with a participating distributor

2024 Planned Program Changes

More measures to be added to the Midstream channel like furnaces and central air conditioners

The program will transition everything to SEER2 standards

Key Process Evaluation Findings

Distributor Interview Results:

- 5/7 distributors satisfied with the program
- 4/5 responding distributors said they tell contractors shopping for equipment about the Midstream Program
- No distributors highlighted specific challenges with the integration of SEER2 equipment

Contractor Interview Results:

- 4/6 responding contractors found out about the program through **CenterPoint Energy**
- 2/6 responding contractors found out through a CLEAResult representative
- 4/5 responding contractors prefer the Midstream Rebates compared to the Residential Rebates because the process was fast and easy

According to interviewed contractors and distributors, the Midstream channel continues to be easy to participate in for themselves and for the customers

Residential New Construction

RESIDENTIAL NEW CONSTRUCTION PROGRAM

2023 Process Analysis Activities

1 CenterPoint Energy staff interview

1 CLEAResult® staff interview

Mixed mode participant builder interviews

8 fully completed

1 partially complete

Program Overview

After being discontinued in 2021, **the Residential New Construction returned in 2023** with an adjusted design that goes beyond (but still includes) HERs scores to reflect increasing efficiency across the market. The program now provides incentives for builders who include energy efficient measures in their new builds, such as: **appliances, insulation, lighting, domestic hot water heaters, and more.**

2023 Program Changes

Added option for builders to receive incentives based on individual measures, rather than solely relying on HERS ratings

Increased outreach and communication with builders to assist them through the transition to the new measure structure

2024 Planned Program Changes

Developing a new "smart sheet" (a dynamic Xcel workbook) to help builders to understand and calculate their estimated incentive

Key Process Evaluation Findings

Builder Interview Results:

5/9
respondents learned about the Residential New Construction program from a SIBA (Southwest Indiana Builders Association) event

3/8
said that they participated in CenterPoint sponsored events for builders in 2023 and all who participated found them very useful

7/8
said they were very likely to recommend the program to another builder

2/8
respondents said the biggest challenge of the program was understanding the program

Ease:

8/8 said that it was easy to participate in the program.

- **7/8** said the onboarding process was easy

Satisfaction:

8/8 were satisfied with the application process.

8/8 respondents were satisfied with the incentive structure.

Income Qualified Weatherization Program

INCOME QUALIFIED WEATHERIZATION PROGRAM

2023 Process Analysis Activities

1 CenterPoint Energy staff interview

1 CLEAResult staff interview

55 online participant surveys

2023 Program Changes

No program design changes since 2022

2024 Planned Program Changes

Increase marketing efforts through canvassing

Changes to scheduling and follow-up scheduling processes for added flexibility and reduced customer burden

Key Process Evaluation Findings

PARTICIPANT SURVEY RESULTS:

93% (n=55)
satisfied with the program overall

- **3/4** dissatisfied participants felt they did not receive sufficient services
- **1/4** felt there was a lack of communication

89% (n=55)
said the main reason they participated in the program was to save on energy bills/reduce energy costs

81% (n=47)
took action on recommended energy-saving behaviors

98% (n=54)
said they were likely to recommend the IQW program to a friend or neighbor

63% (n=55)
learned about the IQW program through CenterPoint (via email, mail, or information included in their bill)

15% (n=55)
learned about the program from a friend, family member, neighbor, or colleague

Participants satisfied with program measures:

100%	(n=40)	Interior LED light bulb(s)
100%	(n=14)	Bathroom faucet aerator(s)
100%	(n=5)	Furnace tune up
100%	(n=2)	Refrigerator
100%	(n=2)	Exterior LED light bulb(s)
100%	(n=1)	Central air conditioner
96%	(n=48)	LED nightlight(s)
95%	(n=21)	Kitchen faucet aerator(s)
94%	(n=18)	Air conditioner tune up
92%	(n=13)	Smart thermostat
88%	(n=50)	Smart strip
71%	(n=7)	High-efficiency showerhead(s)
67%	(n=2)	Attic insulation

One participant dissatisfied with the smart strip said that it did not work

Community Connections Program

COMMUNITY CONNECTIONS PROGRAM

Market Actor	End-Use Customer	Kit Recipients	
Market Barriers	• Saturation of LED lighting in many homes	• Lack of program awareness • Higher cost of efficient measures • Lack of energy efficiency education • Low brand awareness of CenterPoint Energy	• Skepticism of no-cost measures and true energy savings • Negative associations with energy efficient measures
Intervention Strategies / Activities	• Remove LED candelabra bulbs from kit and add smart power strips and door and window weatherstripping	• CenterPoint Energy logo, website, and program information on measure kit box	• Specialty energy efficiency measures offered to customers at no cost • Prominent program signage at giveaway location
Outcomes	• Increased participation • Increased customer satisfaction • Increased awareness	• Increased energy savings • Improved customer perception of energy efficient technologies • Continuation of program services	• Increased saturation of energy efficient technologies • Increased awareness of CenterPoint Energy energy efficiency programs
Key Indicators	• Achievement of program participation and savings goals • Installation rate • Persistence of measures		• Efficient measure saturation in CenterPoint Energy territory • Conversion to other CenterPoint Energy energy efficiency programs • Measure satisfaction ratings

Market Actor	Trade Allies	Food Bank and Trustee Office Staff	
Market Barriers	• Lack of program understanding	• Inability to encourage survey participation • Labor constraints and supply-chain delays	• Lack of understanding of benefits of energy efficiency measures
Intervention Strategies / Activities	• Program implementer trains event staff on how to deliver program		• Incentive for survey participation • Program signage prominent at giveaway event locations
Outcomes	• Measures effectively distributed to customers • Ability to confirm product installations	• Increased saturation of energy efficient lighting • Continuation of program services	• Increased program understanding
Key Indicators	• Achievement of program participation and savings goals • Number of measures distributed • Installation rate	• Efficient measure saturation in CenterPoint Energy territory • Survey response rate	

RESIDENTIAL BEHAVIORAL SAVINGS PROGRAM

2023 Process Analysis Activities

1 CenterPoint Energy staff interview

1 ORACLE staff interview

Program Overview

CenterPoint Energy sends home energy reports to educate customers about their energy consumption patterns

The program is designed as a randomized control trial wherein customers are randomly assigned to either

a **treatment group** (recipients of home energy reports) **OR** or a **control group** (non-recipients)

2023 Program Changes

Operated the 2023 program with three waves:

- 2013 dual fuel wave
- 2020 dual fuel wave
- New 2023 electric-only wave

Retired the 2012 electric-only wave and turned it into a rolling enrollment wave where customers who would like to receive a home energy report can do so rather than limit the reports to customers in the treatment group

Usually sending out four print reports per year to a customer, but an extra print report was added in 2023, bringing the total to five print reports

Cross-program promotions included the Appliance Recycling, Marketplace, and HVAC rebates

2024 Planned Program Changes

Send out high bill alerts to all non-AMI customers receiving the home energy reports in an effort to increase energy savings

Key Process Evaluation Findings

CenterPoint Energy and Oracle closely working together to implement critical changes in 2024 and beyond to address the steady decline in the program's electric savings in recent years. Changes will focus on increasing and stabilizing electric savings for the long-term, increasing the size of the control group for robust evaluation, and maintaining customer satisfaction.

Cross-program marketing modules increased in the home energy reports in 2023 to boost savings across the portfolio

Appliance Recycling Program

APPLIANCE RECYCLING PROGRAM

2023 Process Analysis Activities

1 CenterPoint Energy staff interview

1 CLEAResult® staff interview

Program Overview

CenterPoint Energy removed and recycled old, operable appliances, refrigerators, freezers, and room air conditioners. Customers received a **$50** incentive for their program participation.

Program Flow Map

Customer has an old appliance → Customer applies for the removal and recycling service online → Customer and CLEAResult schedule a pick-up time → CLEAResult picks up the appliance and recycles the appliance following Environmental Protection Agency best practices → Customer receives **$50** check via mail

2023 Program Changes

ARCA went out of business in the middle of summer of 2023

CLOSED

CLEAResult took over implementing the program in October 2023. CLEAResult had an in-house pick-up truck service

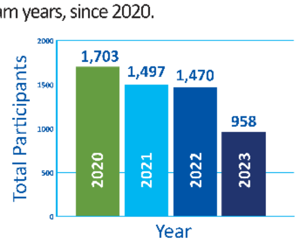
As CLEAResult took on the program, they scheduled and executed pick-ups from a list of contacts that CenterPoint had provided; no marketing nor events were hosted by CLEAResult throughout the rest of the program year

2024 Planned Program Changes

Over time, the ARP program's cost effectiveness has declined primarily due to higher baseline efficiencies as older units become less common in the market; paired with increased costs associated with any new potential vendor, the program is not forecasted to remain cost effective. **Therefore, CenterPoint plans to retire the Appliance Recycling Program starting in 2024, with no plans to offer it again in the future.**

Key Process Evaluation Findings

Participation has declined over the last three program years, since 2020.



- CLEAResult reported minimal complaints for the pick-up service
- Since the program resumed in October 2023, there have been no scheduling cancellations

CNP staff struggled finding suitable, cost-effective implementers for short- and long-term replacements for ARCA

Smart Cycle Program

SMART CYCLE

2023 Process Analysis Activities

1 CenterPoint Energy staff interview

Program Overview

CenterPoint Energy, with help from Schneider Electric, installs Ecobee smart thermostats in residential homes to call load control events during the summer peak season

The program targets demand reductions during the summer peak hours but also achieves energy savings throughout the year

Installation goal of 500 thermostats

2023 Program Changes

New installation contractor: **Schneider Electric**

2024 Planned Program Changes

No changes planned for next year

Key Process Evaluation Findings

Program completed a total of **52 installs in 2023,** meeting only **10% of the installation goal**. Low number of installs due to the workflow transition process to a new installation contractor and not starting up the installs until August 2023.

CenterPoint Energy is hopeful that **installations will gain momentum in 2024**, as they feel confident with their new installation contractor Schneider Electric because:

- Schneider Electric understands CenterPoint Energy expectations thanks to previous experience:
    - Previous installer for Summer Cycler
    - Previous installer for Smart Cycle pilot
- Performed well during the few months of installation activity for 2023

C&I Prescriptive Program

C&I PRESCRIPTIVE PROGRAM

2023 Process Analysis Activities

1 CenterPoint Energy staff interview

1 resource innovations staff interview

33 participant customer surveys (out of 125, 26% response rate)

13 online participant customer surveys

20 phone surveys

17 online Midstream Electric contractor surveys

1 online Midstream Electric distributor survey

2023 Program Changes

New Commercial Midstream program was added in 2023. The program provides an incentive at the distributor level to encourage stocking and promoting more energy-efficient food service equipment and other energy-efficient measures

Select natural gas measures were phased out of the Midstream Channel

The contractor network grew from 136 to 163 contractors

Key Process Evaluation Findings

Process Participant Survey Results:

Top avenues of awareness for the C&I Prescriptive program: (n=33)

- Contact through trade ally/contractor/vendor – 36%
- CenterPoint Energy website – 30%
- Past participation – 15%

83% (n=24)

of program respondents reported being 'very satisfied' with their contractor or vendor

73% (n=33)

of program respondents said they were 'very satisfied' with the Commercial Prescriptive Program overall

33% (n=23)

of respondents said CNP's incentive helped the project receive implementation approval from their organization

Most important factors in decision to make energy efficient upgrades (n=33)

- Saving money and/or reducing energy costs – 33%
- Replacing broken equipment – 24%
- Replacing old but functioning equipment – 18%

Midstream Electric Trade Ally Interview Findings:

Being able to offer incentives is the most motivating factor for contractor respondents to participate in the program **(9/11)**.

Contractor respondents **(7/9)** and the distributor respondent feel that the incentives are sufficient to encourage their customers to purchase high-efficiency equipment

Contractor respondents **(7/11)** and the distributor respondent reported that their level of knowledge changed since the program started. The contractor respondents **(6/7)** and the distributor respondent saw the increased knowledge as a benefit to their business

Over half of contractor respondents **(6/11)** and the distributor respondent reported that participating in the program is easy or very easy

- Two contractor respondents found that participating in the program is *difficult* or *very difficult*, reporting the application portal and interaction with business owners as barriers

C&I Custom Program

C&I CUSTOM PROGRAM

2023 Process Analysis Activities

1 CenterPoint Energy staff interview

1 resource innovations staff interview

5 online surveys with participating customers (n=33, 15% response rate)

Program Overview

Main offerings include:

- Custom Incentives
- Commercial New Construction-Energy Design Assistance
- Building Tune-Up
- Strategic Energy Management
- Refrigeration Tune-Up (Electric only)

2023 Program Changes

Increased electric custom incentives by 40%, from $0.10 to $0.14 per kWh

Offering an electric refrigeration tune-up program

2024 Planned Program Changes

Will onboard a new vendor, HEAP engineering, with the goal of filling a retro commissioning gap

Program implementer looking to promote the Refrigeration Tune-Up offering more to industrial customers and to smaller convenient stores/other small businesses with refrigeration systems

Key Process Evaluation Findings

4/5 program respondents said they were **'very satisfied'** with the Commercial Custom Program overall

4/5 program respondents said they were **'very satisfied'** and one program respondent said they were 'somewhat satisfied' with the vendor or contractor

4/5 program respondents reported that reducing energy consumption by being more efficient (to hit company environmental targets as applicable) was the most important factor in their company's decision to make the energy-efficient upgrades for which they received a rebate

Top avenues of awareness for the C&I Custom program

- Contact by a CenterPoint Energy account manager or customer service representative – (2/5)
- Contact by a trade ally/contractor/vendor who participates in the program – (1/5)
- The CenterPoint Energy website – (1/5)
- Past participation in CenterPoint Energy programs – (1/5)

Small Business Energy Solutions

SMALL BUSINESS DIRECT INSTALL PROGRAM

2023 Process Analysis Activities

1 CenterPoint Energy staff interview

1 resource innovations staff interview

24 mixed mode participant customer surveys

18 phone

6 web

2023 Program Changes

Implemented new HVAC check-up enhancement within the electric small business program

Added refrigeration measures

Implementer added new staff members focused on outreach for the C&I programs as a whole

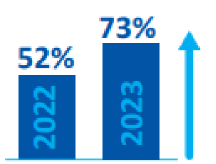
2024 Planned Program Changes

Continue to expand HVAC offerings and find other non-lighting opportunities for savings

Planning to add a vendor in 2024

Key Process Evaluation Findings

SBES project **conversion rates are up**



Conversion rates are calculated based on the number of audits that turn into completed projects within the same calendar year

PARTICIPANT SURVEY RESULTS:

Areas for improvement:

2/24 participants had suggestions of areas for improvement:

- More advertisement of the program
- Add marketing measures: road signage, ingress, egress signage

PARTICIPANT SURVEY RESULTS:

Top two ways participants first heard about the program:

18/24 Contractor contacted them and informed them

3/24 CenterPoint employee, account representative, or customer service employee

Satisfaction:

21/24 participants are satisfied with the program overall

n = 24	Very Satisfied	Somewhat Satisfied
Satisfaction with contractor	23	1
Satisfaction with Equipment	22	2
Satisfaction with Energy Assessment Report	12	8

19/24 said they would be **very likely** to **recommend the program**