BEFORE
THE PUBLIC UTILITIES COMMISSION OF OHIO

In the Matter of the Application of Vectren Energy Delivery of Ohio, Inc. d/b/a CenterPoint Energy Ohio for Approval of an Adjustment to its Energy Efficiency Funding Rider Rate.	)))))	Case No. 21-0820-GA-RDR

APPLICATION

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June 30, 2021

Counsel for Vectren Energy Delivery of Ohio, Inc., d/b/a CenterPoint Energy Ohio

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APPLICATION

Vectren Energy Delivery of Ohio, Inc. d/b/a CenterPoint Energy Ohio ("CEOH") hereby requests approval to revise its Energy Efficiency Funding Rider ("EEFR"). In support of its Application, CEOH states as follows:

1. In Case No. 07-1080-GA-AIR ("2007 Rate Case"), the Public Utilities Commission of Ohio ("Commission") approved a Stipulation and Recommendation which provided for the establishment of the EEFR.[1] Subsequently, CEOH has filed annual applications updating the EEFR rate.[2]

2. In the Aug. 28, 2019 Opinion and Order in CEOH's 2018 Rate Case, the Commission approved the Jan. 4, 2019 Stipulation and Recommendation ("Rate Case Stipulation") wherein CEOH agreed to remove all energy

[1] *In the Matter of the Application of Vectren Energy Delivery of Ohio, Inc. for Authority to Amend its Filed Tariffs to Increase the Rates and Charges for Gas Service and Related Matters*, Case Nos. 07-1080-GA-AIR, *et al.*, Stipulation and Recommendation at 6-7 (Sept. 8, 2008).

[2] *See* Case Nos. 11-2651-GA-RDR, 12-1416-GA-RDR, 13-1032-GA-RDR, 14-747-GA-RDR, 15-735-GA-RDR, 16-839-GA-RDR, 17-782-GA-RDR, 18-444-GA-RDR, 19-779-GA-RDR and 20-640-GA-RDR.

efficiency ("EE") funding from its base rates and provided that all approved EE expenses would be recovered through the EEFR.[3]

3. In accordance with the Order in the 2018 Rate Case, on August 29, 2019, CEOH filed updated compliance tariffs for the EEFR, effectively removing historical EEFR recovery from base rates and including all Demand-Side Management ("DSM") and EE recovery in the EEFR rate.[4]

4. Subsequent to the 2018 Rate Case, the Company, Staff, and interested parties were unable to reach an unopposed EE triannual plan for calendar years 2021 through 2023 by October 1, 2019, as prescribed in the Rate Case Stipulation.[5]

5. Due to the absence of an unopposed plan, and in further accordance with the Rate Case Stipulation, on November 22, 2019, the Company filed an application for authority[6] to continue its DSM/EE programs for years 2021 through 2023 in Case No. 19-2084-GA-UNC.

6. On June 26, 2020, the Signatory Parties (CEOH, Staff, OPAE and ELPC) filed a Stipulation with the intent to resolve all issues in Case No. 19-2084-GA-UNC ("2019 DSM Case Stipulation"), in particular seeking continuation of the DSM/EE programs beyond December 31, 2020 and agreeing to: a) the Plan budget for years 2021 through 2023; b) file an annual application

[3] *In the Matter of the Application of Vectren Energy Delivery of Ohio, Inc. for Approval of an Increase in Gas Rates*, Case Nos. 18-298-GA-AIR, *et al.*, Opin. & Order at 28-29 (Aug. 28. 2019) ("2018 Rate Case").

[4] *See* Case No. 19-779-GA-RDR.

[5] Rate Case Stipulation at 6.

[6] Previously approved by the Commission in Case Nos. 04-571-GA-AIR, 05-1444-GA-UNC, 07-1080-GA-AIR, and 18-0298-GA-AIR.

by July 1st for rates effective on or before November 1st, with rates derived by reconciling the actually-incurred DSM portfolio program costs for the prior calendar year, the EEFR recoveries and the projected DSM portfolio program costs for the subsequent calendar year; and c) the inclusion of the prior year's Evaluation, Measurement and Verification ("EM&V") DSM portfolio programs in the annual rider application.[7]

7. On February 24, 2021, the Commission issued its Opinion and Order approving and adopting the 2019 DSM Case Stipulation.[8] The Order continues the Company's authority for EE/DSM Programs for the triannual period 2021 to 2023 and annual filings to set rates for recovery of those program expenses.[9]

8. Attachment 1 to this Application provides the reconciliation for CEOH's prudently incurred EE program costs during the calendar year ended December 31, 2020, and the Company's recoveries through its EEFR reflected in this reconciliation period.

9. Consistent with CEOH's 2021 DSM Operating Plan as established and approved in the 2019 DSM Case Stipulation, CEOH proposes a revised EEFR rate of $0.01396 per Billing Ccf.[10] This proposed rider rate reconciles actual EEFR recoveries and intended recoveries, and the support for and calculation of the revised rider rate is shown on Attachment 1 hereto.

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[7] Case No. 19-2084-GA-UNC, Stipulation and Recommendation at 3-4 (June 26, 2020).

[8] Case No. 19-2084-GA-UNC, Opin. & Order at 36 (Feb. 24, 2021).

[9] *Id*. at 35.

[10] *See* 2019 DSM Case Stipulation at 2; *see also* 19-2084-GA-UNC, Application at Attachment A, Table 4 (Nov. 22, 2019).

10. The proposed rider rate of $0.01396 per Billing Ccf is just and reasonable and should be approved. A copy of the redlined current tariff sheet and proposed tariff sheet are included as Attachment 2 to this Application.

11. As prescribed in the 2019 DSM Case Stipulation, CEOH's annual EM&V of the 2020 program year is included as Attachment 3 to this Application.

WHEREFORE, CEOH respectfully requests that the Commission approve the new EEFR rate proposed herein.

Respectfully submitted,

/s/ Matthew R. Pritchard

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Counsel for Vectren Energy Delivery of Ohio, Inc., d/b/a CenterPoint Energy Ohio

ATTACHMENT 1

[Support for and Calculation of the EEFR Revised Rate]

Exhibit A

CenterPoint Energy Ohio
Case No. 21-0820-GA-RDR
Energy Efficiency Funding Rider ("EEFR")
Twelve Months Ended December 31, 2020

Total Program Budget

Line	Description	Reference	[A]=[B]+[C]+[D] Total	[B] DSM	[C] VWP I	[D] VWP II
	Current Year Projected Spend					
1	Regulatory Asset Balance 12/31/2019	Prior Filing	$ (665,103)			
2	Total 2022 Budget	2022 DSM Operating Plan	$ 5,981,149	$ 3,876,256	$ 1,102,447	$ 1,002,446
3	Total EEFR Recoverable Amount (19-2084-GA-UNC)		$ 5,981,149	$ 3,876,256	$ 1,102,447	$ 1,002,446
	Prior Year Reconciliation					
4	Total 2020 Program Spend	2020 DSM Annual Plan	$ 4,544,297	$ 3,341,240	$ 741,902	$ 461,155
5	Less: EEFR Recoveries	Exhibit B, Line 14	$ 5,393,901			
6	2020 Variance	Line 4 - Line 5	$ (849,604)			
7	Total EEFR Variance - (Over)/Under	Line 1 + Line 6	$ (1,514,707)			
8	Total EEFR Recoverable Expenses/(Credits)	Line 3 + Line 7	$ 4,466,442			
9	Projected Billing Volumes (Ccf)	Exhibit C, Line 7	319,872,175			
10	Unit Rate ($ per Billing Ccf)	[Line 8 / Line 9]	$ 0.01396			

Exhibit B

CenterPoint Energy Ohio
Case No. 21-0820-GA-RDR
Energy Efficiency Funding Rider ("EEFR")
Actual Recoveries Year-to-Date December 31, 2020

Line	Description	Consumption (Ccf)	EEFR Unit Rate ($ per Ccf)	EEFR Revenue ($) (1)
1	EEFR Recoveries			
2	January 2020	54,319,741	$0.01809	982,644
3	February 2020	55,407,897	$0.01809	1,002,329
4	March 2020	34,405,285	$0.01809	622,392
5	April 2020	24,893,945	$0.01809	450,331
6	May 2020	15,492,515	$0.01809	280,260
7	June 2020	5,833,904	$0.01809	105,535
8	July 2020	5,310,860	$0.01630	86,567
9	August 2020	6,428,536	$0.01630	104,785
10	September 2020	6,412,659	$0.01630	104,526
11	October 2020	17,415,379	$0.01630	283,871
12	November 2020	29,121,868	$0.01630	474,686
13	December 2020	54,967,754	$0.01630	895,974
14	Annual Total	**310,010,343**		**$ 5,393,901**

Notes:
(1) Actual booked EEFR Revenue

Exhibit C

CenterPoint Energy Ohio
Case No. 21-0820-GA-RDR
Projected Sales Volumes (Ccf)

Line No.	Tariff	November 2021 Amount	December 2021 Amount	January 2022 Amount	February 2022 Amount	March 2022 Amount	April 2022 Amount	May 2022 Amount	June 2022 Amount	July 2022 Amount	August 2022 Amount	September 2022 Amount	October 2022 Amount	Annual Amount
1	Rate 310 - Residential DSS Service	1,094,027	1,862,129	2,169,125	1,631,129	1,352,541	732,419	339,052	244,225	163,249	172,290	188,009	539,675	10,487,870
2	Rate 311 - Residential SCO Service	12,682,652	21,586,981	25,145,867	18,909,086	15,679,516	8,490,661	3,930,509	2,831,206	1,892,491	1,997,294	2,179,515	6,256,254	121,582,031
3	Rate 315 - Residential Transportation Service	9,236,187	15,720,797	18,312,569	13,770,610	11,418,665	6,183,355	2,862,407	2,061,836	1,378,213	1,454,537	1,587,240	4,556,140	88,542,557
4	Rate 320 - General Service DSS Service	19,394	33,036	38,525	28,985	24,009	12,975	5,992	4,311	2,880	3,037	3,314	9,512	185,968
5	Rate 321 - General SCO Service	4,663,082	7,943,232	9,263,025	6,969,117	5,772,775	3,119,842	1,440,709	1,036,585	692,356	730,183	796,856	2,287,015	44,714,777
6	Rate 325 - General Transportation Service	6,014,739	9,299,480	11,285,264	8,272,631	7,127,440	3,988,625	1,645,049	1,176,093	911,496	773,807	999,620	2,864,729	54,358,971
7	Total Budgeted Volumes	33,710,080	56,445,655	66,214,375	49,581,557	41,374,946	22,527,877	10,223,718	7,354,256	5,040,685	5,131,148	5,754,553	16,513,325	319,872,175

(To Exhibit A, Line 10)

ATTACHMENT 2

[Redlined Current Tariff Sheet & Proposed Tariff Sheet]

VECTREN ENERGY DELIVERY OF OHIO, INC.
Tariff for Gas Service
P.U.C.O. No. 4

Sheet No. 46
Second Revised Page 1 of 1
Cancels First Revised Page 1 of 1

ENERGY EFFICIENCY FUNDING RIDER

APPLICABILITY

The Energy Efficiency Funding Rider ("EEFR") shall be applicable to all Customers served under the following Rate Schedules and to certain other Customers pursuant to contract:

- Rate 310 – Residential Default Sales Service
- Rate 311 – Residential Standard Choice Offer Service
- Rate 315 – Residential Transportation Service
- Rate 320 – General Default Sales Service
- Rate 321 – General Standard Choice Offer Service
- Rate 325 – General Transportation Service

DESCRIPTION

The EEFR Rate shall be applied to all Billing Ccf for Gas Service rendered to Customers served under the applicable Rate Schedules.

The EEFR shall recover the costs of funding energy efficiency programs as approved by the Commission.

The EEFR Rate shall be updated periodically in accordance with the Commission's Order in Case No. 18-0298-GA-AIR.

The EEFR Rate shall be calculated based on the approved funding to be expended over the subsequent recovery period. The costs to be recovered and the costs actually recovered shall be reconciled annually, with any under- or over- recovery being recovered or returned via the EEFR over a subsequent period.

RECONCILIATION

The EEFR is subject to reconciliation or adjustment annually, including but not limited to, increases or refunds. Such reconciliation or adjustment shall be limited to: (1) the twelve-month period of expenditures upon which rates were calculated, if determined to be unlawful, unreasonable, or imprudent by the Commission in the docket those rates were approved or the Supreme Court of Ohio; (2) the Commission's orders in Case No. 18-47-AU-COI or any case ordered by the Commission to address tax reform changes.

ENERGY EFFICIENCY FUNDING RIDER RATE

The EEFR Rate is $0.01396 per Billing Ccf.

Filed pursuant to the Finding and Order dated _____ in Case No. 21-0820-GA-RDR of The Public Utilities Commission of Ohio.

Issued _____ Issued by Katie J. Tieken, Director Effective _____

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ENERGY EFFICIENCY FUNDING RIDER

APPLICABILITY

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- Rate 310 – Residential Default Sales Service
- Rate 311 – Residential Standard Choice Offer Service
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- Rate 321 – General Standard Choice Offer Service
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ENERGY EFFICIENCY FUNDING RIDER RATE

The EEFR Rate is $0.01396 per Billing Ccf.

ATTACHMENT 3

[Annual Evaluation, Measurement, and Verification of CEOH's 2020 DSM Portfolio Programs]

CADMUS

2019-2020 VECTREN OHIO DEMAND-SIDE MANAGEMENT PROGRAM EVALUATION

May 28, 2021

PREPARED FOR

Vectren Energy Delivery of Ohio

1 Vectren Square
Evansville, Indiana

Table of Contents

Acronyms and Abbreviations

Acronym	Definition
ADC	Average daily consumption
AFUE	Annual fuel utilization efficiency
ASHP	Air-source heat pump
Btu	British thermal unit
Btuh	British thermal units per hour
Ccf	Centum cubic feet
CDD	Cooling degree days
cfm	Cubic feet per minute
CFM	Cubic feet per minute
DHW	Domestic hot water
DK/RF	Don't know/refused
DOE	U.S. Department of Energy
DP&L	Dayton Power & Light
DSM	Demand-side management
ECF	Energy conversion factor
ECM	Electronically commuted motor
EFLH	Effective full load hours
F	Fahrenheit
FPG	Federal poverty guidelines
FR	Freeridership
GPM	Gallons per minute
HDD	Heating degree days
HERS	Home Energy Rating System
HVAC	Heating, ventilation, and air conditioning
ISR	In-service rate
MMBtu	Million British thermal units
MV CAP	Miami Valley Community Action Partnership
n	Population
NTG	Net to gross
OLS	Ordinary least square
POSTNAC	Post-installation weather-normalized
PRENAC	Pre-installation weather-normalized
PRISM	PRInceton Scorekeeping Method
RESNET	Residential Energy Services Network
TMY3	Typical meteorological year 3
TRM	Technical reference manual
UMP	Uniform Methods Project
VWP	Vectren Weatherization Program

EXECUTIVE SUMMARY

Vectren Energy Delivery of Ohio, a subsidiary of CenterPoint Energy, tasked Cadmus with verifying natural gas savings for the following programs:

- 2020 Residential Prescriptive Program (boiler and furnace measures only)
- 2019 Vectren Weatherization Program
- 2020 Commercial Prescriptive Program

These programs target Vectren's residential and commercial customer population, including income-qualified customers. Vectren administers these programs in conjunction with its third-party program implementers.

Program Descriptions

Residential Prescriptive Program

Through the ***Residential Prescriptive Program***, Vectren seeks to achieve energy savings by offering rebates to residential customers who purchase energy-efficient products such as furnaces and boilers. All residential customers are eligible to participate. Rebate amounts vary by measure.

Vectren Weatherization Program (VWP)

Through the ***Vectren Weatherization Program*** (VWP), Vectren offers its income-qualified customers a walk-through home energy audit that includes full diagnostic testing for the home. Auditors recommend weatherization and natural gas heating equipment upgrades that facilitate the installation of energy-saving measures at no cost to the customer. The program has two income-eligibility tiers: VWP I for households that earn up to 200% of the federal poverty guidelines (FPG) and VWP II for households that earn between 200% and 300% of those guidelines.

Commercial Prescriptive Program

Through the ***Commercial Prescriptive Program***, Vectren seeks to achieve energy savings by offering rebates for high-efficiency equipment, including natural gas boilers, boiler tune-ups, furnaces, Wi-Fi thermostats, and commercial kitchen equipment. All commercial customers, aside from transport customers, are eligible to participate. Rebate amounts vary by measure.

Summary of Natural Gas Impacts

This table presents the natural gas savings achieved by the evaluated Vectren programs. Overall, the programs and measures Cadmus evaluated achieved 255,897 Ccf in evaluated, net natural gas savings. Vectren is not required to report net savings in Ohio, but Cadmus provides net-to-gross (NTG) ratios and evaluated, net savings for Vectren's planning purposes only.

VECTREN DEMAND-SIDE MANAGEMENT PROGRAM NATURAL GAS SAVINGS

Program	Reported Participation[1]	*Ex Ante* Savings (Ccf)		Evaluated *Ex Post* Savings (Ccf)	Realization Rate	NTG	Evaluated Net Savings (Ccf)
		Reported[1]	Verified				
2020 Residential Prescriptive Program							
Boilers 95%	23 measures	2,969	2,927	3,476	117%	56%	1,947
Furnaces 95%	1,505 measures	200,165	196,932	184,139	92%	56%	103,118
Furnaces 97%	705 measures	106,624	105,410	99,680	93%	56%	55,821
2019 Vectren Weatherization Program							
VWP I	195 homes	43,875	43,875	34,222	78%	N/A	34,222
VWP II	102 homes	25,704	25,704	21,599	84%	N/A	21,599
2020 Commercial Prescriptive Program							
Prescriptive Measures	52 measures	39,800	39,657	41,692	105%	94%	39,190
Total		**419,137**	**414,506**	**384,809**	**92%**	**66%**	**255,897**

[1] Reported participation and savings are derived from Vectren's 2019 and 2020 DSM Scorecards.

SUMMARY OF RECOMMENDATIONS

Based on the findings from the evaluation, Cadmus proposed recommendations to improve the evaluated programs, as summarized here.

Program Recommendations

Residential Prescriptive Programs (Boilers and Furnaces)

Use the algorithm from the Uniform Methods Project (UMP) when estimating boiler and furnace savings instead of the algorithm from the 2019 Ohio Technical Reference Manual (TRM) to ensure accurate assumption of per-unit savings. The 2019 Ohio TRM's equivalent full load hours (EFLH) are understated, so Cadmus recommends using the EFLH assumption (adjusted for heating degree days [HDD]) for Springfield, Illinois, from the 2020 Illinois TRM instead.

Update planning estimates for boilers starting in 2022 to account for the upcoming change in the federal standard. Because boiler replacements are usually considered replace-on-burnout, the baseline for standard replacements will probably be the federal standard. The exception to this is early replacement cases, which will continue to use less efficient baselines when tracking data indicate an installation qualifies as early replacement.

Vectren Weatherization Program

The VWP continues to operate successfully in terms of participation and savings. Cadmus offers no recommendations for the VWP as it currently operates.

Commercial Prescriptive Program

Collect the following data for Commercial Prescriptive HVAC measures:

Collect the building type for each boiler, furnace, and boiler tune-up customer and match it with the 2019 Ohio TRM. This will lead to more accurate reported savings and better planning.

Collect the boiler type and its efficiency level. Hot water and steam boilers have different efficiency requirements—steam boilers have lower federal efficiency requirements than hot water boilers (resulting in a lower baseline for savings). Cadmus assumed that all rebated boilers were hot water (as they are more common). If any were steam boilers, there would be about 1% to 2% more savings per boiler.

Report the boiler efficiencies for pre- and post-tune-up collected in the rebate form. This would lead to more accurate results and potentially more savings.

In the tracking database, report savings in both therms and centum cubic feet (Ccf). Another option is to specify the therms to Ccf conversion factor explicitly in the tracking database.

Change the language in the rebate form to “must meet ENERGY STAR standards, but if greater than 2,500 MBtuh, combustion efficiency must be 90% or greater.” Note that the specific edge case of boilers with input capacities greater than 2,500 MBtuh could also be further revised depending on program goals. This will lead to greater savings, as some non-ENERGY STAR boilers currently qualify for a rebate.

Use the ENERGY STAR commercial kitchen calculator to more accurately estimate savings based on pan size when program steam cookers have more than six pans. (The deemed savings table in the 2019 Ohio TRM has up to six pans). The 2019 Ohio TRM derives savings for steam cookers from the ENERGY STAR commercial kitchen calculator, and the ENERGY STAR commercial kitchen calculator can be used for most eligible kitchen measures in the program. This will ensure that savings for future kitchen measures are calculated accurately and transparently.

RESEARCH APPROACH

As a part of the impact evaluation, Cadmus collected data directly from program staff and participants, reviewed gross savings values, verified measure installations, and determined freeridership and spillover to calculate a net-to-gross (NTG) percentage and to estimate realized program savings. These tables list the evaluation activities Cadmus performed for each program and the survey respondent groups.

IMPACT EVALUATION TASK BY PROGRAM

Program	Data Collection	Gross Savings Review		Measure Verification		NTG Analysis	
		Engineering Desk Review	*Billing Analysis*	*Data Tracking Review*	*Participant Surveys*	*Self-Report*	*Control Group*
2020 Residential Prescriptive	✓	✓	--	✓	✓	✓	
2019 Vectren Weatherization	✓	--	✓	✓	--	--	✓
2020 Commercial Prescriptive	✓	✓	--	✓	✓	✓	--

Cadmus defined several key savings terms for the impact evaluation:

Reported ex ante savings. Annual gross savings for the evaluation period, as reported by Vectren in the 2019 and 2020 Gas DSM Scorecards.

Verified savings. Annual gross savings, adjusted for the in-service rate.

Evaluated ex post savings. Annual gross savings, adjusted for the in-service rate and savings adjustments resulting from the gross savings review.

Realization rate. The percentage of savings the program actually realized:

$$\text{REALIZATION RATE} = \frac{\textit{EX POST} \text{ SAVINGS}}{\textit{EX ANTE} \text{ SAVINGS}}$$

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

Data Collection

The table shows the number of interviews and surveys Cadmus completed for the Vectren evaluation.

SURVEY RESPONDENT GROUPS BY PROGRAM

Respondent Group	Research Activity	Population	Included in Sample Frame	Target Completes	Achieved Completes
2020 Residential Prescriptive Program					
Vectren Staff	Phone Interview	1	1	1	1
CLEAResult Staff	Phone Interview	1	1	1	1
Participating Furnace Customers (Quarterly Customer Experience and Freeridership Surveys)[1]	Online Survey	2,233	887	100	146
Participating Furnace Customers (Annual Spillover Surveys)[1]	Online Survey	2,233	864	70	107
2019 Vectren Weatherization Program					
Vectren Staff	Phone Interview	1	1	1	1
Miami Valley Community Action Partnership Staff	Phone Interview	1	1	1	1[2]
2020 Commercial Prescriptive Program					
Vectren Staff	Phone Interview	1	1	1	1
CLEAResult Staff	Phone Interview	1	1	1	1
Participating Customers	Phone Interviews	52	28	Census	9

[1] Cadmus attempted to conduct a survey with boiler participants, but none of the boiler customers in the sample responded (nine boiler participants with email contacts were included in the survey sample).
[2] Cadmus spoke with two staff during one interview.

Gross Savings Review

Cadmus calculated natural gas savings for a subset of Vectren Ohio programs. Appendix A. Impact Evaluation Methodology details the specific methodology Cadmus used to determine savings for each program included in the evaluation and associated assumptions.

Engineering Analysis

To assess Vectren's claimed measure energy savings, Cadmus conducted an engineering desk review for the **Residential Prescriptive** and **Commercial Prescriptive** programs. Cadmus used utility program data, assumptions from TRMs from Ohio and other states, and industry studies to determine inputs to the savings estimates, which were calibrated with survey results where possible.

Billing Analysis

Billing analysis is a means of modeling savings by comparing the monthly consumption of program participants to a control group of customers while normalizing for exogenous factors such as weather. Cadmus conducted a billing analysis for the **Vectren Weatherization Program**. Cadmus used pre- and post-installation conditions to estimate program baselines and savings.

Measure Verification

Cadmus reviewed tracking data to verify measure installations for all programs. Cadmus conducted telephone or online surveys with Residential Prescriptive and Commercial Prescriptive program participants to confirm their participation status, the number and types of measures for which they received program incentives, and the persistence of installations. Cadmus used the following equation to calculate the in-service rate (ISR) for each program:

$$\text{IN-SERVICE RATE} = \frac{\textit{VERIFIED INSTALLATIONS}}{\textit{REPORTED INSTALLATIONS}}$$

Net-to-Gross

Cadmus calculated the savings that were directly attributable to Vectren's programs (net savings) by estimating a NTG percentage. Cadmus used the NTG to adjust verified gross savings estimates to account for freeridership and spillover. The individual program chapters and Appendix B. Net-to-Gross Detailed Findings provide information about the specific methodology Cadmus used to determine NTG.

Self-Report Surveys

Cadmus used survey results to derive net savings for the evaluated **Residential Prescriptive Program** measures (boilers and furnaces), as well as for the **Commercial Prescriptive Program**, by adjusting *ex post* gross savings to account for NTG. To mitigate self-report bias, Cadmus used a set of freeridership questions to collect data on each participant's *intention* and the factors that might have had *influence*. The *intention* and *influence* scores contributed equally to the total freeridership score. Cadmus computed the overall freeridership score for each participant as the arithmetic mean of the *intention* and *influence* scores.

Cadmus also gathered the necessary data from the self-report surveys to calculate participant spillover—the program's *influence* on customers' decisions to invest in additional energy efficiency measures for which they did not receive any Vectren *incentives*. 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 has reasonable savings documentation.

Control Group

Cadmus used billing analysis to estimate net impacts for the **Vectren Weatherization Program**. Cadmus calculated net savings by developing a comparison (control) group, which isolates the program impacts from exogenous effects.

2020 Residential Prescriptive Program (Boilers and Furnaces)

The Residential Prescriptive Program encourages customers to purchase energy-efficient products by offering rebates for high-efficiency equipment, including Wi-Fi-enabled and smart thermostats, furnaces, and boilers. All residential gas customers are eligible to participate in the program and receive rebates that vary by measure. CLEAResult, the program implementer, manages all rebate processing. For most of 2020, Vectren managed program planning, marketing, and outreach. In November 2020, the program implementer began handling trade ally outreach activities, which will continue into 2021.

For the 2020 program year, Cadmus evaluated the Residential Prescriptive Program's furnace and boiler measures only.

Accomplishments

Table 1 shows the Residential Prescriptive furnace and boiler measure achievements against goals in 2020. Vectren increased the goals for 95% AFUE boilers and furnaces from 2019 to 2020. During interviews, Vectren said the 95% AFUE boiler projects in 2020 were smaller in size than anticipated, leading to lower savings than forecasted.

However, 97% AFUE furnaces exceeded its participation and savings goals because one highly engaged contractor contributed nearly 45% of qualifying installations of the measure. During the interviews for the 2018 evaluation, Vectren said this contractor negotiated a deal with a vendor and offered the higher efficiency units at a competitive price.

Table 1. 2020 Residential Prescriptive Goals and Achievements

Measure	2020 Actual	2020 Planning Goal	Percentage of Goal
95% AFUE Boiler			
Gross Ccf Savings	2,969	6,433	46%
Participants (number of measures)	23	33	70%
95% AFUE Furnace			
Gross Ccf Savings	200,165	239,367	84%
Participants (number of measures)	1,505	1,800	84%
97% AFUE Furnace			
Gross Ccf Savings	106,624	90,731	118%
Participants (number of measures)	705	600	118%
Total Program			
Program Expenditures[1]	$1,437,268	$1,091,167	132%

Note: Goals and achievements from Vectren's 2020 DSM Scorecard. Actuals represent *ex ante* reported values.
[1] Expenditures are for the Residential Prescriptive Program as a whole, but Cadmus evaluated a subset of program measures in 2020.

Table 2 lists the evaluated savings summary for the Residential Prescriptive HVAC measures. The difference in reported and evaluated savings for furnace measures is due to differences in EFLH assumptions.

Table 2. 2020 Residential Prescriptive Natural Gas Savings

Measure	*Ex Ante* Savings		Evaluated *Ex Post* Savings (Ccf)	Realization Rates	NTG Ratio	Evaluated Net Savings
	Reported	Verified				
95% AFUE Boiler	2,969	2,927	3,476	117%	56%	1,947
95% AFUE Furnace	200,165	196,932	184,139	92%	56%	103,118
97% AFUE Furnace	106,624	105,410	99,680	93%	56%	55,821
Total HVAC Category	**309,759**	**305,270**	**287,295**	**93%**	**56%**	**160,885**

Conclusions and Recommendations

Ex Ante Savings Estimates

The 2019 Ohio TRM algorithm for boiler and furnace savings may lead to inaccurate calculation of savings. The 2019 Ohio TRM uses the input capacity of the baseline unit. However, the Uniform Methods Project (UMP) states that this is rarely known and recommends a different algorithm.[1] The UMP algorithm matches the 2015 Indiana TRM v2.2. Cadmus used this algorithm for both the 2018 and 2020 evaluation of boilers and furnaces. Cadmus used an HDD-adjusted EFLH from the 2020 Illinois TRM for the EFLH input to the UMP algorithm.

Recommendation: Use the UMP algorithm when estimating boiler and furnace savings instead of the algorithm from the 2019 Ohio TRM to ensure accurate assumption of per-unit savings. The 2019 Ohio TRM's equivalent full load hours (EFLH) are understated, so Cadmus recommends using the EFLH assumption (adjusted for heating degree days [HDD]) for Springfield, Illinois, from the 2020 Illinois TRM instead.

Federal Standards Change

A new federal requirement for residential boilers may diminish potential for future savings. This new standard will require manufacturers to make new boilers at least 84% efficient and is expected to come into effect on July 1, 2021. This new baseline will decrease the savings and cost-effectiveness of boiler measures.[2] Vectren can claim full boiler savings through the end of 2021 as vendors sell through their existing stock of products manufactured before the standard came into effect.

Recommendation: Update planning estimates for boilers starting in 2022 to account for the upcoming change in the federal standard. Because boiler replacements are usually considered replace-on-burnout, the baseline for standard replacements will probably be the federal standard. The exception to this is early replacement cases, which will continue to use less efficient baselines when tracking data indicate an installation qualifies as early replacement.

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1 National Renewable Energy Laboratory and David Jacobson. September 2017. *The Uniform Methods Project Chapter 5: Residential Furnaces and Boilers Evaluation Protocol*. https://www.energy.gov/eere/about-us/ump-protocols

2 The current federal standard baseline for natural gas boilers is 82% AFUE. The new baseline will be 84% AFUE.

CADMUS

Program Infographic Summary

RESIDENTIAL PRESCRIPTIVE PROGRAM: FURNACES AND BOILERS

2020 Data Collection Activities

1 VECTREN staff interview

1 CLEAResult® staff interview

146 quarterly online surveys with furnace participants

107 online spillover surveys with furnace participants

*No boiler participants answered the survey (only nine with emails)

2020 Program Changes

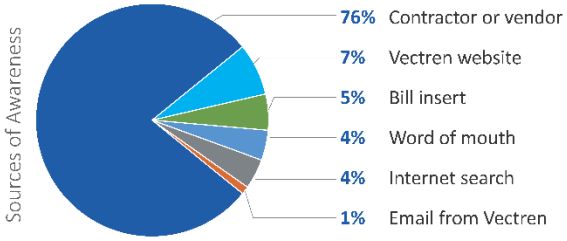
CLEAResult began assisting with outreach to trade allies in November 2020

Key Process Evaluation Findings

Furnace participants were highly satisfied with their program experience

- 100% (n=134) satisfied with furnace installed
- 99% (n=134) satisfied with the program overall
- 99% (n=119) satisfied with the variety of efficiency programs offered
- 98% (n=132) likely to recommend program to a friend or neighbor
- 98% (n=141) satisfied with Vectren's energy-efficiency tips
- 95% (n=118) satisfied with Vectren's efforts to help manage their monthly usage
- 90% (n=124) said Vectren's suggestions on ways to reduce energy usage and lower monthly bills were useful

Furnace participants primarily heard about the program through contractors (n=141)



Majority of furnace participants preferred to receive rebates as a paper check (88%, n=107)

Furnace participants were highly satisfied with the Vectren website

- 100% (n=36) said it was user-friendly
- 97% (n=33) said it was easy to find information about energy efficiency programs
- 94% (n=32) said it was easy to find rebate application

Impact Evaluation

Impact Evaluation Methods and Findings

The Residential Prescriptive Program impact evaluation included multiple data collection efforts and analysis tasks:

- Review tracking database
- Conduct engineering analysis based on 2019 Ohio TRM and other evaluation resources
- Apply self-reported data from a quarterly online survey with 146 Residential Prescriptive furnace participants and an annual spillover survey with 107 additional furnace participants[3]

Gross Savings Review

Table 3 provides per-unit annual gross savings for each evaluated furnace and boiler measure. Additional details for measure-level savings can be found in *Appendix A. Impact Evaluation Methodology* Cadmus did not identify any early replacement projects for 2020.

Table 3. 2020 Residential Prescriptive Per-Unit Gross Savings

Measure	Annual Gross Savings (Ccf)	
	Reported	Evaluated
95% AFUE Boiler	129	153
95% AFUE Furnace	133	124
97% AFUE Furnace	151	143

Cadmus used equations from the UMP's preferred evaluation protocol to calculate furnace and boiler savings (excluding in-service rate). Cadmus found minor differences in reported and evaluated savings due to annual variations in survey and program data.

Reported furnace savings in 2020 are based on evaluation results from 2018. For the 2018 evaluation, Cadmus used the 2015 Indiana TRM v2.2 to evaluate savings, but the Ohio TRM has since been updated. During its review of the 2020 program, Cadmus found an issue in the savings algorithm referenced in the 2019 Ohio TRM. Cadmus compared this algorithm to algorithms in the UMP and found that the 2019 Ohio TRM uses an equation based on baseline unit input capacity.

However, the baseline unit capacity is rarely known, so the algorithm is often incorrectly applied using the efficient unit's capacity, and this results in lower savings.[4] Vectren's program data records input capacity for the efficient measure, so Cadmus used the UMP algorithm associated with this input

[3] Cadmus attempted to survey boiler participants but there were only nine email contacts included in the participant survey sample. Cadmus received zero boiler responses.

[4] National Renewable Energy Laboratory and David Jacobson. September 2017. *The Uniform Methods Project. Chapter 5: Residential Furnaces and Boilers Evaluation Protocol*. https://www.energy.gov/eere/about-us/ump-protocols

capacity variable. This UMP algorithm is the same one used in the 2015 Indiana TRM v2.2 and the same one used to arrive at the reported savings for furnaces (based on the 2018 evaluated results). The differences in *ex ante* and *ex post* savings for the furnace measures are due to differences in EFLH assumptions. Cadmus aligned with the 2019 Ohio TRM's EFLH assumption rather than the methodology used in 2018, which was based on the EFLHs from the 2015 Indiana TRM v2.2. Assumptions for EFLH are dependent upon location, so the 2019 Ohio TRM is the best source for Vectren's Ohio program.

Table 4 lists historical evaluated per-unit savings for the furnace and boiler measures. The differences in per-unit savings between 2018 and 2020 are driven by differences in EFLHs between the 2015 Indiana TRM v2.2 (used in 2018) and the 2019 Ohio TRM (used in 2020).

Table 4. Residential Prescriptive Program Historical Per-Unit Evaluated Savings (Ccf)

Measure	2015[1]	2018	2020
95% AFUE Boiler	127	193	153
95% AFUE Furnace	N/A	133	124
97% AFUE Furnace	158	151	143

[1] The 2015 evaluation calculated different savings values for equipment depending on its use for space heating or water heating. The values in this table represent averages of the two reported heating types.

Measure Verification

Cadmus calculated in-service rates for all measures using 2020 participant survey data with the measures counted in the program tracking data. Table 5 lists the in-service rates for each program measure. Cadmus found minor differences—three fewer 95% AFUE furnace measures and two more 97% AFUE furnace measures in the program data compared to the DSM scorecard.

Table 5. 2020 Residential Prescriptive Measure Verification Results – In-Service Rates

Measure	Installations		In-Service Rate[1]
	Reported	Verified	
95% AFUE Boiler	23	23	99%
95% AFUE Furnace	1,505	1,481	98%
97% AFUE Furnace	705	697	99%
Total HVAC Category	**2,233**	**2,200**	**99%**

[1] Cadmus found that the program data had three fewer units in the 95% AFUE furnace measure and two additional units of the 97% AFUE furnace measure compared to the DSM scorecard. In the 2020 participant survey, 139 of 141 (98.58%) respondents reported their program measure was still installed in their home. Differences in reported and verified Installations are caused by both these factors. These differences are reflected in the in-service rate.

Table 6 lists historical in-service rates for the Residential Prescriptive Program. Annual variance is typically due to differences in reported and verified installations in the program tracking data and survey responses.

Table 6. Residential Prescriptive Program Historical In-Service Rates

Measure	2015	2018	2020
95% AFUE Boiler	100%	100%	99%
95% AFUE Furnace	N/A	100%	98%
97% AFUE Furnace	102%	100%	99%

Net-to-Gross Analysis

Cadmus calculated freeridership and spillover for the Residential Prescriptive Program as a whole using findings from a survey conducted with 248 furnace participants.[5] The program's HVAC measures resulted in a 56% NTG ratio. These findings are described in greater detail in *Appendix B. Net-to-Gross Detailed Findings.*

Table 7. 2020 Residential Prescriptive Program Net-to-Gross Ratio

Measure Category	Freeridership	Spillover	NTG Ratio
HVAC (furnaces and boilers)	45%	1%	56%[1]

[1] Absolute precision at 90% confidence interval is ± 3%.

Table 8 lists historical NTG ratios for furnaces and boilers evaluated in previous program years.[6] The NTG ratios for the program's HVAC measures have remained relatively stable over time.

Table 8. Residential Prescriptive Program Historical Net-to-Gross Ratios

Program Year	Freeridership	Spillover	NTG Ratio
2015	54%	4%	50%
2018	45%	0%	55%
2020	45%	1%	56%

[5] In the quarterly survey, 141 furnace participants completed the freeridership questions. In the annual spillover specific survey, 107 respondents answered the spillover questions.

[6] The 2015 evaluation used two different freeridership methods: the standard self-report *intention* freeridership method and the *Intention/Influence* freeridership method. The 2018 and 2020 analyses used a new method: the intention questions from the standard self-report intention freeridership method for an intention freeridership score and the influence questions from the Intention/Influence method for an influence freeridership score.

Freeridership and Spillover Findings

Cadmus estimated freeridership by combining two methods—the standard self-report intention method and the intention/influence method.[7] The arithmetic mean of the *intention* and *influence* freeridership components resulted in freeridership of 45%, as shown in Table 9.

Table 9. 2020 Residential Prescriptive Program Freeridership Estimate

Freeridership Metric	Estimate
Intention Score	73%[1]
Influence Score	17%[1]
Final Freeridership Score	**45%**

[1] Weighted by *ex post* gross program savings

Three furnace participants reported installing a total of three high-efficiency measures after participating in the Residential Prescriptive Program for which they did not receive an incentive.[8] These respondents said participation in the program was very important in their decision.

Cadmus used the 2019 Ohio TRM for the spillover measures attributed to the Residential Prescriptive Program. Cadmus divided the total survey sample spillover savings by the gross program savings represented by the survey sample to obtain a spillover estimate of 1%, rounded to the nearest whole percentage, as shown in Table 10.

Table 10. Residential Prescriptive Program Spillover Estimate

Survey Sample Spillover Ccf Savings	Survey Sample Program Ccf Savings	Spillover Percentage Estimate
76	14,034[1]	1%

[1] 2020 evaluated gross energy savings.

Evaluated Net Savings Adjustments

Table 11 lists evaluated net savings for the Residential Prescriptive Program furnace and boiler measures. The program achieved 136,098 Ccf net savings.

Table 11. 2020 Residential Prescriptive Natural Gas Savings

Measure	*Ex Ante* Savings (Ccf)		Evaluated *Ex Post* Savings (Ccf)	Realization Rates	NTG Ratio	Evaluated Net Savings (Ccf)
	Reported	Verified				
Boiler 95%	2,969	2,927	3,476	117%	56%	1,947
Furnace 95%	200,165	196,932	184,139	92%	56%	103,118
Furnace 97%	106,624	105,410	99,680	93%	56%	55,821
Total HVAC Category	**309,759**	**305,270**	**287,295**	**93%**	**56%**	**160,885**

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

8 These measures were water heaters and a duct sealing project.

2019 Vectren Weatherization Program

Through the Vectren Weatherization Program (VWP), Vectren offers energy-efficient improvements to income-eligible households at no cost to the customer. The program is focused on shell measure improvements as well as natural gas furnace and water heater repair and replacements. There are two program components, divided by income eligibility:

- **VWP I** is for households that earn up to 200% of the federal poverty guidelines (FPG)
- **VWP II** is for households that earn between 201% and 300% of the FPG

Miami Valley Community Action Partnership (MV CAP) is the program implementer. It delivers the program directly to Vectren customers within Vectren's service territory (Auglaize, Butler, Darke, Greene, Miami, Montgomery, Preble, and Warren counties) and coordinates with other community action partner agencies to deliver the program to Vectren customers in other counties.

Accomplishments

Cadmus evaluated the 2019 VWP instead of the 2020 program because the impact evaluation methodology required one year of post-installation billing data to estimate savings. Table 12 lists the program-reported achievements and goals, which show that Vectren achieved nearly 100% of its VWP savings and participation goals. When broken out by income tier, VWP I achieved 115% of its participation and savings goals, whereas VWP II achieved 74%.

Table 12. 2019 VWP Goals and Achievements

Unit	2019 Actual	2019 Planning Goal	Percentage of Goal
Gross Ccf Savings	69,579	72,801	96%
Participants (households)	297	307	97%
Program Expenditures	$1,997,930	$2,161,729	92%

Note: Goals and achievements from Vectren's 2019 DSM Scorecard. Actuals represent *ex ante* reported values.

During interviews, the program implementer said it continues to be more difficult to recruit participants for VWP II, making it more difficult to achieve goals. According to the implementer, moderate-income customers (those in a household that earns between 200% and 300% of the federal poverty guidelines and eligible for VWP II) may pay less attention to program marketing because they may not know they are eligible for program assistance. Often these customers are not eligible for federal assistance programs. They may also be skeptical that the program costs participants nothing.

Table 13 lists the evaluated savings summary for the 2019 VWP. Vectren's reported savings were based on evaluated billing analysis results from the 2016 program year. For both VWP I and VWP II, some of the annual difference in savings estimates can be attributed to the variability around evaluated participant savings. For 2019, evaluated savings estimates for VWP I and VWP II were not significantly different from reported at the 90% confidence level. In addition, the measure mix installed in program homes varies from year to year, causing differences in reported and evaluated savings.

Table 13. 2019 VWP Natural Gas Savings

Program Component	*Ex Ante* Savings		Evaluated *Ex Post* Savings	Realization Rates	Net-to-Gross	Evaluated Net Savings
	Reported	Verified				
VWP I	43,875	43,875	34,222	78%	N/A	34,222
VWP II	25,704	25,704	21,599	84%	N/A	21,599
Total Program	**69,579**	**69,579**	**55,822**	**80%**	**N/A**	**55,822**

Conclusions and Recommendations

Program Savings

Outlier years may lead to a misrepresentation of expected program savings. Reported savings were based on only one program year (2016), which contributed to lower realization rates in 2019. Beginning in 2020, Vectren will report savings based on a historical three-year average of evaluated savings. Cadmus evaluated realization rates of 78% for VWP I and 84% for VWP II. These realization rates were partly due to the very high gross and percentage savings achieved in 2016. The percentage and gross savings achieved in 2019 were comparable to those in all other years except 2014 and 2016. Vectren's plan to use three-year historical averages for reported savings should stabilize realization rates; using an average should help control for year-to-year variation in savings.

The program achieved high savings in 2019 compared to other comparable low-income weatherization programs. VWP I and VWP II participants achieved savings of 19% and 23% compared to pre-period weather-normalized customers. These savings were in line with recent years for Vectren's program and at the higher end of other similar types of programs.

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Program Infographic Summary

VECTREN WEATHERIZATION PROGRAM

2019 Process Analysis Activities

1 VECTREN staff interview

1 Miami Valley Community Action Partnership staff interview

2019 Program Overview

VWP I (100% – 200%)

Vectren Ohio gas customers at or below **200% of federal poverty guidelines**

- Leverages Ohio Home Weatherization Assistance Program (HWAP) and DP&L funding
- Program follows federal regulations to **qualify for federal HWAP funding**

VWP II (201% – 300%)

Vectren Ohio gas customers who fall between **201%-300% of federal poverty guidelines**

- **No outside funding sources** to share costs results in higher cost per household than VWP I
- More difficult to recruit customers in this income category; MV CAP said moderate income customers are **less likely to realize they are eligible for the program**

July — MV CAP focused primarily on VWP I customers in the summer due to the funding cycle for HWAP starting in July

2019 Program Changes

MV CAP installed a small number of tankless water heaters when unable to install a conventional hot water tank

MV CAP increased the amount of funding spent on advertising to reach more potential participants, including branding trucks and visiting county fairs

MV CAP switched to using CAP60 software to streamline and digitize the data collection process

Future Program Changes

In 2021, MV CAP will no longer be able to leverage funding for energy efficiency improvements from DP&L due to House Bill 6

Impact Evaluation

Impact Evaluation Methods and Findings

The 2019 VWP impact evaluation included multiple data collection efforts and analysis tasks:

- PRInceton Scorekeeping Method (PRISM) regression analysis using customer bill data
- Benchmarking to normalize program results in comparison to other jurisdictions
- Desk review to verify program performance reported in the 2019 DSM Scorecard

More information about Cadmus' savings methodology used to evaluate this program is detailed in *Appendix A*.

Gross Savings Review

Table 14 shows the per-household evaluated, annual gross savings of 175 Ccf for VWP I and 212 Ccf for VWP II, representing a per-household reduction of 19% and 23% of pre-period weather-normalized usage for these program components, respectively. Evaluated savings were lower than reported savings for both VWP I and VWP II, with realization rates of 78% and 84%, respectively.

Table 14. 2019 VWP Per-Unit Gross Savings

Program Component	n	Pre-Period Usage (Ccf/household)	Reported Savings (Ccf/household)	Evaluated Savings (Ccf/household)	Percentage Savings	Relative Precision
VWP I	141	906	225	175	19%	±16%
VWP II	82	922	252	212	23%	±19%

Vectren's 2019 reported savings were derived from 2016 evaluated savings estimates. Differences between savings estimates were not statistically significant for VWP I or VWP II, at the 90% confidence level.[9] The 2016 program year also had among the highest evaluated percentage savings from any program year since 2012, so these savings may be an upper bound on the likely program savings (see *Historical Savings Comparison* section). Beginning in 2020, Vectren's reported savings are based on an average of evaluated savings from prior program years. This should improve realization rates as it will absorb some of the year-to-year variation in evaluated savings.

Cadmus also investigated differences in the measure mixes in 2016 and in 2019 for VWP I and VWP II, as shown in Table 15. Differences in measure mix can identify potential drivers for differences in savings; however, year-to-year differences in individual measure savings could still exist due to differing baseline efficiencies, such as furnace/water heater efficiencies, existing R-values, and baseline household air leakage.

[9] Variability around household savings estimates in a given year are driven by random changes in energy consumption that cannot be accounted for within the regression models. Cadmus used a two-sided t-test on the mean savings in 2016 and 2019, using the standard deviations from the respective years, and determined that the differences were not statistically significant at the 90% confidence level.

Table 15. 2016 vs 2019 Measure Mix

Measure Group	Measure	VWP I		VWP II	
		2016	2019	2016	2019
Domestic Hot Water (DHW)	DHW Direct Installs	2%	0%	0%	0%
	DHW Repair/Tune-Up	24%	4%	56%	13%
	DHW Replacement	30%	60%	36%	62%
HVAC	Furnace Repair/Tune-Up	15%	10%	12%	4%
	Furnace Replacement	61%	43%	64%	74%
Shell	Air Sealing	32%	24%	85%	72%
	Attic Insulation	47%	33%	93%	83%
	Floor Insulation	12%	0%	25%	0%
	Roof Repair	5%	2%	1%	2%
	Wall Insulation	19%	12%	32%	34%
Measures Per Home		**2.46**	**1.89**	**4.04**	**3.45**

The following differences in measure mix may have contributed to lower savings in 2019 than in 2016:

- **VWP I** had fewer measures installed per home in 2019, with 1.89 measures installed per home compared to 2.46 in 2016. More shell measures and furnaces were installed in 2016 and more water heaters were installed in 2019.
- **VWP II** also had fewer measures installed per home in 2019, with 3.45 measures installed in 2019 compared to 4.04 in 2016. Both years had a high number of furnace replacements, which typically have the highest expected savings. Similar to VWP I, the main difference between the measure mixes in the two years was that more shell measures were installed in 2016 and more water heaters were installed in 2019.

Historical Savings Comparison

Table 16 shows VWP savings by year since 2012. Percentage savings have historically ranged from 18% to 30%. Evaluated 2019 gross and percentage savings were comparable to prior years, except for 2014 and 2016, which had notably higher gross and percentage savings.

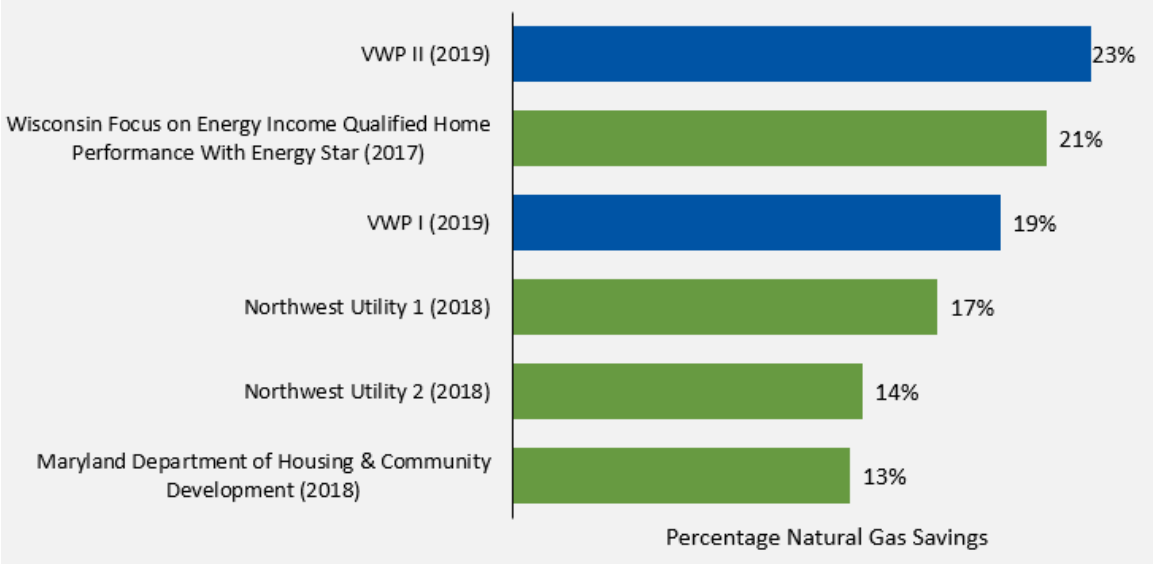
Table 16. Historical Vectren Weatherization Program
Weather-Normalized Per-Household Savings (2012–2019)

VWP	Metric	2012	2013	2014	2015	2016	2017	2018	2019
VWP I	Pre-Period Usage (Ccf/customer)	1,033	881	1,060	909	905	787	860	906
	Evaluated Savings (Ccf/customer)	186	194	260	194	225	158	175	175
	Percentage Savings	**18%**	**22%**	**25%**	**21%**	**25%**	**20%**	**20%**	**19%**
VWP II	Pre-Period Usage (Ccf/customer)	896	899	1,142	857	848	816	877	922
	Evaluated Savings (Ccf/customer)	159	168	319	208	252	187	178	212
	Percentage Savings	**18%**	**19%**	**28%**	**24%**	**30%**	**23%**	**20%**	**23%**

Similar Program Savings Comparison

Figure 1 shows a comparison of VWP percentage savings with savings from similar income-qualified programs in which major weatherization measures were installed. Similar to prior years, the 2019 VWP achieved savings that were in line or on the higher end of comparable income-qualified programs. All programs included here were evaluated using billing analysis.

Figure 1. Income-Qualified Programs' Savings Comparison



Measure Verification

Table 17 lists the in-service rates for both program components. Cadmus conducted a desk review of program tracking data to verify that 100% of reported homes received program services.

Table 17. 2019 VWP Measure Verification Results – In-Service Rates

Program Component	Number of Homes Served		In-Service Rate
	Reported	Verified	
VWP I	195	195	100%
VWP II	102	102	100%
Total	**297**	**297**	**100%**

Evaluated Net Savings Adjustments

Table 18 lists evaluated net savings for the 2019 VWP. Because the program evaluation uses a control group to estimate program savings (pre-installation usage was considered the control group while post-installation usage was considered the comparable treatment group), the evaluated savings are inherently net (there is no NTG ratio). Additionally, most income-qualified customers are not as likely to have the discretionary income to install measures on their own outside of the financial support of the program and therefore, for income-qualified programs, NTG ratios are not typically applied.

Table 18. 2019 VWP Natural Gas Savings

Measure	*Ex Ante* Savings (Ccf)		Evaluated *Ex Post* Savings (Ccf)	Realization Rates	Net-to-Gross	Evaluated Net Savings (Ccf)
	Reported	Verified				
VWP I	43,875	43,875	34,222	78%	N/A	34,222
VWP II	25,704	25,704	21,599	84%	N/A	21,599
Total Program[1]	**69,579**	**69,579**	**55,822**	**80%**	**N/A**	**55,822**

[1] Totals may not sum due to rounding.

2020 Commercial Prescriptive Program

The Commercial Prescriptive Program encourages customers to purchase energy-efficient products by offering rebates for high-efficiency equipment, including natural gas boilers, boiler tune-ups, furnaces, Wi-Fi thermostats, and commercial kitchen equipment. All commercial gas customers, aside from transport customers, are eligible to participate in the program and receive rebates that vary by measure. CLEAResult, the program implementer, manages all rebate processing. For most of 2020, Vectren managed the program planning, marketing, and outreach. In November 2020, the program implementer began handling trade ally outreach activities, which will continue into 2021.

Accomplishments

Table 19 shows the program's achievements against goals in 2020. The 2020 Commercial Prescriptive Program did not reach its participation or savings goals. Ohio allows large commercial customers to negotiate their own gas transportation service.[10] Customers who participate in Vectren's gas transportation service do not pay a general sales rate that includes fees that fund energy efficiency programs and, therefore, are ineligible for program participation. This limits the pool of commercial customers eligible for the Commercial Prescriptive Program.

Table 19. 2020 Commercial Prescriptive Goals and Achievements

Unit	2020 Actual	2020 Planning Goal	Percentage of Goal
Gross Ccf Savings	39,800	47,597	84%
Participants (measures)	52	136	38%
Program Expenditures	$113,492	$188,424	60%

Note: Goals and achievements from Vectren's 2020 DSM Scorecard. Actuals represent *ex ante* reported values.

Table 20 lists the evaluated savings for the Commercial Prescriptive Program.

Table 20. 2020 Commercial Prescriptive Natural Gas Savings

Energy Savings Unit	*Ex Ante* Savings		Evaluated *Ex Post* Savings (Ccf)	Realization Rates	NTG Ratio	Evaluated Net Savings
	Reported	Verified				
Total Ccf	39,800	39,657	41,692	105%	94%	39,190

The realization rate of 105% is primarily because Vectren assumes one building type for all boilers and furnaces rebated through the program. However, Cadmus matched boilers and furnaces of the installed address to a specific building type in the 2019 Ohio TRM.[11] In addition, savings for the program's one

[10] Nonresidential customers with annual usage greater than or equal to 50,000 therms may participate in Vectren's Gas Transportation Service. https://www.vectren.com/information/transportation/oh-suppliers.

[11] Vermont Energy Investment Corporation. August 6, 2010 (updated by Michaels Energy, September 23, 2019). *State of Ohio Energy Efficiency Technical Reference Manual.* Prepared for the Public Utilities Commission of Ohio.

steam cooker installation were underreported by a factor of 10, but Cadmus was unable to determine the exact methodology used to calculate the *ex ante savings*.

Conclusions and Recommendations

Data Tracking

Detailed data reporting may lead to higher annual program savings from HVAC measures. For boilers and furnaces, the reported data are sparse, and more data could lead to more savings and more accurate results. The reported savings assume that all boilers are installed in small retail spaces and all furnaces are installed in small offices. Cadmus matched the buildings of each boiler and furnace installation with a building type in the 2019 Ohio TRM. Cadmus' results found more savings compared to the reported savings. Because Vectren does not evaluate each of its Ohio programs annually, the DSM scorecard may be underestimating savings and there is no annual verification process to true up the savings.

Additionally, efficiencies were not reported for three boiler projects. Cadmus looked these up manually and could not determine what efficiencies were used for the reported savings. For boiler tune-ups, the 2020 application required pre- and post-tune-up efficiencies. However, because some data were missing and boiler tune-ups were not a measure in the 2019 Ohio TRM, Cadmus used a deemed approach to estimate boiler tune-up savings.[12] If pre- and post-tune-up efficiencies were reported, an algorithm like that in the Illinois TRM could be used,[13] and this would provide more accurate results than the current, deemed approach.

Recommendation: Collect the following data for Commercial Prescriptive HVAC measures:

- Collect the building type for each boiler, furnace, and boiler tune-up customer and match it with the 2019 Ohio TRM. This will lead to more accurate reported savings and better planning.
- Collect the boiler type and its efficiency level. Hot water and steam boilers have different efficiency requirements—steam boilers have lower federal efficiency requirements than hot water boilers (resulting in a lower baseline for savings). Cadmus assumed that all rebated boilers were hot water (as they are more common). If any were steam boilers, there would be about 1% to 2% more savings per boiler.
- Report the boiler efficiencies for pre- and post-tune-up collected in the rebate form. This would lead to more accurate results and potentially more savings.

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12 Cadmus developed the deemed approach in 2016.

13 Illinois Commerce Commission. October 17, 2020. *2020 Illinois Statewide Technical Reference Manual for Energy Efficiency Version 8.0—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.

Fuel units are misaligned in various program data. The tracking database reports savings in therms, while the scorecard reports savings in hundred cubic feet (Ccf). For most projects, Cadmus could not exactly recreate therms or Ccf savings, which implies reported savings used a therms-to-Ccf conversion that differed from the 1 therm = 1 Ccf that Cadmus used.

Recommendation: In the tracking database, report savings in both therms and Ccf. Another option is to specify the therms to Ccf conversion factor explicitly in the tracking database.

Boiler Eligibility Requirements

Program eligibility requirements allow rebates for non-ENERGY STAR-certified commercial boilers. As stated above, efficiencies were not reported for three new boilers. Cadmus looked them up and found that two, which had identical model numbers, were Tyler Technologies Hydrotherm KN-10 boilers with a capacity of 2,000 MBtuh; however, these are not ENERGY STAR-certified.

ENERGY STAR efficiency standards differ for residential-sized boilers[14] (or boilers with input capacity ratings less than 300 MBtuh) and commercial-sized boilers[15] (or boilers with input capacities greater than 300 MBtuh and less than 2,500 MBtuh). Note that there are no ENERGY STAR requirements for boilers with input capacities greater than 2,500 MBtuh.

ENERGY STAR-certified residential boilers require an efficiency of at least 90% AFUE. ENERGY STAR-certified commercial boilers require an efficiency of at least 94% thermal efficiency (TE). Vectren's rebate only requires boilers to be at least 90% efficient (by measure of AFUE, TE, or CE [combustion efficiency]).[16]

Recommendation: Change the language in the rebate form to "must meet ENERGY STAR standards, but if greater than 2,500 MBtuh, combustion efficiency must be 90% or greater." Note that the specific edge case of boilers with input capacities greater than 2,500 MBtuh could also be further revised depending on program goals. This will lead to greater savings, as some non-ENERGY STAR boilers currently qualify for a rebate.

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[14] Environmental Protection Agency. *ENERGY STAR Program Requirements for Boilers V3.0.* *https://www.energystar.gov/sites/default/files/specs//private/Boilers%20Program%20Requirements%20Version%203%200.pdf*.

[15] Environmental Protection Agency. *ENERGY STAR Program Requirements for Commercial Packaged Boilers V1.0.* *https://www.energystar.gov/sites/default/files/Commercial%20Packaged%20Boilers%20Final%20Version%201.0.pdf*.

[16] See Vectren's 2020 rebate form: https://m.vectren.com/assets/downloads/oh-business/oh-business-equipment-application-2020.pdf.

Steam Cooker Savings

Vectren is underreporting steam cooker savings. Vectren's reported savings for steam cookers were too conservative and the *ex ante* assumptions were not reported, so it is unclear what algorithm Vectren used to calculate savings. The individual measure realization rate was 1,384%.

Recommendation: Use the ENERGY STAR commercial kitchen calculator to more accurately estimate savings based on pan size when program steam cookers have more than six pans. (The deemed savings table in the 2019 Ohio TRM has up to six pans). The 2019 Ohio TRM derives savings for steam cookers from the ENERGY STAR commercial kitchen calculator, and the ENERGY STAR commercial kitchen calculator can be used for most eligible kitchen measures in the program. This will ensure that savings for future kitchen measures are calculated accurately and transparently.

CADMUS

Program Infographic Summary

COMMERCIAL PRESCRIPTIVE PROGRAM

2020 Data Collection Activities

1 VECTREN staff interview

1 CLEAResult® staff interview

9 participant customer phone interviews

(32% response rate)

2020 Program Changes

Vectren did not conduct outreach for most of 2020 due to COVID-19 pandemic

- CLEAResult began assisting with outreach to trade allies in November 2020

Vectren added a contractor incentive for commercial kitchen equipment to encourage additional sales

- Incentive was 20% of measure rebate
- Two contractors participated in the promotion

Key Process Evaluation Findings

Customers heard about the program primarily through contractors or the Vectren website (n=9)

4 Contacted by trade ally/contractor/vendor

1 Word of mouth

3 Vectren website

1 Previous program experience

Participants were highly satisfied with the Vectren website

6/6 said it was user-friendly

6/6 said it was easy to find information about energy efficiency programs

5/5 said it was easy to find rebate applications

Participants were highly satisfied with their program experience

9/9 very satisfied with overall program

9/9 likely to recommend this program to another business owner or manager

8/8 satisfied with their contractor or vendor

Impact Evaluation

Impact Evaluation Methods and Findings

The Commercial Prescriptive Program impact evaluation included multiple data collection efforts and analysis tasks:

- Tracking database review
- Review *ex ante* savings methodologies and algorithms for the census of program measures
- Develop evaluated (*ex post* gross) savings using the 2019 Ohio TRM
- Incorporate site-specific findings, including in-service rate, spillover, and freeridership into evaluated savings via telephone interviews with participants (n=9)

Gross Savings Review

Figure 2 shows the total *ex post* Ccf savings for each measure type. Boilers made up 70% of total evaluated Ccf savings, and HVAC measures (which include boilers, boiler tune-ups, and furnaces) made up 87% of total evaluated Ccf savings.

Figure 2. 2020 Commercial Prescriptive Program Measure Type Evaluated Ccf Savings

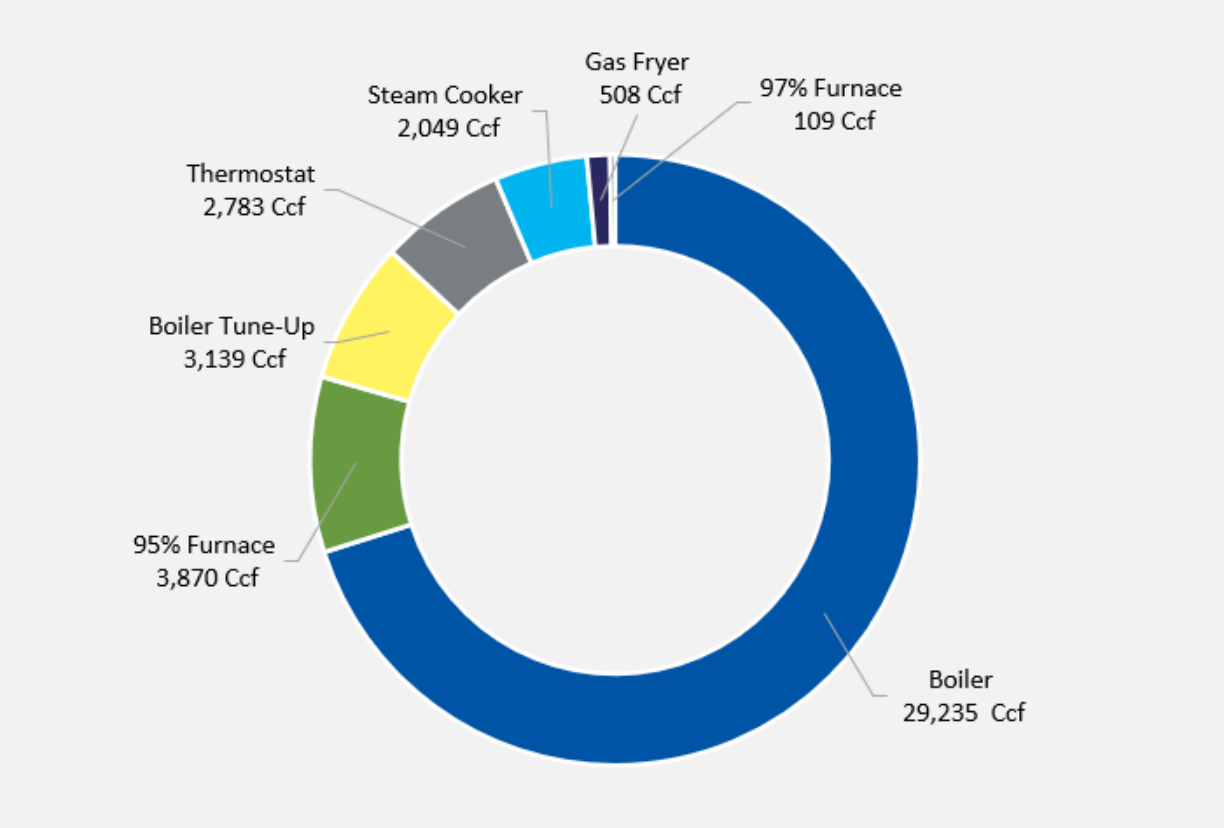


Table 21 provides per-unit annual gross savings for each rebated program measure in 2020.[17] Additional details for measure-level savings can be found in *Appendix A. Impact Evaluation Methodology.*

Table 21. 2020 Commercial Prescriptive Per-Unit Gross Savings

Measure	Annual Gross Savings (Ccf)	
	Reported	Evaluated
Boiler	2,132	2,088
Boiler Tune-Up	3,139	3,139
Furnace - 95% AFUE	143	176
Furnace - 97% AFUE	103	109
Gas Fryer	505	508
Steam Cooker	148	2,049
Thermostat	253	253

For boilers, Cadmus found that evaluated savings were slightly lower than reported savings. For thermostats and boiler tune-ups, Cadmus found that evaluated savings were equal to reported savings. For all other measures, evaluated savings were larger than reported savings.

Cadmus used site-specific inputs whenever possible. For boilers and 95% efficient furnaces,[18] the primary site-specific input Cadmus used was heating hours, based on matching to a building type in the 2019 Ohio TRM. Table 22 summarizes the reported assumed building types for boilers and furnaces compared to Cadmus' evaluated findings. The evaluated weighted average hours by total kBtuh were larger than the reported weighted average hours for boilers and furnaces.

For furnaces, this partly explains why the evaluated savings were higher than the reported savings. However, for boilers, there were still some unknown difference between reported and evaluated savings as Cadmus was never able to recreate the reported therms savings for all boiler projects.

The largest discrepancy in reported and evaluated savings was for steam cookers. Vectren's reported savings did not follow the 2019 Ohio TRM nor the ENERGY STAR commercial kitchen calculator. Though the 2019 Ohio TRM does follow the ENERGY STAR commercial kitchen calculator, instead of providing a savings algorithm, the TRM provides deemed savings based on pan size. The installed steam cooker had 10 pans, a larger number than are provided in the Ohio TRM's deemed savings table, so Cadmus used the ENERGY STAR commercial kitchen calculator for the evaluated savings.

[17] The Commercial Prescriptive Program includes other eligible measures, such as combination and convection ovens, dishwashers, infrared heaters, and unit heaters. In 2020, Cadmus evaluated only the measures for which customers received rebates.

[18] For the one 97% efficient furnace in the program, the site-specific finding matched the reported assumption.

Table 22. Comparison of Boiler and Furnaces Reported and Evaluated Building Types

Measure	Reported			Evaluated		
	Building Type	Hours	Total kBtuh of Rebated Measures	Building Type	Hours	Total kBtuh of Rebated Measures
Boiler	Small Retail	1,125	12,777	Small Office	826	3,400
				Assembly	1,009	2,667
				Religious Worship	1,085	4,400
				Large Office - CV, econ	2,526	2,000
				Other	1,283	155
				Small Retail	1,125	155
	Weighted Average	**1,125**	**12,777**	**Weighted Average**	**1,228**	**12,777**
Furnace - 95% AFUE	Small Office	826	1,990	Small Office	826	1,260
				Small Retail	1,125	200
				Religious Worship	1,085	240
				Assembly	1,009	110
				Other	1,283	100
				Fast Food Restaurant	1,463	80
	Weighted Average	**826**	**1,990**	**Weighted Average**	**935**	**1,990**

Measure Verification

Table 23 lists the in-service rates for each program measure. During interviews with nine respondents, Cadmus found that all measures were still installed and in working condition. However, the DSM scorecard reported an extra 95% efficiency furnace than found in the tracking data. That extra reported furnace caused the overall in-service rate to be 98% instead of 100%.

Table 23. 2020 Commercial Prescriptive Measure Verification Results – In-Service Rates

Measure	Installations		In-Service Rate
	Reported	Verified	
Boiler	14	14	100%
Boiler Tune-Up	1	1	100%
Furnace - 95% AFUE	23	22[1]	96%
Furnace - 97% AFUE	1	1	100%
Gas Fryer	1	1	100%
Steam Cooker	1	1	100%
Thermostat	11	11	100%
Total	**52**	**51**	**98%[2]**

[1] There was one extra furnace reported in the DSM scorecard than in the program tracking data.
[2] Cadmus' survey found that all nine respondents' measures were still installed. However, the extra reported 95% furnace in the scorecard decreased the total ISR to 98%. In other words, Cadmus only awarded savings to measures that were present in the database. Multiplying the Ccf per-unit 95% furnace savings (see Table 21) by 23 furnaces instead of 22 furnaces would be incorrect. The ISR reflects these findings in that the total ISR is simply the sum of all verified installations divided by all reported installations.

Net-to-Gross Analysis

Cadmus calculated freeridership and spillover for the Commercial Prescriptive Program using findings from interviews with nine program participants (32% of the program interview sample). Table 24 presents the NTG results for the program. These findings are described in greater detail in *Appendix B*.

Table 24. 2020 Commercial Prescriptive Net-to-Gross Ratio

Measure	Freeridership[1]	Spillover	NTG Ratio
Total Program	6%	0%	94%

[1] Weighted by evaluated *ex post* gross program Ccf savings.

When furnace and boilers measures for the Commercial Prescriptive Program were last evaluated in 2017, Cadmus found a program NTG of 92%, based on self-report responses from interviews with five program participants.

Freeridership and Spillover Findings

Cadmus estimated freeridership by combining the standard self-report intention method and the intention/influence method.[19] Cadmus calculated the arithmetic mean of the *intention* and *influence* freeridership components to estimate the final program freeridership of 6%, as shown in Table 25.

Table 25. 2020 Commercial Prescriptive Program Freeridership Estimate

Freeridership Metric	Estimate
Intention Score	9%[1]
Influence Score	3%[1]
Final Freeridership Score	**6%**

[1] Weighted by *ex post* gross program Ccf savings.

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. Therefore, no spillover is attributed to the program.

Evaluated Net Savings Adjustments

Table 26 lists evaluated net savings for the Commercial Prescriptive Program. The program achieved 39,190 Ccf net savings.

[19] *Intention* and *influence* freeridership scores both have a maximum of 100%.

Table 26. 2020 Commercial Prescriptive Natural Gas Savings

Measure	*Ex Ante* Savings (Ccf)		Evaluated *Ex Post* Savings (Ccf)	Realization Rates	NTG Ratio	Evaluated Net Savings (Ccf)
	Reported	Verified				
Boiler	29,843	29,843	29,235	98%	94%	27,481
Boiler Tune-Up	3,139	3,139	3,139	100%	94%	2,951
Furnace - 95% AFUE	3,278	3,136	3,870	118%	94%	3,638
Furnace - 97% AFUE	103	103	109	105%	94%	102
Gas Fryer	505	505	508	101%	94%	477
Steam Cooker	148	148	2,049	1,384%	94%	1,926
Thermostat	2,783	2,783	2,783	100%	94%	2,616
Total Program	**39,800**	**39,657**	**41,692**	**105%**	**94%**	**39,190**

Appendix A. Impact Evaluation Methodology

A.1 2020 Residential Prescriptive Program

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

- 95% AFUE boilers
- 95% AFUE furnace
- 97% AFUE furnace

Table A-1 provides per-unit annual gross savings for each evaluated program measure.

Table A-1. 2020 Residential Prescriptive Program Per-Unit Gross Savings

Measure	Annual Gross Savings (Ccf)	
	Reported	Evaluated
95% AFUE Boiler	129	153
95% AFUE Furnace	133	124
97% AFUE Furnace	151	143

A.1.1 Boilers

Cadmus used the Uniform Methods Project's preferred evaluation protocol for calculating boiler savings (excluding in-service rate [ISR]).[20]

$$Ccf\ Savings\ =\ EFLH\ x\ BTUH\ x\ (\frac{AFUEeff}{AFUEbase}\ -1)/Conversion$$

Table A-2 shows the variables used in this evaluation.

Table A-2. Residential Prescriptive Program Natural Gas Boiler Calculation Variables

Variable	Value	Units	Source
EFLH = Equivalent full load hours	842	Hours	*2020 Illinois Statewide Technical Reference Manual for Energy Efficiency Version 8.0*, adjusted to Ohio using HDD
BTUH = Boiler capacity	Varies	BTUH	2020 program tracking database
AFUEeff = Efficiency of efficient boiler	Varies	%	2020 program tracking database
AFUEbase = Baseline unit efficiency	82%, early replacement varies by equipment age	%	Federal standard, RESNET. *Mortgage Industry National Home Energy Rating Systems Standards*. Table 303.8.1(3): Default Values for Mechanical System Efficiency (Age-Based). https://www.resnet.us/about/standards/minhers/
Conversion	100,000	BTUH/ Ccf	Energy conversion factor (ECF) specific to Vectren Ohio territory based on 2020 correspondence with Vectren program staff

[20] National Renewable Energy Laboratory and David Jacobson. *The Uniform Methods Project Chapter 5: Residential Furnaces and Boilers Evaluation Protocol.* September 2017. https://www.energy.gov/eere/about-us/ump-protocols

Early Replacement Units

The program 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 furnace and boiler 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 and an operable condition to be an early replacement installation. Using this approach, in 2020, 0% of furnace and boiler installations qualified as early replacement. Cadmus used the federal standard of 82% AFUE as the baseline for replace-on-burnout units.[21]

A.1.2 Furnaces

Cadmus used the Uniform Methods Project's preferred evaluation protocol for calculating furnace savings (excluding ISR).[22]

$$Ccf\ Savings\ =\ Capacity\ (BTUH)\ x\ EFLH\ x\ (\frac{AFUE_{ee}}{AFUE_{base}} - 1)\ /\ Conversion$$

Table A-3 shows the variables used in this evaluation.

Table A-3. Residential Prescriptive Program Furnace Replacement Calculation Variables

Variable	Value	Units	Source
Capacity (BTUH) = Furnace input capacity	Varies	BTUH	2020 program tracking database
EFLH = Equivalent full load hours	842	Hours	2020 Illinois Statewide Technical Reference Manual for Energy Efficiency Version 8.0, adjusted to Ohio using HDD
AFUEbase = Baseline unit efficiency	80%, 78% early replacement	%	Federal standard, RESNET. *Mortgage Industry National Home Energy Rating Systems Standards*. Table 303.8.1(3): Default Values for Mechanical System Efficiency (Age-Based). Available online at: https://www.resnet.us/about/standards/minhers/
AFUEee = Efficiency of efficient furnace	Varies	%	2020 program tracking database
Conversion	100,000	BTUH/ Ccf	Energy conversion factor (ECF) specific to Vectren Ohio territory based on 2020 correspondence with Vectren program staff

[21] For 2022, the federal standard will change, effective on July 1, 2021, increasing the baseline to 84% AFUE.

[22] National Renewable Energy Laboratory and David Jacobson. September 2017. *The Uniform Methods Project Chapter 5: Residential Furnaces and Boilers Evaluation Protocol*. https://www.energy.gov/eere/about-us/ump-protocols

Early Replacement Units

The program 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 furnace and boiler 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 and an operable condition to be an early replacement installation. Using this approach, in 2020, 0% of furnace and boiler installations qualified as early replacement. Cadmus used the federal standard of 80% AFUE as the baseline for replace-on-burnout units.

A.2 2019 Vectren Weatherization Program

Cadmus' impact evaluation of VWP savings included a billing analysis, which involved these tasks:

- Collected, reviewed, and prepared data
- Conducted PRISM regression analysis and panel regression analysis

Table A-4 provides per-household annual gross savings for the VWP I and VWP II components.

Table A-4. 2019 Vectren Weatherization Program Natural Gas Per-Unit Gross Savings

Program Component	Annual Gross Savings (Ccf)	
	Reported	Evaluated
VWP I	225	175
VWP II	252	212

A.2.1 Data Collection, Review, and Preparation

Cadmus collected billing data and program participation data for all VWP I and VWP II participants who had program measures installed in 2019. Billing data spanned three full years (January 2018 to December 2020) to allow for 12 months of pre-installation data and 12 months of post-installation data.

Cadmus used a rolling pre-installation period of one calendar year before each participant's earliest project completion date and used a rolling post-installation period of one calendar year after the final project completion date. Cadmus followed several steps to prepare the data for billing analysis:

1. Clean the participant tracking information and matched it to the natural gas billing data
2. Use zip code mapping for all weather stations in the United States to determine the nearest station for each zip code
3. Obtain daily average temperature data from January 2018 through December 2020 for five National Oceanic and Atmospheric Administration weather stations representing all zip codes associated with the participants
4. Use daily temperatures to determine variable base 45°F to 70°F heating degree days (HDDs) for each station

5. Obtain typical meteorological year annual HDDs to weather-normalize the billing data
6. Match billing data periods with HDDs from the associated weather stations

Data Screening

Cadmus excluded participants with fewer than 10 pre- and 10 post-installation months, which ensured that data for both periods were balanced and that all seasons were represented in the billing analysis. Cadmus also excluded participants who changed their energy use by more than 70% from the pre- to the post-installation period (since changes of this magnitude, in either direction, are unlikely to have been driven by the program).

Cadmus performed a billing data screen to examine the monthly billing data, plotting each participant's monthly usage. To avoid confounding the billing analysis, Cadmus removed any accounts with outliers, apparent vacancies, seasonal usage, and non-programmatic equipment or apparent occupancy changes in the pre- or post-installation periods. In addition, Cadmus visually inspected the data for anomalies and removed any accounts with atypical consumption patterns.

Table A-5 present model attrition for VWP I and VWP II. The largest source of attrition was having insufficient pre- or post-installation billing data (less than 300 days). Overall, the analysis included 68% of VWP I participants and 77% of VWP II participants.

Table A-5. 2019 Vectren Weatherization Program I and II Attrition

Screen	Projects Remaining	Projects Dropped	Percentage Dropped	Percentage Remaining
VWP I				
Original Natural Gas Accounts	**208[1]**	**0**	**0%**	**100%**
Dropped in Merge with Billing Data	189	19	9%	91%
Insufficient Pre- and Post-Installation Days (<300 days)	167	22	12%	80%
Changed Usage from the Pre- to Post-Period (>70%)	155	12	7%	75%
Failed PRISM due to Incorrect Signs on Coefficients	152	3	2%	73%
Individual Customer Bill Review[2]	141	11	7%	68%
Final Analysis Group	**141**	**67**	**32%**	**68%**
VWP II				
Original Natural Gas Accounts	**107[1]**	**0**	**0%**	**100%**
Dropped in Merge with Billing Data	100	7	7%	93%
Insufficient Pre- and Post-Installation Days (<300 days)	89	11	11%	83%
Changed Usage from the Pre- to Post-Period (>70%)	85	4	4%	79%
Failed PRISM due to Incorrect Signs on Coefficients	85	0	0%	79%
Individual Customer Bill Review[2]	82	3	4%	77%
Final Analysis Group	**82**	**25**	**23%**	**77%**

[1] In the VWP I tracking data, 208 participants had 2019 installation dates, compared to 195 listed on the 2019 Gas DSM Scorecard. In the VWP II tracking data, 107 participants had 2019 installation dates, compared to 102 listed on the 2019 Gas DSM Scorecard.
[2] These projects were removed due to outliers, vacancies, seasonal usage, and equipment changes.

A.2.2 Regression Analyses

To estimate savings for the VWP, Cadmus used household-level PRISM models and pooled customer fixed-effects models. Cadmus ultimately reported on the PRISM model savings; however, the pooled customer fixed-effects savings and relative precisions were nearly identical (see Table A-6 in the *Detailed Model Results* section below).

PRISM Modeling Approach

Cadmus estimated PRISM models for pre- and post-installation billing data. A PRISM model estimates weather-normalized pre- and post-installation annual use for each account.

For each participant home, Cadmus estimated a heating PRISM model to weather-normalize raw billing data for the pre- and post-installation periods (using a variable heating reference temperature ranging from 45°F to 70°F). The PRISM model used the following specification for natural gas participants:

$$ADC_{it} = \alpha_i + \beta_1 AVGHDD_{it} + \varepsilon_{it}$$

Where, for each customer 'i' and calendar month 't':

ADC_{it}	=	Average daily consumption in the pre- or post-installation program period
α_i	=	Participant intercept representing the average daily Ccf base load
β_1	=	Model heating slope parameter value
$AVGHDD_{it}$	=	Variable base 45-70 average daily HDDs for the specific location
ε_{it}	=	Error term

Using this model, Cadmus computed weather-normalized annual consumption for each heating reference temperature, as follows:

$$NAC_i = \alpha_i * 365 + \beta_1 LRHDD_i + \varepsilon_i$$

Where, for each customer 'i':

NAC_i	=	Normalized annual Ccf consumption
α_i	=	Modeled average daily or base load for each participant
$\alpha_i * 365$	=	Annual base load Ccf usage (non-weather-sensitive)
β_1	=	Heating parameter value (usage per HDD from the PRISM model)
$LRHDD_i$	=	Annual, long-run HDDs in a typical meteorological year from the National Oceanic and Atmospheric Administration's TMY3 (1991–2005) series and based on home location [23]
$\beta_1 * LRHDD_i$	=	Weather-normalized annual heating usage
ε_i	=	Error term

[23] Cadmus used the Typical Meteorological Year 3 (TMY3) Normals series (1991-2005) rather than the U.S. Climate Normals series (1981-2010). The U.S. Climate Normals series has five newer years of data but also 10 older years of data, so there are no large differences between the two series. Cadmus will update these normals when the 1991-2020 U.S. Climate Normals series is released as this will better account for more recent changes in climate.

From the models with appropriately defined parameters, Cadmus chose the one with the highest R-square for each participant during the pre- and post-installation periods as best representing consumption under typical weather conditions.

After obtaining the pre- and post-installation usage for each customer, Cadmus screened the data using PRISM-based screening steps, excluding accounts from the analysis for two reasons:

- Post-installation weather-normalized (POSTNAC) use was 70% higher or lower than pre-installation weather-normalized (PRENAC) use, which could indicate property vacancies or that participants added or removed natural gas equipment unrelated to the program.
- PRENAC or POSTNAC estimates were missing (possibly due to negative heating slopes or negative intercepts), indicating possible problems with the billing data.

From the PRISM models shown above, the average difference in normalized annual consumption (PRENAC minus POSTNAC) yielded average program savings. To determine the percentage of savings, Cadmus divided this normalized annual consumption by the PRENAC.

Conditional Savings Analysis Modeling Approach (Customer Fixed Effects)

To provide a second estimate of VWP energy savings, Cadmus conducted pre- and post-installation, conditional savings analysis fixed-effects modeling. Cadmus used pooled monthly time-series (panel) billing data to correct for differences between participants in pre- and post-installation weather conditions. In fixed-effects modeling, the inclusion of a separate intercept for each participant allows for any unobservable factors that influence energy consumption to be considered within the model rather than being reflected as part of the model error. This strengthens the explanatory power of the model. In addition, the fixed-effects model estimates a separate energy baseline for each participant.

This modeling approach ensured that modeled savings estimates would not be skewed by participants with unusually high usage or low usage. Cadmus used the following model specification to determine overall savings:

$$ADC_{it} = \alpha_i + \beta_1 * AVGHDD_{it} + \beta_2 * AVGGDD_{it} * Post_{it} + \beta_3 * POST_{it}$$

Where for participant 'i' and monthly billing period 't':

ADC_{it}	=	Average daily Ccf consumption during the pre- or post-installation period
α_i	=	Average daily Ccf base load intercept for each participant (part of the fixed-effects specification)
β_1	=	Average baseline heating Ccf usage per participant per HDD
$AVGHDD_{it}$	=	Average daily base 60 HDDs based on home location[24]
β_2	=	Heating Ccf savings per HDD for VWP measures
β_3	=	Average daily base load (non-weather sensitive) Ccf savings for the VWP

[24] Base 60 HDDs was chosen for all participants because 60°F was the approximate average heating reference temperature from the PRISM models for both VWP I and VWP II participants.

$POST_{it}$ = Indicator variable that is 1 in the post-program period (after the measure installations), and 0 in the pre-program period

ε_{it} = Error term

Detailed Model Results

Table A-6 shows the savings and error estimates from both the PRISM and fixed-effects modeling approaches. Savings and error estimates from both approaches were nearly identical, indicating that estimated savings for the analysis group were robust to the modeling approach.

Table A-6. 2019 Vectren Weatherization Program Detailed PRISM and Fixed-Effects Model Savings

VWP	Modeling Approach	n	PRENAC	Modeled Savings	Standard Error	Lower 90% CI	Upper 90% CI	Relative Precision	Percentage Savings
VWP I	PRISM	141	906	175	18	147	204	±16%	19%
	Fixed Effects	141	906	173	18	144	202	±17%	19%
VWP II	PRISM	82	922	212	24	172	251	±19%	23%
	Fixed Effects	82	922	210	23	172	247	±18%	23%

A.3 2020 Commercial Prescriptive

Cadmus' impact evaluation of the Commercial Prescriptive Program included measures with attributable natural gas savings, including these:

- Boilers
- Boiler tune-ups
- Furnaces – 95% AFUE and 97% AFUE
- Gas fryers
- Steam cookers
- Thermostats

Table A-7 provides per-unit annual gross savings for each program measure. The 2019 Ohio TRM generally calculates savings in MMBtu, but sometimes in therms, which Cadmus converted to Ccf.

Table A-7. Commercial Prescriptive Per-Unit Gross Savings

Measure	Annual Gross Savings (Ccf)	
	Reported	Evaluated
Boiler	2,132	2,088
Boiler Tune-Up	3,139	3,139
Furnace - 95% AFUE	143	176
Furnace - 97% AFUE	103	109
Gas Fryer	505	508
Steam Cooker	148	2,049
Thermostat	253	253

A.3.1 Boilers

Cadmus based evaluated savings for commercial boilers from the algorithm in the 2019 Ohio TRM:

$$\Delta Ccf = CAP \times EFLH_h \times (1/n_{base} - 1/n_{ee}) \times 10\frac{MMBtu}{Therms} \times 1.00\frac{Ccf}{Therms}$$

Where:

CAP	=	Heating input capacity of installed equipment in MMBtuh
$EFLH_H$	=	Equivalent full load heating hours selected based upon city and building type
n_{BASE}	=	Baseline equipment efficiency, depends on application type and system size, but typically 80% or 82%
n_{EE}	=	Installed equipment efficiency, in units of AFUE, thermal efficiency, or combustion efficiency, average efficiency in the program was 95%
10	=	Conversion to therms
1.00	=	Conversion to Ccf

A.3.2 Boiler Tune-Ups

Commercial boiler tune-ups are not a measure in the 2019 Ohio TRM. Thus, consistent with previous years, Cadmus used the deemed energy savings factor per boiler input Btuh that Cadmus developed in 2016 for Vectren Ohio.

$$\Delta Ccf = CAP \times ESF \times 1.00\frac{Ccf}{Therms}$$

CAP is the capacity of the boiler in Btuh, ESF is 0.0004186 therms/Btu, and 1.00 is the conversion from therms to Ccf.

A.3.3 Furnaces

Cadmus based evaluated savings for furnaces using the algorithm from the 2019 Ohio TRM for efficient furnaces installed with ECM fans:

$$\Delta Ccf = (CAP \times EFLH_h \times (1/n_{base} - 1/n_{ee}) - MMBtu_{ECM}) \times 10\frac{MMBtu}{Therms} \times 1.00\frac{Ccf}{Therms}$$

Where:

CAP	=	Heating input capacity of installed equipment in MMBtuh
$EFLH_H$	=	Equivalent full load heating hours selected based upon city and building type
n_{BASE}	=	Baseline equipment efficiency, depends on application type and system size, 80% for all measures
n_{EE}	=	Installed equipment efficiency, in units of AFUE, thermal efficiency, or combustion efficiency, either at least 95% or at least 97% AFUE

$MMBtu_{ECM}$ = Penalty from installing an ECM fan, no data available in program so set to 0

10 = Conversion to therms

1.00 = Conversion to Ccf

A.3.4 Gas Fryers

Cadmus used the algorithm in the 2019 Ohio TRM for commercial fryers. The only program-specific input was the type of fryer, standard or large vat. The one measure in the program was standard-sized. The equations in the 2019 Ohio TRM are:

$$\Delta E = (\Delta E_{idle} + \Delta E_{cook}) \times Days/CF \times 1.00\frac{Ccf}{Therms}$$

$$\Delta E_{idle} = \left[Idle_{base} \times \left(hours - {}^{LB}/_{PC_{base}}\right)\right] - \left[Idle_{ES} \times \left(hours - {}^{LB}/_{PC_{ES}}\right)\right]$$

$$E_{cook} = \left[LB \times \frac{E_{Food}}{Eff_{base}}\right] - \left[LB \times \frac{E_{Food}}{Eff_{ES}}\right]$$

Where:

ΔE = Energy savings for ENERGY STAR gas fryer

ΔE_{idle} = Difference in idle energy savings between a baseline and ENERGY STAR fryer

ΔE_{cook} = Difference in cooking energy savings between a baseline and ENERGY STAR fryer

Days = Days of operation per year, 365.25

CF = Conversion factor from Btu to therms

1.00 = Conversion factor from therms to Ccf

$Idle_{base}$ = Idle energy rate for baseline fryer, 14,000 Btuh for standard fryer

$Idle_{ES}$ = Idle energy rate for ENERGY STAR fryer, 9,000 Btuh for standard fryer

Hours = Daily operating hours, 16 hours for standard fryer

LB = Pounds of food cooked per day, 150

PC_{Base} = Production capacity of baseline fryer, 60 lb/hr for standard fryer

PC_{ES} = Production capacity of ENERGY STAR fryer, 65 lb/hr for standard fryer

Eff_{Base} = Heavy load cooking energy efficiency for baseline fryer, 35% for standard fryer

Eff_{ES} = Heavy load cooking energy efficiency for ENERGY STAR fryer, 50% for standard fryer

E_{Food} = ASTM energy to food, the amount of energy absorbed by the food during use of the gas fryer, 570 Btu/lb

A.3.5 Steam Cookers

The 2019 Ohio TRM has deemed savings for steam cookers based on number of pans, as shown in Table A-8. However, the one program steam cooker had 10 pans, and reported savings assumed 148 therms, which is not in the 2019 Ohio TRM.

Table A-8. 2019 Ohio TRM Steam Cooker Default Savings

Number of Pans	Gas Unit
	Therms Savings
3 Pan	766
4 Pan	867
5 Pan	962
6 Pan	1,054

Source: Vermont Energy Investment Corporation. August 6, 2010 (updated by Michaels Energy, September 23, 2019). *State of Ohio Energy Efficiency Technical Reference Manual.* Prepared for the Public Utilities Commission of Ohio.

Cadmus used the ENERGY STAR commercial kitchen calculator, followed the assumptions in the 2019 Ohio TRM that the baseline is a boiler-based steam cooker, and used the specific steam cooker type (boiler-less) from the actual installed steam cooker. The ENERGY STAR calculator uses the following algorithm:

$$\Delta E = \left(E_{Daily,base} - E_{Daily,ES}\right) \times Days \times 1.00 \frac{Ccf}{Therms}$$

$$E_{Daily,base\ or\ ES} = E_{idle,base\ or\ ES} + E_{cooking,base\ or\ ES}$$

$$E_{idle} = \left[(1 - T_{steam}) \times Idle_{energy} + T_{steam} \times PC \times Pans \times ASTM/Eff_{cook}\right] \times T_{idle}$$

$$E_{cooking} = LB_{food} \times ASTM/Eff_{cook}$$

Where:

- ΔE = Energy savings for ENERGY STAR steam cooker
- $E_{Daily,base}$ = Total daily energy of base steamer
- $E_{Daily,ES}$ = Total daily energy of ENERGY STAR steamer
- Days = Days of operation per year, 365.25
- 1.00 = Conversion factor from therms to Ccf
- E_{idle} = Total idle energy use per day
- T_{steam} = Time in constant steam mode per day, 40%
- $Idle_{energy}$ = Idle energy rate in Btuh, 15,000 for base and 12,500 for ES
- PC = Production capacity per pan in pounds per hour, 23.3 for base and 20 for ES
- Pans = Number of pans, 10

ASTM	=	Energy absorbed by food during steam cooker process, in Btu/pound, 105
Eff_{cook}	=	Cooking efficiency, 15% for base and 38% for ES
PC	=	Production capacity per pan in pounds per hour, 23.3 for base and 20 for ES
T_{idle}	=	Daily idle time in hours, 11.6 for base and 11.5 for ES
LB_{food}	=	Pounds of food cooked for per day, 100

A.3.6 Thermostats

For thermostats, Cadmus used the average evaluated Ccf savings from 2017. In 2017, Cadmus conducted a billing analysis, and after review, Cadmus determined that those results are still applicable to the 2020 program year and calculated a deemed savings of 253 Ccf for thermostats.

Appendix B. Net-to-Gross Detailed Findings

This appendix provides details of Cadmus' net-to-gross (NTG) methodology and findings.

B.1 2020 Residential Prescriptive Program

Cadmus calculated freeridership and spillover for the Residential Prescriptive Program HVAC measures using findings from a survey conducted with 248 furnace participants.[25] Table B-1 lists the presents the NTG results for the program.

Table B-1. Residential Prescriptive Net-to-Gross Ratio

Measure Category	Freeridership	Spillover	NTG Ratio
HVAC (furnaces and boilers)	45%	1%	56%

B.1.1 Detailed Freeridership Findings

Cadmus estimated freeridership by combining two methods—the standard self-report intention method and the intention/influence method.[26] Cadmus calculated the arithmetic mean of the savings weighted *intention* and *influence* freeridership components to estimate measure category freeridership,[27] 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 the *intention*-focused freeridership questions. As part of past Vectren evaluations, Cadmus developed a transparent, straightforward matrix approach to assign a single score to each participant based on his or her objective responses.

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

[25] 141 furnace participants completed the freeridership questions in the quarterly survey. 107 respondents answered the spillover questions through the annual spillover specific survey.

[26] *Intention* and *influence* freeridership scores both have a maximum of 100%.

[27] *Ex post* gross program savings.

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

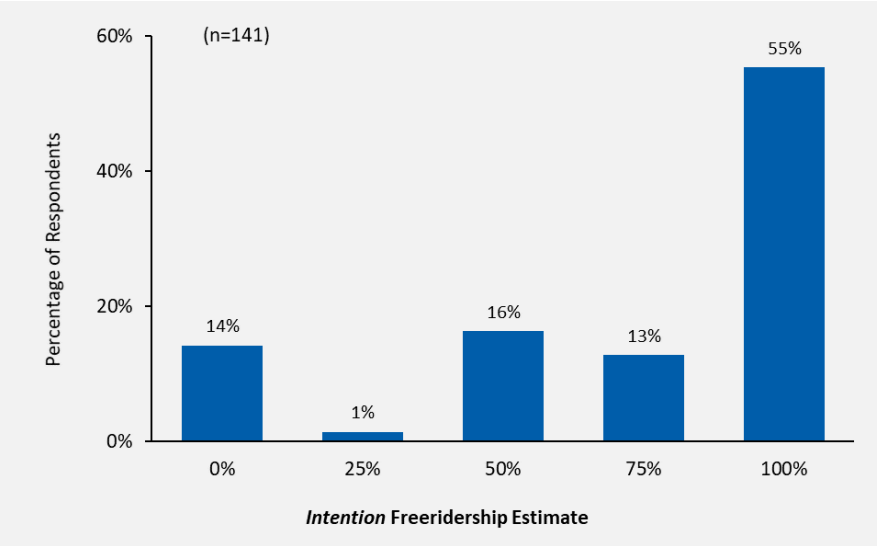


Table B-2 illustrates how responses are translated into whether the response is "yes," "no," or "partially" indicative of freeridership (in parentheses). The value in brackets is the scoring decrement associated with each response option. Each participant freeridership score starts with 100%, which Cadmus then discounts based on their responses to the questions.

Table B-2. Raw Survey Responses Translation to *Intention* Freeridership Scoring Matrix Terminology
Residential Prescriptive Program and Scoring

BEFORE you heard about the Vectren Residential Rebate Program, had you already PLANNED to purchase the [MEASURE]?	Before you heard anything about the Vectren Residential Rebate Program, had you already purchased the [MEASURE]?	To confirm, you installed your new [MEASURE] before you heard anything about the Vectren Residential Rebate Program, correct?	Would you have installed the same [MEASURE] without the rebate from Vectren?	Would you have installed a different type of [MEASURE] without the Vectren rebate or would you have decided not to purchase it?	Without the rebate from Vectren, would you have purchased and installed a [MEASURE] that was just as efficient, less efficient or more efficient than what you purchased?	Would you have installed the same quantity of [MEASURE]s without the incentive from Vectren?	Thinking about timing, without the Vectren rebate, when would you have installed the [MEASURE1]?
Yes (Yes) [-0%]	Yes (Yes) [-0%]	Yes, that's correct (Yes) [100% FR Assigned]	Yes (Yes) [-0%]	I would have installed a different MEASURE_1 (Yes) [-0%]	Just as efficient (Yes) [-0%]	Yes, the same quantity (No) [-0%]	At the same time (No) [-0%]
No (No) [-50%]	No (No) [-0%]	No, that's not correct (No) [-0%]	No (No) [-25%]	I would have decided not to replace it (No) [-25%]	Less efficient (No) [-100%]	No, would have installed fewer (No) [-50%]	Within the same year (No) [-50%]
DK (Partial) [-25%]	DK (No) [-0%]	DK (No) [-0%]	DK (Partial) [-0%]	DK (Partial) [-25%]	More efficient (Yes) [-0%]	No, would have installed more (No) [-0%]	One to two years out (No) [-100%]
					DK (Partial) [-25%]	DK (Partial) [-25%]	More than two years out (No) [-100%]
							Never (No) [-100%]
							DK (Partial) [-25%]

Table B-3 shows the distribution of responses to the influence question: "Please rate the influence of the following program elements on your decision to purchase and install the [MEASURE] on a scale from 1 to 4, with 1 meaning *not at all influential*, 2 *not too influential*, 3 *somewhat influential*, and 4 *very influential*." Cadmus assessed influence freeridership from participants' ratings to the relative influence of various program elements on their purchasing decisions.

Table B-3. Residential Prescriptive Program Freeridership Influence Responses (n=141)

Question E9 Response Options	Influence Score	Information from your contractor	Rebates for the equipment	Information about energy efficiency from Vectren	Previous participation in a Vectren energy efficiency program
1 - Not at all influential	100%	16	21	19	31
2 – Not too influential	75%	6	23	17	9
3 – Somewhat influential	25%	35	48	53	17
4 - Very influential	0%	76	42	35	14
Don't Know	50%	4	6	9	11
Not Applicable	50%	4	1	8	59
Average		**3.3**	**2.8**	**2.8**	**2.2**

Cadmus used the maximum rating given by each participant for any factor in Table B-3 to determine the participant's influence score presented in Table B-4. The counts refer to the number of responses for each factor/influence score response option. Cadmus weighted individual influence scores by each respondent's respective total *ex post* gross savings in the survey sample to arrive at a savings-weighted average influence score of 17% for Residential Prescriptive Program HVAC participants.

Table B-4. Residential Prescriptive Program Influence Freeridership Score (n=141)

Maximum Influence Rating	Influence Score	Count	Total Survey Sample *Ex Post* Ccf Savings	Influence Score Ccf Savings
1 - Not at all influential	100%	10	997	997
2 – Not too influential	75%	6	368	276
3 – Somewhat influential	25%	32	3,229	807
4 - Very influential	0%	90	9,027	0
Don't Know	50%	5	610	305
Average Maximum Influence Rating - Simple Average		**3.5**		
Average Influence Score - Weighted by *Ex Post* Savings		**17%**		

Next, Cadmus calculated the arithmetic mean of the intention and influence freeridership components to estimate a final freeridership value of 45%, weighted by *ex post* gross program savings. The higher the freeridership score, the more savings are deducted from the gross savings estimates. Table B-5 presents the intention, influence, and freeridership scores for the Residential Prescriptive Program HVAC measure category.

Table B-5. Residential Prescriptive Program Intention/Influence Freeridership Score

n	Intention Score	Influence Score	Freeridership Score
141	73%	17%	45%

B.1.2 Detailed Spillover Findings

Three furnace participants reported installing a total of three high-efficiency measures after participating in the Residential Prescriptive Program for which they did not receive an incentive.[28] These respondents said participation in the program was very important in their decision.

Cadmus used the 2019 Ohio TRM to estimate savings for the spillover measures attributed to the Residential Prescriptive Program. Cadmus divided the total survey sample spillover savings by the gross program savings from the survey sample to obtain a spillover estimate of less than 1%, rounded to the nearest whole percent, as shown in Table B-6.

Table B-6. Residential Prescriptive Program Spillover Estimate

Survey Sample Spillover Ccf Savings	Survey Sample Program Ccf Savings	Spillover Percentage Estimate
76	14,034[1]	1%

[1] 2020 evaluated gross energy savings.

B.2 2020 Commercial Prescriptive Program

Cadmus calculated freeridership and spillover for the Commercial Prescriptive Program using findings from interviews conducted with nine program participants. After including spillover, the program resulted in a 94% NTG ratio (Table B-7).

Table B-7. 2020 Commecial Prescriptive Net-to-Gross Ratio

Measure	Freeridership	Spillover	NTG Ratio
Total Program	6%[1]	0%	94%

[1] Weighted by evaluated *ex post* program Ccf savings

[28] These measures were water heaters and a duct sealing project.

B.2.1 Detailed Freeridership Findings

Intention Freeridership Score

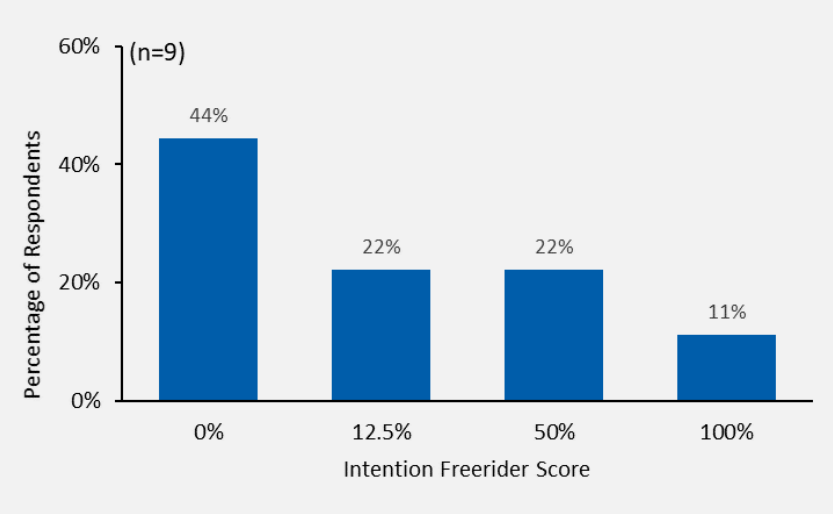
Cadmus estimated *intention* freeridership scores for the program based on interviewed participants' responses to the *intention*-focused freeridership questions. Table B-8 illustrates how initial responses are translated into whether the response is "yes," "no," or "partially" indicative of freeridership (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 discounts based on responses to the questions. After assigning an *intention* freeridership score to every respondent, Cadmus calculated a savings-weighted average *intention* freerider score of 9% for the program.

Table B-8. 2020 Raw Interview Responses Translation to *Intention* Freeridership Scoring Matrix Terminology
Commercial Prescriptive Program and Scoring

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

Figure B-2 shows the distribution of *intention* freeridership estimates Cadmus assigned to participant responses using the pure intention-based freeridership method.

Figure B-2. 2020 Commercial Prescriptive Program Self-Report *Intention* Freeridership Distribution by Estimate



Influence Freeridership Score

Table B-9 shows the distribution of responses to the influence question: "Please rate each item on how influential it was to your decision to complete the project the way it was done. Please use a scale from 1, meaning 'not at all influential', to 4, meaning the item was 'very influential' to your decisions." Cadmus assessed influence freeridership from participants' ratings to the relative importance of various program elements in their purchasing decisions, as shown in Table B-9.

Table B-9. 2020 Commercial Prescriptive Freeridership Influence Responses (n=9)

Question Response Options	Influence Score	Vectren Staff	Rebates for the Equipment	Information about Energy Efficiency Provided by Vectren	Information about Energy Efficiency from Program Staff or my Contractor provided	Previous Participation in a Vectren Energy Efficiency Program
1 – Not at all influential	100%	0	2	1	1	2
2 – Not too influential	75%	1	1	2	1	1
3 – Somewhat influential	25%	5	2	1	3	3
4 - Very influential	0%	0	4	5	4	1
Don't Know	50%	3	0	0	0	2
Not Applicable	50%	0	2	1	1	2
Average		**2.8**	**2.9**	**3.1**	**3.1**	**2.4**

Cadmus used the maximum rating given by each participant for any factor in Table B-9 to determine the participant's influence score presented in Table B-10. Cadmus weighted individual influence scores by each participant's respective *ex post* gross savings associated with the total interview sample to arrive at a savings-weighted average influence score of 3% for Commercial Prescriptive Program participants.

Table B-10. 2020 Commercial Prescriptive Program Influence Freeridership Score (n=9)

Maximum Influence Rating	Influence Score	Count[1]	Total Interview Sample *Ex Post* Ccf Savings	Influence Score Ccf Savings
1 – Not at all influential	100%	1	348	348
2 – Not too influential	75%	0	0	0
3 – Somewhat influential	25%	2	425	106
4 - Very influential	0%	6	13,346	0
Average Maximum Influence Rating - Simple Average		**3.4**		
Average Influence Score - Weighted by *Ex Post* Savings		**3%**		

[1] Refers to the number of responses for each factor/influence score response option.

Final Freeridership Score

Cadmus calculated the arithmetic mean of the intention and influence freeridership components to estimate a final freeridership value of 6%, weighted by *ex post* gross program savings. The higher the freeridership score, the more savings are deducted from the gross savings estimates. Table B-11 presents the intention, influence, and freeridership scores for the Commercial Prescriptive Program.

Table B-11. 2020 Commercial Prescriptive Program Intention/Influence Freeridership Score

n	Intention Score	Influence Score	Freeridership Score
9	9%	3%	6%

B.2.2 Detailed Spillover Findings

None of the interviewed participants reported that, after participating in the program, they had installed additional high-efficiency equipment for which they did not receive an incentive. Therefore, no spillover is attributed to the program.

CERTIFICATE OF SERVICE

In accordance with Rule 4901-1-05, Ohio Administrative Code, the PUCO's e-filing system will electronically serve notice of the filing of this document upon the following parties. In addition, I hereby certify that a service copy of the foregoing *Application* was sent by, or on behalf of, the undersigned counsel for Vectren Energy Delivery of Ohio, Inc. to the following parties of record this 30th day of June 2021, via electronic transmission.

/s/ Matthew R. Pritchard
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Summary: Text In the Matter of the Application for Approval of an Adjustment to its Energy Efficiency Funding Rider Rate electronically filed by Ms. Rebekah J. Glover on behalf of Vectren Energy Delivery of Ohio, Inc. d/b/a CenterPoint Energy Ohio