ILLUME

PROJECT:

2020 DSM Portfolio Evaluation Report

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PROJECT SPONSOR:

NIPSCO

PREPARED BY:

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With subcontractors:

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Optimal Energy, Inc.

ACKNOWLEDGMENTS

ILLUME Advising, LLC is a forward-thinking consulting company at the rare intersection of insight and execution. Founded in 2013 by industry thought-leaders Anne Dougherty and Sara Conzemius, the company has quickly grown to include a deep bench of quantitative and qualitative research experts. ILLUME uses cutting edge research strategies to help build a resilient energy future to enrich lives, improve global health, and ensure a more secure and sustainable future.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACRONYM/ABBREVIATION	DEFINITION
ACFM	Actual cubic feet per minute of compressed air
ARCA	Appliance Recycling Centers of America
C&I	Commercial and Industrial
CAC	Central air conditioner
CBCP	Center beam candle power
CDD	Cooling degree days
CF	Coincidence factor
CFM	Cubic feet per minute
CHA report	Comprehensive home assessment report
COP	Coefficient of performance
DHW	Domestic hot water
DOE	U.S. Department of Energy
DP&L	Dayton Power and Light
DSM	Demand-side management
EFLH	Effective full-load hours
EISA	Energy Independence and Security Act
EM&V	Evaluation, measurement, and verification
HDD	Heating degree day
HEA program	Home Energy Assessment program
HEW	Home energy worksheet
HOU	Hours of use
IQW program	Income Qualified Weatherization program
ISR	In-service rates
M&V	Measurement and verification
MFDI program	Multi-Family Direct Install program
NPV	Net present value
NTG	Net-to-gross
PCT	Participant cost test
PPS	Probability proportional to size
QA/QC	Quality assurance and quality control
RIM	Ratepayer impact measure test
ROI	Return on investment
SBDI program	Small Business Direct Install program
TMY3	Typical meteorological year
TRC	Total resource cost test
TRM	Technical Reference Manual
UCT	Utility cost test
UMP	Uniform Methods Project
VFD	Variable frequency drive
WHF	Waste heat factor

EXECUTIVE SUMMARY

NIPSCO's demand-side management (DSM) portfolio contains twelve residential programs and five commercial and industrial (C&I) programs that serve its customer base. This executive summary includes key findings from the evaluation team's[1] evaluation, measurement, and verification (EM&V) of these programs including impact results (*ex post* gross and net savings impacts), cost-effectiveness, and process findings (program operations, performance, and opportunities for improvement). Overall, the portfolio achieved 121,647,322 kWh *ex post* gross electric energy savings, 18,653 kW *ex post* gross peak demand reduction, and 4,382,669 therms *ex post* gross natural gas energy savings. Considering *ex post* gross savings, the residential portfolio exceeded all electric energy, peak demand reduction, and natural gas energy goals for 2020. The C&I portfolio did not meet its electric energy, peak demand reduction, and natural gas energy goals.

PORTFOLIO PERFORMANCE AND INSIGHTS

Thousands of residential and C&I customers participated in NIPSCO's DSM programs in 2020. NIPSCO's portfolio included similar programs as offered in 2019. However, due to the COVID-19 pandemic, several programs adjusted their program design or delivery or were put on hold in order to safely serve customers. The pandemic's effect on program offerings is discussed throughout this report.

To evaluate program impacts and performance, the evaluation team interviewed utility program and implementation staff and surveyed and interviewed customers and trade allies. The evaluation team also conducted tracking data analysis, engineering analysis, desk reviews, and/or virtual on-sites and interviews for each program.

The next two pages summarize savings impacts, spending, and key accomplishments for the residential and C&I portfolios. As the summaries show, NIPSCO's residential programs performed well against goals and resulted in high realization rates across all fuels. NIPSCO's C&I programs fell short of their electric and natural gas goals; realization rates for the C&I portfolio were relatively close to 100% across all fuels.

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[1] The evaluation team includes ILLUME Advising (lead firm), Cadmus, and Optimal.

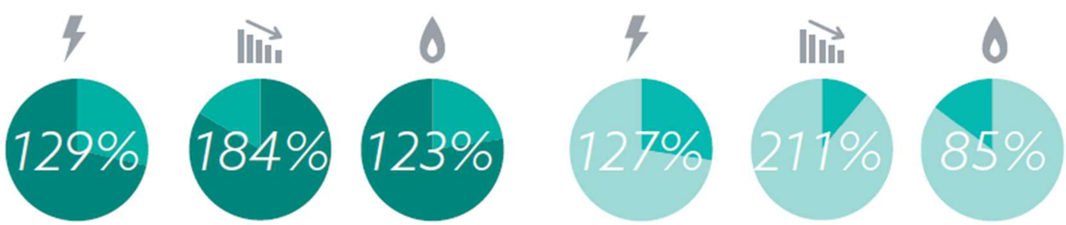
RESIDENTIAL SECTOR

- Despite a challenging year that included a global pandemic, NIPSCO's residential programs performed relatively well across kWh, kW, and therm goals at the portfolio level.
- On the electric side, program performance was largely driven by the Residential Lighting and Behavioral programs. For gas, the HVAC rebates and Behavior programs contributed the most savings.
- Due to COVID-19 restrictions, some programs (such as the direct install programs) saw limited or no participation in 2020. NIPSCO adjusted some program delivery and design, such as offering curbside pickup for the Appliance Recycling program. Other programs, such as the HVAC and New Construction programs, saw increased levels of participation.

	Electric Savings (KWH)	Peak Demand Reduction (KW)	Natural Gas Savings (Therms)
Goal	51,158,291	5,226	2,749,737
Ex Ante	51,639,195	4,548	3,954,439
Audited	51,634,950	4,542	3,954,210
Verified	49,676,426	7,728	3,894,472
Ex Post Gross	65,814,093	9,599	3,371,119
Ex Post Net	48,458,018	6,660	2,752,388

Ex Post Gross Achieved to Gross Goal

Realization Rate



Budget

Electric and Peak Demand

Budget	8,513,665
Expenditures	6,390,959

Spent 75%

Natural Gas

Budget	4,262,491
Expenditures	3,951,012

Spent 93%

COMMERCIAL & INDUSTRIAL SECTOR

- 2020 was a challenging year for the C&I programs, largely due to business disruptions stemming from the COVID-19 pandemic. Overall, the C&I portfolio fell short of its 2020 program year goals.
- Individual program performance was varied; the Prescriptive program performed well on the electric side, while on the gas side only the New Construction program exceeded its goals.
- In general, realization rates were relatively close to 100% across programs; this indicates that ex ante and ex post savings are closely aligned.

	Electric Savings (KWH)	Peak Demand Reduction (KW)	Natural Gas Savings (Therms)
Goal	81,918,372	12,894	1,416,189
Ex Ante	61,028,238	8,286	1,117,267
Audited	60,741,006	9,092	1,116,414
Verified	55,497,110	8,220	1,060,217
Ex Post Gross	55,833,228	9,054	1,011,550
Ex Post Net	48,789,138	7,826	817,302

	Electric	Peak Demand	Natural Gas
Ex Post Gross Achieved to Gross Goal	68%	70%	71%
Realization Rate	91%	109%	91%

Budget

Electric and Peak Demand

Budget	10,095,644
Expenditures	7,015,963

Spent 69%

Natural Gas

Budget	1,960,495
Expenditures	1,537,452

Spent 78%

SAVINGS ACHIEVEMENTS

The following section details the program and portfolio-level savings achievements relative to planning goals, the savings achievements at each step of the impact evaluation, the contribution of each program to portfolio savings, and a summary of recommendations for each program.

PORTFOLIO RESULTS

Table 1 and Table 2 show 2020 gross planning goals for electric and natural gas savings, and each program's performance in achieving those goals. These tables show goal achievement in terms of ex post gross savings.

When compared to 2020 goals, program performance varied widely across individual programs. Some of this variation was due to NIPSCO adjusting program design and delivery due to the COVID-19 pandemic and resulting social distancing requirements that made some existing program designs difficult, if not impossible, to implement. Programs that required face-to-face interaction, such as the Appliance Recycling program and the Direct Install programs, were either put on hold or adjusted in order to allow for safe interactions with customers. All updates or adjustments to program design and delivery due to the pandemic are discussed in more detail in Section 1, Program Offerings.

Other challenges – such as business disruptions due to COVID-19 – affected the C&I programs as well as the Employee Education program which resulted in lower than expected savings. Conversely, some programs saw higher customer demand and therefore increased program performance during the pandemic, such as the HVAC and Residential New Construction programs. Finally, NIPSCO introduced two new programs in 2020 – both a Residential and C&I Marketplace. Both of these programs launched at the end of 2020, and did not see any participation in the 2020 calendar year.

TABLE 1. 2020 PORTFOLIO ELECTRIC GOAL ACHIEVEMENT

PROGRAM	ELECTRICITY			DEMAND		
	GROSS ELECTRIC SAVINGS GOAL (KWH)	*EX POST* GROSS ELECTRIC SAVINGS (KWH)	SHARE OF ELECTRIC GOAL ACHIEVED (%)	GROSS PEAK DEMAND REDUCTION GOAL (KW)	*EX POST* GROSS PEAK DEMAND REDUCTION (KW)	SHARE OF PEAK DEMAND GOAL ACHIEVED (%)
Residential Programs						
HVAC Rebates	998,798.34	980,859.03	98%	594.640	1,211.048	204%
Lighting	20,752,960.00	31,311,083.67	151%	2,791.422	4,262.311	153%
Home Energy Analysis	269,374.94	86,536.37	32%	154.534	34.493	22%
Appliance Recycling	2,275,200.00	1,004,239.00	44%	336.000	148.942	44%
School Education	2,573,344.00	2,321,875.96	90%	318.600	228.658	72%
Multi Family Direct Install	905,389.12	0.00	0%	267.693	0.000	0%
Behavioral	21,660,654.47	29,077,363.05	134%	0.000	3,319.334	n/a
New Construction	570,222.46	858,301.08	151%	422.996	351.236	83%
Home Life EE Calculator	207,176.00	60,816.02	29%	25.650	7.910	31%
Employee Education	207,176.00	1,525.98	1%	25.650	0.198	1%
IQW	637,307.76	111,493.08	17%	268.330	34.820	13%

Marketplace	100,687.62	0.00	0%	20.625	0.000	0%
Total Residential	**51,158,290.71**	**65,814,093.25**	**129%**	**5,226.141**	**9,598.949**	**184%**
Commercial & Industrial Programs						
Prescriptive	24,980,872.00	30,710,230.51	123%	6,918.667	5,734.886	83%
Custom	37,600,000.00	16,425,430.50	44%	3,958.145	1,831.374	46%
New Construction	10,400,000.00	6,970,012.72	67%	1,077.319	1,354.945	126%
Small Business Direct Install	8,800,000.00	1,727,554.72	20%	909.923	132.917	15%
Marketplace	137,500.00	0.00	0%	30.311	0.000	0%
Total Commercial & Industrial	**81,918,372.00**	**55,833,228.45**	**68%**	**12,894.365**	**9,054.122**	**70%**
Total 2020 Portfolio	133,076,662.71	121,647,321.70	91%	18,120.506	18,653.071	103%

TABLE 2. 2020 PORTFOLIO NATURAL GAS GOAL ACHIEVEMENT

PROGRAM	GROSS NATURAL GAS SAVINGS GOAL (THERMS)	*EX POST* NATURAL GAS SAVINGS (THERMS)	SHARE OF NATURAL GAS GOAL ACHIEVED (%)
Residential Programs			
HVAC Rebates	1,064,220.60	1,069,788.66	101%
Lighting	n/a	n/a	n/a
Home Energy Analysis	59,783.55	15,984.52	27%
Appliance Recycling	n/a	n/a	n/a
School Education	186,804.00	86,061.35	46%
Multi Family Direct Install	101,856.16	0.00	0%
Behavioral	1,060,936.01	1,683,361.98	159%
New Construction	38,956.32	477,408.78	1225%
Home Life EE Calculator	15,706.80	2,377.01	15%
Employee Education	15,706.80	217.47	1%
IQW	196,521.67	35,919.61	18%
Marketplace	9,244.96	0.00	0%
Total Residential	**2,749,736.88**	**3,371,119.37**	**123%**
Commercial & Industrial Programs			
Prescriptive	294,292.05	43,567.10	15%
Custom	711,651.69	467,079.00	66%
New Construction	262,818.52	456,873.35	174%
Small Business Direct Install	144,470.64	44,030.68	30%
Marketplace	2,956.32	0.00	0%
Total Commercial & Industrial	**1,416,189.22**	**1,011,550.13**	**71%**
Total 2020 Portfolio	4,165,926.09	4,382,669.50	105%

Table 3 through Table 5 show the electric energy, peak demand reduction, and natural gas energy savings achieved by each program in the 2020 NIPSCO portfolio. The tables include realization rates, which are the percentage of savings claimed by NIPSCO (*ex ante*) that the evaluation team verified. Ideally, realization rates are as close to 100% as possible, indicating that the planned savings closely align with actual savings. At the portfolio-level, this is generally the case; the team verified 108% of electric energy, 145% of demand, and 86% of therms savings. Program-level realization rates varied for reasons described in the individual chapters.

TABLE 3. 2020 PORTFOLIO ELECTRIC ENERGY SAVINGS

PROGRAM	REPORTED ELECTRIC SAVINGS (KWH)			EVALUATED ELECTRIC SAVINGS (KWH)			
	EX ANTE	AUDITED	VERIFIED	*EX POST* GROSS	REALIZATION RATE (%)	NTG RATIO (%)	*EX POST* NET
Residential Programs							
HVAC Rebates	2,384,913.63	2,384,050.31	2,384,050.31	980,859.03	41%	60%	590,764.69
Lighting	14,160,546.01	14,160,554.41	13,390,703.36	31,311,083.67	221%	46%	14,403,985.61
Home Energy Analysis	62,565.76	62,565.94	59,262.10	86,536.37	138%	84%	72,771.46
Appliance Recycling	1,119,787.00	1,116,361.00	1,116,361.00	1,004,239.00	90%	55%	550,225.24
School Education	2,579,014.08	2,579,048.76	2,239,717.10	2,321,875.96	90%	133%	3,096,728.30
Multi Family Direct Install	0.00	0.00	0.00	0.00	n/a	n/a	0.00
Behavioral	29,924,714.00	29,924,714.00	29,077,363.05	29,077,363.05	97%	100%	29,077,363.05
New Construction	1,267,048.70	1,267,048.70	1,267,048.70	858,301.08	68%	54%	463,482.58
Home Life EE Calculator	60,844.32	60,845.14	65,268.85	60,816.02	100%	146%	88,971.73
Employee Education	1,526.56	1,526.58	1,639.60	1,525.98	100%	146%	2,232.29
IQW	78,235.11	78,235.11	75,011.83	111,493.08	143%	100%	111,493.08
Marketplace	0.00	0.00	0.00	0.00	n/a	n/a	0.00
Total Residential	**51,639,195.17**	**51,634,949.95**	**49,676,425.90**	**65,814,093.25**	**127%**	**n/a**	**48,458,018.04**
Commercial & Industrial Programs							
Prescriptive	30,922,969.13	30,818,999.62	30,646,018.01	30,710,230.51	99%	89%	27,332,105.15
Custom	21,539,803.89	21,150,346.29	16,273,664.48	16,425,430.50	76%	92%	15,111,396.06
New Construction	6,876,678.04	7,086,684.14	6,892,451.08	6,970,012.72	101%	67%	4,669,908.53
Small Business Direct Install	1,688,787.06	1,684,976.41	1,684,976.41	1,727,554.72	102%	97%	1,675,728.08
Marketplace	0.00	0.00	0.00	0.00	n/a	n/a	0.00
Total Commercial & Industrial	61,028,238.12	60,741,006.46	55,497,109.98	55,833,228.45	91%	n/a	48,789,137.81
Total 2020 Portfolio	112,667,433.29	112,375,956.41	105,173,535.89	121,647,321.70	108%	n/a	97,247,155.85

TABLE 4. 2020 PORTFOLIO PEAK DEMAND REDUCTION

PROGRAM	REPORTED PEAK DEMAND REDUCTION (KW)			EVALUATED PEAK DEMAND REDUCTION (KW)			
	EX ANTE	AUDITED	VERIFIED	*EX POST* GROSS	REALIZATION RATE (%)	NTG RATIO (%)	*EX POST* NET
Residential Programs							
HVAC Rebates	1,111.887	1,110.812	1,110.812	1,211.048	109%	60%	724.032
Lighting	1,895.387	1,895.395	1,793.717	4,262.311	225%	46%	1,960.787
Home Energy Analysis	30.790	30.767	30.495	34.493	112%	90%	31.091
Appliance Recycling	165.650	165.150	165.150	148.942	90%	55%	81.609
School Education	319.302	314.778	281.314	228.658	72%	134%	306.375
Multi Family Direct Install	0.000	0.000	0.000	0.000	n/a	n/a	0.000
Behavioral	0.000	0.000	3,319.334	3,319.334	n/a	100%	3,319.334
New Construction	987.140	987.140	987.140	351.236	36%	54%	189.667
Home Life EE Calculator	7.533	7.433	10.468	7.910	105%	149%	11.795
Employee Education	0.189	0.186	0.262	0.198	105%	149%	0.296
IQW	30.371	30.371	29.080	34.820	115%	100%	34.820
Marketplace	0.000	0.000	0.000	0.000	n/a	n/a	0.000
Total Residential	**4,548.249**	**4,542.031**	**7,727.772**	**9,598.949**	**211%**	**n/a**	**6,659.806**
Commercial & Industrial Programs							
Prescriptive	4,998.917	5,015.673	5,108.412	5,734.886	115%	89%	5,104.049
Custom	1,814.659	2,695.900	1,756.352	1,831.374	101%	92%	1,684.864
New Construction	1,358.028	1,262.741	1,236.970	1,354.945	100%	67%	907.813
Small Business Direct Install	114.549	118.145	118.145	132.917	116%	97%	128.930
Marketplace	0.000	0.000	0.000	0.000	n/a	n/a	0.000
Total Commercial & Industrial	**8,286.153**	**9,092.458**	**8,219.879**	**9,054.122**	**109%**	**n/a**	**7,825.655**
Total 2020 Portfolio	12,834.402	13,634.490	15,947.652	18,653.071	145%	n/a	14,485.461

TABLE 5. 2020 PORTFOLIO NATURAL GAS SAVINGS

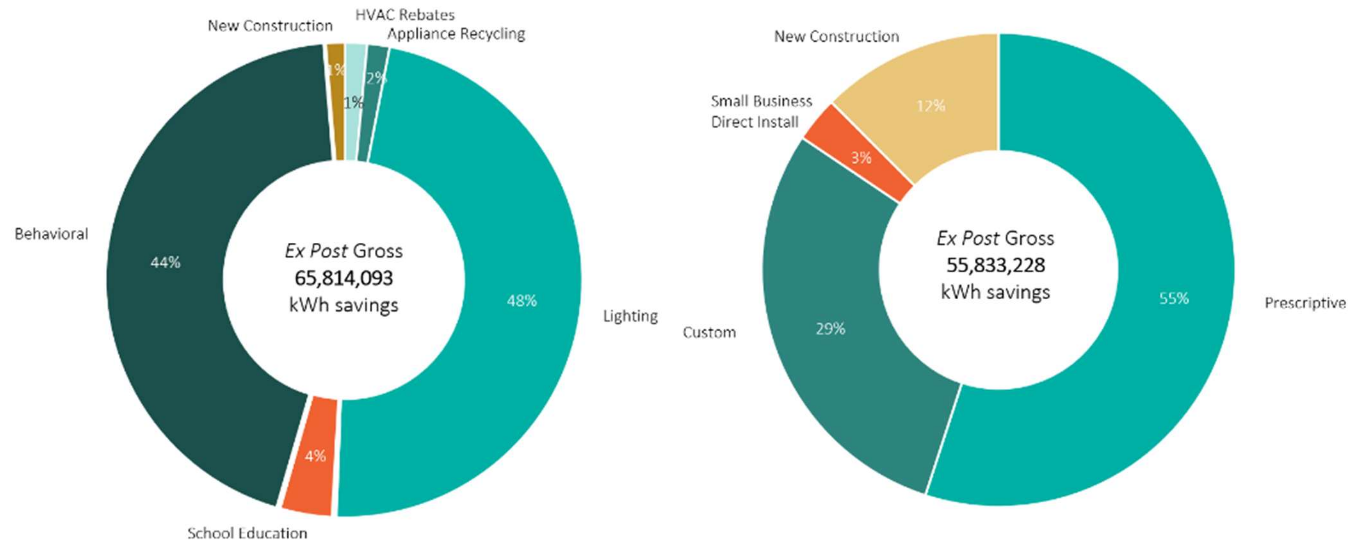
PROGRAM	REPORTED NATURAL GAS SAVINGS (THERMS)			EVALUATED NATURAL GAS SAVINGS (THERMS)			
	EX ANTE	AUDITED	VERIFIED	*EX POST* GROSS	REALIZATION RATE (%)	NTG RATIO (%)	*EX POST* NET
Residential Programs							
HVAC Rebates	1,974,633.98	1,974,384.72	1,974,384.72	1,069,788.66	54%	59%	634,352.04
Lighting	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Home Energy Analysis	13,543.43	13,543.55	13,234.51	15,984.52	118%	90%	14,445.86
Appliance Recycling	n/a	n/a	n/a	n/a	n/a	n/a	n/a
School Education	187,520.04	187,539.51	111,478.17	86,061.35	46%	142%	122,521.97
Multi Family Direct Install	0.00	0.00	0.00	0.00	n/a	n/a	0.00
Behavioral	1,664,979.00	1,664,979.00	1,683,361.98	1,683,361.98	101%	100%	1,683,361.98
New Construction	79,677.23	79,677.23	79,677.23	477,408.78	599%	54%	257,800.74
Home Life EE Calculator	5,697.18	5,697.81	5,588.48	2,377.01	42%	154%	3,652.10
Employee Education	504.60	504.66	473.71	217.47	43%	154%	333.95
IQW	27,884.01	27,884.01	26,273.57	35,919.61	129%	100%	35,919.61
Marketplace	0.00	0.00	0.00	0.00	n/a	n/a	0.00
Total Residential	**3,954,439.47**	**3,954,210.49**	**3,894,472.37**	**3,371,119.37**	**85%**	**n/a**	**2,752,388.26**
Commercial & Industrial Programs							
Prescriptive	48,674.56	48,567.76	48,567.76	43,567.10	90%	89%	38,774.72
Custom	545,718.79	554,900.52	522,330.89	467,079.00	86%	92%	429,712.68
New Construction	476,200.16	466,272.27	445,229.31	456,873.35	96%	67%	306,105.14
Small Business Direct Install	46,673.22	46,673.14	44,089.02	44,030.68	94%	97%	42,709.75
Marketplace	0.00	0.00	0.00	0.00	n/a	n/a	0.00
Total Commercial & Industrial	**1,117,266.73**	**1,116,413.69**	**1,060,216.98**	**1,011,550.13**	**91%**	**n/a**	**817,302.30**
Total 2020 Portfolio	5,071,706.20	5,070,624.18	4,954,689.35	4,382,669.50	86%	n/a	3,569,690.56

PROGRAM CONTRIBUTION TO PORTFOLIO SAVINGS

Figure 1 and Figure 2 illustrate each program's contribution to total *ex post* gross portfolio energy and demand savings. The Lighting program contributed the largest share of electric energy savings to the Residential portfolio, with 48% of total electric energy (kilowatt-hour) savings. The Behavioral program accounted for the next largest share (44%). The Lighting program also accounted for the largest share of peak demand reduction (kilowatts) for the Residential portfolio, contributing 44% of total peak demand reduction, followed by the Behavioral program at 35%.

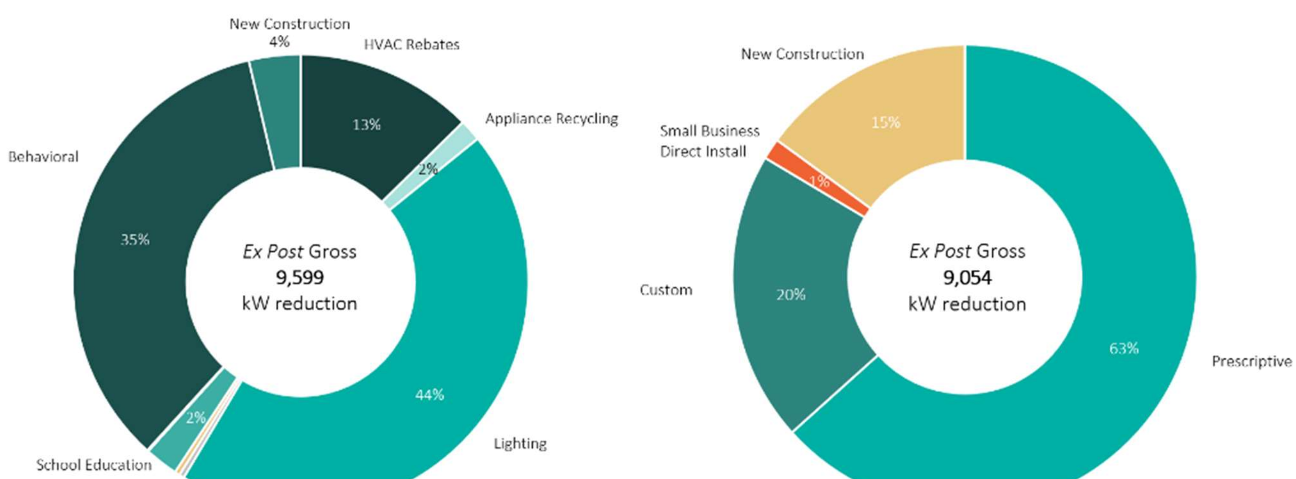
In the C&I sector, the Prescriptive program contributed the largest share of electric energy savings, with 55% of the total C&I portfolio electric energy (kilowatt-hour) savings, with the Custom program contributing 29%. The Prescriptive and Custom programs contributed the largest shares of peak demand reduction (kilowatts) to the C&I portfolio as well, accounting for 63% and 20% of peak demand reduction, respectively.

FIGURE 1. PROGRAM CONTRIBUTIONS TO PORTFOLIO SAVINGS [a,b]



[a] Six residential programs are not labeled due to savings of 1% or less of the total portfolio in 2020. This includes HEA, MFDI, Homelife, Employee Education, IQW and Online Marketplace.
[b] One C&I program, the Online Marketplace, is not labeled as it did not achieve any savings in 2020.

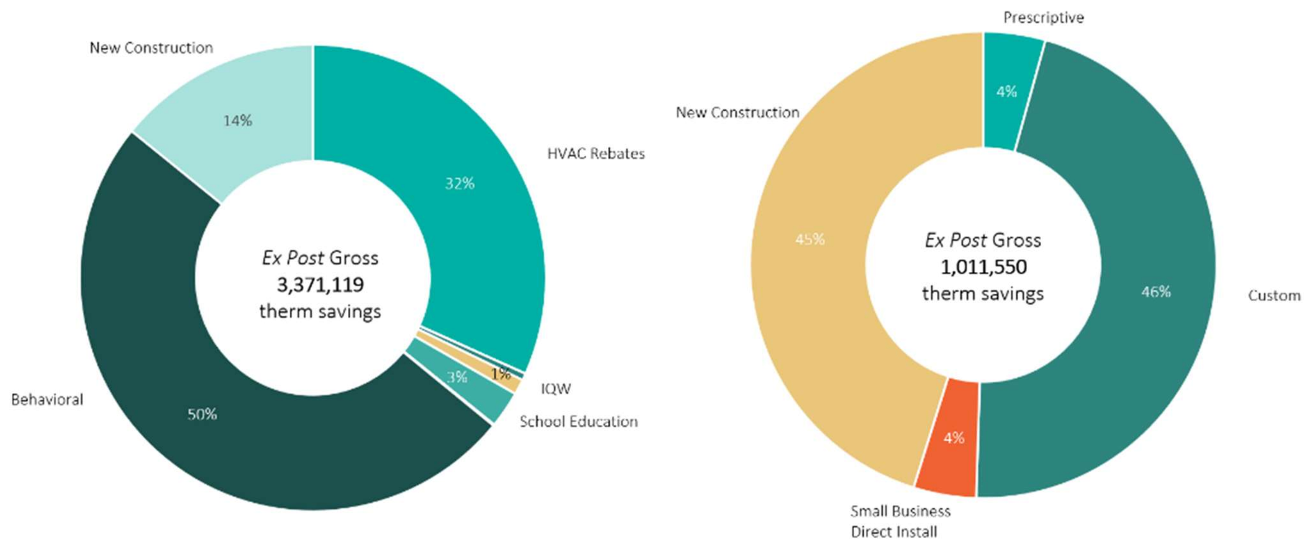
FIGURE 2. PROGRAM CONTRIBUTION TO PORTFOLIO PEAK DEMAND REDUCTION (KW) BY *EX POST* GROSS [a,b]



[a] Six residential programs are not labeled due to savings of 1% or less of the total portfolio in 2020. This includes HEA, MFDI, Homelife, Employee Education, IQW and Online Marketplace.
[b] One C&I program, the Online Marketplace, is not labeled as it did not achieve any savings in 2020.

Figure 3 illustrates each program's contribution to total ex post gross natural gas portfolio energy savings. The Behavioral program accounted for the largest share of Residential natural gas energy (therm) savings, with 50% of the Residential portfolio savings. The HVAC Rebates program was the second largest contributor to the Residential program's natural gas savings total (32%). The Custom program contributed 46% of the natural gas energy savings for the C&I sector, the most of any of the C&I programs, followed by New Construction at 45%.

FIGURE 3. PROGRAM CONTRIBUTION TO PORTFOLIO NATURAL GAS SAVINGS (THERMS) BY *EX POST* GROSS [a,b]



[a] Five residential programs are not labeled due to savings of 1% or less of the total portfolio in 2020. This includes HEA, MFDI, Homelife, Employee Education, and Online Marketplace.
[b] One C&I program, the Online Marketplace, is not labeled as it did not achieve any savings in 2020.

BUDGET AND COST-EFFECTIVENESS

As shown in Table 6 and Table 7, NIPSCO spent 72% of its electric budget and 88% of its natural gas budget for the 2020 portfolio. For additional context around cost-effectiveness, the tables also include the share of goals achieved which allows the reader to view how planned and claimed spend and savings align.

TABLE 6. 2020 ELECTRIC PORTFOLIO BUDGET AND SPENDING

PROGRAM	BUDGET ($)	ACTUAL SPEND ($)	BUDGET SPENT (%)	SHARE OF ELECTRIC GOAL ACHIEVED (%)	SHARE OF PEAK DEMAND GOAL ACHIEVED (%)
Residential Programs					
HVAC Rebates	349,362.45	615,865.76	176%	98%	204%
Lighting	4,268,824.92	2,988,587.28	70%	151%	153%
Home Energy Analysis	158,342.77	39,310.66	25%	32%	22%
Appliance Recycling	331,741.32	166,795.87	50%	44%	44%
School Education	408,378.78	395,454.52	97%	90%	72%
Multi Family Direct Install	510,587.58	30,047.84	6%	0%	0%
Behavioral	1,643,952.40	1,588,821.02	97%	134%	n/a
New Construction	205,721.58	432,479.18	210%	151%	83%
Home Life EE Calculator	33,399.76	11,440.19	34%	29%	31%
Employee Education	33,321.10	2,323.20	7%	1%	1%
IQW	531,175.72	94,833.35	18%	17%	13%
Marketplace	38,856.63	25,000.00	64%	0%	0%
Total Residential	**8,513,665.02**	**6,390,958.87**	**75%**	**129%**	**184%**
Commercial & Industrial Programs					
Prescriptive	3,007,518.96	3,213,414.30	107%	123%	83%
Custom	4,613,777.29	2,646,392.77	57%	44%	46%
New Construction	1,239,807.46	797,668.02	64%	67%	126%
Small Business Direct Install	1,222,332.91	354,987.63	29%	20%	15%
Marketplace	12,207.36	3,500.00	29%	0%	0%
Total Commercial & Industrial	**10,095,643.99**	**7,015,962.72**	**69%**	**68%**	**70%**
Total 2020 Portfolio	18,609,309.01	13,406,921.59	72%	91%	103%

Source: 2020 DSM Scorecard.
Note: Totals may not properly sum due to rounding

TABLE 7. 2020 NATURAL GAS PORTFOLIO BUDGET AND SPENDING

PROGRAM	BUDGET ($)	ACTUAL SPEND ($)	BUDGET SPENT (%)	SHARE OF NATURAL GAS GOAL ACHIEVED (%)
Residential Programs				
HVAC Rebates	1,529,165.24	2,660,589.84	174%	101%
Lighting	n/a	n/a	n/a	n/a
Home Energy Analysis	213,188.17	68,603.10	32%	27%
Appliance Recycling	n/a	n/a	n/a	n/a
School Education	470,432.46	453,805.81	96%	46%
Multi Family Direct Install	182,941.56	11,705.13	6%	0%

Behavioral	389,606.43	374,544.02	96%	159%
New Construction	55,727.30	107,072.77	192%	1225%
Home Life EE Calculator	39,457.31	15,072.50	38%	15%
Employee Education	39,367.66	3,653.31	9%	1%
IQW	1,334,092.63	255,965.60	19%	18%
Marketplace	8,512.56	0.00	0%	0%
Total Residential	**4,262,491.31**	**3,951,012.06**	**93%**	**123%**
Commercial & Industrial Programs				
Prescriptive	379,539.24	91,969.88	24%	15%
Custom	999,614.42	726,027.03	73%	66%
New Construction	368,801.98	624,640.23	169%	174%
Small Business Direct Install	211,073.13	94,815.21	45%	30%
Marketplace	1,465.95	0.00	0%	0%
Total Commercial & Industrial	**1,960,494.72**	**1,537,452.35**	**78%**	**71%**
Total 2020 Portfolio	6,222,986.03	5,488,464.42	88%	105%

Source: 2020 DSM Scorecard.
Note: Totals may not properly sum due to rounding

Table 8 and Table 9 show the results of the cost-effectiveness analysis. Energy efficiency cost-effectiveness is measured by comparing the monetized energy efficiency benefits of an investment with the costs. The evaluation team used four cost-effectiveness tests as a part of this analysis: the total resource cost test (TRC), the utility cost test (UCT, or program administrator cost test), the participant cost test (PCT), and the ratepayer impact measure test (RIM). The inputs used and a description of each test can be found in the Appendix: Cost-Effectiveness Results.

TABLE 8. ELECTRIC PROGRAM COST-EFFECTIVENESS RESULTS

PROGRAM	COST-EFFECTIVENESS			
	TRC	UCT	PCT	RIM
Residential				
HVAC Rebate	4.87	4.22	1.91	1.81
Lighting	1.87	1.93	3.28	0.58
Home Energy Analysis	4.22	3.23	3.13	1.06
Appliance Recycling	4.07	2.77	15.50	0.63
School Education	3.46	2.72	10.48	0.56
Multifamily Direct Install	n/a (limited program activities in 2020)			
Behavioral*	1.33	1.31	n/a	0.45
New Construction	2.74	1.82	2.78	0.79
Home Life	3.89	2.94	12.45	0.61
Employee Education	0.47	0.39	9.72	0.26
Income-Qualified Weatherization	2.29	1.72	2.50	0.74
Residential Marketplace	n/a (limited program activities in 2020)			
Total Residential	**2.23**	**2.05**	**4.43**	**0.65**
Commercial and Industrial				
Prescriptive	4.76	7.62	3.84	0.81
Custom	2.07	4.79	1.77	0.66
Small Business Direct Install	2.30	2.98	2.98	0.54
New Construction	4.32	5.91	3.65	0.82
Commercial Marketplace	n/a (limited program activities in 2020)			
Total Commercial and Industrial	**3.32**	**6.12**	**2.75**	**0.75**
Total 2020 Electric Portfolio	2.99	4.18	3.08	0.72

* This program has no participant costs, so the PCT result is n/a, because the value is not able to be calculated due to a denominator of zero.

TABLE 9. GAS PROGRAM COST-EFFECTIVENESS RESULTS

PROGRAM	COST-EFFECTIVENESS			
	TRC	UCT	PCT*	RIM
Residential				
HVAC Rebate	1.59	1.89	1.56	0.86
Home Energy Analysis	2.66	1.82	2.76	0.87
School Education	1.18	0.89	2.16	0.80
Multifamily Direct Install	n/a (limited program activities in 2020)			
Behavioral*	2.94	2.89	n/a	0.75
New Construction	23.00	18.59	17.36	0.99
Home Life	1.02	0.81	2.05	0.72
Employee Education	0.40	0.33	2.20	0.30
Income-Qualified Weatherization	1.64	1.21	2.18	0.77
Residential Marketplace	n/a (limited program activities in 2020)			
Total Residential	**2.11**	**2.26**	**2.26**	**0.86**
Commercial and Industrial				
Prescriptive	2.28	3.22	1.88	0.89
Custom	2.05	4.79	1.34	0.95
Small Business Direct Install	2.47	3.41	1.93	0.93
New Construction	2.86	3.89	2.11	0.95
Commercial Marketplace	n/a (limited program activities in 2020)			
Total Commercial and Industrial	**2.33**	**4.25**	**1.61**	**0.94**
Total 2020 Gas Portfolio	2.20	2.82	1.96	0.89

* This program has no participant costs, so the PCT result is n/a, because the value is not able to be calculated due to a denominator of zero.

SUMMARY OF RECOMMENDATIONS

Based on the 2020 evaluation findings, the evaluation team proposes a number of recommendations intended to improve program uptake, processes, and performance within NIPSCO's DSM portfolio. This section includes a summary of these recommendations. Please refer to the individual program chapters for more details on recommendations and detailed findings that support these recommendations.

HVAC REBATES PROGRAM

- Ex ante savings should exclude electric savings for furnaces with ECMs, as ECMs became largely the code requirement in July 2019.
- The billing analysis showed furnace EFLH values are approximately 32% less than TRM (2.2) values. Goals should be set noting that furnaces will have reduced therm savings from the TRM (2.2), although aside from variations in capacity and AFUE future furnace savings will likely be 3% higher than average savings for the 2020 program year.
- For future program years, goals should be set noting that smart thermostats will have reduced gas savings and electric energy savings from the deemed savings value in the 2019 report. Therms savings for the 2021 program year can be expected to be 47 therms per site, following results for the 2019 post year which was not impacted by the COVID-19 pandemic.

- Because homes receiving two thermostats did not have statistically different savings than homes who installed one thermostat, this indicates that there may be smaller per thermostat savings for people who install second thermostats. While this is currently a relatively small proportion of customers, monitor the participation rates of people who receive more than one thermostat; if this negatively affects overall program cost-effectiveness, consider limiting participation to one thermostat.
- Ex ante values for several measure categories including air conditioners, air conditioner tune-ups, boilers, boiler tune-ups, thermostats, and water heaters should be updated in the next program year.
    - Air conditioners: Apply actual SEER, EER, and capacity to savings, or use average values from the program data (average SEER = 15.7, average EER = 14.1, average capacity = 34,054 Btuh).
    - Air conditioner tune-ups: Apply actual SEER, EER, and capacity to savings, or use average values from the program data (average SEER = 12.7, average EER = 11.4, average capacity = 31,207 Btuh).
    - Boilers: Apply average program data capacity (127,381 Mbtu) and average AFUE (95%).
    - Boiler tune-ups: Apply average capacity from boiler tune-up measures (103,917 Btuh).
    - Water heaters: Apply a baseline UEF of 0.633 and efficient UEF of 0.950 for instant water heaters and 0.705 for storage
- NIPSCO did not meet the electric energy goal by 2%; but they exceeded the peak demand goal by 104%, and the natural gas goal by 1%. For future program years, realistic goals should be set bearing newly reduced unit savings in mind.
- While rebate applications for simpler self-install measures, like thermostats, are less complicated than for a furnace, consider monitoring satisfaction and customer requests for assistance as these measures are added to the program. In addition, consider implementing a mid-year survey for participants installing measures like thermostats, electric dryers, and air purifiers to see if they are having difficulty with the rebate application.
- If contractors describe to TRC or NIPSCO that they have difficulty collecting customer information, refer them to the graphic, Tips and Tricks for Gathering Customer Information, where participating contractors shared their strategies for gathering this information.
- Consider creating a leave-behind pamphlet that provides customers with the link to the “check rebate status” page on the NIPSCO website and a contact phone number or email that they can use to receive help on their rebate application. For tune-up participants, this information could be included on the checklist contractors provide to customers.
- In addition to the program marketing collateral, consider providing contact information and resources to customers. This could include a contact phone number or email that they can use to provide program feedback. For tune-up participants, this information could be included on the checklist contractors provide to customers.
- While there is not a NIPSCO trade ally network, NIPSCO could provide this pamphlet to contractors with the largest number of submitted rebates or those who are listed on the Contractor Finder page.

RESIDENTIAL LIGHTING PROGRAM

- NIPSCO and the implementation team should continue forward with savings approaches as determined by their current lighting agreement. However, the evaluation team will continue to monitor for new guidance from the Department of Energy regarding any changes to recommended baselines, and will communicate these changes with NIPSCO and the implementation teams.
- For the 2021 evaluation, the evaluation team recommends meeting with NIPSCO, TRC, and the OSB to discuss the planned EM&V approach and align on research priorities and approaches.
- During 2021 evaluation planning, revisit the need to evaluate program net savings. If NIPSCO determines a net-to-gross analysis is warranted, review program performance to date and expected delivery for remaining months to ensure Demand Elasticity Modeling is appropriate. It may also be a worthwhile exercise to review alternative methods, their strengths, and limitations.

HOME ENERGY ASSESSMENT PROGRAM

- When able to, NIPSCO should resume its usual in-person assessments and equipment installs through the HEA program as participants seem to prefer this experience over the virtual one.
- Explore ways to improve the virtual assessments if they continue to be a part of NIPSCO's program offering, including more customized tips and recommendations. Consider additional evaluation activities in program year 2021 to better understand target markets and customer needs for the differing assessment services currently offered by NIPSCO.
- Through current QA/QC procedures, continue to monitor customer receipt of report and cross-channeling materials. Additionally, consider fielding a live-time post-assessment survey to gather information regarding some of the issues raised by customers qualitatively in this evaluation, such as receipt of their report and cross channeling materials as well as the relevancy of the recommendations included in the report.
- Address waste heat factors consistently across programs in *ex ante* savings. If this should be addressed in cost-effectiveness, this factor should be calculated for use in cost effectiveness analyses but not applied against *ex ante* or *ex post* program performance.
- Correct error in *ex ante* waste heat factor therm calculations. For kit programs, this factor is being calculated as MMBTU but not converted to therm savings.

APPLIANCE RECYCLING PROGRAM

- The evaluation team recommends using 2020 evaluated gross per-unit savings for future program planning, as we believe this will most accurately reflect future program performance. However, the evaluation team recommends re-evaluating this program again in 2021 (as portfolio budgets allow) to reassess savings, program processes, and implementer performance.
- The evaluation team should conduct a mid-year check in 2021 of the tracking data to assess the reported age of recycled appliances compared to past years tracking and survey data. In addition, the evaluation team should interview the program managers at the new implementation team as soon as possible to

ensure they can capture necessary information to allow the evaluation team to assess and evaluate the program.

- If significant discrepancies persist between the reported age of recycled appliances in the tracking and survey data, the evaluation team could conduct several additional research activities to understand the reasons behind the shift in appliance age, including geographical analysis, customer interviews, mystery shopping, etc.
- Consider including implementer collected complete and correct model numbers of the recycled appliances in the tracking data, where available. This would allow the evaluation team to provide additional QA/QC as needed. If possible, the implementer could include all variables included in the implementer calculations for age of appliance like compressor style, refrigerant age, or configuration.
- For the 2021 evaluation, if a mid-year review of program tracking data does not indicate additional needs for QA/QC, the evaluation team recommends resuming utilizing the tracking data for key inputs in the evaluation.
- As NIPSCO continues the curbside pickup of appliances with the new implementer, monitor feedback and the time it takes to send the rebates to participants.
- Consider conducting a mid-year survey, to see if satisfaction with the time it takes to receive the rebate has improved with the new implementer.
- If possible, consider creating a "Check Your Rebate Status" page, like the Energy Efficiency Rebates program has, and provide customers with the link to this tracker.
- Most respondents said they were interested in recycling window mount AC units and dehumidifiers. If NIPSCO is interested, the evaluation team could provide additional research support, such as a secondary literature review on other utility programs that recycle these appliances.
- In the 2021 evaluation, consider implementing a participant survey to understand customer experiences and gather impact factors for window mount AC units and dehumidifiers.

SCHOOL EDUCATION PROGRAM

- If desired, consider additional exploratory research to determine if there are additional savings that could be claimed from a differential baseline for LED nightlights. To determine if it is possible to estimate additional savings, additional research may need to be conducted, potentially including a more detailed literature review of other studies to determine if this has been done before, and/or more primary research (such as surveys or on-sites) with participants to better understand impact factors.
- Address waste heat factors consistently across programs in *ex ante* savings. If this is addressed in cost-effectiveness, this factor should be calculated for use in cost effectiveness analyses but not applied against *ex ante* or *ex post* program performance.
- Correct error in *ex ante* waste heat factor therm calculations. For kit programs, this factor is being calculated as MMBTU but not converted to therm savings.
- Given the performance of furnace whistles, consider whether it should be kept in the kit offerings in future program planning. It should be noted that the IL TRM v9.0 (2020) has removed this measure, citing

evaluation results indicating it is not effective. If kept, consider additional ways to educate customers on how to use it properly and the benefits of keeping it installed, to increase long term in-service rates. Per NIPSCO, it is currently planned to remove this measure for the next program cycle.

- Consider ways to increase awareness of other NIPSCO programs to capture energy savings generated from spillover participants. Increasing cross participation also affords NIPSCO additional opportunity to engage with customers and expand their customer relationship.
- Many respondents seemed very engaged in the program. Leverage this enthusiasm to channel respondents to other programs, particularly as they have some baseline understanding of the benefits of energy efficiency behaviors and measures.

MULTI-FAMILY DIRECT INSTALL

- There are no recommendations for the Multi-Family Direct Install program in 2020.

BEHAVIORAL PROGRAM

- The program may be able to achieve additional savings by continuing to educate customers on the new web portal and driving their attention to new features and tips.
- Continue to monitor the statistical significance of savings over time. Consider grouping waves or adding new customers to waves where savings are not consistently statistically significant. For example, given that natural gas Wave 2 and Wave 3 remained not statistically significant between 2018 and 2020, NIPSCO could consider grouping the two waves during evaluation.
- For older waves with high rates of site attrition, NIPSCO should also continue monitoring the pre-treatment equivalency for remaining customers and consider more in-depth equivalency checks (e.g., comparing rate classes and geography amongst the remaining treatment and control customers) as balance between the groups can degrade with increasing site attrition overtime.
- Further inform customers about any new features and uses of the new web portal. Monitor specific customer uses to understand what they use on the web portal. If engagement continues at the current login rates and with the same seasonal patterns, consider ways to drive more traffic to the site to increase engagement and achieve additional savings. Consider messaging during the launches of new participant waves to educate participants about the ongoing nature of the program and drive them to click through emails and engage with the portal on a consistent basis.
- Conduct deeper cross program participation research in future evaluations to understand any trends in program participation across older and newer waves, programs, and measure types.

RESIDENTIAL NEW CONSTRUCTION PROGRAM

- The evaluation team recommends that the program implementer revisit its assumptions and calculation for program home savings to derive a more accurate estimate, considering code changes as described in this report.

- Update the program requirements to account for the energy code change in Indiana. There are several ways that NIPSCO could approach this, ranging from shifting HERS tiers, to adding requirements for certain measures to be included in builds to ensure savings targets are met across fuels.
    - If desired, as an interim support task, the evaluation team can provide a secondary literature review of peer utility new construction program designs, focusing on states with recent code changes, to provide context and support to the implementation team in adjusting program design.
- As part of updating program requirements, consider ways to maximize program influence in building practices, include reassessing rebate levels which may be low compared to savings achieved (especially when comparing to ex post gas savings). Qualitatively, program rebates were rated as a lower influence in builder decision making, when compared to other components such as the HERS rater.
- Explore software-based solutions that would allow the program to have more insight into program performance in live-time.
- HERS raters continue to be a primary driver of program awareness. Future evaluations should include research with HERS raters to understand their current role in influencing the adoption of efficient building practices through the program, as well as ways to engage builders that are not already building energy efficient homes.
- Continue to promote the program through direct outreach to non-participating builders and expand outreach through indirect channels to appeal to builders with less familiarity with HERS rating index and expertise in building above-standard energy efficient homes.
- Streamline application process by reducing the processing times of applications to be able to issue and send checks sooner to increase builder satisfaction levels.
- Consider the results from the 2019 benchmarking analysis to determine if increases to the incentive structure is warranted when compared to other comparable programs, based on energy savings' requirements. A restructuring of incentives can also increase builder satisfaction.

HOMELIFE ENERGY EFFICIENCY CALCULATOR PROGRAM

- Previously, NIPSCO utilized some impact inputs from the School Education program to estimate *ex ante* savings for HomeLife Calculator. The evaluation team recommends updating assumptions to include data from primary research activities for this program and consider tracking kits separately across programs. This includes ISRs, which are higher for HomeLife Calculator, and people per home, which is lower.
- Address waste heat factors consistently across programs in *ex ante* savings. If addressed in cost-effectiveness, this factor should be calculated for use in cost effectiveness analyses but not applied against *ex ante* or *ex post* program performance.
- Ensure the correct units are used when calculating waste heat factors. In kit *ex ante* savings, this factor is being calculated as MMBTU but not converted to therm savings.
- Given the performance of furnace whistles, consider whether it should be kept in the kit offerings in future program planning. It should be noted that the IL TRM v9.0 (2020) has removed this measure, citing evaluation results indicating it is not effective. If kept, consider additional ways to educate customers on

how to use it properly and the benefits of keeping it installed, to increase long term in-service rates. Per NIPSCO, it is currently planned to remove this measure for the next program cycle.

- Consider ways to increase awareness of other NIPSCO programs to capture energy savings generated from spillover participants. Increasing cross participation also affords NIPSCO additional opportunity to engage with customers and expand their customer relationship.
- Qualitative responses from open ended survey questions suggests some respondents may lack awareness and/or understanding of additional programs offered by NIPSCO. Especially in 2021, as programs ramp back up after 2020, consider additional ways to connect customers to other NIPSCO programs, such as sending follow up emails to participants.

EMPLOYEE EDUCATION PROGRAM

- Address waste heat factors consistently across programs in *ex ante* savings. If this should be addressed in cost-effectiveness, this factor should be calculated for use in cost effectiveness analyses but not applied against *ex ante* or *ex post* program performance.
- Ensure the correct units are used when calculating waste heat factors. In kit *ex ante* savings, this factor is being calculated as MMBTU but not converted to therm savings.

INCOME-QUALIFIED WEATHERIZATION PROGRAM

- There are no recommendations for the Income-Qualified Weatherization program in 2020.

COMMERCIAL AND INDUSTRIAL PROGRAMS

- The Custom and Prescriptive programs achieved approximately 10% fewer total savings in 2020 as compared to 2019. The evaluation team recommends closely monitoring savings and participation trends throughout Q3 2021 to determine if this trend will persist and identify whether program strategies, such as bonus incentives to trade allies, could help boost participation in the last quarter.
- SBDI experienced lower than anticipated participation year-over-year. Small businesses experience unique challenges which were likely exacerbated by COVID-19. A market study specifically related to SBDI may be valuable to identify participation and savings potential, reasons for lower than targeted savings, and opportunities to boost participation.
- To be consistent across the portfolio, NIPSCO should calculate waste heat factors for all C&I programs going forward in *ex ante* savings calculations, so these factors can be included in cost-effectiveness and future planning. To do this, NIPSCO should take the following steps:
  - Add extra inputs into the applicable section of the application tool to determine how each area is heated or cooled, per Appendix B of the Indiana TRM. There is a “space conditioning type” variable in the “Project Information” tab of the application, but some areas may be conditioned differently, i.e., warehouses with an attached office area.
  - Add functionality to the application to look up the electricity, demand, and natural gas waste heat factors based on the project site location and the method of heating and cooling.

- Modify the kWh, kW, and therm calculation methodologies in the application excel tool to include these waste heat factors.
- Track fuel type by customers to accurately capture applicable waste heat factors for electric-only vs combo customers.

- The electric energy and demand savings of VFDs is strongly tied to site specific loading and operating hour factors. Deemed values result in a very high variation of energy savings, depending on the application of the VFD. As a result, a one-size-fits-all deemed factor results in a high variation in realization rates for this program. The evaluation team recommends modifying the application tool as follows:
  - Add inputs for average operating speed and baseline control and use these inputs to determine controlled load factors for the baseline and VFD motors.
  - Add a field for application (heating, cooling, ventilation, process, and other). Generally, the coincidence factor will be zero for cooling because the motors are fully loaded, and zero for heating applications because the motors will be off during the utility peak period.
  - Accept operating hours for the motor.
- Calculate measure savings, do not rely on manufacturer PDF calculations which prove to be unreliable.
  - For the purposes of both accuracy in calculations and transparency in the calculations, only accept live spreadsheet calculations from projects. The evaluation team specifically recommends the implementor utilize their measure specific calculation spreadsheets they have developed on all projects to verify ex ante savings, particularly for projects with large savings impacts.
  - If no calculation spreadsheets currently exist for a measure, develop live calculation spreadsheets based on commonly accepted engineering principles. Review and justify all calculation inputs.
  - Clearly document inputs to calculations, providing supporting evidence for those calculations.
- Large savings measures need more rigorous calculations and supporting documentation.
  - Equipment loading should be estimated using logged power information of the baseline system, logs of production provided by the facility, or other methods that will realize realistic estimates of energy savings.
  - Utilize trend data whenever possible to establish an accurate picture of the baseline sequencing, operation and run times of the equipment.
  - Unique equipment with special applications should receive increased review and discussion to determine accurate energy savings estimates before installation. For example, fan wall array systems are rarely utilized as an energy efficiency measure, but more commonly as a critical function redundancy measure.
  - Use the established custom calculator more broadly when possible, particularly on projects where the energy savings are projected to have a large impact.
- Steam pipe insulation measure deemed values are too broadly applied.
  - Use the established custom calculator more broadly, when possible, in place of the deemed savings, particularly on projects where the energy savings are projected to have a large impact.

    - Evaluate the current deemed values used for natural gas savings for steam pipe insulation measures. If deemed values will continue to be used, it is recommended to have different deemed savings values based on at least (1) steam pressure, and (2) operating hours, in addition to the established existing parameters (1) pipe diameter, and (2) linear feet of installed insulation.
    - If actual project values for steam pressure and operating hours are not practical to collect from customers and use in savings calculations, the evaluation team recommends NIPSCO establish tiers for each of these parameters. It might be easiest to break this measure into three different measures based on pressure to reduce the number of deemed values per measure. For example:
        - Measure 1: Hot Water Pipe insulation: Measure has a set average temperature/pressure and insulation thickness. The measure would have three set options for operating hours (low, med, high), and three set options for thickness (currently in place). Final data entry is the linear feet of install.
        - Measure 2: Low Pressure Steam Pipe Insulation: Same pattern as above
        - Measure 3: High Pressure Steam Pipe Insulation: Same pattern as above
- Given the nature of the Custom program, custom calculations are always acceptable, but when there is a well vetted and established TRM measure from a nearby source, we recommend using that measure as a first step toward savings quantification. In some custom calculations, the resulting savings matched closely to the deemed values in other nearby TRMs.
- When the implementation team feels a measure would be best calculated by using TRM values from another state's TRM, the evaluation team would recommend confirming that decision with the evaluation team before proceeding, and to clearly document the sources used and rationale for that decision.
- Clarify the intended delineation of measures that fall into the Building Redesign category or close the Building Redesign measure group and reclassify those projects into the other measure groupings.
- Continue to proactively communicate information on the latest energy efficient technologies and programs that customers may be eligible for or benefit from, using marketing emails and newsletters.
- In program year 2021, integrate research into the evaluation activities to identify barriers to cross-measure promotion and opportunities for overcoming those communication and education barriers. Identify potential opportunities for education and communication and test those opportunities through evaluation-based research. For example, identify the potential to and need to better communicate rebate opportunities at various points of the program process, considering the individual(s) engaged at those points and their decision-making roles. As another example, identify not just the preferred method of communication, but most effective means to provide information about other NIPSCO programs.
- Draw on the different motivations in the way that the different measures are marketed. Advertise lighting measures as an opportunity to reduce operating costs. Advertise non-lighting measures with a focus on their strong ROI.

1. PROGRAM OFFERINGS

NIPSCO's DSM portfolio consists of 17 programs distributed across the Residential and C&I sectors. NIPSCO administers these programs with the support of a third-party implementer, TRC Company (formerly Lockheed Martin Energy). The 2020 program year marked the second year of a three-year program cycle. A brief description of each program's offering follows:

- The HVAC Rebates program provides incentives to natural gas and electric residential customers to purchase energy-efficient heating and cooling products. The program includes energy-efficient measures such as smart thermostats, furnaces, air conditioners, boilers, and heat pumps.

- The Residential Lighting program provides upstream discounts on LED lamps and LED lighting fixtures. NIPSCO works with retailers and manufacturers to offer reduced prices at the point of sale.

- The Home Energy Assessment program provides no-cost, in-home energy assessments to residential customers. During an assessment, an energy assessor analyzes the efficiency of the heating and cooling systems and insulation levels in the home and installs energy-saving lighting and water conservation measures. The assessment concludes with the assessor providing a report of findings and energy-saving recommendations. The primary focus of the program is to educate customers about energy efficiency in their homes. In the second half of 2020, this program pivoted to provide virtual assessments and kits to customers due to COVID-19.

- The Appliance Recycling program provides removal and recycling services to electric customers who reduce energy consumption through recycling unneeded refrigerators and freezers. Annually, participants may recycle up to two working secondary refrigerators or freezers, sized 10 to 30 cubic feet, by scheduling a pickup of the units. In the second half of 2020, this program shifted to a curbside pick up model in order to comply with social distancing measures during the COVID-19 pandemic.

- The School Education program works with fifth-grade teachers to educate students about energy efficiency and how they can make an impact at school and home. Participating teachers receive classroom curriculum and take-home efficiency kits to distribute to their students.

- The Multi-Family Direct Install (MFDI) program provides property owners and managers of multi-family housing a no-cost property walk-through for residential units and common spaces and energy efficiency measures in-unit at no-cost as well. The walk-through results in a report with recommendations for energy-efficient upgrades. During a follow up visit, a program approved contractor will install some or all the suggested energy-efficient measures in the residential units. Due to the COVID-19 pandemic, this program was on hold in 2020.

- The Behavioral program sends paper and/or electronic home energy reports to selected customers that educates them on their energy consumption patterns. Participants receive a targeted, individualized report that is intended to motivate them to engage in energy-saving behaviors. The report shows the participant's monthly energy use and compares this use to similarly sized homes nearby, and it also provides semi-customized energy-saving tips. Participants may opt-out through an online portal.

- The Income-Qualified Weatherization (IQW) program provides no-cost, in-home energy assessments to income-qualified residential customers. Program participants receive a home assessment, where an energy assessor first analyzes the efficiency of heating and cooling systems and insulation levels in the home. Depending on opportunities in the home, the assessor then installs energy-saving lighting and water-conservation measures, as well as duct sealing and air sealing to qualifying homes during the assessment. Homes with refrigerators 10 years old or older are also eligible to receive a new, ENERGY STAR®-rated refrigerator, and those with attic insulation levels below R-11 may qualify for attic insulation. Both of these items are installed after the initial assessment. The assessor also provides a report of findings and energy-saving recommendations. There was limited participation in this program in 2020 due to the COVID-19 pandemic, and it was on hold for the majority of the year. Income-qualified participants were able to participate in the virtual assessment component of HEA offered in 2020.

- The Residential New Construction program provides incentives to residential home builders to build higher efficiency homes. The program offers several tiers of incentives utilizing HERS ratings, to encourage energy efficiency in residential home construction.

- The Homelife Energy Efficiency Calculator program offers residential customers a free online 'do-it-yourself' audit to help customers learn about their home's energy use and provide recommendations on how to save energy. Eligible participants also receive a free energy savings kit with various measures including LEDs, water saving devices, and furnace whistles.

- The Employee Education program provides education and an optional direct install kit to employees of NIPSCO C&I customers. The program offers in-house energy efficiency training seminars, employee energy efficiency kits, and education materials to inform residential customers of opportunities and methods to proactively manage their energy consumption. This program was on hold for the majority of 2020 due to the COVID-19 pandemic.

- The C&I Prescriptive program provides rebates for the installation of energy efficiency equipment and system improvements. The program offers rebates for lighting, pumps and drives, heating, cooling, and refrigeration equipment.

- The C&I Custom program provides incentives for measures not included in the Prescriptive program that are unique to the commercial participant's application or process. The program requires individual engineering analyses to determine savings. This program offers customers incentives based on the calculated savings for energy savings opportunities outside the traditional rebate program.

- The C&I New Construction program offers incentives to encourage building owners, designers and architects to exceed standard building practice. Projects may also qualify for either prescriptive or custom incentives.

- The Small Business Direct Install (SBDI) program provides small business participants incentives for refrigeration, lighting, HVAC, and other natural gas–saving measures typically used in small business operations. These incentives are higher than offered through the C&I Prescriptive program to overcome first-cost barriers traditional experienced by small business customers.

2. EVALUATION OBJECTIVES AND METHODOLOGY

The evaluation team employs consistent methods across programs and from prior evaluation years whenever possible. The evaluation process can be broken into three key areas of research, which are summarized below:

Impact Evaluation. The evaluation team verifies measure installation, calculates evaluated (or gross) savings, and measures freeridership and spillover to produce net savings impacts. This research includes conducting engineering desk reviews of project savings calculations, completing site visits to observe project conditions and measure savings performance, and surveying participants to understand program influence.

Process Evaluation. The evaluation team investigates program processes, participation barriers, and the program experiences of customers and trade allies. This research uses telephone and online surveys with program actors (trade allies, participants, and other supporting actors), and interviews with program and implementation staff to better understand program performance. This research gives stakeholders insight into the aspects of success or potential improvement for each program and provides context for impact findings.

Cost-Effectiveness. The evaluation team conducts a cost-effectiveness analysis (a form of economic analysis) to compare the relative costs and benefits from NIPSCO's investment in each program. In the energy efficiency industry, cost-effectiveness metrics serve as an indicator of the economic attractiveness of any energy efficiency investment or practice, as compared to the costs of energy produced and delivered in the absence of such investments.

Note that some programs in the portfolio had limited or no participation in 2020 due to the COVID-19 pandemic. For several programs with low participation in 2020, including IQW and Employee Education, the evaluation team conducted a limited impact review to focus primarily on engineering and tracking data reviews. The evaluation team recommends conducting additional evaluation activities for program year 2021 if these programs see increased participation.

RESEARCH QUESTIONS

The evaluation team developed key research questions for each program, designed to address program-specific evaluation needs. Impact activities for most programs included an assessment of these research areas:

- Data quality review
- In-service rates or ISRs
- Measure verification
- Freeridership
- Spillover
- Program cost-effectiveness

Process activities for most programs included an assessment of these research areas:

- Program design, delivery, and administration
- Communication and coordination between NIPSCO and its implementers

- Marketing strategies
- Program processes (including application processes)
- Drivers of participation and barriers to participation
- Quality control processes
- Future program plans

IMPACT EVALUATION APPROACH

To determine portfolio impacts, the evaluation team completed the following activities for most programs:

- Compared tracking data, program documents, and scorecard data for alignment and accuracy
- Reviewed savings values, calculations, assumptions, and sources
- Collected ISR data for program measures, where applicable
- Calculated *ex post* gross savings values for programs and the portfolio
- Estimated freeridership and spillover behavior from participant surveys, site visits, and secondary sources
- Calculated *ex post* net savings values for programs and the portfolio

The team employed statistical and engineering-based analysis techniques to achieve these results, adjusting program-reported gross savings (ex ante) using the information gathered through database and document reviews, engineering reviews of tracking data and project work papers, Indiana TRM (v2.2) deemed savings calculation reviews, and on-site verification and metering.

The evaluation team's presentation of analysis results follows a progression, with each savings type corresponding to a specific step in the evaluation process.

The evaluation team defined these key savings terms as follows for the impact evaluation:

- Reported ex ante savings: Annual gross savings for the evaluation period, as reported by NIPSCO in the 2020 DSM Scorecard.
- Audited savings: Annual gross savings after alignment or reconciliation with the program tracking data.
- Verified savings: Annual gross savings after alignment with the program tracking data (i.e., Audited savings), and adjustments related to ISRs.
- Evaluated ex post savings: Annual gross savings with all previous adjustments (i.e., Verified savings), and adjusted to include the best available inputs and methodology available at the time of the evaluation.
- Realization rate (percentage): the percentage of savings the program realized, calculated using the following equation:

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

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

PROCESS EVALUATION APPROACH

For the process evaluation, the evaluation team conducted interviews with program and implementation staff to document how each program worked, identify and understand the important influences on the program's operations, and gain insight into factors influencing the program's performance. For some programs, the evaluation team also conducted surveys and interviews with program participants and participating trade allies to understand their perspectives and experiences with a given program.

RESEARCH ACTIVITIES

The evaluation team conducted the following research activities by program. Table 10 details the activities that informed the impact evaluations, and

Table 11 details the activities that informed the process evaluations.

TABLE 10. 2020 IMPACT EVALUATION ACTIVITIES

PROGRAM	DATABASE REVIEW	ENGINEERING ANALYSIS	VERIFICATION/SITE VISITS	NTG ESTIMATION	GATHER IMPACT INPUTS VIA PARTICIPANT SURVEYS	OTHER
HVAC Rebates	✓	✓		✓	✓	Billing Analysis
Lighting	✓	✓				
HEA	✓	✓				
Appliance Recycling	✓	✓		✓	✓	
School Education	✓	✓		✓	✓	
MFDI	✓	✓				
Behavioral	✓					Billing Analysis
New Construction	✓	✓				
Homelife Calculator	✓	✓		✓	✓	
Employee Education	✓	✓				
IQW	✓	✓				
Prescriptive	✓	✓	✓	✓	✓	
Custom	✓	✓	✓	✓	✓	
New Construction	✓	✓	✓			
SBDI	✓	✓	✓			

TABLE 11. 2020 PROCESS EVALUATION ACTIVITIES

PROGRAM	STAFF INTERVIEWS	MATERIALS REVIEW	PARTICIPANT SURVEYS/INTERVIEWS	TRADE ALLY SURVEYS/INTERVIEWS
RESIDENTIAL				
HVAC Rebates	✓	✓	✓	✓
Lighting	✓	✓		
HEA	✓	✓	✓	✓
Appliance Recycling	✓	✓	✓	
School Education	✓	✓	✓	
MFDI	✓	✓		
Behavioral	✓	✓		
New Construction	✓	✓		✓
Homelife Calculator	✓	✓	✓	
Employee Education	✓	✓		
IQW	✓	✓		
C&I				
Prescriptive	✓	✓	✓	
Custom	✓	✓	✓	
New Construction	✓	✓		
SBDI	✓	✓		

DATABASE AND DOCUMENT REVIEW

The evaluation team reviewed NIPSCO's program tracking databases, scorecards, and other documentation to assess the quality of information and to identify potential anomalous entries, outliers, duplicates, and missing values. This included reviewing all data fields recommended in the Indiana TRM (v2.2), along with those necessary to calculate deemed savings. The evaluation team conducted a database and document review for all programs, including these specific activities:

- Verified that all customer and vendor information needed to conduct primary research was available and complete
- Confirmed that all measure-specific data included the necessary details in the proper formats to enable impact evaluation
- Confirmed that all program costs and other tracking information required to calculate impacts and assess resource allocation were available and complete
- Assessed new marketing, outreach materials, and other related activities

For measures not included in the Indiana TRM (v2.2), the evaluation team reviewed project documentation (e.g., audit reports and savings calculation work papers) from a sample of energy efficiency project sites. The evaluation team closely reviewed the calculation procedures and savings estimate documentation. The evaluation team also verified the appropriateness of NIPSCO's analyses for calculating savings as well as the assumptions used for participating facilities' structural attributes and operational characteristics.

VERIFICATION AND METERING SITE VISITS

For the C&I programs, the evaluation team focused virtual site visit activities on verifying and measuring program measures installed in C&I buildings. Due to COVID-19 impacts, the evaluation team did not perform any onsite activities, including metering, in the 2020 evaluation. Verification was conducted via phone interviews and virtual site visits with select customers.

The total number of measures reviewed via virtual site visits is outlined in Table 12 below. The team reviewed program tracking data in Spring 2020, a second time in fall 2020, and a third time in early 2021, to identify high-saving projects and draw these projects into a sample for recruitment. Virtual verifications were completed between Spring 2020 and February 2021.

TABLE 12. 2020 ON-SITE IMPACT EVALUATION SAMPLES

PROGRAM	TOTAL NUMBER OF SAMPLED MEASURES	NUMBER OF VIRTUAL SITE VISIT MEASURES	PERCENT EX ANTE ELECTRIC SAVINGS SAMPLED	PERCENT EX ANTE GAS SAVINGS SAMPLED
C&I Prescriptive	32	10	21%	18%
C&I Custom	36	22	58%	34%
C&I New Construction	21	15	48%	34%
C&I SBDI	26	3	14%	81%
C&I Total Programs	**115**	**50**	**37%**	**35%**

NIPSCO provided contact information for project decision-makers and implementation contractors, and the evaluation team contacted customers at selected sites to schedule interviews and virtual visits in advance. The evaluation team conducted these primary tasks during the M&V virtual visits:

1. Verified that all measures were installed correctly and functioning properly, and confirmed the operational characteristics of the installed equipment such as temperature, setpoints, and annual operating hours
2. Collected physical data such as cooling capacity or horsepower, and analyzed the energy savings realized from the installed improvements and measures

STAFF INTERVIEWS

The evaluation team interviewed NIPSCO program managers and implementation staff to understand how each program was designed and delivered, what worked well, and what could be improved. The interviews covered wide-ranging topics such as program design and administration, communication and data tracking processes, marketing strategies, trade ally and participant interactions, and challenges and successes.

PARTICIPANT AND TRADE ALLY SURVEYS AND INTERVIEWS

The team conducted both quantitative and qualitative research to address the program's impact and process needs, depending on the status and design of the program. To support the impact and process evaluations, the evaluation team conducted surveys for select programs. The evaluation team designed these surveys to collect data about market awareness of NIPSCO's energy-saving programs, product installation rates, customer behavior and equipment use, participant satisfaction with program components, and barriers to participation. Where applicable, the surveys informed process and impact research questions, such as freeridership and spillover.

The evaluation team also conducted qualitative in-depth interviews for several programs. Qualitative research is especially useful for process evaluation, to explore more deeply how customers or market actors experience the program.

SAMPLING

The evaluation team used a sampling approach to develop sample frames for participant and nonparticipant surveys, and to determine the number of site visits needed for field work. Table 13 shows the population and sample sizes, as well as the number of completes for surveys.

TABLE 13. SURVEY POPULATION AND SAMPLE SIZES

PROGRAM	RESPONDENT GROUP	SURVEYS OR INTERVIEWS	POPULATION (COUNT OF UNIQUE ELIGIBLE CUSTOMERS)	TARGET COMPLETES	ACHIEVED COMPLETES
RESIDENTIAL					
HVAC Rebates	Participants	Surveys	2130	210	240
HVAC Rebates	Trade Allies	Interviews	78	10	8
ARP	Participants	Surveys	1738	280	298
HEA	Participants	Surveys	74	Census	17
HEA	Auditors	Interviews	2	Census	2
School Education	Parents	Surveys	807	75	70
New Construction	Builders	Surveys	126	30	17
Homelife Calculator	Participants	Surveys	219	Census	50
C&I					
Prescriptive	Participants	Surveys	409	70	72
Custom	Participants	Surveys	157	Census	25

NTG METHODS

An NTG ratio is made of two components: freeridership and spillover. Freeridership is the percentage of savings that would have occurred in the absence of the program because participants would have behaved the same (purchasing the same measures) without the influence of the program. Spillover occurs when customers purchase energy-efficient measures or adopt energy-efficient building practices without participating in a utility-sponsored program. The evaluation team used the following equation to calculate NTG for each program:

$$Program\ NTG\ Ratio = 100\% - Freeridership + \ Spillover$$

In 2020, programs that included NTG analysis primarily used the self-report approach. The approach accounted for customers' intention absent the program and influence of program offerings on customers' decisions. Several programs that did not include customer surveys, but would require a self-report approach, used prior years' NTG results.

SELF-REPORT METHOD

To determine a freeridership score, the evaluation team relied on self-report participant surveys, in which the evaluation team asked participants a series of questions about what their actions would have been in the absence of the program. The specific net-to-gross batteries were tailored to each individual program design. The evaluation team used each unique set of responses to calculate a freeridership score for that individual. The evaluation team then aggregated the scores and determined a total freeridership score by fuel type. To facilitate comparisons over program years, the evaluation team used NTG question batteries consistent with those used in the 2018 evaluations.

Spillover is measured by asking participants who purchased a particular measure if, because of the program, they decided to install another energy-efficient measure or undertake some other activity to improve energy efficiency. The evaluation team assessed spillover through self-report surveys, in which interviewers read a list of energy-efficient products to respondents and asked if they had installed any of the products in their home or business since participating in the program. If respondents said they had made energy-efficient improvements or purchased products, interviewers asked how influential the program was on their purchasing decisions.

The evaluation team estimated spillover savings for measures where participants said the program was very influential in their decision. The team used specific information about participants, determined through the evaluation, and used the Indiana TRM (v2.2) and EM&V ex post savings analyses as a baseline reference. The sum of the estimated spillover savings, divided by savings achieved through the program for each relevant measure, yielded spillover savings as a percentage of total savings, which the evaluation team then extrapolated to the population of program participants.

INTENTION/INFLUENCE METHOD FOR SELF-REPORTS

For the *intention/influence* method, the evaluation team assessed freeridership in two steps. Although the questions were similar to those used in the self-report method, the *intention/influence* questions explored the participant's intention and the program's *influence* in more detail. The evaluation team first scored these two parts of the survey separately, then combined them with equal weight to determine one freeridership score for each survey respondent. A similar but slightly modified version of this approach was used for kit programs, which have a somewhat different program design compared to other programs such as the HVAC or C&I programs. Spillover under this method focused on the program's *influence* on a participant's decision to invest in additional energy-efficient measures.

The evaluation team derived the participants' *intention* freeridership score by translating their responses into a matrix value and applying a consistent, rules-based calculation to obtain the final freeridership score.

The evaluation team used the following process for determining the intention freeridership score:

- Customers were categorized as 0% freeriders if they were not aware of a program (i.e., efficient) measure and had no plans to install that measure prior to hearing about the program. Customers also were categorized as 0% freeriders if they knew about the program but had no plans to install an efficient, program-promoted measure.
- Customers were categorized as 100% freeriders if they would have installed the measure in the program's absence or if they had already installed the measure before learning about the program.
- Customers received a partial freeridership score if they planned to install the measure and the program altered their decision. This effect may have included the installation's timing, the number of measures

installed, or the efficiency levels of measures installed. For customers who were highly likely to install a measure, and for whom the program had less effect on their decisions, the evaluation team assigned a higher intention freeridership score.

The evaluation team assessed influence freeridership by asking participants how important various program elements were in their purchase decision-making process. The maximum rating of any program factor determined a participant's influence freeridership score (0% to 100% score range using a 1 to 4 scale).

The evaluation team calculated the arithmetic mean of the intention and influence freeridership components to estimate total freeridership for programs.

$$\text{Total Freeridership} = \frac{\mathit{Intention}\ \text{FR Score}\ + \mathit{Influence}\ \text{FR Score}}{2}$$

The influence and intention scores contribute equally to the total freeridership score. The higher the total freeridership score, the greater the deduction of savings from the gross savings estimates.

Using the calculated freeridership and spillover values, the evaluation team applied the overall NTG ratio to the ex post gross savings to identify the ex post net savings.

DEEMED SAVINGS METHOD

The evaluation team applied a deemed NTG ratio in two types of situations. First, the evaluation team applied an NTG of 100% for programs targeting low-income customers. Low-income programs tend to focus on direct installation of measures and are based on the hypothesis that the customer would not have installed the energy-efficient product without the assistance of the program. For the Income Qualified Weatherization program, the evaluation team applied an NTG of 100%.

Additionally, for several programs, where there was not enough participation or robust enough data to calculate new NTG values from primary research, the evaluation relied on either 1) past evaluation estimates for that same program or 2) NTG values from other NIPSCO programs with similar program designs in order to estimate NTG for the 2020 evaluation year.

3. ENERGY EFFICIENCY REBATES (HVAC REBATES) PROGRAM

PROGRAM DESIGN AND DELIVERY

In 2020, NIPSCO offered the HVAC Rebates program, marketed to natural gas and electric customers as the “Energy Efficiency Rebate” program. Through the program, NIPSCO encourages customers to install energy-efficient equipment to reduce energy consumption. The program is available to all residential customers with an active NIPSCO account. The program includes the following measure categories:

- Furnaces
- Furnaces with ECMs
- Air conditioners
- Air conditioner tune-ups
- Boilers
- Boiler tune-ups
- Air source heat pumps
- Smart and Wi-Fi thermostats
- Water heaters

Program rebates ranged from $30.00 to $250.00, covering a range of HVAC equipment from smart thermostats to boilers and furnaces. Rebate levels varied by equipment efficiency level and measure type.

As in previous years, 2020 participants either installed measures through the contractor of their choice, or through self-installation. A licensed HVAC contractor must complete HVAC tune-ups (for air conditioners and boilers). Customers and contractors were able to fill out the application form on paper or through an online form.

While NIPSCO does not have a contractor network, and does not promote any individual contractors, the program implementer, TRC, has its own network of contractors. Customers can use the link on the NIPSCO website to find a contractor; it will link them to the TRC contractor portal. Contractors have the option to provide an instant discount on equipment or services to their customers and submit the rebate application on their behalf. If contractors do not pursue the instant discount option, participants must fill out and submit rebate forms. Contractors often help participants with the application. Customers or contractors must submit rebate applications within 60 days of installation. Every project is subject to an on-site visual inspection, with program staff randomly inspecting 10% of installations.

NIPSCO advertised for the program through billboards and bill inserts. In 2020 NIPSCO began to promote the program through in-store promotions where HVAC equipment was sold. They used an advertisement with a cardinal, named Hoosier, that directed people to the NIPSCO website.

CHANGES FROM 2019 DESIGN

There were a few changes from the 2019 program design. NIPSCO changed the eligibility requirements, incentive caps, and added a field to the rebate application. First, NIPSCO specified that Residential New Construction Program participating homes are not eligible to participate in the HVAC Rebates program for three years. Second, NIPSCO added specificity to the incentive caps for A/C and Boiler tune-ups and Wi-Fi thermostats.

- A/C and boiler tune-ups are limited to one tune-up per equipment type per installation address every three years.
- Wi-Fi thermostats are limited to two rebates per installation address every three years.

Third, NIPSCO addressed the recommendation the evaluation team made in the 2019 report and added fields to collect the replaced thermostat information (manufacturer, model number, and if it was working). NIPSCO made no changes to rebate amounts in 2020. While the COVID-19 pandemic had an impact on the delivery and/or design of other programs, the HVAC Rebates program operated normally, as contractors continued offering services to customers.

PROGRAM PERFORMANCE

The 2020 HVAC Rebates program fell short of the electric energy goal by 2% but exceeded the peak demand goal by 104% and the natural gas goal by 1%. Despite large reductions to *ex post gross* savings, gross goal achievement was still largely realized because *ex ante* savings far exceeded goals. Table 14 summarizes savings goals and program savings.

TABLE 14. 2020 HVAC REBATE PROGRAM SAVING SUMMARY

METRIC	GROSS SAVINGS GOAL	*EX ANTE*	AUDITED	VERIFIED	*EX POST* GROSS	*EX POST* NET	GROSS GOAL ACHIEVEMENT
Electric Energy Savings (kWh/yr)	998,798.34	2,384,913.63	2,384,050.31	2,384,050.31	980,859.03	590,764.69	98%
Peak Demand Reduction (kW)	594.640	1,111.887	1,110.812	1,110.812	1,211.048	724.03	204%
Natural Gas Energy Savings (therms/yr)	1,064,220.60	1,974,633.98	1,974,384.72	1,974,384.72	1,069,788.66	634,352.04	101%

Table 15 outlines the *ex post* gross and NTG adjustment factors.

TABLE 15. 2020 HVAC REBATE PROGRAM ADJUSTMENT FACTORS

METRIC	REALIZATION RATE (%)[a]	FREERIDERSHIP	SPILLOVER	NTG (%)[b]
Electric Energy Savings (kWh/yr)	41%	40%	1%	60%
Peak Demand Reduction (kW)	109%	41%	1%	60%
Natural Gas Energy Savings (therms/yr)	54%	41%	<1%	59%

[a] Realization Rate is defined as *ex post* Gross savings divided by *ex ante* savings.
[b] NTG is defined as *ex post* net savings divided by *ex post* gross savings.

The program spent 176% of its budget for electric and 174% of its budget for gas. Table 16 lists the 2020 program budget and expenditures by fuel type.

TABLE 16. 2020 HVAC REBATE PROGRAM EXPENDITURES

FUEL	PROGRAM BUDGET	PROGRAM EXPENDITURES	BUDGET SPENT (%)
Electric	$349,362.45	$615,865865.76	176%
Natural Gas	$1,529,165.24	$2,660,589589.84	174%

EVALUATION METHODOLOGY

To inform the 2020 NIPSCO impact and process evaluation, the evaluation team completed the following research activities:

- Documentation and materials review, to provide context on program implementation.
- Tracking data analysis, to audit and verify the accuracy of program participation data.
- Engineering analysis, to review program savings assumptions and algorithms for reasonableness and accuracy.
- Billing analysis, to estimate thermostat savings and update EFLH for furnaces.
- Participating HVAC contractor interviews, to understand how trade allies deliver the program.
- Online participant survey (n=240) of participating customers to understand their program experience and to gather information to calculate free ridership and spillover rates.

IMPACT EVALUATION

The evaluation team completed the impact evaluation to answer the following research questions:

- What assumptions were used to develop savings estimates? Are there any updates that should be made?
- What are *ex post* program savings? Do these suggest any needed updates to program design, delivery, or savings assumptions?
- What are net-to-gross ratios for this program? How influential is the program in customer decision making to install energy efficient HVAC equipment?

For all measure types, the evaluation team compared its engineering calculations to NIPSCO's *ex ante* savings, basing its savings methodologies and inputs for each measure on several sources: standard engineering practices, the 2015 Indiana TRM (v2.2)[2], and NIPSCO's program tracking database. Additionally, the team conducted a billing analysis which measured savings resulting from the installation of smart thermostats and equivalent full-load hours (EFLH) for installed furnaces.

AUDITED AND VERIFIED SAVINGS

In 2020, the program rebated 12,819 measures through the HVAC Rebates program. The evaluation team audited measure quantities by looking for duplicate records, ensuring measures followed program guidelines, and making sure the proper deemed savings values were applied.

When conducting the tracking data audit, we found a few projects that did not match the program guidelines. We removed less than 0.1% of all units. We removed the following records from the tracking data:

- One participant received three furnaces. Program documentation states that one participant can receive a maximum of two.

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[2] Cadmus. *Indiana Technical Reference Manual Version 2.2*. July 28, 2015.

- Nine participants received more than one HVAC tune-up for the same equipment type. One of these participants received two boiler tune-ups and eight participants received two A/C tune-ups. Program guidelines state, "HVAC tune-ups are limited to one tune-up per equipment type, per installation address every three (3) years."

Table 17 summarizes the number of tracking data quantities and the audited quantities for each measure.[3]

TABLE 17. 2020 HVAC REBATE PROGRAM TRACKING AND AUDITED QUANTITIES

MEASURE	TRACKING DATA QUANTITY	AUDITED QUANTITY
Furnace	4,107	4,107
Furnace w/ ECM	3,183	3,182
Air Conditioner	1,271	1,271
Air Conditioner Tune-up	455	447
Boiler	77	77
Boiler Tune-up	7	6
ASHP	6	6
Smart Thermostat	3,439	3,439
Water Heater	274	274
Total	12,819	12,809

Furnaces with ECMs accounted for more than half of program audited electric energy savings, with air source heat pumps (AHSP) making up less than 1% of audited electric energy savings. Air conditioners made up 50% of audited demand reduction, with smart thermostats making up another 28%. Furnaces and furnaces with ECMs make up 76% of audited gas savings, with thermostats making up an additional 23%. Boilers, boiler tune-ups, and water heaters amount to 1.2% of gas savings combined. Table 18 summarizes audited savings for the nine measure categories.

[3] The tracking data contained three general categories of furnace measures: Furnace (without ECM), Furnace with ECM but not electric service through NIPSCO, and Furnace with ECM and electric service through NIPSCO. The latter two categories did not have electric energy savings or demand reduction claimed and were both grouped under the “Furnace” measure category.

TABLE 18. 2020 HVAC REBATE PROGRAM SAVINGS SHARES BY MEASURE TYPE

MEASURE CATEGORY	AUDITED ELECTRIC ENERGY SAVINGS		AUDITED PEAK DEMAND REDUCTION		AUDITED NATURAL GAS ENERGY SAVINGS	
	KWH/YR.	SHARE	KW	SHARE	THERMS/YR.	SHARE
Furnace	0.00		0.000		841,427.66	43%
Furnace w/ ECM	1,320,530.00	55%	187.738	17%	657,846.68	33%
Air Conditioner	681,853.37	29%	551.614	50%	0.00	
Air Conditioner Tune-up	25,049.88	1%	56.769	5%	0.00	
Boiler	0.00		0.000		12,754.28	>1%
Boiler Tune-up	0.00		0.000		255.12	>1%
ASHP	7,121.16	>1%	4.284	>1%	0.00	
Smart Thermostat	349,495.90	15%	310.407	28%	450,537.45	23%
Water Heater	0.00		0.000		11,563.53	>1%
Total	2,384,050.31	100%	1,110.812	100%	1,974,384.72	100%

Note: Totals may not sum properly due to rounding.

As is typical for programs rebating larger HVAC measures, where measures are typically not uninstalled, the installation rate for this program is 100% across all measures. As in past evaluations, installation rates for large HVAC and water heating measures are set to 100%. Given that tune-ups cannot be uninstalled, the evaluation team assumed a 100% ISR for these measures. Thermostat installation rates are also set at 100%, as any uninstallations are accounted for within the ex-post billing analysis savings estimates.

Table 19 summarizes the tracking data quantity, audited quantity, applied installation rates, and resulting verified quantity per measure. To calculate the verified measure quantity, the evaluation team multiplied the audited measure quantity by the installation rate. In this evaluation, with all measures achieving a 100% ISR, the verified savings and measure counts do not differ from the audited savings and measure counts.

TABLE 19. 2020 HVAC REBATE PROGRAM AUDITED AND VERIFIED QUANTITIES

MEASURE	AUDITED QUANTITY	ISR	VERIFIED QUANTITY
Furnace	4,107	100%	4,107
Furnace w/ ECM	3,182	100%	3,182
Air Conditioner	1,271	100%	1,271
Air Conditioner Tune-up	447	100%	447
Boiler	77	100%	77
Boiler Tune-up	6	100%	6
ASHP	6	100%	6
Smart Thermostat	3,439	100%	3,439
Water Heater	274	100%	274
Total	12,809	N/A	12,809

EX POST GROSS SAVINGS

The evaluation team referred to the Indiana TRM (v2.2) to calculate *ex post* electric and natural gas energy savings and demand reduction for many program measures.

- For furnaces, we conducted a billing analysis which updated EFLH by nearest city. We applied these updated values to installed furnaces.
- For smart thermostats, we conducted a billing analysis that provided updated gas and electric savings. In addition, the evaluation team employed measure characteristics provided in the database, for variables such as capacities, efficiencies, HVAC equipment type and model, and project location.
- For smart thermostats we also applied an adjustment, correcting an error in the program year 2019 evaluation, where heating and cooling savings factors were used that were higher than appropriate. This is reported separately where appropriate to accurately reflect current year thermostat performance.
- Finally, for boilers, air conditioners, heat pumps, thermostat cooling savings, and tune-ups, the evaluation team assigned heating and cooling hours and ground water temperatures by matching each installation's city to the closest city from the TRM (2.2).

Table 20 presents *ex ante* and *ex post* savings and realization rates (RR) by measure category. The *ex post* and *ex ante* values are different in many cases because the *ex post* evaluation used actual values for equipment sizing and efficiency, and varied EFLH by measure location. *Ex ante* values use deemed savings values and do not take measure or household specific details into consideration.

TABLE 20. 2020 HVAC REBATES PROGRAM *EX ANTE* AND *EX POST* GROSS SAVINGS VALUES

MEASURE CATEGORY	ELECTRIC ENERGY SAVINGS (kWh/YR)			PEAK DEMAND REDUCTION (kW)			NATURAL GAS ENERGY SAVINGS (THERMS/YR)		
	EX ANTE	*EX POST* GROSS	RR	*EX ANTE*	*EX POST* GROSS	RR	*EX ANTE*	*EX POST* GROSS	RR
Furnace	0.00	0		0.000	0.000		841,427427.66	545,200.91	65%
Furnace w/ ECM	1,320,945.00	297,069.70	22%	187.797	33.455	18%	658,053.42	412,691.10	63%
Air Conditioner	681,853.37	537,882.73	79%	551.614	1,014.531	184%	0.00	0.00	
Air Conditioner Tune-up	25,498.20	19,534.21	77%	57.785	44.331	77%	0.00	0.00	
Boiler	0.00	0.00		0.000	0.000		12,754.28	16,808.95	132%
Boiler Tune-up	0.00	0.00		0.000	0.000		297297.64	288.00	97%
ASHP	7,121.16	6,630.25	93%	4.284	0.884	21%	0.00	0.00	
Smart Thermostat	349,495495.90	198,216.98	57%	310.407	203.729	66%	450,537.45	113,820.00	25%
2019 Smart Thermostat Correction	0.00	-78,474.84	n/a	0	-85.882	n/a	0.00	-29,348.6	n/a
Water Heater	0.00	0.00		0.000	0.000		11,563563.53	10,329.03	89%
Total	2,384,913.63	980,859.03	41%	1,111.887	1,211.048	109%	1,974,633.98	1,069,788.66	54%

Notes: Totals may not sum properly due to rounding.

Ex ante values are presented at the measure level and represent audited values, since the scorecard provides only savings totals.

Table 21 highlights notable differences between *ex ante* and *ex post* gross estimates. The following measure adjustments are most noteworthy:

- Furnaces: The evaluation team conducted a billing analysis for 2018 and 2019 participants, examining weather-dependent gas usage across 2019 and 2020. This indicated heating EFLH values are approximately 32% less than TRM (2.2) values, and reduced savings for furnaces. We also applied these results to heat pump and boiler measures which also previously used TRM (2.2) heating EFLH values.

- Heating/cooling measures with ECMs: Electric energy savings are claimed for all furnaces with ECMs delivered to electric customers, comprising over half of claimed electric energy savings for the HVAC program. However, ECMs were largely required by code as of July 2019.[4,5] The evaluation team allowed for six months of sell-through by granting savings for all program year 2019 installs. But for program year 2020, only installs in 2019 and before were granted these savings. This dramatically reduced electric energy savings for this measure category and the HVAC program.

- Smart thermostats: The evaluation team conducted a billing analysis for 2018 and 2019 participants, examining weather-dependent gas usage across 2017 and 2018 (pre-install) and 2019 and 2020 (post-install). We found that gas base consumption values were like those observed as part of the furnace EFLH calculation. These were approximately 50% less than previously assumed for smart thermostat base load, which employed TRM (2.2) EFLH and assumed an 80% installed furnace AFUE. The measured gas savings percent was also approximately 50% less than previously assumed (5.4% vs. approximately 10.3%), which was a weighted average leveraging results from a 2015 study.[6] The revealed cooling savings fraction was also approximately 50% less than assumed for the 2019 program year (8.3% vs. approximately 15%).

  In addition, for smart thermostats we applied an adjustment to correct an error in the program year 2019 evaluation. In 2019, inappropriate heating and cooling savings factors were applied to the fraction of homes upgrading from programmable to smart thermostats. These homes incorrectly received the heating savings factor for homes that upgraded from a manual to a programmable thermostat. These homes should have received a heating savings factor of 5.6% and not 7.8%. The same error occurred for cooling savings fraction—the value employed was 15.0%, but 1.1% should have been applied. More details on this can be seen in the Smart and Wi-Fi Thermostats, 2019 Program Year Adjustment section.

- Measures that rely on efficiency metrics: We applied the same deemed savings values to measures that have individual efficiency ratings (i.e., AFUE, SEER, HSPF, UEF, etc.), in *ex ante* calculations. However, as

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[4]Electronic Code of Federal Regulations. Title 10, Chapter II, Subchapter D, Part 430, Subpart C, §430.32. Table 1—Energy Conservation Standards for Covered Residential Furnace Fans. https://www.ecfr.gov/cgi-bin/text-idx?SID=0423028877ce42bb0c3e0e2529ac80ba&mc=true&node=se10.3.430_132&rgn=div8

[5]Regulations.gov. 2014-07-03 Energy Conservation Program for Consumer Products: Energy Conservation Standards for Residential Furnace Fans; Final Rule. Table I.1. https://www.regulations.gov/document?D=EERE-2010-BT-STD-0011-0117

[6] Cadmus. Evaluation of the 2013-2014 Programmable and Smart Thermostat Program. Prepared for: Northern Indiana Public Service Company. January 22, 2015.

these values change for high saving measures like water heaters or air conditioners, the *ex post* savings calculations can vary greatly from the *ex ante*. The evaluation team uses semi-custom, equipment-level calculations to find the individual savings values. This will drastically alter realization rates measure to measure and year to year.

- Water heaters: The code-required UEF varies based on water heater type and is a direct function of tank volume for storage water heaters. The evaluation team applied an appropriate baseline UEF and rated efficient UEF for each delivered water heater model.

TABLE 21. 2020 HVAC REBATE NOTABLE DIFFERENCES BETWEEN *EX ANTE* AND *EX POST* GROSS

MEASURE	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST* GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
Furnace	*Ex ante* savings were calculated using HVAC Rebates 2018 EM&V results. AFUE was assumed based on TRM (2.2), and South Bend EFLH were used.	Billing analysis results for EFLH and information in program tracking data. Actual AFUE and capacity values were used to calculate *ex post* savings.	Billing analysis EFLH were approximately 30% less than TRM (2.2) EFLH, plus small differences due to using actual instead of assumed AFUE and capacity.
Furnace with ECM	*Ex ante* savings were calculated using HVAC Rebates 2018 EM&V results. AFUE was assumed based on TRM (2.2), and South Bend EFLH were used.	Billing analysis results for EFLH and information in program tracking data. Actual AFUE and capacity was used to calculate *ex post* savings. We removed electric savings for all units installed in 2020 (the majority of units).	Billing analysis EFLH were approximately 30% less than TRM (2.2) EFLH, plus small differences due to using actual instead of assumed AFUE and capacity. Most kWh savings removed because ECMs are required by code in 2020.
Air conditioners	*Ex ante* savings seemed to be calculated using the TRM (2.2). Heating and circulation motor savings were included for all sites.	TRM (2.2) and information in program tracking data. Assumed EER = 90% x SEER. Did not include heating and circulation motor savings for sites that also received a furnace with an ECM.	Most sites also received a furnace with an ECM, notably reducing savings. Also differences due to using actual instead of assumed SEER, EER, and capacity. Differences between assumed EERee (12.6) and approximate actual EERee (average 14.1) produced marked differences in reported and *ex post* gross demand reduction.
A/C tune-up	*Ex ante* savings were calculated using the TRM (v2.2). Used TRM capacity and SEER and assumed EER = 90% x SEER.	TRM (2.2) and information in program tracking data. Used average actual SEER and varied EFLH by closest city.	Small changes in EER can cause large changes in kW and kWh. Also used the closest city instead of simply South Bend for EFLH.
Boiler	*Ex ante* savings were calculated using the TRM (v2.2). Assumed 50 Btuh per square foot, a 1,700 square foot average home, and South Bend EFLH.	TRM (2.2) and information in program tracking data—actual capacity and AFUE. Used closest city EFLH.	Small differences due to using actual instead of assumed AFUE and capacity.
Boiler Tune-up	*Ex ante* savings were calculated using the TRM (v2.2). Assumed 50 Btuh per square foot, a 1,700 square foot average home, and South Bend EFLH.	TRM (2.2) and information in program tracking data—actual capacity and AFUE. Used closest city EFLH.	Small differences due to using actual instead of assumed AFUE and capacity.
ASHP	*Ex ante* savings seem to be calculated using the TRM (v2.2).[7]	TRM (2.2) for cooling EFLH, furnace billing analysis for heating EFLH. Used actual capacities and efficiencies.	*Ex post* and *ex ante* differ due to the use of actual capacities and efficiencies, plus updated EFLH.
Smart Thermostat	*Ex ante* savings may have been calculated using TRM (2.2) and a combination of 2016 and 2017 EM&V values. EFLH was assumed to be South Bend. Savings factors strictly follow the TRM (2.2), which assumes a manual thermostat baseline.	Therm savings directly from billing analysis results. For cooling savings, TRM (2.2) algorithm, with billing-analysis derived savings fraction. Used the closest city to get EFLH. The change in savings from an error correction in the 2019 program year evaluation was also applied, reducing savings.	Billing analysis indicated gas baseline consumption and savings much lower than those assumed in the TRM (2.2). It also revealed lower cooling savings fraction. When combined with the 2020 performance, the 2019 error correction reduced 2020 *ex post* gross thermostat savings by 40% for energy, 42% for demand, and 26% for therms.
Water Heater	*Ex ante* savings were calculated using the TRM (2.2). Used efficient EF of 0.67, 0.8, and 0.82 for the three measure types, and a baseline EF of 0.594.	TRM (2.2), using actual UEF efficient and most appropriate baseline values.	*Ex ante* and *ex post* differ because of using actual efficient UEF values and model-derived baseline UEF values.

[7] This measure category was not in the Res Measure calcs workbook.

BILLING ANALYSIS

For the 2020 program year, the evaluation team conducted two billing analyses that examined furnace and air conditioner EFLH and electric and gas savings for smart thermostat installations.

1. The EFLH analyses examined over a year of post-install monthly usage data for a robust sample of furnace and air conditioner customers to produce updated EFLH values.
2. The smart thermostat analyses examined a year of pre-install and a year of post-install for 2018 and 2019 program year thermostat customers to produce updated thermostat savings values.

EFLH BILLING ANALYSIS

The EFLH billing analysis examined 17,351 furnace and 1,401 air conditioner participants across the 2018 and 2019 program years and examined weather-normalized monthly gas and electric billing data across 2019 and 2020 for these participants. Using a PRISM modeling approach,[8] the analysis disaggregated the weather-sensitive components of heating gas, cooling electricity, and heating electricity usage in these time periods. The EFLH for each site were then proportional to *[weather-sensitive energy usage] / [equipment capacity in tracking data]*. Site-level EFLH values were arithmetically averaged to produce gas furnace heating EFLH for four TRM (2.2) cities. This produced reliable and reasonable results for gas heating that were approximately 32% less than the values in the TRM (2.2). These results are in-line with the EFLH values of cities with similar heating degree days in the Illinois Technical Reference Manual,[9] which are derived via a metering study and likely quite robust. Overall results can be found in Table 22.

It should be noted that we derived separate gas heating EFLH for the 2019 and 2020 usage years. While they were not statistically different, the 2020 values were approximately 3% to 4% less than the 2019 values.[10] This may be a result of the COVID-19 pandemic—perhaps increased internal gains due to occupants being home more often, and therefore less furnace use needed to heat the home. Therefore, the evaluation team used the 2020 values for the 2020 evaluation but recommends that the 2019 values be used for future years because they may be more indicative of a normal usage year. All billing analysis gas heating EFLH values, and a comparison to those in the TRM (2.2), can be seen in Table 241 and Table 242 in Appendix 1.

While gas heating results were reasonable, electric results indicated that air conditioner cooling EFLH were approximately 240% higher than the TRM (2.2). The EFLH values indicated were also significantly higher than those in cities with similar cooling degree days in the Illinois TRM,[11] which also anchors its cooling EFLH in site-metered results. This almost certainly reflects a preponderance of weather-sensitive usage that is not from the air

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[8] Fels, M. F., *PRISM: An Introduction,* Energy and Buildings. Vol. 9, No. 1 & 2, February/May 1986

[9] Illinois Energy Efficiency Stakeholder Advisory Group. *2021 Illinois Statewide Technical Reference Manual for Energy Efficiency Version 9.0. Volume 3: Residential Measures*. September 25, 2020. Page 93. https://ilsag.s3.amazonaws.com/IL-TRM_Effective_010121_v9.0_Vol_3_Res_09252020_Final.pdf

[10] Depending on if weighting by unit count per city or not.

[11] Ibid

conditioner and is a common occurrence for electric billing analyses.[12,13] Therefore we did not use the cooling values from the billing analysis and instead used the cooling EFLH from the TRM (2.2)

TABLE 22. EFLH BILLING ANALYSIS RESULTS AND RECOMMENDATIONS

ANALYSIS	TRM (2.2) VALUE	2019 RESULTS[A]	2020 RESULTS	CORROBORATING EVIDENCE	RECOMMENDED VALUE
Heating	Indianapolis: 1,341 EFLH South Bend: 1,427 EFLH Fort Wayne: 1,356 EFLH Terre Haute: 804 EFLH	915 EFLH 910 EFLH 1,005 EFLH 984 EFLH	917 EFLH 897 EFLH 936 EFLH 1,124 EFLH	Like values of cities with similar HDDs in the IL TRM	2020 Evaluation use the 2020 results; for planning use 2019 results.
Cooling	South Bend: 431 EFLH Fort Wayne: 373 EFLH Terre Haute: 569 EFLH	792 EFLH 1,032 EFLH 1,118 EFLH	959 EFLH 1,004 EFLH 987 EFLH	The EFLH values were significantly higher than those in cities with similar CDDs in the IL TRM	Use the IN TRM value for both the 2020 evaluation and for planning.

a. Note that we did not have enough sites to calculate heating or cooling for Evansville; we did not have enough sites to calculate cooling for Indianapolis.

THERMOSTAT BILLING ANALYSIS

The smart thermostat billing analysis was more complex. The team examined 1,206 gas and 736 electric customers who received thermostats across the 2018 and 2019 program years. It examined weather-normalized monthly gas and electric billing data across 2019 and 2020 for these participants (the post-install year), as well as 2017 and 2018 (the pre-install year), for each participant. Changes in usage before and after thermostat installation for these participants represent the aggregate effect of thermostat installation and exogenous effects such as changes in energy pricing. To control for these exogenous effects the team also examined usage across similar time periods for a comparison group comprised of *future* thermostat participants—a similar population that did not yet have a thermostat installed in the participant pre- or post-period. The net savings produced by thermostat installation is the difference in savings between the participants and the comparison group. A more detailed description of the methodology and approach for this billing analysis can be found in the Appendix. The overall results can be found in Table 23.

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[12] National Renewable Energy Lab. *The Uniform Methods Project, Chapter 4: Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling Equipment-Efficiency Upgrade Evaluation Protocol*. October 2017. https://www.nrel.gov/docs/fy17osti/68560.pdf

[13] Hwang, Ho-Ling. Assessment of Princeton Scorekeeping Method space-heating estimates using end-use data from the Hood River Conservation Project. https://www.osti.gov/biblio/6297772

TABLE 23. THERMOSTAT BILLING ANALYSIS RESULTS AND RECOMMENDATIONS

ANALYSIS	UNIT	DEEMED APPROACH	2019 RESULTS	2020 RESULTS	CORROBORATING EVIDENCE	RECOMMENDED VALUES
Heating	Base consumption	TRM EFLH, 80% AFUE (~1,300 therms average)	662 therms	654 therms	Base consumption values reasonable, and compatible with those for heating EFLH. Difference between 2019 and 2020 not statistically significant but may reflect COVID-19 pandemic effects.	Use 654 * 5.4% = 35 therms for PY2020. Use 662 * 7.1% = 47 therms for future years
Heating	ESF	TRM (2.2) [14] 12.5% (manual to smart) ESF, better deemed value [15] 13.4% (manual to smart) 7.8% (manual to programmable) 13.4% - 7.8% = 5.6% (programmable to smart) ~9.3% average	7.10%	5.40%		
Cooling	Base consumption	TRM EFLH, 11.15 SEER (~1,100 kWh average for sites with cooling)	2,899 kWh	2,610 kWh	Base consumption values compatible with those for cooling EFLH—both far higher than reasonable, due to non-AC weather-sensitive loads picked up by billing analysis.	Use deemed EFLH and SEER for base consumption, with 8.3% ESF for PY2020 and future years.
Cooling	ESF	TRM (2.2) [16] 13.9% (manual to smart) ESF, better deemed value [17] 16.1% (manual to smart) 15.0% (manual to programmable) 16.1% - 15.0 = 1.1% (programmable to smart) ~8.5% average	8.30%	8.30%		

Using the same PRISM modeling approach, the team disaggregated the weather-sensitive components of heating gas, cooling electricity, and heating electricity usage in these time periods. This quasi-experimental design allowed the team to examine the change in usage before and after installation for the participants, as well as changes for the comparison group over the same time. The difference between changes for the participants and comparison group reflects the net savings from installing a smart thermostat. Table 24 shows a summary of the treatment and comparison groups, and the time frames included in each analysis.

[14] Cadmus. Evaluation of the 2013-2014 Programmable and Smart Thermostat Program. Prepared for Vectren Corporation. January 29, 2015. http://www.cadmusgroup.com/wp-content/uploads/2015/06/Cadmus_Vectren_Nest_Report_Jan2015.pdf

[15] Cadmus. Evaluation of the 2013-2014 Programmable and Smart Thermostat Program. Prepared for: Northern Indiana Public Service Company. January 22, 2015.

[16] Cadmus. Evaluation of the 2013-2014 Programmable and Smart Thermostat Program. Prepared for Vectren Corporation. January 29, 2015. http://www.cadmusgroup.com/wp-content/uploads/2015/06/Cadmus_Vectren_Nest_Report_Jan2015.pdf

[17] Cadmus. Evaluation of the 2013-2014 Programmable and Smart Thermostat Program. Prepared for: Northern Indiana Public Service Company. January 22, 2015.

TABLE 24. TREATMENT AND COMPARISON GROUP TIMING

GROUP	PARTICIPATION TIMING	ANALYSIS PERIOD 1 (PRE)	ANALYSIS PERIOD 2 (POST)A	EXPECTED CHANGE PERIOD 1 TO 2
2018 Participants	2018	Rolling from Jan 2017 - Dec 2018	Rolling from Jan 2018 - Dec 2019	Program Savings + Non-Program Trend
2018 Comparison Group	Late 2019, All 2020	July 2017 - June 2018	July 2018 - June 2019	Non-Program Trend
2019 Participants	2019	Rolling from Jan 2018 - Dec 2019	Rolling from Jan 2019 - Dec 2020	Program Savings + Non-Program Trend
2019 Comparison Group	All 2017, Late 2020	August 2018 - July 2019	August 2019 - July 2020	Non-Program Trend

a. The participant sites all have rolling pre- and post-periods. Thus, the pre- and post- periods for nonparticipants are defined based on the average participation date. Each analysis year, 2018 and 2019, had their own control groups based on the average install dates in each year for better matching. The control group periods should closely resemble the average analysis period in each year but are not the same.[18]

As with the EFLH billing analysis, the model derived reliable and reasonable usage and savings for gas customers. We found that baseline consumption for smart thermostat customers was 50% less than estimated in previous evaluation years. Previous evaluation years used the TRM (2.2) EFLH and assumed an installed AFUE of 80%, producing baseline consumption values of ~1,300 therms. However, we found that the actual baseline consumption for smart thermostat participants was ~670 therms. This is likely a result of two main factors. First, as discussed above, measured heating EFLH are approximately 32% higher than TRM (2.2) values. Second, it is likely that average installed AFUE for smart thermostat participants is higher than the 80% value assumed in the 2019 evaluation, which further reduces actual gas energy usage.

We also found that heating savings fraction (HSF) were lower than the TRM (2.2) prescribes. Its prescribed HSF values are 13.4% for a manual to smart upgrade and 7.8% for a manual to programmable upgrade, indicating 13.4 – 7.8 = 5.6% for a programmable to smart upgrade. For the 2019 program year, the team combined these values with known baseline thermostat fractions, producing an approximate average savings fraction of 10.3%. However, the present billing analysis results show an HSF of approximately 5% to 7%. For sites that got only one thermostat the measured HSF is 7.1% for 2018 participants (2019 post year) and 5.4% for 2019 participants (2020 post year). The results are not statistically different (see Billing Analysis Methodology section in Appendix 1), but this difference may reflect an effect of the COVID-19 pandemic on behavior—likely increased occupancy during the pandemic, reducing savings.

The evaluation used the measured net savings for 2019 participants receiving one thermostat, with 2020 as a post-install year. These results were 35 therms saved per first thermostat at each site (5.4% of 654 therms base consumption). Sites that received two or more thermostats saw between 4% and 5% savings per household, although these results have worse confidence and precision because of lower participant counts and are not statistically different from savings for sites that received one thermostat. The evaluation team determined that sites that received more than one thermostat would only receive savings for the first thermostat. We made this decision because savings for sites receiving two or more thermostats were not statistically different from sites

[18] Cadmus. Evaluation of the 2013-2014 Programmable and Smart Thermostat Program. Prepared for Vectren Corporation. January 29, 2015. http://www.cadmusgroup.com/wp-content/uploads/2015/06/Cadmus_Vectren_Nest_Report_Jan2015.pdf;
Cadmus. Evaluation of the 2013-2014 Programmable and Smart Thermostat Program. Prepared for: Northern Indiana Public Service Company. January 22, 2015.

receiving only one thermostat and because of 2019 survey results indicating that secondary thermostats were all installed in the same home as the first.

Billing analysis results examining thermostat electric savings showed base consumption like that for cooling EFLH, indicating that the PRISM analysis produced baseline consumption that reflected a preponderance of weather-sensitive usage that is not controlled by the thermostat. Therefore, we did not update electric baseline consumptions based on the billing analysis and instead calculated from EFLH in the TRM (2.2). However, although the billing analysis produces higher estimates, these are expected to be consistently high between the pre and post periods. As a result, the billing analysis produces more reasonable and reliable results for cooling savings fraction (CSF) values. Findings varied from 6.6% to 9.2% depending on participant year and if they were percent savings per thermostat for all sites, or just for sites receiving only one thermostat. No results were statistically different from any others.

The team elected to use a CSF of 8.3% which is the result for sites that got one thermostat for both 2018 and 2019 participants. More detail can be seen in the Billing Analysis Methodology section in Appendix 1. This value is not statistically different from the value of approximately 8.5% that would have been applied (see Smart and Wi-Fi Thermostats, 2019 Program Year Adjustment section). However, that value would have been rooted in results from an older study[19] and dependent on assumptions about baseline thermostat distributions. The updated value is likely more representative of the current thermostat participant population.

ENGINEERING REVIEWS

In this section we provide descriptions of the engineering analysis that we ran for each measure category. A detailed description of the engineering analysis methodology is in Appendix 1.

FURNACES

The program tracking data contained 692 furnaces without ECM motors and 3,415 furnaces with ECMs for gas only customers. There was a total of 4,107 rebated furnaces. Evaluated unit therm savings range from 40 to 266 therms, with an average value of 133 therms. The *ex ante* data assigned deemed savings of 196 therms for furnaces without an ECM and 207 therms for furnaces with an ECM, which are close to evaluated savings in program year 2019. The overall natural gas realization rate for this measure category is 65%. This stems largely from reduced EFLH values based on billing analysis results, and likely somewhat from shifting furnace capacity and efficiency.

FURNACES WITH ECMS

In 2020, NIPSCO electric customers installed 3,183 furnaces with ECMs. Blower fan ECM savings amount to about 55% of claimed electric savings in program year 2020.

As of July 3, 2019, the U.S. Department of Energy required residential-sized furnace blower motors to meet a fan energy ratio (FER) performance standard that can generally only be met by ECMs. For program year 2019, ECM savings were passed through for the entire program year, assuming six months of sell-through. However, for program year 2020 the team only granted ECM savings for the 744 furnaces with ECMs installed before calendar year 2020. Of those, 178 were installed with new air conditioning units through the program and received reduced

[19] Cadmus. Evaluation of the 2013-2014 Programmable and Smart Thermostat Program. Prepared for: Northern Indiana Public Service Company. January 22, 2015.

savings because the cooling portion of ECM savings for these units was being accounted for in the air conditioner upgrade. The overall electric energy realization rate for this measure category is 22%.

The TRM (2.2) does not claim any summer peak demand reduction for ECMs. However, the evaluation team did credit savings for summer peak demand reduction since reduced consumption during summer months will reduce fan use. We only applied this demand reduction to sites that received a new furnace before 2020, and not both a furnace and an A/C. The overall demand reduction realization rate for this measure category is 18%.

Natural gas savings employed EFLH values from the billing analysis and actual installed AFUE and capacity values and resulting overall gas savings realization rate for this measure category is 63%.

AIR CONDITIONERS

The evaluation team produced a weighted baseline SEER that blends federal code for broken unit replacements and building stock findings for working replacements. The 2018 participant survey, based on 67 responses, determined that 23% of participants replaced broken units and 77% replaced working units. We used the 2018 survey results because we only received 19 responses to these questions in the 2020 survey. Cooling savings range from 156 kWh to 1,176 kWh, averaging 423 kWh. Small changes in SEER can cause large changes in kWh, which is likely the reason for the large *ex post* and *ex ante* kW discrepancy.

Of the 1,271 delivered air conditioner measures, 943 (77%) were installed alongside a furnace measure. Non-cooling ECM savings are accounted for in the furnace measure savings for those sites. For the other 328 units, an additional 335 kWh of savings from ECM operation in heating and circulation mode are added. Unlike the furnace with ECM measure category where the baseline is a code-required ECM, here the baseline is the stock motor installed with the existing furnace, assumed to be a PSC motor.

The *ex ante* data shows deemed savings values for all air conditioners of 536 kWh; however, the average *ex post* unit energy savings is 423 kWh, so the energy realization rate for this measure category is 79%.

The evaluation team used the formula EER = 0.9 * SEER to calculate demand reduction. This produced an average efficient EER of approximately 14.1, as opposed to the efficient EER value of 12.6 used to calculate reported demand reduction. Resulting demand reduction realization rate is 184%.

AIR CONDITIONER TUNE-UP

The evaluation team calculated the requisite algorithm inputs (Btuh and SEER) by taking the average of the available data and extrapolating it across all the tune-ups; for other inputs, we used the TRM to find location specific values. Evaluated savings range from 25 kWh to 82 kWh, averaging 43 kWh—lower than the reported savings of 56 kWh, for a realization rate of 77% for this measure category. Demand reduction realization rate was 77% because the reported savings employed an EER of ten but evaluated savings employed the actual or average EER of installed units, approximately 14.1—a higher base efficiency reduces savings for tune-up measures.

SMART AND WI-FI THERMOSTATS, 2020 PROGRAM YEAR

Several evaluated savings cases exist within the smart and wi-fi thermostat measure, and each was established within the measure name, with delivered unit population splits shown in the Appendix.

TABLE 25. HVAC CONFIGURATIONS FOR THERMOSTAT MEASURES AND *EX ANTE* SAVINGS

MEASURE NAME-DEFINED CONFIGURATION	COUNT OF UNITS[A]	*EX ANTE* UNIT SAVINGS kWh	kW	THERMS
Natural gas heat with no air conditioner	1,683	0.00	0.000	132.55
Natural gas heat with air conditioner	1,716	155.78	0.177	132.55
Air conditioner only, propane / other heat	18	155.78	0.177	0
Electric resistance heating with air conditioner	16	4,040.56	0.177	0
Electric resistance heating with no air conditioner	3	3,884.78	0	0
Heat pump	3	1,023.36	0.219	0

[a] These quantities reflect physical unit counts, and therefore may not match the scorecard, which counted both fuel types for dual-fuel measures.

The thermostat billing analysis examined all 2018 and 2019 participants, revealing net gas savings of 35 therms (5.4%) and net cooling electric energy savings of 8.3%. The 35 therms gas savings value was applied for all sites with gas heat. In future years we recommend that the billing analysis findings of 47 therms savings (HSF = 7.1%) are applied, as these may be more representative of behavior not impacted by COVID-19. For sites with air conditioning or heat pumps, the TRM cooling EFLH values were applied along with the average air conditioning and heat pump cooling capacities from those measure groups, and the 8.3% CSF from the billing analysis was applied. For sites with heat pump or electric resistance heat, the average furnace capacity was applied and converted to a kW capacity, billing analysis heating EFLH were applied, and the billing analysis HSF of 5.4% was applied.

The 3,439 program thermostats were delivered to 3,288 sites; with 151 thermostats (4.4%) being second thermostats delivered to a given site. The evaluation team investigated the behavior of customers who received more than one thermostat for NIPSCO's 2019 program year. In the 2019 evaluation, the evaluation team obtained survey responses for 58 participants who received two thermostats and found that all of them were using both thermostats to control their homes' HVAC systems. However, the billing analysis did not show that sites receiving more than one thermostat saw savings that were statistically different from those receiving only one.[20] However, because NIPSCO thermostats were not found to be given away to adjacent sites, second thermostats are granted no savings. Note that in the 2018 program year 5.8% of thermostats were second thermostats at a given site, and that number for the 2019 program year was 4.7%.

The overall kWh realization rate for this measure category is 57%, the overall kW realization rate is 66%, and the overall natural gas realization rate is 25%.

SMART AND WI-FI THERMOSTATS, 2019 PROGRAM YEAR ADJUSTMENT

After further review of the 2019 program year findings and the report upon which its thermostat savings fractions were derived,[21] a necessary correction was discovered. The report showed savings fractions for two install scenarios: upgrading from a manual thermostat to a smart thermostat and upgrading from a manual thermostat to a programable thermostat. The savings fractions for the latter scenario were applied directly to the scenario of a programmable to a smart upgrade, as seen in Table 26.

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[20] Results such as these have been observed before in other programs and if there is evidence that second thermostats are given away to other homes, they may be granted some savings.
Cadmus. *2019 Evaluation, Measurement, and Verification Final Report*. Prepared for: Dayton Power and Light. May 6, 2020. PDF page 218, Cadmus report page 56. http://dis.puc.state.oh.us/DocumentRecord.aspx?DocID=762b0518-9da9-459b-9ef1-d8026bcc147f

[21] Cadmus. Evaluation of the 2013-2014 Programmable and Smart Thermostat Program. Prepared for: Northern Indiana Public Service Company. January 22, 2015.

TABLE 26. SAVINGS FRACTIONS USED IN THE 2019 EVALUATION

BASELINE THERMOSTAT	2019 COUNT OF UNITS[a]	2019 % OF KNOWN UNITS	ESF_C	ESF_H	ESF SOURCE / NOTE
Manual	159	50%	16.1%	13.4%	2015 NIPSCO study
Programmable	149	47%	15.0%	7.8%	2015 NIPSCO study
Wi-Fi	12	4%	0.0%	0.0%	Assume 0% savings for upgrade from Wi-Fi to smart; many delivered thermostats are Wi-Fi and receive same evaluated savings as smart
Unknown	1,898	-	15.0%	10.3%	Weighted average of above ESFs based on known baseline thermostat type unit counts

[a] These quantities reflect physical unit counts, and therefore may not match the scorecard, which counted both fuel types for dual-fuel measures.

However, the 15.0% and 7.8% values should only have been applied to manual to programmable upgrades. For the 2019 program year evaluation, the 2015 report findings should have been adapted for a scenario where a programmable thermostat is upgraded to a smart thermostat. They should have been approximated by calculating the difference between a manual to smart and manual to programmable upgrade. This would have produced the savings fractions seen in Table 27.

TABLE 27. CORRECT SAVINGS FRACTIONS FOR 2019 EVALUATION

BASELINE THERMOSTAT	2019 COUNT OF UNITS[a]	2019 % OF KNOWN UNITS	ESF_C	ESF_H	ESF SOURCE / NOTE
Manual	159	50%	16.1%	13.4%	2015 NIPSCO study
Programmable	149	47%	1.1%	5.6%	Approximation from 2015 NIPSCO study: ESF_C = 16.1% - 15.0% = 1.1% and ESF_H = 13.4% - 7.8% = 5.6%.
Wi-Fi	12	4%	0.0%	0.0%	Assume 0% savings for upgrade from Wi-Fi to smart; many delivered thermostats are Wi-Fi and receive same evaluated savings as smart
Unknown	1,898	-	8.5%	9.3%	Weighted average of above ESFs based on known baseline thermostat type unit counts

[a] These quantities reflect physical unit counts, and therefore may not match the scorecard, which counted both fuel types for dual-fuel measures.

With this correction, overall thermostat cooling savings for the 2019 program year drop significantly, and heating savings drop slightly. These changes can be seen in Table 28. The 2020 program year savings have been adjusted to correct for this.

TABLE 28: EVALUATED AND CORRECTED THERMOSTAT SAVINGS FOR 2019 PROGRAM YEAR

METRIC	REPORTED SAVINGS	2019 EVALUATED SAVINGS	2019 EVALUATED REALIZATION RATE	2019 CORRECTED SAVINGS	2019 CORRECTED REALIZATION RATE
Electric Energy Savings (kWh/yr)	197,057.40	200,768.47	102%	122,293293.63	62%
Peak Demand Reduction (kW)	340.290290	188.900900	56%	103.018018	30%
Natural Gas Energy Savings (therms/yr)	290,815	293,352.11	101%	264,003.15	91%

AIR SOURCE HEAT PUMPS

Evaluated savings varied from 419 kWh to 1,976 kWh, averaging 1,105 kWh. The evaluation team used EFLH values from the TRM and AHRI-verified capacities and efficiencies for this analysis. Using the AHRI-verified SEER made *ex post* vary widely from the *ex ante*. Evaluated demand reduction ranged from 0 kW to 0.36 kW, averaging 0.147kW—three units had AHRI-verified EER values that were less than the assumed baseline EER of 11, from the TRM (2.2). The *ex ante* savings used a deemed value of 1,186.86 kWh, and the realization rate for electric energy savings was 93%. Some variance between *ex ante* and *ex post* savings was likely caused by the evaluation team's use of actual values for CAP, $SEER_{EE}$, and $HSPF_{EE}$. *Ex ante* savings were a deemed value of 0.714 kW, and the peak demand realization rate for this measure category was 21%.

WATER HEATERS

The evaluation team applied an appropriate baseline UEF for each delivered water heater model, based on tank size and draw pattern as determined from the AHRI database for that model. The team also used its actual rated efficient UEF to calculate savings. The resulting average evaluated unit therm savings were 37.70 therms, compared to an average *ex ante* value of 42.20 therms, for a realization rate of 89% for this measure category.

BOILERS

There were 77 boiler measures delivered as part of the program in 2020. These measures followed an algorithm like the furnace measures, including using 2020 furnace billing analysis results for EFLH. The TRM (2.2) assumes the same EFLH for boilers and furnaces; any offset between TRM (2.2) and billing analysis results for furnaces likely applies to boilers as well. The resulting realization rate is 132% for this measure, largely because the evaluation team used actual AFUE and capacities to calculate savings.

BOILER TUNE-UP

The algorithm in the TRM assumes a boiler size of 77,386 Btuh but the average size of delivered units for the efficient boiler measure category was 106,236 Btuh. Instead of the TRM we used the tracking data value when available, and the average tracking data value when not. Evaluated savings average 48 therms, and the overall realization rate for this measure category is 97%.

REALIZATION RATES

The next four tables (Table 29 – Table 32) show the program's *ex ante* reported savings, verified savings, and *ex post* gross savings program and measure level. Please note that smart thermostat realization rates are shown both with and without the 2019 correction, to show performance just for program year 2020. Savings reported for the overall program in 2020 do include this correction.

TABLE 29. 2020 HVAC REBATE PROGRAM MEASURE LEVEL REALIZATION RATES

MEASURE	kWh	kW	Therms
Furnace	-	-	65%
Furnace w/ ECM	22%	18%	63%
Air Conditioner	79%	184%	-
Air Conditioner Tune-up	77%	77%	-
Boiler	-	-	132%
Boiler Tune-up	-	-	110%
ASHP	93%	21%	-
Smart Thermostat, Without 2019 Correction	57%	66%	25%
Smart Thermostat, With 2019 Correction	34%	38%	19%
Water Heater	-	-	89%

TABLE 30. 2020 HVAC REBATE PROGRAM *EX ANTE* AND *EX POST* GROSS ELECTRIC ENERGY SAVINGS

MEASURE	*EX ANTE*[a] ELECTRIC ENERGY SAVINGS (kWh/yr)	AUDITED GROSS ELECTRIC ENERGY SAVINGS (kWh/yr)	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (kWh/yr)	*EX POST* GROSS ELECTRIC ENERGY SAVINGS (kWh/yr)
Furnace	0.00	0.00	0.00	0.00
Furnace w/ ECM	1,320,945.00	1,320,530.00	1,320,530.00	297,069.70
Air Conditioner	681,853.37	681,853.37	681,853.37	537,882.73
Air Conditioner Tune-up	25,498.20	25,049.88	25,049.88	19,534.21
Boiler	0.00	0.00	0.00	0.00
Boiler Tune-up	0.00	0.00	0.00	0.00
ASHP	7,121.16	7,121.16	7,121.16	6,630.25
Smart Thermostat	349,495.90	349,495.90	349,495.90	198,216.98
2019 Smart Thermostat Correction	0.00	0.00	0.00	-78,474.84
Water Heater	0.00	0.00	0.00	0.00
Total Savings	2,384,913.63	2,384,050.31	2,384,050.31	980,859.03
Total Program Realization Rate				41%

Note: Totals may not sum properly due to rounding.

[a] Values presented at a measure-level represent Audited values, since the scorecard provides only savings totals.

TABLE 31. 2020 HVAC REBATE PROGRAM *EX ANTE* AND *EX POST* GROSS PEAK DEMAND REDUCTION

MEASURE	*EX ANTE* PEAK DEMAND REDUCTION (kW/yr) [a]	AUDITED GROSS PEAK DEMAND REDUCTION (kW/yr)	VERIFIED GROSS PEAK DEMAND REDUCTION (kW/yr)	*EX POST* GROSS PEAK DEMAND REDUCTION (kW/yr)
Furnace	0.000	0.000	0.000	0.000
Furnace w/ ECM	187.797	187.738	187.738	33.455
Air Conditioner	551.614	551.614	551.614	1,014.531
Air Conditioner Tune-up	57.785	56.769	56.769	44.331
Boiler	0.000	0.000	0.000	0.000
Boiler Tune-up	0.000	0.000	0.000	0.000
ASHP	4.284	4.284	4.284	0.884
Smart Thermostat	310.407	310.407	310.407	203.729
2019 Smart Thermostat Correction	0.000	0.000	0.000	-85.882882
Water Heater	0.000	0.000	0.000	0.000
Total Savings	1,111.887	1,110.812	1,110.812	1,211.048
Total Program Realization Rate				109%

Note: Totals may not sum properly due to rounding.

[a] Values presented at a measure-level represent Audited values, since the scorecard provides only savings totals.

TABLE 32. 2020 HVAC REBATE PROGRAM *EX ANTE* AND *EX POST* GROSS NATURAL GAS SAVINGS

MEASURE	*EX ANTE* NATURAL GAS ENERGY SAVINGS (therms/yr) [a]	AUDITED GROSS NATURAL GAS ENERGY (therms/yr)	VERIFIED GROSS NATURAL GAS ENERGY SAVINGS (therms/yr)	*EX POST* GROSS NATURAL GAS ENERGY SAVINGS (therms/yr)
Furnace	841,427.66	841,427.66	841,427.66	545,200.91
Furnace w/ ECM	658,053.42	657,846.68	657,846.68	412,691.10
Air Conditioner	0.00	0.00	0.00	0.00
Air Conditioner Tune-up	0.00	0.00	0.00	0.00
Boiler	12,754.28	12,754.28	12,754.28	16,808.95
Boiler Tune-up	297.64	255.12	255.12	287.64
ASHP	0.00	0.00	0.00	0.00
Smart Thermostat	450,537.45	450,537.45	450,537.45	113,820.00
2019 Smart Thermostat Correction	0	0	0	-29,348.96
Water Heater	11,563.53	11,563.53	11,563.53	10,329.03
Total Savings	1,974,633.98	1,974,384.72	1,974,384.72	1,069,788.66
Total Program Realization Rate				54%

Note: Totals may not sum properly due to rounding.
[a] Values presented at a measure-level represent Audited values, since the scorecard provides only savings totals.

In Table 33 we present the per unit *ex ante* and *ex post gross* savings for each discrete measure type.

TABLE 33. 2020 HVAC REBATE PROGRAM *EX ANTE* AND *EX POST GROSS* PER MEASURE SAVINGS

MEASURE	*EX ANTE*			*EX POST GROSS*		
	ELECTRIC ENERGY SAVINGS (kWh/YR)	PEAK DEMAND REDUCTION (kW)	NATURAL GAS ENERGY SAVINGS (THERMS/YR)	ELECTRIC ENERGY SAVINGS (kWh/YR)	PEAK DEMAND REDUCTION (kW)	NATURAL GAS ENERGY SAVINGS (THERMS/YR)
Air Conditioner 15+ SEER	536.47	0.434	-	423.20	0.798	-
Air Conditioner Maintenance/Tune-Up	56.04	0.127	-	43.70	0.099	-
Boiler Tune-Up	-	-	42.52	-	-	47.94
Heat Pump with ECM	1,186.86	0.714	-	1,105.04	0.147	-
Natural Gas Boiler - 92% AFUE	-	-	165.64	-	-	218.30
Natural Gas Condensing Water Heater (0.80 EF)	-	-	50.97	-	-	26.68
Natural Gas Furnace - 95% AFUE	-	-	195.68	-	-	121.31
Natural Gas Furnace - 95% AFUE with ECM - Electric and Gas Savings	415.00	0.059	206.74	93.36	0.011	129.70
Natural Gas Furnace - 95% AFUE with ECM - Gas Only	-	-	206.74	-	-	135.07
Natural Gas Tankless Water Heater (whole house; 0.82 EF)	-	-	54.56	-	-	52.45
Natural Gas Water Heater (0.67 EF)	-	-	22.45	-	-	14.93
Smart Wi-Fi Programmable Thermostat - Electric Cooling and Gas Heating Savings	155.78	0.177	132.55	102.24	0.116	32.86
Smart Wi-Fi Programmable Thermostat - Electric Cooling and Heating Savings	4,040.56	0.177	-	1,074.79	0.116	-
Smart Wi-Fi Programmable Thermostat - Electric Cooling Only Savings	155.78	0.177	-	95.48	0.110	-
Smart Wi-Fi Programmable Thermostat - Electric Heating Only Savings	3,884.78	-	-	1,031.16	-	-
Smart Wi-Fi Programmable Thermostat - Gas Heating Only Savings	-	-	132.55	-	-	34.13
Smart Wi-Fi Programmable Thermostat - Heat Pump Savings	1,023.36	0.219	-	256.33	0.120	-

Note: these values do not include the 2019 correction. Instead, only include the 2020 *ex post gross* values.
Measure categories are expanded to match the Per Unit *Ex Post* Gross Savings values in the 2020 HVAC workbook.

EX POST NET SAVINGS

The team estimated freeridership and spillover for non-thermostat measures using survey data collected from 2020 participants. As shown in Table 34, the evaluation team estimated a 58% NTG ratio for equipment measures, 72% NTG ratio for smart thermostats and a 56% NTG ratio for tune-ups.

TABLE 34. 2020 HVAC REBATE PROGRAM EVALUATION NTG RESULTS – NON-THERMOSTAT MEASURES

MEASURE	RESPONSES (n)	FREERIDERSHIP[A]	PARTICIPANT SPILLOVER	NTG
Equipment Measures	99	42%	0%	58%
Smart Thermostats	100	30%	2%	72%
Air Conditioner Tune-Ups[b]	41	49%	5%	56%

a This score is an average weighted by survey sample *ex post* gross program MMBtu savings.

b While we did not have any respondents who received a boiler tune-up, we applied the same A/C tune-up freeridership, spillover, and NTG values to boiler tune-ups.

As discussed above, smart thermostat savings were estimated via billing analysis. Depending on the methodology used to develop a comparison group, some billing analysis results are inclusive of net savings.[22] In this case, the evaluation team used a future participant comparison group approach, which results in gross savings. Therefore, net savings are applied to the *ex post* billing analysis results for the smart thermostat measures.

FREERIDERSHIP

To determine equipment intention freeridership, the evaluation team asked participants questions about whether they would have installed equipment at the same efficiency level, at the same time, and in same amount in the HVAC Rebate program's absence. To determine air conditioner tune-up intention freeridership, the evaluation team asked participants about whether prior to participating in the NIPSCO program if they had a maintenance contract with a HVAC contractor that provided tune-ups, whether the contract covered the work necessary to receive the tune-up rebate from NIPSCO, and if the NIPSCO program had not provided tune-up rebate, when they would have had a tune-up service completed. By combining the previously used *intention* methodology with *influence* methodology, the evaluation team produced a freeridership score for the program by averaging savings-weighted *intention* and *influence* freeridership scores.

INTENTION FREERIDERSHIP

The evaluation team estimated *intention* freeridership scores for all participants, based on their responses to the *intention*-focused freeridership questions. Table 35 shows the 2020 HVAC Rebate program's *intention* freeridership scores for equipment measures, smart thermostats, and air conditioner tune-ups.

[22] Agnew, K., & Goldberg, M. (2013). *Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol; The Uniform Methods Project: Methods for Determining Energy Efficient Savings for Specific Measures.* Madison: National Renewable Energy Laboratory (NREL).

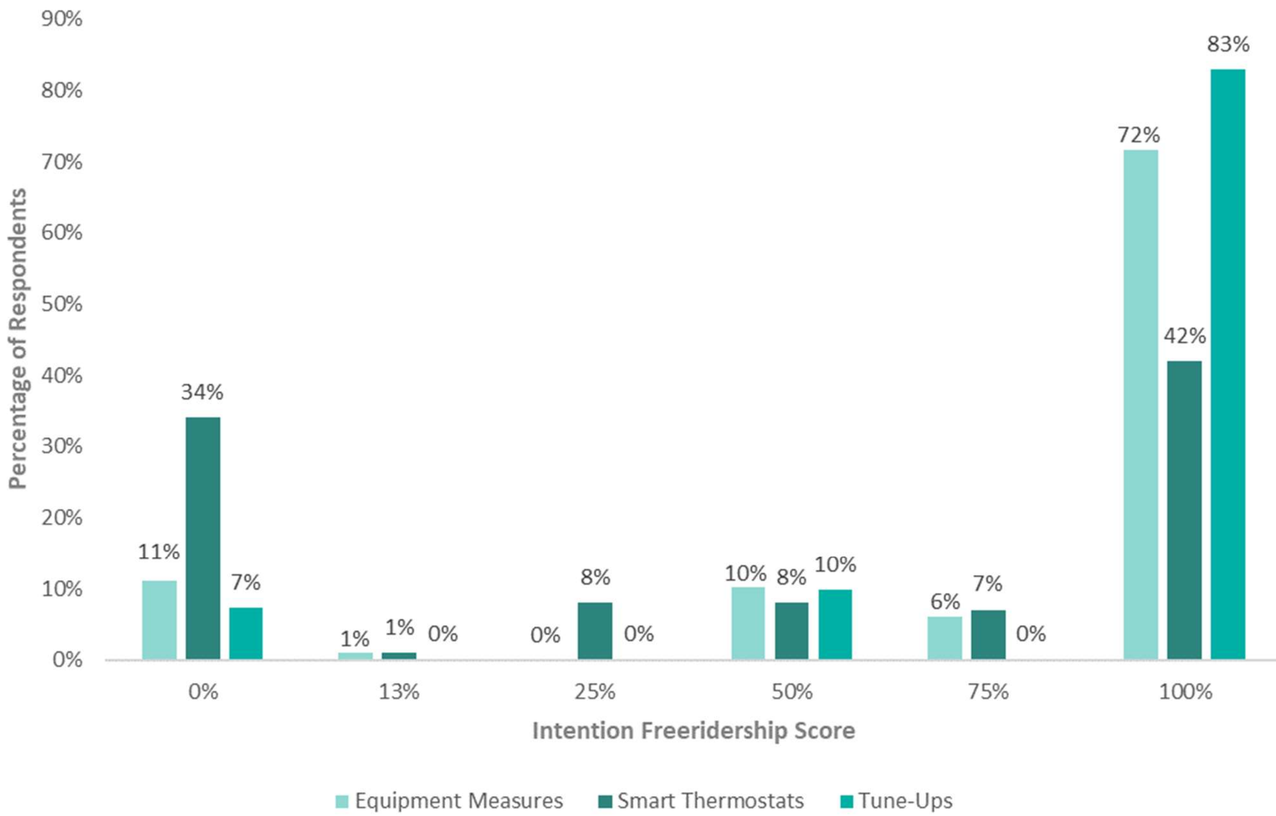
TABLE 35. 2020 HVAC REBATE PROGRAM *INTENTION* FREERIDERSHIP RESULTS – EQUIPMENT MEASURES, SMART THERMOSTATS AND AIR CONDITIONER TUNE-UPS

MEASURE	RESPONSES (N)	INTENTION FREERIDERSHIP SCORE (%)[A]
Equipment Measures	99	81%
Smart Thermostats	100	53%
Air Conditioner Tune-Ups [b]	41	88%

[a] The freeridership score was weighted by survey sample *ex post* gross program MMBtu savings
b While we did not have any respondents who received a boiler tune-up, we applied the same A/C tune-up freeridership, spillover, and NTG values to boiler tune-ups.

Figure 4 shows the distribution of individual intention freeridership scores for equipment.

FIGURE 4. 2020 HVAC REBATE PROGRAM DISTRIBUTION OF INTENTION FREERIDERSHIP SCORES – EQUIPMENT MEASURES (n=99), SMART THERMOSTATS (n=100), AND TUNE-UPS (n=41)



Source: Participant Survey. Questions: H1 to H9 are used to estimate an *intention* freeridership scores for equipment measures and smart thermostats. Questions: H10 to H15 are used to estimate an *intention* freeridership score for air conditioner tune-up measures.

INFLUENCE FREERIDERSHIP

The evaluation team assessed influence freeridership by asking participants how important various program elements were in their purchasing decision-making process.

Table 37 and Table 38 show the program elements participants rated for importance, along with a count and average rating for each factor. The evaluation team determined each respondent's influence freeridership rate using the maximum rating provided for any factor included.

TABLE 36. 2020 HVAC REBATE PROGRAM INFLUENCE FREERIDERSHIP RESPONSES – EQUIPMENT MEASURES (n=99)

INFLUENCE RATING	INFLUENCE SCORE	INFORMATION ABOUT THE PROGRAM FROM A CONTRACTOR	REBATE FOR THE MEASURE	INFORMATION ABOUT ENERGY EFFICIENCY THAT NIPSCO PROVIDED	PREVIOUS PARTICIPATION IN A NIPSCO ENERGY EFFICIENCY PROGRAM
1 - Not at all important	100%	4	6	7	21
2	75%	8	10	9	10
3	25%	21	30	35	16
4 - Very important	0%	57	45	31	13
Not Applicable / Don't Know	50%	9	8	17	39
Average Rating		**3.5**	**3.3**	**3.1**	**2.4**

TABLE 37. 2020 HVAC REBATE PROGRAM INFLUENCE FREERIDERSHIP RESPONSES – THERMOSTATS (n=100)

INFLUENCE RATING	INFLUENCE SCORE	INFORMATION ABOUT THE PROGRAM FROM A CONTRACTOR	REBATE FOR THE MEASURE	INFORMATION ABOUT ENERGY EFFICIENCY THAT NIPSCO PROVIDED	PREVIOUS PARTICIPATION IN A NIPSCO ENERGY EFFICIENCY PROGRAM
1 - Not at all important	100%	33	6	7	21
2	75%	7	7	12	14
3	25%	19	24	42	17
4 - Very important	0%	7	62	30	18
Not Applicable / Don't Know	50%	34	1	9	30
Average Rating		**2.0**	**3.4**	**3.0**	**2.5**

TABLE 38. 2020 HVAC REBATE PROGRAM INFLUENCE FREERIDERSHIP RESPONSES – TUNE-UPS (n=41)

INFLUENCE RATING	INFLUENCE SCORE	INFORMATION ABOUT THE PROGRAM FROM A CONTRACTOR	REBATE FOR THE MEASURE	INFORMATION ABOUT ENERGY EFFICIENCY THAT NIPSCO PROVIDED	PREVIOUS PARTICIPATION IN A NIPSCO ENERGY EFFICIENCY PROGRAM
1 - Not at all important	100%	0	3	3	5
2	75%	4	3	5	5
3	25%	14	12	18	12
4 - Very important	0%	18	23	12	7
Not Applicable / Don't Know	50%	5	0	3	12
Average Rating		**3.4**	**3.3**	**3.0**	**2.7**

As shown in Table 39, the respondents' maximum influence ratings ranged from 1 (not at all important) to 4 (very important). A minimum score of 1 meant the customer ranked all factors from the table as not at all important, while a maximum score of 4 means the customer ranked at least 1 factor very important. Counts refer to the number of "maximum *influence*" responses for each factor, or *influence* score, response option.

TABLE 39. 2020 HVAC REBATE PROGRAM INFLUENCE FREERIDERSHIP SCORE – EQUIPMENT MEASURES (n=99), SMART THERMOSTATS (n=100) AND TUNE-UPS (n=41)

MAXIMUM INFLUENCE RATING	INFLUENCE SCORE	EQUIPMENT MEASURES	SMART THERMOSTATS	TUNE-UPS
1 - Not at all important	100%	3	1	1
2	75%	2	4	0
3	25%	18	22	10
4 - Very important	0%	72	73	30
Not Applicable / Don't Know	50%	4	0	0
Average Maximum Influence Rating - Simple Average		**3.7**	**3.7**	**3.7**
Average Influence Score - Weighted by *Ex Post* Gross Savings		**2%**	**7%**	**9%**

The average influence scores of 2% for equipment measures, 7% for smart thermostats, and 9% for tune-ups are weighted by *ex post* gross MMBtu program savings.

FINAL FREERIDERSHIP

The evaluation team calculated the mean of *intention* and the *influence* of freeridership components estimate final freeridership for the 2020 HVAC Rebate program. A higher freeridership score translates to more savings that are deducted from the gross savings estimates. Table 40 lists the intention, influence, and final freeridership scores for the 2020 HVAC Rebate program.

TABLE 40. 2020 HVAC REBATE PROGRAM FREERIDERSHIP SCORE – EQUIPMENT MEASURES (n=99), SMART THERMOSTATS (n=100), AND TUNE-UPS (n=41)

MEASURE	INTENTION SCORE	INFLUENCE SCORE	FREERIDERSHIP SCORE
Equipment Measures	81%	2%	42%
Smart Thermostats	53%	7%	30%
Air Conditioner Tune-Up[a]	88%	9%	49%

a While we did not have any respondents who received a boiler tune-up, we applied the same A/C tune-up freeridership, spillover, and NTG values to boiler tune-ups.

PARTICIPANT SPILLOVER

The evaluation team estimated participant spillover[23] measure savings using specific information about participants determined through the evaluation using the Indiana TRM v2.2 as a baseline reference. The evaluation team estimated the percentage of program participant spillover by dividing the sum of additional spillover savings (as

[23] Non-participant spillover evaluation activities were not conducted for the 2020 program year.

reported by survey respondents[24]) by the total gross savings achieved by all survey respondents. The participant spillover estimates for the HVAC Rebate program, rounded to the nearest whole percent, can be seen in Table 41.

TABLE 41. 2020 HVAC REBATE PROGRAM PARTICIPANT SPILLOVER RESULTS – EQUIPMENT MEASURES (n=99), SMART THERMOSTATS (n=100), AND TUNE-UPS (n=41)

MEASURE	SPILLOVER SAVINGS (MMBtu)	PARTICIPANT PROGRAM SAVINGS (MMBtu)	PARTICIPANT SPILLOVER
Equipment Measures	1.8	1,283.3	0%
Smart Thermostats	7.5	350.6	2%
Air Conditioner Tune-Up[a]	0.3	6.1	5%

a While we did not have any respondents who received a boiler tune-up, we applied the same A/C tune-up freeridership, spillover, and NTG values to boiler tune-ups.

RESULTING NET SAVINGS

Table 42 presents the resulting net electric savings, demand reduction, and natural gas savings.

TABLE 42. 2020 HVAC REBATE PROGRAM *EX POST* NET SAVINGS

MEASURE	*EX POST* GROSS SAVINGS/REDUCTION			NTG	*EX POST* NET SAVINGS/REDUCTION		
	kWh	kW	therms		kWh	kW	therms
Furnace	0.00	0.000	545,200.91	0.58	0.00	0.000	316,216.53
Furnace w/ ECM	297,069.70	33.455	412,691.10	0.58	172,300.43	19.404	239,360.84
Air Conditioner	537,882.73	1,014.531	0.00	0.58	311,971.98	588.428	0.00
Air Conditioner Tune-up	19,534.21	44.331	0.00	0.56	10,939.16	24.825	0.00
Boiler	0.00	0.000	16,808.95	0.58	0.00	0.000	9,749.19
Boiler Tune-up	0.00	0.000	287.64	0.56	0.00	0.000	161.08
ASHP	6,630.25	0.884	0.00	0.58	3,845.54	0.513	0.00
Smart Thermostat	198,216.98	203.729	113,820.00	0.72	142,716.23	146.685	81,950.40
2019 Smart Thermostat Correction	-78,474.84	-85.882	-29,348.96	0.65	-51,008.65	-55.823	-19,076.83
Water Heater	0.00	0.000	10,329.03	0.58	0.00	0.000	5,990.83
Total Savings	980,859.03	1,211.048	1,069,788.66		590,764.69	724.032	634,352.04

Note: Totals may not sum properly due to rounding.

[24] The spillover measures attributed to the program are an energy efficient central air conditioner that did not receive a program rebate (equipment measure respondent) and an ENERGY STAR refrigerator (tune-up respondent).

Table 43 shows the NTG for each fuel.

TABLE 43. 2020 HVAC REBATE PROGRAM NTG RESULTS BY FUEL TYPE

SAVINGS TYPE	*EX ANTE* GROSS SAVINGS	*EX POST* GROSS SAVINGS	NTG RATIO (%)	*EX POST* NET SAVINGS
Electric Energy Savings (kWh/yr)	2,384,913.63	980,859.03	60%	590,764.69
Peak Demand Reduction (kW)	1,111.887	1,211.048	60%	724.032
Natural Gas Energy Savings (therms/yr)	1,974,633.98	1,069,788.66	59%	634,352.04

PROCESS EVALUATION

The evaluation team conducted a survey of HVAC rebate program participants and interviewed participating HVAC contractors to answer the following research questions:

- What affected customer decision making?
- How effective were program marketing efforts in driving participation?
- How satisfied were customers with the program?
- How familiar were participants with other NIPSCO energy efficiency programs?
- What opportunities exist for program improvement?
- What is the customer experience for those who install thermostats, other large HVAC equipment, or receive tune-ups?
- How has COVID impacted program participation and participant experience?

In the survey we focused heavily on the program process for those who purchased a rebated thermostat and those who received an A/C or boiler tune-up. Below the team provides detailed findings resulting from these activities.

PARTICIPANT FEEDBACK

The evaluation team surveyed 240 customers who participated in the program. To understand how participants may experience the program differently based on the type of measure they install, the evaluation team surveyed program participants who received thermostats, A/C or boiler tune-ups, and all other program measures (hereafter known as "HVAC" or "large HVAC equipment") to learn more about the program experience for each of these measure types. The number of responses by measure type is listed in Table 44.

TABLE 44. PARTICIPANT SURVEY DISPOSITION

INSTALLED MEASURE	RESPONSES
Thermostat	100
A/C or Boiler Tune-up	41
Large HVAC Equipment	99
TOTAL	240

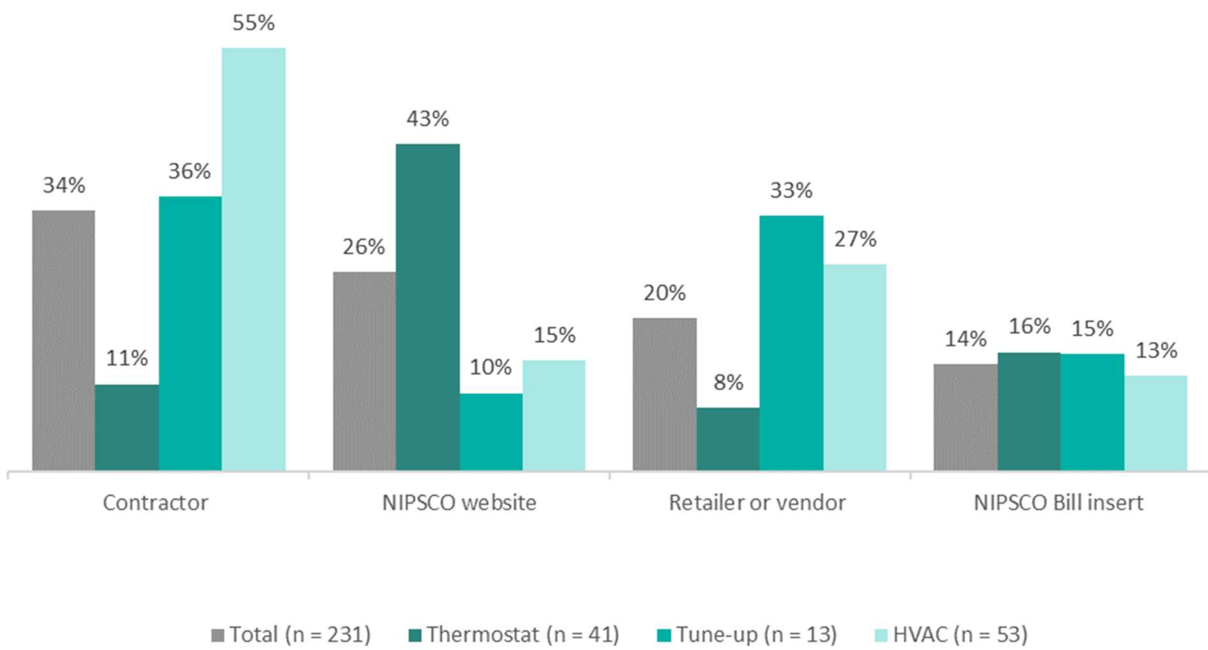
The following sections describe the results related to source of awareness, reasons for participation, participant experience in the program and variations depending on measure installed, satisfaction with the program, and the effects of the COVID-19 pandemic on customers.

ENERGY EFFICIENCY AWARENESS AND MARKETING

Survey respondents reported finding out about the HVAC Rebates program in various ways. The most common way respondents reported finding out about the program was through their contractor (34%), followed by the NIPSCO website (26%), and through a retailer or vendor (20%).

Program awareness varies slightly for each measure. The most common way tune-up and HVAC respondents heard about the program was through an existing contractor; 36% of tune-up and 55% of HVAC respondents heard about the program through their contractor. However, only 11% of thermostat participants found out about the program through a contractor. The most common way thermostat participants found out about the program was through the NIPSCO website (43%) (Figure 5).

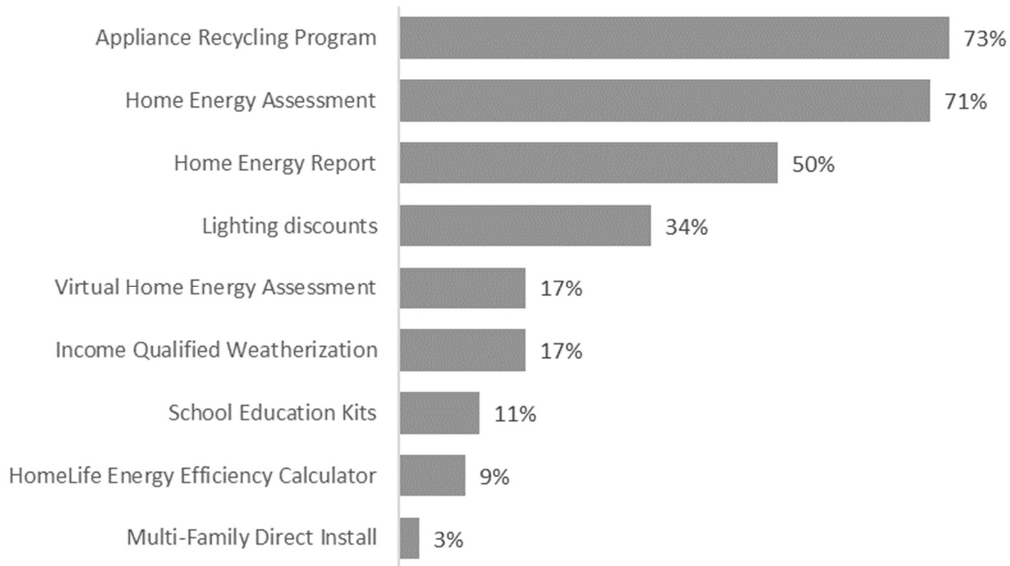
FIGURE 5. SOURCE OF PROGRAM AWARENESS BY MEASURE TYPE



Source: Participant survey. Question: "How did you learn about NIPSCO's Energy Efficiency Rebate Program?"

Survey respondents reported being aware of various other energy efficiency programs offered by NIPSCO. Over half (56%) of the respondents were aware that NIPSCO offers other energy efficiency programs. Of the respondents that have heard about other NIPSCO programs, the most common programs were the Appliance Recycling Program (73%), the Home Energy Assessment program (71%), and the Home Energy Report (50%) (Figure 6).

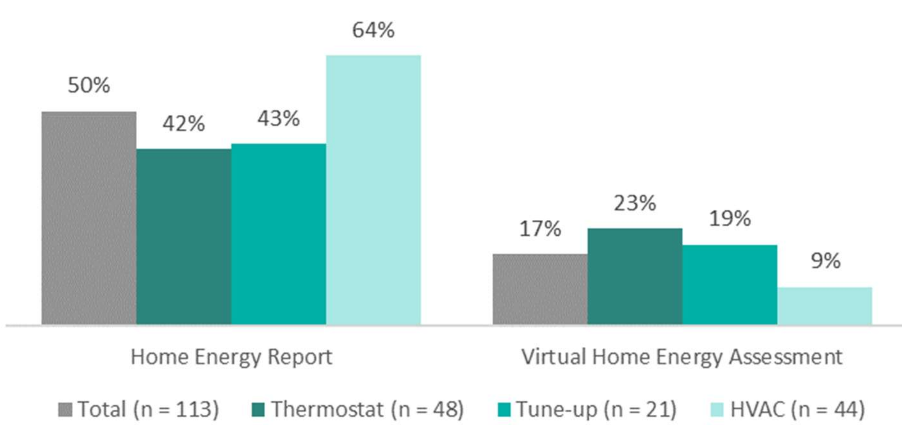
FIGURE 6. OTHER NIPSCO PROGRAM AWARENESS (N=113)



Source: Participant survey. Question: "What energy efficiency programs are you aware of?"

Program awareness varied slightly between thermostat and HVAC respondents. For example, 64% of HVAC respondents recall the Home Energy Report while only around 43% of thermostat respondents recall it. Conversely, 23% of thermostat respondents recall the virtual home energy assessment while only 9% of HVAC respondents recall it. The differences in program recall between the HVAC respondents and thermostat respondents is statistically significant at the 0.05 level (Figure 7).

FIGURE 7. PROGRAM AWARENESS BY MEASURE TYPE*

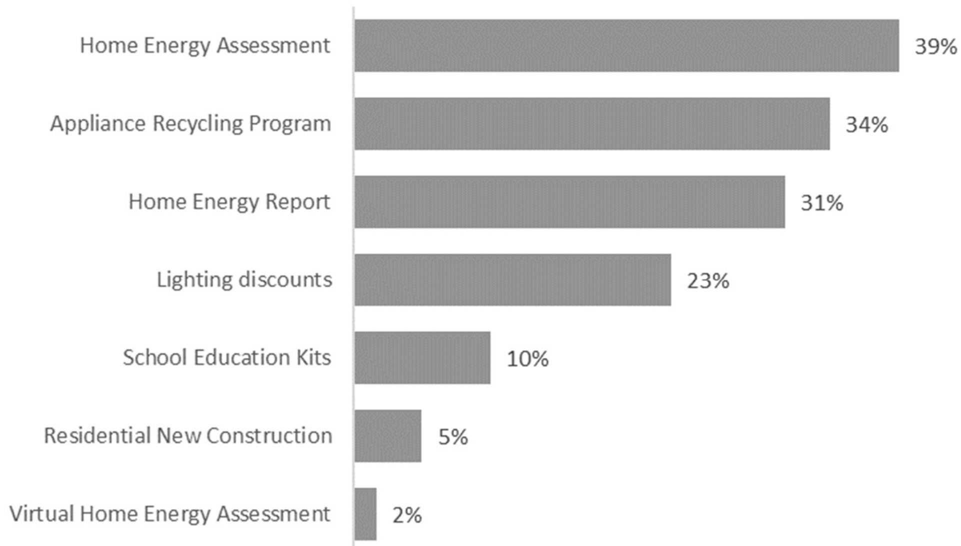


*The proportion of thermostat respondents was not significantly different from thermostat or HVAC participants

Source: Participant survey. Question: "What energy efficiency programs are you aware of?"

Of the respondents that reported being aware of other NIPSCO programs, 55% said they had participated in a NIPSCO energy efficiency program; 26% of all survey respondents said they had participated in a NIPSCO program in the past. The most common responses of past participation were the Home Energy Assessment (39%), Appliance Recycling Program (34%), and the Home Energy Report (31%) (Figure 8).

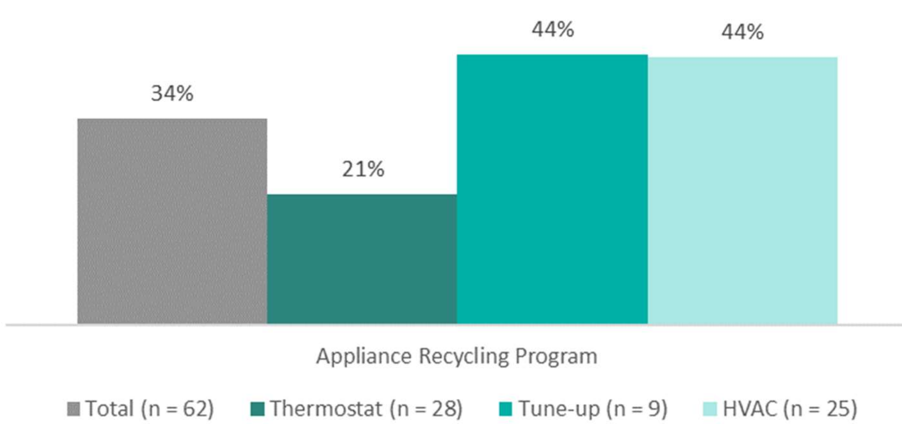
FIGURE 8. OTHER NIPSCO PROGRAM PARTICIPATION (N=62)



Source: Participant survey. Question: "Have you ever participated in any of the following programs?"

Significantly more HVAC respondents reported participating in the Appliance Recycling Program than thermostat respondents. Under half (44%) of HVAC respondents participated in Appliance Recycling Program while only 21% of thermostat respondents participated in Appliance Recycling Program. The difference between past program participation for HVAC respondents and thermostat respondents is statistically significant (Figure 9).

FIGURE 9. PROGRAM PARTICIPATION BY MEASURE TYPE*



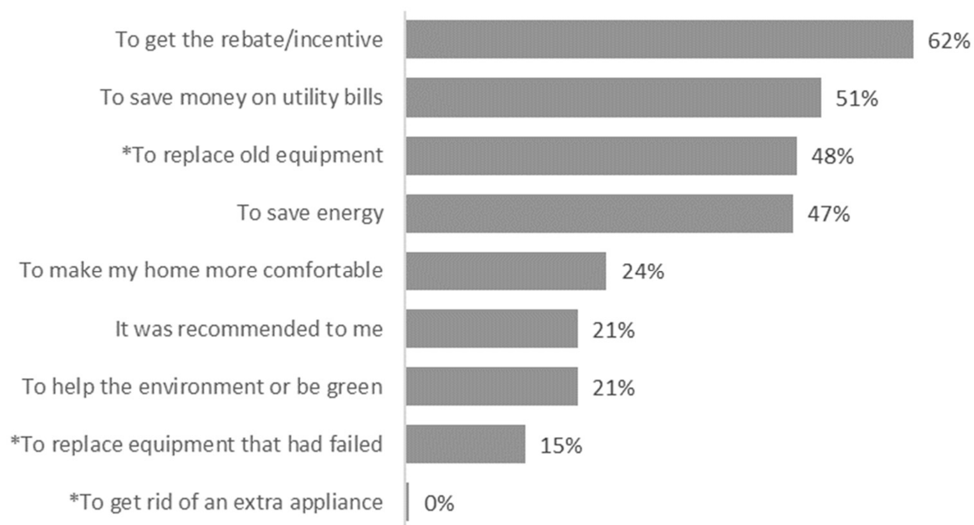
*The proportion of tune-up respondents was not significantly different from thermostat or HVAC participants

Source: Participant survey. Question: “Have you ever participated in any of the following programs?”

PARTICIPATION DRIVERS

Respondents most frequently reported they decided to participate in the program to receive the rebate (62%), save money on utility bills (51%), and replace old equipment (48%) (Figure 10). These reasons do not vary greatly by measure type.

FIGURE 10. REASON FOR PARTICIPATING IN PROGRAM (N=233)

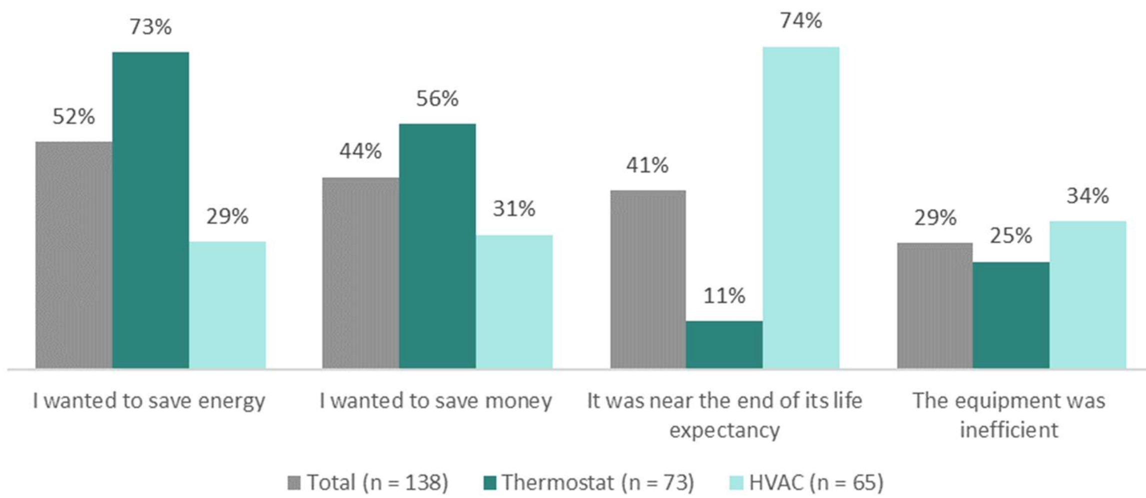


*These responses were only shown to HVAC and thermostat respondents.

Source: Participant survey. Question: “Why did you decide to participate in NIPSCO’s Energy Efficiency Rebate Program?”

Over half (58%) of HVAC and thermostat respondents reported the replaced unit was working well when they replaced it. Of the respondents that replaced HVAC equipment that was still working, 74% replaced their old unit because it was near the end of its life expectancy. Of the respondents that replaced a thermostat that was still working, 73% replaced their old unit because they wanted to save energy (Figure 11).

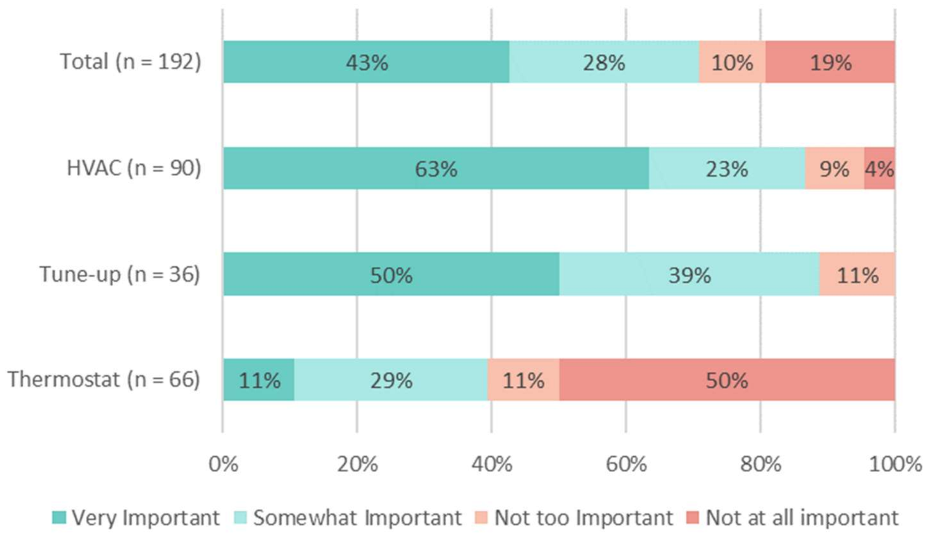
FIGURE 11. REASON FOR REPLACING EQUIPMENT BY MEASURE TYPE



Source: Participant survey. Question: “Why did you decide to participate in NIPSCO’s Energy Efficiency Rebate Program?”

Lastly, 71% of respondents reported the information about the program from a contractor was important in their decision to participate; 43% reported it was very important. Importance of the information the contractor provided varied by measure type (Figure 12). Only 11% of thermostat respondents reported the information from a contractor was very important for their participation, while 50% of tune-up and 63% HVAC participants reported information from a contractor to be very important. The proportions of respondents who think the contractor information was very important are statistically different between thermostats and tune-ups and thermostats and HVAC at the 0.05 level. Given the role contractors play in recommending and installing large HVAC systems, this is not unexpected, and further highlights the importance of an engaged and educated contractor network for programs like these.

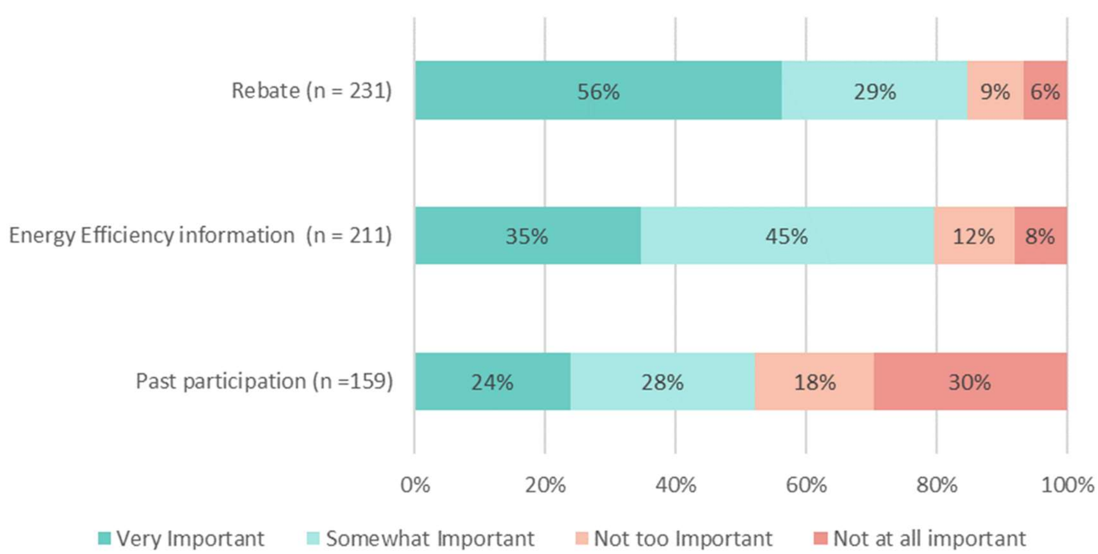
FIGURE 12. IMPORTANCE OF INFORMATION FOR PARTICIPATION



Source: Participant survey. Question: "Please rate the importance of the following elements on your decision to participate in this program: Information about the program from a contractor."

The top three most important reasons respondents reported participating in the HVAC rebates program were 1) the rebate (85%), 2) information about energy efficiency provided by NIPSCO (80%), and 3) past participating in a NIPSCO energy efficiency program (52%) (Figure 13). These reasons did not vary greatly by measure type.

FIGURE 13 IMPORTANCE OF REBATE, EE INFORMATION, AND PAST PARTICIPATION



Source: Participant survey. Question: "Please rate the importance of the following elements on your decision to participate in this program: rebate for the [MEASURE TYPE]; Information about energy efficiency that NIPSCO provided; Previous participation in a NIPSCO energy efficiency program"

PROGRAM AND MEASURE EXPERIENCE

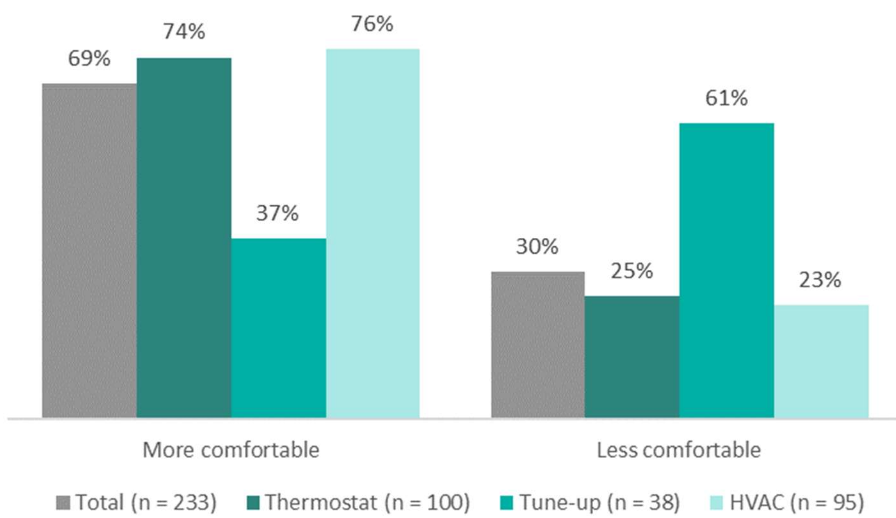
The following sections highlight the similarities and differences in the program experience by measure type.

GENERAL

There were some program aspects that each participant experienced regardless of measure type. We asked respondents to tell us about the perceived effect of installing the measure within their home, experience with their contractors (where applicable), experience with the rebates, and their general thermostat behavior.

First, we asked respondents about how their home's comfort has changed since participating in the program. Over two-thirds of respondents (69%) said that their home was more comfortable since participating in the program. There was a statistically significant difference between the proportion of thermostat and HVAC respondents and tune-up respondents who said their home was more comfortable since participating in the program (Figure 14). Nearly three-quarters of the thermostat (74%) and HVAC respondents (76%) reported their home being more comfortable while only one-third of tune-up respondents (34%) reported their home being more comfortable. Nearly two-thirds of tune-up respondents (61%) reported that they could not tell the difference in their home before and after the tune-up.

FIGURE 14. HOME COMFORT BY MEASURE TYPE

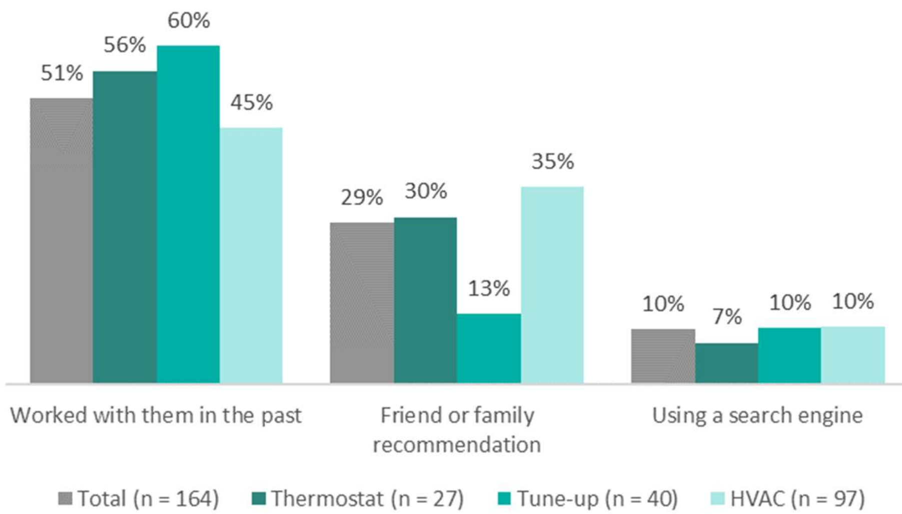


Source: Participant survey. Question: "Since participating in the program, would you say the comfort level in your home is…"

Second, all but one HVAC respondent used a contractor to install their measures and all tune-up respondents used a contractor to conduct their tune-ups (as per program requirements). Nearly one-third of thermostat respondents (28%) reported that contractors installed their thermostats.

Generally, around half of the respondents (51%) who reported using a contractor said they worked with an existing contractor to install the measure or conduct the tune-up. This varied slightly by measure type (Figure 15). About two-thirds of tune-up respondents reported using an existing contractor; 56% of thermostat respondents and 45% of HVAC respondents reported using an existing contractor. Respondents who did not work with a contractor they already had a relationship with found contractors via word of mouth and general web searching. Only one respondent mentioned finding their HVAC contractor via the NIPSCO website.

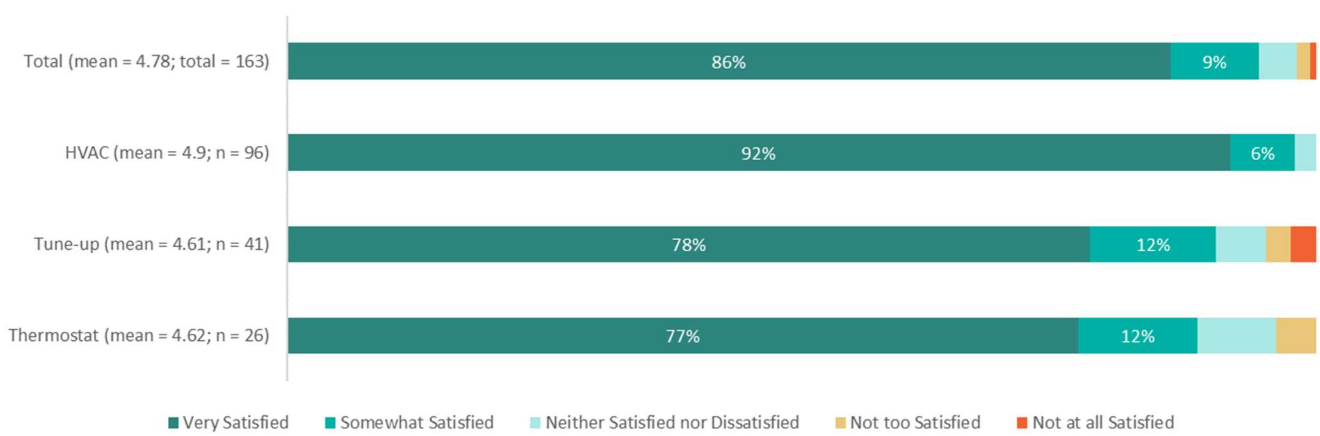
FIGURE 15. TOP THREE SOURCES FOR CONTRACTOR BY MEASURE TYPE



Source: Participant survey. Question: "How did you find your contractor?"

Most respondents (95%) reported that they are satisfied with their contractor; with 86% reporting that they are very satisfied. Respondents gave contractors a mean satisfaction score, on a scale of one to five, one being not at all satisfied and five being very satisfied, a 4.78 (Figure 16). One respondent said, "Our contractor was very good and helpful through everything for start to finish. We could not have received better service. We would highly recommend them to anyone." At the measure level, HVAC respondents had the highest proportion of respondents satisfied with their contractor at 98% with a mean score of 4.9. There is a statistically significant difference between the measure types in mean satisfaction with their contractor. Most respondents reported that there was not anything else the contractor could do or reported being generally satisfied (73%).

FIGURE 16. SATISFACTION WITH CONTRACTOR BY MEASURE



Source: Participant survey. Question: "Respondents were asked to rank satisfaction with their contractor on a scale of 1 - 5"

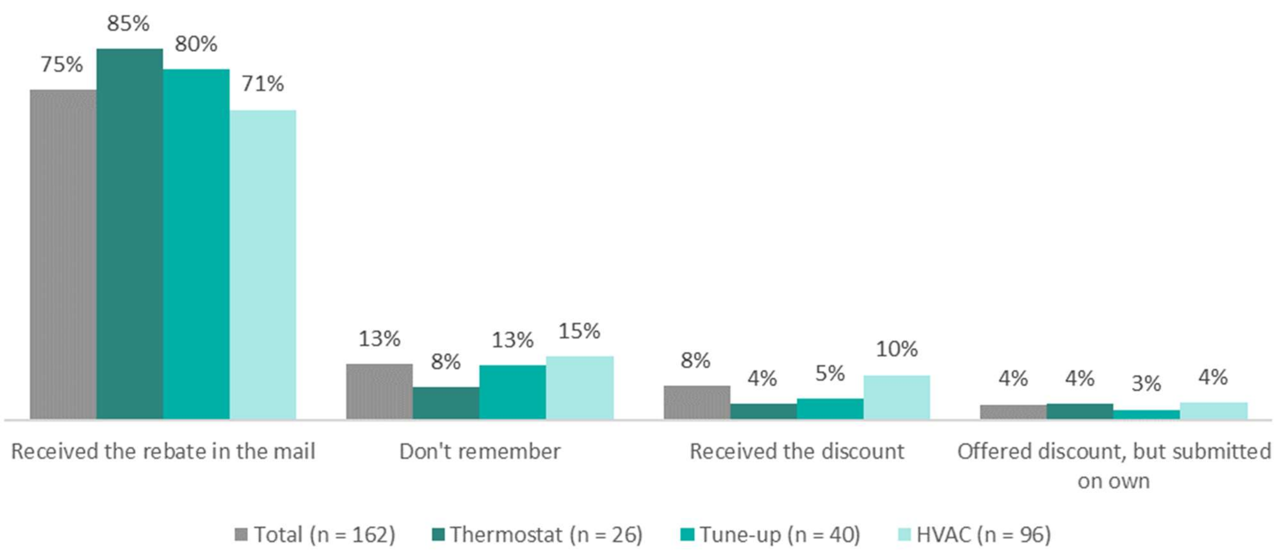
There were seven respondents who reported having difficulty with their contractor and the quality of the installation. One respondent said, "He had to return because he had not wired it properly." When asked what their contractor could have done to improve their experience in the program respondents mentioned the following:

- Provide more information on other NIPSCO rebates and opportunities to save energy (n = 6)
- Make the rebate application a bit simpler (n = 5)
- Increased communication between participant and the contractor (n = 4)
- Install the measure more quickly after scheduling (n = 3)

Some of this feedback aligns with feedback the evaluation team also received from contractors during in-depth interviews. As described in the HVAC Contractor Feedback section, contractors described the rebate application being complicated for non-industry experts to fill out.

Approximately three-quarters (75%) of respondents received the rebate directly instead of receiving a discount on equipment or services. There was slight variation across measure types. Most thermostat respondents (85%), who used a contractor, received the rebate in the mail; 71% of HVAC respondents received the rebate in the mail (Figure 17). In interviews with contractors, they also reported that it is more common for contractors to help the customer fill out the application, but still have the customer submit the application rather than offering an instant discount.

FIGURE 17. REBATE RECEIVER BY MEASURE TYPE



Source: Participant survey. Question: "Did your contractor offer you a discount on your new equipment, or did you receive a rebate in the mail?"

Of the participants that reported filling out the rebate application, 49% reported waiting less than eight weeks to receive the rebate check. Nearly one-third (27%) reported waiting between eight and 15 weeks. One respondent reported waiting more than 15 weeks and two reported never receiving the rebate check. Twelve respondents were unsure how long they waited to receive the rebate check. When providing feedback for the program, 11 respondents said that the program could improve by sending the rebate more quickly.

Generally, respondents were satisfied with the rebate and the rebate process (Figure 18). Most respondents (82%) are satisfied with the application process; 58% of respondents are very satisfied. The mean satisfaction score was 4.3. There is not much variation between measure types. Nearly three-quarters of respondents (72%) reported being satisfied with the time it took to receive the rebate; 46% reported being very satisfied. The mean satisfaction score was 3.97; 83% reported being satisfied with the rebate amount and 53% were very satisfied. The mean satisfaction score was 4.3.

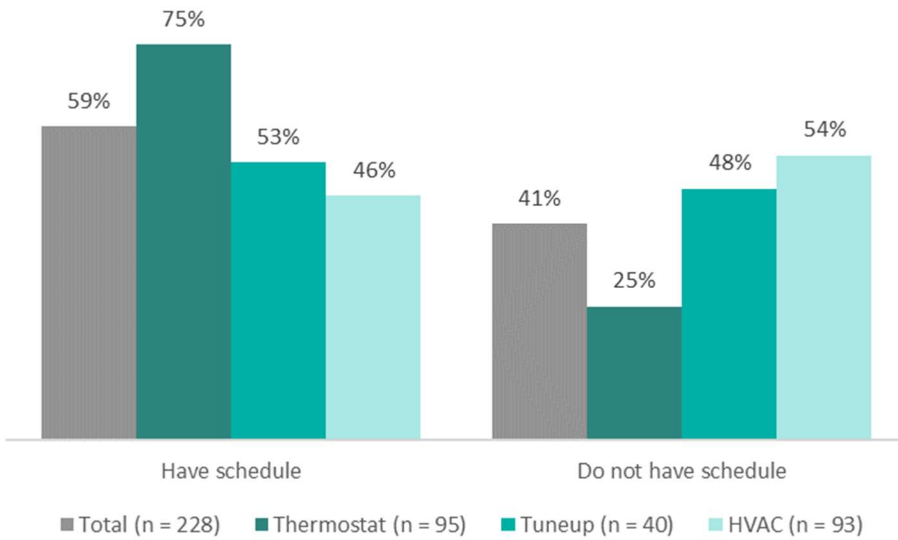
FIGURE 18. SATISFACTION WITH THE REBATE

Source: Participant survey. Question: "Respondents were asked to rank the statements on a scale of 1 - 5"

Ten respondents described being dissatisfied with the required paperwork and were confused about what information they needed to provide. One respondent said, "I had a challenge submitting information for the rebate. Had several communications with requests from NIPSCO before it finally processed." And, another respondent said, "Provided invoice in format required by NIPSCO. But NIPSCO was too strict in what they required to prove that we paid. We paid in advance so our invoice said $0 which NIPSCO wouldn't accept."

Finally, given the evaluation team's interest in thermostats, we asked all respondents about their thermostat behavior. Over half of respondents (59%) said they have a program for their thermostats. This varies by measure type. Three-quarters of thermostat respondents (75%), 53% of tune-up respondents and, and 46% of HVAC respondents said they have a schedule (Figure 19).

FIGURE 19. THERMOSTAT SCHEDULE BY MEASURE TYPE



Source: Participant survey. Question: “Do you have a schedule for your thermostat?”

THERMOSTAT EXPERIENCE

In general, thermostat respondents are satisfied with the program and are comfortable with their new thermostat. Most thermostat respondents (89%) are satisfied with the HVAC rebate program; 64% are very satisfied. Their mean satisfaction rating for the HVAC rebate program is 4.49. Most respondents (92%) reported feeling comfortable with their new thermostats. Those who were less comfortable said they wanted to read the manual and that they did not think it was intuitive. Nearly two-thirds of respondents (62%) who installed a smart thermostat through the program reported that they replaced a programmable thermostat, with 36% replacing a manual thermostat. Two respondents reported they did not replace a thermostat. This proportion is different than what we found in the thermostat billing analysis where we found that 51% replaced a manual thermostat.

Thermostat respondents describe using the Wi-Fi and “smart” features of their thermostats with relative ease. Most respondents (88%) said they programmed their own schedule after they installed the thermostat. Since installing a new thermostat, 66% of participants reported adjusting the temperature settings, 52% reported using the schedule settings, and 31% reported using the vacation or away modes. About one-third of respondents (30%) with thermostats reported adjusting the temperature once or a few times a week. Less than one-quarter of respondents (22%) said they adjust the thermostat at least once a day.

Respondents report that they use the mobile app to control the thermostat often. Nearly one-third of respondents (29%) said they use the app to control the thermostat at least once a day and 28% said that they use it at least once per week. Respondents who reported using their phone to adjust their thermostats reported using their phones to adjust the following settings:

- Temperature (92%)
- Home or away modes (55%)
- Schedule (46%)
- Fan (33%).

A/C AND BOILER TUNE-UPS

Tune-up respondents are also satisfied with the program. Most tune-up respondents (93%) are satisfied with the HVAC rebate program; 58% are very satisfied. Their mean satisfaction rating for the HVAC rebate program is 4.5. 93% of respondents received an A/C tune-up and 8% received a boiler tune-up.

Three-quarters of tune-up respondents (76%) did not have a maintenance contract with an HVAC contractor prior to taking part in the program. Of the ten tune-up recipients that had a maintenance contract, nine reported receiving a tune-up annually.

Respondents said that contractors provided them with the following information before they signed up for the tune-up:

- Information on what was involved in the tune-up process (n = 28),
- How the tune-up could improve the efficiency of the unit (n = 25),
- Setting a schedule of when they should complete tune-ups of the equipment (n = 20),
- The added benefits for home's comfort (n = 13),
- Estimates about how much money or energy it could save (n = 7),
- The environmental impact (n = 5).

Respondents reported receiving the tune-up quickly after scheduling and that the tune-up itself was relatively quick. Nearly two-thirds of respondents (62%) that received tune-ups reported waiting one week or less after scheduling to receive it. Almost half of respondents (46%) said the tune-up took less than an hour.

During the tune-up, contractors showed 83% of respondents a tune-up checklist, as described by the program documentation; 12% were unsure whether they had seen the checklist. Most respondents (93%) reported their equipment condition; two respondents said the contractor did not share this information with them. Of those who shared, 50% said their equipment was in excellent condition. Three-quarters of respondents (76%) did not receive any recommendations after they completed the tune-up. Of those who received recommendations, contractors recommended the following:

- Regular maintenance (n = 3)
- Part replacement (n = 3)
- Get a booster that helps with energy efficiency (n = 1)

Three-quarters of tune-up respondents (73%) did not schedule their next tune-up visit. All respondents reported that the contractors covered the work necessary for the tune-up rebate for the pre-existing maintenance contract and there were no added charges in the tune-up for the participants that had a pre-existing maintenance contract.

If NIPSCO had not provided the tune-up rebate, 85% of participants would still have completed a tune-up. Few responded they would not have (7%) and few said they are unsure (7%).

LARGE HVAC EQUIPMENT

HVAC respondents are also satisfied with the program. Most tune-up respondents are satisfied with the HVAC rebate program (92%); 62% are very satisfied. Their mean satisfaction rating for the HVAC rebate program is 4.54.

HVAC participants reported receiving the following information from their contractors when they installed the new equipment:

- Efficiency of their new unit (85%),
- Details about the efficiency ratings (84%),
- The size or capacity of the new equipment (82%),
- Estimates on how much energy or money it could save (59%).

SATISFACTION WITH PROGRAM AND NIPSCO

OVERALL PROGRAM SATISFACTION

Respondents reported being satisfied with the HVAC rebates program and with NIPSCO itself. Most respondents (91%) said they were satisfied with the program; 62% said they were very satisfied with the program. The mean satisfaction score was 4.3. Notably, 97% of survey respondents would recommend participating in the Energy Efficiency Rebates Program to a friend or a family member. One respondent said, “It [the program] was helpful. It’s been a good experience.” There was not much variation between the measure types in their satisfaction with the HVAC rebate program. Respondents said they were satisfied with the program for the following reasons:

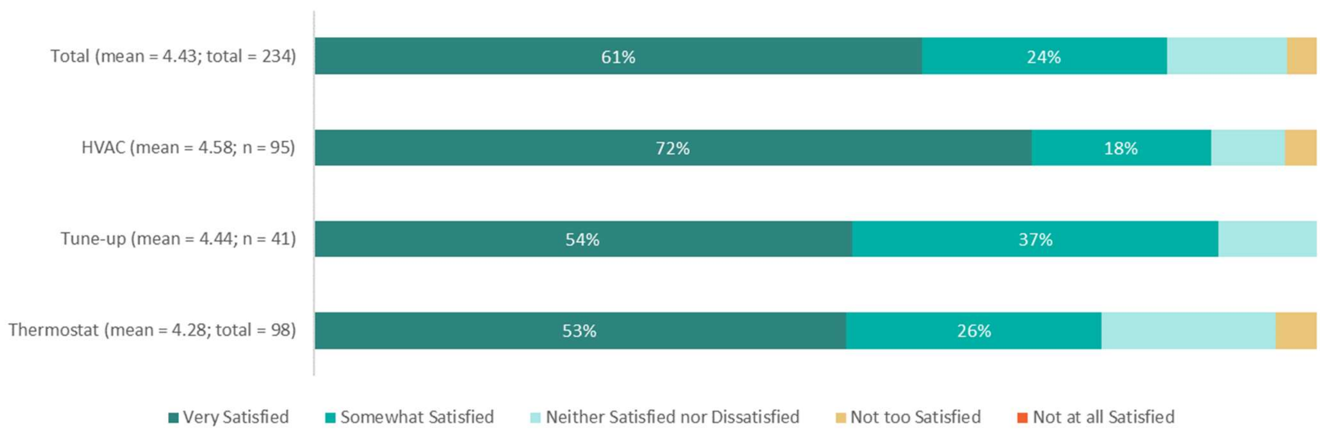
- They received an incentive (n = 42)
- It was easy to participate (n = 24)
- Knowing that NIPSCO cares about energy efficiency (n = 18)
- It allowed them to make an upgrade to their home equipment (n = 17)
- It helps them save energy (n = 17).

NIPSCO SATISFACTION

In addition to general satisfaction with the program, respondents reported being satisfied with their communication with NIPSCO. Over three-quarters of respondents (79%) said they were satisfied with the communication they had with NIPSCO; 55% said they were very satisfied. The mean satisfaction score was 4.3. There was not much variation between measure types.

Finally, respondents reported they were satisfied with NIPSCO overall. Most respondents (85%) said they were satisfied with NIPSCO; 61% said they were very satisfied. The mean satisfaction score was 4.4 and no respondents said they were not satisfied at all. One respondent said, “I have been a customer for years and never had any problems with them.” There was variation between the measure types in their satisfaction with NIPSCO. HVAC respondents gave NIPSCO the highest satisfaction score at 4.6; thermostat respondents gave NIPSCO the lowest satisfaction score at 4.3 (Figure 20). The mean responses for HVAC respondents and thermostat respondents are statistically different from one another.

FIGURE 20. SATISFACTION WITH NIPSCO BY MEASURE TYPE



Source: Participant survey. Question: “How satisfied are you with NIPSCO overall as your energy service provider? Would you say you are…?”

SUGGESTIONS FOR IMPROVEMENT

Survey respondents provided suggestions on how NIPSCO could improve the HVAC rebate program. The top suggestions were 1) increasing program advertising and cross program promotion; 2) providing more information and support about the rebate application; and 3) providing more opportunities for feedback.

First, 36 respondents said that they would like to see more advertising for the program. One respondent said, “I think you should make the energy efficient program specials more easily known about, perhaps through an email or a flyer in the monthly statement.” Similarly, six respondents said they would like to learn about more opportunities that NIPSCO provides to save energy and receive rebates. One respondent said, “Need to include information with bill to promote these types of programs. People need to save money these days as the cost of utilities are going up.” While 56% of respondents said they were aware of other energy efficiency programs offered by NIPSCO, and 26% of respondents have participated in other energy efficiency programs, there are respondents who have additional saving potential but need more information on where and how they can participate.

Second, 14 respondents said that they had trouble filling out the rebate application and five respondents said that they would prefer to fill out an application online. As previously stated, some respondents said that filling out the rebate application and finding the requisite information was difficult. One respondent said, “He [my contractor] was very helpful in helping us fill out the application, and without him, I doubt we could have done it ourselves as it was a very complicated application.” In the HVAC contractor interviews, we found that most contractors help their customers fill out the rebate application; most respondents reported they received the rebate in the mail (and did not receive and instant discount). These respondents may have had help filling out the rebate application from their contractor but still found portions of it to be complicated. For some measures, like furnaces or A/C units, it may be very difficult for customers to fill out the application independently and they will need to reach out to their contractors for help. But, for other measures, like thermostats or electric dryers, customers may be more able to complete the applications on their own.

Some respondents said they wanted an online application, meaning they were unaware of the online portal from which they could submit the application. One respondent said, “Make the rebate form online instead of the requirement to mail it in." Especially as new measures become available, that are easier to self-install, customers may need more assistance and information on filling out the rebate application.

Third, as mentioned before, seven respondents reported having issues with their contractors. For example, one respondent said, "There appears to have been a competency or completeness issue [with my contractor]". While NIPSCO does not have partner contractors or trade allies, and therefore, is not officially affiliated with any of the contractors who install measures for the HVAC rebate program, customers will correlate contractor behavior with NIPSCO. There is not currently a streamlined means for customers to provide feedback to NIPSCO about the program.

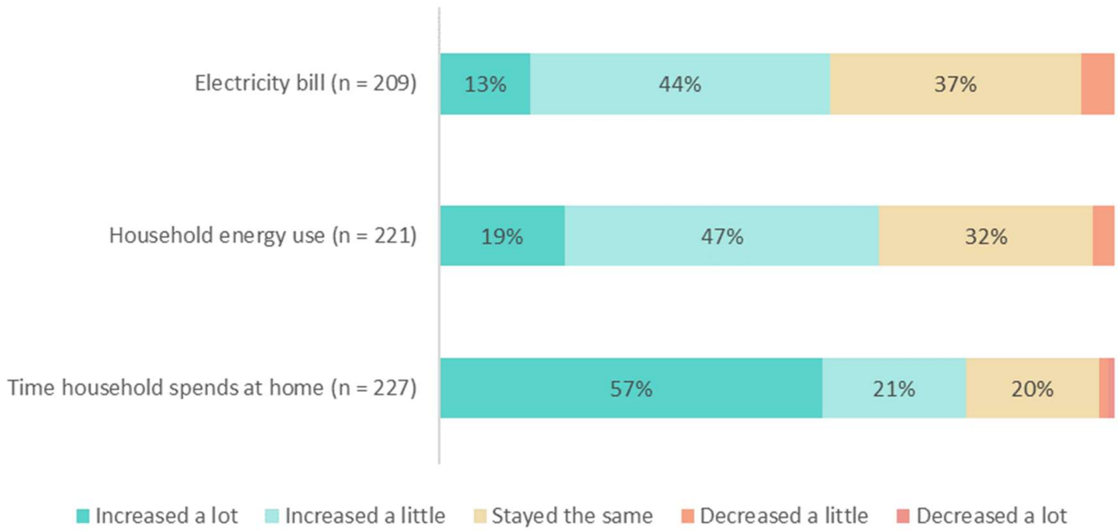
EFFECTS OF COVID-19

While the COVID-19 pandemic did not pause the program, like with other NIPSCO programs, the evaluation team included several questions about how the pandemic has affected customers to understand how their needs or experiences may have changed. We asked survey respondents about how the pandemic has affected them and what NIPSCO could do to help alleviate some of the effects, if anything. First, we will describe how the COVID-19 pandemic affected respondents. Second, we will describe how respondents' thermostat behavior has changed since March of 2020. And, finally, we will describe opportunities for NIPSCO to assist their customers during this time.

First, the pandemic has had a relatively small financial effect on most respondents. Over half of the respondents (55%) reported that their household income was at least $75k before 2020. And 56% said that they expect their 2020 income to be about the same. The other respondents were split between their income being higher (24%) and lower (21%) than in 2019. Most respondents said their working situation has not changed since the start of the pandemic (85%).

Respondents reported that in 2020 they have spent more time at home than in 2019. Over three-quarters of respondents (78%) said the time their household has spent at home has increased since before the pandemic; 57% say that it has increased a lot. Over one-half of respondents (54%) said they are now working from. Given the sharp increase in time spent at home, respondents also reported an increase in their household energy use and their household energy bills. Nearly two-thirds of respondents (65%) said they think the amount of energy their household uses in each week has increased since before the pandemic; 19% said it has increased a lot. Over half of respondents (58%) said they think their energy bills have increased since before the pandemic; 13% said their bills have increased a lot (Figure 21).

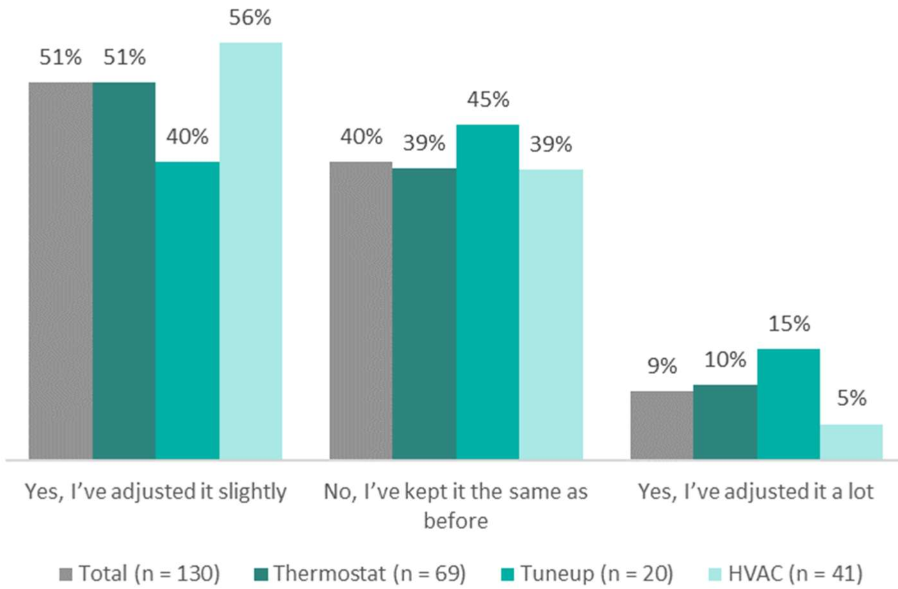
FIGURE 21. EFFECT OF COVID-19 ON ELECTRIC BILLS, ENERGY USE, AND TIME AT HOME



Source: Participant survey. Respondents were asked to rank the statements from “decreased a lot” to “increased a lot”

Second, the evaluation team asked respondents to describe how their thermostat behavior has changed since March 2020 to understand if people changed their settings or programs given more time spent at home. Over one-half of respondents (59%) said they have a program for their thermostats, varying by measure type. Three-quarters of thermostat respondents (75%), 53% of tune-up respondents, and 46% of HVAC respondents said they have a schedule. Of those who reported having a thermostat schedule (n = 135), 51% said they have slightly adjusted their thermostat's schedule since the start of the pandemic. This varies slightly by measure type. Thermostat respondents most frequently said they had adjusted the temperature settings on their thermostat during the pandemic (68%) followed by adjusting the schedule (35%) (Figure 22).

FIGURE 22. THERMOSTAT SCHEDULE CHANGES BY MEASURE TYPE



Source: Participant survey. Question: "Have you adjusted your thermostat's schedule since the start of the pandemic"

Third, when asked about how NIPSCO could help them during the pandemic, respondents suggested the following:

- Reduce bill amount (n = 18)
- Continue to provide reliable services (n = 14)[25]
- Keep rates stable (n = 11)
- Provide more opportunities for rebates (n = 5).

The most common result was reducing bill amounts. In addition, a few respondents asked for more ways to save money on their bills. The other three responses are a bit more actionable. First, respondents asked for NIPSCO to continue to provide reliable services and reduce outages. One respondent said, "Make sure we get our supply of gas and electric." Second, and similarly, respondents asked for rates to stay about the same and asked for NIPSCO to reduce increasing rates. One respondent said, "Keep attaining green energy. Keep the prices as low as possible. Keep the energy reliable. If the electric goes out, fix it quickly. We want great, reliable service first, low price second. I do not want a Texas effect." Finally, as previously mentioned in the Satisfaction section, respondents are looking for more opportunities to receive rebates for energy efficient actions. One respondent said, "Make getting energy efficient products at a lower price or more rebates easier."

PARTICIPANT SURVEY DEMOGRAPHICS

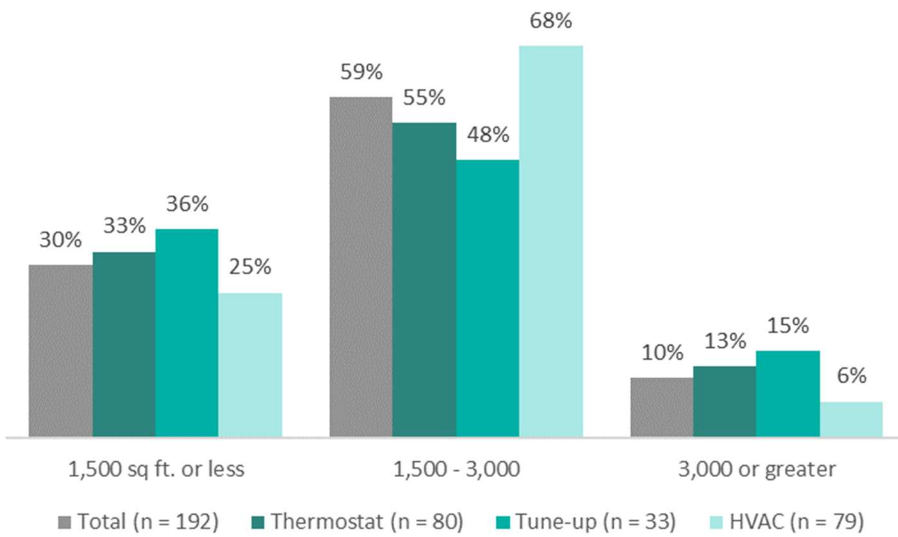
[25] We fielded this survey the week of February 15th at the same time of the 2021 Texas Power Crisis. We saw a few mentions of grid reliability and explicit references to what happened in Texas.

Respondents were generally older, wealthier, and had high levels of education. In addition, they have lived in their home for more than ten years and live in homes that are medium to large. In this section we will describe the detailed demographic composition of our respondents and how the demographic characteristics vary by measure type and mode.

GENERAL DEMOGRAPHICS

Over one-half of respondents (59%) reported that they live in homes between 1,500 and 3,000 sq ft. (Figure 23). Of the three measure types, HVAC respondents reported living in homes that were between 1,500 and 3,000 sq ft. with the highest frequency; 15% of tune-up respondents live in homes larger than 3,000 sq ft. while 6% of HVAC respondents live in homes larger than 3,000 sq ft. These proportions are not statistically different.

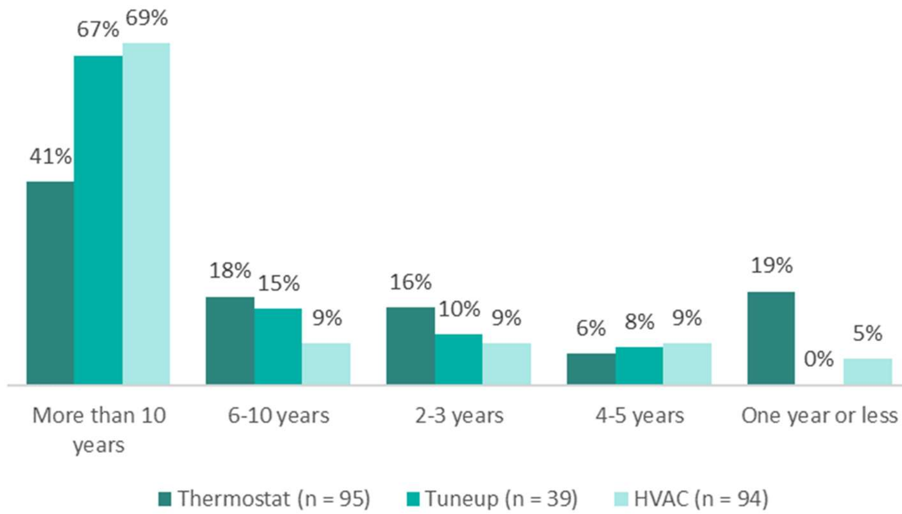
FIGURE 23. HOME SIZE BY MEASURE TYPE



Source: Participant survey. Question: "What is the square footage of your home?"

Over one-half of respondents (57%) have lived in their homes for more than ten years. However, there is more variation between the measure types than other demographic characteristics. Most tune-up and HVAC respondents have lived in their homes for more than ten years, while most thermostat respondents have lived in their homes for at least five years (Figure 24).

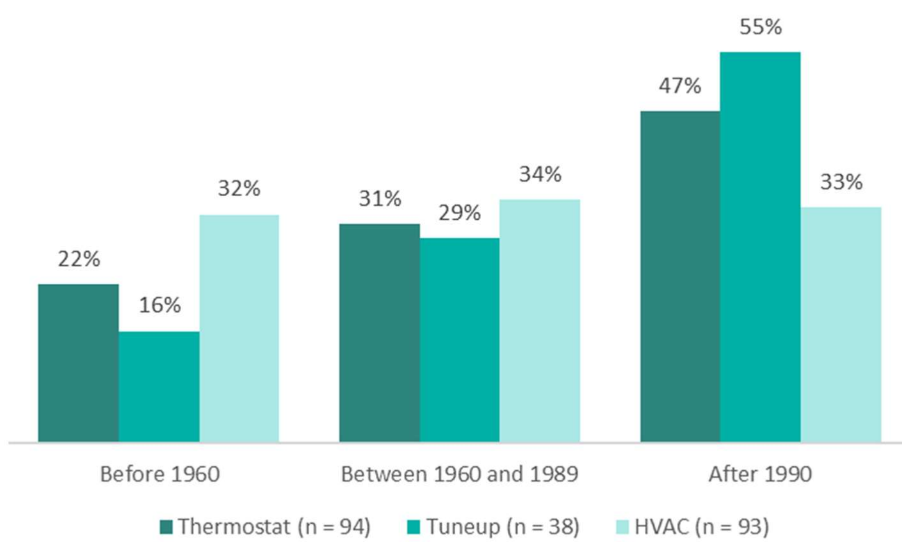
FIGURE 24. TENURE IN HOME BY MEASURE TYPE (N=228)



Source: Participant survey. Question: "How many years have you lived in your current home"

Most respondents heat their water (92%) with natural gas and 98% of homes have gas heat. All respondents reported that they own their homes. Most respondents (90%) live in single family detached homes. 13% of tune-up respondents and 8% of thermostat respondents live in attached homes (i.e., townhouses) while only 2% of HVAC respondents reported living in attached homes. Respondents reported most frequently that their homes were built between 1960 and 1990 (Figure 25). While HVAC participants reported a relatively even spread in terms of their home's age, both thermostat and tune-up participants most commonly reported their home was built after 1990 (55%, n = 21).

FIGURE 25. AGE OF HOME BY MEASURE TYPE (N=225)



Source: Participant survey. Question: "When was your home built?"

Respondents in our survey are older, more educated, and wealthier than the median and average citizen of Indiana (Table 45).[26] Respondents most frequently reported being between 62 and 81-years-old (43%). 57% of respondents have at least a bachelor's degree. And 55% of respondents reported making at least $75,000 per year.

TABLE 45. DEMOGRAPHIC COMPARISON TO STATE

CATEGORY	SURVEY	INDIANA
Age	43% older than 62	16% older than 65
Income	55% make at least $75k	Median income is $56k
Education	57% have a bachelor's or more	27% have a bachelor's or more

Source: Participant survey. Questions: "When were you born?"; "What is the highest level of education you have completed"; "Which of the following best represents your annual household income from all sources in 2019 before taxes"

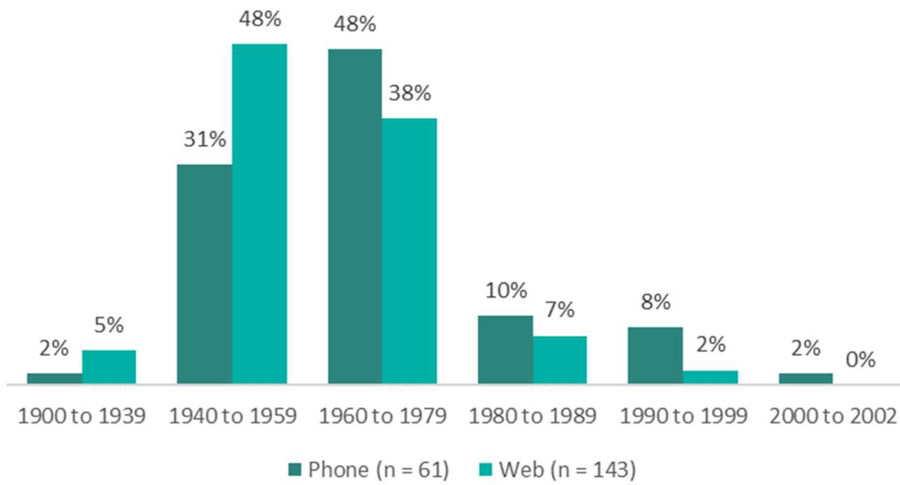
DIFFERENCES BY MODE

We randomly split the survey sample into two groups. We delivered the survey by phone to one group and by web to the other group. We did this to test if mode made a difference in certain survey questions. We had 68 respondents via phone and 172 via web. They are very similar demographically. But there were a few statistically significant differences between the populations. The modes are statistically different at the 0.05 level in terms of house size, age, and tenure in home. No satisfaction scores varied by mode.

Web respondents reported that they live in larger homes than phone respondents. Nearly two-thirds of web respondents (64%) lived in homes between 1,500 and 3,000 sq. ft. while 49% of phone respondents lived in homes between 1,500 and 3,000 sq. ft. Web respondents reported having lived in their home for at least ten years which is longer than phone respondents reported. Nearly two-thirds of web respondents (62%) reported living in their homes for at least ten years while 45% of phone respondents reported living in their homes for at least ten years. Web respondents reported being older than phone respondents (Figure 26). Most web respondents were born before 1959 (53%) while most phone respondents were born between 1960 and 1989 (57%).

[26] United States Census Bureau. (2019). Quick Facts Indiana. Retrieved from United States Census Bureau Quick Facts: https://www.census.gov/quickfacts/IN

FIGURE 26. AGE OF RESPONDENT BETWEEN MODES (N=204)



Source: Participant survey. Question: “When were you born?”

HVAC CONTRACTOR FEEDBACK

The evaluation team interviewed eight HVAC contractors who participate in the HVAC rebate program. We primarily spoke with administrative staff at the HVAC businesses, rather than the HVAC contractors themselves. The people we spoke with handle the utility program rebates and had the most experience with the program. Figure 27 shows the types of businesses with whom we spoke.

FIGURE 27. DISPOSITION OF HVAC CONTRACTOR IDI PARTICIPANTS

100+	100 or more projects in the tracking data	**2 BUSINESSES**
50+	50 or more projects in the tracking data	**3 BUSINESS**
	installs thermostats through the program	**7 BUSINESSES**
	conducts tune-ups through the program	**2 BUSINESSES**
	NIPSCO gas territory	**8 BUSINESSES**
	NIPSCO electric territory	**4 BUSINESSES**

The following sections describe the results related to the program process, reasons for participation, experience with the rebate process, satisfaction with the program, and how COVID-19 has affected their business and the program.

PROGRAM PROCESS

The HVAC businesses we spoke with had a similar process for participating in the program (Figure 28).

FIGURE 28. ENERGY EFFICIENT REBATES CONTRACTOR PROCESS

1. Customer contacts business to request new equipment
2. Contractor evaluates needs and recommends efficient equipment. Describes NIPSCO rebates.
3. Equipment is installed and invoice is paid
4. Office staff fills out rebate application
5. Office staff talks with customer to complete application
6. Office staff or customer submit application

First, the customer contacts the business with a need for HVAC services (i.e., furnace replacement or an HVAC tune-up). While some contractors said customers have called them to purchase only a thermostat, most said that they more commonly include a new thermostat with an HVAC system upgrade.

Second, the contractor would go to the customer's home and evaluate the needs. At this point, the contractor recommends the more efficient equipment and describes the equipment's possible eligibility for the NIPSCO energy efficiency rebate. When customers agree to purchase, the contractor establishes an installation date.

Third, the contractor installs the equipment and collects some requisite information for the rebate application (i.e., removed equipment information, installed equipment information). After, the contractor leaves the customer an invoice. Program implementers described providing contractors with other NIPSCO program information. The contractors we spoke with did not mention having this collateral.

Fourth, after the contractor installs the equipment, and the customer pays the invoice, the rebate processer at the business takes the information gathered and fills out the rebate application. All businesses we spoke with said they fill out most of the rebate application for their customers. This participant survey corroborates this. One respondent said, "[my contractor] provided the serial numbers on one sheet of paper instead of me having to search for them." Two contractors said they use the online portal.

Fifth, some contractors have a back-and-forth with the customer to gather information like NIPSCO account numbers and the location where the customer wants the rebate sent.

Finally, the contractor or customer submits the application. Two contractors said while they help customers fill out the application, it is up to the customer to submit the application. Seven of the contractors we spoke with said the customer receives the rebate; only one contractor we spoke with said they discount the rebate amount from the customer cost. Contractors did not describe cross-promoting other NIPSCO rebate programs.

PARTICIPATION DRIVERS

Seven of the eight contractors we spoke with said they had participated in the HVAC rebates program for over five years. They said their business decided to participate in the program because they wanted to provide even more value and care to their customers. One contractor said, "it was added value for our customer. Being able to say 'yes, it is this much, but look at what we can offer, there's these rebates out there that can help', that is a win-win."

Contractors said their businesses continue to participate in the program for two reasons. First, because their customers are happy with the possibility for rebates. They said that customers appreciate the money they can save by participating in the program. One contractor said, "I would say that our customers that do participate, they've always been happy. In their eyes, who doesn't like money coming back in their pocket?" The second reason businesses continue to participate is because it is easy for the business to participate. Contractors said that the application process is relatively easy and interactions with NIPSCO are positive. One contractor said, "I think the application itself is pretty easy…the program itself makes it kind of hard to make errors." Seven of the businesses we spoke with have one dedicated staff member who handles the program day-to-day; at the other business, the HVAC contractors who install the equipment fill out rebate applications. This person processes the rebates, interacts with customers after installation, and communicates with NIPSCO. Seven of the contractors said they have so much experience with the program that filling out the application is like second nature to them. One contractor, who had only been at her business for a month, said she easily figured out how to fill out the rebate application. Contractors said if they have questions or concerns with the program, they feel they can easily get answers from NIPSCO.

EXPERIENCE WITH THE REBATE PROCESS

Three trends emerged surrounding the rebates when speaking to participating contractors. First, while all contractors we spoke with helped fill out the rebate application, seven contractors have the rebate sent to the customer. They do not receive the rebate in-house to provide customers with an instant discount. Second, opinions are split on the length of time it takes for customers to receive the rebate. Third, contractors said the application would be difficult for someone without HVAC experience to fill out.

First, as previously stated, only one contractor we spoke with offers an instant discount. All other contractors have the rebate check sent to the customers. One contractor we spoke with said they had tried offering the customers an instant discount but stopped offering the instant discount because it could be difficult to get customers to fill out all application fields. The business had to cover the cost of the rebate when this happened. All contractors we spoke with fill out most of the rebate applications for their customers. Three contractors said they experience some difficulty in completing the rebate application. While *they* are fluent in the rebate application language (i.e., industry terms like AHRI), there are still fields they need the customer to complete:

- NIPSCO account numbers and account holder name,
- address and name of the place to send the rebate check,
- and customer signature.

It can be difficult to gather this information from the customers. One contractor said, “I put all the information in for them, I highlight the sections that they need to fill out along with the signature line…you would be amazed how many people didn’t put in their account number or something like that.” Three contractors described highlighting the fields needed from customers before sending the application to them. Others described a follow up process in which they repeatedly mention to customers what they will need to complete the application – by the time the contractor needs the final information, the customer is aware of what they need to do and which fields they are responsible for. The two contractors who used the online portal did not describe having issues at the same magnitude with gathering this information. Contractors who struggled to gather complete rebate applications said that the frequency with which this occurs ranges between 5% and 90% of the time. One contractor said, “I want to say, probably 90% of the time, people don’t finish the application. They leave something undone…but I don’t know how you’re going to train the public”. Two contractors said that it was especially difficult with their older clientele to gather this information because they may not have an email address or might be wary of providing account numbers.

When asked about the timing of rebates, four contractors said customers do not have an issue with the length of time it takes to receive their rebates. Two of these contractors said setting expectations with customers helps. One contractor said that he tells customers, "It's like any rebate - it could take two months." One contractor, whose business is in a NIPSCO gas territory but not NIPSCO electric, said that the NIPSCO rebate takes longer than the other utility rebate. When customers have something to compare rebate timing to, it makes them think the rebate is taking too long.

Third, while contractors fill out most of the rebate application, three mentioned that it would be difficult for a customer, without any HVAC experience, to fill out the application alone. They said that industry jargon, while briefly defined on the application, might be difficult for customers to understand or to be able to find. One contractor said it would be helpful to, “Make the application easier for people not as knowledgeable about the system, so they’re not calling me and asking me ‘what does this mean?’.” For example, customers might not know what an AHRI is and would struggle locating the AHRI number to put in the application. One survey respondent said, “I was surprised at the amount of documentation I had to find or go seek out and find on my own.” This highlights the importance of contractor support in the program delivery process. While contractors mentioned that the application is complicated for customers, they also described the overall process as being simple for them. There is not much more NIPSCO, or the contractors can do to simplify the application, but they can both continue to support and assist customers when completing the application.

COVID-19 IMPACTS

Contractors said that their businesses have been relatively unaffected by the COVID-19 pandemic. Only one contractor said that they have noticed a decrease in their residential business. All other contractors said that their business has remained the same or has increased. Those who said their business has increased think it is because customers are now at home more than before and notice how their home's comfort can be improved. One contractor said, "They're (SIC) working from home so they're more apt to hear their furnace making a funny noise or the house not being as warm as they thought…when you spend more time in your home you tend to notice." Three mentioned that they have implemented safety precautions for entering people's homes like requiring masks, other PPE, and virtual audits. Some said that customers were more worried toward the beginning of the pandemic but are less concerned about people in their homes now. One contractor said, "It got a little scary, the phone was not ringing…but once we got through that first two or three weeks, the phone started ringing like crazy." Contractors do not expect the pandemic to affect the program and their participation in the program long term.

SATISFACTION WITH PROGRAM AND NIPSCO

Contractors were highly satisfied with the program. All contractors said they will continue to participate in the program and, those asked, said that they would recommend the program to another business. Contractors were primarily satisfied with the program because of the value it added to their customers. The contractors we spoke with focused on customer care and providing the highest quality of service to their customers. They believe that this program provides them with another way they can help their customers. As previously stated, they think that the program is easy to participate in. Contractors said that participating in the program does not take extra work to provide this valuable service to their customers. One contractor said, "It's pretty easy. You just go online and it's self-explanatory. Just fill in where you got to and email it."

Contractors were also highly satisfied with NIPSCO. Contractors said that they primarily interact with NIPSCO when there are issues with the rebate applications or if they have questions about the program. First, contractors said they receive emails about rebate applications that need additional or amended information. They said that the information is usually easy to fix. One contractor said, "NIPSCO does a really good job of emailing us if for some reason there's some kind of complication." Second, five contractors said they have had questions at some point about an aspect of the program. They easily contacted NIPSCO and were able to have their questions answered.

FURNACES WITH ECMS

Contractors described their experiences with the code change that made ECMs the baseline standard for furnaces. Two contactors said they were transitioning away from selling furnaces without ECMs and two contractors mentioned they only offer furnaces with ECMs. Those who were transitioning away from furnaces without ECMs said that now most, if not all, of the furnaces they offer have ECMs.

SUGGESTIONS FOR IMPROVEMENT

Contractors said that the program was going well and did not have suggestions for improvement. The largest barrier was missing information in rebate applications. While the contractors did not have suggestions to address this problem, as one contractor said, "I have thought about that, and I don't know if there is a way really," we heard a few methods of gathering this information that seemed valuable. These tips and tricks from contractors could be useful to share with contractors who are struggling to gather this information (Figure 29).

FIGURE 29. TIPS AND TRICKS FOR GATHERING CUSTOMER INFORMATION

1

One contractor said they reminded customers at three different steps in the process that they would need their account number and account holder name: during scoping, during installation, during the rebate application process.

2

One contractor said they request a copy of a NIPSCO bill with the signed contract so that the person processing the rebate had all of the necessary information when it was time to fill out the rebate application.

3

Three contractors described a follow-up interaction with their customers. During this follow-up they could more explicitly ask for the information they needed to complete the rebate application.

- One contractor we talked to said he brings the final application during the follow up visit. He is there in person to ask for them to sign it and add information.
- Sending a customer data request with the final invoice - they need the signed invoice to send back to NIPSCO so this is a perfect time to get all information.
- One contractor sends a care package after the install - that is when they can get all the information they need for the rebate.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSION 1: ELECTRIC ENERGY SAVINGS FOR FURNACES WITH ECMS HAVE BEEN ELIMINATED.

Because ECMs became largely the code requirement in July 2019 but we allowed a six-month sell-through period, no electric savings were granted for furnaces installed after 2019. Qualitative interviews with contractors indicated most completely stopped or drastically reduced selling furnaces without ECMs. There should be no electric savings for these furnaces expected for program year 2021.

Recommendations:

- *Ex ante* savings should exclude electric savings for furnaces with ECMs.

CONCLUSION 2: BILLING ANALYSIS RESULTS SHOWED REDUCED FURNACE EFLH VALUES.

The billing analysis showed furnace EFLH values are approximately 32% less than TRM (2.2) values. Using billing analysis results for the 2020 post year (impacted by the COVID-19 pandemic), average EFLH for the participant population was approximately 908 hours. If billing analysis results for the 2019 post year (not impacted by the COVID-19 pandemic) were used, the average EFLH for the participant population would have been approximately 933 hours. Furnace savings going forward should use EFLH values for the 2019 post year, approximately 3% higher.

Recommendations:

- Goals should be set noting that furnaces will have reduced therm savings from the TRM (2.2), although aside from variations in capacity and AFUE, future furnace savings will likely be 3% higher than average savings for the 2020 program year.

CONCLUSION 3: BILLING ANALYSIS RESULTS SHOWED REDUCED THERMOSTAT SAVINGS.

The billing analysis showed gas heating savings are approximately 75% less than TRM (2.2) calculations showed in previous evaluation years, due to:

- reduced base heating consumption (related to the EFLH findings),
- reduced heating savings fraction (versus older results),
- and likely because installed furnaces are more efficient than the TRM (2.2) assumes.

Overall evaluated therms savings were 35 therms per site based on 2020 post year results. The analysis also showed cooling savings are approximately 50% less than previously assumed due to reduced cooling savings factor. Finally, the analysis showed that sites receiving second thermostats do not save gas or energy at a level statistically different from those receiving one thermostat.

Recommendations:

- For future program years, goals should be set noting that smart thermostats will have reduced gas savings and electric energy savings from the deemed savings value in the 2019 report. Therms savings for the 2021 program year can be expected to be 47 therms per site, following results for the 2019 post year which was not impacted by the COVID-19 pandemic.

- Because homes receiving two thermostats did not have statistically different savings than homes who installed one thermostat, this indicates that there may be smaller per thermostat savings for people who install second thermostats. While this is currently a relatively small proportion of customers, monitor the participation rates of people who receive more than one thermostat; if this negatively affects overall program cost-effectiveness, consider limiting participation to one thermostat.

CONCLUSION 4: THE EVALUATION TEAM IDENTIFIED SEVERAL MEASURE LEVEL SAVINGS ADJUSTMENTS.

Ex ante values for several measure categories including air conditioners, air conditioner tune-ups, boilers, boiler tune-ups, thermostats, and water heaters should be updated in the next program year. This will make the program savings estimates more accurate.

Recommendations:

- *Air conditioners*: Apply actual SEER, EER, and capacity to savings, or use average values from the 2019 program data (average SEER = 15.7, average EER = 14.1, average capacity = 34,054 Btuh).
- *Air conditioner tune-ups*: Apply actual SEER, EER, and capacity to savings, or use average values from the 2019 program data (average SEER = 12.7, average EER = 11.4, average capacity = 31,207 Btuh).
- *Boilers*: Apply average program data capacity (127,381 Mbtu) and average AFUE (95%).
- *Boiler tune-ups*: Apply average capacity from boiler tune-up measures (103,917 Btuh).
- *Water heaters*: Apply a baseline UEF of 0.633 and efficient UEF of 0.950 for instant water heaters and 0.705 for storage.

CONCLUSION 5: NIPSCO NEARLY MET THEIR SAVINGS GOALS FOR ELECTRIC ENERGY WHILE EXCEEDING THEIR PEAK DEMAND, AND NATURAL GAS SAVINGS GOALS.

NIPSCO did not meet the electric energy goal by 2%; but they exceeded the peak demand goal by 104%, and the natural gas goal by 1%. This occurred despite gross realization rates of 41% for electric energy, largely because of a lack of *ex post* gross kWh savings for furnaces with ECM measures, and 54% for gas, due to reduced furnace EFLH and thermostat usage and savings fraction. Achievement was realized because *ex ante* savings far exceeded goals.

Recommendations:

- For future program years, realistic goals should be set, keeping newly reduced unit savings in mind.

CONCLUSION 6: SURVEY RESPONDENTS AND INTERVIEWED CONTRACTORS WERE HIGHLY SATISFIED WITH THE HVAC REBATES PROGRAM AND NIPSCO.

Survey respondents gave high satisfaction rating for all aspects of the program, the program itself, and NIPSCO as their energy provider. Participating contractors said they were highly satisfied with the program and that they would continue participating.

CONCLUSION 7: RESPONDENTS MOST FREQUENTLY LEARN ABOUT THE PROGRAM FROM CONTRACTORS. CONTRACTORS AND CONTRACTOR RELATIONSHIPS ARE INTEGRAL TO PROGRAM SUCCESS.

Respondents reported finding out about the program from their contractor more frequently than any other source. In addition, contractors reported that they inform their customers about the program during the initial stages of customer contact. Contractors and survey respondents both reported that contractors are integral in filling out the rebate application and ensuring the rebates can be successfully submitted.

CONCLUSION 8: CONTRACTORS PROVIDE CRITICAL SUPPORT TO CUSTOMERS, WHO MAY STRUGGLE WITH THE TECHNICAL REQUIREMENTS OF THE REBATE APPLICATION PROCESS. ADDITIONALLY, SOME CONTRACTORS STRUGGLED TO PROCURE COMPLETE INFORMATION FROM CUSTOMERS.

Survey respondents reported that the current rebate application is complicated because it asks for highly technical information; contractors reported that they primarily fill out the application because they have the most industry knowledge. For participants without in depth knowledge of these topics, it may be difficult to fill out independently. This is certainly expected for more complex HVAC measures, and highlights the importance of the contractor in the program delivery process. However, the evaluation team wanted to flag this for consideration as the program adds additional self-install measures to the program, to ensure that the rebate application for these measures is user-friendly. Additionally, some contractors described having a difficult time collecting information necessary to complete the rebate, like customer account number and customer contact information. So, even for simple measures, it may be difficult for customers to complete the applications.

Recommendations:

- While rebate applications for simpler self-install measures, like thermostats, are less complicated than for a furnace, consider monitoring satisfaction and customer requests for assistance as these measures are added to the program. In addition, consider implementing a mid-year survey for participants installing measures like thermostats, electric dryers, and air purifiers to see if they are having difficulty with the rebate application.
- If contractors describe to TRC or NIPSCO that they have difficulty collecting customer information, refer them to the graphic, Tips and Tricks for Gathering Customer Information, where participating contractors shared their strategies for gathering this information.
- Consider creating a leave-behind pamphlet that provides customers with the link to the “check rebate status” page on the NIPSCO website and a contact phone number or email that they can use to receive help on their rebate application. For tune-up participants, this information could be included on the checklist contractors provide to customers.

CONCLUSION 9: RESPONDENTS ARE INTERESTED IN PARTICIPATING IN OTHER ENERGY EFFICIENCY PROGRAMS. IN ADDITION, THEY ARE LOOKING FOR A PLACE TO PROVIDE FEEDBACK.

Survey respondents reported being very interested in other energy efficiency programs offered through NIPSCO. When describing programs that they would like to participate in, they described current program offerings.

Additionally, a few respondents described dissatisfying experiences with the program (i.e., with their contractor or with the rebate).

Recommendations:

- In addition to the program marketing collateral, consider providing contact information and resources to customers. This could include a contact phone number or email that they can use to provide program feedback. For tune-up participants, this information could be included on the checklist contractors provide to customers.
- While there is not a NIPSCO trade ally network, NIPSCO could provide this pamphlet to contractors with the largest number of submitted rebates or those who are listed on the Contractor Finder page.

4. RESIDENTIAL LIGHTING PROGRAM

PROGRAM DESIGN AND DELIVERY

Through the Residential Lighting program, NIPSCO seeks to reduce electric energy consumption and peak demand through increased awareness and adoption of energy-efficient lighting technologies. By partnering with retailers and manufacturers, NIPSCO provides program customers with instant discounts on efficient lighting purchases that meet standards set forth by the DOE ENERGY STAR program. The Lighting program promotes customer awareness and purchase of program-discounted products through a range of marketing and outreach strategies, such as point-of-purchase marketing and promotional materials, website advertising, and in-store lighting events. NIPSCO also provides program training to store staff at participating retailers.

In 2020, NIPSCO offered program discounts on standard and specialty light-emitting diodes (LEDs) and LED fixtures across a wide range of applications, package sizes, and wattages. Participating retailers varied and included big-box stores, do-it-yourself stores, club stores, and discount stores.

TRC implemented the program in 2020 and was responsible for maintaining manufacturer and retailer relationships, providing point-of-purchase materials and in-store training, conducting in-store promotional events, and overseeing data tracking, reporting, and invoicing processes.

PROGRAM PERFORMANCE

Throughout 2020, the Residential Lighting program discounted 1,049,755 light bulbs and fixtures, with counts based on the evaluation team's audit step. The tracking data and scorecard agree on the total program energy savings and demand reduction of 14,161 MWh and 1,895 kW. Table 46 presents a savings summary for the program, including program gross savings goals. In terms of *ex post* gross savings, the program achieved 151% of the electric energy savings goal and 153% of the peak demand reduction goal.

TABLE 46. 2020 RESIDENTIAL LIGHTING PROGRAM SAVINGS SUMMARY

METRIC	GROSS SAVINGS GOAL	*EX ANTE*	AUDITED	VERIFIED	*EX POST* GROSS	*EX POST* NET	GROSS GOAL ACHIEVEMENT
Electric Energy Savings (kWh/yr.)	20,752,960.00	14,160,546.01	14,160,554.41	13,390,703.36	31,311,083.67	14,403,985.61	151%
Peak Demand Reduction (kW)	2,791.422	1,895.387	1,895.395	1,793.631	4,262.311	1,960.787	153%
Natural Gas Energy Savings (therms/yr.)	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 47 outlines the *ex post* gross and NTG adjustment factors.

TABLE 47. 2020 RESIDENTIAL LIGHTING PROGRAM ADJUSTMENT FACTORS

METRIC	REALIZATION RATE (%)[a]	FREERIDERSHIP	SPILLOVER	NTG (%)[b]
Electric Energy Savings (kWh/yr.)	221%	54%	0%	46%
Peak Demand Reduction (kW)	225%	54%	0%	46%
Natural Gas Energy Savings (therms/yr.)	N/A	N/A	N/A	N/A

[a] Realization Rate is defined as *ex post* gross savings divided by *ex ante* savings.

[b] NTG is defined as *ex post* net savings divided by *ex post* gross savings.

Table 48 lists the Residential Lighting program's budget and expenditures. In 2020, the program spent 70% of its electric budget.

TABLE 48. 2020 RESIDENTIAL LIGHTING PROGRAM EXPENDITURES

FUEL	PROGRAM BUDGET	PROGRAM EXPENDITURES	BUDGET SPENT (%)
Electric	$4,268,824.92	$2,988,587.28	70%
Natural Gas	N/A	N/A	N/A

EVALUATION METHODOLOGY

To inform the 2020 Residential Lighting evaluation, the evaluation team completed the following research activities:

- **Utility and implementation staff interviews**, to understand program design and delivery
- **Documentation and materials review,** to provide context on program implementation
- **Tracking data analysis,** to audit and verify the accuracy of program participation data
- **Engineering analysis**, to review available documentation and develop *ex post* gross savings values

IMPACT EVALUATION

This section details each step of the impact evaluation and its associated electric energy savings and peak demand reduction. The evaluation team conducted research activities to answer the following key research questions for the program:

- What are the program's gross energy and demand savings by lamp type?
- What are the program's net savings estimates?
- What assumptions were used to develop savings estimates? Are there any updates that should be made?
- Are there opportunities to focus on different lamp types or increase discounts to maximize energy savings?
- What are the options for improving program data tracking?

AUDITED AND VERIFIED SAVINGS

To audit energy savings and demand reduction, the evaluation team reviewed the program tracking database and checked savings estimates and calculations against the Indiana TRM (v2.2) to confirm accurate application of the assumptions. Following the review, the evaluation team recalculated program energy savings and demand reduction to account for errors, omissions, and inconsistencies identified in the program tracking data.

To confirm consistency in the tracking data, the evaluation team audited bulb quantities by comparing bulb descriptions, numbers of packs, and numbers of units provided in the tracking database. The evaluation team also validated bulb quantities through an analysis of rebate and buy-down dollar amounts, and found that the data were accurate, complete, and comprehensive and did not require any modifications. The evaluation team thoroughly investigated energy savings and demand reduction assumptions. Throughout this investigation, the evaluation team did not identify any significant tracking errors that required adjustments to *ex ante* claimed savings.

The current *ex ante* value assumes an ISR of 100%, per the Indiana TRM. The evaluation team estimated ISRs using first-year in-service rates from a 2015 Opinion Dynamics Market Effects Study, the most current research available from Indiana.[27] To adjust the ISR to take into account carryover savings from delayed installation of program lamps, the evaluation team used the UMP-recommended "Discount Future Savings" method (National Renewable Energy Laboratory/UMP Chapter 21, 2015), which indicated that most bulbs placed in storage (up to 97%) were installed within four years (including the initial program year), with 24% of bulbs left over from Year one installed in Year two, 24% in Year three, and so on. However, given expected baseline lighting changes anticipated to be applied as part of EISA 2007, all standard LEDs are anticipated to effectively function as baseline lamps. Therefore, the evaluation team decided not to extend GSL baseline savings beyond 2023, what would be considered year three in the UMP-recommended method. Using the first-year in-service rates from the 2015 Opinion Dynamics study and this UMP method, the evaluation team calculated an adjusted lifetime ISR of 92% to standard LEDs and a 96% ISR for specialty and reflector lamps, thus accounting for carryover savings, resulting in a weighted lamp ISR of 93%. LED fixtures retained a 100% ISR, as in keeping with prior evaluation years.

Table 49 lists the ISRs for all program-installed measures.

TABLE 49. RESIDENTIAL LIGHTING PROGRAM ISR RATIOS BY MEASURE

MEASURE	ISR
LED Fixture	100%
LED General Service	92%
LED Reflector	96%
LED Specialty	96%

Table 50 summarizes the tracking data quantity, audited quantity, applied in-service rates (ISR), and resulting verified quantity per measure. To calculate the verified measure quantity, the evaluation team multiplied the audited measure quantity by the ISR.

TABLE 50. RESIDENTIAL LIGHTING PROGRAM AUDITED AND VERIFIED QUANTITIES

MEASURE	UNIT OF MEASURE	AUDITED QUANTITY	ISR	VERIFIED QUANTITY
LED Fixture	Fixture	64,354	100%	64,354
LED General Service	Lamp	760,856	92%	699,988
LED Reflector	Lamp	113,973	96%	109,414
LED Specialty	Lamp	110,572	96%	106,149
		1,049,755	93%	979,905

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

EX POST GROSS SAVINGS

The evaluation team determined the program's *ex post* gross energy savings and demand reduction through an engineering analysis. Like the *ex ante* calculations, algorithms included hours of use (HOU), interactive effects, coincident factor (CF) for demand reduction from the Indiana TRM (v2.2), and the recommended baseline watts approach prescribed in the most recent version of the UMP. The evaluation team used a range of data sources to ensure the most recent and accurate savings assumptions were used. The Appendix: Residential lighting Algorithms and Assumptions contains the detailed equations the evaluation team used to calculate 2020 energy savings and demand reduction for the program, and provides a summary table of savings assumptions, their sources, and how they compare to the *ex ante* assumptions.

EX POST GROSS SAVINGS

Table 51 shows the *ex ante* deemed savings and *ex post* gross per-measure savings for the 2020 Residential Lighting program measures. The overall realization rate for the program is 221% for energy savings and 225% for demand reduction (Table 54 and Table 55). The variance in realization rates is largely a product of methodological differences between the evaluation team's calculation of *ex post* savings and the calculation of *ex ante* savings.

Ex ante calculations use the post-2020 EISA requirements to establish baseline wattage, however, the 2020 backstop portion of EISA has not yet been implemented and halogen lamps continue to be available in the market.[28] The evaluation team therefore used the UMP-recommended ENERGY STAR lumens binning approach, with halogen lamps serving as the baseline comparison lamps, to determine baseline wattages for each program lamp consistent with previous evaluation years. The baseline lamp should remain a halogen until EISA is either fully instated or the U.S. Department of Energy determines new rules. This difference in calculation resulted in substantially higher *ex post* per-unit savings for most lamps.[29] We recognize that that market conditions affect savings, and account for those market conditions through the net-to-gross portion of the evaluation (as discussed later).

TABLE 51. 2020 RESIDENTIAL LIGHTING *EX ANTE* AND *EX POST* GROSS PER-MEASURE SAVINGS VALUES

MEASURE	UNIT OF MEASURE	*EX ANTE* DEEMED SAVINGS*		*EX POST* GROSS PER-MEASURE SAVINGS	
		kWh	kW	kWh	kW
LED Fixture	Fixture	38.65	0.005	28.27	0.004
LED General Service	Lamp	9.95	0.001	27.65	0.004
LED Reflector	Lamp	23.80	0.003	43.69	0.006
LED Specialty	Lamp	12.55	0.002	31.44	0.004

**Ex ante* per-measure deemed savings based on audited savings since the scorecard does not provide this detail.

[28] Pending the resolution of several rulemaking processes and lawsuits, the backstop was not enforced by the Trump administration U.S. Department of Energy.

[29] For lamps with lumen output that exceeds those found in standard residential lighting and are outside the bins presented in the appendix, the evaluation team passed through claimed savings for those lamps with stated baselines. Very few of these lamps are present in program data.

Table 52 highlights notable differences between *ex ante* and *ex post* gross estimates.

TABLE 52. 2020 RESIDENTIAL LIGHTING NOTABLE DIFFERENCES BETWEEN *EX ANTE* AND *EX POST* GROSS

MEASURE	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST* GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
All Bulb Types	Post-2020 EISA baseline wattage	UMP lumen equivalence approach to determine baseline wattage and calculate delta watts	The 2020 backstop portion of EISA has not yet been implemented and halogen lamps continue to be available in the market

WASTE HEAT FACTOR - THERM PENALTIES

In 2019, and prior years, the evaluation team did not calculate waste heat factor therm penalties for the Residential Lighting program, as this program is electric-only. In discussions with NIPSCO, for the 2020 evaluation year, the evaluation team will be addressing waste heat factor therm penalties by calculating and applying them within the electric program cost-effectiveness analysis. Therm penalties will not be included in EM&V reported program savings or performance. This approach will be applied consistently for all NIPSCO programs where therm penalties are generated due to LED lighting measures. The evaluation team believes this approach is appropriate, as it accounts for the penalty on the electric side (where it is generated) and allows the evaluation team to show gas program and measure performance more clearly, where applicable. NIPSCO plans to take a similar, consistent approach to account for waste heat factors across programs in their planning process. Table 53 shows the therm penalty calculated for the Residential Lighting program.

TABLE 53. 2020 RESIDENTIAL LIGHTING WASTE HEAT FACTOR THERM PENALTY

MEASURE	EVALUATED EX POST SAVINGS (THERMS)
LED Fixture	(37,163)
LED General Service	(429,778)
LED Reflector	(101,723)
LED Specialty	(71,025)
Total	(639,689)

It should be noted that electric waste heat factors, including cooling credits and electric heating penalties, are currently reported within the kWh and kW savings for the overall program as described in the Appendix. This is consistent with evaluation approaches in previous years.

REALIZATION RATES

The next two tables (Table 54 and Table 55) show the program's *ex ante* reported savings, verified savings, and *ex post* gross savings.

TABLE 54. 2020 RESIDENTIAL LIGHTING *EX ANTE* AND *EX POST* GROSS ELECTRIC ENERGY SAVINGS

MEASURE	*EX ANTE*[a] ELECTRIC ENERGY SAVINGS (kWh/yr.)	AUDITED GROSS ELECTRIC ENERGY SAVINGS (kWh/yr.)	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (kWh/yr)	*EX POST* GROSS ELECTRIC ENERGY SAVINGS (kWh/yr.)
LED Fixture	2,487,359.64	2,487,359.64	2,487,359.64	1,819,022.78
LED General Service	7,573,081.60	7,573,081.60	6,967,235.07	21,036,488.67
LED Reflector	2,712,052.47	2,712,052.47	2,603,570.37	4,979,084.37
LED Specialty	1,388,060.70	1,388,060.70	1,332,538.27	3,476,487.85
Total Savings	14,160,554.41	14,160,554.41	13,390,703.36	31,311,083.67
Total Program Realization Rate				221%

Note: Totals may not sum properly due to rounding.
[a] Values presented at a measure-level represent Audited values, since the scorecard provides only savings totals.

TABLE 55. RESIDENTIAL LIGHTING *EX ANTE* AND *EX POST* GROSS PEAK DEMAND REDUCTION

MEASURE	*EX ANTE*[a] PEAK DEMAND REDUCTION (kW/yr.)	AUDITED GROSS PEAK DEMAND REDUCTION (kW/yr.)	VERIFIED GROSS PEAK DEMAND REDUCTION (kW/yr.)	*EX POST* GROSS PEAK DEMAND REDUCTION (kW/yr.)
LED Fixture	326.052	326.052	326.052	247.994
LED General Service	972.603	972.603	894.795	2,863.346
LED Reflector	397.162	397.162	381.276	677.775
LED Specialty	199.578	199.578	191.595	473.196
Total Savings	1,895.395	1,895.395	1,793.717	4,262.311
Total Program Realization Rate				225%

Note: Totals may not sum properly due to rounding.
[a] Values presented at a measure-level represent Audited values, since the scorecard provides only savings totals.

EX POST NET SAVINGS

The evaluation team used the 2019 net-to-gross values for the 2020 evaluation, as scoped in the evaluation plan. Table 56 shows the freeridership scores by measure.

TABLE 56. NIPSCO 2020 FREERIDERSHIP BY MEASURE

MEASURE	2020 FREERIDERSHIP
LED - Fixture	54%
LED - General Service	54%
LED - Reflector	47%
LED - Specialty	64%
Total Program	54%

Table 57 shows the resulting NTG ratios by measure.

TABLE 57. 2020 RESIDENTIAL LIGHTING PROGRAM NTG RATIOS BY MEASURE

MEASURE	NTG
LED Fixture	46%
LED General Service	46%
LED Reflector	53%
LED Specialty	36%
Total Program	46%

Table 58 presents the resulting net electric savings, demand reduction, and natural gas savings, calculated by applying the net-to-gross ratios to the *ex post* gross savings values.

TABLE 58. 2020 RESIDENTIAL LIGHTING PROGRAM *EX POST* NET SAVINGS

MEASURE	*EX POST* GROSS SAVINGS/REDUCTION			NTG	*EX POST* NET SAVINGS/REDUCTION		
	kWh	kW	therms		kWh	kW	therms
LED Fixture	1,819,022.78	247.994	N/A	46%	836,750.48	114.077	N/A
LED General Service	21,036,488.67	2,863.346	N/A	46%	9,676,784.79	1,317.139	N/A
LED Reflector	4,979,084.37	677.775	N/A	53%	2,638,914.72	359.221	N/A
LED Specialty	3,476,487.85	473.196	N/A	36%	1,251,535.62	170.351	N/A
Total Savings	31,311,083.67	4,262.311	N/A	46%	14,403,985.61	1,960.787	N/A

Note: Totals may not sum properly due to rounding.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSION 1: THE RESIDENTIAL LIGHTING PROGRAM MET SAVINGS TARGETS AND SPENT JUST 70% OF ITS 2020 BUDGET.

Savings goals were exceeded due to methodological differences between *ex ante* and *ex post* savings calculations regarding the EISA 2020 backstop which resulted in much higher per-unit savings than was planned for.

CONCLUSION 2: *EX ANTE* SAVINGS CALCULATIONS ASSUME A POST-2020 EISA BASELINE REPLACEMENT LAMP. SINCE THE EISA 2020 BACKSTOP NEVER WENT INTO EFFECT, THE BASELINE LAMP SHOULD REMAIN AT PRE-2020 VALUES.

The evaluation team determined as part of its confirmation of ex-ante savings that the implementation team used a post-2020 EISA baseline replacement lamp as an input in their calculation of savings. While this is in line with previous years' reports based on the expected implementation of the EISA 2020 backstop, the Trump administration voided that backstop in 2019, effectively extending the period in which halogen lamps would be available in the retail market. The continued presence of halogens on store shelves across the country, and at retailers operating in NIPSCO territory, make the pre-2020 baseline the most appropriate to use for upstream lighting until new rules are promulgated by the Department of Energy.

Recommendations:

- NIPSCO and the implementation team should continue forward with savings approaches as determined by their current lighting agreement. However, the evaluation team will continue to monitor for new guidance from the Department of Energy regarding any changes to recommended baselines, and will communicate these changes with NIPSCO and the implementation teams.
- For the 2021 evaluation, the evaluation team recommends meeting with NIPSCO, TRC, and the OSB to discuss the planned EM&V approach and align on research priorities and approaches.
- During PY2021 evaluation planning, revisit the need to evaluate program net savings. If NIPSCO determines a net-to-gross analysis is warranted, review program performance to date and expected delivery for remaining months to ensure Demand Elasticity Modeling is appropriate. It may also be a worthwhile exercise to review alternative methods, their strengths, and limitations.

5. HEA (HOME ENERGY ANALYSIS) PROGRAM

PROGRAM DESIGN AND DELIVERY

The primary focus of the HEA program is to educate customers about energy efficiency in their homes. Traditionally, the HEA program provides no-cost, in-home energy assessments to residential customers. During an assessment, an energy assessor analyzes the efficiency of the heating and cooling systems and insulation levels in the home and installs energy-saving lighting, water conservation, and other energy-saving measures. The assessment concludes with the assessor providing a report of findings and energy-saving recommendations.

CHANGES FROM 2019 DESIGN

Due to the COVID-19 pandemic, NIPSCO put the in-person HEA program on hold in March 2020, after completing a small number of in-person assessments and equipment installations. In September 2020, NIPSCO began offering virtual assessments through the HEA program. The program implementer, TRC contracted with SEEL to do the virtual assessments. TRC created a waiting list of customers who expressed interest in an in-person assessment throughout 2020. TRC scheduled a virtual assessment with these waitlisted customers once available. Customers not on the waitlist were also able to sign up for the virtual assessment through NIPSCO's website. Per eligibility requirements, the program did not serve customers that received a NIPSCO-sponsored energy assessment in the past three years and a customer could not receive an in-person assessment for one year after receiving the virtual assessment.

SEEL auditors completed the virtual assessments with participants via Microsoft Teams video call or phone call, depending on the customer's preference. The auditors ask participants questions about their home, including the types of energy-using equipment they have. If using video, customers were able to walk around their home and show the auditor the different types of equipment they have as well as other characteristics of their home.

After completing the virtual assessment, the auditor compiled a report containing the information gathered during the virtual assessment, along with recommendations for how the customer can save energy in their home. The auditor discussed the findings with the customer and reviewed instructions for installing and using the items they received in their energy saving kit. After the virtual assessment was completed, the assessment report was emailed to the customer. TRC then mailed the customer an energy-saving kit with the following items, depending on their fuel type:

- Dual Fuel and Electric-Only Kit:
  - 4 LED bulbs (ENERGY STAR certified 9W A-Line)
  - 1 LED nightlight
  - 1 Bathroom faucet aerator (1.0 gpm or less)
  - 1 Kitchen faucet aerator (1.5 gpm or less)
  - 1 Low-flow showerhead
  - 1 HVAC filter whistle
- Gas-Only Kit
  - 2 Bathroom faucet aerators (1.0 gpm or less)
  - 2 Kitchen faucet aerators (1.5 gpm or less)

- 2 Low-flow showerheads
- 1 HVAC filter whistle

PROGRAM PERFORMANCE

The HEA program fell short of its savings goals in 2020 primarily because the program was unable to serve customers for about half of the year because of the COVID-19 pandemic. Further, the program's inability to directly install larger savings equipment, and reliance only on mailed energy savings kits, inhibited program progress against goals.

Table 59 summarizes savings for the program, including program savings goals.

TABLE 59. 2020 HEA PROGRAM SAVINGS SUMMARY

METRIC	GROSS SAVINGS GOAL	*EX ANTE*	AUDITED	VERIFIED	*EX POST* GROSS	*EX POST* NET	GROSS GOAL ACHIEVEMENT
Electric Energy Savings (kWh/yr)	269,374.94	62,565.76	62,565.94	59,262.10	86,536.37	72,771.46	32%
Peak Demand Reduction (kW)	154.534	30.790	30.767	30.495	34.493	31.091	22%
Natural Gas Energy Savings (therms/yr)	59,783.55	13,543.43	13,543.55	13,234.51	15,984.52	14,445.86	27%

Verified savings were somewhat lower than claimed values due to in-service rates (ISR) of select measures, however the engineering analysis completed for the *ex post* gross analysis increased the electric energy, peak demand, and natural gas energy savings values (Table 60).

TABLE 60. 2020 HEA PROGRAM ADJUSTMENT FACTORS

METRIC	REALIZATION RATE (%)[a]	FREERIDERSHIP	SPILLOVER	NTG (%)[b]
Electric Energy Savings (kWh/yr)	138%	16%	0%	84%
Peak Demand Reduction (kW)	112%	10%	0%	90%
Natural Gas Energy Savings (therms/yr)	118%	10%	0%	90%

[a] Realization Rate is defined as *ex post* Gross savings divided by *Ex ante* savings.

[b] NTG is defined as *ex post* net savings divided by *ex post* gross savings.

Due to the program being on hold for most of the year, the HEA program came in well under its budget for 2020, although the spending closely aligns with savings. Table 61 lists the 2020 program budget and expenditures by fuel type.

TABLE 61. 2020 HEA PROGRAM EXPENDITURES

FUEL	PROGRAM BUDGET	PROGRAM EXPENDITURES	BUDGET SPENT (%)
Electric	$158,342.77	$39,310.66	25%
Natural Gas	$213,188.17	$68,603.10	32%

EVALUATION METHODOLOGY

To inform the 2020 NIPSCO impact and process evaluation, the evaluation team completed the following research activities:

- **Utility and implementation staff interviews,** to understand program design and delivery
- **Documentation and materials review,** to provide context on program implementation
- **Tracking data analysis,** to audit and verify the accuracy of program participation data
- **Engineering analysis,** to review program savings assumptions and algorithms for reasonableness and accuracy
- **Online survey of 17 program participants,** to understand source of awareness, reasons for participation, experience with the virtual assessment, satisfaction with the program, and program impacts

IMPACT EVALUATION

This section details each step of the impact evaluation and its associated electric energy savings, peak demand reduction, and natural gas savings. The evaluation team sought to answer the following research questions through the impact evaluation:

- What assumptions were used to develop savings estimates? Are there any updates that should be made?
- What are *ex post* program savings? Do these suggest any needed updates to program design, delivery, or savings assumptions?

The measures evaluated in the impact evaluation include direct install measures that were installed in early 2020 when in-person assessments were still taking place, along with kit measures that were sent to customers after completing the virtual assessment in late 2020.

AUDITED AND VERIFIED SAVINGS

AUDITED SAVINGS

To develop an audited measure quantity and savings, the evaluation team first analyzed the program tracking data for duplicates or other data quality issues and found none. The evaluation team also ensured documented deemed savings were applied correctly and looked for any discrepancies between the program tracking data and the program scorecard and found no issues.

The evaluation team reviewed the kit savings documentation ("NIPSCO Res Measure Calcs") which contained measure-level and kit level savings. Importantly, NIPSCO includes installation rates from past EM&V efforts in their ex-ante assumptions for the kit program. The program documentation included discount rates to adjust savings for both installation practices and water heater fuel saturation.

Upon review of this document, measure-level savings values in the tracking data aligned with NIPSCO's kit savings documentation. However, program tracking data savings are reported at the kit-level with a rounded total kit value, and NIPSCO's Measure Calculation file savings are reported at the measure-level with un-rounded per measure values. This difference in the unit of analysis resulted in rounding errors, meaning that the sum of total audited measure savings was off slightly from the tracking data savings. These rounding errors will be noted where applicable in the remainder of this report.

VERIFIED SAVINGS

IN-SERVICE RATES

The analysis treated in-service rates (ISRs) for direct install and kit measures differently:

- To calculate the verified measure quantity for direct install measures, the evaluation team multiplied the audited measure quantity by the installation rate.
- Kit measure *ex ante* savings account for deemed ISRs. Therefore, instead of adjusting the verified quantity based on the ISR for kit measures, the evaluation team calculated per-unit verified savings using the updated ISR and kept the verified quantity the same as the audited quantity. The per-unit verified savings for kit measures are shown in Table 62.

Given the limited participation in the program, and inability to conduct enough surveys to calculate ISRs, the evaluation team established ISRs for all measures claimed through the HEA program using two different sources:

1. For measures directly installed in early 2020, the evaluation team used ISRs from the 2019 HEA participant survey.
2. For kit measures from the virtual assessments in late 2020, the evaluation team used ISRs from the 2020 NIPSCO HomeLife participant survey[30].

Table 62 lists the ISRs for all program-installed measures.

[30] ISRs calculated from the 2020 HomeLife participant survey were used for the HEA kit measures because the contents of the kit were the same and there was a sufficient sample to calculate ISRs.

TABLE 62. 2020 HEA PROGRAM IN-SERVICE RATES RATIOS BY MEASURE

MEASURE	ISR	SOURCE
LED Bulbs	91%	2019 HEA Survey
Bathroom Aerator	79%	2019 HEA Survey
Kitchen Aerator	82%	2019 HEA Survey
Showerhead	100%	2019 HEA Survey
Pipe Wrap	87%	2019 HEA Survey
Water Heater Wrap[a]	100%	2019 HEA Survey
Duct Sealing	100%	2019 HEA Survey
Insulation	100%	2019 HEA Survey
Furnace Whistle	100%	2019 HEA Survey
Assessment Recommendations	75%	2019 HEA Survey
Virtual Assessment Recommendations	75%	2019 HEA Survey
LED (9W) - Kit	87%	2020 HomeLife Survey
Nightlight - Kit	85%	2020 HomeLife Survey
Bathroom Aerator - Kit	33%	2020 HomeLife Survey
Kitchen Aerator - Kit	44%	2020 HomeLife Survey
Showerhead - Kit	43%	2020 HomeLife Survey
Filter Whistle - Kit	30%	2020 HomeLife Survey

As described in the 2019 report, the ISRs are less than 100% for two reasons: (1) respondents report that a measure was not installed, or that a lower quantity than the program reported was installed, and/or (2) respondents report removing items after installation.

Table 63 summarizes the audited quantity, applied installation rates, and resulting verified quantity per measure for all direct install (non-kit) measures. The table excludes kit quantities. As noted above, kits embed ISRs within *ex ante* calculations (Table 64 documents the *ex ante* and evaluated ISRs for the kit contents). Therefore, it is not possible to cleanly apply ISRs to quantity to show the verified quantity. Further, the tracking data reports at the kit-level versus individual kit components. In total, the program distributed 70 kits (58 dual fuel, 3 electric only, and 9 gas only).

TABLE 63. 2020 HEA PROGRAM AUDITED AND VERIFIED QUANTITIES - DIRECT INSTALL MEASURES

MEASURE	UNIT OF MEASURE	AUDITED QUANTITY	ISR	VERIFIED QUANTITY
A-Line LEDs - Dual Fuel	Lamp	1,367	91%	1,244
A-Line LEDs - Electric	Lamp	29	91%	26
Candelabra LEDs - Dual Fuel	Lamp	444	91%	404
Candelabra LEDs - Electric	Lamp	7	91%	6
Globe LEDs - Dual Fuel	Lamp	234	91%	213
Globe LEDs - Electric	Lamp	8	91%	7
Bathroom Aerator 1.0 gpm - Electric	Aerator	5	79%	4
Bathroom Aerator 1.0 gpm - Gas	Aerator	90	79%	71
Kitchen Aerator 1.5 gpm - Electric	Aerator	3	82%	2
Kitchen Aerator 1.5 gpm - Gas	Aerator	51	82%	42
Low Flow Showerhead 1.5 gpm - Electric	Showerhead	4	100%	4
Low Flow Showerhead 1.5 gpm - Gas	Showerhead	74	100%	74
Low Flow Showerhead with Shower Start - Gas	Showerhead with Shower Start	3	100%	3
Shower Start Only - Gas	Shower Start	2	100%	2
Pipe Wrap - Electric	Per foot	60	87%	52
Pipe Wrap - Gas	Per foot	764	87%	665
Water Heater Wrap - Electric	Water Heater	2	100%	2
Duct Sealing Package - Electric Cooling and Gas Heating	Home	60	100%	60
Duct Sealing Package - Electric Cooling and Heating	Home	1	100%	1
Duct Sealing Package - Gas Heating	Home	35	100%	35
Attic Insulation (Uninsulated Hatch) - Electric Cooling and Gas Heating	Per ksf	15	100%	15
Attic Insulation (Uninsulated Hatch) - Gas Heating	Per ksf	4	100%	4
Filter Whistle - Gas Heating	Whistle	1	100%	1
Assessment Recommendations - Dual Fuel	Home	124	75%	93
Assessment Recommendations - Electric	Home	2	75%	2
Assessment Recommendations - Gas	Home	20	75%	15
Virtual Assessment Recommendations - Dual Fuel	Home	61	75%	46
Virtual Assessment Recommendations - Electric	Home	3	75%	2
Virtual Assessment Recommendations - Gas	Home	10	75%	8
		3,483	N/A	3,103

TABLE 64. 2020 HEA PROGRAM *EX ANTE* AND EMBEDDED ISRS - KIT MEASURES

MEASURE	*EX ANTE* ISR (EMBEDDED IN *EX ANTE* SAVINGS)	EVALUATED ISR (FROM 2020 HOMELIFE SURVEY)
LED (9W) - Kit	86%	87%
Nightlight - Kit	68%	85%
Bathroom Aerator - Kit	38%	33%
Kitchen Aerator - Kit	43%	44%
Showerhead - Kit	49%	43%
Filter Whistle - Kit	15%	30%

KITS

Table 66 summarizes the per unit audited and verified savings values for kits with ISRs applied. As noted above, audited savings already include ISR and water heater saturation adjustments, and these were updated using the current calculated ISRs and water heater saturation adjustment factors.

In addition to ISRs, the savings account for adjustments to water heater fuel types, which affected all water saving devices. The evaluation team used data from the 2020 Home Energy Worksheet (HEW) results from the School Education program[31] to calculate water heater type saturation rates. This study provided a large sample of customers who report their water heater fuel, shown in Table 65. Results indicate a slight discrepancy between *ex ante* and verified electric and natural gas domestic water heating saturation rates.

TABLE 65. 2020 HEA PROGRAM WATER HEATER FUEL SATURATION

SAVINGS TYPE	ELECTRIC WATER HEATING SATURATION RATE (%)	NATURAL GAS WATER HEATING SATURATION RATE (%)
Reported *ex ante*	20%	73%
Verified[a]	23%	64%

[a] Electric and natural gas saturation rates do not total 100% because 7% of respondents replied “Other” and 6% replied “Propane” on the HEW.

[31]Water heater saturation calculated from the 2020 School Education program data was used for the HEA kit measures because the contents of the kit were the same and there was a sufficient sample. The HomeLife survey (used for ISRs and NTG) did not include questions about water heater saturation.

TABLE 66. 2020 HEA AUDITED AND VERIFIED PER UNIT SAVINGS - KIT MEASURES

MEASURE	AUDITED ISRS	VERIFIED ISRS[a]	AUDITED KWH SAVINGS	VERIFIED KWH SAVINGS	AUDITED KW REDUCTION	VERIFIED KW REDUCTION	AUDITED THERM SAVINGS	VERIFIED THERM SAVINGS
LED (9W) - Dual Fuel Kit	86%	87%	30.94	31.17	0.003	0.003	(0.06)	(0.06)
LED (9W) - Electric Only Kit	86%	87%	30.94	31.17	0.003	0.003	0.00	0.00
Nightlight - Dual Fuel Kit	68%	85%	3.58	4.47	0.000	0.000	0.00	0.00
Nightlight - Electric Only Kit	68%	85%	3.58	4.47	0.000	0.000	0.00	0.00
Bathroom Aerator - Dual Fuel Kit	38%	33%	3.87	3.86	0.0002	0.0002	0.62	0.47
Bathroom Aerator - Electric Only Kit	38%	33%	3.87	3.86	0.0002	0.0002	0.00	0.00
Bathroom Aerator - Gas Only Kit	38%	33%	0.00	0.00	0.000	0.000	0.62	0.47
Kitchen Aerator - Dual Fuel Kit	43%	44%	28.71	33.43	0.001	0.001	4.61	4.11
Kitchen Aerator - Electric Only Kit	43%	44%	28.71	33.43	0.001	0.001	0.00	0.00
Kitchen Aerator - Gas Only Kit	43%	44%	0.00	0.00	0.000	0.000	4.61	4.11
Showerhead - Dual Fuel Kit	49%	43%	49.49	50.11	0.002	0.002	7.95	6.17
Showerhead - Electric Only Kit	49%	43%	49.49	50.11	0.002	0.002	0.00	0.00
Showerhead - Gas Only Kit	49%	43%	0.00	0.00	0.000	0.000	7.95	6.17
Filter Whistle - Dual Fuel Kit	15%	30%	8.68	17.39	0.011	0.021	2.49	5.00
Filter Whistle - Electric Only Kit	15%	30%	8.68	17.39	0.011	0.021	0.00	0.00
Filter Whistle - Gas Only Kit	15%	30%	0.00	0.00	0.000	0.000	2.49	5.00

[a] From 2020 HomeLife Survey

EX POST GROSS SAVINGS

The evaluation team reviewed the programs *ex ante* assumptions, sources, and algorithms for reasonableness and updates. Below are detailed *ex post* gross analysis results.

ENGINEERING REVIEW

The evaluation team referred to the Indiana TRM (v2.2) for assumptions to calculate *ex post* gross electric energy savings, demand reduction, and natural gas savings. Where data were unavailable in the Indiana TRM (v2.2), the evaluation team used data from the 2016 Pennsylvania TRM, the Uniform Methods Project (UMP), and findings reported in the 2019 NIPSCO EM&V report. The evaluation team revised assumptions for savings estimates applicable to the NIPSCO service territory, as needed. The Appendix: Home Energy Assessment (HEA) Algorithms and Assumptions contains more details on the specific algorithms, variable assumptions, and references for the direct install program measure *ex post* gross calculations. The Appendix: Homelife Calculator Algorithms and Assumptions contains the approach used for kits.

Through the engineering review, the evaluation team uncovered differences between *ex ante* and *ex post* gross savings. These differences were primarily driven by the following overarching factors:

- The evaluation team referenced the Indiana TRM (v2.2) for most of the measures and used specific characteristics provided within the tracking data for installed measures, and the 2019 EM&V program application materials for variables such as pre- and post-installation R-values, square footage, and project location in *ex post* gross savings. *Ex ante* savings referenced the Indiana TRM (v2.2) for all measures except the shower start measure, which was not included in the Indiana TRM (v2.2). For this measure, the *ex ante* savings referenced the Michigan Energy Measure Database (MEMD), but the evaluation team referenced the Pennsylvania TRM, which allows for inputs that align with the Indiana TRM, including entering water temperature, people per home, and showers per home.

- The evaluation team used the installation zip code to match each customer participating in the 2020 program to the closest city from the Indiana TRM (v2.2)—for example, South Bend and Fort Wayne—to more precisely account for variations in climate for measures including LED bulbs, faucet aerators, low-flow showerheads, duct sealing, and attic insulation. NIPSCO applied values from the previous evaluation, which reflected customers participating in 2019.

EX POST GROSS SAVINGS

Table 67 shows the *ex ante* deemed savings and *ex post* gross per-measure savings for the 2020 HEA program. Table 68 shows *ex ante* deemed savings and *ex post* gross per-measure savings for individual kit measures.

TABLE 67. 2020 HEA PROGRAM *EX ANTE* AND *EX POST* GROSS PER-MEASURE SAVINGS VALUES

MEASURE	UNIT OF MEASURE	*EX ANTE* DEEMED SAVINGS			*EX POST* GROSS PER-MEASURE SAVINGS		
		kWh	kW	therms	kWh	kW	therms
A-Line LEDs - Electric and Gas Savings	Lamp	17.97	0.002	(0.37)	28.49	0.004	0.00
A-Line LEDs - Electric Only Savings	Lamp	17.97	0.002	0.00	28.49	0.004	0.00
Candelabra LEDs - Electric and Gas Savings	Lamp	9.98	0.001	(0.20)	29.33	0.004	0.00
Candelabra LEDs - Electric Only Savings	Lamp	9.98	0.001	0.00	29.33	0.004	0.00
Globe LEDs - Electric and Gas Savings	Lamp	11.98	0.002	(0.24)	28.49	0.004	0.00
Globe LEDs - Electric Only Savings	Lamp	11.98	0.002	0.00	28.49	0.004	0.00
Bathroom Aerator 1.0 gpm - Electric	Aerator	34.39	0.003	0.00	31.64	0.003	0.00
Bathroom Aerator 1.0 gpm - Gas	Aerator	0.00	0.000	1.50	0.00	0.000	1.38
Kitchen Aerator 1.5 gpm - Electric	Aerator	182.12	0.008	0.00	183.13	0.008	0.00
Kitchen Aerator 1.5 gpm - Gas	Aerator	0.00	0.000	7.97	0.00	0.000	7.95
Low Flow Showerhead 1.5 gpm - Electric	Showerhead	350.23	0.017	0.00	310.61	0.017	0.00
Low Flow Showerhead 1.5 gpm - Gas	Showerhead	0.00	0.000	15.23	0.00	0.000	13.51
Low Flow Showerhead with Shower Start - Gas	Showerhead with Shower Start	0.00	0.000	17.30	0.00	0.000	15.77
Shower Start Only - Gas	Shower Start	0.00	0.000	2.70	0.00	0.000	3.96
Pipe Wrap - Electric (per foot)	Per Foot	23.95	0.003	0.00	23.95	0.003	0.00
Pipe Wrap - Gas (per foot)	Per Foot	0.00	0.000	1.07	0.00	0.000	1.07
Water Heater Wrap - Electric	Water Heater	79.00	0.009	0.00	79.00	0.009	0.00
Duct Sealing Package - Electric Cooling and Gas Heating Savings	Home	119.52	0.354	94.14	118.97	0.354	93.96

MEASURE	UNIT OF MEASURE	*EX ANTE* DEEMED SAVINGS			*EX POST* GROSS PER-MEASURE SAVINGS		
		kWh	kW	therms	kWh	kW	therms
Duct Sealing Package - Electric Cooling and Heating Savings	Home	1,260.4	0.354	0.00	1,189.56	0.354	0.00
Duct Sealing Package - Gas Heating Only Savings	Home	0.00	0.000	92.75	0.00	0.000	93.63
Attic Insulation (Uninsulated Hatch) - Electric Cooling and Gas Heating Savings	Per ksf	34.48	0.081	54.13	236.00	0.116	207.00
Attic Insulation (Uninsulated Hatch) - Gas Heating Only Savings	Per ksf	0.00	0.000	54.13	100.20	0.000	217.00
Filter Whistle - Gas Heating Only Savings	Home	0.00	0.000	25.82	0.00	0.000	0.00
Assessment Recommendations - Electric and Gas Savings	Home	21.60	0.012	2.74	21.60	0.012	2.74
Assessment Recommendations - Electric Only	Home	21.60	0.012	0.00	21.60	0.012	0.00
Assessment Recommendations - Gas Only	Home	0.00	0.000	2.74	0.00	0.000	2.74
Virtual Assessment Recommendations - Electric and Gas Savings	Home	21.60	0.012	2.74	21.60	0.012	2.74
Virtual Assessment Recommendations - Electric Only	Home	21.60	0.012	0.00	21.60	0.012	0.00
Virtual Assessment Recommendations - Gas Only	Home	0.00	0.000	2.74	0.00	0.000	2.74
Total Home Energy Analysis Kits - Electric Only Kit	Kit	218.08	0.027	0.00	218.15	0.028	0.00
Total Home Energy Analysis Kits - Gas Only Kit	Kit	0.00	0.000	24.24	0.00	0.000	10.46
Total Home Energy Analysis Kits - Combo Kit	Kit	218.08	0.027	15.42	218.00	0.028	6.33

TABLE 68. 2020 HEA PROGRAM *EX ANTE* AND *EX POST* GROSS PER-MEASURE SAVINGS VALUES – KIT MEASURES

MEASURE	UNIT OF MEASURE	*EX ANTE* DEEMED SAVINGS			*EX POST* GROSS PER-MEASURE SAVINGS		
		kWh	kW	therms	kWh	kW	therms
LED (9W) - Dual Fuel Kit	Lamp	30.94	0.003	(0.06)	31.18	0.003	0.00
LED (9W) - Electric Only Kit	Lamp	30.94	0.003	0.00	31.09	0.003	0.00
Nightlight - Dual Fuel Kit	Nightlight	3.58	0.000	0.00	1.45	0.000	0.00
Nightlight - Electric Only Kit	Nightlight	3.58	0.000	0.00	1.45	0.000	0.00
Bathroom Aerator - Dual Fuel Kit	Aerator	3.87	0.0002	0.62	2.38	0.0002	0.29
Bathroom Aerator - Electric Only Kit	Aerator	3.87	0.0002	0.00	4.31	0.0002	0.00
Bathroom Aerator - Gas Only Kit	Aerator	0.00	0.000	0.62	0.00	0.000	0.29
Kitchen Aerator - Dual Fuel Kit	Aerator	28.71	0.001	4.61	18.33	0.001	2.24
Kitchen Aerator - Electric Only Kit	Aerator	28.71	0.001	0.00	33.06	0.001	0.00
Kitchen Aerator - Gas Only Kit	Aerator	0.00	0.000	4.61	0.00	0.000	2.26
Showerhead - Dual Fuel Kit	Showerhead	49.49	0.002	7.95	30.96	0.002	3.79
Showerhead - Electric Only Kit	Showerhead	49.49	0.002	0.00	55.73	0.002	0.00

MEASURE	UNIT OF MEASURE	*EX ANTE* DEEMED SAVINGS			*EX POST* GROSS PER-MEASURE SAVINGS		
		kWh	kW	therms	kWh	kW	therms
Showerhead - Gas Only Kit	Showerhead	0.00	0.000	7.95	0.00	0.000	3.81
Filter Whistle - Dual Fuel Kit	Whistle	8.68	0.011	2.49	40.16	0.012	0.00
Filter Whistle - Electric Only Kit	Whistle	8.68	0.011	0.00	40.16	0.012	0.00
Filter Whistle - Gas Only Kit	Whistle	0.00	0.000	2.49	0.00	0.000	0.00

Table 69 highlights differences between *ex ante* and *ex post* gross estimates.

TABLE 69. 2020 HEA NOTABLE DIFFERENCES BETWEEN *EX ANTE* AND *EX POST* GROSS

MEASURE	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST GROSS* SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
LED	*Ex ante* savings are based on the Indiana TRM (v2.2). Baseline wattage, ISR, and Hours per TRM. WHF values for South Bend, per TRM tables.	*Ex post* gross savings are based on the Indiana TRM (v2.2), The UMP, and program tracking data. Baseline wattage value per UMP. WHF use TRM weighted average values assigned with ZIP code mapping.	Differences in baseline wattage and WHF assumptions.
Low-Flow Faucet Aerator	*Ex ante* savings are based on the Indiana TRM (v2.2) and the 2019 EMV.	*Ex post* gross savings as based on the Indiana TRM (v2.2); cold-water inlet temperature based on 2020 participant location faucets per home taken from survey data.	Different assumptions for water temperatures and faucets per household.
Low-Flow Showerhead	*Ex ante* savings are based on the Indiana TRM (v2.2) and the 2019 EMV.	*Ex post* gross savings as based on the Indiana TRM (v2.2); cold-water inlet temperature based on 2020 participant location; showerheads per home taken from survey data.	Different assumptions for water temperatures and showerheads per household.
Shower Start	*Ex ante* savings based on 2017 Michigan Energy Measure Database (MEMD) Shower Start measure.	*Ex post* gross savings are based on the PA TRM 2016 Shower Start measure with inputs such as: cold-water inlet, GPM low and base, and minutes per shower taken from the Indiana TRM. Number of showerheads per home taken from survey data.	*Ex ante* savings are deemed, whereas *ex post* gross savings are based on the 2016 PA TRM, which allows for inputs that align with the Indiana TRM, including entering water temperature, people per home, and showers per home.
Attic Insulation	*Ex ante* savings are based on the Indiana TRM (v2.2) with weighted R-values from Better Buildings Calculator.	*Ex post* gross savings are based on the Indiana TRM (v2.2) and insulation values based on a sample of 2019 participant CHA reports. Savings were calculated for each of the sampled participants, and then average savings values, by HVAC system type, were applied across the program. Electric savings are assigned to gas only customers to account for the reduction in furnace fan run time.	Large differences in R-values for pre and post installation contributed to savings differences; *ex ante* savings assumed a higher pre-R value and a lower post- R than determined through evaluation. The *ex post* approach interloped savings values based on the actual insulation levels, whereas the *ex ante* approach assumed average insulation values for the hatch and insulation.
Duct Sealing	*Ex ante* savings are based on the Indiana TRM (v2.2) and the 2019 EMV.	*Ex post* gross savings are based on the Indiana TRM (v2.2), with full load heating and cooling hours based on 2020 participant location.	Different assumptions for full load heating and cooling hours. The *ex post* analysis updated full load heating and cooling hours based on 2020 participant location.

WASTE HEAT FACTOR - THERM PENALTIES

In 2019, and prior years, the evaluation team applied waste heat factors to lighting measures, representing kWh, kW, and therm penalties resulting from LED lighting. In discussions with NIPSCO, for the 2020 evaluation year, the evaluation team is not including therm penalties when calculating evaluated savings. However, cost-effectiveness results will include these penalties and be applied to the electric program cost-effectiveness. The evaluation team believes this approach is appropriate, as it accounts for the penalty on the electric side (where it is generated) and allows the evaluation team to show gas program and measure performance more clearly. NIPSCO plans to take a consistent approach to accounting for waste heat factors in their planning process.

Currently, in their ex-ante assumptions, NIPSCO does not account for therm penalties consistently across programs, and the evaluation team recommends that this approach is made consistent going forward across all programs that offer LED lighting. Currently, the ex-ante savings for all kit programs include therm penalties. These have been removed in the ex-post analysis, and the evaluation team is reporting these below, to be used in the cost-effectiveness analysis. In total, the therm penalty for cost-effectiveness analysis is – 666.17 therms.

TABLE 70. 2020 HEA PROGRAM WASTE HEAT FACTOR THERM PENALTY

MEASURE	WASTE HEAT FACTOR THERM PENALTY
A-Line LEDs - Dual Fuel	(505.79)
Candelabra LEDs - Dual Fuel	(88.80)
Globe LEDs - Dual Fuel	(56.16)
LED (9W) - Dual Fuel Kit	(14.66)
Total	**-666.17**

It should be noted that electric waste heat factors, including cooling credits and electric heating penalties, are currently reported within the kWh and kw savings for the overall program.

REALIZATION RATES

The next three tables (Table 71 through Table 73) show the program's *ex ante* reported savings, verified savings, and *ex post* gross savings. The program achieved electric energy, peak demand reduction, and natural gas energy realization rates of 138%, 112%, and 118%, respectively.

TABLE 71. 2020 HEA PROGRAM *EX ANTE* AND *EX POST* GROSS ELECTRIC ENERGY SAVINGS

MEASURE	*EX ANTE*[a] ELECTRIC ENERGY SAVINGS (kWh/yr)	AUDITED GROSS ELECTRIC ENERGY SAVINGS (kWh/yr)	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (kWh/yr)	*EX POST* GROSS ELECTRIC ENERGY SAVINGS (kWh/yr)
A-Line LEDs - Dual Fuel	24,564.99	24,564.99	22,354.14	35,441.42
A-Line LEDs - Electric	521.13	521.13	474.23	751.87
Candelabra LEDs - Dual Fuel	4,431.12	4,431.12	4,032.32	11,849.90
Candelabra LEDs - Electric	69.86	69.86	63.57	186.82
Globe LEDs - Dual Fuel	2,803.32	2,803.32	2,551.02	6,066.78
Globe LEDs - Electric	95.84	95.84	87.21	207.41

MEASURE	*EX ANTE*[a] ELECTRIC ENERGY SAVINGS (kWh/yr)	AUDITED GROSS ELECTRIC ENERGY SAVINGS (kWh/yr)	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (kWh/yr)	*EX POST* GROSS ELECTRIC ENERGY SAVINGS (kWh/yr)
Bathroom Aerator 1.0 gpm - Electric	171.95	171.95	135.84	124.97
Bathroom Aerator 1.0 gpm - Gas	0.00	0.00	0.00	0.00
Kitchen Aerator 1.5 gpm - Electric	546.36	546.36	448.02	450.50
Kitchen Aerator 1.5 gpm - Gas	0.00	0.00	0.00	0.00
Low Flow Showerhead 1.5 gpm - Electric	1,400.92	1,400.92	1,400.92	1,242.44
Low Flow Showerhead 1.5 gpm - Gas	0.00	0.00	0.00	0.00
Low Flow Showerhead with Shower Start - Gas	0.00	0.00	0.00	0.00
Shower Start Only - Gas	0.00	0.00	0.00	0.00
Pipe Wrap - Electric	1,437.00	1,437.00	1,250.19	1,250.08
Pipe Wrap - Gas	0.00	0.00	0.00	0.00
Water Heater Wrap - Electric	158.00	158.00	158.00	158.00
Duct Sealing Package - Electric Cooling and Gas Heating	7,171.20	7,171.20	7,171.20	7,137.98
Duct Sealing Package - Electric Cooling and Heating	1,260.40	1,260.40	1,260.40	1,189.56
Duct Sealing Package - Gas Heating	0.00	0.00	0.00	0.00
Attic Insulation (Uninsulated Hatch) - Electric Cooling and Gas Heating	526.79	526.79	526.79	3,605.61
Attic Insulation (Uninsulated Hatch) - Gas Heating	0.00	0.00	0.00	373.55
Filter Whistle - Gas Heating	0.00	0.00	0.00	0.00
Assessment Recommendations - Dual Fuel	2,678.40	2,678.40	2,008.80	2,008.80
Assessment Recommendations - Electric	43.20	43.20	32.40	32.40
Assessment Recommendations - Gas	0.00	0.00	0.00	0.00
Virtual Assessment Recommendations - Dual Fuel	1,317.60	1,317.60	988.20	988.20
Virtual Assessment Recommendations - Electric	64.80	64.80	48.60	48.60
Virtual Assessment Recommendations - Gas	0.00	0.00	0.00	0.00
LED (9W) - Dual Fuel Kit	7,177.17	7,177.17	7,231.22	7,234.12
LED (9W) - Electric Only Kit	371.23	371.23	374.03	373.07
Nightlight - Dual Fuel Kit	207.91	207.91	259.45	84.21
Nightlight - Electric Only Kit	10.75	10.75	13.42	4.36
Bathroom Aerator - Dual Fuel Kit	224.47	224.47	223.67	138.32
Bathroom Aerator - Electric Only Kit	11.61	11.61	11.57	12.94
Bathroom Aerator - Gas Only Kit	0.00	0.00	0.00	0.00
Kitchen Aerator - Dual Fuel Kit	1,665.25	1,665.25	1,939.10	1,063.02
Kitchen Aerator - Electric Only Kit	86.13	86.13	100.30	99.19
Kitchen Aerator - Gas Only Kit	0.00	0.00	0.00	0.00
Showerhead - Dual Fuel Kit	2,870.32	2,870.32	2,906.49	1,795.52
Showerhead - Electric Only Kit	148.46	148.46	150.34	167.20

MEASURE	*EX ANTE*[a] ELECTRIC ENERGY SAVINGS (kWh/yr)	AUDITED GROSS ELECTRIC ENERGY SAVINGS (kWh/yr)	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (kWh/yr)	*EX POST* GROSS ELECTRIC ENERGY SAVINGS (kWh/yr)
Showerhead - Gas Only Kit	0.00	0.00	0.00	0.00
Filter Whistle - Dual Fuel Kit	503.71	503.71	1,008.51	2,329.07
Filter Whistle - Electric Only Kit	26.05	26.05	52.16	120.47
Filter Whistle - Gas Only Kit	0.00	0.00	0.00	0.00
Total Savings	**62,565.94**	**62,565.94**	**59,262.10**	**86,536.37**
Total Program Realization Rate				**138%**

Note: Totals may not sum properly due to rounding.

[a] Values presented at a measure-level represent Audited values, since the scorecard provides only savings totals.

TABLE 72. 2020 HEA PROGRAM *EX ANTE* AND *EX POST* GROSS PEAK DEMAND REDUCTION

MEASURE	*EX ANTE*[a] PEAK DEMAND REDUCTION (kW/yr)	AUDITED GROSS PEAK DEMAND REDUCTION (kW/yr)	VERIFIED GROSS PEAK DEMAND REDUCTION (kW/yr)	*EX POST* GROSS PEAK DEMAND REDUCTION (kW/yr)
A-Line LEDs - Dual Fuel	2.734	2.734	2.488	4.829
A-Line LEDs - Electric	0.058	0.058	0.053	0.102
Candelabra LEDs - Dual Fuel	0.444	0.444	0.404	1.615
Candelabra LEDs - Electric	0.007	0.007	0.006	0.025
Globe LEDs - Dual Fuel	0.468	0.468	0.426	0.827
Globe LEDs - Electric	0.016	0.016	0.015	0.028
Bathroom Aerator 1.0 gpm - Electric	0.015	0.015	0.012	0.013
Bathroom Aerator 1.0 gpm - Gas	0.000	0.000	0.000	0.000
Kitchen Aerator 1.5 gpm - Electric	0.024	0.024	0.020	0.021
Kitchen Aerator 1.5 gpm - Gas	0.000	0.000	0.000	0.000
Low Flow Showerhead 1.5 gpm - Electric	0.068	0.068	0.068	0.068
Low Flow Showerhead 1.5 gpm - Gas	0.000	0.000	0.000	0.000
Low Flow Showerhead with Shower Start - Gas	0.000	0.000	0.000	0.000
Shower Start Only - Gas	0.000	0.000	0.000	0.000
Pipe Wrap - Electric	0.180	0.180	0.157	0.143
Pipe Wrap - Gas	0.000	0.000	0.000	0.000
Water Heater Wrap - Electric	0.018	0.018	0.018	0.018
Duct Sealing Package - Electric Cooling and Gas Heating	21.240	21.240	21.240	21.242
Duct Sealing Package - Electric Cooling and Heating	0.354	0.354	0.354	0.354
Duct Sealing Package - Gas Heating	0.000	0.000	0.000	0.000
Attic Insulation (Uninsulated Hatch) - Electric Cooling and Gas Heating	1.237	1.237	1.237	1.772

MEASURE	*EX ANTE*[a] PEAK DEMAND REDUCTION (kW/yr)	AUDITED GROSS PEAK DEMAND REDUCTION (kW/yr)	VERIFIED GROSS PEAK DEMAND REDUCTION (kW/yr)	*EX POST* GROSS PEAK DEMAND REDUCTION (kW/yr)
Attic Insulation (Uninsulated Hatch) - Gas Heating	0.000	0.000	0.000	0.000
Filter Whistle - Gas Heating	0.000	0.000	0.000	0.000
Assessment Recommendations - Dual Fuel	1.488	1.488	1.116	1.116
Assessment Recommendations - Electric	0.024	0.024	0.018	0.018
Assessment Recommendations - Gas	0.000	0.000	0.000	0.000
Virtual Assessment Recommendations - Dual Fuel	0.732	0.732	0.549	0.549
Virtual Assessment Recommendations - Electric	0.036	0.036	0.027	0.027
Virtual Assessment Recommendations - Gas	0.000	0.000	0.000	0.000
LED (9W) - Dual Fuel Kit	0.776	0.776	0.782	0.784
LED (9W) - Electric Only Kit	0.040	0.040	0.040	0.041
Nightlight - Dual Fuel Kit	0.000	0.000	0.000	0.000
Nightlight - Electric Only Kit	0.000	0.000	0.000	0.000
Bathroom Aerator - Dual Fuel Kit	0.014	0.014	0.014	0.014
Bathroom Aerator - Electric Only Kit	0.001	0.001	0.001	0.001
Bathroom Aerator - Gas Only Kit	0.000	0.000	0.000	0.000
Kitchen Aerator - Dual Fuel Kit	0.041	0.041	0.048	0.045
Kitchen Aerator - Electric Only Kit	0.002	0.002	0.002	0.003
Kitchen Aerator - Gas Only Kit	0.000	0.000	0.000	0.000
Showerhead - Dual Fuel Kit	0.095	0.095	0.096	0.097
Showerhead - Electric Only Kit	0.005	0.005	0.005	0.005
Showerhead - Gas Only Kit	0.000	0.000	0.000	0.000
Filter Whistle - Dual Fuel Kit	0.617	0.617	1.236	0.701
Filter Whistle - Electric Only Kit	0.032	0.032	0.064	0.036
Filter Whistle - Gas Only Kit	0.000	0.000	0.000	0.000
Total Savings	**30.767**	**30.767**	**30.495**	**34.493**
Total Program Realization Rate				**112%**

Note: Totals may not sum properly due to rounding.

[a] Values presented at a measure-level represent Audited values, since the scorecard provides only savings totals.

TABLE 73. 2020 HEA PROGRAM *EX ANTE* AND *EX POST* GROSS NATURAL GAS ENERGY SAVINGS

MEASURE	*EX ANTE*[a] NATURAL GAS ENERGY SAVINGS (therms/yr)	AUDITED GROSS NATURAL GAS ENERGY (therms/yr)	VERIFIED GROSS NATURAL GAS ENERGY SAVINGS (therms/yr)	*EX POST* GROSS NATURAL GAS ENERGY SAVINGS (therms/yr)
A-Line LEDs - Dual Fuel	(505.790)	(505.790)	(460.269)	0.000

MEASURE	*EX ANTE*[a] NATURAL GAS ENERGY SAVINGS (therms/yr)	AUDITED GROSS NATURAL GAS ENERGY (therms/yr)	VERIFIED GROSS NATURAL GAS ENERGY SAVINGS (therms/yr)	*EX POST* GROSS NATURAL GAS ENERGY SAVINGS (therms/yr)
A-Line LEDs - Electric	0.00	0.00	0.00	0.00
Candelabra LEDs - Dual Fuel	(88.80)	(88.80)	(80.81)	0.00
Candelabra LEDs - Electric	0.00	0.00	0.00	0.00
Globe LEDs - Dual Fuel	(56.16)	(56.16)	(51.11)	0.00
Globe LEDs - Electric	0.00	0.00	0.00	0.00
Bathroom Aerator 1.0 gpm - Electric	0.00	0.00	0.00	0.00
Bathroom Aerator 1.0 gpm - Gas	135.00	135.00	106.65	97.97
Kitchen Aerator 1.5 gpm - Electric	0.00	0.00	0.00	0.00
Kitchen Aerator 1.5 gpm - Gas	406.47	406.47	333.31	332.38
Low Flow Showerhead 1.5 gpm - Electric	0.00	0.00	0.00	0.00
Low Flow Showerhead 1.5 gpm - Gas	1,127.02	1,127.02	1,127.02	999.83
Low Flow Showerhead with Shower Start - Gas	51.90	51.90	51.90	47.32
Shower Start Only - Gas	5.40	5.40	5.40	7.93
Pipe Wrap - Electric	0.00	0.00	0.00	0.00
Pipe Wrap - Gas	817.48	817.48	711.21	709.84
Water Heater Wrap - Electric	0.00	0.00	0.00	0.00
Duct Sealing Package - Electric Cooling and Gas Heating	5,648.40	5,648.40	5,648.40	5,637.69
Duct Sealing Package - Electric Cooling and Heating	0.00	0.00	0.00	0.00
Duct Sealing Package - Gas Heating	3,246.25	3,246.25	3,246.25	3,277.09
Attic Insulation (Uninsulated Hatch) - Electric Cooling and Gas Heating	827.02	827.02	827.02	3,162.55
Attic Insulation (Uninsulated Hatch) - Gas Heating	201.80	201.80	201.80	808.98
Filter Whistle - Gas Heating	25.82	25.82	25.82	0.00
Assessment Recommendations - Dual Fuel	339.76	339.76	254.82	254.82
Assessment Recommendations - Electric	0.00	0.00	0.00	0.00
Assessment Recommendations - Gas	54.80	54.80	41.10	41.10
Virtual Assessment Recommendations - Dual Fuel	167.14	167.14	125.36	125.36
Virtual Assessment Recommendations - Electric	0.00	0.00	0.00	0.00
Virtual Assessment Recommendations - Gas	27.40	27.40	20.55	20.55
LED (9W) - Dual Fuel Kit	(14.66)	(14.66)	(14.77)	0.00
LED (9W) - Electric Only Kit	0.00	0.00	0.00	0.00
Nightlight - Dual Fuel Kit	0.00	0.00	0.00	0.00
Nightlight - Electric Only Kit	0.00	0.00	0.00	0.00
Bathroom Aerator - Dual Fuel Kit	36.05	36.05	27.52	16.94
Bathroom Aerator - Electric Only Kit	0.00	0.00	0.00	0.00
Bathroom Aerator - Gas Only Kit	11.19	11.19	8.54	5.29

MEASURE	*EX ANTE*[a] NATURAL GAS ENERGY SAVINGS (therms/yr)	AUDITED GROSS NATURAL GAS ENERGY (therms/yr)	VERIFIED GROSS NATURAL GAS ENERGY SAVINGS (therms/yr)	*EX POST* GROSS NATURAL GAS ENERGY SAVINGS (therms/yr)
Kitchen Aerator - Dual Fuel Kit	267.42	267.42	238.56	130.17
Kitchen Aerator - Electric Only Kit	0.00	0.00	0.00	0.00
Kitchen Aerator - Gas Only Kit	41.50	41.50	37.02	20.31
Showerhead - Dual Fuel Kit	460.94	460.94	357.57	219.87
Showerhead - Electric Only Kit	0.00	0.00	0.00	0.00
Showerhead - Gas Only Kit	143.05	143.05	110.97	68.55
Filter Whistle - Dual Fuel Kit	144.71	144.71	289.73	0.00
Filter Whistle - Electric Only Kit	0.00	0.00	0.00	0.00
Filter Whistle - Gas Only Kit	22.46	22.46	44.96	0.00
Total Savings	**13,543.55**	**13,543.55**	**13,234.51**	**15,984.52**
Total Program Realization Rate				**118%**

Note: Totals may not sum properly due to rounding.

a Values presented at a measure-level represent Audited values, since the scorecard provides only savings totals.

EX POST NET SAVINGS

Given the limited participation in the program, and inability to conduct enough surveys to calculate NTG, the evaluation team based the NTG ratios on two sources:

1. For measures directly installed in early 2020, the evaluation team used the NTG ratios from the 2019 HEA participant survey.
2. For kit measures from the virtual assessments in late 2020, the evaluation team used NTG ratios from the 2020 HomeLife participant survey[32].

Participant spillover represents savings that result from purchases and actions taken outside of the program due to program influence. Because the evaluation team captured savings for energy-saving behavior and/or subsequent installation of energy-efficient equipment associated with the energy assessment recommendations measure (for both in-home and virtual), calculating participant spillover would be redundant to those savings. Therefore, spillover is not included in the NTG ratio for the HEA program (consistent with methods used in the 2015 – 2019 evaluations).

In the 2019 evaluation, for four measures, the evaluation team deemed the NTG ratios for the following reasons:

[32] NTG calculated from the 2020 HomeLife participant survey was used for the HEA kit measures because the contents of the kit were the same and there was a sufficient sample to calculate NTG.

- Shower start (stand-alone) and water heater wrap – Program participation for these measures in 2019 was not sufficient to achieve adequate sample sizes. Because of the direct install nature of the program, the team deemed the NTG ratio at 100% for the 2019 program year.
- Attic insulation – There were too few survey responses from participants that received attic insulation (n=2) to be confident in the results. The team deemed the NTG ratio at 80% for the attic insulation which is like the 2018 evaluation results, and results from a similar program in Illinois.[33]
- Assessment recommendations - As in previous evaluations (2015 – 2018), the evaluation team used an NTG ratio of 100% for the assessment recommendations measure because participants would not have received the recommendations if they had not participated in the program. In 2020, the evaluation team used this same approach for the Virtual Assessment recommendations.

Table 74 shows the NTG ratios by measure.

TABLE 74. 2020 HEA PROGRAM NET-TO-GROSS RATIOS BY MEASURE

MEASURE	NTG	SOURCE
LED Bulbs	81%	2019 HEA Survey
Bathroom Aerator	96%	2019 HEA Survey
Kitchen Aerator	96%	2019 HEA Survey
Showerhead	93%	2019 HEA Survey
Shower Start (stand-alone)*	100%	2019 HEA Survey
Pipe Wrap	94%	2019 HEA Survey
Water Heater Wrap*	100%	2019 HEA Survey
Duct Sealing	93%	2019 HEA Survey
Attic Insulation*	80%	2019 HEA Survey
Assessment Recommendations*	100%	2019 HEA Survey
Virtual Assessment Recommendations*	100%	2019 HEA Survey
LED (9W) - Kit	80%	2020 HomeLife Survey
Nightlight - Kit	87%	2020 HomeLife Survey
Bathroom Aerator - Kit	93%	2020 HomeLife Survey
Kitchen Aerator - Kit	95%	2020 HomeLife Survey
Showerhead - Kit	94%	2020 HomeLife Survey
Filter Whistle - Kit	100%	2020 HomeLife Survey

*NTG ratios for these measures were deemed for reasons explained above.

[33] https://s3.amazonaws.com/ilsag/AIC_2019_NTGR_Recommendations_Summary_FINAL_2018-09-25.pdf

Table 170 presents the resulting net electric savings, demand reduction, and natural gas savings after applying the NTG ratios to the *ex post gross* savings.

TABLE 75. 2020 HEA PROGRAM *EX POST* NET SAVINGS

MEASURE	*EX POST* GROSS SAVINGS/REDUCTION			NTG	*EX POST* NET SAVINGS/REDUCTION		
	kWh	kW	therms		kWh	kW	therms
A-Line LEDs - Dual Fuel	35,441.42	4.829	0.00	81%	28,601.22	3.897	0.00
A-Line LEDs - Electric	751.87	0.102	0.00	81%	606.76	0.083	0.00
Candelabra LEDs - Dual Fuel	11,849.90	1.615	0.00	81%	9,562.87	1.303	0.00
Candelabra LEDs - Electric	186.82	0.025	0.00	81%	150.77	0.021	0.00
Globe LEDs - Dual Fuel	6,066.78	0.827	0.00	81%	4,895.89	0.667	0.00
Globe LEDs - Electric	207.41	0.028	0.00	81%	167.38	0.023	0.00
Bathroom Aerator 1.0 gpm - Electric	124.97	0.013	0.00	96%	119.60	0.012	0.00
Bathroom Aerator 1.0 gpm - Gas	0.00	0.000	97.97	96%	0.00	0.000	93.76
Kitchen Aerator 1.5 gpm - Electric	450.50	0.021	0.00	96%	433.38	0.020	0.00
Kitchen Aerator 1.5 gpm - Gas	0.00	0.000	332.37	96%	0.00	0.000	319.74
Low Flow Showerhead 1.5 gpm - Electric	1,242.44	0.068	0.00	93%	1,159.19	0.064	0.00
Low Flow Showerhead 1.5 gpm - Gas	0.00	0.000	999.83	93%	0.00	0.000	932.84
Low Flow Showerhead with Shower Start - Gas	0.00	0.000	47.32	93%	0.00	0.000	44.15
Shower Start Only - Gas	0.00	0.000	7.93	100%	0.00	0.000	7.93
Pipe Wrap - Electric	1,250.08	0.143	0.00	94%	1,175.08	0.134	0.00
Pipe Wrap - Gas	0.00	0.000	709.84	94%	0.00	0.000	667.25
Water Heater Wrap - Electric	158.00	0.018	0.00	100%	158.00	0.018	0.00
Duct Sealing Package - Electric Cooling and Gas Heating	7,137.98	21.242	5,637.69	93%	6,666.88	19.840	5,265.60
Duct Sealing Package - Electric Cooling and Heating	1,189.56	0.354	0.00	93%	1,111.05	0.331	0.00
Duct Sealing Package - Gas Heating	0.00	0.000	3,277.09	93%	0.00	0.000	3,060.80
Attic Insulation (Uninsulated Hatch) - Electric Cooling and Gas Heating	3,605.61	1.772	3,162.55	80%	2,884.49	1.418	2,530.04
Attic Insulation (Uninsulated Hatch) - Gas Heating	373.55	0.000	808.98	80%	298.84	0.000	647.18
Filter Whistle - Gas Heating	0.00	0.000	0.00	100%	0.00	0.000	0.00
Assessment Recommendations - Dual Fuel	2,008.80	1.116	254.82	100%	2,008.80	1.116	254.82
Assessment Recommendations - Electric	32.40	0.018	0.00	100%	32.40	0.018	0.00
Assessment Recommendations - Gas	0.00	0.000	41.10	100%	0.00	0.000	41.10
Virtual Assessment Recommendations - Dual Fuel	988.20	0.549	125.36	100%	988.20	0.549	125.36
Virtual Assessment Recommendations - Electric	48.60	0.027	0.00	100%	48.60	0.027	0.00
Virtual Assessment Recommendations - Gas	0.00	0.000	20.55	100%	0.00	0.000	20.55
LED (9W) - Dual Fuel Kit	7,234.12	0.784	0.00	80%	5,787.29	0.627	0.00
LED (9W) - Electric Only Kit	373.07	0.041	0.00	80%	298.45	0.032	0.00
Nightlight - Dual Fuel Kit	84.21	0.000	0.00	87%	73.27	0.000	0.00
Nightlight - Electric Only Kit	4.36	0.000	0.00	87%	3.79	0.000	0.00

MEASURE	*EX POST* GROSS SAVINGS/REDUCTION			NTG	*EX POST* NET SAVINGS/REDUCTION		
	kWh	kW	therms		kWh	kW	therms
Bathroom Aerator - Dual Fuel Kit	138.32	0.014	16.94	93%	128.63	0.013	15.75
Bathroom Aerator - Electric Only Kit	12.94	0.001	0.00	93%	12.04	0.001	0.00
Bathroom Aerator - Gas Only Kit	0.00	0.000	5.29	93%	0.00	0.000	4.92
Kitchen Aerator - Dual Fuel Kit	1,063.02	0.045	130.17	95%	1,009.87	0.043	123.66
Kitchen Aerator - Electric Only Kit	99.19	0.003	0.00	95%	94.23	0.002	0.00
Kitchen Aerator - Gas Only Kit	0.00	0.000	20.31	95%	0.00	0.000	19.30
Showerhead - Dual Fuel Kit	1,795.52	0.097	219.87	94%	1,687.78	0.091	206.68
Showerhead - Electric Only Kit	167.20	0.005	0.00	94%	157.17	0.005	0.00
Showerhead - Gas Only Kit	0.00	0.000	68.55	94%	0.00	0.000	64.43
Filter Whistle - Dual Fuel Kit	2,329.07	0.701	0.00	100%	2,329.07	0.701	0.00
Filter Whistle - Electric Only Kit	120.47	0.036	0.00	100%	120.47	0.036	0.00
Filter Whistle - Gas Only Kit	0.00	0.000	0.00	100%	0.00	0.000	0.00
Total Savings	86,536.37	34.493	15,984.52		72,771.46	31.091	14,445.86

Table 76 shows the NTG for each fuel, which ranged from 84% for electric energy savings (kWh) to 90% for peak demand reduction (kW) and natural gas energy savings (therms).

TABLE 76. 2020 HEA NTG RESULTS BY FUEL TYPE

SAVINGS TYPE	*EX ANTE* GROSS SAVINGS	*EX POST* GROSS SAVINGS	NTG RATIO (%)	*EX POST* NET SAVINGS
Electric Energy Savings (kWh/yr)	62,565.76	86,536.37	84%	72,771.46
Peak Demand Reduction (kW)	30.790	34.493	90%	31.091
Natural Gas Energy Savings (therms/yr)	13,543.43	15,984.52	90%	14,445.86

PROCESS EVALUATION

This section describes the evaluation team’s process evaluation findings derived from conducting interviews with NIPSCO and TRC program staff, reviewing program materials, and surveying virtual HEA program participants. The evaluation team sought to answer the following process-related research questions through these research activities:

- What was the customer experience with the program, from sign-up through completion?
- How did customers become aware of the program?
- What were customer motivations for participation?
- How satisfied were customers with the program, including the participation process, interactions with the program implementer, the assessment report, and the kit they received?
- Would customers have preferred an in-home assessment?
- What do participants recommend for program improvement?

- During the virtual assessment, were customers given additional energy savings tips that they have put into practice? If yes, what have they done?
- How has COVID-19 affected customers' behaviors and energy usage?
- What are the demographics of customers who participated in the Virtual HEA program.

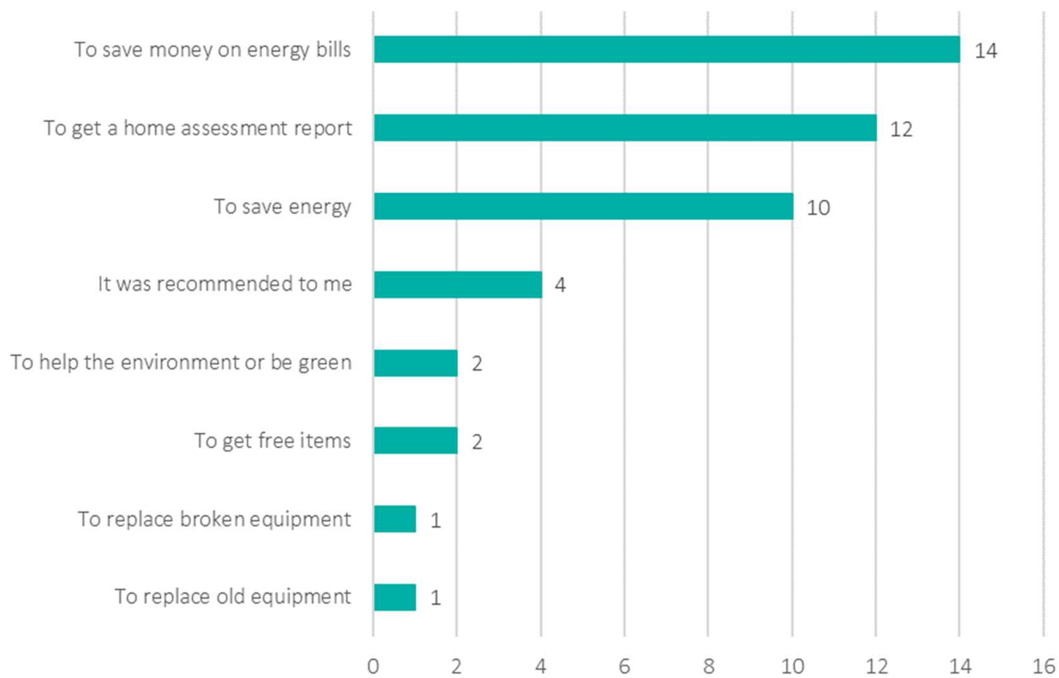
PARTICIPANT FEEDBACK

The evaluation team surveyed 17 customers who participated in the virtual HEA program[34]. The following sections describe the results related to reasons for participation, experience with the virtual assessment, and satisfaction with the program.

PARTICIPATION DRIVERS

Surveyed participants were asked to select all the factors that motivated their decision to participate in the virtual HEA program. The most mentioned reasons were to save money on energy bills (n=14), to get a home assessment report (n=12), and to save energy (n=10). These were also the top three participation drivers in 2019.

FIGURE 30. REASONS FOR PARTICIPATING IN THE VIRTUAL HEA PROGRAM



Source: Participant survey. Question: "Why did you decide to participate in NIPSCO's Virtual HEA program?"

[34] There were 15 participants that completed the survey in full and 2 that partially completed. Due to the small available population, the partial completes are included in our analysis, when applicable.

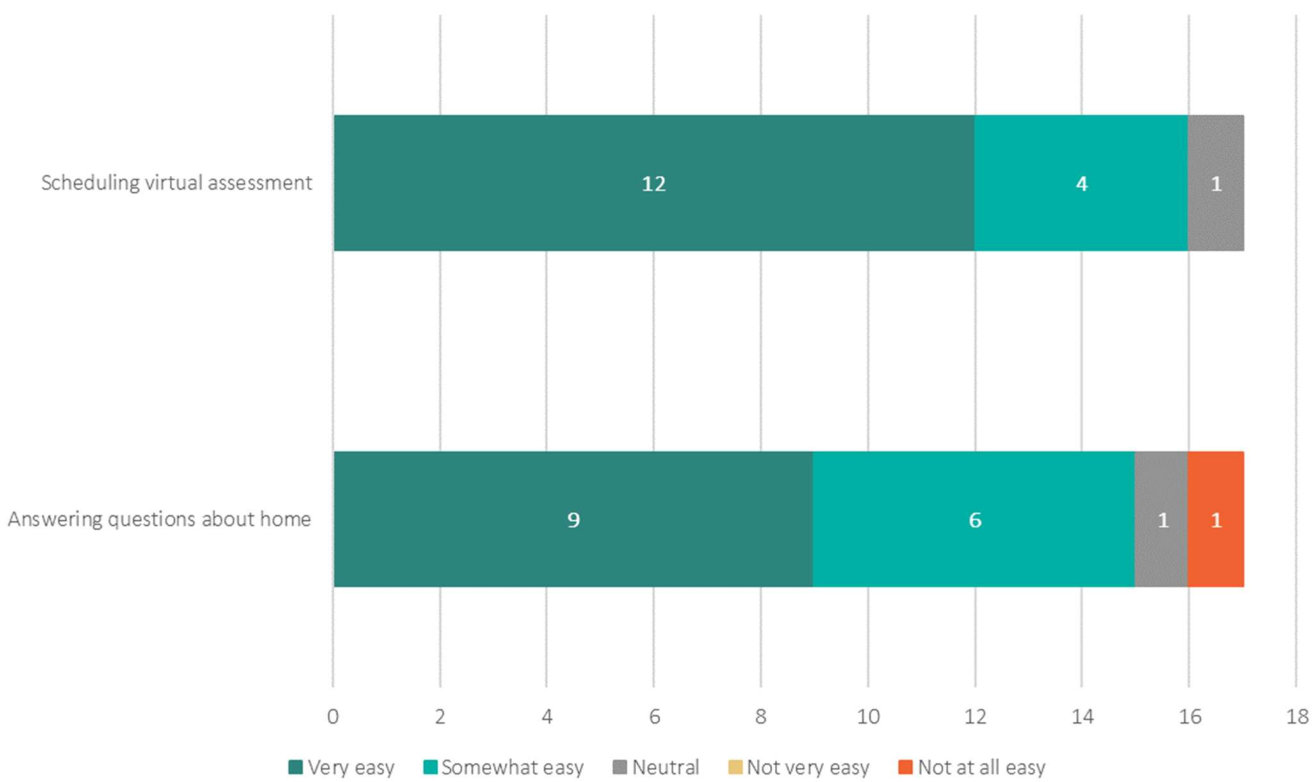
In interviews with the two SEEL auditors who conducted virtual assessments with customers, it was mentioned that a potential barrier to participation was the restriction on receiving an in-home energy assessment after getting a virtual assessment. According to the program rules, a customer cannot receive an in-person assessment for one year after receiving the virtual assessment. The SEEL auditors cited this as a common reason that customers were denying a virtual assessment, and instead remaining on the waitlist for an in-person visit.

VIRTUAL ASSESSMENT EXPERIENCE

Most surveyed participants had been on the waitlist for an in-person assessment when they were contacted about the option of a virtual assessment (n=12). All but one surveyed participant said it was very or somewhat easy to schedule their virtual assessment (n=16). More surveyed participants participated in the virtual assessment via a video call (n=11) than over the phone (n=6).

All but two surveyed participants said it was very or somewhat easy to answer the questions about their home during the virtual assessment (n=15). One respondent was neutral, and one said it was not at all easy to answer the questions.

FIGURE 31. EASE OF COMPLETING VIRTUAL ASSESSMENT



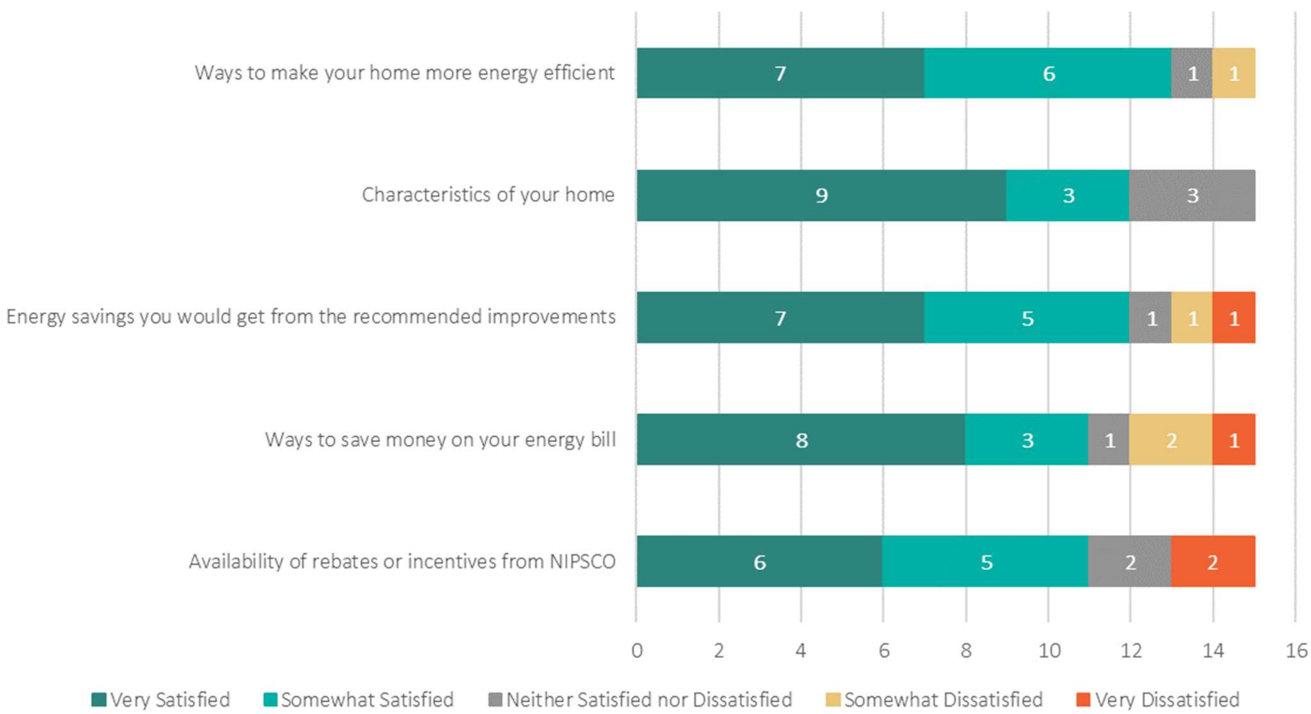
Source: Participant survey. Questions: “How easy was it to schedule your virtual energy assessment?” “How easy was it to answer the questions about your home during your virtual assessment?”

Despite the ease of the virtual assessment, most surveyed participants indicated that they still would have preferred to receive an in-person assessment if the option had been available to them (n=13). Of these, all but one said they would have allowed an auditor into their home at the time they received the virtual assessment. Only two surveyed participants said they would not have preferred the in-person visit.

VIRTUAL ASSESSMENT REPORT

Two surveyed participants reported that they did not receive their assessment report at all after completing the virtual assessment. Those who did receive the report were satisfied with the report. Specifically, almost all respondents said that they were very or somewhat satisfied with how the report explained ways to make their home more efficient (n=13). Also receiving high satisfaction was the way the report explained the energy savings they would get from the improvements that were recommended in the report, and the characteristics of their home (n=12 very or somewhat satisfied). The aspect of the report that received the lowest satisfaction ratings was the way it explained the availability of rebates or incentives from NIPSCO, with two customers who were neutral and two who were very dissatisfied.

FIGURE 32. SATISFACTION WITH ASPECTS OF ASSESSMENT REPORT



Source: Participant survey. Questions: "How satisfied were you with how the report explained each of the following?"

Most surveyed participants said it was very or somewhat easy to understand the assessment report (n=14), and that the information provided in the report was very or somewhat useful (n=11). Four surveyed participants said the report was not very useful, explaining that they already knew the information, or had already done the recommendations included in the report.

There were five surveyed participants with suggestions for improving the virtual assessment and/or assessment report. The suggestions that were given are listed below:

- "Explain other services NIPSCO has for those trying to make the home energy efficient."
- "Follow up. My meters were supposed to be checked, never heard any feedback."
- "Have a better understanding of my electric usage."
- "I never received my report, and I sent an email but never heard back."

- "Use better prepared or experienced people."

RECOMMENDED IMPROVEMENTS

Most surveyed participants reported receiving low or no-cost improvement recommendations to save energy in their home during their virtual assessment or in the assessment report (n=12). Of those, all but two said they acted on at least one of the recommendations. Below are the reported recommendations that respondents acted on because of the recommendations given during the virtual assessment:

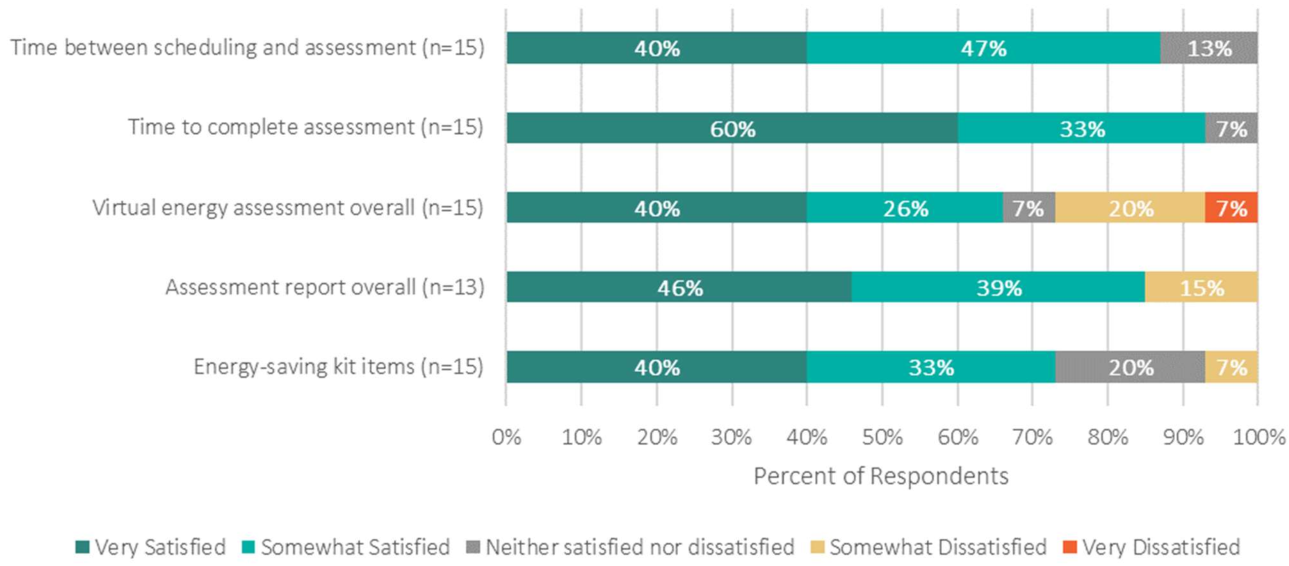
- Caulked windows (n=3)
- Installed LED bulbs (n=2)
- Installed new windows (n=2)
- Installed a new furnace and air conditioner (n=1)
- Insulated outlets and switches, added insulation strips to attic entry, windowsills, and garage door (n=1)
- Installed a new thermostat (n=1)
- Changed fan setting on furnace (n=1)
- Installed new siding with insulation (n=1)
- Fixed air drafts (n=1)

The two surveyed participants who had not acted on the suggested recommendations said that they had already done the recommended actions prior to receiving their virtual assessment.

SATISFACTION WITH VIRTUAL ENERGY ASSESSMENT

Respondents were satisfied with the virtual assessment process. The time it took to complete the virtual assessment received the highest ratings with all but one surveyed participant rating their satisfaction as very or somewhat satisfied. While respondents rate the process highly, they were less satisfied with the virtual assessment overall, with a few respondents saying they were somewhat or very dissatisfied (n=4).

FIGURE 33. SATISFACTION WITH THE VIRTUAL ENERGY ASSESSMENT



Source: Participant survey. Questions: "How satisfied were you with each of the following?"

SATISFACTION WITH PROGRAM

About two-thirds of surveyed participants said they were very or somewhat satisfied with the virtual HEA program overall (n=10). Four surveyed participants said they were very or somewhat dissatisfied and one was neutral. The two surveyed participants who did not receive their assessment report said they were somewhat dissatisfied with the program overall.

FIGURE 34. SATISFACTION WITH THE VIRTUAL HEA PROGRAM

Source: Participant survey. Questions: "How satisfied are you with NIPSCO's Virtual HEA program?"

Surveyed participants were asked to explain their satisfaction rating for the overall program. Positive comments included satisfaction with the kit items, the auditors and the information learned from the assessment and report. Consistent with respondents' recommended improvements, negative comments included not learning anything new from the assessment and report, and not receiving the assessment report at all. A selection of direct quotes from the survey are shown below.

Very or Somewhat Satisfied

- "It was helpful in giving me ideas about how to be more energy efficient"
- "I liked the free items"
- "The assessor that I worked with did a nice job of helping verify some of the major energy offenders"
- "They weren't rushed. The right questions got the right assessment answers from me. I knew my home of 50 years but needed a little help."

Neither Satisfied nor Dissatisfied

- "It's a nice resource but not very informative done virtually"

Somewhat or Very Dissatisfied

- "Nothing new was suggested or offered and the significant use and billing increase that occurred for several months was not addressed at all adequately."
- "While I felt the virtual video chat was somewhat effective, there was a lot of information to absorb and I was told I would receive a report with all the findings and recommendations. I never received a report despite sending numerous emails to verify status of said report--I never received a response to any of those emails at all."

SATISFACTION WITH NIPSCO

Overall, surveyed participants were satisfied with NIPSCO as their energy provider. All but two surveyed participants said that they were very or somewhat satisfied with NIPSCO. The other two participants were somewhat dissatisfied with NIPSCO.

COVID IMPACTS

Surveyed participants were asked how the COVID-19 pandemic affected their household and energy use. Overall, respondents reported that the average number of people living in their home did not change between 2019 and 2020 (an average of three household members). Most surveyed participants reported that at least one adult in their household was working outside of the home (n=9), and another six said that at least one adult in their household was retired. Four surveyed participants said that their employment situation changed because of the pandemic. Two said they were no longer working, one said they were primarily working from home, and one said they had one adult working from home and one who was laid off.

About half of surveyed participants said they expected their income in 2020 to be about the same as it was in 2019 (n=8). Another four said they expected their 2020 income to be higher than 2019, and two said they thought it would be lower.

Most surveyed participants said that the amount of time they spend at home in 2020 increased either by a little or a lot compared to 2019 (n=12). Most also said that the amount of energy their household used in 2020 increased either by a little or a lot compared to 2019 (n=11). One person said that their energy use decreased a little in 2020 compared to 2019. All but two surveyed participants said that their electric bill increased either by a little or a lot compared to 2019.

Over one-half of surveyed participants said that they made improvements to their home during the pandemic (n=9), and more than half of those improvements were not planned before the pandemic (n=5). Some of these improvements included:

- Door hardware updates
- Lighting upgrades
- New windows
- New countertops
- Landscaping
- New concrete patio
- Appliance upgrades
- Weatherstripping

When asked what NIPSCO can do to help their customers during this time, the most common response was to offer a discount on bills, or a bill deferral period (n=5). One respondent said that NIPSCO could offer to help fix broken equipment for those who are not financially able to fix it themselves.

RESPONDENT DEMOGRAPHICS

All but two surveyed participants had single-family detached homes, and all but one owned their residence. Most used natural gas as a fuel for their water heating (n=10) and for heating (n=13).

TABLE 77. HOME CHARACTERISTICS OF SURVEYED HEA PARTICIPANTS

HOME CHARACTERISTICS	COUNT	PERCENT
Type of residence		
Single-family detached home	13	86.7%
Multifamily apartment or condo building (with 4 or more units)	1	6.7%
Attached house (townhouse, row house, or twin)	1	6.7%
Total	15	100.0%
Ownership of residence		
Own	14	93.3%
Rent	1	6.7%
Total	15	100.0%
Primary fuel source for water heating		
Electricity	3	21.4%
Natural gas	10	71.4%
Propane	1	7.1%
Total	14	100.0%
Primary fuel source for heating		
Electricity	1	6.7%
Natural gas	13	86.7%

HOME CHARACTERISTICS	COUNT	PERCENT
Propane	1	6.7%
Total	15	100.0%
Year home was built		
Before 1900	1	6.7%
1900 to 1939	2	13.3%
1940 to 1959	4	26.7%
1960 to 1979	1	6.7%
1990 to 1999	3	20.0%
2000 to 2004	1	6.7%
2005 or later	3	20.0%
Total	15	100.0%

Source: Participant survey. Questions: "What type of residence do you live in?" "Do you own or rent your residence?" "Which of the following is the primary fuel source used for water heating in your home?" "Which of the following is the primary fuel you use to heat your home?" "When was your home built?"

Demographic characteristics were varied among surveyed participants. About one-half reported having lived in their home for five years or less (n=8). One-third were born between 1940 and 1959 and another third were born between 1960 and 1979. Almost three-fourths had a least a 4-year college degree (n=11).

TABLE 78. DEMOGRAPHICS OF SURVEYED HEA PARTICIPANTS

PARTICIPANT DEMOGRAPHICS	COUNT	PERCENT
Number of years lived in home		
2-3 years	5	33.3%
4-5 years	3	20.0%
6-10 years	1	6.7%
More than 10 years	6	40.0%
Total	15	100.0%
Year born		
1900 to 1939	1	6.7%
1940 to 1959	5	33.3%
1960 to 1979	5	33.3%
1980 to 1989	3	20.0%
1990 to 1999	1	6.7%
Total	15	100.0%
Highest level of education completed		
Some college, no degree	2	13.3%
Two-year college degree	2	13.3%
Four-year college degree	6	40.0%
Graduate or professional degree	5	33.3%
Total	15	100.0%

Source: Participant survey. Questions: “How many years have you lived in your current home?” “In what year were you born?” “What is the highest level of education you have completed?”

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSION 1: RESPONDENTS WERE SATISFIED WITH THE VIRTUAL ASSESSMENTS BUT WOULD HAVE PREFERRED AN IN-PERSON VISIT.

Two-thirds of surveyed respondents were satisfied with the program overall and most reported that the process was easy, but almost all indicated that they would have preferred an in-person visit had it been offered as an option in 2020. Surveyed participants indicated that they received good suggestions from the virtual assessment and assessment report, but the experience would have been more beneficial had it been in person. It is worth noting that the customers who received a virtual assessment had the option to remain on the wait list for an in-person assessment but chose to receive the virtual assessment instead.

Recommendations:

- When able to, NIPSCO should resume its usual in-person assessments and equipment installs through the HEA program as participants seem to prefer this experience over the virtual one.
- Explore ways to improve the virtual assessments if they continue to be a part of NIPSCO’s program offering, including more customized tips and recommendations. Consider additional evaluation activities in program year 2021 to better understand target markets and customer needs for the differing assessment services currently offered by NIPSCO.

CONCLUSION 2: REPORT DELIVERY AND CONTENT PRESENT OPPORTUNITIES FOR IMPROVEMENT.

While only two surveyed participants reported that they did not receive their assessment report, this resulted in lower satisfaction with the program overall. Most surveyed participants said the report was useful, but those who did not indicated that the report included information that they already knew and recommended improvements that they had already done. There is also opportunity to include more information about other NIPSCO program offerings. Information about the availability of rebates or incentives from NIPSCO was the lowest rated aspect of the assessment report with only 11 respondents indicating that they were very or somewhat satisfied with the level of information provided.

Recommendations:

- Through current QA/QC procedures, continue to monitor customer receipt of report and cross-channeling materials. Additionally, consider fielding a live-time post-assessment survey to gather information regarding some of the issues raised by customers qualitatively in this evaluation, such as receipt of their report and cross channeling materials as well as the relevancy of the recommendations included in the report.

CONCLUSION 3: FURTHER RESEARCH MAY BE NEEDED TO DETERMINE IF THE VIRTUAL HOME ENERGY ASSESSMENT PROGRAM SHOULD CONTINUE TO BE OFFERED IN TANDEM WITH THE TRADITIONAL IN-PERSON HOME ENERGY ASSESSMENT PROGRAM.

While almost all surveyed participants indicated that they would have preferred an in-person assessment, it may be worthwhile to conduct additional research with a wider pool of virtual assessment recipients to determine if there is a group that may be better served by a virtual assessment, compared to an in-person visit. Further research could also be conducted to consider the longer-term costs of the HEA program and whether retaining the virtual assessments as an option would make the program more cost-effective.

CONCLUSION 4: WASTE HEAT FACTORS ARE NOT APPLIED CONSISTENTLY ACROSS PROGRAMS.

Waste heat factor adjustments *are* applied to qualifying residential measures in kits or direct install programs (e.g., LED lights). However, these adjustments are *not* made to qualifying commercial and industrial measure savings performance. Going forward, both NIPSCO and the evaluation team propose addressing therm penalties within electric program cost-effectiveness.

Recommendations:

- Address waste heat factors consistently across programs in ex-ante savings. If this should be addressed in cost-effectiveness, this factor should be calculated for use in cost effectiveness analyses but not applied against *ex ante* or *ex post* program performance.
- Correct error in ex-ante waste heat factor therm calculations. For kit programs, this factor is being calculated as MMBTU but not converted to therm savings.

6. APPLIANCE RECYCLING PROGRAM

PROGRAM DESIGN AND DELIVERY

NIPSCO offers the Appliance Recycling program to incent customers to remove their inefficient secondary refrigerators and freezers. Recycling these secondary units can provide long term energy savings by removing the inefficient appliances from the grid. The program implementer picks up appliances and recycles them in an environmentally friendly manner and customers receive a $50 rebate. The implementer fulfills rebates by issuing rebates directly to customers and receiving reimbursement from TRC. In the 2020 program year, the program recycled 1,163 appliances. Of these, 987 were refrigerators and 176 were freezers.

TRC and NIPSCO utilized the services of Recleim to schedule and pickup appliances, carry out the recycling functions, and process the rebates for the Appliance Recycling program. This program had to shift program delivery and operations in 2020 due to the COVID-19 pandemic; these changes are discussed in more detail below.

In the first quarter of 2020, the program operated similarly to program year 2019. After customers learned about the Appliance Recycling program, they could participate by scheduling a pickup with Recleim over the phone or via an online scheduler. Recleim's pickup crew called customers the day before their pickup and while the driver was in route. On site, Recleim's pickup crew members confirmed the appliances' eligibility (i.e., whether they are plugged in, operational, and the correct size) and removed the appliances for transport to the processing centers. The Recleim pickup crew input the unit's information, including their assessment of the appliance's age and other characteristics, into the TRC database once they have left the customer's home.

NIPSCO marketed the program to customers in various ways in 2020, including through bill inserts, billboards, emails, the NIPSCO website, NIPSCO's social media, and cross-promotion through other programs such as the kit programs. Marketing via leave-behinds during HEA or IQW visits and in-person NIPSCO events were not possible due to the COVID-19 pandemic. NIPSCO had planned an extensive ad campaign for Q2 of 2020 but it was cancelled due to the pandemic. Instead, they shifted to using social media.

The program paused in March 2020 due to the COVID-19 pandemic. When the program started again in September 2020, Recleim started implementing curbside pickup. The curbside pickup model worked like the previous model, but specialists would retrieve the appliance from the curb or a garage instead of going into the customer's home.

In 2021, the program implementation will be conducted by ARCA.

CHANGES FROM 2019 DESIGN

While the core principles of the program did not change from 2019, the COVID-19 pandemic forced the program delivery model to change. As previously stated, NIPSCO finished the program year utilizing curbside pickup to reduce contact with customers.

The 2020 program abstract specifies leave behind marketing by explicitly stating the pickup crew leaves participants with a marketing flyer promoting all NIPSCO residential EE programs. In addition, it clarifies the size requirements of recycled appliances by stating "dorm-sized" appliances are not accepted in the program. All other aspects of the program have remained the same.

PROGRAM PERFORMANCE

Comparing the *ex post* gross savings with savings goals, Table 79 shows the Appliance Recycling program fell short of its goals in 2020; the gross goal achievement for both electric savings and peak demand reduction was 44%. As the program was paused for approximately half of the year due to the COVID-19 pandemic, this is not unexpected. The program realization rate for both electric savings and peak demand reduction is 90%. The evaluation team conducted surveys with 2020 program participants to inform the NTG calculation and in-service rates (ISR). The NTG ratio was 55% for energy and demand savings, and the ISR was 100%.

TABLE 79. 2020 APPLIANCE RECYCLING SAVINGS SUMMARY

METRIC	GROSS SAVINGS GOAL	*EX ANTE*	AUDITED	VERIFIED	*EX POST* GROSS	*EX POST* NET	GROSS GOAL ACHIEVED
Electric Energy Savings (kWh/yr.)	2,275,200.00	1,119,787.00	1,116,361.00	1,116,361.00	1,004,239.00	550,225.24	44%
Peak Demand Reduction (kW)	336.000	165.650	165.150	165.150	148.942	81.609	44%

The program spent 50% of its budget during the 2020 program year. Table 80 lists the 2020 program budget and expenditures.

TABLE 80. 2020 APPLIANCE RECYCLING EXPENDITURES

FUEL	PROGRAM BUDGET	PROGRAM EXPENDITURES	BUDGET SPENT (%)
Electric	$331,741.32	$166,795.87	50%

IMPACT EVALUATION

This section details each step of the impact evaluation and its associated electric energy savings, and peak demand reduction. The research questions addressed in the impact analysis are below.

- What assumptions were used to develop savings estimates? Are there any updates that should be made?
- What are *ex post* program savings? Do these suggest any needed updates to program design, delivery, or savings assumptions?

AUDITED AND VERIFIED SAVINGS

The evaluation team looked at the program tracking data provided by TRC and audited the program savings and recycled appliances by looking for duplicate records, misapplied deemed savings calculations, and program participants or appliances that did not meet the program requirements. According to program tracking data, the program recycled 1,163 appliances in the 2020 Program Year. Of these, 987 were refrigerators and 176 were freezers.

The evaluation team found that less than 1% (n = 3) of recycled appliances were outside of the program required unit sizes. Two freezers and one refrigerator were too small. The team removed these units from the analysis. Table 81 describes the sizes and appliance types that did not comply with program requirements.

TABLE 81. 2020 APPLIANCE RECYCLING OUTSIDE OF PROGRAM REQUIREMENTS

MEASURE	CUBIC FEET	COUNT
Refrigerator	6	1
Freezer	6	1
Freezer	8	1
	TOTAL	3

In addition to removing units that were outside of the program requirements, we removed one participant who reached out to the evaluation team during the survey. They responded to our survey email request saying the implementation team never picked their refrigerator up. We found no evidence of other recycled appliances that were recorded in the tracking data but were not picked up. We removed this participant at the audited step rather than adjusting the program level ISR. This, and removing the appliances that were too small, brought the audited quantity of recycled appliances to 1,159 (985 refrigerators and 174 freezers).

Table 82 summarizes the tracking data quantity, audited quantity, applied installation rates, and resulting verified quantity per measure. To calculate the verified measure quantity, the evaluation team multiplied the audited measure quantity by the in-service rate. The team deemed the in-service rate at 100% using the 2020 participant survey.

TABLE 82. 2020 APPLIANCE RECYCLING AUDITED & VERIFIED QUANTITIES

MEASURE	TRACKING DATA QUANTITY	AUDITED QUANTITY	ISR	VERIFIED QUANTITY
Refrigerators	987	985	100%	985
Freezers	176	174	100%	174
	1,163	1,159	N/A	1,159

EX POST GROSS SAVINGS

The evaluation team calculated *ex post* gross per-measure savings for recycled appliances using algorithms and variable assumptions from the Indiana TRM (V2.2) and the U.S. DOE's UMP evaluation protocol for refrigerator recycling.[35] The UMP model is based on an aggregated in situ dataset of 591 appliances metered for evaluations conducted in California, Wisconsin, and Michigan. Collectively, the in situ dataset offered a wide distribution of appliance ages, sizes, configurations, usage scenarios (primary or secondary), and climate conditions. Because utility-specific in situ metering has never been conducted for NIPSCO, these in situ data provided an ideal secondary source for determining the independent variable coefficients to be used in the energy savings algorithm specified in the Indiana TRM (V2.2) to determine the energy savings for appliances recycled during the 2020 Program Year.

The UMP protocol methods focus on energy savings, but do not include other parameter assessments, such as a peak CF for calculating demand reduction. The evaluation team calculated demand reduction using the Indiana TRM (v2.2) algorithm.

[35] U.S. Department of Energy. October 2018. The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. https://www.energy.gov/eere/about-us/ump-protocols.

We estimated gross and net impact components on a per-unit basis and for the program overall. We used 2020 participant survey results for the part-use factor, the unit age, the percent of refrigerators that were used as a primary unit, and the percent of units that were in unconditioned spaces.

Ex post gross impacts encompass estimates of the following sources:

TABLE 83. 2020 APPLIANCE RECYCLING *EX POST* GROSS IMPACT INPUT SOURCES

ESTIMATE	PURPOSE	SOURCE
Per-unit energy consumption	In situ metering-based regression modeling	2020 Tracking Data
Part-use factor	Accounting for units not in use for the entire year	2020 Participant Survey
Average gross per-unit energy savings	Based on per-unit energy consumption and part use factors	2020 Tracking Data and 2020 Participant Survey

The Appendix: Appliance Recycling Algorithms and Assumptions section presents the algorithms, variable assumptions, and specific references for all program measure *ex post* calculations. It also contains detailed descriptions that explain the differences between *ex ante* and *ex post* savings.

Table 84 shows the *ex ante* deemed savings and *ex post* gross per-measure savings for 2020 Appliance Recycling measures. As in previous years, program evaluation findings from two years prior (i.e., 2018 findings) informed the ex-ante savings for 2020. The sections below explore differences between these program years in more detail.

TABLE 84. 2020 APPLIANCE RECYCLING *EX ANTE* & *EX POST* GROSS PER-MEASURE SAVINGS VALUES

MEASURE	UNIT OF MEASURE	*EX ANTE* DEEMED SAVINGS		*EX POST* GROSS PER-MEASURE SAVINGS	
		kWh	kW	kWh	kW
Refrigerators	Recycled appliance	1,009.00	0.150	901.00	0.134
Freezers	Recycled appliance	704.00	0.100	671.00	0.100

Upon review of program tracking and survey data, the evaluation team found some discrepancies in appliance age, which the UMP model uses as coefficients, which affected the savings. We include a more detailed description of the differences in age in the Appliance Age section below, as well as in the Appendix. After considerable triangulation, the evaluation team determined that utilizing the survey-reported age was the most appropriate and conservative value to use within the impact analyses.

The evaluation team calculated the age variable for the UMP model by multiplying the tracking data age by an adjustment factor based on the 2020 survey respondents' report of appliance age. We multiplied the refrigerator by an adjustment factor of 0.63 and the freezer age by an adjustment factor of 0.71. For refrigerators, the adjustment factor resulted in decreases in average age[36], shift in proportion of appliances manufactured before 1990[36], and shift in unit volume size and the part-use estimate (Table 85). For freezers, the adjustment factor resulted in decreases in average age[37], adjustment to the proportion of appliances manufactured before 1990[37], and shift in the proportion of chest unit configuration (Table 85). Newer refrigerators and freezers result in lower savings..

36 Based on tracking data ages multiplied by refrigerator age adjustment factor of 0.63 from 2020 survey results.

37 Based on tracking data ages multiplied by freezer age adjustment factor of 0.71 from 2020 survey results.

Further, the part use estimate – which calculates the percentage of time the unit operates full-time – will affect savings. The higher the value, the more run-time the unit experiences, and the greater the subsequent savings.

TABLE 85. 2020 APPLIANCE RECYCLING DIFFERENCES BETWEEN PROGRAM YEARS

PROGRAM YEAR	PROPORTION OF PRE-1990 REFRIGERATORS	PROPORTION OF PRE-1990 FREEZERS	PROPORTION OF PRIMARY UNIT REFRIGERATORS RECYCLED	PROPORTION OF SIDE-BY-SIDE REFRIGERATORS	PROPORTION OF CHEST FREEZERS	PART-USE VALUE - REFRIGERATORS	PART-USE VALUE - FREEZERS
2017	32%	60%	41%	23%	47%	0.84	0.82
2018	21%	47%	54%	25%	31%	0.90	0.83
2019	57%	64%	54%[a]	28%	27%	0.90[a]	0.83[a]
2020	2%[b]	13%[c]	58%	25%	23%	0.89	0.90

a. Using the 2018 survey results

b. Based on tracking data ages multiplied by refrigerator age adjustment factor of 0.63 from 2020 survey results.

c. Based on tracking data ages multiplied by freezer age adjustment factor of 0.71 from 2020 survey results.

Table 86 highlights notable differences between variables used in the *ex ante* and *ex post* gross estimates.

TABLE 86. 2020 APPLIANCE RECYCLING NOTABLE DIFFERENCES BETWEEN *EX ANTE* & *EX POST* GROSS

MEASURE	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST* GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
Refrigerators	*Ex ante* savings are based on the 2018 evaluation results.	DOE's UMP evaluation protocol for energy savings. The UMP protocol methods focus on energy savings, but do not include other parameter assessments, such as a peak CF for calculating demand reduction. The evaluation team calculated demand reduction using the Indiana TRM (v2.2) algorithm.	Decreases in • average age [a], • proportion manufactured before 1990[a], • unit volume size, • part-use estimate
Freezers	*Ex ante* savings are based on the 2018 evaluation results.	Since the UMP does not include specifications for freezers, the evaluation team created an analogous freezer model using metering data from three different utilities. The evaluation team calculated demand reduction using the Indiana TRM (v2.2) algorithm.	Increases in • average age [b], • proportion manufactured before 1990[b], • proportion of chest unit configuration

a. Based on tracking data ages multiplied by refrigerator age adjustment factor of 0.63 from 2020 survey results.
b. Based on tracking data ages multiplied by freezer age adjustment factor of 0.71 from 2020 survey results.

APPLIANCE AGE

As noted above, the evaluation team identified in 2019 that the average age documented in the program tracking data for both refrigerators and freezers had increased considerably when compared to prior years. At that time, the team identified this as an important research question for 2020, to understand what was driving this shift in the average age of appliances. The evaluation team conducted an enhanced survey with customers to capture their self-reported appliance age, as well as context around how confident they are in that estimation. In addition, the evaluation team conducted several other analyses to triangulate these findings.

Correctly estimating old appliance ages is not entirely straightforward and can sometimes be imprecise. An example from another recent study found that survey respondents reported their appliance was on average about five years younger than the tracking data documentation.[38] However, the 2020 NIPSCO evaluation survey found that the discrepancy between survey-reported age and tracking data reported age ranged between eight to fifteen years, on average.

TABLE 87. AVERAGE REPORTED AND TRACKING DATA AGES BY PROGRAM YEAR

	2019 - SURVEY	2019 - TRACKING	2020 - SURVEY	2020 - TRACKING
Refrigerator	18	33	17	27
Freezer	22	35	22	30

Source: Tracking data and participant survey. Survey questions: "About how old was [UNIT.COLOR] [UNIT.MAKE] refrigerator you recycled (in years)?" & "About how old was [UNIT.COLOR] [UNIT.MAKE] freezer you recycled (in years)?"

Because this discrepancy was much larger than expected, the evaluation team conducted additional analyses to triangulate these findings and determine which value was the most appropriate to use in the impact analyses. These additional triangulation analyses included:

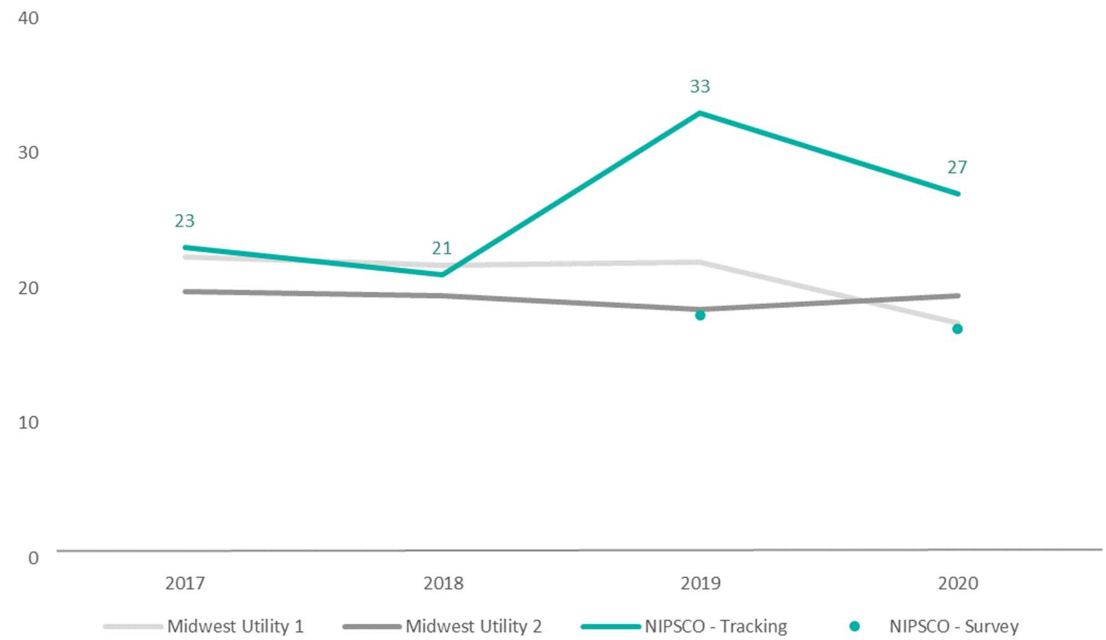
- Reviewing additional questions asked in the survey to understand how accurate participant self-report may be. The additional questions added this year included whether the participant purchased the appliance themselves, whether it was purchased new or used, or whether it was given to them from someone else. These questions were intended to provide additional context around the confidence of customer self-report.
- Comparing reported appliance color and configuration in the tracking data to the tracking data age, in conjunction with an internet review to understand common trends in appliance color and configuration over time.
- Attempting lookups on appliance model numbers, although most were incomplete or missing.

Detailed findings for these analyses are in the Appendix: Appliance Recycling Algorithms and Assumptions. Qualitatively, the results from these triangulation analyses provided support for using the self-reported survey age as the most appropriate number in our impact analyses.

Importantly, as a final triangulation step, the evaluation team wanted to understand regional trends and compare to other utilities. The evaluation team reviewed the average age of recycled refrigerators and freezers reported in program tracking data since 2017 for two other geographically similar utilities that utilize ARCA as their implementer, as well as our self-reported survey age for comparison (Figure 35 and Figure 36). For both refrigerators and freezers, the reported age from this year's evaluation survey aligns very closely with the peer utility tracking data.

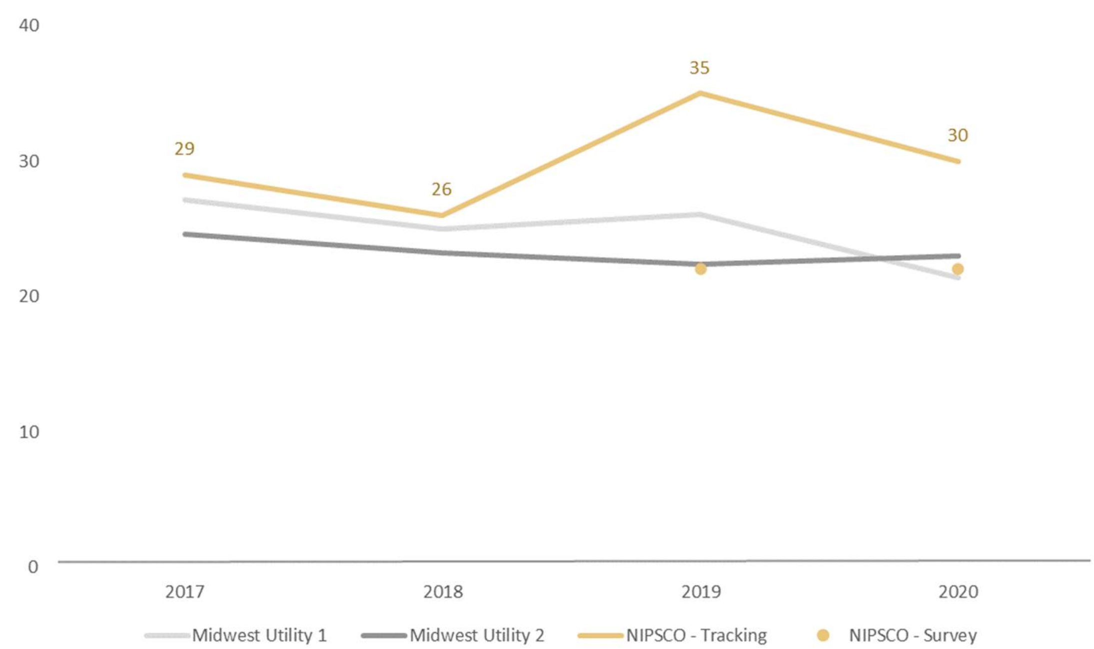
[38] Opinion Dynamics and EMI Consulting. (2015). Appliance Recycling Program 2015. Columbia: Public Service Commission of South Carolina.

FIGURE 35. AGE OF REFRIGERATORS IN MIDWEST COMPARED TO NIPSCO



Source: Tracking data and participant survey. Survey question: “About how old was [UNIT.COLOR] [UNIT.MAKE] refrigerator you recycled (in years)?”

FIGURE 36. AGE OF FREEZERS IN MIDWEST COMPARED TO NIPSCO



Source: Tracking data and participant survey. Survey question: “About how old was [UNIT.COLOR] [UNIT.MAKE] freezer you recycled (in years)?”

Given how closely the average age reported in this year's NIPSCO survey aligns with the peer utility tracking data age, the evaluation team determined that utilizing the survey age would be most appropriate and conservative in our impact analyses. As NIPSCO is planning to utilize ARCA as their implementer in 2021 and forward, our team also believes this will be the most appropriate value for planning for future program performance.

As noted, both peer utilities utilize ARCA as their implementer, and the evaluation team's understanding is that ARCA does incorporate customer self-report into their ultimate determination of appliance age (to the evaluation team's understanding, Recleim does not). Aside from recognizing that Recleim and ARCA utilize different methods to determine appliance age, the evaluation team was unable to determine what may be driving the discrepancy between the tracking data reported age and the survey reported age. The evaluation team recommends additional evaluation in future program years to continue to track and monitor for these discrepancies, and if found, to understand what might be causing them.

REALIZATION RATES

Table 88 and Table 89 show the program's *ex ante* reported savings, audited savings, verified savings, and *ex post* gross savings. In 2020, the program achieved an overall realization rate of 90% for both kWh savings and coincidence peak kW savings.

TABLE 88. 2020 APPLIANCE RECYCLING *EX ANTE* & *EX POST* GROSS ELECTRIC ENERGY SAVINGS

MEASURE	*EX ANTE* [a] ELECTRIC ENERGY SAVINGS (kWh/yr.)	AUDITED GROSS ELECTRIC ENERGY SAVINGS (kWh/yr.) [a]	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (kWh/yr.)	*EX POST* GROSS ELECTRIC ENERGY SAVINGS (kWh/yr.)
Refrigerators	995,883.00	993,865.00	993,865.00	887,485.00
Freezers	123,904.00	122,496.00	122,496.00	116,754.00
Total Savings	1,119,787.00	1,116,361.00	1,116,361.00	1,004,239.00
Total Program Realization Rate				90%

Note: Totals may not sum properly due to rounding.
a. Values presented at a measure-level represent Audited values, since the scorecard provides only savings totals.

TABLE 89. 2020 APPLIANCE RECYCLING *EX ANTE* & *EX POST* GROSS PEAK DEMAND REDUCTION

MEASURE	*EX ANTE* [a] PEAK DEMAND REDUCTION (kW/yr.)	AUDITED GROSS PEAK DEMAND REDUCTION (kW/yr.) [a]	VERIFIED GROSS PEAK DEMAND REDUCTION (kW/yr.)	*EX POST* GROSS PEAK DEMAND REDUCTION (kW/yr.)
Refrigerators	148.050	147.750	147.750	131.611
Freezers	17.600	17.400	17.400	17.331
Total Savings	165.650	165.150	165.150	148.942
Total Program Realization Rate				90%

Note: Totals may not sum properly due to rounding.

a. Values presented at a measure-level represent Audited values, since the scorecard provides only savings totals.

EX POST NET SAVINGS

To calculate net savings, the evaluation team applied refrigerator and freezer NTG ratios based on 2020 participant survey data. The NTG ratio estimates were based on self-reported responses to questions related to what the customer would have done with their appliance absent the program. We calculated NTG ratios by removing freeridership and secondary market impact values (program savings that would have happened in the programs absence) from gross savings. Greater detail of NTG methodology is in the Appendix: Appliance Recycling Algorithms and Assumptions section.

As with the 2018 NIPSCO Appliance Recycling program evaluation, the evaluation team followed UMP methodology recommendations to exclude participant spillover to adjust net savings. The UMP suggests that although appliance recycling programs promote enrollment in other energy efficiency programs, spillover of unrelated measures is unlikely to occur.

In 2020 the evaluation team found that there was a NTG of 52% for refrigerators and 76% for freezers; we found a total program NTG of 55%.

Table 90 presents the resulting net electric savings and demand reduction.

TABLE 90. 2020 APPLIANCE RECYCLING NET-TO-GROSS RESULTS BY FUEL TYPE

SAVINGS TYPE	*EX ANTE* GROSS SAVINGS	*EX POST* GROSS SAVINGS	NTG RATIO (%)	*EX POST* NET SAVINGS
Electric Energy Savings (kWh/yr.)	1,119,787.00	1,004,239.00	55%	550,225.24
Peak Demand Reduction (kW)	165.650	148.942	55%	81.609

The 2020 refrigerator NTG ratio of 52% is lower than the 2018 NIPSCO Appliance Recycling program evaluation refrigerator NTG ratio (63%), primarily due to fewer 2020 participants reporting they would have kept their refrigerator in absence of the program compared to 2018 participants. The 2020 freezer NTG ratio of 76% is comparable to the 2018 NIPSCO Appliance Recycling program evaluation freezer NTG ratio (74%).

PROCESS EVALUATION

This section details each task of the process evaluation including an analysis of the age of appliances and the participant survey. The research questions addressed in the process analysis are below:

- How has the transition from in person to curbside pickup gone?
- How satisfied are customers with the program? Are there any pain points?
- How do customers find out about the program? How effective is program marketing? How does this compare to past years?
- What affects customer decisions to recycle their appliance?
- How has COVID impacted program participation and participant experience?

The evaluation team surveyed customers three times during our evaluation: first, we surveyed 2019 and early 2020 participants via phone; second, we followed-up via web with those who did not complete the phone survey; third, we surveyed curbside participants who had an appliance picked up between October and November 2020, via web.

The disposition of each survey wave is in Table 91. In total we surveyed 298 Appliance Recycling Program participants: 241 refrigerator respondents and 57 freezer respondents.

TABLE 91. APPLIANCE RECYCLING PARTICIPANT SURVEY DISPOSITION

SURVEY	RESPONDENTS	MODE	TOTAL RESPONDENTS [a]	REFRIGERATOR	FREEZER
September 2020	Late 2019 and early 2020 participants	Phone	118	87	31
December 2020	Follow up to September 2020 survey	Web	118	102	16
February 2021	Curbside participants from October to December 2020	Web	62	52	10
Total			298	241	57

a. 24 respondents responded to the survey for more than one recycled appliance

This section describes the survey results from the three survey waves.

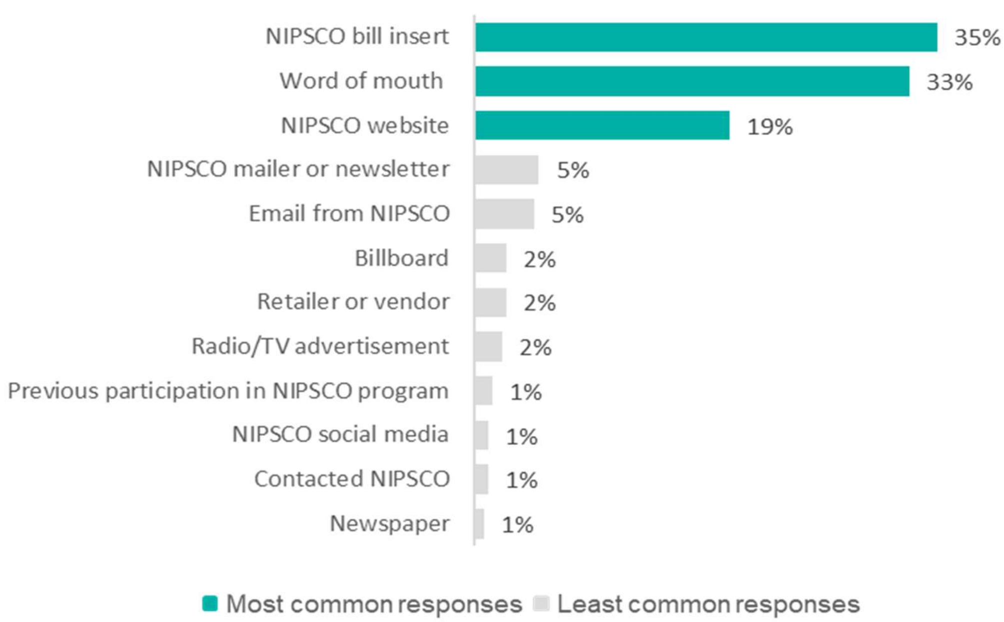
PARTICIPANT FEEDBACK

The evaluation team surveyed 298 Appliance Recycling program participants who participated in the program at the end of 2019 and through November of 2020. The following sections describe the results related to source of awareness and program marketing, descriptions of the recycled appliance, participation drivers, program and NIPSCO satisfaction, the curbside pickup process, and the effects of COVID-19 on survey respondents.

SOURCE OF AWARENESS AND PROGRAM MARKETING

Survey respondents reported finding out about the Appliance Recycling program in various ways. The most common way participants found out about the program was through a NIPSCO bill insert (35%), followed by word of mouth (33%), and through NIPSCO's website (19%) (Figure 37). The least common ways respondents reported finding out about the program were email or newsletter (5%), newspaper (1%), and social media (1%). NIPSCO primarily used social media campaigns after the COVID-19 pandemic halted a full ad campaign.

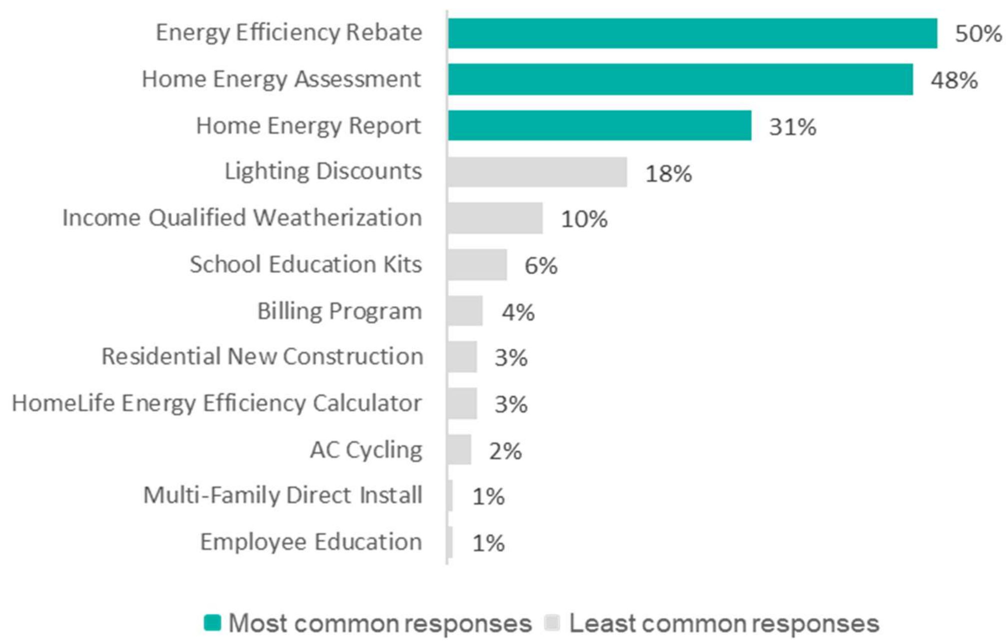
FIGURE 37. METHODS OF AWARENESS (N=285)



Source: Participant survey. Question: "How did you learn about NIPSCO's Appliance Recycling program?"

About two-thirds of survey respondents (67%) reported that they were aware of at least one other NIPSCO energy efficiency program. The most common programs respondents were aware of are the Energy Efficiency Rebates program (50%), Home Energy Assessment program (48%), and Home Energy Reports program (31%) (Figure 38).

FIGURE 38. OTHER PROGRAMS PARTICIPANTS ARE AWARE OF (N=163)



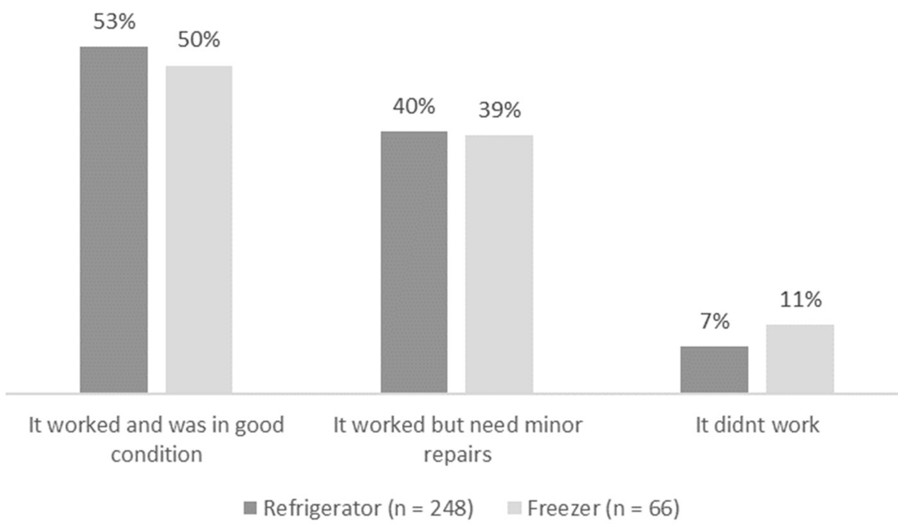
Source: Participant survey. Question: "What energy efficiency programs are you aware of?"

DESCRIPTION OF RECYCLED APPLIANCES

We use the following responses in the calculation of savings: condition, location, time spent plugged in, and replacement of the appliance. In total, respondents reported recycling 255 refrigerators and 67 freezers.[39] Of these recycled appliances, respondents reported that 53% of refrigerators and 50% of freezers were in good working condition (Figure 39. Condition of Appliances by Appliance Type). The proportions of appliance condition between appliance type were not statistically different.

[39] If respondents recycled more than one appliance, we asked questions about both appliances.

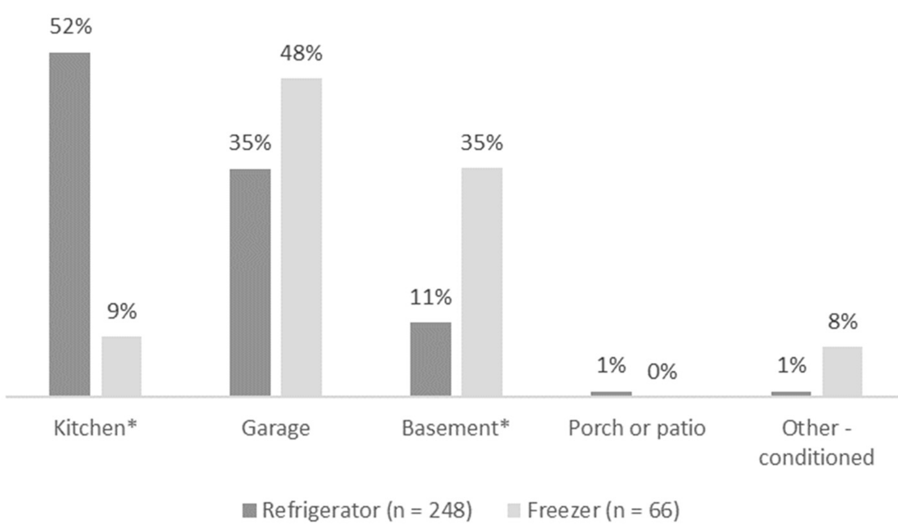
FIGURE 39. CONDITION OF APPLIANCES BY APPLIANCE TYPE



Source: Participant survey. Question: “How would you describe the condition of the [UNIT.TYPE] you disposed of? Would you say…”

The most common locations for recycled units were in the kitchen (43%) and in the garage (38%). Respondents also reported that their appliances were in the basement (16%), another air-conditioned space, like a utility room or laundry room (2%), or a porch or patio (1%) (Figure 40). There are significant differences between where respondents had their recycled refrigerators and freezers. Respondents reported that refrigerators were in the kitchen at a higher proportion than freezers; and respondents reported that freezers were in the basement with a higher proportion than refrigerators.

FIGURE 40. LOCATION OF APPLIANCES BY APPLIANCE TYPE

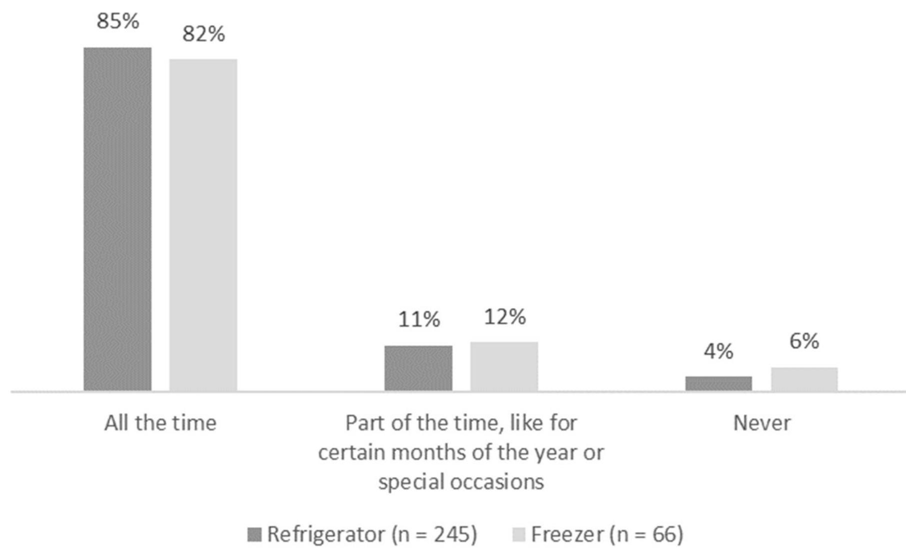


*Statistically significant at the 0.05 level

Source: Participant survey. Question: “And in that time, where was the [UNIT.TYPE] located?”

Overall, 84% of respondents reported that their appliances were plugged in and running all the time in the last 12 months before they were removed. Another 12% of appliances were plugged in part of the time, and 4% were never plugged in (Figure 41). Of those who said their appliance was plugged in part of the time, a little over one-half (58%) reported having the appliance they recycled plugged in for six months or more. There was no significant difference between recycled refrigerators and freezers as far as the length of time they were running before they were recycled.

FIGURE 41. LENGTH OF TIME RUNNING OF APPLIANCES BY APPLIANCE TYPE



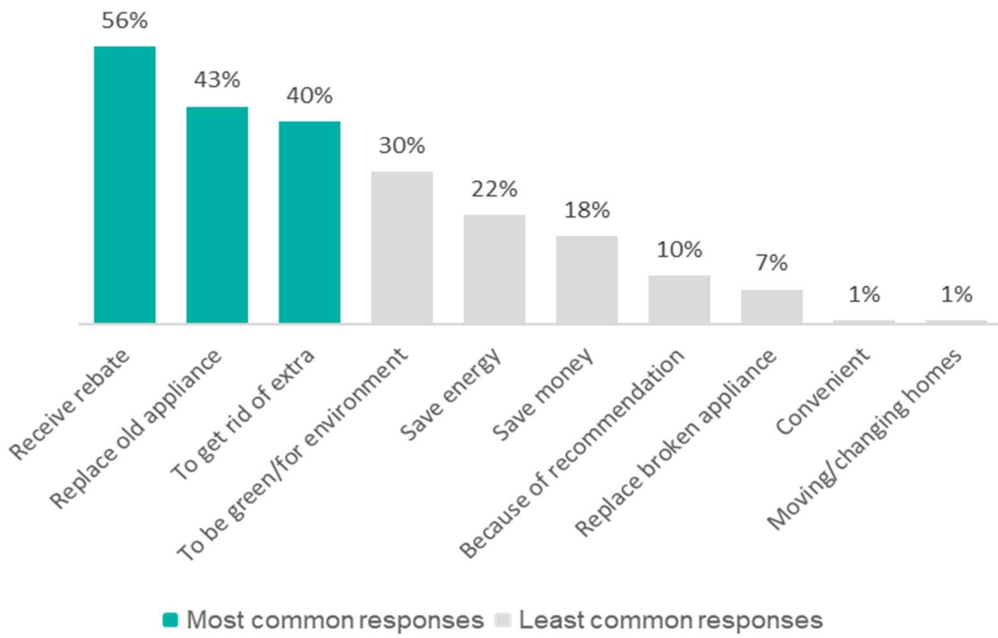
Source: Participant survey. Question: "In the last 12 months before it was removed, how much of the time was the appliance pugged in and running? Was it…"

Almost three-quarters of respondents (73%) reported that they replaced their appliance after participating in the program. Of the respondents who said they replaced the appliance, 27% replaced their recycled appliance with an energy efficient appliance.

PARTICIPATION DRIVERS

Respondents decided to participate in the Appliance Recycling program for several reasons. The most common reasons were to receive the rebate (56%), wanting to replace an old appliance (43%), or to get rid of an extra appliance (40%) (Figure 42). Almost one-third of participants (30%) reported they participated to help the environment.

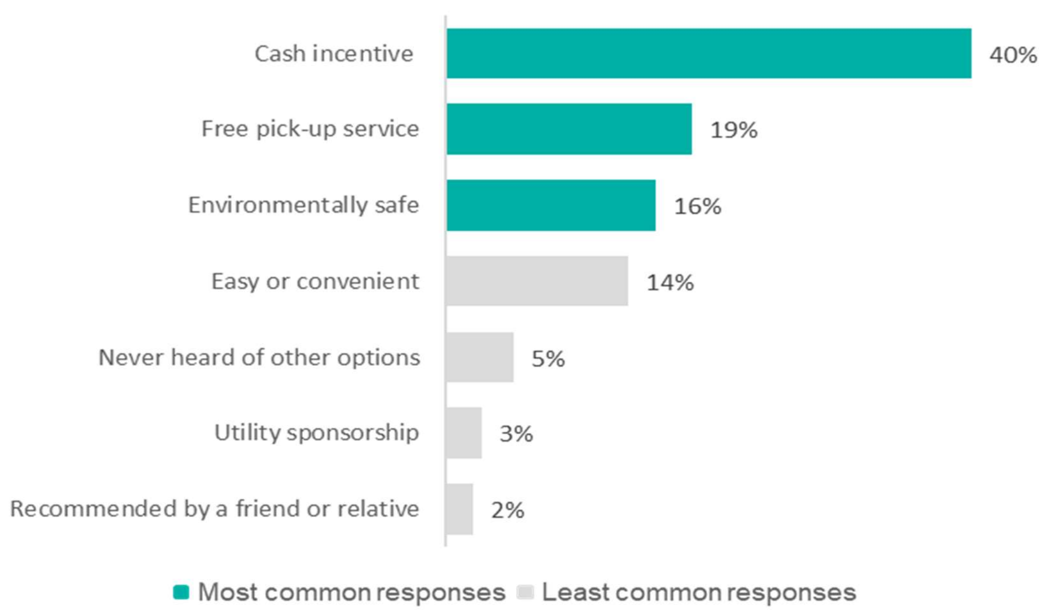
FIGURE 42. REASON FOR PARTICIPATION (N=290)



Source: Participant survey. Question: "Why did you choose to participate in NIPSCO's Appliance Recycling Program?"

A little over three-quarters of respondents (77%) reported that they had considered getting rid of their appliance before they heard about the NIPSCO Appliance Recycling program. When respondents were asked what the main reason was for choosing to participate in NIPSCO's Appliance Recycling program instead of recycling their appliance through other means, the most common responses were to receive the cash incentive (40%), that it was a free service (19%), and that it was environmentally safe (16%) (Figure 43).

FIGURE 43. MAIN REASON FOR CHOOSING APPLIANCE RECYCLING (N=290)



Source: Participant survey. Question: "What was the main reason you chose NIPSCO's program over other methods of disposing of your appliance?"

Most respondents (60%) reported that they would have still participated in the NIPSCO Appliance Recycling program if the rebate had been less, and of those respondents, two-thirds said they would have participated even if the rebate was not offered at all.

INTEREST IN OTHER APPLIANCES

Respondents expressed interest in recycling both window-mounted air conditioning units (55%) and dehumidifiers (65%). Baby Boomers (between 56 and 74-years-old) most frequently reported that they were interested in recycling a window-mounted air conditioning unit (41%) and dehumidifiers (38%). Those who reported making between $50,000 and $75,000 per year reported most frequently that they would be interested in recycling both the window unit (33%) and the dehumidifier (36%). Those who reported making over $100,000 per year reported they were least interested in recycling the window unit (10%) or the dehumidifier (10%).

PROGRAM AND NIPSCO SATISFACTION

NIPSCO SATISFACTION

Overall, respondents are satisfied with NIPSCO as their energy service provider. Over three-quarters of respondents (80%) were at least somewhat satisfied with NIPSCO as their energy service provider – just over one-half (52%) were very satisfied. Overall, respondents gave NIPSCO an average satisfaction rating of 4.2 on a scale of 1 to 5 where 1 was “not at all satisfied” and 5 was “very satisfied”.

OVERALL PROGRAM SATISFACTION

Respondents were also satisfied with the Appliance Recycling program overall, with 88% of respondents at least somewhat satisfied with the program and 73% very satisfied. Overall, respondents gave the program an average rating of 4.7 on a scale of 1 to 5 where 1 was “not at all satisfied” and 5 was “very satisfied”. The main reason respondents were satisfied with the program was because it was convenient (33% of respondents). One respondent said, “I thought this was a very nice program and I would recommend it to anyone with an old working fridge. Saved me a huge headache and apparently it's good for the earth and that's always a plus.”. Additionally, respondents were satisfied with the program because it helped them save money (14%), and it was good for the environment (9%).

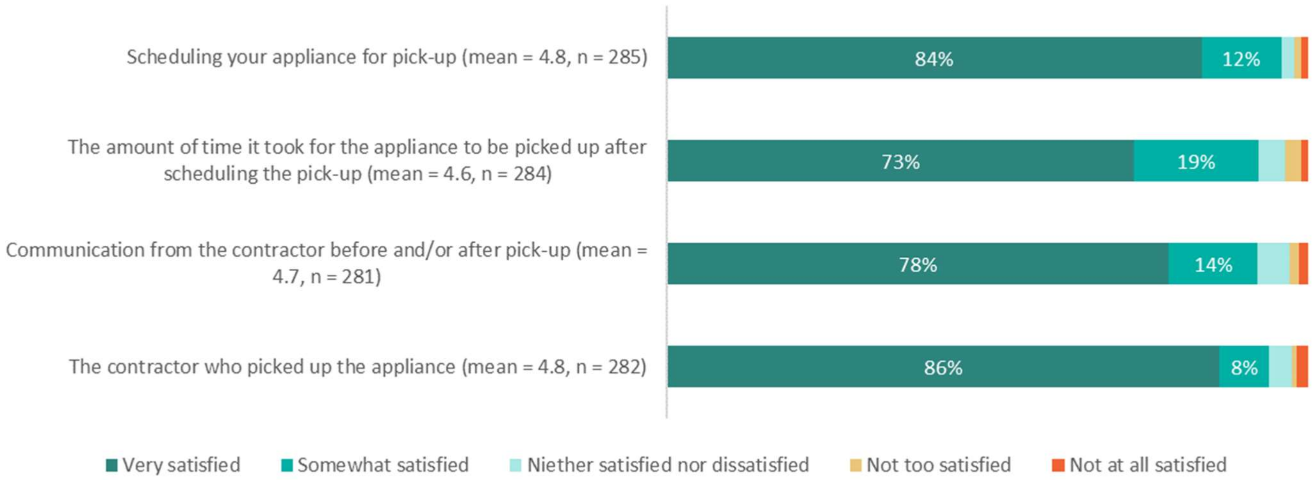
While respondents were highly satisfied with the program, the length of time to receive the rebate was the most common reason for lower satisfaction – 38% of respondents said that the rebate took a long time to receive. Most responses for how the program could be improved were about the rebates. We address this issue more in the Rebate Satisfaction and The Curbside Pickup Process sections. Other ways respondents said that the program could be improved included:

- Adding a follow up for rebate receipt (n = 12)
- Providing more scheduling options for the pickup (n = 6)
- Increasing advertisement efforts (n = 6)
- Reducing lead time between signing up for the program and having appliance picked up (n = 5)
- Increasing the rebate amount (n = 5)

RECLEIM SATISFACTION

Respondents were highly satisfied with their experience with Recleim in scheduling, communicating, and with the pickup crew (Figure 44).

FIGURE 44. SATISFACTION WITH RECLEIM



Source: Participant survey. Respondents were asked to rank the statements on a scale of 1 – 5.

Almost all respondents (96%) said they were at least somewhat satisfied with the scheduling process for having their appliance picked up and 84% were very satisfied. In addition to being satisfied with the scheduling process, 92% of respondents were at least somewhat satisfied with the time it took for the appliance to be picked up after scheduling, with 73% of respondents being very satisfied. When providing feedback on how NIPSCO could improve the program, five respondents requested reducing the amount of time between scheduling and when the appliance was picked up. One respondent said, “The wait time for pickup was about a month out so that was a bit inconvenient as we had nowhere to put the appliance in the meantime.”.

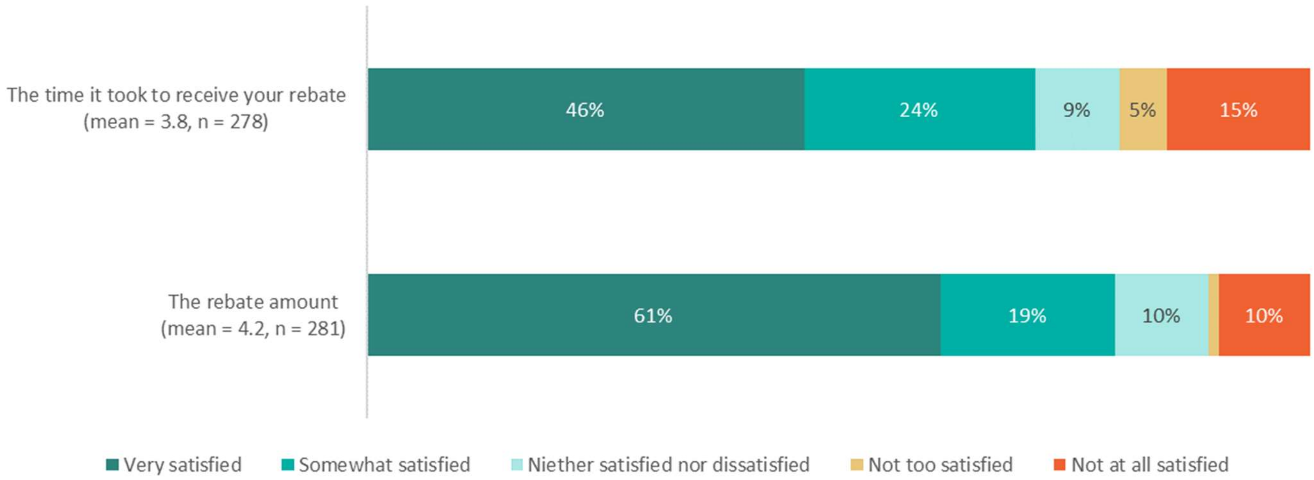
Respondents were also satisfied with the communication from Recleim before and after their appliance was picked up, with 92% being at least somewhat satisfied and 78% who were very satisfied. Overall, 94% of respondents were at least somewhat satisfied with the contractor who picked up the appliance and 86% were very satisfied. Of the respondents who were dissatisfied and provided feedback (n = 37), 23 mentioned the rebate as an issue. For example, one respondent said, “Still have not received the rebate check. Not sure what’s taking so long or if I’ll get it.”. Another respondent said, “Several months went by and no check. When we called to question about the check we were advised, ‘It is getting processed for mailing’. It was not until January that the rep from NIPSCO, who was fabulous, got involved and lo and behold a check was sent.”. Respondents who were dissatisfied were less satisfied for the following reasons:

- Have not yet received rebate as of taking the survey (n = 17)
- Looking for better communication (n = 9)
- Rebate was delayed (n = 6)
- Time between scheduling and pickup was longer than expected (n = 3)
- Property damage (n = 2)

REBATE SATISFACTION

As previously mentioned, while respondents were highly satisfied with the program overall, they were less satisfied with the Appliance Recycling rebates, specifically how long they took to arrive (Figure 45).

FIGURE 45. SATISFACTION WITH REBATES



Source: Participant survey. Respondents were asked to rank the statements on a scale of 1 – 5.

Respondents were least satisfied with the time it took to receive the rebate. Almost three-quarters (71%) of respondents were at least somewhat satisfied with the time it took to receive the rebate and almost half (46%) were very satisfied. However, 41 respondents, as of the time taking the survey, had not yet received their rebate and 40 of these respondents were curbside participants (discussed further in The Curbside Pickup Process section). These customers are likely driving this lower satisfaction rating.

While respondents were less satisfied with the rebate timing, they were more satisfied with the rebate amount (mean score of 4.2). Over three-quarters (79%) were at least somewhat satisfied with the rebate amount and 61% said they were very satisfied with the rebate amount.

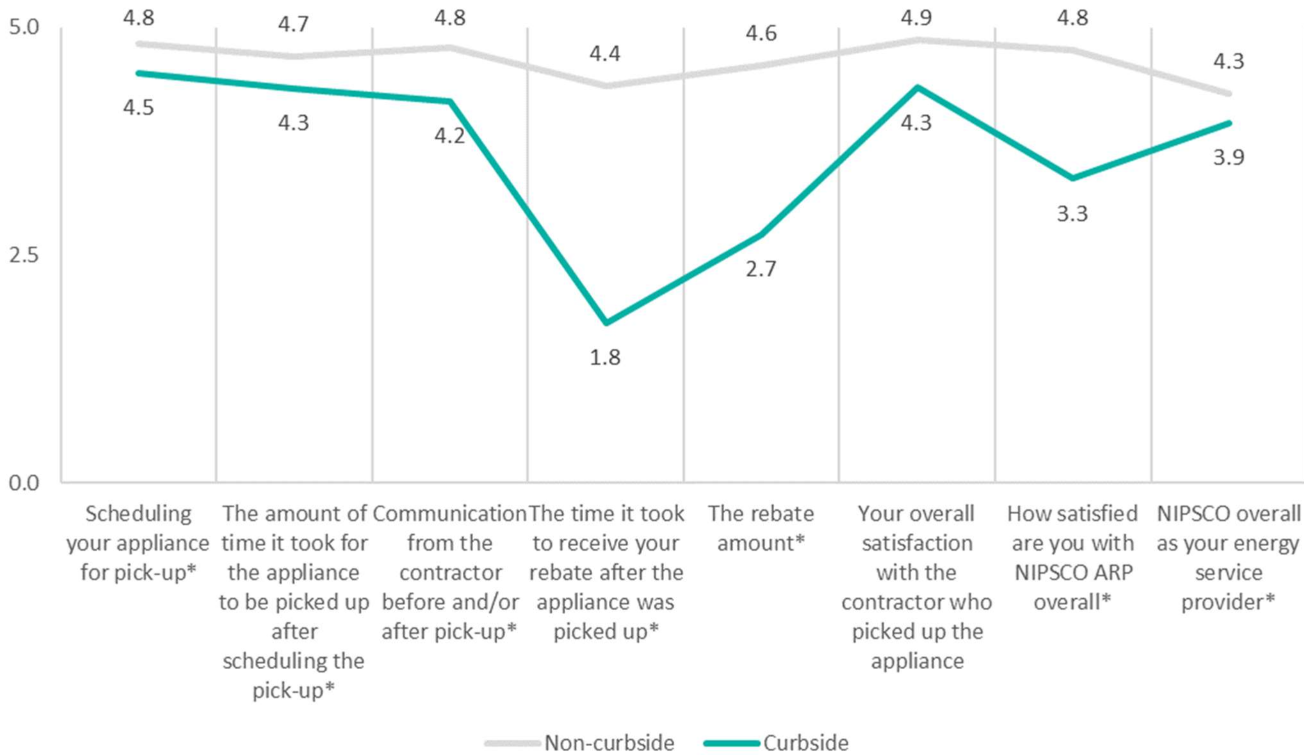
THE CURBSIDE PICKUP PROCESS

In September 2020 NIPSCO started to offer the Appliance Recycling program again, after a hiatus caused by the COVID-19 pandemic. To ensure safety, Recleim started a curbside pickup service for appliances. While the primary program processes were the same, the evaluation team compared the pickup processes between the curbside participants and the standard program participants.

When looking at only the curbside pickup participants, average satisfaction scores were lower across all program aspects compared to non-curbside pickup participants. There was a statistically significant difference between the curbside respondents and the non-curbside respondents for nearly all satisfaction questions. Curbside respondents' satisfaction ratings were especially low for questions related to the rebate. These respondents said they gave their satisfaction rating because the rebate took longer than they expected.

Figure 46 shows the mean satisfaction scores across program facets, like scheduling pickup and satisfaction with NIPSCO overall.

FIGURE 46. MEAN SATISFACTION SCORES ACROSS PROGRAM FACETS BY CURBSIDE VS. NON-CURBSIDE



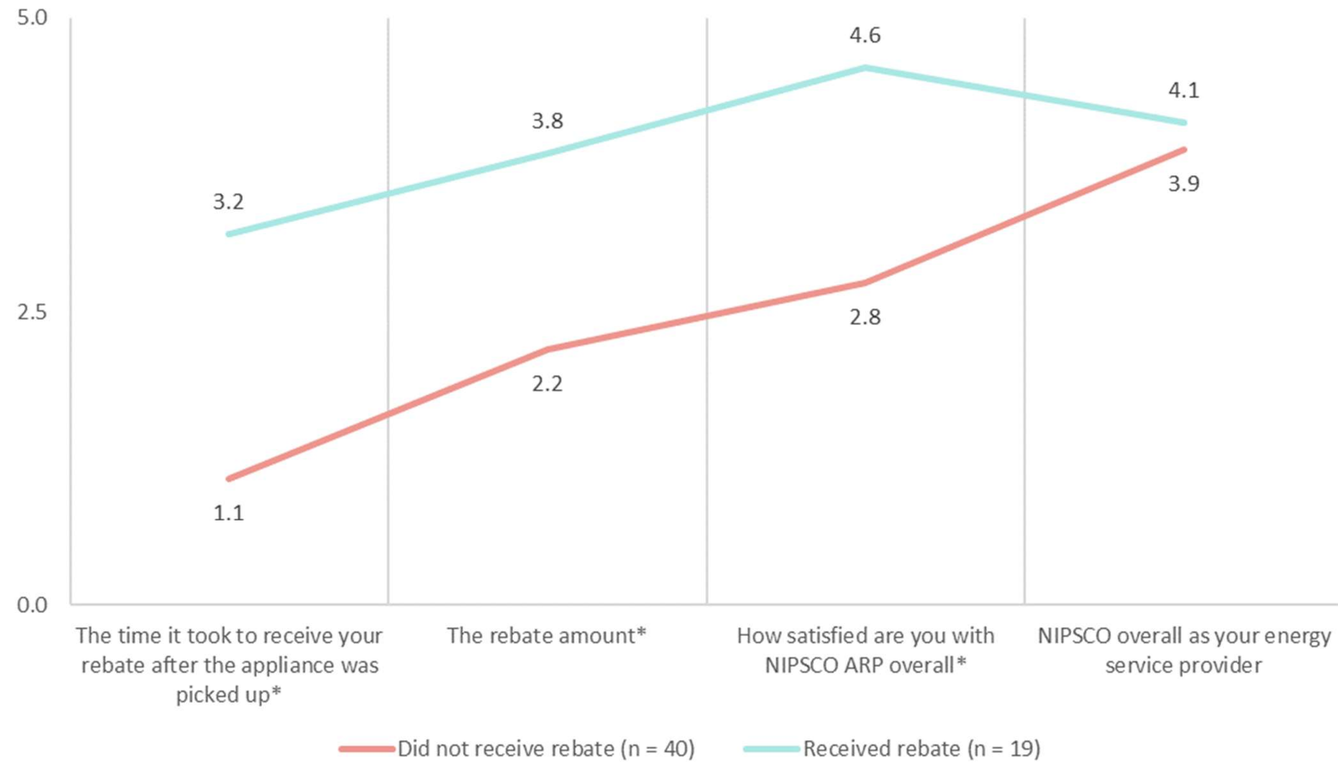
*Statistically significant at the 0.05 level

Source: Participant survey. Respondents were asked to rank the statements on a scale of 1 – 5.

There is a sharp decline in satisfaction scores among curbside respondents for the time it took to receive the rebate after the appliance was picked up and the rebate amount. As of the survey launch date (February 2, 2021), 65% of curbside respondents had not yet received their rebate. In addition, the evaluation team received six emails from the curbside sample (three of whom took the survey and three who only responded to our request) stating they had not yet received the rebate. NIPSCO followed up with these participants to ensure they received their rebate. In the survey, those who did not receive a rebate said they rated NIPSCO the way they did because of the rebate timing.

There is a statistically significant difference in satisfaction scores between those curbside respondents who had received a rebate and those who did not. Respondents who had received the rebate by the time of the survey, rated three program aspects higher than those who had not yet received the rebate: 1) time it took to receive the rebate, 2) the rebate amount, and 3) satisfaction with the program overall (Figure 47). The mean values for the curbside participants who had received their rebates are still lower than for the non-curbside respondents.

FIGURE 47. SATISFACTION DIFFERENCES BETWEEN REBATE STATUS OF CURBSIDE PARTICIPANTS



*Statistically significant at the 0.05 level

Source: Participant survey. Respondents were asked to rank the statements on a scale of 1 – 5.

When making recommendations on how the program can improve, ten respondents said NIPSCO could follow-up with them on whether they had received the rebate and three respondents said they had difficulty locating contact information for asking about their rebates. One respondent said they wanted, “Online tracking of rebate. I have not received and have no idea where to look or who to call.”. Only five non-curbside respondents mentioned having trouble with the rebate timing.

Given that the differences in satisfaction ratings between curbside and non-curbside respondents are statistically significant, and that there were few respondents in the non-curbside group who reported having issues with the rebate timing, we think that this rebate issue is unique to the curbside process. In the future, with curbside programs, implementers should be especially careful and transparent in timing and communication. The pickup method exaggerates lag time in communication, or mistakes made in communication. Especially with the prevalence of curbside pickup during the COVID-19 pandemic, respondents may be more well-versed in how curbside processes should work (e.g., curbside restaurant pickup) and may have higher expectations.

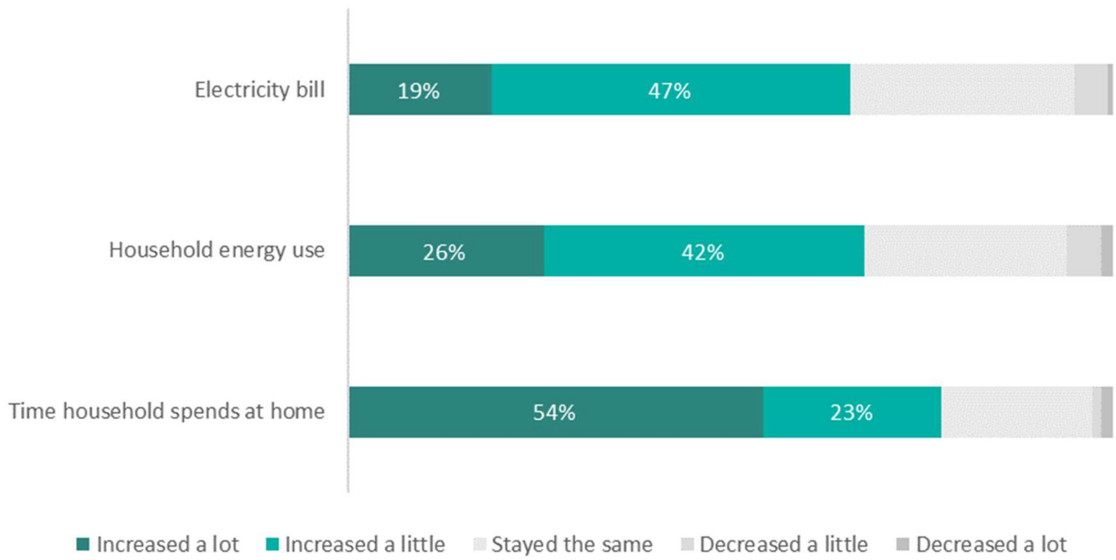
EFFECTS OF COVID-19

We asked survey respondents about how they have been affected by the COVID-19 pandemic and what NIPSCO could do to help alleviate some of the effects. First, we will describe how respondents have been affected by COVID-19. Second, we will describe opportunities for NIPSCO to assist their customers during this time.

Respondents reported that the pandemic has had a small financial effect; but those who reported a change in work since 2019 have seen a decrease in hours and employment. Most respondents were financially similar in 2020 to how they were the year before. Just over one-half (55%) of respondents thought their 2020 income will be about the same as in 2019 and 79% did not report a change in their employment. Twenty respondents reported a change in employment since 2019. Changes include loss of a job (n = 14), a change in career (n = 2), reduced hours (n = 2), and reduced wages (n = 2).

Respondents reported that in 2020 they have spent more time at home than in 2019. About three-quarters (77%) of respondents said there has been an increase in the time spent at home in each week compared to 2019. Less than one-half (43%) of respondents who were still employed, reported now working from home. Given the sharp increase in time spent at home, respondents also reported an increase in their perception of their household energy use and their household energy bills. About two-thirds (68%) said that their energy use has increased since the start of the pandemic and 66% said their energy bills have increased (Figure 48).

FIGURE 48. CHANGES TO HOUSEHOLD SINCE COVID-19 (N=262)



Source: Participant survey. Respondents were asked to rank the statements from “decreased a lot” to “increased a lot”.

The evaluation team also found that 38% of respondents reported making a home improvement since the beginning of the COVID-19 pandemic. The most common cost of a home improvement was between $500 and $1,000 (35%); 38% of respondents made home improvements that cost over $5,000 (19% between $5,000 and $10,000 and 19% greater than $10,000). About one-fourth (24%) of respondents who made improvements reported making “small” improvements like fixing one thing in their home (i.e., a window, painting, a door, etc.). One-half completed a “medium” improvement like addressing multiple items or installing larger appliances or equipment (i.e., HVAC equipment or stoves). Another quarter (26%) said they took on a “large” improvement like complete renovations or demolitions. Of the respondents that made home improvements during the pandemic, nearly three-quarters of the projects were planned before the pandemic. Respondents are interested in improving their homes and there may be opportunities for NIPSCO to provide resources for them to improve the energy efficiency of their homes.

As the evaluation team found, a little over one-third of respondents have made home improvements during the COVID-19 pandemic. In the Energy Efficiency Rebates evaluation, we spoke with HVAC contractors. We found that business for HVAC needs have increased because respondents are spending more time at home. One contractor said, "they're working from home so they're more apt to hear their furnace making a funny noise or the house not being as warm as they thought…when you spend more time in your home you tend to notice more and so residentially, we actually probably did better.". This might mean there is an opportunity to promote the Energy Efficiency Rebates program or other energy efficiency programs to recent participants or those who might be likely to participate. One respondent said, "I wish they had a weatherization program. I would like to have more reviews on my bill on why my house uses more energy," and another said they wanted NIPSCO to, "Offer rebates for the energy efficient improvements and appliances.". Ensuring that the pickup crew are providing cross-program promotion could ensure respondents like this are aware of and take advantage of other NIPSCO opportunities.

When asked what NIPSCO can do to support respondents, respondents suggested the following:

- Reduce bill amount (n = 38)
- Increase rebate opportunities (n = 9)
- Credits on bill instead of rebate (n = 9)
- Send rebates more promptly (n = 7)
- Extend due dates (n = 4).

Two categories of suggestions had to do with billing. The most common response was asking for a reduction in bills and another response was to extend due dates. One respondent said that they perceived their rate to be fluctuating, "Lower the rates. Seems they jumped a lot in the last few months.". Next, respondents mentioned applying credits to bills instead of sending rebate checks. One respondent said they would like, "Help lower my billing or give a credit so I cannot be worried about paying on the next one on time". And, finally, some respondents asked for their rebates to be sent more promptly.

PARTICIPANT SURVEY DEMOGRAPHICS

The respondents to this survey were, on average, older, wealthier, and well educated.[40] Almost two-thirds (65%) of respondents were in the Baby Boomer or Silent Generation (older than 55) and 56% of respondents have at least a two-year college degree. A majority (57%) of respondents reported making at least $50,000 in 2019; the most common response was between $50k and $70k (29%). Just over one-half (55%) of respondents reported a household size of one to two people. A majority (57%) of respondents are employed (46% outside of their home and 11% in their home) and about 26% are retired. Almost all (95%) of both refrigerator and freezer respondents live in an urban or microcore area.

The respondents to this survey, on average, live in older homes, have lived in their homes for more than ten years, are homeowners, and use natural gas to heat their homes. Almost two-thirds (63%) of respondents live in homes built before 1980 and 55% have lived in their home for more than ten years. Almost all (97%) respondents own their homes and 82% of respondents live in homes that are between 1,000 sq. ft. and 3,000 sq. ft. More than 80% of respondents use natural gas to heat their home (83%) and to heat their water (82%).

[40] There was no significant difference in survey mode for these demographic factors.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSION 1: AGE OF APPLIANCES, AS REPORTED IN THE PROGRAM TRACKING DATA, INCREASED SIGNIFICANTLY FROM THE PREVIOUS PROGRAM CYCLE. AFTER CONSIDERABLE QA/QC AND TRIANGULATION, THE EVALUATION TEAM DECIDED TO USE SURVEY-REPORTED AGE OF APPLIANCE IN OUR ANALYSES.

The evaluation team adjusted our impacts analysis for 2020 to utilize survey reported appliance ages, instead of tracking data reported ages, due to discrepancies identified in the tracking data. In 2019 and 2020, the age of both refrigerators and freezers that was reported in the program tracking data was considerably higher than the age reported by participants in the survey, as well as considerably higher than peer utility data in nearby markets. As this was unusual, the evaluation team conducted several QA/QC steps to attempt to corroborate or triangulate appliance ages. Ultimately, the evaluation team chose to adjust the tracking data ages using the survey results as the most appropriate and conservative source.

Recommendations:

- The evaluation team recommends using 2020 evaluated gross per-unit savings for future program planning, as we believe this will most accurately reflect future program performance. However, the evaluation team recommends re-evaluating this program again in 2021 (as portfolio budgets allow) to reassess savings, program processes, and implementer performance.
- We recommend that the evaluation team conduct a mid-year check in 2021 of the tracking data to assess the reported age of recycled appliances compared to past years tracking and survey data. In addition, we recommend that the evaluation team interview the program managers of the new implementation team as soon as possible to ensure they can capture necessary information to allow the evaluation team to assess and evaluate the program.
- If significant discrepancies persist, the evaluation team could conduct several additional research activities to understand the reasons behind the shift in appliance age, including geographical analysis, customer interviews, mystery shopping, etc.
- Consider including implementer collected complete and correct model numbers of the recycled appliances in the tracking data, where available. This would allow the evaluation team to provide additional QA/QC as needed. If possible, the implementer could include all variables included in the implementer calculations for age of appliance, like compressor style, refrigerant age, or configuration.
- For the 2021 evaluation, if a mid-year review of program tracking data does not indicate additional needs for QA/QC, the evaluation team recommends resuming utilizing the tracking data for key inputs in the evaluation next year.

CONCLUSION 2: OVERALL, PARTICIPANTS ARE GENERALLY SATISFIED WITH THE PROGRAM AND WITH NIPSCO; HOWEVER, CURBSIDE PICKUP RESPONDENTS WERE SIGNIFICANTLY LESS SATISFIED WITH THEIR EXPERIENCE.

Most respondents said they were satisfied with the program, the pickup crew, and NIPSCO, with the mean satisfaction scores for each of these aspects being above a 4. The biggest concerns with the program that respondents reported were rebate timing; this was particularly problematic for curbside respondents, as many experienced considerable delays or had not received their rebate yet at the time of the survey. This led to lower satisfaction ratings for the program overall. Respondents also asked for more communications surrounding the pickup and rebate timing. TRC indicated they are working with the new program implementer to improve this process, including creating leave-behind communication collateral to provide customers with more information about their pick-up and rebate.

Recommendations:

- As NIPSCO continues the curbside pickup of appliances with the new implementer, monitor feedback and the time it takes to send the rebates to participants.
- Consider conducting a mid-year survey, to see if satisfaction with the time it takes to receive the rebate has improved with the new implementer.
- If possible, consider creating a “Check Your Rebate Status” page, like the Energy Efficiency Rebates program has, and provide customers with the link to this tracker.

CONCLUSION 3: RESPONDENTS REPORTED BEING INTERESTED IN RECYCLING WINDOW MOUNT AC UNITS AND DEHUMIDIFIERS. THESE MEASURES HAVE BEEN ADDED TO THE 2021 PROGRAM OFFERING.

Most respondents said they were interested in recycling window mount A/C units and dehumidifiers. NIPSCO has added both window mount A/C units and dehumidifiers to the 2021 program offering. Respondents between the ages of 56 and 74 most frequently reported being interested in recycling both units, compared to other age groups. Respondents who made between $55k - $75k per year also most frequently reported being interested in recycling both units, compared to other income levels.

Recommendations:

- If NIPSCO is interested, the evaluation team could provide additional research support, such as a secondary literature review on other utility programs that recycle these appliances.
- In 2021, the evaluation team could consider implementing a participant survey to understand customer experiences and gather impact factors for these measures.

7. SCHOOL EDUCATION PROGRAM

PROGRAM DESIGN AND DELIVERY

The School Education program is designed to produce cost-effective electric and gas savings by influencing fifth grade students and their families to focus on the efficient use of electricity and gas. It provides classroom instruction, posters, and activities aligned with national and state learning standards and energy education kits filled with energy saving products and advice. Students participate in an energy education presentation at school learning about basic energy concepts through class lessons and activities. Students also receive an energy education kit of quality, high-efficiency products and are instructed to install the energy-efficient products at home with their families as well as complete a worksheet. The experience at home supplements the learning cycle started at school.

TRC served as the program implementer, managing the overall program, and acting as a liaison between NIPSCO and program subcontractors. To deliver the program, TRC contracted with AM Conservation Group to distribute the kit and the National Energy Foundation (NEF) to develop curriculum and marketing materials.

AM Conservation Group and NEF distributed the kits and curriculum materials to individual teachers signed up for the program. Two types of kits were included:

1. Combo kits for schools in NIPSCO's natural gas and electric territory
2. Gas-only kits for schools in the natural gas territory.

The kits contained the following energy-saving measures, along with the other educational materials and activities:

- Combo Kits Measures
    - One kitchen faucet aerator (1.5 gpm)
    - One bathroom faucet aerator (1.0 gpm)
    - One low-flow showerhead (1.5 gpm)
    - Four 9-watt LEDs
    - One 0.5-watt LED night-light
    - One furnace filter whistle

- Gas Only Kits Measures
    - One kitchen faucet aerator (1.5 gpm)
    - Two bathroom faucet aerators (1.0 gpm)
    - Two low-flow showerheads (1.5 gpm)
    - One furnace filter whistle

The COVID-19 pandemic affected utility programs across the country, including NIPSCO's. Impact magnitude varied depending on the individual program's design. The School Education program did continue offering kits to students during the pandemic.

PROGRAM PERFORMANCE

Overall, the program came close to meeting electric goals and fell somewhat short of meeting peak demand and gas savings goals (Table 92).

TABLE 92. 2020 SCHOOL EDUCATION PROGRAM SAVINGS SUMMARY

METRIC	GROSS SAVINGS GOAL	*EX ANTE*	AUDITED	VERIFIED	*EX POST* GROSS	*EX POST* NET	GROSS GOAL ACHIEVEMENT
Electric Energy Savings (kWh/yr.)	2,573,344.00	2,579,014.08	2,579,048.76	2,239,717.10	2,321,875.96	3,096,728.30	90%
Peak Demand Reduction (kW)	318.600	319.302	314.778	281.314	228.658	306.375	72%
Natural Gas Energy Savings (therms/yr.)	186,804.00	187,520.04	187,539.51	111,478.17	86,061.35	122,521.97	46%

Table 93 outlines *ex post* gross values and NTG adjustment factors. Note, spillover values are considerably higher than past years'; this is discussed in detail in the spillover section.

TABLE 93. 2020 SCHOOL EDUCATION PROGRAM ADJUSTMENT FACTORS

METRIC	REALIZATION RATE (%) [a]	FREERIDERSHIP	SPILLOVER	NTG (%) [b]
Electric Energy Savings (kWh/yr.)	90%	19%	52%	133%
Peak Demand Reduction (kW)	72%	18%	52%	134%
Natural Gas Energy Savings (therms/yr.)	46%	10%	52%	142%

[a] Realization Rate is defined as *ex post* Gross savings divided by *Ex ante* savings.

[b] NTG is defined as *ex post* net savings divided by *ex post* gross savings.

The School Education program came in slightly under program budget. The implementation team spent 97% and 96% of the allocated budget for electric and gas savings, respectively (Table 94).

TABLE 94. 2020 SCHOOL EDUCATION PROGRAM EXPENDITURES

FUEL	PROGRAM BUDGET	PROGRAM EXPENDITURES	BUDGET SPENT (%)
Electric	$408,378.78	$395,454.52	97%
Natural Gas	$470,432.46	$453,805.81	96%

IMPACT EVALUATION

The Evaluation team completed the impact evaluation to answer the following research questions:

- What assumptions were used to develop deemed savings estimates? Are there any updates that should be made?
- What are ex-post program savings? Do these suggest any needed updates to program design, delivery, or savings assumptions?
- What are installation rates for kit measures? Are there certain measures that are installed most often? Least often?
- How effective was the program in influencing participant decision making? What are the program's spillover and freeridership estimates (net savings)?
- Did the program meet its participation and savings goals?

This section details each step of the impact evaluation and its associated electric energy savings, peak demand reduction, and natural gas savings.

AUDITED AND VERIFIED SAVINGS

AUDITED SAVINGS

To audit program savings, the evaluation team performed the following reviews to verify alignment with the program's scorecard:

1. Audited Kits Quantity. Reviewed program tracking data provided by the implementer and audited the number of kits distributed.
2. Confirm Measure-Level Savings Calculations. Reviewed per-measure and per-kit savings in the documentation provided by NIPSCO.
3. Savings Estimate Review. Confirmed program-level total savings.

AUDITED QUANTITY OF KIT

NIPSCO reported a total of 11,826 combo kits and 213 gas-only kits distributed through the School Education program. These reported scorecard values were checked against the program tracking data and the values align (Table 95).

TABLE 95. 2020 SCHOOL EDUCATION PROGRAM AUDITED KIT QUANTITY

KIT TYPE	SCORECARD	TRACKING DATA
Combo Kits	11,826	11,826
Gas Only Kits	213	213
Total	12,039	12,039

CONFIRM MEASURE-LEVEL SAVINGS

The evaluation team reviewed the kit savings documentation ("NIPSCO Res Measure Calcs") which contained measure-level and kit level savings. Importantly, NIPSCO included installation rates from past EM&V efforts in their ex-ante assumptions for the kit program. The program documentation included rates to adjust savings for both installation practices and water heater fuel saturation.

Upon review of this document, measure-level savings values in the tracking data aligned with NIPSCO's kit savings documentation. However, program tracking data savings were reported at the kit-level with a rounded total kit value, and NIPSCO's Measure Calculation file savings were reported at the measure-level with un-rounded per measure values. This difference in the unit of analysis resulted in a discrepancy due to rounding, meaning that the sum of total measure savings was slightly off from the tracking data savings. These rounding discrepancies will be noted where applicable in the remainder of this report.

SAVINGS ESTIMATE REVIEW

Measure-level and total savings values were also reviewed. Savings values in the program tracking data were summed and compared to savings values reported in the scorecard. The savings values align across all energy savings types (Table 96).

TABLE 96. 2020 SCHOOL EDUCATION PROGRAM TOTAL SAVINGS REVIEW

UNIT OF ENERGY SAVINGS	SCORECARD	TRACKING DATA
MWh	2,579.01	2,579.01
kWh	2,579,014.08	2,579,014.08
kW	319.300	319.300
Therms	187,520.04	187,520.04

VERIFIED SAVINGS

In-service rates (ISRs) for the School Education program were calculated using self-reported parent survey data and the Home Energy Worksheet (HEW) data.

Parents whose children participate in the program were asked to fill out HEWs which collect various home characteristics, energy behavior information, and initial measure installation rates. The HEWs are voluntary and not all parents fill them out. HEWs are completed very shortly after kit distribution and likely do not reflect long-term installation rates as participants may install or uninstall measures as time passes. Thus, the primary data source for in-service rates is the parent survey, where respondents are asked to self-report if measures were installed at the time of the survey.

Using the same approach as last year, the evaluation team examined if survey ISRs were representative of the broader population of customers who completed the HEW. The HEW in-service rates for the full HEW population (n = 3,328) were compared to the subsample of those who completed the survey (n = 70).

As Table 97 shows, relative to the full HEW population, the sample of customers who responded to the parent survey had higher in-service rates even at the time of the HEW. This may be driven by response bias. In other words, these respondents were more engaged with the program and thus more likely to participate in the follow-up parent survey. In short, it was likely the evaluation team only spoke with engaged participants who were most likely to install the kit measures.

TABLE 97. 2020 SCHOOL EDUCATION PROGRAM IN-SERVICE RATES: HEW VS EM&V SURVEY

MEASURE	FULL HEW POPULATION ISR (n = 3,328)	PARENTS WHO COMPLETED THE HEW AND 2020 EM&V SURVEY (n = 70)	
		HEW ISR	EM&V SURVEY ISR
LEDs	40%	52%	87%
Nightlight	76%	90%	81%
Bathroom Aerator	24%	44%	48%
Kitchen Aerator	22%	33%	49%
Showerhead	28%	48%	44%
Furnace Whistle	28%	32%	15%

To account for this potential response bias when calculating ISRs for the program, the evaluation team adjusted ISRs to align with *likely* installation rates of the broader participant population.

The relative change in ISRs was calculated using HEW and survey responses for participants who completed the survey (n = 70). The relative change value was then applied to the overall HEW ISR to better approximate the *likely* measure-level ISR for the full participant population (Table 98).

Furnace whistles experienced the highest removal rate. Nearly one third of HEW participants had the filter whistle measure installed when they filled out the HEW. Just 15% of survey respondents said the filter whistle was still installed at the time of the survey. Other measures, like LEDs, experienced higher rates of installation as time passed between filling out the HEW and participating in the survey.

Finally, to account for LED lamps currently stored for future use, carryover savings were calculated for the LEDs included in the kit. The evaluation team used the UMP-recommended “Discount Future Savings” method (National Renewable Energy Laboratory/UMP Chapter 21, 2015) to calculate carryover savings. This method assumes most bulbs placed in storage (up to 97%) are installed within four years (including the initial program year), with 24% of bulbs left over from Year one installed in Year two, 24% in Year three, and so on. However, given expected baseline lighting changes mandated by EISA 2007, all standard LEDs are anticipated to function as baseline lamps. Thus, the evaluation team did not extend GSL baseline savings beyond 2023, Year three in the UMP-recommended method. This resulted in a final ISR for LEDs of 83%.

TABLE 98. 2020 SCHOOL EDUCATION PROGRAM MEASURE-LEVEL ADJUSTED ISRS

MEASURE	PARENTS WHO COMPLETED 2020 EM&V SURVEY (n = 70)		RELATIVE CHANGE IN ISR	HEW FULL POPULATION ISR (n = 3,328)	FINAL ADJUSTED ISR
	HEW ISR	EM&V SURVEY ISR			
LEDs	52%	87%	167%	40%	83%
Nightlight	90%	81%	90%	76%	69%
Bathroom Aerator	44%	48%	110%	24%	26%
Kitchen Aerator	33%	49%	151%	22%	34%
Showerhead	48%	44%	92%	28%	26%
Furnace Whistle	32%	15%	45%	28%	13%

[a] Final LED ISR includes the addition of carryover savings. The adjusted ISR without carryover savings was 65%.

WATER HEATER SATURATION

The evaluation team also adjusted the *ex ante* electric and natural gas saturation rates for water-saving measures by analyzing data from the 2020 HEW results (Table 99). Results indicate a slight discrepancy between *ex ante* and verified electric and natural gas domestic water heating saturation rates.

TABLE 99. 2020 SCHOOL EDUCATION PROGRAM WATER HEATER FUEL SATURATION

SAVINGS TYPE	ELECTRIC WATER HEATING SATURATION RATE (%)	NATURAL GAS WATER HEATING SATURATION RATE (%)
Reported *ex ante*	20%	73%
Verified[a]	23%	64%

[a] Electric and natural gas saturation rates do not total 100% because 7% of respondents replied “Other” and 6% replied “Propane” on the HEW.

Table 100 summarizes the per unit audited and verified savings values with ISRs applied. In addition to ISRs, the evaluation team applied water heating saturation adjustment factors to all water saving devices. As noted above, audited savings already include ISR and water heater saturation adjustments, and these were updated using the current calculated ISRs and water heater saturation adjustment factors.

TABLE 100. 2020 SCHOOL EDUCATION AUDITED AND VERIFIED PER UNIT MEASURE SAVINGS

MEASURE	VERIFIED ISRS	AUDITED KWH SAVINGS	VERIFIED KWH SAVINGS	AUDITED KW REDUCTION	VERIFIED KW REDUCTION	AUDITED THERM SAVINGS	VERIFIED THERM SAVINGS
LED (9W) - Combo Kit	83%	30.94	29.76	0.003	0.003	-0.06	-0.06
Nightlight - Combo Kit	69%	3.58	3.62	0.000	0.000	0.00	0.00
Bathroom Aerator - Combo Kit	26%	3.87	3.05	0.000	0.000	0.62	0.38
Bathroom Aerator - Gas Only Kit	26%	0.00	0.00	0.000	0.000	0.62	0.38
Kitchen Aerator - Combo Kit	34%	28.71	25.59	0.001	0.001	4.61	3.15
Kitchen Aerator - Gas Only Kit	34%	0.00	0.00	0.000	0.000	4.61	3.15
Low Flow Showerhead - Combo Kit	26%	49.49	30.68	0.002	0.001	7.95	3.77
Low Flow Showerhead - Gas Only Kit	26%	0.00	0.00	0.000	0.000	7.95	3.77
Filter Whistle - Combo Kit	13%	8.68	7.40	0.011	0.009	2.49	2.13
Filter Whistle - Gas Only Kit	13%	0.00	0.00	0.000	0.000	2.49	2.13

EX POST GROSS SAVINGS

The evaluation team reviewed the programs *ex ante* assumptions, sources, and algorithms for reasonableness and updates. Below are detailed *ex post* gross analysis results.

ENGINEERING REVIEWS

The evaluation team referred to the Indiana TRM (v2.2) and the 2016 Pennsylvania TRM to calculate *ex post* gross electric energy savings, demand reduction, and natural gas savings. Where NIPSCO customer specific information was available, such as for persons per home and water heater fuel saturation, the evaluation team revised input assumptions. The Appendix: Residential School Education Program Algorithms and Assumptions contains details on the specific algorithms, variable assumptions, and references for all program measure *ex post* gross calculations.

Through the engineering review, the evaluation team found differences between *ex ante* and *ex post* gross savings. These differences were primarily driven by the following factors:

- The evaluation team applied updated ISRs, persons per household, bathroom faucets and showerheads per household, and water heater saturation rates based on the 2020 HEW and parent survey.
- The evaluation team referred the 2016 Pennsylvania TRM for the *ex post* savings for the filter whistle measure.

The evaluation team also noted in the parent survey several families reported using the LED night light in place of another light source, such as a hallway or bathroom light. Potentially, if a defensible approach is determined, additional savings could be available to NIPSCO for the nightlight measure based on displacing a higher wattage light source with the lower wattage LED nightlight. As such, the evaluation team recommends further investigation into the defensibility of claiming these savings, identifying the appropriate savings to claim, and adding survey questions around alternate light sources and behaviors to inform baseline wattage and hours-of-use assumptions in the energy savings calculations.

The following sections summarize the team's findings and recommendations based on the engineering review.

EX POST GROSS SAVINGS

Ex post gross savings reflect the engineering adjustments made to verified measure savings. The evaluation team calculated *ex post* electric energy, peak demand, and natural gas energy savings for each measure kit using algorithms from the Indiana TRM (v2.2) and the Pennsylvania TRM 2016. The evaluation team leveraged the 2020 HEW and survey results to estimate people per household, in-service rates, and water heater fuel type saturation, then used this information to inform *ex post* gross savings calculations. *Ex post* savings calculations differed from *ex ante* analysis for the following overarching reasons:

- LED and Nightlight: Updated ISRs drive the difference between the *ex post* gross savings and the *ex ante*. In addition, the evaluation team identified an error in the *ex ante* gas savings calculations, which are reported in MMBtu and not converted to therms. The *ex post* savings are reported in therms. Additional discussion of therm penalties generated by LED lighting is discussed in more detail below.
- Furnace filter whistle: The evaluation team referred to the 2016 Pennsylvania TRM to calculate filter whistle electric savings, which assigns electric energy and demand savings to blower motor energy reduction because dirty filters increase electricity consumption for the circulating fan. The evaluation team does not assign therm savings for the filter whistle measure because in our best judgement any therm savings will be minimal, and a review of available literature reveals that at this time there is a lack of defensible evidence for assigning therm savings. The furnace filter whistle electric savings are achieved by the effect of a dirty filter on the static pressure of an ECM fan, but the filter whistle does not provide notable therm savings because the furnace operates to meet temperature, which does not change based on filter condition. The *ex ante* approach referenced HVAC tune-up measures from the Indiana TRM (v2.2) to evaluate savings.
- Low-flow faucet aerators and showerheads: The evaluation team used updated water heater saturation information and ISRs based on 2020 HEW and survey results. These updated ISR and natural gas saturation values were lower than the *ex ante* values used by NIPSCO. As reported in Table 99, the verified natural gas water heater saturation rate is lower than *ex ante*, 73% and 64% respectively. Additionally, ISRs for gas-savings measures were lower in 2020 relative to *ex ante* ISRs. A lower natural gas water heater saturation rate combined with lower ISRs drove down therm savings for gas-saving measures like showerheads and aerators.

Table 101 shows the *ex ante* savings and *ex post* gross per-measure savings for 2020 School Education program measures, including all adjustments for in-service rates, people per home, and electric and gas water heater saturation rates.

Table 101. 2020 School Education PROGRAM *EX ANTE* and *EX POST* GROSS PER-MEASURE SAVINGS VALUES

MEASURE	NUMBER OF MEASURES	*EX ANTE* PER-MEASURE SAVINGS			*EX POST* GROSS PER-MEASURE SAVINGS		
		KWH	KW	THERMS	KWH	KW	THERMS
LED (9W) - Combo Kit	4	123.74	0.013	(0.25)	119.15	0.013	0.00
Nightlight - Combo Kit	1	3.58	0.000	0.00	2.27	0.000	0.00
Bathroom Aerator – Combo Kit	1	3.87	0.000	0.62	2.82	0.000	0.35
Bathroom Aerator – Gas Only Kit	2	0.00	0.000	1.24	0.00	0.000	0.69
Kitchen Aerator – Combo Kit	1	28.71	0.001	4.61	25.13	0.001	3.08
Kitchen Aerator – Gas Only Kit	1	0.00	0.000	4.61	0.00	0.000	3.08
Low Flow Showerhead - Combo Kit	1	49.49	0.002	7.95	29.87	0.001	3.66
Low Flow Showerhead - Gas Only Kit	2	0.00	0.000	15.89	0.00	0.000	7.31
Filter Whistle - Combo Kit	1	8.68	0.011	2.49	17.11	0.005	0.00
Filter Whistle - Gas Only Kit	1	0.00	0.000	2.49	0.00	0.000	0.00
Per Combo Kit		218.08	0.027	15.42	196.34	0.020	7.08
Per Gas-Only Kit		0	0	24.24	0	0	11.08

Table 102 highlights notable differences between *ex ante* and *ex post* gross estimates.

TABLE 102. 2020 SCHOOL EDUCATION NOTABLE DIFFERENCES BETWEEN *EX ANTE* AND *EX POST* GROSS

MEASURE	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST* GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
Kitchen aerator, Bathroom aerator, and Low-flow showerheads	Indiana TRM (v2.2) and 2019 EMV	Indiana TRM (v2.2), with 2020 HEW updates for people per household, and faucets and showerheads per household.	Survey-derived, NIPSCO-specific values were used for persons per household and updated the hot water heating saturation based on 2020 School Kit survey information. Somewhat lower ISRs and water heater saturation rates are driving lower savings for these measures.
9W LED	Indiana TRM (v2.2) and 2019 EMV	Indiana TRM (v2.2); UMP for baseline wattages	Baseline wattages. Therm penalties for LEDs are reported separately (discussed below). The difference in gas penalties is because the *ex ante* gas savings are reported in MMBtu and the *ex post* gas penalties are reported in therms.
Filter Whistle	Indiana TRM (v2.2) approach for HVAC Tune-up	Pennsylvania TRM 2016 – Furnace Whistle measure	The Pennsylvania TRM was referenced to calculate savings for the filter whistle measure, where savings are based on blower motor energy reduction.

WASTE HEAT FACTOR - THERM PENALTIES

In 2019, and prior years, the evaluation team applied waste heat factors to lighting measures, representing electric cooling credits and electric and gas heating (therm) penalties resulting from LED lighting. In discussion with NIPSCO, for the 2020 evaluation year, the evaluation team will be addressing waste heat factor therm penalties by calculating and applying them within the electric program cost-effectiveness analysis. Therm penalties will not be included in EM&V reported program savings or performance. This approach will be applied consistently for all NIPSCO programs where therm penalties are generated due to LED lighting measures. The evaluation team believes this approach is appropriate, as it accounts for the penalty on the electric side (where it is generated) and allows the evaluation team to show gas program and measure performance more clearly, where applicable. NIPSCO plans to take a similar, consistent approach to accounting for waste heat factors across programs in their planning process.

The evaluation team recommends that this approach is made consistent going forward across all programs that offer LED lighting; currently, some *ex ante* assumptions include therm penalties, and some do not. Currently, the *ex ante* savings for all kit programs include therm penalties. These have been removed in the *ex post* analysis, and the evaluation team is reporting these below, to be used in the cost-effectiveness analysis. Table 103 shows the therm penalty calculated for the School Education program.

TABLE 103. 2020 SCHOOL EDUCATION WASTE HEAT FACTOR THERM PENALTY

MEASURE	WASTE HEAT FACTOR THERM PENALTY
LED (9W) - Combo Kit	(28,787.526)

It should be noted that electric waste heat factors, including cooling credits and electric heating penalties, are currently reported within the kWh and kW savings for the overall program as described in the Appendix. This is consistent with evaluation approaches in previous years.

REALIZATION RATES

The next three tables (Table 104 through Table 106) show the program's *ex ante* reported savings, verified savings, and *ex post* gross savings. Note, no errors were found in the tracking data and total savings values align across the scorecard and tracking data. However, program tracking data savings are reported at the kit-level and NIPSCO's Measure Calculation file, savings are reported at the measure-level. This difference in the unit of analysis resulted in rounding errors. For instance, kit-level kWh savings in the tracking data total 2,579,014.08 kWh but due to rounding error, when measure-level kWh savings are totaled, they equal 2,579,048.76 kWh– a difference of 34.68 kWh. This difference is too small to affect overall calculated realization rates at the kit level; therefore, audited measure level savings are shown for both ex-ante and audited measure values to allow for comparison of ex-ante and ex-post gross savings.

TABLE 104. 2020 SCHOOL EDUCATION EX ANTE AND EX POST GROSS ELECTRIC ENERGY SAVINGS

MEASURE	*EX ANTE*[A] ELECTRIC ENERGY SAVINGS (KWH/YR.)	AUDITED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	*EX POST* GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)
LED (9W) - Combo Kit	1,463,399.35	1,463,399.35	1,407,797.75	1,409,073.62
Nightlight - Combo Kit	42,391.38	42,391.38	42,801.10	26,805.40
Bathroom Aerator - Combo Kit	45,768.08	45,768.08	36,070.90	33,333.57
Bathroom Aerator - Gas Only Kit	0.00	0.00	0.00	0.00
Kitchen Aerator - Combo Kit	339,537.90	339,537.90	302,632.93	297,140.44
Kitchen Aerator - Gas Only Kit	0.00	0.00	0.00	0.00
Low Flow Showerhead - Combo Kit	585,247.34	585,247.34	362,866.98	353,216.01

MEASURE	*EX ANTE*[A] ELECTRIC ENERGY SAVINGS (KWH/YR.)	AUDITED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	*EX POST* GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)
Low Flow Showerhead - Gas Only Kit	0.00	0.00	0.00	0.00
Filter Whistle - Combo Kit	102,704.70	102,704.70	87,547.45	202,306.91
Filter Whistle - Gas Only Kit	0.00	0.00	0.00	0.00
Total Savings	2,579,048.76	2,579,048.76	2,239,717.10	2,321,875.96
Total Program Realization Rate				90%

Note: Totals may not sum properly due to rounding.

[a] Values presented at a measure-level represent audited values, since the scorecard provides only savings totals.

TABLE 105. 2020 SCHOOL EDUCATION PROGRAM *EX ANTE* AND *EX POST* GROSS PEAK DEMAND REDUCTION

MEASURE	*EX ANTE*[A] PEAK DEMAND REDUCTION (KW/YR.)	AUDITED GROSS PEAK DEMAND REDUCTION (KW/YR.)	VERIFIED GROSS PEAK DEMAND REDUCTION (KW/YR.)	*EX POST* GROSS PEAK DEMAND REDUCTION (KW/YR.)
LED (9W) - Combo Kit	158.298	158.298	152.283	152.421
Nightlight - Combo Kit	0.000	0.000	0.000	0.000
Bathroom Aerator - Combo Kit	2.856	2.856	2.251	0.000
Bathroom Aerator - Gas Only Kit	0.000	0.000	0.000	0.000
Kitchen Aerator - Combo Kit	8.422	8.422	7.507	7.605
Kitchen Aerator - Gas Only Kit	0.000	0.000	0.000	0.000
Low Flow Showerhead - Combo Kit	19.360	19.360	12.003	11.935
Low Flow Showerhead - Gas Only Kit	0.000	0.000	0.000	0.000
Filter Whistle - Combo Kit	125.842	125.842	107.271	56.697
Filter Whistle - Gas Only Kit	0.000	0.000	0.000	0.000
Total Savings	314.778	314.778	281.314	228.658
Total Program Realization Rate				72%

Note: Totals may not sum properly due to rounding.

[a] Values presented at a measure-level represent audited values, since the scorecard provides only savings totals.

TABLE 106. 2020 SCHOOL EDUCATION PROGRAM *EX ANTE* AND *EX POST* GROSS NATURAL GAS SAVINGS

MEASURE	*EX ANTE*[A] NATURAL GAS ENERGY SAVINGS (THERMS/YR.)	AUDITED GROSS NATURAL GAS ENERGY (THERMS/YR.)	VERIFIED GROSS NATURAL GAS ENERGY SAVINGS (THERMS/YR.)	*EX POST* GROSS NATURAL GAS ENERGY SAVINGS (THERMS/YR.)
LED (9W) - Combo Kit	(2,989.74)	(2,989.74)	(2,876.15)	0.00
Nightlight - Combo Kit	0.00	0.00	0.00	0.00
Bathroom Aerator - Combo Kit	7,349.83	7,349.83	4,437.66	4,080.90
Bathroom Aerator - Gas Only Kit	264.76	264.76	159.85	147.00
Kitchen Aerator - Combo Kit	54,525.87	54,525.87	37,231.73	36,377.71

MEASURE	*EX ANTE*[A] NATURAL GAS ENERGY SAVINGS (THERMS/YR.)	AUDITED GROSS NATURAL GAS ENERGY (THERMS/YR.)	VERIFIED GROSS NATURAL GAS ENERGY SAVINGS (THERMS/YR.)	*EX POST* GROSS NATURAL GAS ENERGY SAVINGS (THERMS/YR.)
Kitchen Aerator - Gas Only Kit	982.07	982.07	670.59	655.20
Low Flow Showerhead - Combo Kit	93,983.98	93,983.98	44,642.08	43,242.82
Low Flow Showerhead - Gas Only Kit	3,385.52	3,385.52	1,608.11	1,557.71
Filter Whistle - Combo Kit	29,505.78	29,505.78	25,151.29	0.00
Filter Whistle - Gas Only Kit	531.43	531.43	453.00	0.00
Total Savings	187,539.51	187,539.51	111,478.17	86,061.35
Total Program Realization Rate				46%

Note: Totals may not sum properly due to rounding.

[a] Values presented at a measure-level represent audited values, since the scorecard provides only savings totals.

EX POST NET SAVINGS

The evaluation team calculated freeridership and participant spillover using the survey data collected from 2020 participants. The evaluation team found varying levels of freeridership by measure, although generally consistent with the 2019 evaluation. Spillover savings were very high in 2020, resulting in total measure level NTG ratios above 100% (Table 166).

TABLE 107. 2020 SCHOOL EDUCATION PROGRAM NET-TO-GROSS RATIOS BY MEASURE

MEASURE	NTG
LED	126%
Nightlight	143%
Bathroom Aerator	143%
Kitchen Aerator	140%
Showerhead	144%
Filter Whistle	152%

FREERIDERSHIP

Measure-level freeridership values for each participant were calculated using the following survey questions:

- FR1. If you had not received the kit, would you have purchased a [MEASURE] on your own?
- FR2. “Would you have purchased the [MEASURE]…around the same time you received the kit, later but within one year, or later but more than one year?”

Respondents who gave a response of “No” to FR1 were assigned a freeridership score of 0%. Those who said “Yes” were asked FR2 and assigned a freeridership score based on the timing of their decision (Table 108).

TABLE 108. 2020 SCHOOL EDUCATION PROGRAM FREERIDERSHIP ASSIGNMENT

FR2. RESPONSE OPTION	ASSIGNED FREERIDERSHIP VALUE
Around the same time you received the kit	100%
Later but within one year	50%
Later but more than one year	0%
Not sure	25%

Measure-level freeridership was low for most measures except for LED lamps (26%). Notably, no respondents said they would have purchased the filter whistle on their own (Table 109).

TABLE 109. SCHOOL EDUCATION PROGRAM FREERIDERSHIP BY MEASURE

MEASURE	2020 FREERIDERSHIP (%)
LED (n = 70)	26%
Nightlight (n = 57)	9%
Bathroom Aerator (n = 70)	9%
Kitchen Aerator (n = 70)	12%
Showerhead (n = 70)	8%
Filter Whistle (n = 70)	0%

SPILLOVER

The evaluation team estimated participant spillover using survey responses and the Indiana TRM (v2.2) and program measure calculations as a baseline reference. If survey respondents met the following criteria, based on self-reported survey responses, they qualified as a spillover participant:

1. Installed additional energy efficient measures
2. School Education program participation was "very influential" in their decision to install an additional energy efficient measure
3. Did not receive a rebate for the additional measure

Nine survey respondents installed a total of 14 additional energy efficient measures totaling 50.28 MMBtu in spillover savings. Program participation spillover was calculated by dividing the sum of additional spillover savings by the total gross savings achieved by all surveyed program respondents (Table 110).

TABLE 110. SCHOOL EDUCATION PROGRAM SPILLOVER

SPILLOVER SAVINGS (MMBTU)	SURVEY RESPONDENT PROGRAM SAVINGS (MMBTU)	PARTICIPANT SPILLOVER (%)
50.28	96.44	52%

The evaluation team found considerably higher spillover in 2020 than in past years. Spillover was 6% in 2018 and 18% in 2019. Spillover can shift substantially for programs where per participant savings (the denominator in spillover calculations) are relatively low. This is because if just a few spillover participants install a higher-saving measure (the numerator in spillover calculations) it can increase spillover results by a higher magnitude than other programs who may have higher per participant savings. These findings of higher spillover are consistent across both the School Education and Homelife programs.

While it is unclear exactly why program spillover is considerably higher in 2020, the evaluation team hypothesizes that the COVID-19 pandemic may be driving it. As discussed in the process findings below, approximately two-thirds of customers reported their time spent at home has “increased a lot” since the beginning of the pandemic, and about half reported their household energy use has also “increased a lot.” A little over one-third said they made home improvements since the pandemic as well. Customers who have means to make improvements may be more easily motivated by program education and recommendations, as they are more urgently looking to make improvements to their home that can save them energy, particularly as they are using more energy while working and/or attending school from home.

A detailed summary of spillover measures and their savings values are summarized in Spillover.

NET-TO-GROSS

Table 111 presents the resulting net electric savings, demand reduction, and natural gas savings.

TABLE 111. 2020 SCHOOL EDUCATION PROGRAM *EX POST* NET SAVINGS

MEASURE	*EX POST* GROSS SAVINGS/REDUCTION			NTG	*EX POST* NET SAVINGS/REDUCTION		
	KWH	KW	THERMS		KWH	KW	THERMS
LED (9W) - Combo Kit	1,409,073.62	152.421	0.00	126%	1,777,352.06	192.258	0.00
Nightlight - Combo Kit	26,805.40	0.000	0.00	143%	38,368.24	0.000	0.00
Bathroom Aerator - Combo Kit	33,333.57	0.000	4,080.90	143%	47,712.41	0.000	5,841.24
Bathroom Aerator - Gas Only	0.00	0.000	147.00	143%	0.00	0.000	210.42
Kitchen Aerator - Combo Kit	297,140.44	7.605	36,377.71	140%	416,401.35	10.657	50,978.35
Kitchen Aerator - Gas Only	0.00	0.000	655.20	140%	0.00	0.000	918.18
Low Flow Showerhead - Combo Kit	353,216.01	11.935	43,242.82	144%	509,112.17	17.203	62,328.56
Low Flow Showerhead - Gas Only Kit	0.00	0.000	1,557.71	144%	0.00	0.000	2,245.22
Filter Whistle - Combo Kit	202,306.91	56.697	0.00	152%	307,782.06	86.257	0.00
Filter Whistle - Gas Only Kit	0.00	0.000	0.00	152%	0.00	0.000	0.00
Total Savings	2,321,875.96	228.658	86,061.35		3,096,728.30	306.375	122,521.97

Table 112 shows the NTG results by fuel type. Again, the high NTG values are largely driven by high spillover rates.

TABLE 112. 2020 SCHOOL EDUCATION NTG RESULTS BY FUEL TYPE

SAVINGS TYPE	*EX ANTE* GROSS SAVINGS	*EX POST* GROSS SAVINGS	NTG RATIO (%)	*EX POST* NET SAVINGS
Electric Energy Savings (kWh/yr.)	2,579,014.08	2,321,875.96	133%	3,096,728.30
Peak Demand Reduction (kW)	319.302	228.658	134%	306.375
Natural Gas Energy Savings (therms/yr.)	187,520.04	86,061.35	142%	122,521.97

PROCESS EVALUATION

The evaluation team completed several evaluation activities to answer the following key researchable questions:

- How satisfied are parents with the equipment included in the kit?
- What are parents' perspectives on the program materials? What are the barriers to parents installing equipment from the kit and engaging with program materials?
- Do customers learn about other programs? Do they engage in any additional energy behaviors?
- Does the program experience vary by demographics?
- Do families move on to participate in other programs? If so, which?

To answer these research questions, the evaluation team completed the following research tasks:

- Mixed mode telephone and web survey of program participants (parents/guardians) (n=70) to understand families' experiences with the materials and kits, satisfaction with the program, and inform impacts inputs.
- Utility and implementation staff interviews, to understand program design and delivery.
- Documentation and materials review, to provide context on program implementation.

PARENT SURVEY FINDINGS

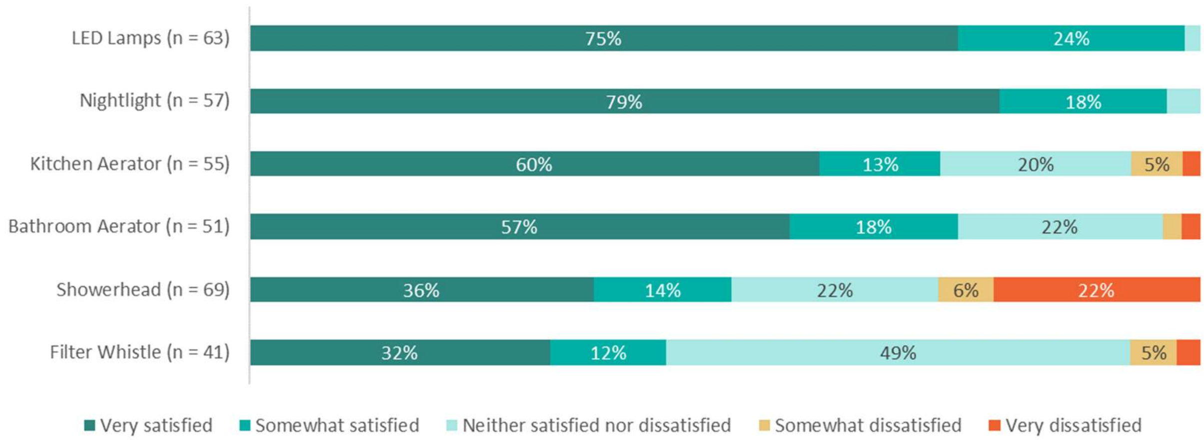
The evaluation team surveyed 70 program participants. The following sections describe surveyed parents' experience with the kit and program satisfaction.

DIRECT-INSTALL MEASURES

Overall, respondents were satisfied with the kit measures. Notably, not a single respondent was dissatisfied with the LED lamps or the LED nightlight. The low-flow showerhead had the highest rate of dissatisfaction with 22% of respondents reporting being "very dissatisfied" with it. Respondents who were dissatisfied with the showerhead cited the following reasons:

- Water pressure (n = 7)
- Have not installed it yet (n = 6)
- Disliked the showerhead (n = 4)

FIGURE 49. MEASURE SATISFACTION



LED LAMPS

The LED lamps included in the kit largely replaced incandescent or CFL lamps, 42% and 32% respectively (Table 113). Just over a quarter (27%) of the LED lamps replaced already existing LEDs.

TABLE 113. TYPE OF LAMP THE LED REPLACED*

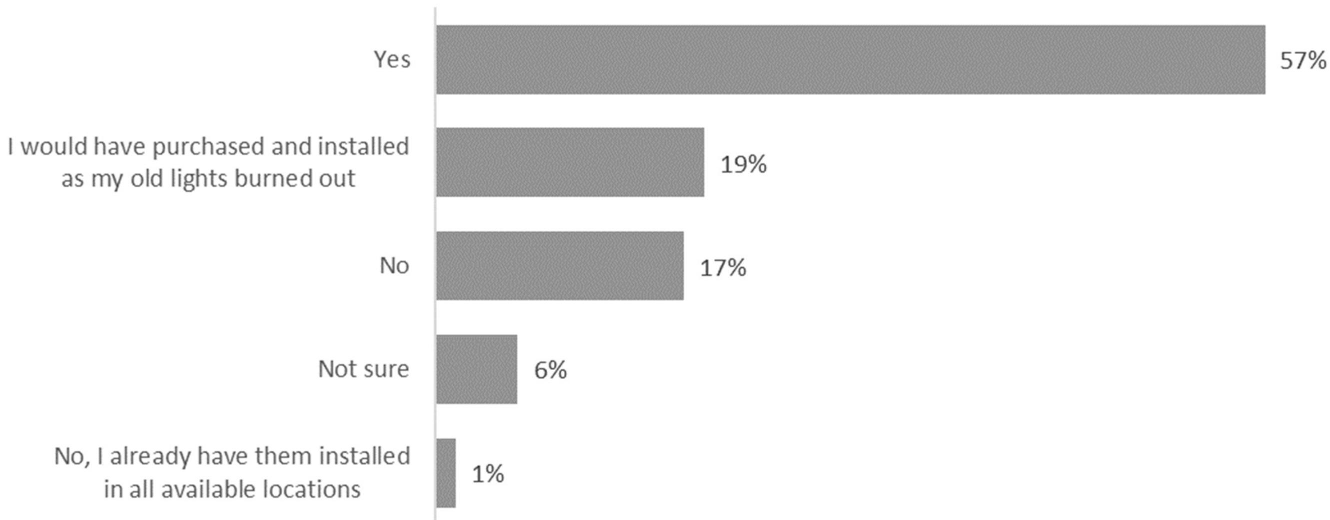
LED REPLACED…	COUNT	PERCENT
Incandescent	83	42%
CFL	64	32%
LED	53	27%
TOTAL	200	100%

* Total lamps do not equal the number of distributed lamps to respondents due to respondents skipping survey questions.

Nearly all respondents (98%) with LEDs currently installed were satisfied with the bulbs. In fact, 75% of respondents said they were very satisfied with the LED lamps. Not one respondent said they were dissatisfied.

Just over half of respondents (57%) said they would have purchased the LED lamps if they had not received them in the kit (Figure 50). Of these respondents, 78% said they would have purchased the LED lamps around the same time as receiving the kit or within a year.

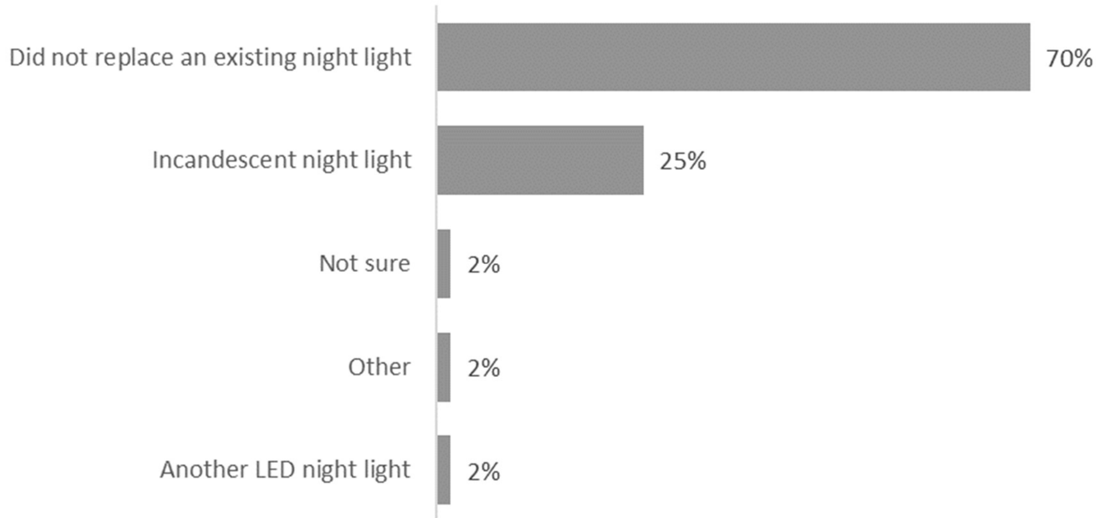
FIGURE 50. SCHOOL EDUCATION PROGRAM: IF YOU HAD NOT RECEIVED THE KIT, WOULD YOU HAVE PURCHASED LED LIGHT BULBS ON YOUR OWN? (N = 70)



LED NIGHT LIGHT

Most respondents, 81%, currently have the LED night light installed. Of the 57 respondents who currently have the night light installed, 70% said the night light did not replace an existing light (Figure 51). However, of the 41 respondents who *did not* replace an existing light with the LED night light, 20 said the night light is used in lieu of keeping other lights on (e.g., bathroom or hallway).

FIGURE 51. SCHOOL EDUCATION PROGRAM:
WHAT DID THE LED NIGHT LIGHT FROM THE KIT REPLACE? (N = 57)



Nearly all respondents (96%) were satisfied with the LED night light. In fact, 79% of respondents were very satisfied with the night light and not a single respondent expressed dissatisfaction.

LOW FLOW SHOWERHEAD

Of the 31 respondents who reported having their showerhead currently installed, 26 said it was installed in a primary bathroom. The 38 respondents who did not have the showerhead installed cited several reasons:

- Already had a low-flow showerhead (n = 12)
- The current showerhead is “fine”, or they recently purchased a new showerhead (n = 9)
- Three respondents did not like how the showerhead worked
- Three respondents simply have not made time to install the showerhead

Over half of respondents (51%) were satisfied with the low-flow showerhead. Just four respondents were very dissatisfied and 15 were not sure.

KITCHEN AERATOR

Of the 35 respondents who did not have the kitchen faucet aerator installed, 14 said it did not fit and eight said they already had one. Of 55 respondents, 73% were satisfied with the kitchen faucet aerator. Just four respondents expressed dissatisfaction with this measure. Of the 15 respondents who were not satisfied with the kitchen faucet aerator, seven said it did not fit.

BATHROOM AERATOR

Of the 33 respondents who did not have the bathroom faucet installed, nine said it did not fit and/or they already had one. Most respondents, 75%, were satisfied with the bathroom faucet aerator. Just two respondents were not satisfied. Issues with measure fit and water pressure were the top reasons respondents were dissatisfied with the measure.

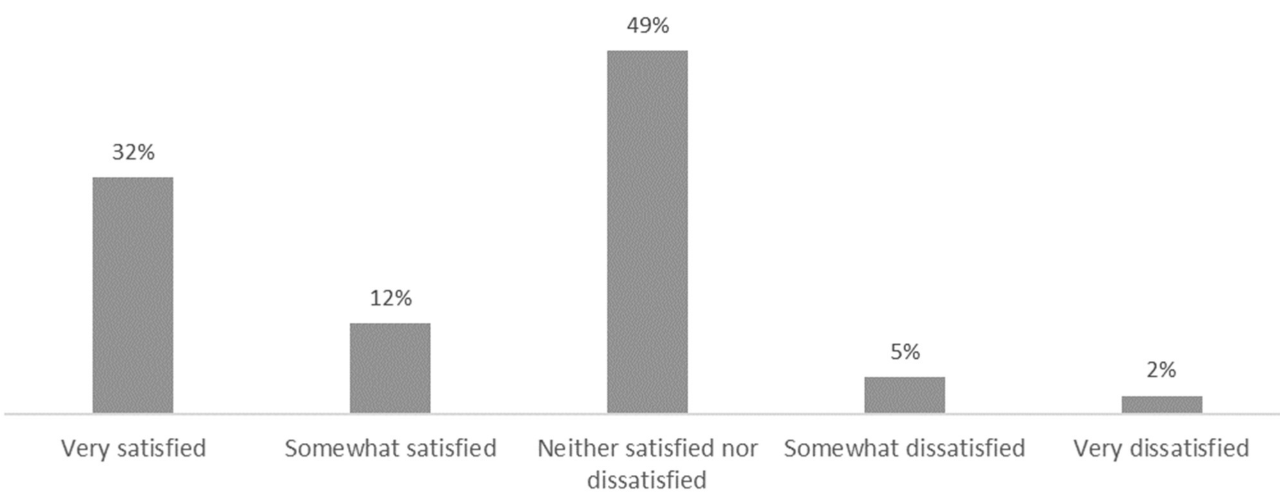
FILTER WHISTLE

As reported above, the filter whistle experienced low installation rates (Figure 52). Sixty-nine percent of 62 respondents said they never installed the filter whistle and just nine respondents said it was currently installed.

Of the 53 respondents who did have the filter whistle installed, 23 respondents said they did not understand what it was. Other respondents simply said they had not yet installed it or that it did not fit.

Nearly half of respondents said they were neither satisfied nor dissatisfied with the filter whistle. However, 18 of 41 respondents reported being satisfied with the filter whistle. Respondents who were not satisfied with the filter whistle said they did not understand what it was, some respondents simply did not use it, and others already change their filter frequently.

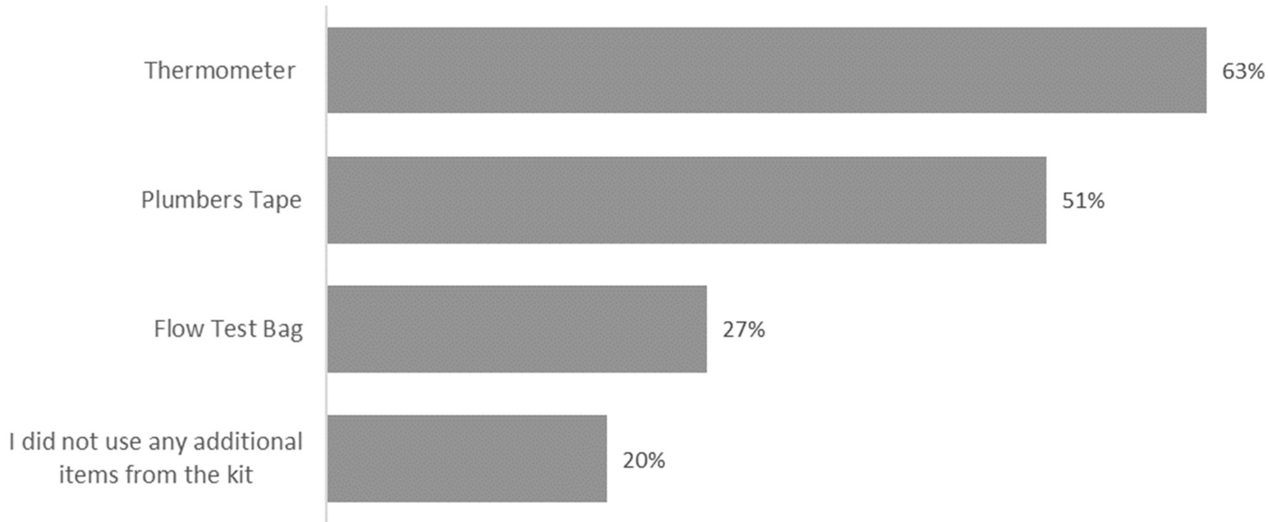
FIGURE 52. SCHOOL EDUCATION PROGRAM:
HOW SATISFIED ARE YOU WITH THE FILTER WHISTLE OVERALL? (N = 41)



ADDITIONAL MEASURES

Of the additional measures included in the kit, the thermostat and plumbers' tape were the most widely used by respondents, 63% and 51% respectively (Figure 53). Just over a quarter of respondents (27%) used the flow test bag and 14 respondents did not use any additional measures.

FIGURE 53. SCHOOL EDUCATION PROGRAM:
WHICH OF THE FOLLOWING OTHER ITEMS FROM THE KIT DID YOU USE? (N = 70, MULTIPLE RESPONSE)



Overall, respondents found the additional measures to be very useful. Several respondents mentioned the usefulness of the thermometer and water flow test bag:

- "I really found all of the items useful. We had a problem with our refrigerator fan and if it wasn't for the thermometer, we wouldn't have realized that the temperature was under normal levels but still cold enough to not think about it."
- "The thermometer helped us make adjustments to the refrigerator and freezer."
- "I found the water flow bag useful I never realized how much water flows thru the shower or the faucet."
- "It was cool to see the water flow test."

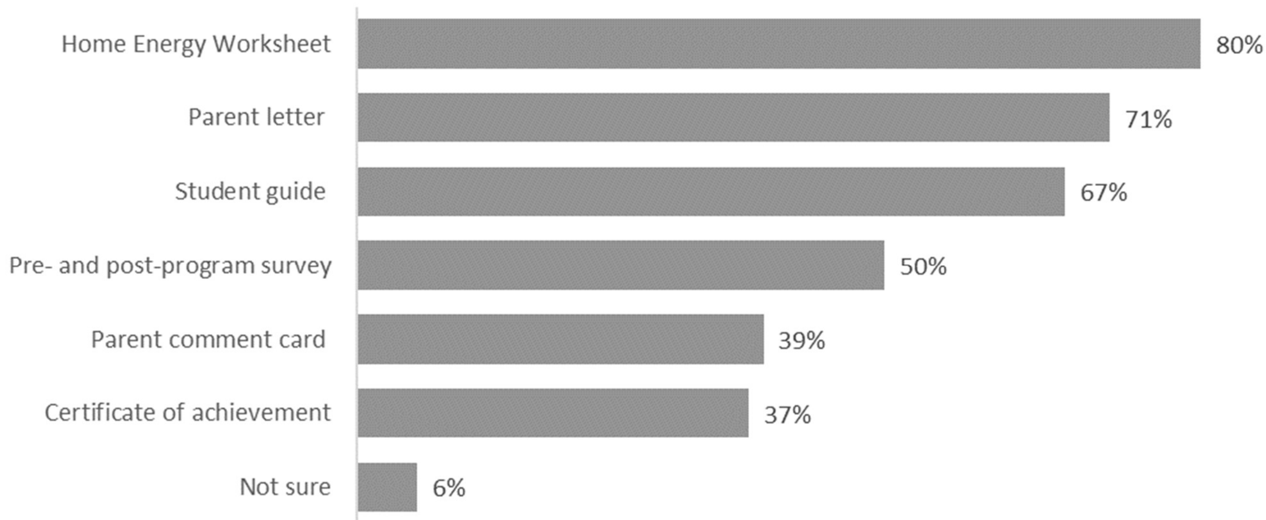
PARTICIPATION IN ADDITIONAL PROGRAMS

Just one respondent reported participating in an additional program, appliance recycling, since receiving the energy kit. Six respondents were not sure if they had participated in another program.

PROGRAM ENGAGEMENT

Recall of program materials varied (Figure 54). Most respondents recalled the Home Energy Worksheet (80%), the parent letter (71%), and the student guide (67%). Just half of respondents recall the pre- and post-program survey.

FIGURE 54. SCHOOL EDUCATION PROGRAM:
WHICH MATERIALS DO YOU RECALL SEEING ALONG WITH THE KIT? (N = 70)



Of 65 respondents, 86% spoke with their child about the energy efficiency tips and facts they learned about in school. Conversations with children largely centered around the energy and cost savings benefits of the kit measures. Conversation themes are summarized below:

- Reduced water consumption from the low-flow showerhead and faucet aerators.
- Switched to LEDs to save money.
- No cost behaviors like turning off lights when not in use, turning down the thermostat in the winter, and turning off the faucet while brushing one's teeth.

Several parents noted how excited and engaged their children were with the program saying:

- "My twins were little jabber boxes and tried to start installing everything themselves. They were super excited."
- "He made me install everything and made it very important to save energy."
- "Very chatty about the light bulbs. Was impressed by how much information she retained."
- "We did some of the things that came in the kit. He was very excited about them. We still use thermometer to monitor the freezer and talked about it a lot when the power went out to know when to get food out."

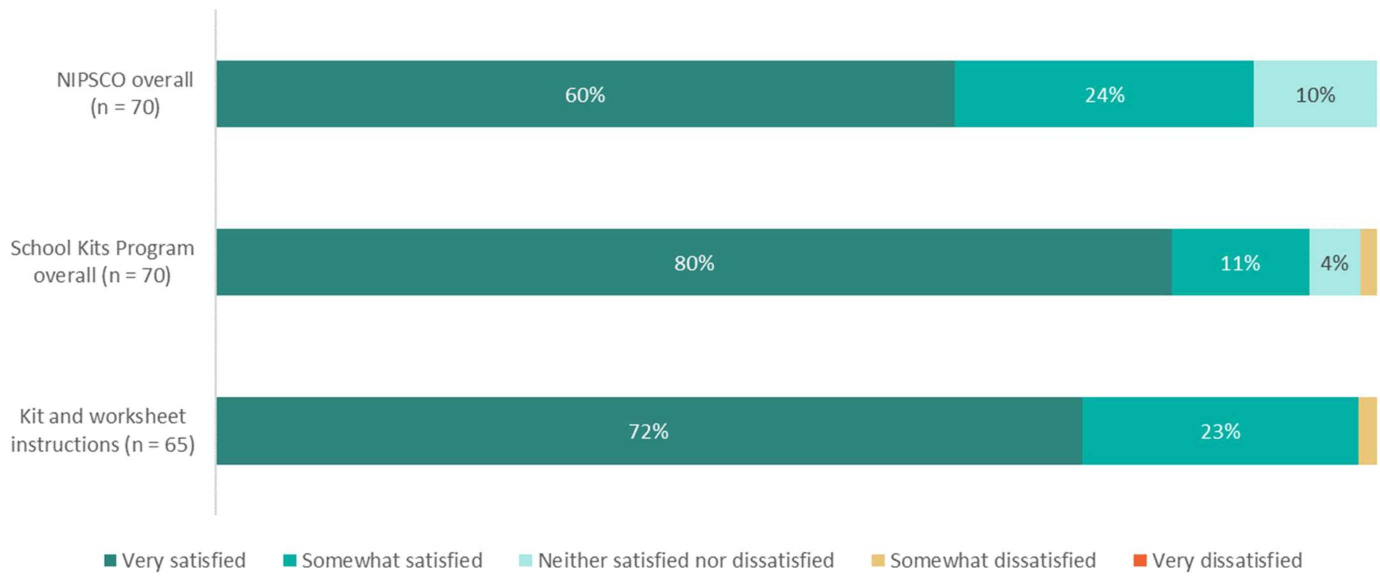
Of the 56 respondents who spoke with their child about energy efficiency tips, 63% modified their behavior based on these tips. Modified behaviors included taking shorter showers, turning lights off, closing doors more often, and turning down the thermostat in the winter and using the AC less. Fifteen respondents did not modify their behavior and six could not recall if they modified their behavior.

SATISFACTION

Overall satisfaction with the Energy Efficiency School Kits program and NIPSCO was high. Most respondents (91%) reported being very or somewhat satisfied with the program and 84% said they were satisfied with NIPSCO overall.

No respondents said they were dissatisfied with NIPSCO overall. Most respondents (95%) were satisfied with the instructions included in the kit and worksheet. Just one respondent said they were somewhat dissatisfied with the instructions.

FIGURE 55. SCHOOL EDUCATION PROGRAM: PROGRAM AND UTILITY SATISFACTION



DEMOGRAPHICS AND HOME CHARACTERISTICS

RESPONDENT DEMOGRAPHICS

Over half of respondents (58%) have college degrees and 60% are between 31 and 40 years old. Respondents tend to be longer-term occupants of their homes. Nearly one third of respondents have lived in their homes for more than 10 years. Just 13% have lived in their home for one year or less.

HOME CHARACTERISTICS

Over three quarters of respondents (76%) live in a single-family home and 78% own their home. Many respondents (41%) live in homes built before 1980. Most respondents (87%) have just one kitchen sink; 12% have two. Nearly half of respondents (48%) have two showers in their home, 28% have one, and 25% have three showers.

The following is a snapshot of self-reported HVAC home characteristics:

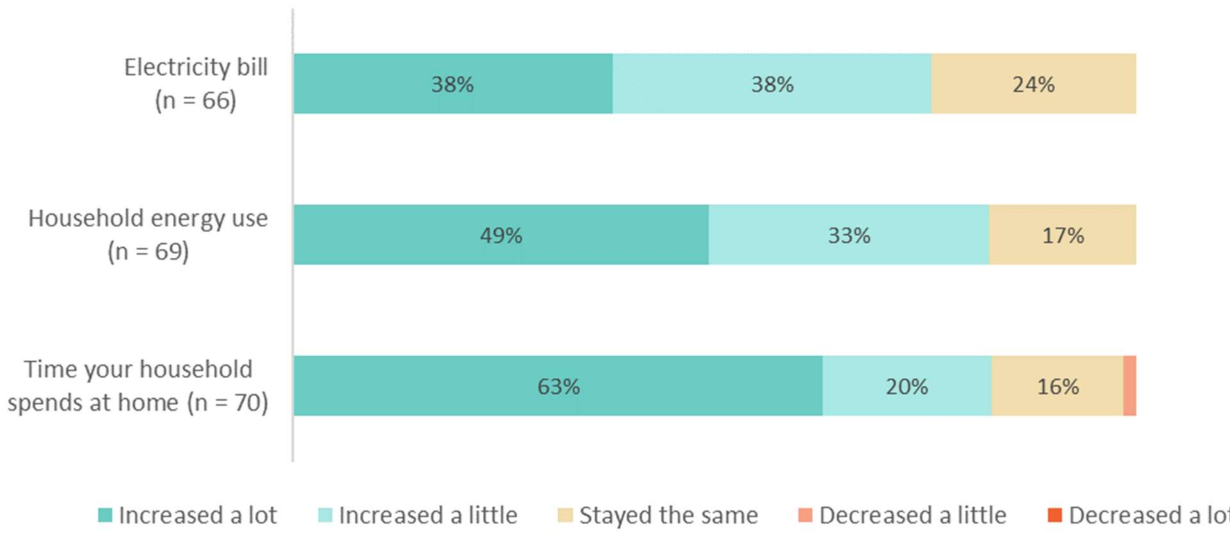
- Water heating: 62% use natural gas and 28% use electricity.
- Home heating: 77% use natural gas and 16% use electricity.
- Heating equipment: 86% heat their homes with a furnace.
- Cooling equipment: 76% have central air conditioning and 19% use AC units.

COVID-19 FINDINGS

While the COVID-19 pandemic did not pause the program, the evaluation team included several questions about how the pandemic has affected customers to understand how their needs or experiences may have changed.

Over 80% of respondents reported that time spent at home has increased relative to 2019; 63% said it increased a lot (Figure 56). Consequently, self-reported energy use and monthly electric costs reveal that most respondents experienced increases in energy consumption and thus, energy costs since the start of the pandemic. Notably, not one respondent said their weekly energy has decreased since the start of the pandemic. In fact, 81% of respondents said their energy use has increased. Most respondents (71%) said their monthly electric bill has increased since the start of the pandemic.

FIGURE 56. SCHOOL EDUCATION PROGRAM: EFFECT OF COVID ON HOUSEHOLD



The pandemic has financially impacted some respondents more than others. Forty percent of respondents said their employment situation was affected by Covid-19. Many of these respondents reported losing their jobs or had hours reduced. Not surprisingly, 40% of respondents also expected their household income to decrease in 2020 (relative to 2019). Just 23% of respondent expected their income to increase in 2020. Household income was distributed with 38% earning less than $50,000, 38% earning between $50,000 and $100,000, and 24% earning more than $100,000.

Just over a third of respondents (36%) made home improvements during the pandemic. Home improvements ranged from bathroom remodels, new appliances, new windows, and new roofs. Most home improvements cost $5,000 or less. Also, of the 25 respondents who made home improvements, 13 made upgrades that were not planned before the pandemic.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSION 1: MOST IMPACT FACTORS REMAINED CONSISTENT ACROSS PROGRAM YEAR EVALUATIONS. FOR SOME WATER SAVING DEVICES, SOMEWHAT LOWER INSTALLATION RATES AND WATER HEATER SATURATION IS DRIVING LOWER SAVINGS.

In general, participants reported similar rates of installation across all measures, when compared to previous years. Similarly, free ridership rates remained relatively consistent to past years. For both showerheads and bathroom aerators, a combination of somewhat lower installation rates and lower reported water heater saturation is driving lower savings compared to previous years, especially on the gas side.

CONCLUSION 2: SOME PARTICIPANTS REPORTED THEY USED THEIR LED NIGHTLIGHT IN PLACE OF LEAVING ANOTHER LIGHT, SUCH AS A BATHROOM OR HALLWAY LIGHT ON.

Most respondents who installed an LED night light did not use it to replace an existing nightlight. However, some respondents (n = 20) did use the night light as a substitute for leaving other lights on.

Recommendations:

- If desired, consider additional exploratory research to determine if there are additional savings that could be claimed from a differential baseline. Currently, the IN TRM only accounts for nightlights within the baseline, and in an initial review the evaluation team was not able to find other studies that had estimated savings resulting from nightlights replacing other types of lights. To determine if it is possible to estimate additional savings, additional research may need to be conducted, potentially including a more detailed literature review of other studies to determine if this has been done before, and/or more primary research (such as surveys or on-sites) with participants to better understand impact factors.

CONCLUSION 3: WASTE HEAT FACTORS ARE NOT APPLIED CONSISTENTLY ACROSS PROGRAMS.

Waste heat factor adjustments *are* applied to qualifying residential measures in kits or direct install programs (e.g., LED lights). However, these adjustments are *not* currently made to qualifying commercial and industrial measure savings performance. Going forward, both NIPSCO and the evaluation team propose addressing therm penalties within electric program cost-effectiveness.

Recommendations:

- Address waste heat factors consistently across programs in ex-ante savings. If this is addressed in cost-effectiveness, this factor should be calculated for use in cost effectiveness analyses but not applied against *ex ante* or *ex post* program performance.
- Correct error in ex-ante waste heat factor therm calculations. For kit programs, this factor is being calculated as MMBTU but not converted to therm savings.

CONCLUSION 4: FEW PARTICIPANTS KEEP FURNACE WHISTLES INSTALLED, RESULTING IN LOW INSTALLATION RATES. SOME PARTICIPANTS DO NOT UNDERSTAND THE PURPOSE OF THE FURNACE WHISTLE.

The evaluation team found low installation rates for furnace whistles in 2020. Respondents reported some confusion with this measure, which likely contributes to lower installation rates; however, a relatively high number of participants also remove the measure after installing it.

Recommendations:

- Given this measure's performance, consider whether it should be kept in the kit offerings in future program planning. It should be noted that the IL TRM v9.0 (2020) has removed this measure, citing evaluation results indicating it is not effective. If kept, consider additional ways to educate customers on how to use it properly and the benefits of keeping it installed, to increase long term in-service rates. Per NIPSCO, it is currently planned to remove this measure for the next program cycle.

CONCLUSION 5: PARTICIPANTS WERE GENERALLY SATISFIED WITH KIT MEASURES, THE PROGRAM, AND NIPSCO OVERALL.

Over half of respondents were "very satisfied" with all measures, except the low-flow showerhead and the filter whistle. The highest satisfaction ratings were for lighting measures, LEDs, and the night light. Participants also reported high satisfaction with the program overall, with some citing increased engagement with their children in discussing energy efficiency and modified behaviors.

CONCLUSION 6: PARTICIPATION SPILLOVER WAS VERY HIGH IN 2020 AND CROSS PROGRAM PARTICIPATION WAS VERY LOW.

Spillover participants installed additional energy efficient measures which qualified for rebates for which they did not receive rebates. Additionally, just one respondent reported participating in another program after participating in the School Education program.

Recommendations:

- Consider ways to increase awareness of other NIPSCO programs to capture energy savings generated from spillover participants. Increasing cross participation also affords NIPSCO additional opportunity to engage with customers and expand their customer relationship.
- Many respondents seemed very engaged in the program. Leverage this enthusiasm to channel respondents to other programs, particularly as they have some baseline understanding of the benefits of energy efficiency behaviors and measures.

8. BEHAVIORAL PROGRAM

PROGRAM DESIGN AND DELIVERY

First launched in 2011, the Residential Behavioral program provides paper and electronic Home Energy Reports (HERs) to select NIPSCO customers. HERs detail the customer's energy usage—including their historical consumption data as well as a comparison to other households—and provide low-cost and no-cost tips to save energy. Customers participating in the program with a valid email address also receive a monthly electronic HER and access to the program-affiliated web portal to review their energy consumption and see additional energy saving tips. HERs also promote and encourage participation in other NIPSCO energy efficiency programs.

The program uses a randomized control trial (RCT) design whereby customers are randomly assigned to a treatment or control group. Customers in the treatment group receive a HER while customers in the control group do not receive a HER. The customer population is divided into nine waves based on when a customer began receiving the HER (Table 114). The initial five waves have respective natural gas and electric populations known as cohorts. The program launched a sixth wave of gas-only customers in September 2017, a seventh wave of electric-only customers in May 2018, and eighth and ninth waves with gas and electric customers in April 2019 and April 2020. Treatment group participants in all nine waves received paper reports; those with a valid email address on file received email reports and had access to the web portal in 2020. The number of reports a treatment group participant received varied by their fuel type and by availability of a valid email address.

TABLE 114. 2020 CUSTOMER COUNTS BY WAVE

		NUMBER OF ELECTRIC CUSTOMERS (JANUARY 2020)		NUMBER OF GAS CUSTOMERS (JANUARY 2020)	
WAVE	FUEL	TREATMENT	CONTROL	TREATMENT	CONTROL
Wave 1 (first report March 2011)	Dual	84,303	28,048	84,005	27,949
Wave 2 (first report June 2012)	Dual	6,487	6,520	6,449	6,477
Wave 3 (first report July 2014)	Dual	27,933	6,335	27,882	6,342
Wave 4 (first report March 2015)	Dual	20,650	5,303	20,480	5,260
Wave 5 (first report June 2017)	Dual	23,235	7,566	23,162	7,560
Wave 6 (first report September 2017)	Natural Gas	-	-	40,212	9,631
Wave 7 (first report in May 2018)	Electric	17,944	8,521	-	-
Wave 8 (first report in April 2019)	Dual	24,094	11,851	23,986	11,801
Wave 9 (first report in April 2020)	Dual	18,246	9,001	18,157	8,982
TOTAL		222,892	83,145	244,333	84,002

Source: ILLUME analysis of data provided by Oracle

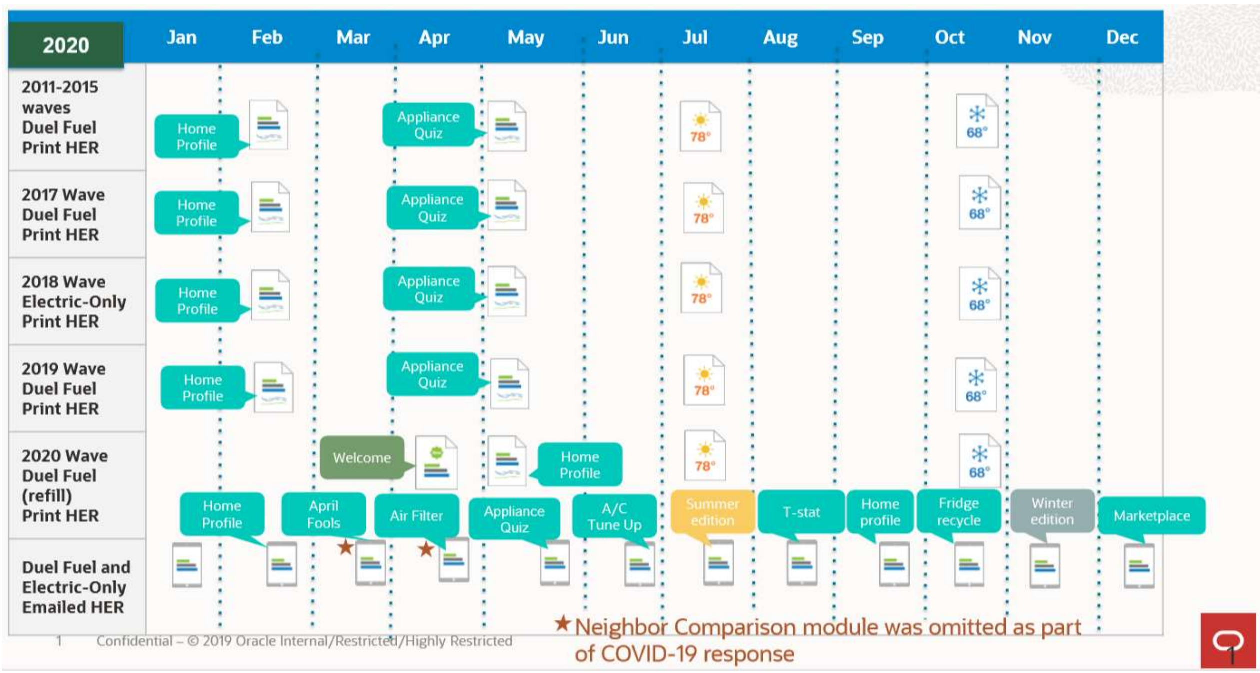
Note: For the dual fuel waves, the same group of customers receive natural gas and electric feedback. The customer counts shown are based on billing data. Due to missing billing data, there are differences in counts between electric and natural gas.

CHANGES FROM 2019 DESIGN

There were four primary changes from 2019 to 2020. First, in 2020, the Behavioral program introduced a new dual fuel wave. The program also added an appliance quiz for electric and dual fuel customers, as shown in Figure 57. The NIPSCO web portal migrated to the newest instance of Opower's platform in late March 2020. Last, in response to the COVID-19 pandemic, the program did not send out the neighbor comparison emails in March and April 2020.

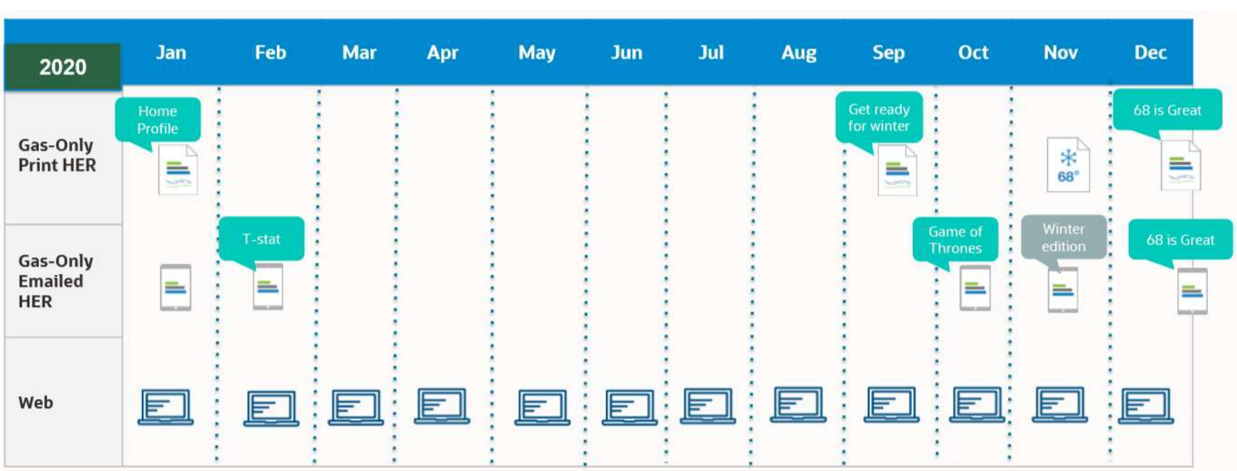
Some energy saving tips were also removed from the list of tips a customer could receive because they were not aligned with government guidance on COVID-19 safety protocols.

FIGURE 57. 2020 PROGRAM DESIGN - ELECTRIC AND DUAL FUEL CUSTOMERS



Source: Oracle

FIGURE 58. 2020 PROGRAM DESIGN - GAS ONLY CUSTOMERS



Source: Oracle

PROGRAM PERFORMANCE

Table 115 presents a savings summary for the program, including goals. Like the 2019 program year[41], the program achieved 134% of its electric gross savings goal and 159% of its natural gas gross savings goal (aggregate of all nine waves). NIPSCO did not have a demand reduction goal for the program and did not track *ex ante* demand reduction; the evaluation team calculated it as part of the *ex-post* savings analysis.

Note that the experimental design and evaluation methods (comparing change in energy use over time between a treatment and control group) means that ex post savings are by design net savings. No additional adjustments are needed.

TABLE 115. 2020 BEHAVIORAL PROGRAM SAVINGS SUMMARY

METRIC	GROSS SAVINGS GOAL	*EX ANTE*	*EX POST* GROSS	*EX POST NET*	GROSS GOAL ACHIEVEMENT
Electric Energy Savings (kWh/yr)	21,660,654.47	29,924,714.00	29,077,363.05	29,077,363.05	134%
Peak Demand Reduction (kW)	0.000	0.000	3,319.334	3,319.334	N/A
Natural Gas Energy Savings (therms/yr)	1,060,936.01	1,664,979.00	1,683,361.98	1,683,361.98	159%

Source: ILLUME analysis of data provided by NIPSCO

Table 116 outlines the *ex post* gross and NTG adjustment factors. ILLUME's evaluation verified the *ex ante* savings, yielding a 97% realization rate for electric savings and 101% realization rate for natural gas savings. The evaluation produces a net savings value with a NTG of 100%, because the program follows a randomized study design. In this study design, participants would not receive reports in absence of the program (i.e., no freeridership) and any spillover within participants is captured in the evaluation as program savings (i.e., spillover is N/A).

TABLE 116. 2020 BEHAVIORAL PROGRAM ADJUSTMENT FACTORS

METRIC	REALIZATION RATE (%)[a]	FREERIDERSHIP	SPILLOVER	NTG (%)[b]
Electric Energy Savings (kWh/yr)	97%	0%	N/A	100%
Peak Demand Reduction (kW)	N/A	0%	N/A	100%
Natural Gas Energy Savings (therms/yr)	101%	0%	N/A	100%

Source: ILLUME analysis of data provided by Oracle and NIPSCO
[a] Realization Rate is defined as *ex post* gross savings divided by *ex ante* savings.
[b] The appropriate NTG for HER programs is 100%.

As of December 31, 2020, the program spent 97% of its annual electric program budget and 96% of its annual natural gas program budget. Table 117 lists the 2020 program budget and expenditures by fuel type.

[41] In the 2019 program year the program achieved 149% of the 20,768,2018.41 kWh electric energy savings goal, and 163% of the 933,740 therms gas energy savings goal.

TABLE 117. 2020 BEHAVIORAL PROGRAM EXPENDITURES

FUEL	PROGRAM BUDGET	PROGRAM EXPENDITURES	BUDGET SPENT (%)
Electric	$1,643,952.40	$1,588,821.02	97%
Natural Gas	$389,606.43	$374,544.02	96%

Source: ILLUME analysis of data provided by NIPSCO

RESEARCH QUESTIONS

The evaluation team conducted qualitative and quantitative research activities to answer the following key research questions for the program:

- What are ex post program savings? Do these suggest any needed updates to program design, delivery, or savings assumptions?
- Is the program on track to meet its savings goals?
- Does the program impact participation in other EE programs?
- Are all program years achieving statistically significant savings? How has this changed with terminating old waves or adding new waves?
- What are opt-out rates? Have they changed over time?
- How are treatment and control group sizes changing over time?
- To what extent are treatment customers reading the email HER? Has that changed from last program year?
- Are customers using the online portal? Has use changed from last program year?
- Do the tips and marketing messaging align with NIPSCO's channeling goals and with changing consumer habits?
- How have the savings changed over time and what might that indicate for future savings?

IMPACT EVALUATION

This section details each step of the impact evaluation and its associated electric energy savings and natural gas savings. The evaluation team conducted a billing analysis for the 2020 program year with a cross program participation analysis, and reviewed Oracle's estimated impacts by wave and month.

For the impact analysis, the evaluation team collected the implementer's data for monthly energy usage and savings for each wave as well as billing data for all waves from one year prior to the start of the wave through the 2020 program year. With this data, the evaluation team verified the *ex ante* savings in two steps: (1) corroborating the savings field in the implementer's data and (2) estimating savings for 2020 across waves using billing data. In summary, the evaluation team successfully corroborated the *ex ante* savings: evaluated (*ex post*) savings were slightly lower for electric and slightly higher for gas than the *ex ante* savings.

CORROBORATE IMPLEMENTER-PROVIDED SAVINGS

The implementer provided monthly savings for each wave. ILLUME corroborated this data by comparing the implementer's estimated savings to a simple difference between control and treatment average daily usage. The percent savings based on a simple difference was 0.3% higher than the implementer's modeled monthly savings for electric and the same for gas. This small degree of difference validates the implementer provided data.

TABLE 118. DIFFERENCES BETWEEN CONTROL AND TREATMENT USAGE

WAVE	ELECTRIC		GAS	
	SIMPLE DIFFERENCE (%)	EX-POST SAVINGS (%)	SIMPLE DIFFERENCE (%)	EX-POST SAVINGS (%)
Wave 1 (first report March 2011)	5.5%	2.4%	0.2%	0.7%
Wave 2 (first report June 2012)	0.8%	1.5%	0.7%	0.9%
Wave 3 (first report July 2014)	1.3%	1.5%	0.6%	0.5%
Wave 4 (first report March 2015)	1.1%	0.9%	1.2%	0.8%
Wave 5 (first report June 2017)	1.4%	0.7%	1.5%	1.1%
Wave 6 (first report September 2017)	-	-	1.4%	1.2%
Wave 7 (first report in May 2018)	1.2%	1.0%	-	-
Wave 8 (first report in April 2019)	0.2%	0.4%	1.0%	0.7%
Wave 9 (first report in April 2020)	0.4%	0.5%	-0.3%	0.1%
AVERAGE	1.5%	1.2%	0.8%	0.8%

BILLING ANALYSIS

The evaluation team applied several steps for our Behavioral billing analysis:

- Data cleaning: The evaluation team identified respondent data to exclude from the analysis. Reasons for exclusion include an insufficient number of pre-period or program period months or insufficient billing days within a given month to determine a monthly average.
- Equivalency check: The evaluation team verified that the distribution of average monthly energy usage prior to receiving the HERs was sufficiently similar between the treatment and control groups, consistent with the random assignment of customers to treatment and control groups.
- Regression analysis: The evaluation team verified program impacts using two alternative statistical models: a post-program regression (PPR) analysis with lagged participant controls and a linear fixed effects regression (LFER) analysis. Both models control for individual respondent differences, but the PPR achieves this by including lagged participant controls for each participant as an explanatory variable while the LFER removes each participant's average energy consumption before modeling. The evaluation team applied both models to monthly energy usage data obtained from respondent bill records. The results of the PPR model are reported as the official impact estimates, with the LFER model serving as a check on those results. More details are provided in *Residential Behavioral Program Regression Analysis and Cross Program Participation Analysis*.

- **Cross program participation analysis:** The evaluation team estimated the cross program participation in other energy efficiency programs due to actions suggested by HERs through a post-only differences approach applied to tracking data from other programs. Post-only differences are a direct comparison of program uptake in the post-period as a percentage of respondents from treatment and control groups. More details are provided in *Residential Behavioral Program Regression Analysis and Cross Program Participation Analysis*.

DATA CLEANING

As shown in Table 119 and Table 120 for electric and natural gas customers, respectively, the evaluation team cleaned the billing data to ensure that data used in the billing analysis contained sufficient pre-period (11) and post-period (2) months in the analysis periods, and sufficient billing days. Customers with insufficient post-period data had either moved or disconnected service after their respective waves' inception, but before this evaluation period began. As a result, some of the earlier deployment waves appear to have considerably high numbers of customers removed. Treatment and control customers have shown near identical rates of attrition, as the difference in the percent of treatment and percent of control customers removed from any one wave does not exceed two percentage points.

TABLE 119. PARTICIPANTS FILTERED OUT BY DATA SUFFICIENCY CHECKS FOR ELECTRIC CUSTOMERS

	WAVE 1		WAVE 2		WAVE 3		WAVE 4	
	TREAT.	CONTROL	TREAT.	CONTROL	TREAT.	CONTROL	TREAT.	CONTROL
Original randomly assigned homes	148,974	51,130	14,999	15,000	51,955	11,852	41,000	10,500
Records in billing data for 2020 evaluation	129,931	44,323	12,073	12,069	43,862	9,977	33,539	8,560
Applied filters:								
Insufficient post-period data	46,005	16,404	5,628	5,608	16,125	3,670	13,052	3,307
Insufficient pre-period data	1,396	611	199	194	729	155	1,175	316
Total Filtered	47,401	17,015	5,827	5,802	16,854	3,825	14,227	3,623
FINAL ESTIMATION SAMPLE	82,530	27,308	6,246	6,267	27,008	6,152	19,312	4,937
ATTRITION RATE	55%	53%	42%	42%	52%	52%	47%	47%

	WAVE 5		WAVE 7		WAVE 8		WAVE 9	
	TREAT.	CONTROL	TREAT.	CONTROL	TREAT.	CONTROL	TREAT.	CONTROL
Original randomly assigned homes	36,796	12,000	25,000	12,000	30,430	14,999	18,703	9,212
Records in billing data for 2020 evaluation	34,733	11,345	23,906	11,473	29,391	14,523	18,378	9,070
Applied filters:								
Insufficient post-period data	11,735	3,862	6,145	3,049	5,677	2,906	1,410	661
Insufficient pre-period data	931	296	298	131	991	486	1,039	527
Total Filtered	12,666	4,158	6,443	3,180	6,668	3,392	2,449	1,188
FINAL ESTIMATION SAMPLE	22,067	7,187	17,463	8,293	22,723	11,131	15,929	7,882
ATTRITION RATE	60%	60%	70%	69%	75%	74%	85%	86%

TABLE 120. PARTICIPANTS FILTERED OUT BY DATA SUFFICIENCY CHECKS FOR NATURAL GAS CUSTOMERS

	WAVE 1		WAVE 2		WAVE 3		WAVE 4	
	TREAT.	CONTROL	TREAT.	CONTROL	TREAT.	CONTROL	TREAT.	CONTROL
Original randomly assigned homes	148,974	51,130	14,999	15,000	51,955	11,852	41,000	10,500
Records in billing data for 2020 evaluation	127,904	43,606	11,742	11,758	43,152	9,798	32,758	8,361
Applied filters:								
Insufficient post-period data	44,266	15,790	5,336	5,330	15,461	3,495	12,381	3,123
Insufficient pre-period data	4,386	1,565	850	839	2,511	556	3,405	872
Total Filtered	48,652	17,355	6,186	6,169	17,972	4,051	15,786	3,995
FINAL ESTIMATION SAMPLE	79,252	26,251	5,556	5,589	25,180	5,747	16,972	4,366
ATTRITION RATE	53%	51%	37%	37%	48%	48%	41%	42%

	WAVE 5		WAVE 6		WAVE 8		WAVE 9	
	TREAT.	CONTROL	TREAT.	CONTROL	TREAT.	CONTROL	TREAT.	CONTROL
Original randomly assigned homes	36,796	12,000	50,000	12,000	30,430	14,999	18,703	9,212
Records in billing data for 2020 evaluation	34,154	11,143	48,159	11,571	29,094	14,373	18,206	8,999
Applied filters:								
Insufficient post-period data	11,213	3,653	8,163	1,993	5,476	2,781	1,394	659
Insufficient pre-period data	2,440	814	2,088	500	3,746	1,812	2,190	1,112
Total Filtered	13,653	4,467	10,251	2,493	9,222	4,593	3,584	1,771
FINAL ESTIMATION SAMPLE	20,501	6,676	37,908	9,078	19,872	9,780	14,622	7,228
ATTRITION RATE	56%	56%	76%	76%	65%	65%	78%	78%

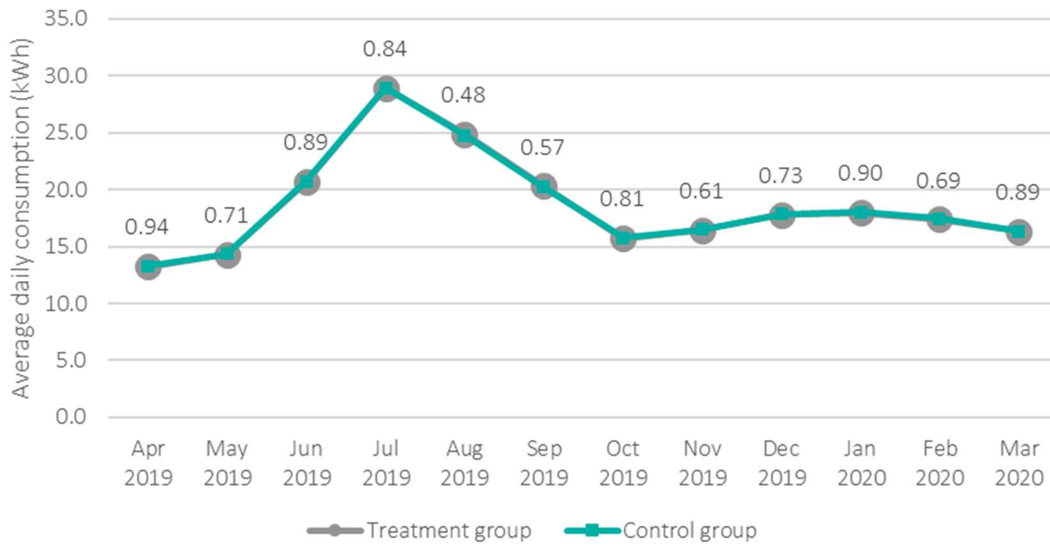
EQUIVALENCY CHECK

Because the treatment and control groups are randomly assigned, pre-treatment energy use should theoretically be equivalent between the groups. The evaluation team performed an equivalency check of the energy usage patterns of the treatment and control groups of each wave in the year preceding the rollout to confirm that the data in each case were consistent with an RCT evaluation approach. All analyzed groups except the Wave 1 gas with email group passed equivalency checks. While the Wave 1 gas with email group did not pass, the evaluation team considers the results reliable. The wave level savings are statistically significant and are non-equivalent by no more than 2% of usage each month.

The evaluation team employed two methods to assess the equivalency of treatment and control energy usage:

- Visual inspection of overlaid plots of monthly mean energy use for treatment and control groups (an example is shown in Figure 59).
- T-tests of the monthly differences in mean energy use between treatment and control groups in each month. A significant difference (p<0.05) indicates that pre-period usage is dissimilar between groups.[42]

FIGURE 59. EQUIVALENCY CHECK FOR 2020 WAVE



This figure represents the equivalency check for the 2020 electric usage of Wave 9, with p-values reported above the data points. The average daily consumption between treatment and control groups is highly similar.

REGRESSION ANALYSIS

The regression analysis produced savings estimates of 29,077 MWh of electricity and 1,683,362 therms of natural gas in 2020. Note that modeled electric savings for four waves (Wave 4, Wave 5, Wave 8, and Wave 9) and modeled natural gas savings for four waves (Wave 2, Wave 3, Wave 4, and Wave 9) are not statistically significant (p>0.10). Since the program is an RCT experimental design, these results are the unbiased, best estimates of true savings values. Although with these waves the evaluation team cannot rule out that savings are unequal to zero, with all the waves the evaluation team cannot rule out that the savings are unequal to a different value in the confidence interval. The evaluation team reports confidence intervals for all waves and for all waves used the point estimate as the best estimate of savings (see Table 121). For example, the Wave 2 confidence interval for electric savings ranges from 28 MWh to 986 MWh, yet the evaluation team reports the center point (507 MWh) as the evaluated savings. The evaluation team applied the same approach across all waves even if the interval included zero.

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42 A t-test is a statistical test of the difference between the mean values of observed characteristics between two populations. In this case, it is a test of the difference in average energy usage in each month between treatment and control group respondents.

These savings values do not account for cross program participation savings from participation in other NIPSCO offerings; those adjustments were generated through a cross program participation analysis and are presented in a subsequent section, Cross Program Participation.

Table 121 displays the claimed and verified savings (before cross program participation analysis) and the per-household electric savings percentage for each wave reporting electric savings. Verified savings were typically like the implementer reported savings, exceeding them for five of the nine waves. However, the verified savings for Wave 9 were only 40% of the implementer reported savings. The evaluation team expects that this deviation is due to being a new wave with only a partial year of savings, relatively low savings per customer, a relatively small sample size, and a relatively large confidence interval on savings.

TABLE 121. 2020 BEHAVIORAL PROGRAM CLAIMED AND VERIFIED ELECTRIC SAVINGS

	ELECTRIC SAVINGS (MWH)				EVALUATED SAVINGS PERCENTAGE PER HOME		
WAVE	CLAIMED	VERIFIED	90% CI LOWER BOUND	90% CI UPPER BOUND	HOUSEHOLD	90% CI LOWER BOUND	90% CI UPPER BOUND
Wave 1 (eHer)[a]	18,754.083	4,900.798	3,383.438	6,418.158	1.90%	1.31%	2.49%
Wave 1 (No eHer)[a]		13,457.615	10,394.862	16,520.369	2.43%	1.88%	2.99%
Wave 2	591.506	507.266	28.402	986.130	1.32%	0.07%	2.56%
Wave 3	3,717.020	3,941.984	1,844.534	6,039.433	1.52%	0.71%	2.32%
Wave 4[±]	1,421.674	1,568.275	(54.429)	3,190.978	0.95%	-0.03%	1.94%
Wave 5[±]	1,499.225	1,437.499	(69.298)	2,944.296	0.68%	-0.03%	1.38%
Wave 7	1,925.898	2,107.512	927.829	3,287.195	1.10%	0.48%	1.71%
Wave 8[±]	836.141	963.234	(177.476)	2,103.943	0.47%	-0.09%	1.03%
Wave 9[±]	485.874	193.181	(571.921)	958.283	0.19%	-0.55%	0.93%
TOTAL UNADJUSTED[b]	29,231.421[c]	29,077.364	15,705.941	42,448.785	1.44%[d]	0.76%[d]	2.12%[d]

[a] The eHer and no eHer populations had significantly different baseline consumption numbers such that it was necessary to model them separately to achieve accurate and significant results.
[b] Unadjusted savings do not account for channeling analysis.
[c] The electric scorecard as of 12/31/2020 reported 29,925 MWh of savings. The savings provided from Oracle in Q1 2021 that were broken out by wave totaled 29,231 MWh.
[±] Savings for Wave 4, Wave 5, Wave 8, and Wave 9 were not statistically significant.
[d] Averages are weighted by participant days in analysis.

Table 122 displays the claimed and verified savings (before cross program participation analysis) and per-household natural gas savings percentage for each wave reporting natural gas savings. Among the natural gas cohorts, only Wave 6 exceeded 1% savings of per-household natural gas consumption (1.27%).

TABLE 122. 2018 BEHAVIORAL PROGRAM VERIFIED NATURAL GAS SAVINGS

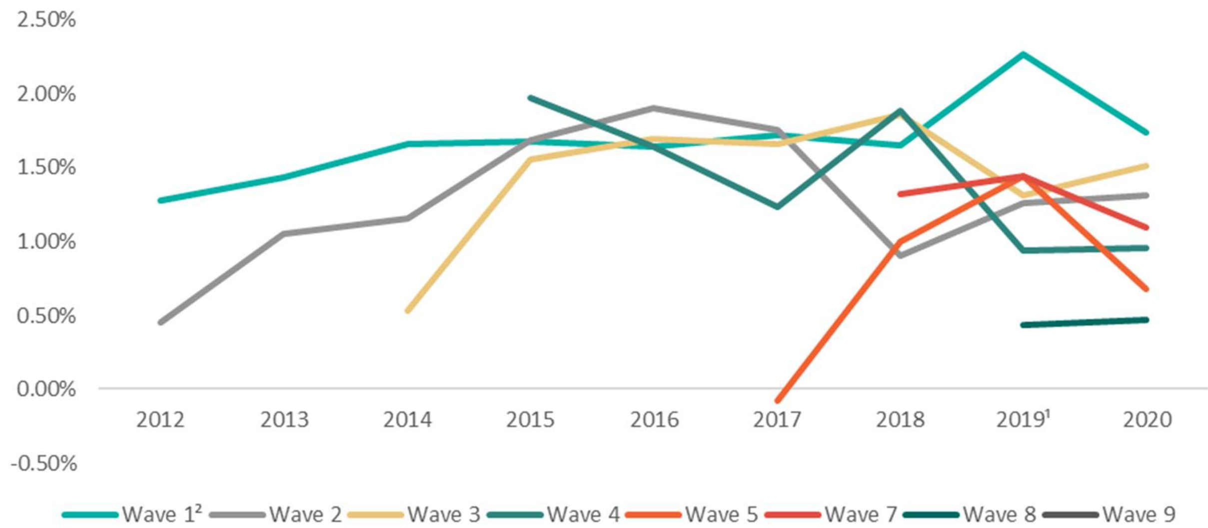
	GAS SAVINGS (THERMS)				EVALUATED SAVINGS PERCENTAGE PER HOME		
WAVE	CLAIMED	VERIFIED	90% CI LOWER BOUND	90% CI UPPER BOUND	HOUSEHOLD	90% CI LOWER BOUND	90% CI UPPER BOUND
Wave 1 (eHer)	503,380.19	117,622.65	22,913.72	212,331.57	0.54%	0.11%	0.98%
Wave 1 (No eHer)		413,811.84	207,255.18	620,368.50	0.77%	0.39%	1.16%
Wave 2[a]	43,691.29	11,366.64	(26,734.93)	49,468.20	0.24%	-0.56%	1.03%
Wave 3[a]	112,407.39	98,889.84	(31,681.88)	229,461.56	0.41%	-0.13%	0.95%
Wave 4[a]	119,922.73	101,110.38	(6,219.16)	208,439.92	0.62%	-0.04%	1.27%
Wave 5	205,056.60	144,851.23	51,646.21	238,056.26	0.77%	0.27%	1.26%
Wave 6	629,036.04	641,324.54	454,295.47	828,353.61	1.27%	0.90%	1.63%
Wave 8	122,954.47	145,851.94	77,495.57	214,208.31	0.75%	0.40%	1.09%
Wave 9[a]	7,484.08	8,532.92	(23,070.59)	40,136.43	0.16%	-0.42%	0.74%
TOTAL UNADJUSTED[b]	1,743,932.79[c]	1,683,361.98	725,899.59	2,640,824.36	0.73%[d]	0.27%[d]	1.19%[d]

[a] Savings for Wave 2, Wave 3, Wave 4 and Wave 9 were not statistically significant in for natural gas fuel types.
[b] Unadjusted savings do not account for the channeling analysis.
[c] The gas scorecard as of 12/31/2020 reported 1,664,579 therms of savings. The savings provided from Oracle in Q1 2021 were broken out by wave and totaled 1,743,933 MWh.
[d] Averages are weighted by participant days in analysis.

In general, industry research suggests that participants of residential behavior change programs save between 1.2% and 2.2% of household electricity usage per year and save between 0.3% and 1.6% of household natural gas usage per year; most waves exhibit a one- or two-year ramp-up period, with savings continuing at the ramped-up level for at least the following five years.[43] Within that context, the household savings percentage of each wave fall within these expectations (see Figure 60 and Figure 61), except for Wave 4 and Wave 5, where savings may be declining earlier than expected. However, there could be an uptick in savings after a decline, as seen in Wave 2, and these waves have stable or increasing gas savings. As such it will be valuable to look at Wave 4 and Wave 5 in future years to see if electric savings increase again. The following figures show average household-level electric savings as a percentage of usage for all eight Behavioral program waves from 2012 to 2020.

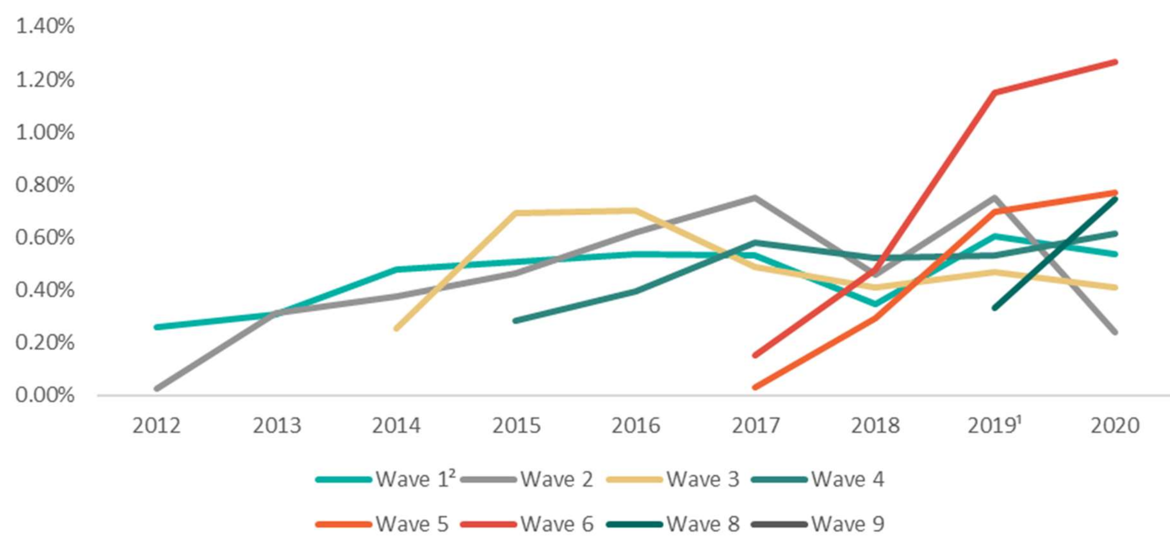
FIGURE 60. HOUSEHOLD-LEVEL PERCENTAGE SAVINGS OF ELECTRICITY FOR BEHAVIORAL PROGRAM PARTICIPANTS, BY WAVE AND YEAR

[43] Sussman, R., and M. Chikumbo. 2016. "Behavior Change Programs: Status and Impact." American Council for an Energy-Efficient Economy. https://aceee.org/sites/default/files/publications/researchreports/b1601.pdf



[1] The 2019 results are based on Oracle's percent savings estimates as they were not modeled as part of this evaluation.
[2] Wave 1 results are presented as weighted averages of the eHer and non-eHer waves.

FIGURE 61. HOUSEHOLD-LEVEL PERCENTAGE SAVINGS OF NATURAL GAS FOR BEHAVIORAL PROGRAM PARTICIPANTS, BY WAVE AND YEAR



[1] The 2019 results are based on Oracle's percent savings estimates as they were not modeled as part of this evaluation.
[2] Wave 1 results are presented as weighted averages of the eHer and non-eHer waves.

CROSS PROGRAM PARTICIPATION

Table 123 and Table 124 show electric and natural gas savings, respectively, for savings that can be attributed to participation in other NIPSCO energy efficiency programs. The team found higher savings from other energy efficiency programs among control customers than treatment customers, i.e., negative cross program participation savings. More specifically, the team estimates cross program savings of -23,940 kWh for electric and -5,054 therms for natural gas (shown in Table 125). In the 2018 report, negative cross program savings were observed for some waves. While evaluators may include negative cross program participation savings at the wave-level when summing total cross program savings, for this evaluation, the team suggests excluding the cross program effects from the savings for 2020 and to conduct deeper cross program participation research in future evaluations. This recommendation reflects a conservative approach to ensure the evaluation does not overestimate total behavioral program savings.

Note that Table 123 and Table 124 calculate a per-home value for comparison to average per-home savings from the Behavioral program, though only a subset of treatment households participated in energy efficiency programs.

TABLE 123. CROSS PROGRAM PARTICIPATION ELECTRIC SAVINGS

PROGRAM	WAVE 1 (EHER) SAVINGS		WAVE 1 (NO EHER) SAVINGS		WAVE 2 SAVINGS		WAVE 3 SAVINGS		WAVE 4 SAVINGS	
	PER HOME (KWH)	TOTAL (MWH)	PER HOME (KWH)	TOTAL (MWH)	PER HOME (KWH)	TOTAL (MWH)	PER HOME (KWH)	TOTAL (MWH)	PER HOME (KWH)	TOTAL (MWH)
Appliance Recycling	(0.21)	(5.19)	(0.27)	(16.11)	(0.11)	(0.72)	(0.03)	(0.86)	(0.47)	(9.81)
HEA	0.04	0.88	0.07	4.30	(0.05)	(0.35)	0.02	0.44	(0.07)	(1.47)
HVAC Rebate	(0.40)	(9.86)	0.17	10.33	0.66	4.31	(0.51)	(14.35)	0.15	3.14
FINAL ESTIMATION SAMPLE	(0.57)	(14.17)	(0.03)	(1.48)	0.50	3.24	(0.52)	(14.77)	(0.39)	(8.14)

PROGRAM	WAVE 5 SAVINGS		WAVE 7 SAVINGS		WAVE 8 SAVINGS		WAVE 9 SAVINGS	
	PER HOME (KWH)	TOTAL (MWH)	PER HOME (KWH)	TOTAL (MWH)	PER HOME (KWH)	TOTAL (MWH)	PER HOME (KWH)	TOTAL (MWH)
Appliance Recycling	0.34	7.85	0.17	3.02	0.05	1.24	0.02	0.38
HEA	0.06	1.41	0.26	4.75	-	-	-	-
HVAC Rebate	(0.34)	(7.83)	0.26	4.62	(0.18)	(4.23)	0.01	0.18
FINAL ESTIMATION SAMPLE	0.06	1.43	0.69	12.39	(0.13)	(2.99)	0.03	0.56

TABLE 124. CROSS PROGRAM PARTICIPATION NATURAL GAS SAVINGS

PROGRAM	WAVE 1 (EHER) SAVINGS		WAVE 1 (NO EHER) SAVINGS		WAVE 2 SAVINGS		WAVE 3 SAVINGS		WAVE 4 SAVINGS	
	PER HOME (THERMS)	TOTAL (THERMS)	PER HOME (THERMS)	TOTAL (THERMS)	PER HOME (THERMS)	TOTAL (THERMS)	PER HOME (THERMS)	TOTAL (THERMS)	PER HOME (THERMS)	TOTAL (THERMS)
Appliance Recycling	-	-	-	-	-	-	-	-	-	-
HEA	0.00	75.47	0.02	1,217.52	(0.02)	(120.29)	(0.01)	(143.19)	(0.03)	(626.26)
HVAC Rebate	(0.10)	(2,494.31)	(0.09)	(5,659.50)	(0.13)	(809.86)	(0.17)	(4,673.78)	0.13	2,688.07
FINAL ESTIMATION SAMPLE	(0.10)	(2,418.84)	(0.07)	(4,441.98)	(0.15)	(930.15)	(0.18)	(4,816.97)	0.10	2,061.81

PROGRAM	WAVE 5 SAVINGS		WAVE 6 SAVINGS		WAVE 8 SAVINGS		WAVE 9 SAVINGS	
	PER HOME (THERMS)	TOTAL (THERMS)	PER HOME (THERMS)	TOTAL (THERMS)	PER HOME (THERMS)	TOTAL (THERMS)	PER HOME (THERMS)	TOTAL (THERMS)
Appliance Recycling	-	-	-	-	-	-	-	-
HEA	0.01	226.66	0.02	609.30	-	-	-	-
HVAC Rebate	(0.15)	(3,480.25)	0.25	10,214.43	(0.09)	(2,221.06)	0.01	143.20
FINAL ESTIMATION SAMPLE	(0.14)	(3,253.59)	0.27	10,823.73	(0.09)	(2,221.06)	0.01	143.20

TABLE 125. CROSS PROGRAM PARTICIPATION ELECTRIC AND NATURAL GAS SAVINGS AS A PERCENTAGE OF TOTAL WAVE SAVINGS

WAVE	ELECTRICITY SAVINGS		NATURAL GAS SAVINGS	
	CROSS PROGRAM PARTICIPATION SAVINGS (KWH)	PERCENTAGE OF TOTAL BEHAVIORAL PROGRAM SAVINGS	CROSS PROGRAM PARTICIPATION SAVINGS (THERMS)	PERCENTAGE OF TOTAL BEHAVIORAL PROGRAM SAVINGS
Wave 1 (eHer)	(14,177.67)	-0.29%	(2,418.84)	-2.06%
Wave 1 (No eHer)	(1,473.76)	-0.01%	(4,441.98)	-1.07%
Wave 2	3,243.93	0.64%	(930.15)	-8.18%
Wave 3	(14,778.39)	-0.37%	(4,816.97)	-4.87%
Wave 4	(8,141.17)	-0.52%	2,061.81	2.04%
Wave 5	1,433.03	0.10%	(3,253.59)	-2.25%
Wave 6	-	-	10,823.73	1.69%
Wave 7	12,387.93	0.59%	-	-
Wave 8	(2,992.69)	-0.31%	(2,221.06)	-1.52%
Wave 9	558.52	0.29%	143.20	1.68%
TOTAL UNADJUSTED	(23,940.27)	-0.08%	(5,053.85)	-0.30%

UPSTREAM LIGHTING CROSS PROGRAM PARTICIPATION

The cross program participation savings analysis does not include NIPSCO's upstream lighting program. In upstream lighting programs, utilities work directly with manufacturers, distributors, retailers, or a combination to offer built-in discounts on energy-efficient products, rather than paying incentives directly to program participants. Because of this design, these programs do not track detailed participation data such as respondent names and billing account numbers, which are typically available for utility rebate programs. Consequently, the evaluation team could not identify HER treatment and control group respondents who participated in an upstream lighting program. Obtaining the data necessary to adjust for upstream programs requires expensive primary data collection that relies on home visits or customer surveys and requires respondents to recall their lighting purchases.

In a recent secondary literature review presented to the Michigan utilities, an evaluation team found 10 evaluations of HER programs from 2013 to 2018 that addressed the effects of upstream lighting.[44] Five of these evaluations relied on surveys (three phone, one online, one in person), one relied on an onsite home inventory, three on secondary literature, and one used a deemed savings factor. The onsite inventory found the highest rate of cross program participation savings at 2.6%. Three reported no difference in purchases between treatment and control customers. Others ranged from -0.9 kWh/household/year to 11.1 kWh/household/year. The evaluators presenting to Michigan utilities concluded that most efforts to calculate the cross program participation rate of upstream programs result in 0% or negative results or the differences are statistically insignificant.

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[44] *Avoiding the Double-Counting of Savings in Michigan's Behavioral EWR Programs: Current Practice & Future Options.* April 16, 2019. https://www.michigan.gov/documents/mpsc/Avoiding_Double_Counting_-_20190416_652854_7.pdf

Given these data limitations, the evaluation team did not estimate cross program participation savings from upstream programs. Because adjustments to electric savings due to other programs are small, this omission should not affect the total claimed savings significantly.

DEMAND REDUCTION

The evaluation team used the conservative estimate of equally distributing savings across all 8,760 annual hours to estimate demand reduction.[45] As such, the demand reduction estimates are directly proportional to the electric savings estimates calculated above. Table 126 displays the demand reduction estimates for all waves in 2020, at both the individual level and the program level. The 90% confidence intervals are also shown. The total demand reduction is calculated at 3,319 kW.

TABLE 126. DEMAND REDUCTION ESTIMATES FOR ALL WAVES

WAVE	ESTIMATED PEAK DEMAND REDUCTION (KW)		90% CONFIDENCE INTERVAL	
	PER HOME	TOTAL	LOWER BOUND	UPPER BOUND
Wave 1 (eHer)	0.023	559.452	386.237	732.666
Wave 1 (No eHer)	0.026	1,536.257	1,186.628	1,885.887
Wave 2	0.009	57.907	3.242	112.572
Wave 3	0.016	449.998	210.563	689.433
Wave 4 [a]	0.009	179.027	(6.213)	364.267
Wave 5 [a]	0.007	164.098	(7.911)	336.107
Wave 7	0.013	240.584	105.917	375.251
Wave 8 [a]	0.005	109.958	(20.260)	240.176
Wave 9 [a]	0.001	22.053	(65.288)	109.393
TOTAL UNADJUSTED	-	3,319.334	1,792.915	4,845.752

[a] Savings for Wave 4, Wave 5, Wave 8, and Wave 9 were not statistically significant.

PROCESS EVALUATION

The evaluation team performed the 2020 Behavioral program process evaluation using a desk review. The evaluation team reviewed:

- Monthly energy savings by wave and fuel type
- Monthly customer counts and opt-out rates by wave and fuel type
- Cross program participation analysis
- Email engagement (e.g., click-throughs)
- Web portal engagement (e.g., number of log ins)

45 Demand reduction estimates from AMI data are as high as 2.3 times the 8,760 model estimate, because electric savings are usually weighted to the summer and likely correspond to changes in peak air conditioner usage. See also: Stewart, James, and Pete Cleff. November 2013. "Are You Leaving Peak Demand Savings on the Table? Estimates of Peak-Coincident Demand Savings from PPL Electric's Residential Behavior-Based Program." Oracle Utilities Opower Whitepaper.

- Sample printed and electronic HER

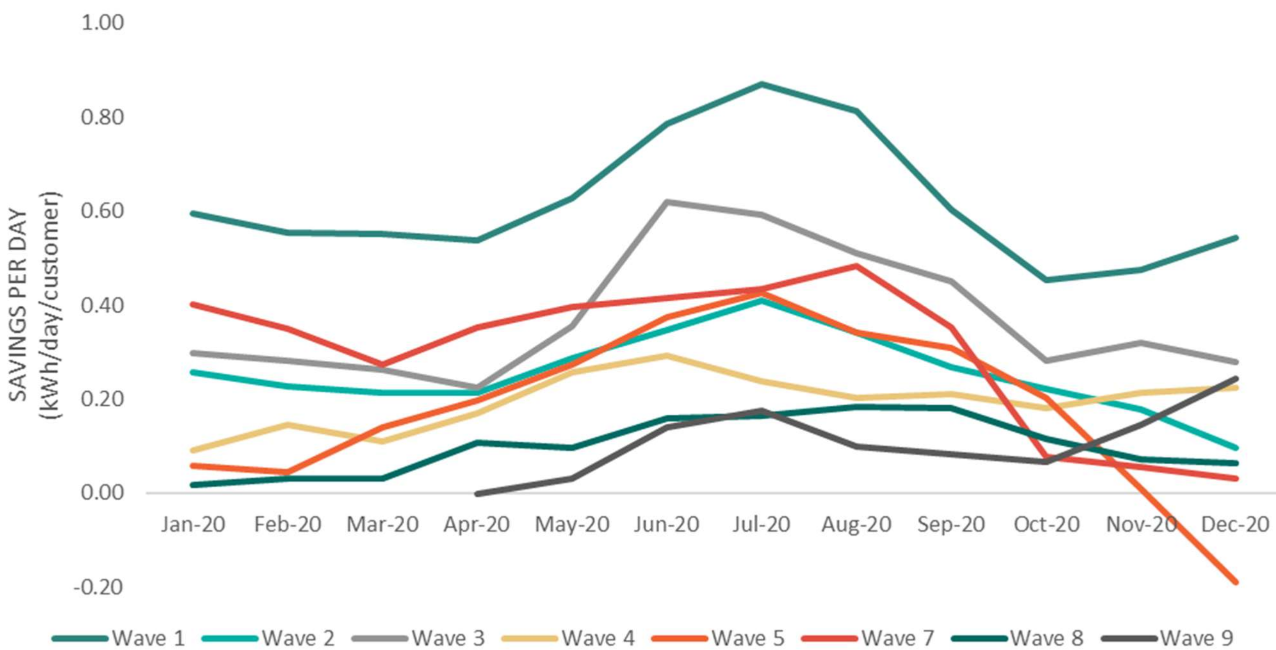
The following sections describe results related to trends in savings over time and between waves, customer counts during 2020, email engagement, web portal engagement, and channeling.

SAVINGS TRENDS

The evaluation team reviewed monthly savings for each wave to identify interesting trends over time and between waves. In summary, the program savings in 2020 were steady, clearly identifiable and there were no signs in this data that savings will decline substantially in 2021.

As shown in Figure 62, electric savings were relatively consistent throughout 2020, although highest in the summer across all waves. Wave 1 had the highest average household savings and Wave 9 (launched in 2020) showed late summer savings, but otherwise low savings in 2020. Savings for new waves typically built up over time. As such, it will be valuable to watch the electric savings for Wave 9 in 2021.

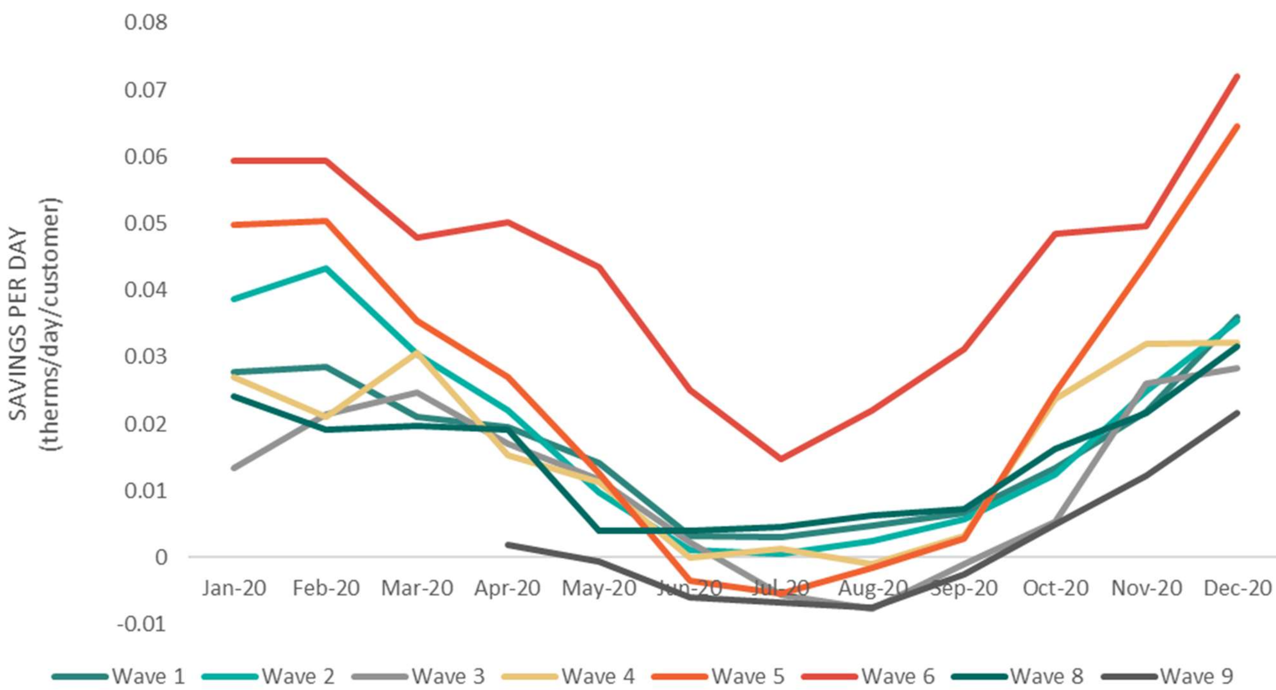
FIGURE 62. AVERAGE DAILY ELECTRIC SAVINGS BY WAVE AND MONTH



Source: ILLUME analysis of data provided by Oracle and NIPSCO

As shown in Figure 63, natural gas savings demonstrate the typical heating load shape with higher savings in the winter and lower savings in the summer. Wave 6 (a gas-only wave) follows that general shape, but with higher summer savings than other waves. Wave 9 (launched in 2020) shows relatively low savings until October 2020. The delayed savings for Wave 9 is partially due to seasonality and the typical delayed effect of the HER in new waves where savings start to build over time.

FIGURE 63. AVERAGE DAILY GAS SAVINGS BY WAVE AND MONTH



Source: ILLUME analysis of data provided by Oracle and NIPSCO

CUSTOMER COUNT TRENDS

In 2020, NIPSCO's Behavioral program lost 8% (electric) and 7% (gas) treatment participants on average. Available data suggests these participants left the program by moving during 2020, rather than by opting out. Based on Oracle's data, less than 0.5% of participants over the life of the program left the program voluntarily by opting out. As shown in Table 127, customers in more recent waves are moving at a higher rate than older waves, thus leaving the program.

TABLE 127. JANUARY AND DECEMBER 2020 CUSTOMER COUNTS BY WAVE AND FUEL TYPE

WAVE	NUMBER OF PARTICIPANTS JANUARY 2020	NUMBER OF PARTICIPANTS DECEMBER 2020	DECLINE RATE (%)	NUMBER OF PARTICIPANTS JANUARY 2020	NUMBER OF PARTICIPANTS DECEMBER 2020	DECLINE RATE (%)
	ELECTRIC			GAS		
Wave 1 (first report March 2011)	84,303	80,696	4%	84,005	80,397	4%
Wave 2 (first report June 2012)	6,487	6,074	6%	6,449	6,058	6%
Wave 3 (first report July 2014)	27,933	26,247	6%	27,882	26,250	6%
Wave 4 (first report March 2015)	20,650	19,191	7%	20,480	19,078	7%
Wave 5 (first report June 2017)	23,235	21,265	8%	23,162	21,233	8%
Wave 6 (first report September 2017)	-	-	-	40,212	38,146	5%
Wave 7 (first report in May 2018)	17,944	16,343	9%	-	-	-

WAVE	NUMBER OF PARTICIPANTS JANUARY 2020	NUMBER OF PARTICIPANTS DECEMBER 2020	DECLINE RATE (%)	NUMBER OF PARTICIPANTS JANUARY 2020	NUMBER OF PARTICIPANTS DECEMBER 2020	DECLINE RATE (%)
	ELECTRIC			GAS		
Wave 8 (first report in April 2019)	24,094	21,082	13%	23,986	21,100	12%
Wave 9 (first report in April 2020)	18,246	15,257	16%	18,157	15,260	16%
TOTAL	222,892	206,155	8%	244,333	227,522	7%

Source: ILLUME analysis of data provided by Oracle and NIPSCO

CROSS PROGRAM PARTICIPATION ANALYSIS

Table 128 indicates the percentage difference in program participation of treatment recipients relative to their respective control groups, for four applicable programs in the 2020 program year. Each wave exhibits positive cross program participation in at least one of the evaluated programs; however, Wave 1, Wave 2, Wave 4, Wave 5, Wave 6, and Wave 9 exhibit negative cross program participation in at least one program. These results corroborate the impact analysis, where cross program participation savings show that HER are sometimes encouraging participation in other programs, but to a relatively small degree compared to the total program size and total program savings.

TABLE 128. CROSS PROGRAM PARTICIPATION DUE TO HOME ENERGY REPORTS

PROGRAM	WAVE 1	WAVE 2	WAVE 3	WAVE 4	WAVE 5	WAVE 6	WAVE 7	WAVE 8	WAVE 9
Appliance Recycling	-0.01%	-0.01%	0.03%	0.00%	-0.06%	0.06%	0.00%	0.04%	0.00%
HEA	0.08%	0.04%	0.03%	0.03%	-0.05%	0.06%	0.04%	0.06%	0.00%
HVAC Rebate	-0.08%	0.01%	0.18%	-0.35%	0.09%	-0.28%	0.15%	0.17%	-0.24%

EMAIL HER ENGAGEMENT

Behavioral programs drive savings by influencing customer behavior through paper and electronic messaging. As such, metrics around email engagement (e.g., click throughs) may correlate with savings and provide an indication of program engagement. The email engagement metrics for NIPSCO's Behavioral program show that the program is successfully engaging participants who receive emails.

As shown in Table 129, NIPSCO's Behavioral program participants clicked through between 1% and 3% of program emails each month in 2020. While participants clicked through emails at a relatively consistent rate throughout the year, the highest open rate was in May. Participants likely opened more program emails in May than other months for a combination of two reasons: (1) because of high summer electric bills, and (2) adding the new 2020 wave participants, which started in April 2020. Overall, the annual average of emails sent per customer each month increased from 19% of participants in 2019 to 38% in 2020.

TABLE 129. EMAIL ENGAGEMENT BY MONTH AND YEAR

MONTH	EMAILS SENT PER CUSTOMER (%)	EMAILS SUCCESSFULLY RECEIVED (%)	EMAILS CLICKED THROUGH (%)
Jan. 2020	37%	99%	1%
Feb. 2020	40%	99%	1%
Mar. 2020	1%	99%	1%
Apr. 2020	35%	99%	2%

MONTH	EMAILS SENT PER CUSTOMER (%)	EMAILS SUCCESSFULLY RECEIVED (%)	EMAILS CLICKED THROUGH (%)
May 2020	66%	99%	3%
Jun. 2020	38%	99%	1%
Jul. 2020	34%	99%	1%
Aug. 2020	35%	99%	1%
Sep. 2020	33%	99%	1%
Oct. 2020	46%	99%	1%
Nov. 2020	51%	99%	1%
Dec. 2020	41%	99%	1%
2020 AVERAGE	38%	99%	1%
2019 AVERAGE	19%	99%	1%

Source: ILLUME analysis of email analytics data provided by Oracle

WEB PORTAL ENGAGEMENT

Like the 2019 program year evaluation findings, very few of NIPSCO's Behavioral program participants are engaging with the online portal; participants who do engage with it appear to value the portal. On average, 0.02% of NIPSCO's Behavioral program participants log into the web portal each month, but when they do, they stay on the site for an average of nine minutes (Table 130). Due to the low number of log ins, it is unlikely that the portal is currently driving additional savings. However, based on the average length of time that participants stay on the website, participants who log in appear to engage with the web portal.

TABLE 130. WEB PORTAL ANALYTICS BY MONTH

MONTH	UNIQUE PARTICIPANT LOG INS (%)	AVERAGE TIME ON PORTAL (MINUTES)
Jan. 2020	0.02%	9
Feb. 2020	0.03%	11
Mar. 2020	0.02%	14
Apr. 2020[a]	0.00%	0
May 2020	0.03%	16
Jun. 2020	0.01%	7
Jul. 2020	0.01%	6
Aug. 2020	0.01%	7
Sep. 2020	0.01%	9
Oct. 2020	0.01%	12
Nov. 2020	0.01%	7
Dec. 2020	0.01%	7
AVERAGE	0.01%	9

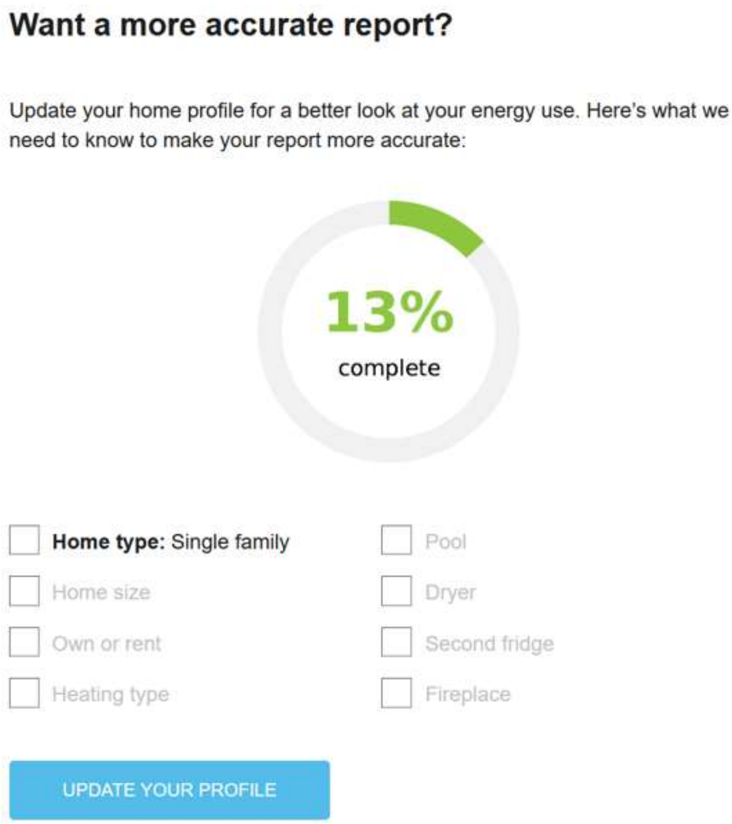
Source: ILLUME analysis of web portal analytics data provided by Oracle

[a] Oracle migrated the NIPSCO web portal to the newest instance of Opower's platform in late March 2020. Customers inadvertently could not access the portal during this transition.

REPORT CHANGES

In 2018, the evaluation team surveyed Behavioral program participants and received feedback that customers wanted a way to improve the accuracy of their reports. In 2019, and continued in 2020, some reports included specific messaging for customers to improve the accuracy of their reports by updating their Home Profiles on the web portal (see Figure 64). The frequency of NIPSCO Behavioral program participants receiving this messaging increased to twice in 2020. Also, the messaging included that the Home Profile site log-in may be different than the log-in participants use for NIPSCO and that the Home Profile site's customer experience was updated for ease of use. While few participants are logging into the portal regularly, this messaging may be helpful for the participants who are interested in improving the accuracy of their reports. Some energy saving tips, which are provided in reports, were paused in late March 2020 because they did not align with CDC guidance on COVID-19. The paused tips have not been reinstated and so there is a shorter list of customer tips than there was at the beginning of 2020.

FIGURE 64. HER MESSAGING SAMPLE: REPORT ACCURACY



Source: Oracle's 2020 HER samples

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSION 1: THE EVALUATION RESULTS CORROBORATE THE EX ANTE ESTIMATES FROM ORACLE.

The *ex ante* saving estimates from Oracle and the *ex post* results from the billing and cross program participation analyses were very similar, resulting in a 97% realization rate for electricity and 101% realization rate for natural gas. The realization rates are like the results of the 2018 billing analysis, when the realization rate for electricity was 101% and natural gas was 105%.

CONCLUSION 2: THE BEHAVIORAL PROGRAM IS CONSISTENTLY EXCEEDING PLANNING ESTIMATES.

In the past three program years the gross goal achievements have consistently exceeded planned program goals. The gross goal achievement for electricity ranged from 130% in 2018 to 149% in 2019. Similarly for natural gas, the gross goal achievement ranged from 156% in 2018 to 163% in 2019. Electric savings were relatively consistent across the year, although highest in the summer across all waves. Natural gas savings demonstrated the typical heating load shape with higher savings in the winter and lower savings in the summer. There are no signs that savings will decline substantially in 2021.

CONCLUSION 3: MORE PARTICIPANTS ARE RECEIVING EMAILS IN 2020.

In 2019, the evaluation team found that only 19% of participants were receiving emails from the program on average each month. In 2020, an average of 38% of participants received emails each month. However, click through rates did not increase, averaging 1% again this year.

Recommendations:

- The program may be able to achieve additional savings by continuing to educate customers on the new web portal and driving their attention to new features and tips.

CONCLUSION 4: THE BILLING ANALYSIS DID NOT YIELD STATISTICALLY SIGNIFICANT SAVINGS FOR SEVERAL WAVES.

Electric Wave 4, Wave 5, Wave 8, and Wave 9 did not yield statistically significant savings. Natural gas Wave 2, Wave 3, Wave 4, and Wave 9 did not yield statistically significant savings. This is a greater number of waves with savings that are not statistically significant than the 2018 billing analysis, but different waves are not statistically significant. In 2018, electric Wave 2, an older wave with a small number of participants, did not have statistically significant savings, but did achieve significant savings in 2020. Wave 2 and Wave 3 for natural gas remained not statistically significant between 2018 and 2020.

Sample size influences statistical significance, and site attrition may be impacting older waves. Customer decline rates, which impact statistical significance, are consistent year over year, typically less than 10% for older waves and more than 10% for newer waves. For natural gas Wave 2, overall customer attrition from the beginning of the wave to 2020 is 37% and for electric Wave 2 overall customer attrition is 42%.

Recommendations:

- Continue to monitor the statistical significance of savings over time. Consider grouping waves or adding new customers to waves where savings are not consistently statistically significant. For example, given that natural gas Wave 2 and Wave 3 remained not statistically significant between 2018 and 2020, NIPSCO could consider grouping the two waves during evaluation.
- For older waves with high rates of site attrition, NIPSCO should also continue monitoring the pre-treatment equivalency for remaining customers and consider more in-depth equivalency checks (e.g., comparing rate

classes and geography amongst the remaining treatment and control customers) as balance between the groups can degrade with increasing site attrition overtime.

CONCLUSION 5: MONITOR THE CUSTOMER ENGAGEMENT METRICS WITH THE NEW WEB PORTAL AND WITH NEW WAVES.

Oracle migrated the NIPSCO web portal to the newest instance of Opower's platform in late March 2020. Customer logins remained at 0.01% of customers through the end of 2020, and average time on the portal remained consistent with prior years, which sees an uptick at the beginning of the heating and cooling seasons.

In addition to the seasonal patterns of customer engagement with the web portal and email click through rates, when launching Wave 9 in 2020 there was a noticeable uptick in customer engagement in May. In May 2020, the email click through rate was its highest all year, with 3% of emails clicked through. Unique participant logins into the web portal was also the highest all year (0.03% of participants, tied with February), and average time spent on the portal was the highest all year (16 minutes).

Recommendations:

- Further inform customers about any new features and uses of the new web portal. Monitor specific customer uses to understand what they use on the web portal. If engagement continues at the current login rates and with the same seasonal patterns, consider ways to drive more traffic to the site to increase engagement and achieve additional savings. Consider messaging during the launches of new participant waves to educate participants about the ongoing nature of the program and drive them to click through emails and engage with the portal on a consistent basis.

CONCLUSION 6: CROSS PROGRAM PARTICIPATION AS A RESULT OF HERS WAS LIMITED.

Cross program participation impacts ranged from -0.35% to 0.18% across all three programs evaluated and across all waves. This finding is consistent with the rates in 2018, which were no higher than 1% across all programs and waves, and negative for some waves. While in 2020 cross program participation savings were negative overall for both electricity and natural gas, the percentage of total Behavioral program savings was only 0.08% for electricity and 0.30% for natural gas.

Recommendations:

Conduct deeper cross program participation research in future evaluations to understand any trends in program participation across older and newer waves, programs, and measure types.

9. RESIDENTIAL NEW CONSTRUCTION PROGRAM

PROGRAM DESIGN AND DELIVERY

The Residential New Construction Program provides a prescriptive incentive to residential home builders that are building homes to a higher efficiency standard than the state energy code of Indiana, as defined by the RESNET Home Energy Rating System (HERS) Index. Incentives are paid directly to home builders or HERS rating companies that submit incentive applications. Participating homes must have NIPSCO residential electric and/or natural gas service. Only detached single family, duplex, or multifamily end unit type homes are eligible to participate.

Homes with NIPSCO electric service are eligible for the electric incentive and homes with NIPSCO gas service are eligible only for the gas incentive. Homes with both NIPSCO gas and electric service are eligible for both incentives. Incentives are tiered by HERS Index Range. Homes with lower HERS Index scores receive higher incentives, as these homes are more energy efficient.

TABLE 131. PROGRAM INCENTIVES

HERS INDEX SCORE	ELECTRIC INCENTIVE	GAS INCENTIVE
Platinum Star - HERS ≤ 56	$450	$60
Gold Star - HERS 65 – 57	$400	$50
Silver Star - HERS 75 – 66	$350	$40

NIPSCO markets the program to builders and HERS raters directly and through industry organizations, such as builder associations. NIPSCO does not currently market homes directly to prospective homebuyers. The Residential New Construction Program was newly introduced in 2019.

CHANGES FROM 2019 DESIGN

The program did not have any design changes in 2020. The COVID-19 pandemic did not appear to negatively affect program participation.

PROGRAM PERFORMANCE

The Residential New Construction Program overachieved its electric energy targets and underachieved its electric demand targets. Additionally, the program significantly overachieved its gas savings targets. The drivers of the high electric achievement rates and high gas achievement rates were measure-level realization rates and program participation. Like 2019, for electric savings these realization rates were low, while the realization rates for gas measures were very high. Table 132 summarizes savings for the program, including program savings goals.

TABLE 132. 2020 RESIDENTIAL NEW CONSTRUCTION PROGRAM SAVINGS SUMMARY

METRIC	GROSS SAVINGS GOAL	*EX ANTE*	AUDITED	VERIFIED	*EX POST* GROSS	*EX POST* NET	GROSS GOAL ACHIEVEMENT
Electric Energy Savings (kWh/yr.)	570,222.46	1,267,048.70	1,267,048.70	1,267,048.70	858,301.08	463,482.58	151%
Peak Demand Reduction (kW)	422.996	987.140	987.140	987.140	351.236	189.667	83%
Natural Gas Energy Savings (therms/yr.)	38,956.32	79,677.23	79,677.23	79,677.23	477,408.78	257,800.74	1,225%

Table 133 outlines the *ex post* gross and NTG adjustment factors. The low electric and high gas realization rates are driven by significant difference between assumed *ex ante* and evaluated *ex post* savings.

Table 133. 2020 Residential New Construction Program Adjustment Factors

METRIC	REALIZATION RATE (%)[a]	FREERIDERSHIP	SPILLOVER	NTG (%)[b]
Electric Energy Savings (kWh/yr.)	68%	46%	0%	54%
Peak Demand Reduction (kW)	36%	46%	0%	54%
Natural Gas Energy Savings (therms/yr.)	599%	46%	0%	54%

[a] Realization Rate is defined as *ex post* gross savings divided by *Ex ante* savings.

[b] NTG is defined as *ex post* net savings divided by *ex post* gross savings.

During the COVID-19 pandemic, other programs were underperforming while demand for rebates in the new construction program remained strong. This resulted in the program significantly overspending its electric and gas budgets. Table 80 lists the 2020 program budget and expenditures by fuel type.

TABLE 134. 2020 RESIDENTIAL NEW CONSTRUCTION PROGRAM EXPENDITURES

FUEL	PROGRAM BUDGET	PROGRAM EXPENDITURES	BUDGET SPENT (%)
Electric	$205,721.58	$432,479.18	210%
Natural Gas	$55,727.30	$107,072.77	192%

RESEARCH QUESTIONS

The evaluation team conducted a survey and impact analysis to answer the following key research questions for the program:

IMPACT

- What assumptions were used to develop savings estimates? Are there any updates that should be made?
- What are *ex post* program savings? Do these suggest any needed updates to program design, delivery, or savings assumptions?
- How effective was the program in influencing participant decision making? What are the program's spillover and freeridership estimates (net savings)?
- What are the effects of COVID-19 on program participation and savings goals?
- How did the new residential building code affect savings?
- Are there any opportunities to improve program data tracking?
- Is the program on track to meet its participation and savings goals?

PROCESS

- What are builders' experiences with the program processes?
- How satisfied are builders with the program?
- What are barriers to participation?
- What program design changes could be made to increase participation? What program design changes could be made to increase depth of participation (i.e., encourage more, higher tier homes to be built)?
- What program design changes could be made to streamline program processes?
- How has the program influenced builder organizations' overall design and construction decisions?
- How has the new building code impacted the way builders are constructing homes?

IMPACT EVALUATION

This section details each step of the impact evaluation and its associated electric energy savings, peak demand reduction, and natural gas savings.

AUDITED AND VERIFIED SAVINGS

The evaluation team conducted a careful review of the program tracking data, creating multiple data summaries, and checking measure identifiers for duplicates. The team also sampled 124 projects and confirmed the HERS documentation verifying rebate amount, HERS scores and program tier. The evaluation team found no inconsistencies in the data, and therefore we have applied an installation rate of 100% to all tiers.

Table 135 summarizes the audited quantity, applied installation rates, and resulting verified quantity per measure. To calculate the verified measure quantity, the evaluation team multiplied the audited measure quantity by the installation rate.

TABLE 135. 2020 RESIDENTIAL NEW CONSTRUCTION PROGRAM AUDITED AND VERIFIED QUANTITIES

MEASURE	UNIT OF MEASURE	AUDITED QUANTITY	ISR	VERIFIED QUANTITY
Silver Star (HERS 66-75) Electric	Home	200	100%	200
Silver Star (HERS 66-75) Gas	Home	249	100%	249
Gold Star (HERS 57-65) Electric	Home	544	100%	544
Gold Star (HERS 57-65) Gas	Home	1027	100%	1,027
Platinum Star (HERS <=56) Electric	Home	70	100%	70
Platinum Star (HERS <=56) Gas	Home	199	100%	199
		2,289	100%	2,289

EX POST GROSS SAVINGS

The evaluation team modeled home energy savings relative to the requirements of the Indiana statewide residential energy code. The team modeled savings in the REM/Rate (version 16.0.6) software utilizing prototype home characteristics based on a sample of HERS certificates from PY 2020 Program homes. These HERS certificates provided key model inputs, including home square footage, insulation levels, home tightness, duct tightness, and mechanical equipment efficiency. The team developed prototypes according to the nearest weather station, water heater type and fuel, and foundation type. The evaluation team used 124 HERS Certificates to develop inputs for the models. Silver, gold, and platinum rated homes can have a myriad of different home characteristics within each grouping, and therefore is not preferable to group prototypes by those ratings but instead the actual home characteristics. The team modeled homes that reflect how the homes are constructed, given the available information, to generate an overall analysis of the population of homes. The overall weighted realization rate, based on the random sample, ensures correct overall adjustments.

Appendix 7: Residential New Construction Program

provides a full description of the methods used to calculate gross energy savings.

EX POST GROSS SAVINGS

The significant differences between estimates of ex-ante and ex-post electricity and natural gas savings likely result from different methodologies used by the program implementer and the evaluation team to estimate measure savings. While the evaluation team used program home-specific inputs to model savings for homes, the implementer calculated its electric energy and demand deemed savings by modeling the consumption of baseline home using inputs from a regional program, and then calculating savings based on the HERS score of the NIPSCO program home. This misalignment in methods and possible differences between the implementer's assumption about program homes, such as square footage, likely resulted in the discrepancy in ex-ante and ex-post savings. The implementer was unable to share the method for calculating deemed gas savings. Therefore, it is unclear what resulted in the discrepancy in savings in ex-ante and ex-post savings.

Table 136 shows the *ex ante* deemed savings and *ex post* gross per-measure savings for PY 2020 Residential New Construction program measures.

TABLE 136. 2020 RESIDENTIAL NEW CONSTRUCTION PROGRAM EX ANTE AND EX POST GROSS PER-MEASURE SAVINGS VALUES

MEASURE	UNIT OF MEASURE	*EX ANTE* DEEMED SAVINGS			*EX POST* GROSS PER-MEASURE SAVINGS		
		KWH	KW	THERMS	KWH	KW	THERMS
Silver Star (HERS 66-75) Electric	Home	1,519.00	0.90	0.00	1,028.97	0.320	0.00
Silver Star (HERS 66-75) Gas	Home	0.00	0.00	52.37	0.00	0.000	313.79
Gold Star (HERS 57-65) Electric	Home	1,551.00	1.31	0.00	1,050.65	0.466	0.00
Gold Star (HERS 57-65) Gas	Home	0.00	0.00	53.48	0.00	0.000	320.44
Platinum Star (HERS <=56) Electric	Home	1,707.21	1.35	0.00	1,156.47	0.480	0.00
Platinum Star (HERS <=56) Gas	Home	0.00	0.00	58.86	0.00	0.000	352.68

Table 137 highlights notable differences between *ex ante* and *ex post* gross estimates.

TABLE 137. 2020 RESIDENTIAL NEW CONSTRUCTION DIFFERENCES BETWEEN *EX ANTE* AND *EX POST* GROSS

MEASURE	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST* GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
Silver, Gold and Platinum Star Savings	Gas modeling assumptions are unknown. Electric savings modeled based on HERS scores and benchmarked savings.	As-built home characteristics from program a random sample of home HERS certificates (n=75 for electric homes, n=124 for gas homes) modeled in REM/Rate version 16.0.6 (4 electric home prototypes, 8 gas prototypes).	Without the actual calculations for ex-ante savings, the reason for the difference in savings could not be determined.

The evaluation team's savings estimates are consistent with what was found for a similar new construction program in Indiana, Vectren. In 2018, the estimated kW for a Vectren Gold Star home were 0.4 kW and a Platinum Star home were 0.5 kW. The estimated gas savings for Vectren Gold Star home were 332 therms and 454 therms for a Platinum Star home.[46] Therefore, the average evaluated *ex post* gross savings are more in line with other utilities and supports the finding that the *ex ante* deemed gas savings were too low.

RESIDENTIAL CODE CHANGE

Importantly, Indiana adopted the 2020 Indiana Residential Code in December of 2019. These code changes increased the minimum energy efficiency requirements in Indiana, which effectively raises the baseline from which savings are measured.

However, homes are built to the standards in effect at the time the building permit was issued. As building permits are issued before the construction process starts, homes submitted to the program in 2020 were likely permitted before the code change was in effect. Since the code change likely did not significantly impact 2020 program homes, the gross baseline of the 2010 energy code was used to calculate gross savings.

This is supported by qualitative survey findings from builders. Of the 17 homebuilders surveyed, 13 were aware of the energy code change and 11 builders indicated they did not make any changes to how they build non-participating homes in 2020. Two builders said they did make changes to how they build non-participating homes in 2020 including making their homes more airtight and increasing the insulation of those homes. This supports that there was limited change to building practices based on the code change in program year 2020. However, beginning in program year 2021, this code change will affect the program baseline as it is likely most homes built will have had their permits issued post-code change.

REALIZATION RATES

The next three tables (Table 138 through Table 140) show the program's *ex ante* reported savings, verified savings, and *ex post* gross savings. The realization rates are very high for natural gas savings and low for demand savings.

TABLE 138. 2020 RESIDENTIAL NEW CONSTRUCTION PROGRAM *EX ANTE* AND *EX POST* GROSS ELECTRIC ENERGY SAVINGS

MEASURE	*EX ANTE*[A] ELECTRIC ENERGY SAVINGS (KWH/YR.)	AUDITED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	*EX POST* GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)
Silver Star (HERS 66-75) Electric	303,800.00	303,800.00	303,800.00	205,794.67
Silver Star (HERS 66-75) Gas	0.00	0.00	0.00	0.00
Gold Star (HERS 57-65) Electric	843,744.00	843,744.00	843,744.00	571,553.71
Gold Star (HERS 57-65) Gas	0.00	0.00	0.00	0.00
Platinum Star (HERS <=56) Electric	119,504.70	119,504.70	119,504.70	80,952.70
Platinum Star (HERS <=56) Gas	0.00	0.00	0.00	0.00
Total Savings	1,267,048.70	1,267,048.70	1,267,048.70	858,301.08
Total Program Realization Rate				68%

46 https://www.vectren.com/assets/downloads/planning/irp/IRP-2018-vectren-electric-dsm-evaluation.pdf

MEASURE	*EX ANTE*[A] ELECTRIC ENERGY SAVINGS (KWH/YR.)	AUDITED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	*EX POST* GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)

Note: Totals may not sum properly due to rounding.

[a] Values presented at a measure-level represent audited values, since the scorecard provides only savings totals.

TABLE 139. 2020 RESIDENTIAL NEW CONSTRUCTION PROGRAM *EX ANTE* AND *EX POST* GROSS PEAK DEMAND REDUCTION

MEASURE	*EX ANTE*[A] PEAK DEMAND REDUCTION (KW/YR.)	AUDITED GROSS PEAK DEMAND REDUCTION (KW/YR.)	VERIFIED GROSS PEAK DEMAND REDUCTION (KW/YR.)	*EX POST* GROSS PEAK DEMAND REDUCTION (KW/YR.)
Silver Star (HERS 66-75) Electric	180.000	180.000	180.000	64.046
Silver Star (HERS 66-75) Gas	0.000	0.000	0.000	0.000
Gold Star (HERS 57-65) Electric	712.640	712.640	712.640	253.566
Gold Star (HERS 57-65) Gas	0.000	0.000	0.000	0.000
Platinum Star (HERS <=56) Electric	94.500	94.500	94.500	33.624
Platinum Star (HERS <=56) Gas	0.000	0.000	0.000	0.000
Total Savings	987.140	987.140	987.140	351.236
Total Program Realization Rate				36%

Note: Totals may not sum properly due to rounding.

[a] Values presented at a measure-level represent audited values, since the scorecard provides only savings totals.

TABLE 140. 2020 RESIDENTIAL NEW CONSTRUCTION PROGRAM *EX ANTE* AND *EX POST* GROSS GAS ENERGY SAVINGS

MEASURE	*EX ANTE*[A] NATURAL GAS ENERGY SAVINGS (THERMS/YR.)	AUDITED GROSS NATURAL GAS ENERGY (THERMS/YR.)	VERIFIED GROSS NATURAL GAS ENERGY SAVINGS (THERMS/YR.)	*EX POST* GROSS NATURAL GAS ENERGY SAVINGS (THERMS/YR.)
Silver Star (HERS 66-75) Electric	0.00	0.00	0.00	0.00
Silver Star (HERS 66-75) Gas	13,040.13	13,040.13	13,040.13	78,133.65
Gold Star (HERS 57-65) Electric	0.00	0.00	0.00	0.00
Gold Star (HERS 57-65) Gas	54,923.96	54,923.96	54,923.96	329,092.53
Platinum Star (HERS <=56) Electric	0.00	0.00	0.00	0.00
Platinum Star (HERS <=56) Gas	11,713.14	11,713.14	11,713.14	70,182.61
Total Savings	79,677.23	79,677.23	79,677.23	477,408.78
Total Program Realization Rate				599%

Note: Totals may not sum properly due to rounding.

[a] Values presented at a measure-level represent audited values, since the scorecard provides only savings totals.

EX POST NET SAVINGS

The evaluation team interviewed 17 builders who represented 3% of the *ex post* gross program population savings and estimated lower and upper NTG ratio bounds of 42% and 78%, respectively. Due to low representativeness of the population of savings, and therefore low confidence in the representativeness of the respondents relative to the population, the evaluation team did not apply the NTG research to 2020 program savings and used a benchmarked NTG ratio from a program with similar performance tiers and requirements. Vectren Indiana offers a similar program and has a more established history of program participation. Vectren Indiana has published[47] NTG ratios for its 2018 program; this NTG value was used for the NIPSCO new construction program for 2019. Upon review, the evaluation team recommends continuing to use this value for the 2020 evaluation. The evaluation team applied these NTG ratios to the 2020 Residential New Construction program.

Table 141 shows the NTG ratios by measure.

TABLE 141. 2020 RESIDENTIAL NEW CONSTRUCTION PROGRAM NTG RATIOS BY MEASURE

MEASURE	NTG
Silver Star (HERS 66-75) Electric	54%
Silver Star (HERS 66-75) Gas	54%
Gold Star (HERS 57-65) Electric	54%
Gold Star (HERS 57-65) Gas	54%
Platinum Star (HERS <=56) Electric	54%
Platinum Star (HERS <=56) Gas	54%

More qualitative discussion of the contractor decision-making process is included in the process findings below. It should be noted that due to the code change, net-to-gross should be re-assessed in future years, depending on how program design is changed to address the new baseline.

Table 142 presents the resulting net electric savings, demand reduction, and natural gas savings.

TABLE 142. 2020 RESIDENTIAL NEW CONSTRUCTION PROGRAM *EX POST* NET SAVINGS

MEASURE	*EX POST* GROSS SAVINGS			NTG	*EX POST* NET SAVINGS		
	KWH	KW	THERMS		KWH	KW	THERMS
Silver Star (HERS 66-75) Electric	205,794.67	64.046	0.00	0.54	111,129.12	34.585	0.00
Silver Star (HERS 66-75) Gas	0.00	0.00	78,133.65	0.54	0.00	0.00	42,192.17
Gold Star (HERS 57-65) Electric	571,553.71	253.566	0.00	0.54	308,639.00	136.925	0.00
Gold Star (HERS 57-65) Gas	0.00	0.00	329,092.53	0.54	0.00	0.00	177,709.96
Platinum Star (HERS <=56) Electric	80,952.70	33.624	0.00	0.54	43,714.46	18.157	0.00
Platinum Star (HERS <=56) Gas	0.00	0.00	70,182.61	0.54	0.00	0.00	37,898.61
Total Savings	858,301.08	351.236	477,408.78	54%	463,482.58	189.667	257,800.74

Table 143 shows the freeridership for each fuel type. The evaluation team applied savings-weighted freeridership, based on MMBtu, to develop a program-level NTG of 54% NTG for 2020 (Table 144).

47 https://www.vectren.com/assets/downloads/planning/irp/IRP-2018-vectren-electric-dsm-evaluation.pdf

TABLE 143. 2020 RESIDENTIAL NEW CONSTRUCTION NTG RESULTS BY FUEL TYPE

SAVINGS TYPE	*EX ANTE* GROSS SAVINGS	*EX POST* GROSS SAVINGS	NTG RATIO (%)	*EX POST* NET SAVINGS
Electric Energy Savings (kWh/yr.)	1,267,048.70	858,301.08	54%	463,482.58
Peak Demand Reduction (kW)	987.140	351.236	54%	189.667
Natural Gas Energy Savings (therms/yr.)	79,677.23	477,408.78	54%	257,800.74

TABLE 144. 2020 RESIDENTIAL NEW CONSTRUCTION PROGRAM-LEVEL NET-TO-GROSS

RESPONSES (N)	FREERIDERSHIP (%)	SPILLOVER (%)	NTG RATIO (%)
N/A	46%	N/A	54%

PROCESS EVALUATION

To inform the process evaluation, the evaluation team conducted qualitative research with participating builders to learn about their experience with the program. The survey gathered feedback on the program's processes, motivations to participate, barriers to participation and satisfaction with the program. In addition, we asked builders how the COVID-19 pandemic has impacted their business.

SAMPLE DESIGN

The sampling frame included a census of builder companies (n=126) who completed a program home in 2020. The total target quota was 30 completes. Given the fewer number of Platinum and Silver tier builders, we attempted to achieve the following quotas by tier:

TABLE 145. SURVEY TARGET

TIER	SAMPLE	QUOTA	COMPLETED
Platinum	18	5	5
Gold	94	20	10
Silver	13	5	2
Total	126	30	17

PARTICIPANT FEEDBACK

The following findings reflect the experiences and opinions of 17 participating builders. While their perspectives are valid, these results should be viewed qualitatively, as they may not be reflective of the larger population. As a result, the data presented in this summary and throughout the report avoids using percentages and includes more generalized characterizations of responses and themes.

PROGRAM AWARENESS AND COMMUNICATIONS

Like the 2019 evaluation findings, most respondents learned about the program through their HERS rater (n=9). A smaller set of builders (n=5), learned about the program through NIPSCO's outreach, including contact from a NIPSCO representative, an email from NIPSCO, or NIPSCO's website. Two builders indicated that they were involved with the program in the past (likely referring to the previous version of the program) and did not recall how they first learned about it. Only one respondent reported hearing about the program from another builder. None of the respondents said they learned about the program through TRC staff, the Homebuilder Association, or a Homebuilder Show. Table 146 summarizes participant survey responses.

TABLE 146. SOURCES OF AWARENESS ABOUT NIPSCO PROGRAM

SOURCE OF AWARENESS	COUNT
HERS Rater (phone call, email, or in-person meeting)	9
NIPSCO's program representative (phone call, email, or in-person meeting)	3
Do not recall	2
Informational email from NIPSCO	1
NIPSCO website	1
From another homebuilder/contractor	1
TOTAL	17

C1. How did your organization learn about NIPSCO's Residential New Construction program? Single response only.

Most builders indicated that their preferred communications channel with NIPSCO about energy saving opportunities is a direct email (n=11). Several builders (n=4) preferred other NIPSCO channels, including mailings, bill inserts, and the website, and two preferred communications through their HERS rater (for details see Table 147. Preferred communication channels). No respondents indicated preference for social media, local events, trade associations, or in-person meetings or phone calls with NIPSCO representatives.

TABLE 147. PREFERRED COMMUNICATION CHANNELS

COMMUNICATION CHANNEL	COUNT
Direct email from NIPSCO	11
HERS Rater	2
Letter/flyer/other mailings	2
NIPSCO website	1
Bill inserts	1
TOTAL	17

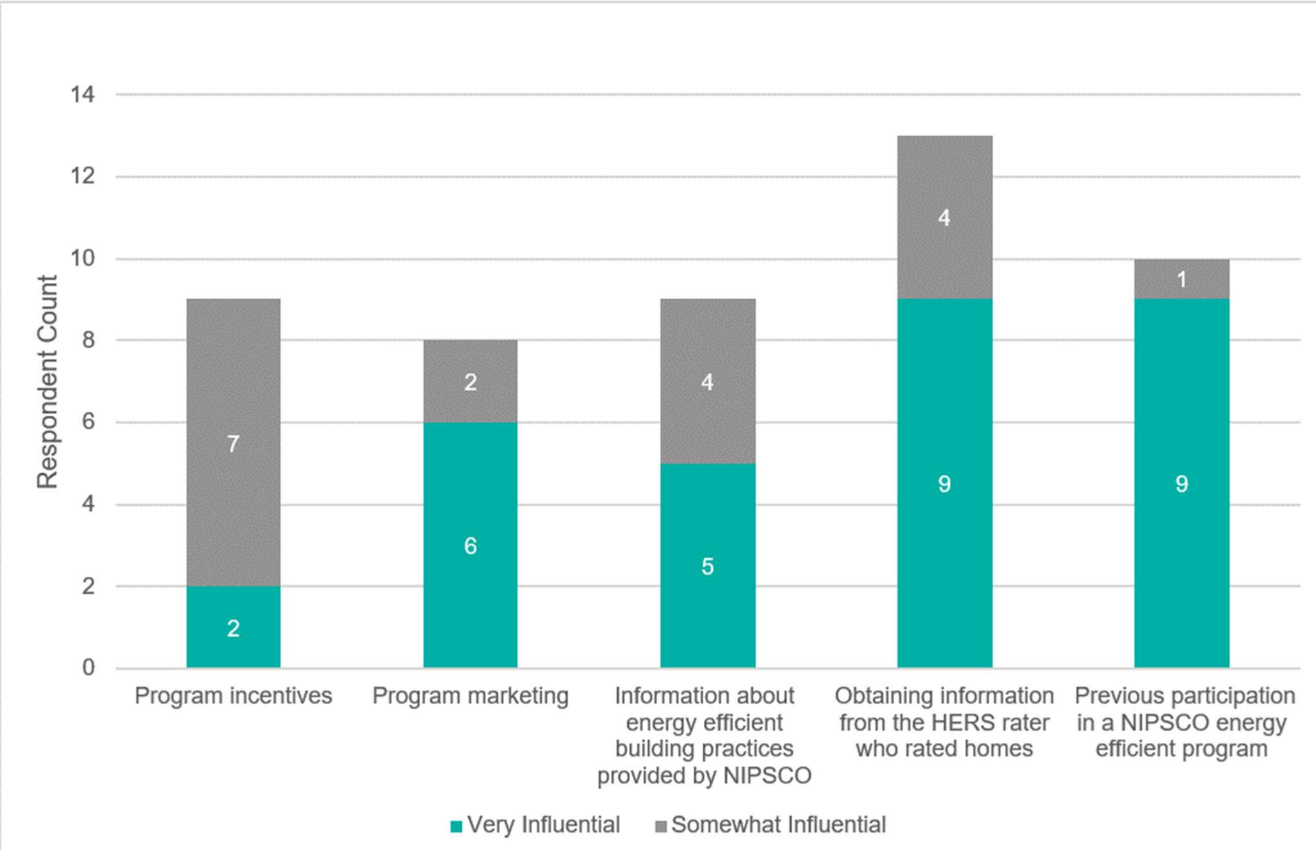
C2. In your opinion, what is the best way for NIPSCO to keep organizations like yours informed about opportunities to save energy? Single response only.

PARTICIPATION DRIVERS AND DECISION-MAKING

Builders predominately participate in the program to receive the incentive. Most respondents (n=13) stated that the incentive was either the most important or the second most important reason for participating. Of those 13, three stated that the incentive was the only reason they participated in the program. Other motivations, such as building an energy-efficient home and gaining a competitive advantage by achieving a lower HERS score, were generally secondary to receiving the rebates.

However, builders provided somewhat different feedback when asked how influential these rebates are in their building practices. As described in the discussion of net savings above, the evaluation team did not use this year's survey data to calculate a net-to-gross ratio due to a low proportion of savings representation of the builders who responded to the survey. Qualitatively, builders reported differing levels of influence across various program components. Figure 65 shows how respondents rated program components in terms of their influence on their decision to build homes that met the program standards. Again, the influence and importance of the HERS rater in influencing builder decision-making is highlighted here, with 13 of 17 builders saying their rater was somewhat or very influential. Approximately half of builders rated the program marketing, program information, and program rebates as somewhat or very influential. However, only two builders said the rebates themselves were very influential.

FIGURE 65. INFLUENTIAL PROGRAM COMPONENTS[48]



In future evaluations, the evaluation team recommends including HERS raters in the evaluation research to better understand their role in recommending the program to builders and encouraging more efficient building practices through the program. This will be especially important if program design changes to account for the 2019 code change.

BARRIERS TO PARTICIPATION

Most builders (n=14) did not report any challenges to participating in the NIPSCO program.[49] Of the three builders (two Gold tier and one Platinum tier) who expressed challenges with the program, two reported issues with

[48] D11. Please rate each item on how influential it was to your decision to build homes to NIPSCO Residential New Construction program standards of at least a HERS [HERS] or below during 2020. Please use a scale from 1, meaning “not at all influential,” to 4, meaning the item was “very influential” to your decisions.

[49] G1. Did you experience any challenges participating in NIPSCO’s Residential New Construction program?

receiving the rebate check. The third felt that the program changes every year, which made it difficult for them to understand program requirements. This builder also expressed challenges completing and submitting the rebate application.

Builders were asked if there were any challenges to increasing the depth of their program participation (i.e., building homes with lower HERS scores).[50] The two builders that provided responses (one Gold tier and one Silver tier) both mentioned financially related challenges: the cost to build to a higher tier and the return on investment.

IMPACTS OF COVID-19

Most builders reported no impact from the COVID-19 pandemic in the number of homes built (n=11). Several respondents (n=4) reported building fewer homes and two said they built more homes than in past years (see Table 148 for details).

TABLE 148. HOMES BUILT DURING COVID-19 PANDEMIC

NUMBER OF HOMES	COUNT
Fewer homes overall than you would have otherwise	4
More homes overall than you would have otherwise	2
No impact from the COVID-19 pandemic	11
TOTAL	17

G7. As a result of the COVID-19 pandemic, did your organization build…?

Similarly, the number of program eligible homes built in 2020 was not affected by the pandemic, regardless of tier. Most participants reported that the COVID-19 pandemic had no impact on the number of program eligible homes they built (n=15). Only two participants reported building fewer program eligible homes. Both were custom homebuilders who explained that they encountered issues with the supply chain for building materials, which caused them to build fewer program eligible homes.

TABLE 149. PROGRAM ELIGIBLE HOMES BUILT DURING COVID-19 PANDEMIC

NUMBER OF HOMES	COUNT
Fewer program eligible homes than you would have otherwise	2
No impact from the COVID-19 pandemic	15
TOTAL	17

G8. As a result of the COVID-19 pandemic, did your organization build…?

BUILDER SATISFACTION

OVERALL PROGRAM SATISFACTION AND FEEDBACK

Overall, respondents were very satisfied with the program. On average, respondents rated their program satisfaction as 4.41 on a scale of 1 to 5, where 1 was not at all satisfied and 5 was very satisfied. Among the nine

[50] G4 & G5. What challenges does your organization encounter in building more homes that can achieve the [Gold Star standards of a HERS score 65 to 75] [Platinum Star standards of HERS 56 or lower]?

builders who gave the program high satisfaction scores,[51] several mentioned that NIPSCO's staff is friendly, helpful, and easy to work with (n=6) and two builders thought the program process was smooth.

> *"I just really like [NIPSCO] and they make it so easy for me. The people that I have worked with are just great." – Production Builder, High Satisfaction*
>
> *"Applications are easy and quick. We can get answers. Good customer service."*
>
> *– Custom Homebuilder, High Satisfaction*

There were eight builders that gave the program a moderate satisfaction score.[52] Two of these builders gave a moderate satisfaction score because they thought the application could be easier and change less. Two others expressed difficulty getting service or connecting to the right person at NIPSCO for program support.

> *"Sometimes it is hard to get in touch with right person with NIPSCO." – Custom Builder, Moderate Satisfaction*
>
> *"My only complaint is the application system…[it] changes constantly." – Custom and Production Homebuilder, Moderate Satisfaction*

SATISFACTION WITH PROGRAM COMPONENTS

Overall, builders were satisfied with most aspects of the program, but they were most satisfied with their HERS rater and the HERS rating process. Like last year, builders were least satisfied with the rebate amount and the time it took to receive the rebate. In this regard, one respondent commented: "*We usually have to call back and follow up regarding the rebate…It seems to take quite a while*." Along the same lines, another respondent said, "*I just received a rebate that was sent out back in November."*

Respondents were satisfied with interactions with NIPSCO. On average, builders rated their overall satisfaction with working with NIPSCO 4.3 on a scale of 1 to 5, where 1 was not at all satisfied and 5 was very satisfied.

Only one participant gave low scores when asked about working with both TRC and NIPSCO. This builder reported that they achieved a HERS score of 37 but did not receive a rebate. When they contacted TRC to understand why they had not received the rebate, the builder reported that they did not get a response. As a result, their low satisfaction with NIPSCO came from them feeling like *"there was no follow through on their end."*

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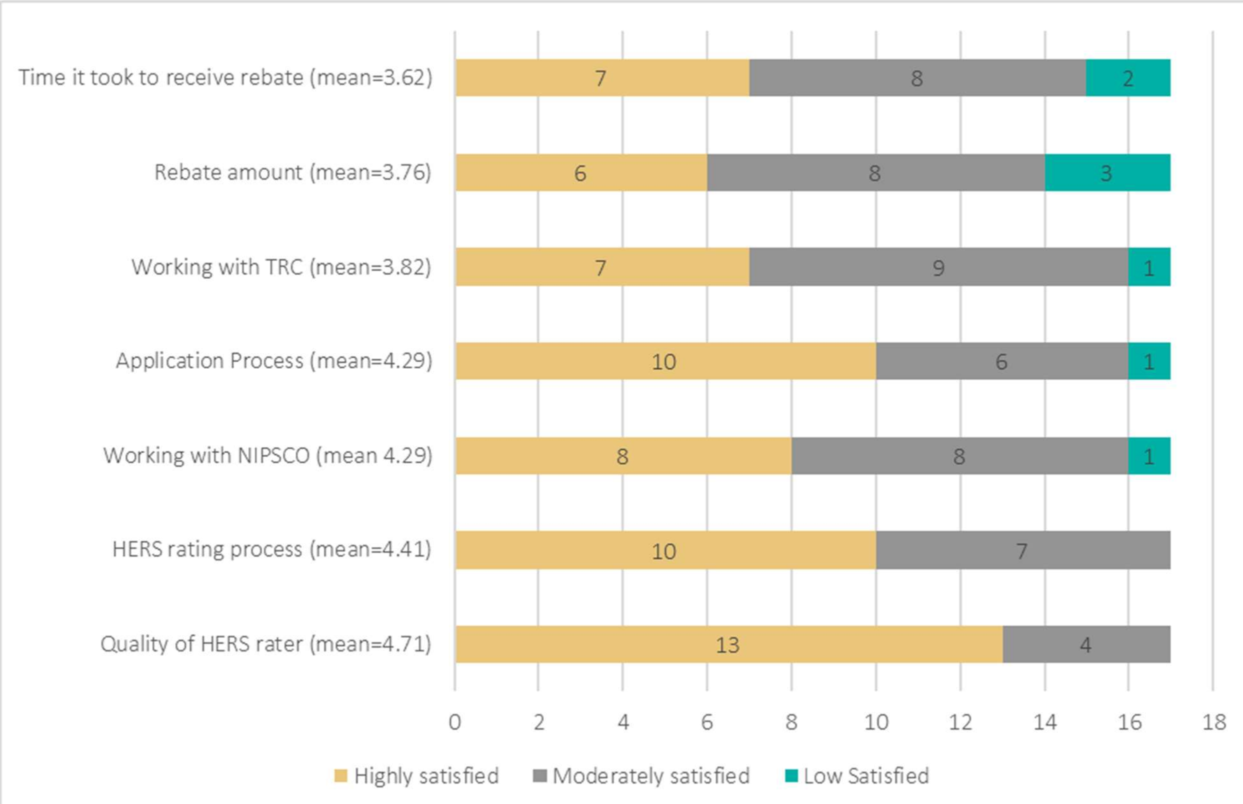
[51] High satisfaction refers to ratings of 5 on a scale from 1 to 5.

[52] Moderate satisfaction refers to ratings of 3 or 4 on a scale from 1 to 5.

FIGURE 66: SATISFACTION WITH PROGRAM ELEMENTS[53]



I1. Next, I have some questions about your satisfaction with NIPSCO's Residential New Construction program. How satisfied are you with the following statements?

SUGGESTIONS FOR IMPROVEMENT

Four participants offered suggestions to improve the program.[54] These included improvements to the application process, offering a direct deposit option to receive the incentive, and making both the requirements and process more consistent year to year.

One Platinum-tier builder thought the program could '*do better on energy efficiency'* by '*incentivizing people to do better than just the basics or code.'* This builder suggested the program increase the tier thresholds and increase the incentive.

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[53] High satisfaction refers to ratings of 5 on a scale from 1 to 5; moderate satisfaction refers to ratings of 3 or 4 on the same scale; low satisfaction refers to ratings of 1 or 2 on the same scale.

[54] G3. What could NIPSCO have done to help your organization overcome the challenges you faced with this program?

If there is a stricter or higher level that is rewarded by an additional comparative incentive amount, that would make people more likely to try for a higher level. – Custom Homebuilder

PARTICIPANT SURVEY FIRMOGRAPHICS

Most respondents were custom homebuilders, followed by production homebuilders, and builders that constructed both custom and production homes.[55] Likewise, most respondents built homes for second-time and/or experience homebuyers with five builders also serving the first-time homebuyer market. There was one Gold-tier builder who built homes for first-time homebuyers.

Most respondents only operated in NIPSCO's territory with several also operating through the state of Indiana. Only two respondents were multi-state homebuilders. Table 150 shows a summary of self-reported firmographic information.

[55] Production homes were defined as "homes that are typically sold to the customer after the start of construction." Custom homes were defined as homes "where the customer purchases the home prior to the start of construction."

TABLE 150. FIRMOGRAPHICS OF RESPONDENTS

FIRMOGRAPHICS	RESPONDENTS
Home Type	Count
Custom	10
Production	4
Both custom and production	3
Geographical Area	Count
Only NIPSCO territory	9
Throughout Indiana	6
Throughout Indiana and other states	2
Homebuyer Market	Count[56]
First-time	6
Second-time	10
Experienced	12
Builder Size	Count
1-10	8
11-25	7
More than 25	2

Table 151 provides further detail of builder size by tier.

TABLE 151. NUMBER OF HOMES BUILT BY BUILDER TIER

HOMES BUILT	SILVER	GOLD	PLATINUM
1 to 10	1	6	1
11 to 25	0	4	3
More than 25	1	0	1
TOTAL	2	10	5

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSION 1: *EX ANTE* ESTIMATES FOR RESIDENTIAL NEW CONSTRUCTION HOMES DID NOT REFLECT EVALUATED SAVINGS. HOMES SAVED SIGNIFICANTLY MORE GAS THAN ANTICIPATED, WHILE SAVING LESS ELECTRIC ENERGY AND DEMAND THAN ESTIMATED.

The evaluation team estimated *ex post* gross savings based on the home characteristics of PY 2020 homes. Based on model results, the evaluation team estimated that evaluated gas savings were almost six times as high as assumed *ex ante* savings (599% realization rate, like 2019 evaluation findings). Electric savings, both energy and demand savings, were lower in the evaluation team's estimate compared to *ex ante* savings. The realization rate

[56] These counts do not total to 17 because it was a multiple response question.

for kWh is 68% and the realization rate for kW is 36%. This is like the 2019 program evaluation results where the realization rate for kWh was 72% and the realization rate for kW was 24%.

As discussed in the 2019 program evaluation, the difference in evaluated and *ex ante* savings likely comes from difference in methods and assumptions used by the program implementer and the evaluation team. While the evaluation team based its evaluated savings on as-built program home characteristics, the program implementer based its *ex ante* values and its electric savings on HERS scores and benchmarked savings. The implementer's method for determining *ex ante* gas savings is unknown.

Recommendations:

- The evaluation team recommends that the program implementer revisit its assumptions and calculation for program home savings to derive a more accurate estimate, considering code changes as described in this report.

CONCLUSION 2: THE ADOPTION OF THE NEW 2020 ENERGY CODE IN INDIANA WILL SIGNIFICANTLY REDUCE PROGRAM SAVINGS IN 2021.

The new energy code raises the baseline for the program by requiring all homes to install more efficient lighting, insulation and build tighter homes and duct systems. We estimate the code change will eliminate most electric savings and noticeably reduce gas savings under the current program requirements. While the state of Indiana limited the scope of the IECC 2018 code by amending key areas of the code including attic insulation level and windows and foundation insulation, high efficiency lighting and air sealing requirements remain higher than the previous code. Most of the programs current electric savings are due to participant builders installing high efficiency lighting.

Additionally, participants in the program are typically using rating software packages such as REM/Rate and Ekotrope to confirm homes are meeting program requirements. Both software providers can calculate energy savings for each home that is built. The program could leverage this data and capability to increase the accuracy of estimates of energy savings prior to evaluation. Both software providers offer state specific reports and even program specific reports (PPL in Pennsylvania, First Energy in Ohio and EMPower in Maryland for several examples) that calculate energy and demand savings for each home submitted to the program allowing program managers to track program progress.

Recommendations:

- Update the program requirements to account for the energy code change in Indiana. There are several ways that NIPSCO could approach this, ranging from shifting HERS tiers, to adding requirements for certain measures to be included in builds to ensure savings targets are met across fuels.
    - If desired, as an interim support task, the evaluation team can provide a secondary literature review of peer utility new construction program designs, focusing on states with recent code changes, to provide context and support to the implementation team in adjusting program design.
- As part of updating program requirements, consider ways to maximize program influence in building practices, include reassessing rebate levels which may be low compared to savings achieved (especially

when comparing to *ex post* gas savings). Qualitatively, program rebates were rated as a lower influence in builder decision making, when compared to other components such as the HERS rater.

- Explore software-based solutions that would allow the program to have more insight into program performance in live-time.

CONCLUSION 3: HERS RATING COMPANIES CONTINUE TO DRIVE PROGRAM PARTICIPATION.

Like the 2019 evaluation, most builders heard of the program from their HERS rater. Communications or interactions with NIPSCO representatives was the second most common source of awareness. Additionally, builders said raters were the most influential in their decision to build homes to the program standard. The influence of the program on the rater, however, is unclear, and the evaluation team recommends exploring this more in future research.

Recommendations:

- Future evaluations should include research with HERS raters to understand their current role in influencing the adoption of efficient building practices through the program, as well as ways to engage builders that are not already building energy efficient homes.
- Continue to promote the program through direct outreach to non-participating builders and expand outreach through indirect channels to appeal to builders with less familiarity with HERS rating index and expertise in building above-standard energy efficient homes.

CONCLUSION 4: SATISFACTION WITH THE PROGRAM REMAINS HIGH AND BUILDERS REPORT FEW CHALLENGES TO PARTICIPATE.

Builders remain satisfied with the program overall and did not report many challenges to participating in the program. High satisfaction is driven primarily by positive experiences with HERS rating companies and working with NIPSCO representative. As in 2019, one source of dissatisfaction was the processing time of rebate checks, which builders considered to be too long. Similarly, reported participation challenges predominately centered on the time it took to receiving the incentive checks.

Recommendations:

- Streamline application process by reducing the processing times of applications to be able to issue and send checks sooner can increase builder satisfaction levels.
- Consider the results from the 2019 benchmarking analysis to determine if increases to the incentive structure is warranted when compared to other comparable programs, based on energy savings' requirements. A restructuring of incentives can also increase builder satisfaction.

10. HOMELIFE ENERGY EFFICIENCY CALCULATOR PROGRAM

PROGRAM DESIGN AND DELIVERY

The HomeLife Energy Efficiency Calculator (HomeLife Calculator) program provides residential customers a free online 'do-it-yourself' audit and a free energy savings kit for carrying out this audit. The intent of this tool is to 1) identify low-cost/no-cost measures that a NIPSCO residential customer can easily implement to manage their gas and electric consumption; 2) allow eligible customers to request a free home energy kit; 3) educate customers about the variety of programs available to them through the residential EE portfolio. This program is implemented by TRC.

The online calculator is available to individuals with a NIPSCO account number who log onto NIPSCO's website; and, to receive a kit one must be an active electric and/or gas NIPSCO customer. The calculator provides tips on low to no cost improvements that will save customers energy and money and provides an analysis of their energy consumption along with recommendations to improve their homes efficiency.

All customers – combo, electric-only, and gas-only – are eligible to receive a kit. Electric-only customers receive the combo kit, but NIPSCO does not claim savings for the gas measures. Gas-only customers receive a kit that has additional water saving devices:

- Measures in Combo and Electric Only Kits
    - One kitchen faucet aerator (1.5 gpm)
    - One bathroom faucet aerator (1.0 gpm)
    - One low-flow showerhead (1.5 gpm)
    - Four 9-watt LEDs
    - One 0.5-watt LED night-light
    - One furnace filter whistle
- Measures in Gas Only Kits
    - One kitchen faucet aerator (1.5 gpm)
    - Two bathroom faucet aerators (1.0 gpm)
    - Two low-flow showerheads (1.5 gpm)
    - One furnace filter whistle

PROGRAM PERFORMANCE

The HomeLife Calculator program was added to the program portfolio in 2019. In 2020, this program fell short of meeting its electric, demand, or gas savings goals (Table 152).

TABLE 152. 2020 HOMELIFE CALCULATOR PROGRAM SAVINGS SUMMARY

METRIC	GROSS SAVINGS GOAL	*EX ANTE*	AUDITED	VERIFIED	*EX POST* GROSS	*EX POST* NET	GROSS GOAL ACHIEVEMENT
Electric Energy Savings (kWh/yr)	207,176.00	60,844.32	60,845.05	65,268.85	60,816.02	88,971.73	29%
Peak Demand Reduction (kW)	25.650	7.533	7.433	10.468	7.910	11.795	31%
Natural Gas Energy Savings (therms/yr)	15,706.80	5,697.18	5,697.81	5,588.48	2,377.01	3,652.10	15%

Table 153 outlines *ex post* gross values and NTG adjustment factors. Note, spillover values are high; this is discussed in detail in the spillover section.

TABLE 153. 2020 HOMELIFE CALCULATOR PROGRAM ADJUSTMENT FACTORS

METRIC	REALIZATION RATE (%)[a]	FREERIDERSHIP	SPILLOVER	NTG (%)[b]
Electric Energy Savings (kWh/yr)	100%	13%	59%	146%
Peak Demand Reduction (kW)	105%	10%	59%	149%
Natural Gas Energy Savings (therms/yr)	42%	6%	59%	154%

[a] Realization Rate is defined as *ex post* Gross savings divided by *Ex ante* savings.

[b] NTG is defined as *ex post* net savings divided by *ex post* gross savings.

The HomeLife Calculator program came in under budget. The implementation team spent 34% and 38% of the allocated budget for electric and gas savings respectively (Table 154).

TABLE 154. 2020 HOMELIFE CALCULATOR PROGRAM EXPENDITURES

FUEL	PROGRAM BUDGET	PROGRAM EXPENDITURES	BUDGET SPENT (%)
Electric	$33,399.76	$ 11,440.19	34%
Natural Gas	$39,457.31	$ 15,072.50	38%

IMPACT EVALUATION

The Evaluation team completed the impact evaluation to answer the following research questions:

- What assumptions were used to develop deemed savings estimates? Are there any updates that should be made?
- What are ex-post program savings? Do these suggest any needed updates to program design, delivery, or savings assumptions?
- What are installation rates for kit measures? Are there certain measures that are installed most often? Least often?

This section details each step of the impact evaluation and its associated electric energy savings, peak demand reduction, and natural gas savings.

AUDITED AND VERIFIED SAVINGS

AUDITED SAVINGS

To audit program savings, the evaluation team performed the following reviews to verify alignment with the program's scorecard:

4. Audited Kits Quantity. Reviewed program tracking data provided by the implementer and audited the number of kits distributed.
5. Confirm Measure-Level Savings Calculations. Reviewed per-measure and per-kit savings in the documentation provided by NIPSCO.
6. Savings Estimate Review. Confirmed program-level total savings.

AUDITED QUANTITY OF KIT

NIPSCO reported a total of 261 combo kits, 69 gas-only kits, and 18 electric only kits distributed through the HomeLife Calculator program. These reported scorecard values were checked against the program tracking data and kit quantities aligned (Table 155).

TABLE 155. 2020 HOMELIFE CALCULATOR PROGRAM AUDITED KIT QUANTITY

KIT TYPE	SCORECARD	TRACKING DATA
Combo Kits	261	261
Electric Only Kits	18	18
Gas Only Kits	69	69
Total	349	348

CONFIRM MEASURE-LEVEL SAVING

The evaluation team reviewed the kit savings documentation ("NIPSCO Res Measure Calcs") which contained measure-level and kit level savings. Importantly, NIPSCO included installation rates from past EM&V efforts in their ex-ante assumptions for the kit program (as the HomeLife Calculator program was new for this cycle, assumptions were pulled from the 2018 School Education evaluation). The program documentation included rates to adjust savings for both installation practices and water heater fuel saturation.

Upon review of this document, measure-level savings values in the tracking data aligned with NIPSCO's kit savings documentation. However, program tracking data savings were reported at the kit-level with a rounded total kit value, and NIPSCO's Measure Calculation file savings were reported at the measure-level with un-rounded per measure values. This difference in the unit of analysis resulted in a rounding discrepancy, meaning that the sum of total measure savings was slightly off from the tracking data savings. These rounding discrepancies will be noted where applicable in the remainder of this report.

SAVINGS ESTIMATE REVIEW

Measure-level and total savings values were also reviewed. Savings values in the program tracking data were summed and compared to savings values reported in the scorecard. The savings values align (Table 156).

TABLE 156. 2020 HOMELIFE CALCULATOR PROGRAM TOTAL SAVINGS REVIEW

UNIT OF ENERGY SAVINGS	SCORECARD	TRACKING DATA
kWh	60,844.32	60,844.32
kW	7.533	7.533
therms	5,697.18	5,697.18

VERIFIED SAVINGS

The evaluation team took a census of all available customers for the HomeLife Calculator program and confirmed installation of all measures. Installation rates for the HomeLife Calculator program were somewhat higher across the board relative to the current adjusted Schools installation rates. This is expected given differences in program design, as customers may specifically opt in to the HomeLife program because they want to receive a kit (whereas Schools participants are provided a kit without requesting it). Consistent with the Schools evaluation, lighting measures had the highest installation rates, with most of those measures installed at the time of the survey. Furnace whistles had the lowest installation rates (30%). Most measures had relatively consistent installation rates with what was assumed in the *ex ante* savings, except for furnace whistles and nightlights, where installation rates were somewhat higher.

Finally, to account for LED lamps currently stored for future use, carryover savings were calculated for the LEDs included in the kit. The evaluation team used the UMP-recommended "Discount Future Savings" method (National Renewable Energy Laboratory/UMP Chapter 21, 2015) to calculate carryover savings. This method assumes most bulbs placed in storage (up to 97%) are installed within four years (including the initial program year), with 24% of bulbs left over from Year one installed in Year two, 24% in Year three, and so on. However, given expected baseline lighting changes mandated by EISA 2007, all standard LEDs are anticipated to function as baseline lamps. Thus, the evaluation team did not extend GSL baseline savings beyond 2023, Year three in the UMP-recommended method. This resulted in a final ISR for LEDs of 87%.

TABLE 157. 2020 HOMELIFE CALCULATOR PROGRAM IN-SERVICE RATES RATIOS BY MEASURE

MEASURE	ISR
LED	87%
Nightlight	85%
Bathroom Aerator	33%
Kitchen Aerator	44%
Showerhead	43%
Filter Whistle	30%

WATER HEATER SATURATION

The evaluation team adjusted the *ex ante* electric and natural gas saturation rates for water-saving measures by analyzing data from the 2020 HEW results from the School Education program, which provides a large sample of customers who report their water heater fuel, shown in Table 158. Results indicate a slight discrepancy between *ex ante* and verified electric and natural gas domestic water heating saturation rates.

TABLE 158. 2020 HOMELIFE CALCULATOR PROGRAM WATER HEATER FUEL SATURATION

SAVINGS TYPE	ELECTRIC WATER HEATING SATURATION RATE (%)	NATURAL GAS WATER HEATING SATURATION RATE (%)
Reported *ex ante*	20%	73%
Verified[a]	23%	64%

[a] Electric and natural gas saturation rates do not total 100% because 7% of respondents replied "Other" and 6% replied "Propane" on the HEW.

Table 159 summarizes the per unit audited and verified savings values with ISRs applied. In addition to ISRs, the evaluation team applied water heating saturation adjustment factors to all water saving devices. As noted above, audited savings already include ISR and water heater saturation adjustments, and these were updated using the current calculated ISRs and water heater saturation adjustment factors. Most electric savings for water saving devices increased slightly, as the saturation rate for electric water heaters increased.

TABLE 159. 2020 HOMELIFE CALCULATOR AUDITED AND VERIFIED PER UNIT MEASURE SAVINGS

MEASURE	VERIFIED ISRS	AUDITED KWH SAVINGS	VERIFIED KWH SAVINGS	AUDITED KW REDUCTION	VERIFIED KW REDUCTION	AUDITED THERM SAVINGS	VERIFIED THERM SAVINGS
LED - Combo Kit (Dual Fuel)	87%	30.94	31.17	0.003	0.003	-0.06	-0.06
LED - Electric Only Kit	87%	30.94	31.17	0.003	0.003	0.00	0.00
Night light - Combo Kit (Dual Fuel)	85%	3.58	4.47	0.000	0.000	0.00	0.00
Night light - Electric Only Kit	85%	3.58	4.47	0.000	0.000	0.00	0.00
Bath aerator - Combo Kit (Dual Fuel)	33%	3.87	3.86	0.000	0.000	0.62	0.47
Bath aerator - Electric Only Kit	33%	3.87	3.86	0.000	0.000	0.00	0.00
Bath aerators - Gas Only Kit	33%	0.00	0.00	0.000	0.000	0.62	0.47
Kitchen aerator - Combo Kit (Dual Fuel)	44%	28.71	33.43	0.001	0.001	4.61	4.11
Kitchen aerator - Electric Only Kit	44%	28.71	33.43	0.001	0.001	0.00	0.00
Kitchen aerator - Gas Only Kit	44%	0.00	0.00	0.000	0.000	4.61	4.11
Showerhead - Combo Kit (Dual Fuel)	43%	49.49	50.11	0.002	0.002	7.95	6.17
Showerhead - Electric Only Kit	43%	49.49	50.11	0.002	0.002	0.00	0.00
Showerheads - Gas Only Kit	43%	0.00	0.00	0.000	0.000	7.95	6.17
Filter whistle - Combo Kit (Dual Fuel)	30%	8.68	17.39	0.011	0.021	2.49	5.00
Filter whistle - Electric Only Kit	30%	8.68	17.39	0.011	0.021	0.00	0.00
Filter whistle - Gas Only Kit	30%	0.00	0.00	0.000	0.000	2.49	5.00

EX POST GROSS SAVINGS

The evaluation team reviewed the programs *ex ante* assumptions, sources, and algorithms for reasonableness and updates. Below are detailed *ex post* gross analysis results.

ENGINEERING REVIEWS

The evaluation team referred to the Indiana TRM (v2.2) and the 2016 Pennsylvania TRM to calculate *ex post* gross electric energy savings, demand reduction, and natural gas savings. Where NIPSCO customer specific information was available, such as for persons per home and water heater fuel saturation, the evaluation team revised input assumptions. The Appendix: Homelife Calculator Algorithms and Assumptions contains details on the specific algorithms, variable assumptions, and references for all program measure *ex post* gross calculations.

Through the engineering review, the evaluation team found differences between *ex ante* and *ex post* gross savings. These differences were primarily driven by the following overarching factors:

- The evaluation team did not assign a therm penalty to the LED measures, consistent with the C&I approach.
- As this program did not exist in the previous cycle, *ex ante* assumptions relied on School Education EM&V results for some savings inputs. The evaluation team was able to update several inputs using more tailored information to the HomeLife Calculator program design and participant characteristics. This includes:
    - The evaluation team used in-service rates from the 2020 Home Energy Assessment program for the *ex post* analysis,
    - The evaluation team also determined that utilizing the Indiana TRM people-per-households assumption (2.64) is most appropriate. Previously the assumptions utilized the School Education value of 4.86, which may be overstated due to the specific participant population for that program (families with at least one child).
- The evaluation team used geolocation for each customer address in the database then matched each address with the closest city from the Indiana TRM (v2.2)—for example, South Bend and Fort Wayne—to more precisely account for variations in climate for measures including faucet aerators, showerheads, and LED bulbs.
- The evaluation team referred the 2016 Pennsylvania TRM for the *ex post* savings for the filter whistle measure.

The following sections summarize the team's findings and recommendations based on the engineering review.

EX POST GROSS SAVINGS

Ex post savings reflect the engineering adjustments made to verified measure savings. The evaluation team calculated *ex post* electric energy, peak demand, and natural gas energy savings for each measure kit using algorithms and inputs from the Indiana TRM (v2.2), the Pennsylvania TRM 2016, as well as customer location to account for weather effects. The evaluation team leveraged the parent worksheet and survey results from the School Education program to estimate people per household and water heater fuel type saturation, then used this information to inform *ex post* gross savings calculations. *Ex post* savings calculations differed from *ex ante* analysis as follows:

- Furnace Filter Whistle: The evaluation team referred to the 2016 Pennsylvania TRM to calculate savings for the filter whistle savings, which assigns electric energy and demand savings to blower motor energy reduction because dirty filters increase electricity consumption for the circulating fan. The evaluation team does not assign therm savings for the furnace whistle measure because in our best judgement any therm savings will be minimal, and a review of available literature reveals that at this time, there a lack of defensible evidence for assigning therm savings. The furnace filter whistle electric savings are achieved by the effect of a dirty filter on the static pressure of an ECM fan, but the filter whistle does not provide thermal savings because the furnace operates to meet temperature, which does not change based on filter condition. The *ex ante* approach referenced HVAC tune-up measures from the Indiana TRM (v2.2) to evaluate savings.

- Low-flow faucet aerators and showerheads: The primary driver of lower *ex post* savings is that the evaluation team used the Indiana TRM (v2.2) assumption for number of people per home, which is considerably lower than the Schools value (2.64, compared to 4.86 used in the *ex ante* assumptions). All Schools participants have at least one child in school, meaning their family size is almost certainly larger than average. This is not the case for other NIPSCO kit programs, meaning the average home size from the TRM is a more appropriate assumption. The evaluation team also used updated water heater saturation information and ISRs based on 2020 HEW and survey results. As reported in Table 7, the verified natural gas water heater saturation rate is lower than *ex ante*, 73% and 64% respectively which contributed to somewhat lower gas savings. Additionally, ISRs for some measures were slightly lower in 2020 relative to *ex ante* ISRs.

TABLE 160. 2020 HOMELIFE CALCULATOR PROGRAM *EX ANTE* AND *EX POST* GROSS PER-MEASURE SAVINGS VALUES

MEASURE	NUMBER OF MEASURES	*EX ANTE PER-MEASURE SAVINGS*			*EX POST GROSS PER-MEASURE SAVINGS*		
		KWH	KW	THERMS	KWH	KW	THERMS
LED - Combo Kit (Dual Fuel)	4	123.74	0.013	-0.25	124.78	0.014	0.00
LED - Electric Only Kit	4	123.74	0.013	0.00	124.27	0.014	0.00
Night light - Combo Kit (Dual Fuel)	1	3.58	0.000	0.00	1.45	0.000	0.00
Night light - Electric Only Kit	1	3.58	0.000	0.00	1.45	0.000	0.00
Bath aerator - Combo Kit (Dual Fuel)	1	3.87	0.0002	0.62	2.38	0.0002	0.29
Bath aerator - Electric Only Kit	1	3.87	0.0002	0.00	2.43	0.0003	0.00
Bath aerators - Gas Only Kit	2	0.00	0.000	1.24	0.00	0.000	0.60
Kitchen aerator - Combo Kit (Dual Fuel)	1	28.71	0.001	4.61	18.29	0.001	2.24
Kitchen aerator - Electric Only Kit	1	28.71	0.001	0.00	18.58	0.001	0.00
Kitchen aerator - Gas Only Kit	1	0.00	0.000	4.61	0.00	0.000	2.28
Showerhead - Combo Kit (Dual Fuel)	1	49.49	0.002	7.95	30.91	0.002	3.78
Showerhead - Electric Only Kit	1	49.49	0.002	0.00	31.31	0.002	0.00
Showerheads - Gas Only Kit	2	0.00	0.000	15.89	0.00	0.000	7.69
Filter whistle - Combo Kit (Dual Fuel)	1	8.68	0.011	2.49	40.16	0.012	0.00
Filter whistle - Electric Only Kit	1	8.68	0.011	0.00	40.16	0.012	0.00
Filter whistle - Gas Only Kit	1	0.00	0.000	2.49	0.00	0.000	0.00
Per Combo Kit		218.08	0.027	15.42	217.96	0.028	6.31
Per Electric-Only Kit		218.08	0.027	0.00	218.19	0.028	0.00
Per Gas-Only Kit		0.00	0.000	24.24	0.00	0.000	10.56

Table 160 summarizes the differences between *ex ante* and *ex post* gross estimates.

TABLE 161. 2020 HOMELIFE CALCULATOR NOTABLE DIFFERENCES BETWEEN *EX ANTE* AND *EX POST* GROSS

MEASURE	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST* GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
Kitchen aerator, Bathroom aerator, and Low-Flow showerheads	Indiana TRM (v2.2) and 2018 EMV	Indiana TRM (v2.2) and information in program tracking data. Cold water inlet temperature averaged across current participant location, ISRs from 2020 survey, and percent water heater type from 2020 School Kits program.	The evaluation team used the Indiana TRM (v2.2) assumption for the number of people per home, updated the hot water heating saturation based on 2020 School Kit survey information, and applied inlet water temperature based on current participant type and location.
9W LED	Indiana TRM (v2.2) and 2018 EMV	Indiana TRM (v2.2); UMP for baseline wattages	Baseline wattages. The difference in gas savings is because the *ex ante* gas savings are reported in MMBtu and the *ex post* gas savings are reported in therm.
Nightlight	Indiana TRM (v2.2) and 2018 EMV	Indiana TRM (v2.2) and 2020 HEA survey information	The 2020 HomeLife Calculator survey indicated 13% of households replaced an incandescent nightlight with the LED nightlight, whereas the *ex ante* value, based on a previous survey, is 40%.
Filter Whistle	Indiana TRM (v2.2) approach for HVAC Tune-up	Pennsylvania TRM 2016 – Furnace Whistle measure	The evaluation team utilized the Pennsylvania TRM to calculate savings for the filter whistle measure, where savings are based on blower motor energy reduction.

WASTE HEAT FACTOR - THERM PENALTIES

In 2019, and prior years, the evaluation team applied waste heat factors to lighting measures, representing kWh, kW, and therm penalties resulting from LED lighting. In discussions with NIPSCO, for the 2020 evaluation year, the evaluation team is not including therm penalties when calculating evaluated savings. However, cost-effectiveness results will include these penalties and be applied to the electric program cost-effectiveness. The evaluation team believes this approach is appropriate, as it accounts for the penalty on the electric side (where it is generated) and allows the evaluation team to show gas program and measure performance more clearly. NIPSCO plans to take a consistent approach to accounting for waste heat factors in their planning process.

The evaluation team recommends that the approach to applying waste heat factors is made consistent going forward across all programs that offer LED lighting. Currently, the ex-ante savings for all kit programs include therm penalties. These have been removed in the ex-post analysis, and the evaluation team is reporting these below, to be used in the cost-effectiveness analysis. In total, the therm penalty for cost-effectiveness analysis is (665.96) therms (Table 162).

TABLE 162. 2020 HOMELIFE CALCULATOR WASTE HEAT FACTOR THERM PENALTY

MEASURE	WASTE HEAT FACTOR THERM PENALTY
LED (9W) - Combo Kit	(665.96)

It should be noted that electric waste heat factors, including cooling credits and electric heating penalties, are currently reported within the kWh and kw savings for the overall program.

REALIZATION RATES

The next three tables (Table 163 through Table 165) show the program's *ex ante* reported savings, verified savings, and *ex post* gross savings.

TABLE 163. 2020 HOMELIFE CALCULATOR *EX ANTE* AND *EX POST* GROSS ELECTRIC ENERGY SAVINGS

MEASURE	*EX ANTE*[A] ELECTRIC ENERGY SAVINGS (KWH/YR.)	AUDITED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	*EX POST* GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)
LED - Combo Kit (Dual Fuel)	32,297.25	32,297.25	32,540.48	32,566.49
LED - Electric Only Kit	2,227.40	2,227.40	2,244.17	2,236.79
Night light - Combo Kit (Dual Fuel)	935.58	935.58	1,167.50	378.96
Night light - Electric Only Kit	64.52	64.52	80.52	26.14
Bath aerator - Combo Kit (Dual Fuel)	1,010.10	1,010.10	1,006.53	620.92
Bath aerator - Electric Only Kit	69.66	69.66	69.42	43.67
Bath aerators - Gas Only Kit	0.00	0.00	0.00	0.00
Kitchen aerator - Combo Kit (Dual Fuel)	7,493.61	7,493.61	8,725.97	4,774.31
Kitchen aerator - Electric Only Kit	516.80	516.80	601.79	334.51
Kitchen aerator - Gas Only Kit	0.00	0.00	0.00	0.00
Showerhead - Combo Kit (Dual Fuel)	12,916.42	12,916.42	13,079.21	8,067.01
Showerhead - Electric Only Kit	890.79	890.79	902.01	563.59
Showerheads - Gas Only Kit	0.00	0.00	0.00	0.00
Filter whistle - Combo Kit (Dual Fuel)	2,266.69	2,266.69	4,538.28	10,480.83
Filter whistle - Electric Only Kit	156.32	156.32	312.98	722.82
Filter whistle - Gas Only Kit	0.00	0.00	0.00	0.00
Total Savings	60,845.14	60,845.13	65,268.85	60,816.02
Total Program Realization Rate				100%

Note: Totals may not sum properly due to rounding.
[a] Values presented at a measure-level represent audited values, since the scorecard provides only savings totals.

TABLE 164. 2020 HOMELIFE CALCULATOR PROGRAM *EX ANTE* AND *EX POST* GROSS PEAK DEMAND REDUCTION

MEASURE	*EX ANTE*[A] PEAK DEMAND REDUCTION (KW/YR.)	AUDITED GROSS PEAK DEMAND REDUCTION (KW/YR.)	VERIFIED GROSS PEAK DEMAND REDUCTION (KW/YR.)	*EX POST* GROSS PEAK DEMAND REDUCTION (KW/YR.)
LED - Combo Kit (Dual Fuel)	3.494	3.494	3.520	3.526
LED - Electric Only Kit	0.241	0.241	0.243	0.243
Night light - Combo Kit (Dual Fuel)	0.000	0.000	0.000	0.000
Night light - Electric Only Kit	0.000	0.000	0.000	0.000

Bath aerator - Combo Kit (Dual Fuel)	0.063	0.063	0.063	0.064
Bath aerator - Electric Only Kit	0.004	0.004	0.004	0.005
Bath aerators - Gas Only Kit	0.000	0.000	0.000	0.000
Kitchen aerator - Combo Kit (Dual Fuel)	0.186	0.186	0.216	0.218
Kitchen aerator - Electric Only Kit	0.013	0.013	0.015	0.015
Kitchen aerator - Gas Only Kit	0.000	0.000	0.000	0.000
Showerhead - Combo Kit (Dual Fuel)	0.427	0.427	0.433	0.437
Showerhead - Electric Only Kit	0.029	0.029	0.030	0.031
Showerheads - Gas Only Kit	0.000	0.000	0.000	0.000
Filter whistle - Combo Kit (Dual Fuel)	2.777	2.777	5.561	3.154
Filter whistle - Electric Only Kit	0.192	0.198	0.383	0.217
Filter whistle - Gas Only Kit	0.000	0.000	0.000	0.000
Total Savings	7.426	7.433	10.468	7.910
Total Program Realization Rate				105%

Note: Totals may not sum properly due to rounding.

[a] Values presented at a measure-level represent audited values, since the scorecard provides only savings totals.

As discussed above, the evaluation team did *not* adjust LED lamp natural gas savings for waste heat factor therm penalties. This change results in higher *ex post* gross natural gas savings.

TABLE 165. 2020 HOMELIFE CALCULATOR PROGRAM *EX ANTE* AND *EX POST* GROSS NATURAL GAS SAVINGS

MEASURE	*EX ANTE*[A] NATURAL GAS ENERGY SAVINGS (THERMS/YR.)	AUDITED GROSS NATURAL GAS ENERGY (THERMS/YR.)	VERIFIED GROSS NATURAL GAS ENERGY SAVINGS (THERMS/YR.)	*EX POST* GROSS NATURAL GAS ENERGY SAVINGS (THERMS/YR.)
LED - Combo Kit (Dual Fuel)	(65.98)	(65.98)	(66.48)	0.00
LED - Electric Only Kit	0.00	0.00	0.00	0.00
Night light - Combo Kit (Dual Fuel)	0.00	0.00	0.00	0.00
Night light - Electric Only Kit	0.00	0.00	0.00	0.00
Bath aerator - Combo Kit (Dual Fuel)	162.21	162.21	123.83	76.02
Bath aerator - Electric Only Kit	0.00	0.00	0.00	0.00
Bath aerators - Gas Only Kit	85.77	85.77	65.47	41.14
Kitchen aerator - Combo Kit (Dual Fuel)	1,203.39	1,203.39	1,073.52	584.50
Kitchen aerator - Electric Only Kit	0.00	0.00	0.00	0.00
Kitchen aerator - Gas Only Kit	318.14	318.14	283.80	157.46
Showerhead - Combo Kit (Dual Fuel)	2,074.23	2,074.23	1,609.08	987.61
Showerhead - Electric Only Kit	0.00	0.00	0.00	0.00
Showerheads - Gas Only Kit	1,096.72	1,096.72	850.78	530.28
Filter whistle - Combo Kit (Dual Fuel)	651.19	651.19	1,303.79	0.00
Filter whistle - Electric Only Kit	0.00	0.00	0.00	0.00
Filter whistle - Gas Only Kit	172.15	172.15	344.68	0.00
Total Savings	5,697.81	5,697.81	5,588.48	2,377.01

Total Program Realization Rate	42%

Note: Totals may not sum properly due to rounding.
[a] Values presented at a measure-level represent audited values, since the scorecard provides only savings totals.

EX POST NET SAVINGS

The evaluation team calculated freeridership and participant spillover using the survey data collected from 2020 HomeLife Calculator program participants. The evaluation team found varying levels of freeridership by measure. Spillover savings were very high in 2020, resulting in total measure level NTG ratios above 100% (Table 166).

TABLE 166. 2020 HOMELIFE CALCULATOR PROGRAM NET-TO-GROSS RATIOS BY MEASURE

MEASURE	NTG
LEDs	139%
Nightlight	146%
Bath Aerator	152%
Kitchen Aerator	154%
Showerhead	153%
Filter Whistle	159%

FREERIDERSHIP

Measure-level freeridership values for each participant were calculated using the following survey questions:

- FR1. If you had not received the kit, would you have purchased a [MEASURE] on your own?
- FR2. "Would you have purchased the [MEASURE]…around the same time you received the kit, later but within one year, or later but more than one year?"

Respondents who gave a response of "No" to FR1 were assigned a freeridership score of 0%. Those who said "Yes" were asked FR2 and assigned a freeridership score based on the timing of their decision (Table 167).

TABLE 167. 2020 HOMELIFE CALCULATOR PROGRAM FREERIDERSHIP ASSIGNMENT

FR2. RESPONSE OPTION	ASSIGNED FREERIDERSHIP VALUE
Around the same time you received the kit	100%
Later but within one year	50%
Later but more than one year	0%
Not sure	25%

Measure-level freeridership was low for most measures except for LED lamps (20%) and the night light (13%). Notably, not a single respondent said they would have purchased the filter whistle on their own.

TABLE 168. 2020 HOMELIFE CALCULATOR PROGRAM FREERIDERSHIP

MEASURE	HOMELIFE CALCULATOR FREERIDERSHIP
LEDs	20%
Nightlight	13%
Bath Aerator	7%
Kitchen Aerator	5%
Showerhead	6%
Filter Whistle	0%

Note: Totals may not sum properly due to rounding.

SPILLOVER

The evaluation team estimated participant spillover using survey responses and the Indiana TRM (v2.2) and program measure calculations as a baseline reference. If survey respondents met the following criteria, based on self-reported survey responses, they qualified as a spillover participant:

4. Installed additional energy efficient measures.
5. HomeLife Calculator program participation was "very influential" in their decision to install an additional energy efficient measure.
6. Did not receive a rebate for the additional measure.

Three survey respondents installed a total of six additional energy efficient measures totaling 40.83 MMBtu in spillover savings. Program participation spillover was calculated by dividing the sum of additional spillover savings by the total gross savings achieved by all surveyed program respondents (Table 169).

TABLE 169. 2020 HOMELIFE CALCULATOR PROGRAM SPILLOVER

SPILLOVER SAVINGS (MMBtu) (N = 3)	SURVEY RESPONDENT PROGRAM SAVINGS (MMBtu) (N = 50)	PARTICIPANT SPILLOVER (%)
40.83	68.76	59%

The evaluation team found higher spillover in 2020 than in past years. Spillover was 6% in 2018 and 18% in 2019. Spillover can shift substantially for programs where per participant savings (the denominator in spillover calculations) are relatively low. This is because if just a few spillover participants install a higher-saving measures (the numerator in spillover calculations) it can increase spillover results by a higher magnitude than other programs who may have higher per participant savings. A detailed summary of spillover measures and their savings values are summarized in Spillover.

NET-TO-GROSS

Table 170 presents the resulting net electric savings, demand reduction, and natural gas savings.

TABLE 170. 2020 HOMELIFE CALCULATOR PROGRAM *EX POST* NET SAVINGS

MEASURE	*EX POST* GROSS SAVINGS/REDUCTION			NTG	*EX POST* NET SAVINGS/REDUCTION		
	KWH	KW	THERMS		KWH	KW	THERMS
LED - Combo Kit (Dual Fuel)	32,566.49	3.526	0.00	139%	45,267.42	4.901	0.00
LED - Electric Only Kit	2,236.79	0.243	0.00	139%	3,117.64	0.339	0.00
Night light - Combo Kit (Dual Fuel)	378.96	0.000	0.00	146%	554.73	0.000	0.00
Night light - Electric Only Kit	26.14	0.000	0.00	146%	38.26	0.000	0.00
Bath aerator - Combo Kit (Dual Fuel)	620.92	0.064	76.02	152%	946.15	0.098	115.83
Bath aerator - Electric Only Kit	43.67	0.005	0.00	152%	66.55	0.007	0.00
Bath aerators - Gas Only Kit	0.00	0.000	41.14	152%	0.00	0.000	62.69
Kitchen aerator - Combo Kit (Dual Fuel)	4,774.31	0.218	584.50	154%	7,370.58	0.337	902.35
Kitchen aerator - Electric Only Kit	334.51	0.015	0.00	154%	516.42	0.024	0.00
Kitchen aerator - Gas Only Kit	0.00	0.000	157.46	154%	0.00	0.000	243.08
Showerhead - Combo Kit (Dual Fuel)	8,067.01	0.437	987.61	153%	12,373.18	0.670	1,514.80
Showerhead - Electric Only Kit	563.59	0.031	0.00	153%	864.43	0.047	0.00
Showerheads - Gas Only Kit	0.00	0.000	530.28	153%	0.00	0.000	813.35
Filter whistle - Combo Kit (Dual Fuel)	10,480.83	3.154	0.00	159%	16,704.35	5.026	0.00
Filter whistle - Electric Only Kit	722.82	0.217	0.00	159%	1,152.02	0.347	0.00
Filter whistle - Gas Only Kit	0.00	0.000	0.00	159%	0.00	0.000	0.00
Total Savings	60,816.02	7.910	2,377.01		88,971.73	11.795	3,652.10

Note: Totals may not sum properly due to rounding.

Table 171 shows the NTG results by fuel type. Again, the high NTG values are largely driven by high spillover rates.

TABLE 171. 2020 HOMELIFE CALCULATOR NET-TO-GROSS RESULTS BY FUEL TYPE

SAVINGS TYPE	*EX ANTE* GROSS SAVINGS	*EX POST* GROSS SAVINGS	NTG RATIO (%)	*EX POST* NET SAVINGS
Electric Energy Savings (kWh/yr.)	60,844.32	60,816.02	146%	88,971.73
Peak Demand Reduction (kW)	7.533	7.910	149%	11.795
Natural Gas Energy Savings (therms/yr.)	5,697.18	2,377.01	154%	3,652.10

PROCESS EVALUATION

The evaluation team conducted qualitative and quantitative research activities to answer the following key research questions for the program:

- What was the customer experience with the program, from sign-up through completion?
- How did customers become aware of the program?
- What were customer motivations for participation?

- How satisfied were customers with the program, including the participation process, interactions with the program implementer, and satisfaction with each piece of equipment received?
- How useful were the recommendations customers received after the audit?
- What do participants recommend for program improvement?

To answer these research questions, the evaluation team completed the following research activities:

- Mixed mode telephone and web survey of program participants (n = 50) to understand families' experiences with the materials and kits, satisfaction with the program, and inform impacts inputs.
- Utility and implementation staff interviews, to understand program design and delivery.
- Documentation and materials review, to provide context on program implementation.

PARTICIPANT SURVEY FINDINGS

The evaluation team took a census of all available program participants with contact information; 50 program participants completed surveys. The following sections describe surveyed parents' experience with the kit and program satisfaction.

PROGRAM AWARENESS AND DECISION MAKING

Participants learned about the program through various channels but largely from the NIPSCO website. Respondents cited the following as the top four channels for learning about the HomeLife Calculator program:

1. NIPSCO website (n = 25)
2. Word of mouth (n = 8)
3. Email from NIPSCO (n = 7)
4. NIPSCO bill insert (n = 6)

Nearly three quarters of respondents (74%) participated to save money on their bills and 50% to save energy. Additional reasons for participating include:

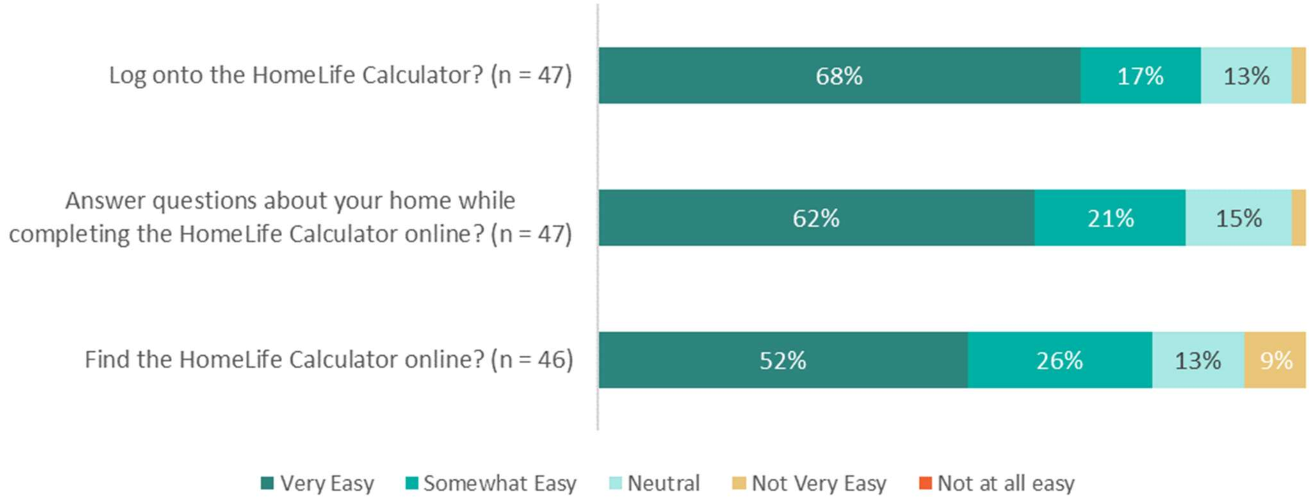
- To get a home assessment report (n = 11)
- To help the environment (n = 10)
- To receive energy efficient measures (n = 7)
- The program was recommended (n = 6)

ONLINE AUDIT EXPERIENCE

Overall, respondents characterized their online audit experience as easy. Very few respondents had difficulty finding the HomeLife Calculator online or logging in. Generally, respondents found it was easy to answer questions about their home.

Most respondents (85%) said it was easy to find the HomeLife calculator and just four said it was not easy (Figure 67). One respondent said it was not easy to find because "it wasn't on the front of the page" and another said, "the lady had to tell me how to find it."

FIGURE 67. 2020 HOMELIFE CALCULATOR: HOW EASY WAS IT TO DO THE FOLLOWING?

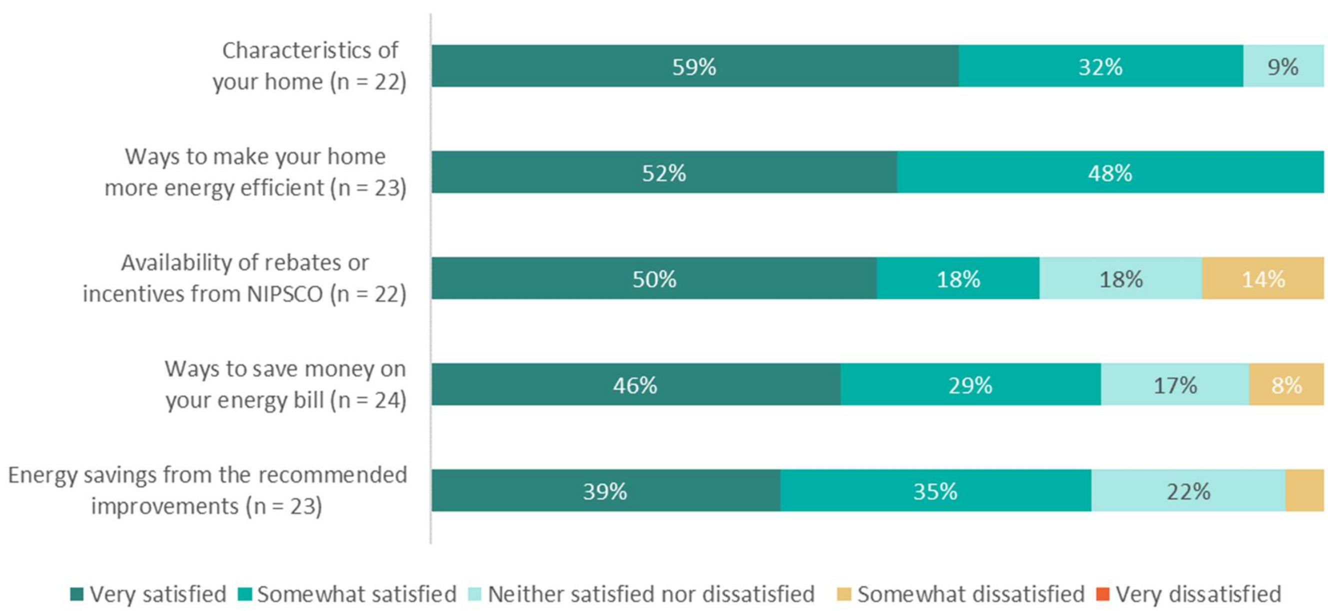


Nearly half of respondents (48%) recalled receiving personalized recommendations after filling out the HomeLife Calculator. However, 11 respondents did not and 15 said they do not know if they received personalized recommendations.

Overall, respondents were satisfied with the various personalized suggestions they received after completing the online audit. In fact, not a single respondent reported being very dissatisfied with a single suggestion. However, among respondents who expressed neutrality or dissatisfaction with the recommendations, the majority cited the high costs as a driver of their lack of satisfaction. One respondent summarized this sentiment by stating, “You have to spend a lot to get the rebates. Have to have the money”.

FIGURE 68. 2020 HOMELIFE CALCULATOR:

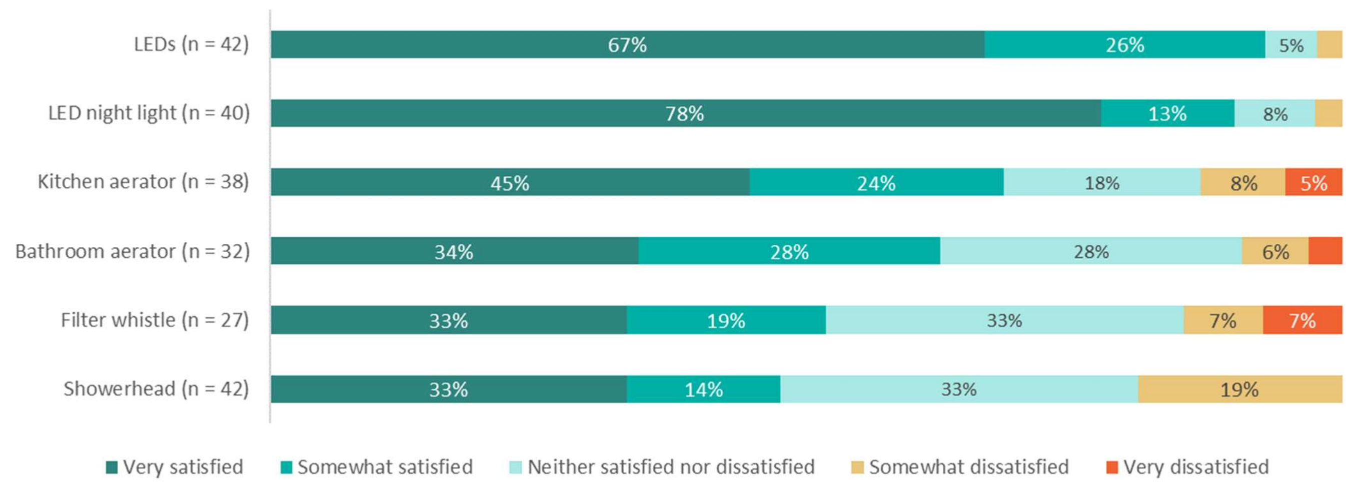
SATISFACTION WITH PERSONALIZED RECOMMENDATIONS OF THE FOLLOWING



DIRECT-INSTALL MEASURES

Generally, respondents were satisfied with the kit measures (Figure 69). Lighting measures experienced the highest satisfaction rates while the showerhead and filter whistle experienced the highest rates of dissatisfaction.

FIGURE 69. 2020 HOMELIFE CALCULATOR: MEASURE SATISFACTION



LED LAMPS

The LED lamps included in the kit largely replaced incandescent or CFL lamps, 54% and 26% respectively. Less than a quarter (19%) of the LED lamps replaced already existing LEDs. Just two lamps were installed in a new light fixture.

TABLE 172. 2020 HOMELIFE CALCULATOR PROGRAM: TYPE OF LAMP THE LED REPLACED*

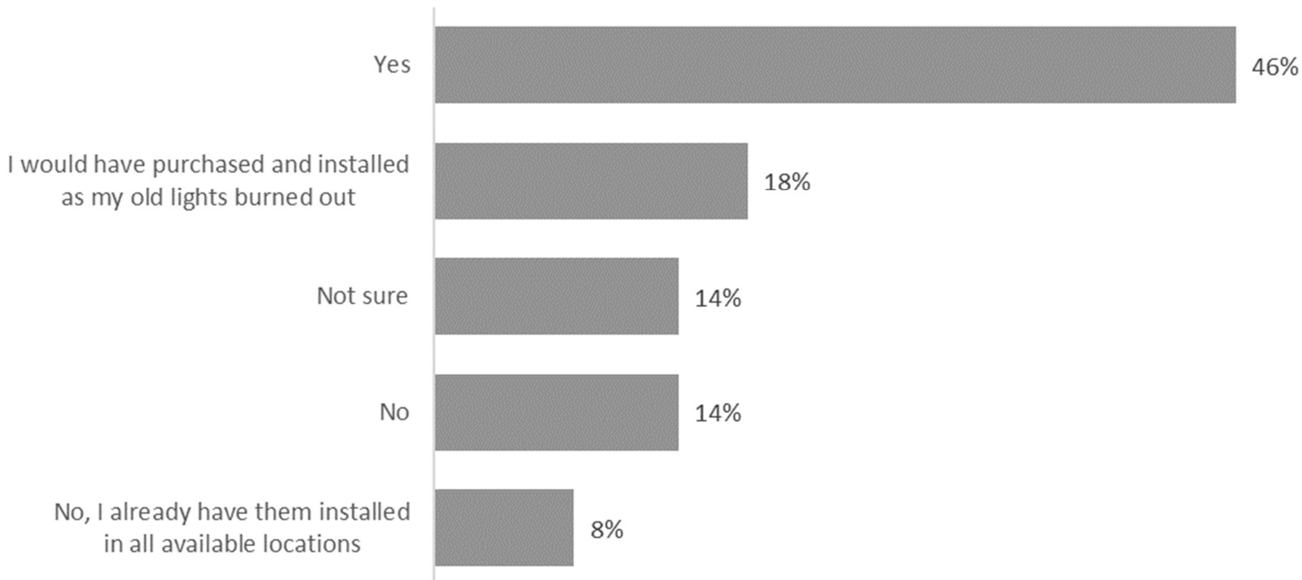
LED REPLACED...	COUNT	PERCENT
Incandescent	69	54%
CFL	33	26%
LED	24	19%
New light fixture/Did not replace existing lamp	2	2%
TOTAL	128	100%

* Total lamps do not equal the number of distributed lamps to respondents due to respondents skipping survey questions.

Nearly all respondents (93%) with LEDs currently installed were satisfied with the bulbs. In fact, 67% of respondents said they were very satisfied with the LED lamps. Not one respondent said they were dissatisfied.

Just under half of respondents (46%) said they would have purchased the LED lamps if they had not received them in the kit (Figure 70). Of these respondents, 18 of 23 said they would have purchased the LED lamps around the same time as receiving the kit or within a year.

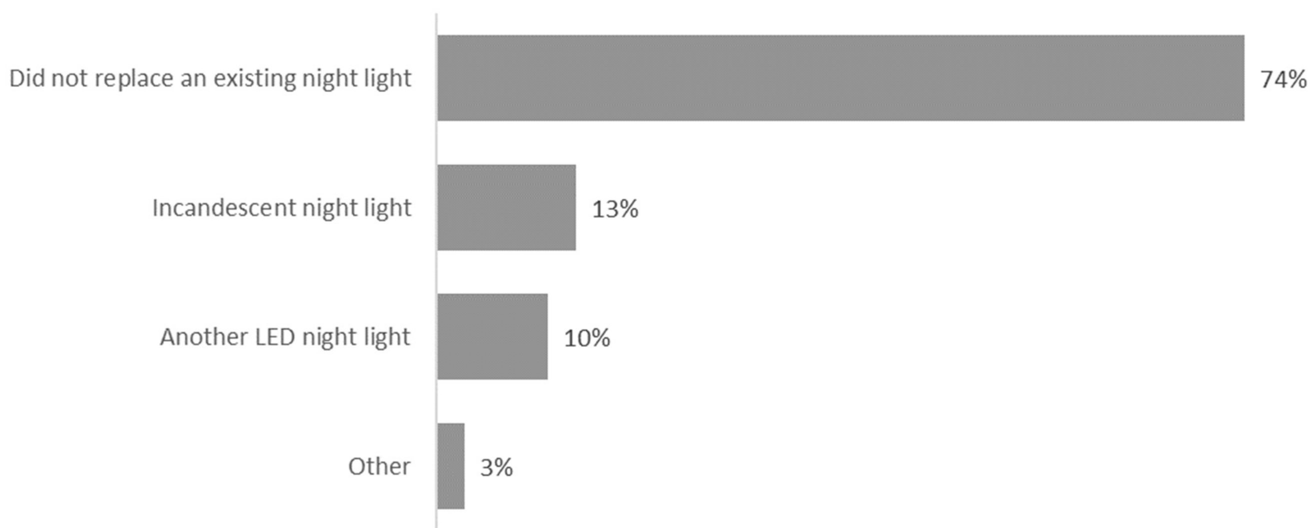
FIGURE 70. 2020 HOMELIFE CALCULATOR PROGRAM: IF YOU HAD NOT RECEIVED THE KIT, WOULD YOU HAVE PURCHASED LED LIGHT BULBS ON YOUR OWN? (N = 50)



LED NIGHT LIGHT

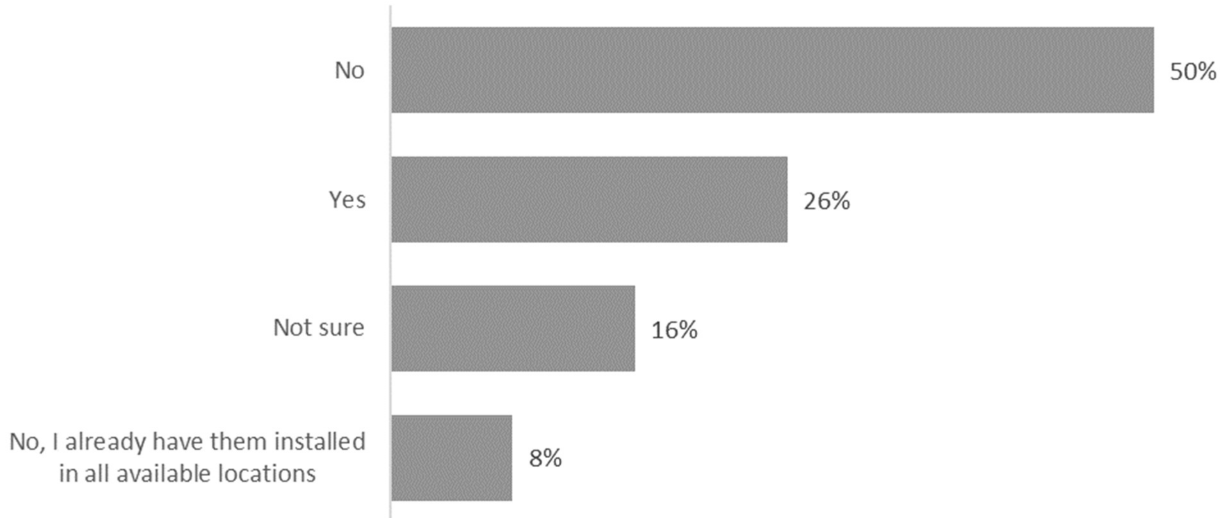
Most respondents, 85%, currently have the LED night light installed. Of the 39 respondents who currently have it installed, 74% said the night light did *not* replace an existing light (5). Sixteen respondents said they use the night light in lieu of keeping other lights on (e.g., bathroom or hallway).

FIGURE 71. 2020 HOMELIFE CALCULATOR PROGRAM:
WHAT DID THE LED NIGHT LIGHT FROM THE KIT REPLACE? (N = 39)



Just over a quarter (26%) of respondents would have purchased the LED night light on their own (6). Over half of respondents (58%) would not have purchased the night light on their own and eight respondents were not sure.

FIGURE 72. 2020 HOMELIFE CALCULATOR PROGRAM:
IF YOU HAD NOT RECEIVED THE KIT, WOULD YOU HAVE PURCHASED AN LED NIGHT LIGHT ON YOUR OWN? (N = 50)



A large majority of respondents (90%) were satisfied with the LED night light. In fact, 78% of respondents were very satisfied with the night light. Just one respondent expressed dissatisfaction.

LOW-FLOW SHOWERHEAD

Of the 21 respondents who reported having their showerhead currently installed, 17 said it was installed in a primary bathroom. The 28 respondents who did not have the showerhead installed cited several reasons:

- Already had a low-flow showerhead (n = 6)
- The showerhead did not fit (n = 5)
- Did not like the look of it (n = 4)
- Did not like how it worked (n = 4)
- Did not know how to install it (n = 4)

Just 20 of 42 were satisfied with the low-flow showerhead. Fourteen respondents were neutral and eight were somewhat dissatisfied. Reasons for neutral or dissatisfied ratings included:

- Water pressure (n = 9)
- Disliked the showerhead (n = 4)
- Did not like the look or design (n = 3)

KITCHEN AERATOR

Of the 28 respondents who did not have the kitchen faucet aerator installed, 13 said it did not fit and seven said they already had one. Of 38 respondents, 26 were satisfied with the kitchen faucet aerator. Five respondents expressed dissatisfaction with this measure and seven were neutral. Of 11 respondents who were not satisfied with the kitchen faucet aerator, six said it did not fit.

BATHROOM AERATOR

Of the 31 respondents who did not have the bathroom faucet aerator installed, 11 said it did not fit and six said they already had one. Three respondents did not install the bathroom faucet aerator because they did not like how it worked. Many respondents, 20 of 32, were satisfied with the bathroom faucet aerator. Nine respondents were neutral and three were dissatisfied with the bathroom aerator. Issues with measure fit was the main driver of dissatisfaction (n = 4).

FILTER WHISTLE

As discussed in the impact section, the filter whistle experienced the lowest installation rates. Thirty of 43 respondents said the filter whistle is not currently installed. Of these respondents, 18 said it was because they did not understand what it was. Other respondents simply said they had not yet installed it or that it did not fit. One respondent said they did not know where to put it.

Fourteen of 27 respondents said they were satisfied with the filter whistle and nine were neutral. Four respondents reported being dissatisfied with the filter whistle. Respondents who were not satisfied with the filter whistle said they did not understand what it was, did not understand how to install it, or that the measure did not work properly.

PARTICIPATION IN ADDITIONAL PROGRAMS

Just two respondents reported participating in additional NIPSCO programs since receiving the kit. However, when asked which program they participated in, respondents said, the "free electric program" and auto bill pay. This suggests that there is a lack of awareness and understanding of other NIPSCO energy efficiency programs among respondents.

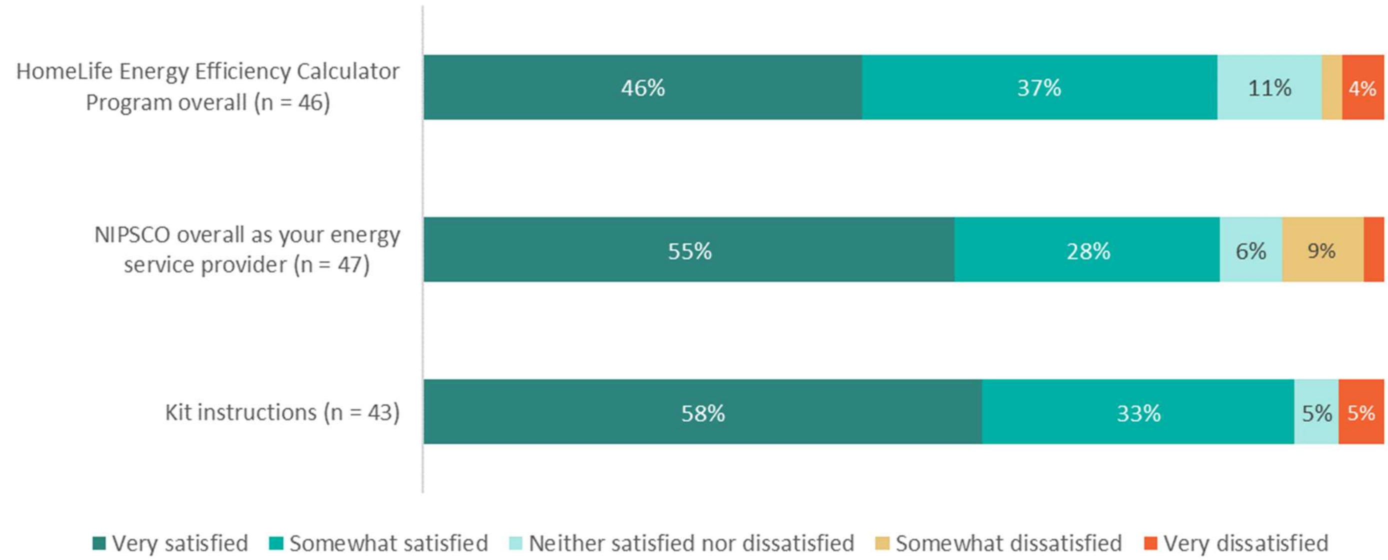
SATISFACTION

Overall satisfaction with the HomeLife Calculator program and NIPSCO was high. Most respondents (83%) reported being very or somewhat satisfied with the program and with NIPSCO overall (Figure 73). Just three respondents were neutral, and five respondents said they were somewhat or very dissatisfied with NIPSCO as their service provider. Reasons for dissatisfaction or neutrality included:

- Energy costs are high (n = 2)
- Did not receive a call back from the program (n = 1)
- Utility rates are not competitive (n = 1)
- Desire for more input on how to reduce energy costs (n = 1)
- "*I cannot afford my utilities and struggle monthly"* (n = 1)
- *"Home Energy program never called"* (n = 1)

Most respondents (91%) were satisfied with the instructions included in the kit. Just two respondents said they were somewhat dissatisfied with the instructions.

FIGURE 73. 2020 HOMELIFE CALCULATOR PROGRAM: PROGRAM AND UTILITY SATISFACTION



SUGGESTIONS FOR PROGRAM IMPROVEMENT

When asked what one thing NIPSCO could do to improve the HomeLife Calculator program, several respondents mentioned:

- Provide better kit instructions that are easier to understand
- Increase program awareness
- Provide in-person audits

Additionally, some respondents made recommendations that suggests a lack of awareness of other NIPSCO programs. For instance, two respondents suggested NIPSCO aid low-income households. Another respondent asked that NIPSCO offer lighting rebates (e.g., flood lights).

HOME CHARACTERISTICS

Nearly all respondents (98%) live in a single-family home and all respondents have access to their water heater and 98% have access to their furnace. Most respondents (90%) have one or two showers in their home. Over two thirds of respondents (68%) have less than three bathroom faucets and 26% have three in their home.

The following is a snapshot of self-reported HVAC home characteristics:

- Home heating: 83% use natural gas and 13% use electricity.
- Heating equipment: 87% heat their homes with a furnace.
- Cooling equipment: 83% have central air conditioning and 13% use AC units.

COVID-19 FINDINGS

While the COVID-19 pandemic did not pause the program, the evaluation team included several questions about how the pandemic has affected customers to understand how their needs or experiences may have changed.

Self-reported energy use and monthly electric costs reveal that many respondents experienced increases in energy consumption and thus, energy costs since the start of the pandemic. Just two respondents said their energy use and electricity bill have decreased since the start of the pandemic.

Over a quarter of respondents (30%) made home improvements during the pandemic. Just three of the nine home improvement projects were planned prior to the pandemic. Home improvements ranged from lower-cost upgrades, like installing lighting, to costly upgrades like insulating attics and basements. One respondent purchased a home which was nearly gutted and upgraded. Home improvement costs varied with seven respondents spending less than $500 and six spending $1000 or more.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSION 1: AS THE PROGRAM DESIGNS ARE SOMEWHAT DIFFERENT, SOME IMPACT FACTORS MAY NEED TO BE TAILORED TO THE DIFFERENT PROGRAMS WHERE KITS ARE OFFERED.

Previously, NIPSCO utilized some impact inputs from the School Education program to estimate *ex ante* savings for HomeLife Calculator. At the time, this was used as a proxy given the HomeLife Calculator program was new for this program cycle. However, now that primary research has been completed, NIPSCO may want to use more customized inputs tailored to each program's design.

Recommendations:

- Update assumptions to include data from primary research activities for this program and consider tracking kits separately across programs. This includes ISRs, which are higher for HomeLife Calculator, and people per home, which is lower.

CONCLUSION 2: WASTE HEAT FACTORS ARE NOT APPLIED CONSISTENTLY ACROSS PROGRAMS.

Waste heat factor adjustments *are* applied to qualifying residential measures in kits or direct install programs (e.g., LED lights). However, these adjustments are *not* made to qualifying commercial and industrial measures.

Recommendations:

- Address waste heat factors consistently across programs in ex-ante savings. If addressed in cost-effectiveness, this factor should be calculated for use in cost effectiveness analyses but not applied against *ex ante* or *ex post* program performance.
- Ensure the correct units are used when calculating waste heat factors. In kit *ex ante* savings, this factor is being calculated as MMBTU but not converted to therm savings.

CONCLUSION 3: OF ALL MEASURES, FURNACE WHISTLES EXPERIENCED THE LOWEST INSTALLATION RATES. SOME PARTICIPANTS DO NOT UNDERSTAND THE PURPOSE OF THE FURNACE WHISTLE.

The evaluation team found that many people do not install the furnace whistle. Respondents reported some confusion with this measure, which likely contributes to lower installation rates.

Recommendations:

- Given this measure's performance, consider whether it should be kept in the kit offerings in future program planning. It should be noted that the IL TRM v9.0 (2020) has removed this measure, citing evaluation results indicating it is not effective. If kept, consider additional ways to educate customers on how to use it properly to increase long term in-service rates. Per NIPSCO, it is currently planned to remove this measure for the next program cycle.

CONCLUSION 4: PARTICIPANT SPILLOVER WAS VERY HIGH IN 2020 AND SELF-REPORTED CROSS PROGRAM PARTICIPATION WAS LOW.

Spillover participants installed additional energy efficient measures which qualified for rebates for which they did not receive rebates. Additionally, just two respondents reported participating in another program after participating in the HomeLife Calculator program.

Recommendations:

- Consider ways to increase awareness of other NIPSCO programs to capture energy savings generated from spillover participants. Increasing cross participation also affords NIPSCO additional opportunity to engage with customers and expand their customer relationship.
- Qualitative responses from open ended survey questions suggests some respondents may lack awareness and/or understanding of additional programs offered by NIPSCO. Especially in 2021, as programs ramp back up after 2020, consider additional ways to connect customers to other NIPSCO programs, such as sending follow up emails to participants.

CONCLUSION 5: PARTICIPANTS WERE GENERALLY SATISFIED WITH KIT MEASURES, THE PROGRAM, AND NIPSCO OVERALL.

Over half of respondents were "very satisfied" with all measures but the low-flow showerhead. The highest satisfaction ratings were for lighting measures, LEDs and the night light. Participants also reported high satisfaction with the program overall, and most respondents found the online participation process easy.

11. EMPLOYEE EDUCATION PROGRAM

PROGRAM DESIGN AND DELIVERY

The Employee Education program was first offered in the 2019 program year and had 24 participants in the 2020 program year. Through this program, NIPSCO offers energy efficiency training seminars at places of employment, provides optional energy efficiency kits, and distributes educational materials to inform residential customers of opportunities and methods to proactively manage their energy consumption. This program is implemented by TRC and NEF.

All customers—dual fuel (combo), electric-only, and gas-only—are eligible to receive a kit. Electric-only customers receive the combo kit, but NIPSCO does not claim savings for the gas measures. Gas-only customers receive a kit that has additional water saving devices.

- Measures in Combo and Electric Only Kits
    - One kitchen faucet aerator (1.5 gpm)
    - One bathroom faucet aerator (1.0 gpm)
    - One low-flow showerhead (1.5 gpm)
    - Four 9-watt LEDs
    - One 0.5-watt LED night-light
    - One furnace filter whistle
- Measures in Gas Only Kits
    - One kitchen faucet aerator (1.5 gpm)
    - Two bathroom faucet aerators (1.0 gpm)
    - Two low-flow showerheads (1.5 gpm)
    - One furnace filter whistle

In 2020, this program saw minimal participation prior to the COVID-19 pandemic and did not operate for most of the program year. In 2021, the program will be offering both in-person and virtual presentations. The evaluation team conducted a high level impact evaluation, primarily to align ex post per measure savings with other kit programs.

PROGRAM PERFORMANCE

In 2020, the program distributed 24 energy-saving kits:

- 6 – Combo Kits
- 1 - Electric Only Kit
- 17 - Gas Only Kits

The program goals, *ex ante* savings, audited savings, verified savings, and *ex post* gross savings values are presented in TABLE 173.

TABLE 173. 2020 EMPLOYEE EDUCATION PROGRAM SAVINGS SUMMARY

METRIC	GROSS SAVINGS GOAL	*EX ANTE*	AUDITED	VERIFIED	*EX POST* GROSS	*EX POST* NET	GROSS GOAL ACHIEVEMENT
Electric Energy Savings (kWh/yr)	207,176.00	1,526.56	1,526.58	1,639.60	1,525.98	2,232.29	1%
Peak Demand Reduction (kW)	25.650	0.189	0.186	0.262	0.198	0.296	1%
Natural Gas Energy Savings (therms/yr)	15,706.80	504.60	504.66	473.71	217.47	333.95	1%

The Employee Education Program came in short of the program budget due to the loss of opportunities to engage with employees at their places of employment when employees were working from home during the COVID-19 pandemic. The implementation team spent 7% of the $33,321 allocated budget for electric savings and 9% of the $39,368 allocated budget for natural gas savings.

TABLE 174 lists the 2020 program budget and expenditures by fuel type.

TABLE 174. 2020 EMPLOYEE EDUCATION PROGRAM EXPENDITURES

FUEL	PROGRAM BUDGET	PROGRAM EXPENDITURES	BUDGET SPENT (%)
Electric	$33,321.10	$2,323.20	7%
Natural Gas	$39,367.66	$3,653.31	9%

IMPACT EVALUATION

As the program saw minimal participation in 2020, the evaluation team conducted a high level impact evaluation of this program primarily to align measure level savings recommendations with other kit programs. This section details each step of the impact evaluation and its associated electric energy savings, peak demand reduction, and natural gas savings.

AUDITED AND VERIFIED SAVINGS

NIPSCO reported a total count of 6 combo kits, 1 electric-only kit, and 17 gas-only kits distributed through the Employee Education program. The evaluation team compared the savings reported in the scorecard with the tracking data and found no issues.

The evaluation team reviewed the kit savings documentation ("NIPSCO Res Measure Calcs") which contained measure-level and kit level savings. Importantly, NIPSCO included installation rates from past EM&V efforts in their ex-ante assumptions for the kit program. The program documentation included rates to adjust savings for both installation practices and water heater fuel saturation.

Upon review of this document, measure-level savings values in the tracking data aligned with NIPSCO's kit savings documentation. However, program tracking data savings were reported at the kit-level with a rounded total kit value, and NIPSCO's Measure Calculation file savings were reported at the measure-level with un-rounded per measure values. This difference in the unit of analysis resulted in rounding errors, meaning that the sum of total measure savings was slightly off from the tracking data savings. These rounding errors will be noted where applicable in the remainder of this report.

IN-SERVICE RATES (ISR)

Given the low number of participants in the Employee Education program, the evaluation team applied in-service rates from the HomeLife Calculator program to the measures in Employee Education Program[57]. TABLE 175 lists the ISRs for the kit measures.

TABLE 175. 2020 EMPLOYEE EDUCATION PROGRAM IN-SERVICE RATES RATIOS BY MEASURE

MEASURE	ISR
LED	87%
Nightlight	85%
Bathroom Aerator	33%
Kitchen Aerator	44%
Showerhead	43%
Filter Whistle	30%

WATER HEATER SATURATION

The evaluation team also adjusted the *ex ante* electric and natural gas saturation rates for water-saving measures by analyzing data from the 2020 HEW results from the School Education program, which provides a large sample of customers who report their water heater fuel, shown in TABLE 176. Results indicate a slight discrepancy between *ex ante* and verified electric and natural gas domestic water heating saturation rates.

TABLE 176. 2020 EMPLOYEE EDUCATION WATER HEATER FUEL SATURATION

SAVINGS TYPE	ELECTRIC WATER HEATING SATURATION RATE (%)	NATURAL GAS WATER HEATING SATURATION RATE (%)
Reported ex ante	20%	73%
Verified[a]	23%	64%

[a] Electric and natural gas saturation rates do not total 100% because 7% of respondents replied "Other" and 6% replied "Propane" on the HEW.

Table 177 summarizes the per unit audited and verified savings values with ISRs applied. In addition to ISRs, the evaluation team applied water heating saturation adjustment factors to all water saving devices. As noted above, audited savings already include ISR and water heater saturation adjustments, and these were updated using the current calculated ISRs and water heater saturation adjustment factors.

TABLE 177. 2020 EMPLOYEE EDUCATION AUDITED AND VERIFIED PER UNIT MEASURE SAVINGS

MEASURE	VERIFIED ISRS	AUDITED KWH SAVINGS	VERIFIED KWH SAVINGS	AUDITED KW REDUCTION	VERIFIED KW REDUCTION	AUDITED THERM SAVINGS	VERIFIED THERM SAVINGS
LED (9W) - Combo Kit	87%	30.94	31.22	0.003	0.003	(0.06)	(0.06)
LED (9W) - Electric Kit	87%	30.94	31.22	0.003	0.003	0.00	0.00

[57] ISRs calculated from the 2020 HomeLife participant survey were used for the Employee Education kit measures because the contents of the kit were the same and there was a sufficient sample to calculate ISRs.

MEASURE	VERIFIED ISRS	AUDITED KWH SAVINGS	VERIFIED KWH SAVINGS	AUDITED KW REDUCTION	VERIFIED KW REDUCTION	AUDITED THERM SAVINGS	VERIFIED THERM SAVINGS
Nightlight - Combo Kit	85%	3.58	4.47	0.000	0.000	0.00	0.00
Nightlight - Electric Kit	85%	3.58	4.47	0.000	0.000	0.00	0.00
Bathroom Aerator - Combo Kit	33%	3.87	3.90	0.000	0.000	0.62	0.48
Bathroom Aerator - Electric Kit	33%	3.87	3.90	0.000	0.000	0.00	0.00
Bathroom Aerator - Gas Kit	33%	0.00	0.00	0.000	0.000	0.62	0.48
Kitchen Aerator - Combo Kit	44%	28.71	33.43	0.004	0.001	4.61	4.11
Kitchen Aerator - Electric Kit	44%	28.71	33.43	0.001	0.001	0.00	0.00
Kitchen Aerator - Gas Kit	44%	0.00	0.00	0.000	0.000	4.61	4.11
Showerhead - Combo Kit	43%	49.49	50.28	0.002	0.002	7.95	6.19
Showerhead - Electric Kit	43%	49.49	50.28	0.002	0.002	0.00	0.00
Showerhead - Gas Kit	43%	0.00	0.00	0.000	0.000	7.95	6.19
Filter Whistle - Combo Kit	30%	8.68	17.25	0.011	0.021	2.49	4.96
Filter Whistle - Electric Kit	30%	8.68	17.25	0.011	0.021	0.00	0.00
Filter Whistle - Gas Kit	30%	0.00	0.00	0.000	0.000	2.49	4.96

EX POST GROSS SAVINGS

The evaluation team reviewed the programs *ex ante* assumptions, sources, and algorithms for reasonableness and updates, and developed updates to these estimates to use for future program years. Below are detailed *ex post* gross analysis results.

ENGINEERING REVIEWS

The evaluation team referred to the Indiana TRM (v2.2) and the 2016 Pennsylvania TRM to calculate *ex post* gross electric energy savings, demand reduction, and natural gas savings, and, given the limited participation in the 2020 Employee Education Program, the team referenced the HomeLife Calculator and the School Kits Programs for NIPSCO household characteristic and in-service rate assumptions. The Appendix: Homelife Calculator Algorithms and Assumptions contains details on the specific algorithms, variable assumptions, and references used in the Employee Education *ex post* gross calculations.

The following sections summarize the team's findings and recommendations based on the engineering review.

EX POST GROSS SAVINGS

Ex post savings reflect the engineering adjustments made to verified measure savings. The evaluation team calculated *ex post* electric energy, peak demand, and natural gas energy savings for each measure kit using algorithms and inputs from the Indiana TRM (v2.2), the Pennsylvania TRM 2016, as well as customer location information from the 2020 HomeLife Calculator program to account for weather effects. The evaluation team leveraged the parent worksheet and survey results from the 2020 School Education program to estimate water heater fuel type saturation, then used this information to inform *ex post* gross savings calculations. In-service rates are from the HomeLife Calculator program.

As the evaluation team did not conduct primary research for Employee Education due to minimal participation, the team referenced all applicable inputs from the HomeLife Calculator evaluation. The HomeLife Calculator report chapter provides additional detail on reasons for differences between *ex ante* and *ex post* savings.

The significant differences between estimates of ex-ante and ex-post electricity and natural gas savings likely result from different methodologies used by the program implementer and the evaluation team to estimate measure savings. While the evaluation team used program home-specific inputs to model savings for homes, the implementer calculated its electric energy and demand deemed savings by modeling the consumption of baseline home using inputs from a regional program, and then calculating savings based on the HERS score of the NIPSCO program home. This misalignment in methods and possible differences between the implementer's assumption about program homes, such as square footage, likely resulted in the discrepancy in ex-ante and ex-post savings. The implementer was unable to share the method for calculating deemed gas savings. Therefore, it is unclear what resulted in the discrepancy in savings in ex-ante and ex-post savings.

Table 136 shows the *ex ante* deemed savings and *ex post* gross per-measure savings for PY 2020 Residential New Construction program measures.

Table 136 shows the *ex ante* deemed savings and *ex post* gross per-measure savings for 2020 Employee Education Program.

TABLE 178. 2020 EMPLOYEE EDUCATION PROGRAM *EX ANTE* & *EX POST* GROSS PER-MEASURE SAVINGS VALUES

MEASURE	NUMBER OF MEASURES	*EX ANTE* PER-MEASURE SAVINGS			*EX POST* GROSS PER-MEASURE SAVINGS		
		kWh	kW	therms	kWh	kW	therms
LED (9W) - Combo Kit - Dual Fuel	4	123.74	0.013	(0.25)	124.78	0.014	0.00
LED (9W) - Combo Kit - Electric Fuel	4	123.74	0.013	0.00	124.27	0.014	0.00
Nightlight - Combo Kit - Dual Fuel	1	3.58	0.000	0.00	1.45	0.000	0.00
Nightlight - Combo Kit - Electric Fuel	1	3.58	0.000	0.00	1.45	0.000	0.00
Bathroom Aerator - Combo Kit - Dual Fuel	1	3.87	0.000	0.62	2.38	0.000	0.29
Bathroom Aerator - Combo Kit - Electric Fuel	1	3.87	0.000	0.00	2.43	0.000	0.00
Bathroom Aerator - Gas Only Kit	2	0.00	0.000	1.24	0.00	0.000	0.60
Kitchen Aerator - Combo Kit - Dual Fuel	1	28.71	0.001	4.61	18.29	0.001	2.24
Kitchen Aerator - Combo Kit - Electric Fuel	1	28.71	0.001	0.00	18.58	0.001	0.00
Kitchen Aerator - Gas Only Kit	1	0.00	0.000	4.61	0.00	0.000	2.28
Showerhead - Combo Kit - Dual Fuel	1	49.49	0.002	7.95	30.91	0.002	3.78
Showerhead - Combo Kit - Electric Fuel	1	49.49	0.002	0.00	31.31	0.002	0.00
Showerhead - Gas Only Kit	2	0.00	0.000	15.89	0.00	0.000	7.69
Filter Whistle - Combo Kit - Dual Fuel	1	8.68	0.011	2.49	40.16	0.012	0.00
Filter Whistle - Combo Kit - Electric Fuel	1	8.68	0.011	0.00	40.16	0.012	0.00
Filter Whistle - Gas Only Kit	1	0.00	0.000	2.49	0.00	0.000	0.00
Per Combo Kit		218.08	0.027	15.42	217.96	0.028	6.31
Per Electric-Only Kit		218.08	0.027	0.00	218.19	0.028	0.00
Per Gas-Only Kit		0.00	0.000	24.24	0.00	0.000	10.56

Note: Totals may not sum exactly due to rounding

Table 179 shows the program's total *ex ante* reported savings and *ex post* gross savings.

TABLE 179. 2020 EMPLOYEE EDUCATION PROGRAM *EX ANTE* & *EX POST* GROSS SAVINGS VALUES

MEASURE	NUMBER OF MEASURES	*EX ANTE* SAVINGS			*EX POST* GROSS SAVINGS		
		kWh	kW	therms	kWh	kW	therms
LED (9 watt) - Combo Kit	24	742.47	0.080	(1.52)	748.65	0.080	0.00
LED (9 watt) - Electric Only Kit	4	123.74	0.013	0.00	124.27	0.014	0.00
Nightlight - Combo Kit	6	21.51	0.000	0.00	8.71	0.000	0.00
Nightlight - Electric Only Kit	1	3.58	0.000	0.00	1.45	0.000	0.00
Bathroom Aerator - Combo Kit	6	23.22	0.001	3.73	14.27	0.000	1.75
Bathroom Aerator - Electric Only Kit	1	3.87	0.000	0.00	2.43	0.000	0.00
Bathroom Aerator - Gas Only Kit	34	0.00	0.000	21.13	0.00	0.000	10.14
Kitchen Aerator - Combo Kit	6	172.27	0.004	27.66	109.75	0.005	13.44
Kitchen Aerator - Electric Only Kit	1	28.71	0.001	0.00	18.58	0.001	0.00
Kitchen Aerator - Gas Only Kit	17	0.00	0.000	78.38	0.00	0.000	38.79
Low Flow Showerhead - Combo Kit	6	296.93	0.010	47.68	185.45	0.010	22.70
Low Flow Showerhead - Electric Only Kit	1	49.49	0.002	0.00	31.31	0.002	0.00
Low Flow Showerhead - Gas Only Kit	34	0.00	0.000	270.21	0.00	0.000	130.65
Filter Whistle - Combo Kit	6	52.11	0.064	14.97	240.94	0.070	0.00
Filter Whistle - Electric Only Kit	1	8.68	0.011	0.00	40.16	0.012	0.00
Filter Whistle - Gas Only Kit	17	0.00	0.000	42.41	0.00	0.000	0.00
Combo Kits	6	1,308.50	0.160	92.53	1,307.78	0.170	37.89
Electric Only Kits	1	218.08	0.027	0.00	218.19	0.028	0.00
Gas Only Kits	17	0.00	0.000	412.13	0.00	0.000	179.58

Note: Totals may not sum exactly due to rounding

WASTE HEAT FACTOR - THERM PENALTIES

In 2019, and prior years, the evaluation team applied waste heat factors to lighting measures, representing electric cooling credits and electric and gas heating (therm) penalties resulting from LED lighting. In discussion with NIPSCO, for the 2020 evaluation year, the evaluation team will be addressing waste heat factor therm penalties by calculating and applying them within the electric program cost-effectiveness analysis. Therm penalties will not be included in EM&V reported program savings or performance. This approach will be applied consistently for all NIPSCO programs where therm penalties are generated due to LED lighting measures. The evaluation team believes this approach is appropriate, as it accounts for the penalty on the electric side (where it is generated) and allows the evaluation team to show gas program and measure performance more clearly, where applicable. NIPSCO plans to take a similar, consistent approach to accounting for waste heat factors across programs in their planning process.

The evaluation team recommends that this approach is made consistent going forward across all programs that offer LED lighting; currently, some *ex ante* assumptions include therm penalties, and some do not. Currently, the *ex ante* savings for all kit programs include therm penalties. These have been removed in the *ex post* analysis, and the evaluation team is reporting these below, to be used in the cost-effectiveness analysis. Table 180 shows the therm penalty calculated for the Employee Education program.

TABLE 180. 2020 EMPLOYEE EDUCATION WASTE HEAT FACTOR THERM PENALTY

MEASURE	WASTE HEAT FACTOR THERM PENALTY
LED (9W) - Combo Kit	(1.52)

It should be noted that electric waste heat factors, including cooling credits and electric heating penalties, are currently reported within the kWh and kW savings for the overall program as described in the Appendix. This is consistent with evaluation approaches in previous years.

EX POST NET SAVINGS

To calculate *ex* post net savings, the evaluation team used freeridership and participant spillover from the 2020 HomeLife Calculator participant survey[58]. The evaluation team found varying levels of freeridership by measure. Spillover savings were very high in 2020 for the HomeLife Calculator program, resulting in total measure level net-to-gross (NTG) ratios above 100% (Table 181). Detail regarding the NTG calculations can be found in the HomeLife Calculator chapter.

TABLE 181. 2020 EMPLOYEE EDUCATION PROGRAM NET-TO-GROSS RATIOS BY MEASURE

MEASURE	NTG
LEDs	139%
Nightlight	146%
Bath Aerator	152%
Kitchen Aerator	154%
Showerhead	153%
Filter Whistle	159%

[58] NTG calculated from the 2020 HomeLife participant survey was used for the Employee Education kit measures because the contents of the kit were the same and there was a sufficient sample to calculate NTG.

Table 170 presents the resulting net electric savings, demand reduction, and natural gas savings.

TABLE 182. 2020 EMPLOYEE EDUCATION PROGRAM EX POST NET SAVINGS

MEASURE	EX POST GROSS SAVINGS/REDUCTION			NTG	EX POST NET SAVINGS/REDUCTION		
	kWh	kW	therms		kWh	kW	therms
LED (9W) - Combo Kit	748.65	0.081	0.000	139%	1,040.63	0.113	0.00
LED (9W) - Electric Kit	124.27	0.014	0.000	139%	172.73	0.019	0.00
Nightlight - Combo Kit	8.71	0.000	0.000	146%	12.75	0.000	0.00
Nightlight - Electric Kit	1.45	0.000	0.000	146%	2.13	0.000	0.00
Bathroom Aerator - Combo Kit	14.27	0.001	1.750	152%	21.75	0.002	2.66
Bathroom Aerator - Electric Kit	2.43	0.000	0.000	152%	3.70	0.000	0.00
Bathroom Aerator - Gas Kit	0.00	0.000	10.140	152%	0.00	0.000	15.45
Kitchen Aerator - Combo Kit	109.75	0.005	13.440	154%	169.44	0.008	20.74
Kitchen Aerator - Electric Kit	18.58	0.001	0.000	154%	28.69	0.001	0.00
Kitchen Aerator - Gas Kit	0.00	0.000	38.790	154%	0.00	0.000	59.89
Showerhead - Combo Kit	185.45	0.010	22.700	153%	284.44	0.015	34.82
Showerhead - Electric Kit	31.31	0.002	0.000	153%	48.02	0.003	0.00
Showerhead - Gas Kit	0.00	0.000	130.650	153%	0.00	0.000	200.39
Filter Whistle - Combo Kit	240.94	0.072	0.000	159%	384.01	0.116	0.00
Filter Whistle - Electric Kit	40.16	0.012	0.000	159%	64.00	0.019	0.00
Filter Whistle - Gas Kit	0.00	0.000	0.000	159%	0.00	0.000	0.00
Total	1525.98	0.198	217.47		2,232.29	0.296	333.95

Table 183 shows the NTG results by fuel type. Again, the high NTG values are largely driven by high spillover rates.

TABLE 183. 2020 HOMELIFE CALCULATOR NET-TO-GROSS RESULTS BY FUEL TYPE

SAVINGS TYPE	*EX ANTE* GROSS SAVINGS	*EX POST* GROSS SAVINGS	NTG RATIO (%)	*EX POST* NET SAVINGS
Electric Energy Savings (kWh/yr)	1,526.56	1,525.98	146%	2,232.29
Peak Demand Reduction (kW)	0.189	0.198	149%	0.296
Natural Gas Energy Savings (therms/yr)	504.60	217.47	154%	333.95

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSION 1: WASTE HEAT FACTORS ARE NOT APPLIED CONSISTENTLY ACROSS PROGRAMS.

Waste heat factor adjustments *are* applied to qualifying residential measures in kits or direct install programs (e.g., LED lights). However, these adjustments are *not* made to qualifying commercial and industrial measures.

Recommendations:

- Address waste heat factors consistently across programs in ex-ante savings. If this should be addressed in cost-effectiveness, this factor should be calculated for use in cost effectiveness analyses but not applied against ex ante or ex post program performance.
- Ensure the correct units are used when calculating waste heat factors. In kit ex ante savings, this factor is being calculated as MMBTU but not converted to therm savings.

12. INCOME-QUALIFIED WEATHERIZATION PROGRAM

PROGRAM DESIGN AND DELIVERY

Through the Income-Qualified Weatherization (IQW) program, NIPSCO provides walk-through energy assessments and direct installations of energy efficiency measures to income-qualified single-family homeowners or renters (with landlord approval), and the program is open to income-qualified residential natural gas and/or electric customers living in homes that have not been weatherized in the past 10 years or participated in Home Energy Assessment (HEA) in the past three years. Customers are income-qualified if they are at or below 200% of current federal poverty guidelines.

Additionally, the account holder must either receive Low Income Home Energy Assistance, Temporary Assistance for Needy Families, or Supplemental Security Income. An account holder may also be eligible if they receive Social Security Disability Insurance and meet total household income guidelines. If the customer does not receive any of these services, they may still qualify if they meet the DOE's Weatherization Assistance Program Low-Income Guidelines (per program documents).

TRC is responsible for program design and management, contractor payment processing, quality assurance and quality control, technical training, and contractor support to facilitate the quality installation of energy efficient measures. TRC also recruits and manages a network of trade allies (program-approved contractors and energy assessors) to implement the IQW program. These trade allies perform the in-home assessments and direct installation of measures. TRC trains the trade allies to ensure work quality and customer service meet program standards. TRC and NIPSCO collaborate to promote the program.

CHANGES FROM 2019 DESIGN

The IQW program was on hold for nearly the full 2020 program year. The program was transitioning to take implementation in-house (via a subcontractor who would perform assessments) during Q1 of 2020; it was put on hold completely starting in March due to the COVID-19 pandemic. Low-income customers instead had the option to receive a virtual assessment and energy-saving kit through the Virtual Home Energy Assessment (HEA) program.

PROGRAM PERFORMANCE

In 2020, the IQW program fell short of its goals, due to the lack of opportunities to perform walk-through energy assessments and direct installations because of the COVID pandemic. Most participation in 2020 were projects that began in 2019, except for two projects that took place in the beginning of 2020.

Table 184 summarizes savings for the program, including program savings goals.

TABLE 184. 2020 IQW PROGRAM SAVINGS SUMMARY

METRIC	GROSS SAVINGS GOAL	*EX ANTE*	AUDITED	VERIFIED	*EX POST* GROSS	*EX POST* NET	GROSS GOAL ACHIEVEMENT
Electric Energy Savings (kWh/yr)	637,307.76	78,235.11	78,235.11	75,407.77	111,889.02	111,889.02	18%
Peak Demand Reduction (kW)	268.330	30.371	30.371	29.138	34.878	34.878	13%
Natural Gas Energy Savings (therms/yr)	196,521.67	27,884.01	27,884.01	26,273.57	35,919.61	35,919.61	18%

Program expenditures in 2020 included expenses from projects installed 2019 but processed in 2020, projects installed in January 2020, and administration expenses. Table 185 lists the 2020 program budget and expenditures by fuel type.

TABLE 185. 2020 IQW PROGRAM EXPENDITURES

FUEL	PROGRAM BUDGET	PROGRAM EXPENDITURES	BUDGET SPENT (%)
Electric	$531,175.72	$94,833.35	18%
Natural Gas	$1,334,092.63	$255,965.60	19%

IMPACT EVALUATION

This section details each step of the impact evaluation and its associated electric energy savings, peak demand reduction, and natural gas savings.

AUDITED AND VERIFIED SAVINGS

The evaluation team compared the savings reported in the scorecard with the tracking data and found no issues. Due to very limited participation in 2020, and that nearly all projects were rolled over from 2019, the evaluation team used in-service rates from the 2019 evaluation to calculate verified savings (Table 186).

TABLE 186. 2020 IQW PROGRAM IN-SERVICE RATES RATIOS BY MEASURE

MEASURE	ISR
LED	97%
Bathroom Aerator	85%
Kitchen Aerator	91%
Showerhead	89%
Shower Start	100%
Pipe Wrap	90%
Water Heater Wrap[a]	100%
Programmable Thermostat	70%
Filter Whistle	87%
Air Sealing	100%
Duct Sealing	99%
Attic Insulation	100%

MEASURE	ISR
Refrigerator	97%
Assessment Recommendations	72%

[a]Deemed at 100% in 2019.

As described in the 2019 report, the ISRs are less than 100% for two reasons: (1) respondents report that a measure was not installed, or that a lower quantity than the program reported was installed, and/or (2) respondents report removing items after installation.

Table 187 summarizes the audited quantity, applied installation rates, and resulting verified quantity per measure. To calculate the verified measure quantity, the evaluation team multiplied the audited measure quantity by the installation rate.

TABLE 187. 2020 IQW PROGRAM AUDITED & VERIFIED QUANTITIES

MEASURE	UNIT OF MEASURE	AUDITED QUANTITY	ISR	VERIFIED QUANTITY
A-Line LEDs - Dual Fuel	Lamp	1,576	97%	1,529
A-Line LEDs - Electric	Lamp	29	97%	28
Candelabra LEDs - Dual Fuel	Lamp	286	97%	277
Candelabra LEDs - Electric	Lamp	8	97%	8
Globe LEDs - Dual Fuel	Lamp	136	97%	132
Globe LEDs - Electric	Lamp	13	97%	13
Bathroom Aerator - Electric	Aerator	4	85%	3
Bathroom Aerator - Gas	Aerator	85	85%	72
Kitchen Aerator - Electric	Aerator	4	91%	4
Kitchen Aerator - Gas	Aerator	66	91%	60
Low Flow Showerhead - Electric	Showerhead	2	89%	2
Low Flow Showerhead - Gas	Showerhead	56	89%	50
Low Flow Showerhead with Shower Start - Electric	Showerhead	1	89%	1
Low Flow Showerhead with Shower Start - Gas	Showerhead	16	89%	14
Shower Start - Gas	Shower Start	2	100%	2
Pipe Wrap - Electric	Per foot	30	90%	27
Pipe Wrap - Gas	Per foot	802	90%	722
Water Heater Wrap - Electric	Water Heater	2	100%	2
Programmable Thermostat - Electric Cooling and Gas Heating	Thermostat	14	70%	10
Programmable Thermostat - Electric Cooling	Thermostat	1	70%	1
Programmable Thermostat - Gas Heating	Thermostat	37	70%	26
Filter Whistle - Gas Heating	Filter Whistle	3	87%	3
Air Sealing - Electric Cooling and Gas Heating	Participant	56	100%	56
Air Sealing - Electric Cooling and Heating	Participant	1	100%	1
Air Sealing - Gas Heating	Participant	38	100%	38
Duct Sealing Package - Electric Cooling and Gas Heating	Participant	38	99%	38
Duct Sealing Package - Electric Cooling and Heating	Participant	1	99%	1

MEASURE	UNIT OF MEASURE	AUDITED QUANTITY	ISR	VERIFIED QUANTITY
Duct Sealing Package - Gas Heating	Participant	54	99%	53
Attic Insulation (Uninsulated Hatch) - Electric Cooling and Gas Heating	Thousand Square Feet	42	100%	42
Attic Insulation (Uninsulated Hatch) - Gas Heating	Thousand Square Feet	18	100%	18
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: <1993, New Capacity: 16 CF)	Refrigerator	1	97%	1
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: <1993, New Capacity: 20 CF)	Refrigerator	2	97%	2
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: 1993-2010, New Capacity: 14 CF)	Refrigerator	1	97%	1
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: 1993-2010, New Capacity: 16 CF)	Refrigerator	2	97%	2
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: 1993-2010, New Capacity: 18 CF)	Refrigerator	22	97%	21
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: 1993-2010, New Capacity: 20 CF)	Refrigerator	18	97%	17
Assessment Recommendations - Dual Fuel	Participant	116	72%	84
Assessment Recommendations - Electric	Participant	3	72%	2
Assessment Recommendations - Gas	Participant	39	72%	28
		3,624	N/A	3,390

Note: Totals may not sum exactly due to rounding.

EX POST GROSS SAVINGS

The evaluation team reviewed the programs *ex ante* assumptions, sources, and algorithms for reasonableness and updates. Below are detailed *ex post* gross analysis results.

ENGINEERING REVIEW

The evaluation team referred to the Indiana TRM (v2.2) for variable assumptions to calculate *ex post* gross electric energy savings, demand reduction, and natural gas savings. Where data were unavailable in the Indiana TRM (v2.2), the evaluation team used data from the 2016 Pennsylvania TRM, the Uniform Methods Project (UMP), and the 2019 NIPSCO EMV. The evaluation team revised assumptions for savings estimates applicable to the NIPSCO service territory, as needed. The Appendix: IQW Algorithms and Assumptions contains more details on the specific algorithms, variable assumptions, and references for the program measure *ex post* gross calculations.

There are significant differences between *ex ante* and *ex post* gross savings which are accounted for by the following overarching factors:

- The evaluation team calculated *ex post* gross savings for most of the measures using the Indiana TRM (v2.2). The planning and reporting assumptions NIPSCO used to calculate *ex ante* savings referenced the Indiana TRM (v2.2) and the 2018 evaluation, measurement, verification (EM&V) results, and sometimes included an average of the savings values provided in each source.
- The evaluation team used specific characteristics of installed measures provided within the tracking data or program application materials for variables such as pre- and post-installation R-values, square footage, duct leakage, and project location in *ex post* gross savings. The team calculated *ex ante* savings using savings

values from past studies or deemed inputs from secondary sources, including the TRMs of neighboring jurisdictions. Calculations using actual participant data were invariably different than deemed values.

- The evaluation team used the installation ZIP code to match each customer to the closest city from the Indiana TRM (v2.2)—for example, South Bend and Fort Wayne—to more precisely account for variations in climate for measures including LED bulbs, faucet aerators, low-flow showerheads, duct sealing, and attic insulation.
- For the air sealing and attic insulation measures, the Indiana TRM (v2.2) outlines both electric and gas savings for homes with gas heating that do not have a central air conditioner. The electric savings reflect a reduction in furnace fan energy usage because of improved insulation or reductions in air leakage because the building shell has been improved: the gas furnace does not need to provide as much heating during the winter months, and therefore runs for a shorter time.
- For this evaluation, we could identify which fuels customers received. In some cases, this resulted in measures labeled as "Gas Heating" receiving a small amount of electric savings for NIPSCO electric customers without central air conditioning.

EX POST GROSS SAVINGS

Table 188 shows the *ex ante* deemed savings and *ex post* gross per-measure savings for the 2020 IQW program.

TABLE 188. 2020 IQW PROGRAM *EX ANTE* & *EX POST* GROSS PER-MEASURE SAVINGS VALUES

MEASURE	UNIT OF MEASURE	*EX ANTE* DEEMED SAVINGS			*EX POST* GROSS PER-MEASURE SAVINGS		
		KWH	KW	THERMS	KWH	KW	THERMS
A-Line LEDs - Dual Fuel	Lamp	17.97	0.002	(0.37)	28.52	0.004	0.00
A-Line LEDs - Electric	Lamp	17.97	0.002	0.00	28.42	0.004	0.00
Candelabra LEDs - Dual Fuel	Lamp	9.98	0.001	(0.20)	29.35	0.004	0.00
Candelabra LEDs - Electric	Lamp	9.98	0.001	0.00	29.26	0.004	0.00
Globe LEDs - Dual Fuel	Lamp	11.98	0.002	(0.24)	28.52	0.004	0.00
Globe LEDs - Electric	Lamp	11.98	0.002	0.00	28.42	0.004	0.00
Bathroom Aerator - Electric	Aerator	34.39	0.003	0.00	32.18	0.003	0.00
Bathroom Aerator - Gas	Aerator	0.00	0.00	1.50	0.00	0.00	1.38
Kitchen Aerator - Electric	Aerator	182.12	0.008	0.00	182.12	0.008	0.00
Kitchen Aerator - Gas	Aerator	0.00	0.00	7.97	0.00	0.00	7.95
Low Flow Showerhead - Electric	Showerhead	350.23	0.017	0.00	310.61	0.017	0.00
Low Flow Showerhead - Gas	Showerhead	0.00	0.00	15.23	0.00	0.00	13.51
Low Flow Showerhead with Shower Start - Electric	Showerhead	394.00	0.024	0.00	401.75	0.024	0.00
Low Flow Showerhead with Shower Start - Gas	Showerhead	0.00	0.00	17.30	0.00	0.00	15.77
Shower Start - Gas	Shower Start	0.00	0.00	2.70	0.00	0.00	3.96
Pipe Wrap - Electric	Per foot	23.95	0.003	0.00	23.95	0.003	0.00
Pipe Wrap - Gas	Per foot	0.00	0.00	1.07	0.00	0.00	1.07
Water Heater Wrap - Electric	Water Heater	79.00	0.009	0.00	79.00	0.009	0.00
Programmable Thermostat - Electric Cooling and Gas Heating	Thermostat	98.53	0.114	74.46	100.87	0.00	75.11

MEASURE	UNIT OF MEASURE	*EX ANTE* DEEMED SAVINGS			*EX POST* GROSS PER-MEASURE SAVINGS		
		KWH	KW	THERMS	KWH	KW	THERMS
Programmable Thermostat - Electric Cooling	Thermostat	98.53	0.114	0.00	100.87	0.00	0.00
Programmable Thermostat - Gas Heating	Thermostat	0.00	0.00	74.46	0.00	0.00	75.11
Filter Whistle - Gas Heating	Filter Whistle	0.00	0.00	25.82	0.00	0.00	0.00
Air Sealing - Electric Cooling and Gas Heating	Participant	83.76	0.043	98.54	83.78	0.043	98.59
Air Sealing - Electric Cooling and Heating	Participant	1,966.71	0.109	0.00	1,966.71	0.109	0.00
Air Sealing - Gas Heating	Participant	0.00	0.00	113.19	53.89	0.00	113.20
Duct Sealing Package - Electric Cooling and Gas Heating	Participant	119.52	0.354	94.14	118.97	0.354	93.96
Duct Sealing Package - Electric Cooling and Heating	Participant	1260.40	0.354	0.00	1189.56	0.354	0.00
Duct Sealing Package - Gas Heating	Participant	0.00	0.000	92.75	0.00	0.00	93.63
Attic Insulation (Uninsulated Hatch) - Electric Cooling and Gas Heating	Thousand Square Feet	34.48	0.081	54.13	237.50	0.150	207.00
Attic Insulation (Uninsulated Hatch) - Gas Heating	Thousand Square Feet	0.00	0.00	54.13	102.15	0.00	210.31
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: <1993, New Capacity: 16 CF)	Refrigerator	1,301.80	0.191	0.00	1,301.80	0.191	0.00
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: <1993, New Capacity: 20 CF)	Refrigerator	1,618.24	0.238	0.00	1,618.24	0.238	0.00
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: 1993-2010, New Capacity: 14 CF)	Refrigerator	395.94	0.058	0.00	395.94	0.058	0.00
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: 1993-2010, New Capacity: 16 CF)	Refrigerator	379.94	0.056	0.00	379.94	0.056	0.00
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: 1993-2010, New Capacity: 18 CF)	Refrigerator	439.87	0.065	0.00	439.87	0.065	0.00
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: 1993-2010, New Capacity: 20 CF)	Refrigerator	473.62	0.070	0.00	473.62	0.070	0.00
Assessment Recommendations - Dual Fuel	Participant	21.60	0.012	2.74	21.60	0.012	2.74
Assessment Recommendations - Electric	Participant	21.60	0.012	0.00	21.60	0.012	0.00
Assessment Recommendations - Gas	Participant	0.00	0.00	2.74	0.00	0.00	2.74

Table 189 highlights differences between *ex ante* and *ex post* gross estimates.

TABLE 189. 2020 IQW NOTABLE DIFFERENCES BETWEEN *EX ANTE* & *EX POST* GROSS

MEASURE	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST* GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
LED	Ex ante savings are based on the Indiana TRM (v2.2). Baseline wattage, ISR, and Hours per TRM. WHF values for South Bend, per TRM tables.	*Ex post* savings are based on the Indiana TRM (v2.2), The UMP, and program tracking data. Baseline wattage value per UMP. WHF use TRM weighted average values assigned with ZIP code mapping	Differences in baseline wattage and WHF assumptions. The evaluation team did not assign a therm penalty, consistent with the C&I program.
Low-Flow Faucet Aerator	Ex ante savings are based on the Indiana TRM (v2.2). GPM_{base} and $GPMl_{ow}$, People per home, Faucets per home, and cold-water temperature assumes South Bend per TRM tables.	Ex post savings as based on the Indiana TRM (v2.2); cold-water inlet temperature based on customer location faucets per home taken from survey data.	Different assumptions for water temperatures and faucets per household.
Low-Flow Showerhead	Ex ante savings are based on the Indiana TRM (v2.2). GPM_{base} and $GPMl_{ow}$, People per home, Faucets per home, and cold-water temperature assumes South Bend per TRM tables.	Ex post savings as based on the Indiana TRM (v2.2); cold-water inlet temperature based on customer location; showerheads per home taken from survey data.	Different assumptions for water temperatures, and showerheads per household.
Shower Start	Ex ante savings based on 2017 MEMD Shower Start measure.	Ex post savings are based on the PA TRM 2016 Shower Start measure with inputs such as: cold-water inlet, $GPMl_{ow}$ and base, and minutes per shower taken from the Indiana TRM. Number of showerheads per home taken from survey data.	Ex ante savings are deemed, whereas ex post savings are based on the 2016 PA TRM.
Air Sealing – Gas Heating	Ex ante savings do not claim kWh savings for the air sealing measure with gas heating, but the savings value does appear in the Measure Characterization file.	Ex post savings include kWh savings associated with fan energy for the air sealing measure with gas heating, per the Indiana TRM (v2.2)	Different assumptions for kWh savings.
Duct Sealing	Ex ante savings are based on the Indiana TRM (v2.2)	Ex post savings are based on the Indiana TRM (v2.2), with full load heating and cooling hours based on participant location.	Different assumptions for full load heating and cooling hours.
Attic Insulation	Ex ante savings are based on the Indiana TRM (v2.2) with weighted R-values from Better Buildings Calculator.	Ex post savings are based on the Indiana TRM (v2.2) and insulation values based on a sample of 2019 participant CHA reports. Savings were calculated for each of the sampled participants, and then average savings values, by HVAC system type, were applied across the program.	Large differences in R-values for pre and post contributed to savings differences (pre-R was lower in ex post and post-R was higher than their ex ante comparisons). Interpolation of savings values contributed to higher values by assigning savings based on observed insulation levels.

WASTE HEAT FACTOR - THERM PENALTIES

In 2019, and prior years, the evaluation team applied waste heat factors to lighting measures, representing kWh, kW, and therm penalties resulting from LED lighting. In discussions with NIPSCO, for the 2020 evaluation year, the evaluation team is not including therm penalties when calculating evaluated savings. However, cost-effectiveness results will include these penalties and be applied to the electric program cost-effectiveness. The evaluation team believes this approach is appropriate, as it accounts for the penalty on the electric side (where it is generated) and allows the evaluation team to show gas program and measure performance more clearly. NIPSCO plans to take a consistent approach to accounting for waste heat factors in their planning process.

Currently, in their ex-ante assumptions, NIPSCO does not account for therm penalties consistently across programs, and the evaluation team recommends that this approach is made consistent going forward across all programs that offer LED lighting. Currently, the ex-ante savings for all kit programs include therm penalties. These have been removed in the ex-post analysis, and the evaluation team is reporting these below, to be used in the cost-effectiveness analysis.

TABLE 190. 2020 IQW PROGRAM WASTE HEAT FACTOR THERM PENALTY

MEASURE	WASTE HEAT FACTOR THERM PENALTY
A-Line LEDs - Dual Fuel	(918.54)
Candelabra LEDs - Dual Fuel	(171.59)
Globe LEDs - Dual Fuel	(79.27)
Total	

It should be noted that electric waste heat factors, including cooling credits and electric heating penalties, are currently reported within the kWh and kw savings for the overall program.

REALIZATION RATES

The next three tables (Table 191 through Table 193) show the program's *ex ante* reported savings, audited savings, verified savings, and *ex post* gross savings. The program achieved electric energy, peak demand reduction, and natural gas energy realization rates of 143%, 115%, and 129%, respectively.

TABLE 191. 2020 IQW PROGRAM *EX ANTE* & *EX POST* GROSS ELECTRIC ENERGY SAVINGS

MEASURE	*EX ANTE*[A] ELECTRIC ENERGY SAVINGS (KWH/YR.)	AUDITED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	*EX POST* GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)
A-Line LEDs - Dual Fuel	28,320.72	28,320.72	27,471.10	43,593.02
A-Line LEDs - Electric	521.13	521.13	505.50	799.45
Candelabra LEDs - Dual Fuel	2,854.28	2,854.28	2,768.65	8,143.59
Candelabra LEDs - Electric	79.84	79.84	77.44	227.02
Globe LEDs - Dual Fuel	1,629.28	1,629.28	1,580.40	3,761.83
Globe LEDs - Electric	155.74	155.74	151.07	358.37
Bathroom Aerator - Electric	137.56	137.56	116.93	109.42
Bathroom Aerator - Gas	0.00	0.00	0.00	0.00
Kitchen Aerator - Electric	728.48	728.48	662.92	662.91
Kitchen Aerator - Gas	0.00	0.00	0.00	0.00
Low Flow Showerhead - Electric	700.46	700.46	623.41	552.88
Low Flow Showerhead - Gas	0.00	0.00	0.00	0.00
Low Flow Showerhead with Shower Start - Electric	394	394.00	350.66	357.55
Low Flow Showerhead with Shower Start - Gas	0.00	0.00	0.00	0.00
Shower Start - Gas	0.00	0.00	0.00	0.00
Pipe Wrap - Electric	718.50	718.50	646.65	646.60
Pipe Wrap - Gas	0.00	0.00	0.00	0.00

MEASURE	*EX ANTE*[A] ELECTRIC ENERGY SAVINGS (KWH/YR.)	AUDITED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	*EX POST* GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)
Water Heater Wrap - Electric	158.00	158.00	158.00	158.00
Programmable Thermostat - Electric Cooling and Gas Heating	1,379.42	1,379.42	965.59	988.51
Programmable Thermostat - Electric Cooling	98.53	98.53	68.97	70.61
Programmable Thermostat - Gas Heating	0.00	0.00	0.00	0.00
Filter Whistle - Gas Heating	0.00	0.00	0.00	0.00
Air Sealing - Electric Cooling and Gas Heating	4,690.56	4,690.56	4,690.56	4,691.59
Air Sealing - Electric Cooling and Heating	1,966.71	1,966.71	1,966.71	1,966.71
Air Sealing - Gas Heating	0.00	0.00	0.00	2,047.90
Duct Sealing Package - Electric Cooling and Gas Heating	4,541.76	4,541.76	4,496.34	4,475.52
Duct Sealing Package - Electric Cooling and Heating	1,260.40	1,260.40	1,247.80	1,177.66
Duct Sealing Package - Gas Heating	0.00	0.00	0.00	0.00
Attic Insulation (Uninsulated Hatch) - Electric Cooling and Gas Heating	1,432.94	1,432.94	1,432.94	9,870.03
Attic Insulation (Uninsulated Hatch) - Gas Heating	0.00	0.00	0.00	1,803.71
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: <1993, New Capacity: 16 CF)	1,301.80	1,301.80	1,262.75	1,262.75
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: <1993, New Capacity: 20 CF)	3,236.48	3,236.48	3,139.39	3,139.39
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: 1993-2010, New Capacity: 14 CF)	395.94	395.94	780.00	780.00
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: 1993-2010, New Capacity: 16 CF)	759.88	759.88	737.08	737.08
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: 1993-2010, New Capacity: 18 CF)	9,677.14	9,677.14	9,386.83	9,386.83
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: 1993-2010, New Capacity: 20 CF)	8,525.16	8,525.16	8,269.41	8,269.41
Assessment Recommendations - Dual Fuel	2,505.60	2,505.60	1,804.03	1,804.03
Assessment Recommendations - Electric	64.80	64.80	46.66	46.66
Assessment Recommendations - Gas	0.00	0.00	0.00	0.00

MEASURE	*EX ANTE*[A] ELECTRIC ENERGY SAVINGS (KWH/YR.)	AUDITED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	*EX POST* GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)
Total Savings	78,235.11	78,235.11	75,407.77	111,889.02
Total Program Realization Rate				143%

Note: Totals may not sum properly due to rounding.

[a] Values presented at a measure-level represent Audited values, since the scorecard provides only savings totals.

TABLE 192. 2020 IQW PROGRAM *EX ANTE* & *EX POST* GROSS PEAK DEMAND REDUCTION

MEASURE	*EX ANTE*[A] PEAK DEMAND REDUCTION (KW/YR.)	AUDITED GROSS PEAK DEMAND REDUCTION (KW/YR.)	VERIFIED GROSS PEAK DEMAND REDUCTION (KW/YR.)	*EX POST* GROSS PEAK DEMAND REDUCTION (KW/YR.)
A-Line LEDs - Dual Fuel	3.152	3.152	3.057	5.935
A-Line LEDs - Electric	0.058	0.058	0.056	0.109
Candelabra LEDs - Dual Fuel	0.286	0.286	0.277	1.109
Candelabra LEDs - Electric	0.008	0.008	0.008	0.031
Globe LEDs - Dual Fuel	0.272	0.272	0.264	0.512
Globe LEDs - Electric	0.026	0.026	0.025	0.049
Bathroom Aerator - Electric	0.012	0.012	0.010	0.011
Bathroom Aerator - Gas	0.000	0.000	0.000	0.000
Kitchen Aerator - Electric	0.032	0.032	0.029	0.030
Kitchen Aerator - Gas	0.000	0.000	0.000	0.000
Low Flow Showerhead - Electric	0.034	0.034	0.030	0.030
Low Flow Showerhead - Gas	0.000	0.000	0.000	0.000
Low Flow Showerhead with Shower Start - Electric	0.024	0.024	0.021	0.022
Low Flow Showerhead with Shower Start - Gas	0.000	0.000	0.000	0.000
Shower Start - Gas	0.000	0.000	0.000	0.000
Pipe Wrap - Electric	0.090	0.090	0.081	0.074
Pipe Wrap - Gas	0.000	0.000	0.000	0.000
Water Heater Wrap - Electric	0.018	0.018	0.018	0.018
Programmable Thermostat - Electric Cooling and Gas Heating	1.596	1.596	1.117	0.000
Programmable Thermostat - Electric Cooling	0.114	0.114	0.080	0.000
Programmable Thermostat - Gas Heating	0.000	0.000	0.000	0.000
Filter Whistle - Gas Heating	0.000	0.000	0.000	0.000
Air Sealing - Electric Cooling and Gas Heating	2.408	2.408	2.408	2.429

MEASURE	*EX ANTE*[A] PEAK DEMAND REDUCTION (KW/YR.)	AUDITED GROSS PEAK DEMAND REDUCTION (KW/YR.)	VERIFIED GROSS PEAK DEMAND REDUCTION (KW/YR.)	*EX POST* GROSS PEAK DEMAND REDUCTION (KW/YR.)
Air Sealing - Electric Cooling and Heating	0.109	0.109	0.109	0.109
Air Sealing - Gas Heating	0.000	0.000	0.000	0.000
Duct Sealing Package - Electric Cooling and Gas Heating	13.452	13.452	13.317	13.319
Duct Sealing Package - Electric Cooling and Heating	0.354	0.354	0.350	0.350
Duct Sealing Package - Gas Heating	0.000	0.000	0.000	0.000
Attic Insulation (Uninsulated Hatch) - Electric Cooling and Gas Heating	3.371	3.371	3.371	6.234
Attic Insulation (Uninsulated Hatch) - Gas Heating	0.000	0.000	0.000	0.000
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: <1993, New Capacity: 16 CF)	0.191	0.191	0.185	0.185
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: <1993, New Capacity: 20 CF)	0.476	0.476	0.462	0.462
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: 1993-2010, New Capacity: 14 CF)	0.058	0.058	0.114	0.114
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: 1993-2010, New Capacity: 16 CF)	0.112	0.112	0.109	0.109
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: 1993-2010, New Capacity: 18 CF)	1.430	1.430	1.387	1.387
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: 1993-2010, New Capacity: 20 CF)	1.260	1.260	1.222	1.222
Assessment Recommendations - Dual Fuel	1.392	1.392	1.002	1.002
Assessment Recommendations - Electric	0.036	0.036	0.026	0.026
Assessment Recommendations - Gas	0.000	0.000	0.000	0.000
Total Savings	30.371	30.371	29.138	34.878
Total Program Realization Rate				115%

Note: Totals may not sum properly due to rounding.

[a] Values presented at a measure-level represent Audited values, since the scorecard provides only savings totals.

TABLE 193. 2020 IQW PROGRAM *EX ANTE* & *EX POST* GROSS GAS SAVINGS

MEASURE	*EX ANTE*[A] NATURAL GAS ENERGY SAVINGS (THERMS/YR.)	AUDITED GROSS NATURAL GAS ENERGY (THERMS/YR.)	VERIFIED GROSS NATURAL GASS ENERGY SAVINGS (THERMS/YR.)	*EX POST* GROSS NATURAL GAS ENERGY SAVINGS (THERMS/YR.)
A-Line LEDs – Dual Fuel	(583.12)	(583.12)	(565.63)	0.00
A-Line LEDs - Electric	0.00	0.00	0.00	0.00
Candelabra LEDs - Dual Fuel	(57.20)	(57.20)	(55.48)	0.00
Candelabra LEDs - Electric	0.00	0.00	0.00	0.00
Globe LEDs - Dual Fuel	(32.64)	(32.64)	(31.66)	0.00
Globe LEDs - Electric	0.00	0.00	0.00	0.00
Bathroom Aerator - Electric	0.00	0.00	0.00	0.00
Bathroom Aerator - Gas	127.50	127.50	108.38	99.55
Kitchen Aerator - Electric	0.00	0.00	0.00	0.00
Kitchen Aerator - Gas	526.02	526.02	478.68	477.34
Low Flow Showerhead - Electric	0.00	0.00	0.00	0.00
Low Flow Showerhead - Gas	852.88	852.88	759.06	673.40
Low Flow Showerhead with Shower Start - Electric	0.00	0.00	0.00	0.00
Low Flow Showerhead with Shower Start - Gas	276.80	276.80	246.35	224.60
Shower Start - Gas	5.40	5.40	5.40	7.93
Pipe Wrap - Electric	0.00	0.00	0.00	0.00
Pipe Wrap - Gas	858.14	858.14	772.33	770.84
Water Heater Wrap - Electric	0.00	0.00	0.00	0.00
Programmable Thermostat - Electric Cooling and Gas Heating	1,042.44	1,042.44	729.71	736.08
Programmable Thermostat - Electric Cooling	0.00	0.00	0.00	0.00
Programmable Thermostat - Gas Heating	2,755.02	2,755.02	1,928.51	1,945.35
Filter Whistle - Gas Heating	77.46	77.46	67.39	0.00
Air Sealing - Electric Cooling and Gas Heating	5,518.24	5,518.24	5,518.24	5,520.84
Air Sealing - Electric Cooling and Heating	0.00	0.00	0.00	0.00
Air Sealing - Gas Heating	4,301.22	4,301.22	4,301.22	4,301.63
Duct Sealing Package - Electric Cooling and Gas Heating	3,577.32	3,577.32	3,541.55	3,534.83
Duct Sealing Package - Electric Cooling and Heating	0.00	0.00	0.00	0.00
Duct Sealing Package - Gas Heating	5,008.50	5,008.50	4,958.42	5,005.52
Attic Insulation (Uninsulated Hatch) – Electric Cooling and Gas Heating	2,249.55	2,249.55	2,249.55	8,602.51
Attic Insulation (Uninsulated Hatch) - Gas Heating	955.78	955.78	955.78	3,713.41
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: <1993, New Capacity: 16 CF)	0.00	0.00	0.00	0.00
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: <1993, New Capacity: 20 CF)	0.00	0.00	0.00	0.00

MEASURE	*EX ANTE*[A] NATURAL GAS ENERGY SAVINGS (THERMS/YR.)	AUDITED GROSS NATURAL GAS ENERGY (THERMS/YR.)	VERIFIED GROSS NATURAL GASS ENERGY SAVINGS (THERMS/YR.)	*EX POST* GROSS NATURAL GAS ENERGY SAVINGS (THERMS/YR.)
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: 1993-2010, New Capacity: 14 CF)	0.00	0.00	0.00	0.00
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: 1993-2010, New Capacity: 16 CF)	0.00	0.00	0.00	0.00
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: 1993-2010, New Capacity: 18 CF)	0.00	0.00	0.00	0.00
ENERGY STAR Refrigerator replace non-ENERGY STAR refrigerator (Old Model Year: 1993-2010, New Capacity: 20 CF)	0.00	0.00	0.00	0.00
Assessment Recommendations - Dual Fuel	317.84	317.84	228.84	228.84
Assessment Recommendations - Electric	0.00	0.00	0.00	0.00
Assessment Recommendations - Gas	106.86	106.86	76.94	76.94
Total Savings	27,884.01	27,884.01	26,273.57	35,919.61
Total Program Realization Rate				129%

Note: Totals may not sum properly due to rounding.

[a] Values presented at a measure-level represent Audited values, since the scorecard provides only savings totals.

EX POST NET SAVINGS

The *ex post* net savings values reflect savings attributed to the program after adjusting for freeridership and spillover by applying an NTG ratio.

Evaluators typically calculate NTG using survey participants' self-reported responses to questions related to what participants would have done in the absence of the program (freeridership) and the influence the program had on their decision to implement additional energy efficiency projects after participation in the program (spillover). Because of the income-qualified focus of the program, the evaluation team used an industry-standard assumption that, absent the program, participants would not have purchased and installed the measures provided due to financial constraints. In this situation, the NTG ratio is 100%, where both freeridership and spillover equal 0%.

With a NTG ratio of 100%, the ex post net savings are identical to the ex post gross savings (**Table 194**).

TABLE 194. 2020 IQW NET-TO-GROSS RESULTS BY FUEL TYPE

SAVINGS TYPE	*EX ANTE* GROSS SAVINGS	*EX POST* GROSS SAVINGS	NTG RATIO (%)	*EX POST* NET SAVINGS
Electric Energy Savings (kWh/yr.)	78,235.11	111,889.02	100%	111,889.02
Peak Demand Reduction (kW)	30.371	34.878	100%	34.878
Natural Gas Energy Savings (therms/yr.)	27,884.01	35,919.61	100%	35,919.61

CONCLUSIONS AND RECOMMENDATIONS

As this program essentially did not operate in 2020, the evaluation team does not have any updated conclusions or recommendations in addition to what was recommended in 2019, and any recommendations from the HEA program that would be applicable to IQW once this program resumes operation.

13. COMMERCIAL AND INDUSTRIAL PROGRAMS

PROGRAM DESIGN AND DELIVERY

Through the Commercial and Industrial programs, NIPSCO offers incentives for nonresidential customers who install energy efficiency measures in new and existing facilities. The program implementer (TRC) oversees program management, delivery, and marketing to customers and trade allies. Trade allies are instrumental in identifying energy-saving opportunities and promoting the programs to customers. NIPSCO's Major Account Managers also assist with implementation efforts through direct support and program assistance to customers within the service territory. The following programs are offered for nonresidential customers.

Prescriptive program. The Prescriptive program offers a set rebate for one-for-one replacements of dozens of measures including efficient lighting, pumps and drives, heating, cooling, and refrigeration equipment.

Custom program. The Custom program offers incentives for non-standard projects that involve more complex technologies or equipment changes than are covered in the one-for-one replacement offers available through the Prescriptive program. Custom incentives are based on a project's estimated first-year peak demand reduction and electric or natural gas energy savings.

New Construction program. The New Construction program provides financial incentives to C&I new construction facilities that exceed the energy efficiency requirements of statewide building codes. Energy savings are determined using the ASHRAE 90.1 2007 standard as a baseline energy usage. The following types of projects are eligible for the program:

- New buildings
- Additions or expansions to existing buildings
- Gut rehabs for a change of purpose requiring replacement of all electrical and mechanical equipment

Small Business Direct Install (SBDI) program. The SBDI program is designed to encourage small business customers—those with peak electric demand of 200 kW or less over the past 12 months—to service or replace standard equipment with higher efficiency equipment. Incentives available through the SBDI program are typically higher than those offered through the Prescriptive and Custom programs, and customers can also apply for Prescriptive and Custom program incentives for equipment that falls outside the scope of the SBDI program. Although not a program requirement, TRC encourages trade allies to offer walk-through assessments of facilities and support the application process, including submitting the application for payment on a participant's behalf. The program further encourages trade allies to include the rebate on their invoice then accept the rebate on behalf of the customer, thereby reducing the total cost to the customer.

Commercial Marketplace. NIPSCO launched the Commercial Marketplace program in late 2020 to alleviate the long-term effects COVID-19 will have on achieving its energy savings goals and to broaden offerings to small businesses. The program targets retail, restaurant, and office businesses to take advantage of no-cost kits specific to these business applications. Business customers may order up to five kits per electric account and perform the installation of kit measures themselves. TRC delivers the marketing for this program and subcontracted TechniArt Incorporated to manage program logistics including online registration platform, shipments, and customer support. Commercial

Marketplace will begin realizing savings in 2021; therefore, this evaluation report does not include any findings from this program.

CHANGES FROM 2019 DESIGN

With exception to the introduction of the Commercial Marketplace program, 2020 program design changes were limited to those needed to address operations during the COVID-19 pandemic. To limit in-person contact, TRC adjusted its project verification process to allow for virtual inspections or photo submissions. TRC also focused trade ally and customer outreach on virtual webinars and phone contact over face-to-face outreach.

PROGRAM PERFORMANCE

Comparing the *ex post* gross savings with goals, Table 195 shows that the C&I portfolio fell short of its goals at the portfolio level, achieving 68% of electric savings, 70% of demand savings and 72% of therms savings. The gross goal achievement varied by program and fuel type.

- Prescriptive program achieved the greatest percentage of electric savings goals (123%) and lowest gas savings goal (15%).
- New Construction program achieved the greatest percentage of demand and gas savings goals (126% and 174% of goal, respectively).
- SBDI program fell far short of electric, demand and therms savings goals of (20%, 15% and 30%, respectively).

The implementer attributed low participation levels to the COVID-19 pandemic. Specifically, TRC reported that workforce and supply chain availability, along with customer hesitation to proceed with capital projects during the quarantine period, inhibited participation.

TABLE 195. 2020 C&I PROGRAMS SAVINGS SUMMARY

	GROSS SAVINGS GOAL	*EX ANTE*	AUDITED	VERIFIED	*EX POST* GROSS	*EX POST* NET	GROSS GOAL ACHIEVEMENT
Prescriptive Program							
Electric Energy Savings (kWh/yr.)	24,980,872.00	30,922,969.13	30,818,999.62	30,646,018.01	30,710,230.51	27,332,105.15	123%
Peak Demand Reduction (kW)	6,918.667	4,998.917	5,015.673	5,108.412	5,734.886	5,104.049	83%
Natural Gas Energy Savings (therms/yr.)	294,292.05	48,674.56	48,567.76	48,567.76	43,567.10	38,774.72	15%
Custom Program							
Electric Energy Savings (kWh/yr.)	37,600,000.00	21,539,803.89	21,150,346.29	16,273,664.48	16,425,430.50	15,111,396.06	44%
Peak Demand Reduction (kW)	3,958.145	1,814.659	2,695.900	1,756.352	1,831.374	1,684.864	46%
Natural Gas Energy Savings (therms/yr.)	711,651.69	545,718.79	554,900.52	522,330.89	467,079.00	429,712.68	66%
New Construction Program							
Electric Energy Savings (kWh/yr.)	10,400,000.00	6,876,678.04	7,086,684.14	6,892,451.08	6,970,012.72	4,669,908.53	67%
Peak Demand Reduction (kW)	1,077.319	1,358.028	1,262.741	1,236.970	1,354.945	907.813	126%
Natural Gas Energy Savings (therms/yr.)	262,818.52	476,200.16	466,272.27	445,229.31	456,873.35	306,105.14	174%
Small Business Direct Install Program							
Electric Energy Savings (kWh/yr.)	8,800,000.00	1,688,787.06	1,684,976.41	1,684,976.41	1,727,554.72	1,675,728.08	20%
Peak Demand Reduction (kW)	909.923	114.549	118.145	118.145	132.917	128.930	15%
Natural Gas Energy Savings (therms/yr.)	144,470.64	46,673.22	46,673.14	44,089.02	44,030.68	42,709.75	30%
Total Commercial & Industrial Portfolio[59]							
Electric Energy Savings (kWh/yr.)	81,918,372.00	61,028,238.12	60,741,006.46	55,497,109.98	55,833,228.45	48,789,137.81	68%
Peak Demand Reduction (kW)	12,894.365	8,286.153	9,092.458	8,219.879	9,054.122	7,825.655	70%
Natural Gas Energy Savings (therms/yr.)	1,416,189.22	1,117,266.73	1,116,413.69	1,060,216.98	1,011,550.13	817,302.30	71%

NIPSCO spent 69% of its electric and 78% of its natural gas budgets. The proportion of spending aligned with savings toward goals. Table 196 lists the 2020 budget and expenditures by fuel type for the C&I programs.

TABLE 196. 2020 C&I PROGRAMS EXPENDITURES

FUEL	PROGRAM BUDGET	PROGRAM EXPENDITURES	BUDGET SPENT (%)
C&I Prescriptive Program			

[59] The C&I Online Marketplace offering was introduced in 2020 and savings goals were defined for the program. The goals for C&I Online Marketplace have been incorporated into the total Commercial and Industrial Portfolio goals outlined. C&I Online Marketplace did not have any participation within calendar year 2020 and is therefore not represented in the table as an evaluated program in 2020.

FUEL	PROGRAM BUDGET	PROGRAM EXPENDITURES	BUDGET SPENT (%)
Electric	$3,007,518.96	$3,213,414.30	107%
Natural Gas	$379,539.24	$91,969.88	24%
C&I Custom Program			
Electric	$4,613,777.29	$2,646,392.77	57%
Natural Gas	$999,614.42	$726,027.33	73%
C&I New Construction Program			
Electric	$1,239,807.46	$797,668.02	64%
Natural Gas	$368,801.98	$624,640.23	169%
C&I SBDI Program			
Electric	$1,222,332.91	$354,987.63	29%
Natural Gas	$211,073.13	$94,815.21	45%
Total C&I Programs[60]			
Electric	$10,095,643.99	$7,012,463.00	69%
Natural Gas	$1,960,494.72	$1,537,452.00	78%

IMPACT EVALUATION

This section details each step of the impact evaluation and its associated electric energy savings, peak demand reduction, and natural gas savings. The impact evaluation addressed the following research questions:

- Are tracking database savings sourced with proper project documentation?
  - Do claimed savings algorithms align with the Indiana Technical Reference Manual (TRM) v2.2 or other appropriate secondary sources? Are there any updates that should be made?
  - What assumptions were used to develop savings estimates? Are there any updates that should be made?
- What are *ex post* program savings? Do these suggest any needed updates to program design, delivery, or savings assumptions?

AUDITED AND VERIFIED SAVINGS

To develop an audited measure quantity and savings, the evaluation team first checked the program tracking data for duplicates or other data quality issues. Minor modifications were made to quantities and resulting energy savings values for sampled projects when discrepancies were found between the measure documentation and the reported values.

[60] The C&I Online Marketplace offering was introduced and budgeted for in 2020. The budget for C&I Online Marketplace has been incorporated into the total Commercial and Industrial Portfolio budget outlined. C&I Online Marketplace did not have any participation within calendar year 2020 and is therefore not represented in the table as an evaluated program in 2020.

EX POST GROSS SAVINGS

The evaluation team adjusted 2020 measure savings in the *ex post* gross analysis. The evaluation team updated savings for many reasons, with the most common overarching reasons and data sources as follows:

- Discrepancies in quantity, equipment capacity, equipment efficiency, or lighting wattage discovered during a review of project documents or virtual site inspections.
- Annual operating hours from online schedules, posted store schedules, logged data, or IN TRM v2.2 values for the building type or equipment type.
- Inclusion of electric WHFs and peak summer coincident factors (CFs) consistent with the 2015 Indiana TRM v2.2.
- IN TRM v2.2 methodologies or simple calculation methods instead of using deemed values.

SAMPLING STRATEGY

The evaluation team sampled 2020 C&I program measures for desk reviews and virtual audits. The evaluation strives to achieve a minimum 90% confidence within 10% precision *for each C&I program across the 3-year program period (*program year 2019 through program year 2021). To achieve this, the evaluation team selected a representative sample of measures from each individual program to evaluate. Results have been represented at both the C&I level and program level to better illustrate measure category level trends across all commercial programs but note that ultimately the evaluation team's strategy focused on providing sufficient sampling and analysis at the program level.

The evaluation team classified measures into measure types and stratified the sample into two groups: 1) lighting measures and 2) non-lighting measures. The measures were further defined by measure types within those groups; however, savings estimates (and extrapolations) are within those two broader groups.

Measures were hand-picked (purposive) or randomly sampled from each program. Out of the 3,158 unique measures in the population, the C&I programs evaluation sample resulted in 115 total unique measures[61] receiving an engineering review (36 through purposive sampling and 79 through proportional sampling). Of these, 65 received desk reviews only and 50 received virtual audits.

- The purposive sampling selected the largest saving measures in the program. For each program, the purposive sampling process selected measures that comprised at least 5% of the cumulative program savings, and measures that comprised as least 20% of the measure category savings. Because these measures were sampled with certainty (100% of eligible highest saving measures were sampled) the results *were not* extrapolated to the population. These measures are referred to as hand-picked measures.
- The proportional sampling measures were randomly selected from the population of the specific program measures, ensuring at least one measure from each measure category was sampled. Findings were

[61] Measures are defined as a measure type installed by a customer account. One measure could account for multiple pieces of equipment installed and rebated.

extrapolated to the population of savings for the relevant measure categories. These measures are referred to as randomly sampled measures.

An outline of this methodology is shown in Figure 74 below, using the Lighting Measure within the 2020 Custom program to illustrate the example. The Lighting measure group realization rates were calculated from the collective realization rate of the randomly sampled measures for each program. The lighting realization rates were then used to extrapolate to the full lighting population for each program to determine *ex post* gross savings.

Handpicked sampled measures received a realization rate specific to the individual measure, which did not factor into the extrapolation to the rest of the population. The realization rate determined for the handpicked measure was applied only to that individual measure to determine the *ex post* gross savings for the measure. *Ex post* gross savings from handpicked measures were added to *ex post* savings from the rest of the population to determine the cumulative *ex post* savings for the program.

There are many measure types in the non-lighting measure group. The *ex post* gross results from these measure types were aggregated to create a realization rate for the non-lighting measure group. The non-lighting realization rates were then used for extrapolation to the complete non-lighting population for each program.

This report breaks out measures into measure types to provide transparency on results and guidance on how to best improve program savings estimates and activities; however, the sampled population was never designed to estimate realization rates by measure types beyond lighting and non-lighting groups by program.

FIGURE 74. SAMPLING METHODOLOGY

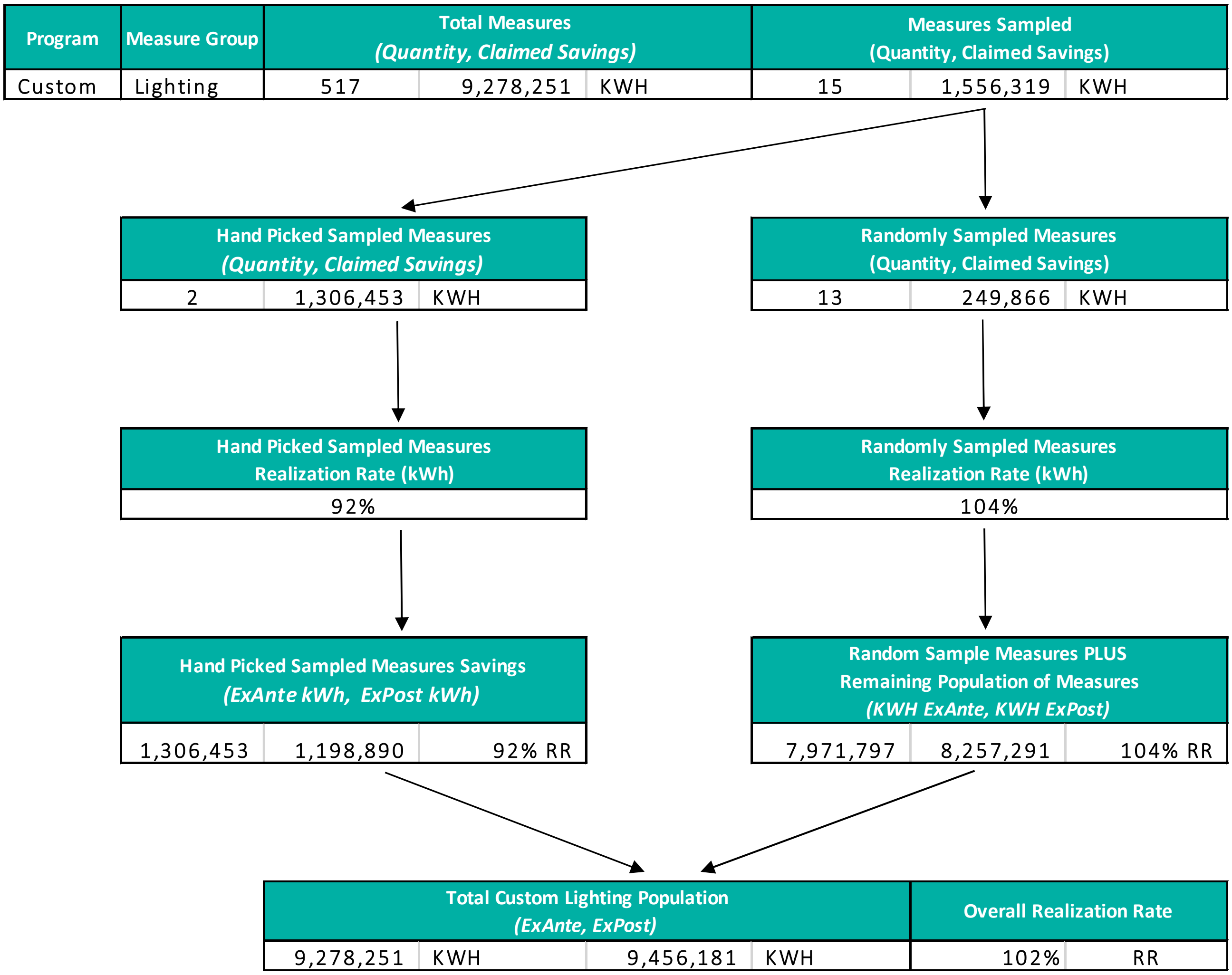


Table 197 summarizes the number of evaluated measures and the proportion of *ex ante* program savings the evaluated measures represent. The 2020 C&I programs sample covered 37% of cumulative program electricity savings, and 35% of gas savings. In the table below, the lighting measure category has been highlighted as the largest measure category. The sample captured 24% of total lighting electricity savings. All other measures have been grouped into the non-lighting measure category. The cumulative non-lighting sample captured 79% of electricity savings and 35% of gas savings.

Each following measure-related section provides sampling distribution by C&I program.

TABLE 197. 2020 COMBINED C&I PROGRAMS *EX ANTE* SAMPLED MEASURES

MEASURE CATEGORY	MEASURE COUNTS				TOTAL *EX ANTE* SAVINGS			SAMPLED *EX ANTE* SAVINGS & PROPORTION OF SAVINGS SAMPLED			
	TOTAL	SAMPLED TOTAL	HAND PICKED	RANDOM	KWH	KW	THERMS	KWH	% KWH	THERMS	% THERMS
Lighting	**2,755**	**60**	**15**	**45**	**46,696,116.03**	**7,178.267**	**-**	**11,225,719.02**	**24%**	**-**	
Non-Lighting	**403**	**55**	**21**	**34**	**14,332,122.09**	**1,107.886**	**1,117,266.73**	**11,292,659.10**	**79%**	**393,766**	**35%**
Compressed Air	17	4	2	2	2,305,229.95	23.655	-	1,779,917.00	77%	-	
Controls	20	3	2	1	451,236.00	13.838	81,009.00	120,477.00	27%	36,926-	46%
HVAC	229	29	14	15	1,813,232.74	624.194	988,580.17	1,008,683.00	56%	349,276	35%
Process	17	4	2	2	2,042,912.00	24.536	22,194.16	1,811,068.00	89%	-	0%
Refrigeration	33	6		6	203,219.40	26.581	-	59,778.60	29%	-	
VFD	56	3		3	610,364.00	89.751	-	26,383.50	4%	-	
Water Heat	16	2		2	-	-	7,559.40	-		312	4%
Other	2	1		1	-	-	17,924.00	-		7,252	40%
Kitchen	2	1		1	46,076.00	7.106	-	36,864.00	80%	-	
Motors	10	1	1		6,847,724.00	298.225	-	6,437,360.00	94%	-	
Building Redesign	1	1		1	12,128.00	-	-	12,128.00	100%		
Total	3,158	115	36	79	61,028,238.12	8,286.153	1,117,266.73	22,518,378.12	37%	393,766	35%

ENGINEERING REVIEWS, REALIZATION RATES, AND *EX POST* GROSS SAVINGS

The evaluation team completed engineering desk reviews on 115 measures for the 2020 C&I programs. The team sampled 98 unique customer sites (as defined by NIPSCO tracking data as “site codes”) as a subset of the 115 evaluated measures.

The sections below summarize the results of the engineering review by lighting and non-lighting measures. For brevity, this section summarizes reasons for adjustments, focusing on those that had the greatest impact in savings and/or where the evaluation team recommends adjustments in values and/or calculation methods. Appendix A provides more detailed discussion on the reasons for adjustment by each measure type.

LIGHTING MEASURES

All four C&I programs contain lighting measures. Table 198 documents the number of measures, savings, and sample sizes by each program. The team evaluated 60 lighting measures across the C&I programs.

TABLE 198. 2020 C&I PROGRAMS SAMPLED LIGHTING MEASURES

PROGRAM	NUMBER OF MEASURES				PROPORTION OF PROGRAM SAVINGS EVALUATED		
	TOTAL	SAMPLED TOTAL	HAND PICKED	RANDOM	KWH	KW	THERMS
Prescriptive	1,818	17	6	11	21%	23%	N/A
Custom	517	15	2	13	17%	21%	N/A
SBDI	324	19	2	17	14%	19%	N/A
New Construction	96	9	5	4	55%	52%	N/A
Total	2,755	60	15	45	24%	30%	-

Below details the reasons for adjustments, organized by interior and exterior lighting measures.

Lighting - Interior. Of the total 60 lighting measures evaluated this year, 43 measures were interior lighting measures. Measures were adjusted for the following types of issues:

- *Ex ante* calculations excluded waste heat factors for interior lighting measures that the IN TRM states should be applied (43 measures). The *ex post* gross savings integrate waste heat factor kW and kWh penalties. Waste heat factor therms penalties were calculated for cost effectiveness testing but are not included in ex-post gross savings.
- Several interior lighting projects were misclassified as exterior lighting measures.
- There were minor operating hour changes based on reviews of the posted schedules for the buildings, interview with the customer site contact, or reviews of the TRM hours for the building types.
- There were changes to the coincidence factors to better match the specific building type where the measure was installed in a few instances.
- Changes to the number of baseline fixtures, number of installed fixtures, and wattage of fixtures based on a review of invoices, counts of fixtures during the inspection, and review of lighting specification sheets.

Lighting - Exterior. The evaluation reviewed 17 exterior lighting measures. Of these, 15 measures resulted in a 100% realization rate. The remaining two measures were adjusted due to slight differences in installed wattage specification.

Table 199 shows the complete list of lighting measure subcategories represented by the 2020 C&I population. The number of units refers to the units specified for the measure subcategory algorithms with the IN TRMv2.2. Units can refer to number of lamps, bulbs, fixtures, watts reduced, or linear feet reduced depending on the specific measure subcategory algorithm. The number of measures refers to the count of each measure type installed as part of a completed project across all C&I programs. Sampling was completed at the measure level for each program. For lighting, 60 measures were sampled from the total 2,755 measures. Sampling within the lighting category was done randomly across the measure subcategories.

TABLE 199. 2020 C&I PROGRAMS LIGHTING MEASURES BY SUBCATEGORY

MEASURE SUBCATEGORY	*SUM OF UNITS*	*SUM OF MEASURES*	SUM OF SAMPLED MEASURES
Interior Lighting	230,210	1,976	43
LED < 10W Replacing Incandescent >=25W	2,103	11	1
LED <= 12W Replacing Incandescent 25-45W	1,747	15	
LED <= 15W Replacing Incandescent 46-65W	3,837	123	3
LED <= 17W Replacing Incandescent 66-90W	1,613	66	1
LED <= 20W Replacing Incandescent >90W	709	20	
LED 2x2 Fixture Replacing T12 2 Lamp U-Tube	492	26	
LED 2x2 Fixture Replacing T8 2 lamp U-Tube	262	20	
LED 2x4 Fixture Replacing T12 4ft 3 Lamp or 4 Lamp	1,403	57	1
LED 2x4 Fixture Replacing T8 4ft 3 Lamp or 4 Lamp	3,703	60	1
LED Exit Sign Fixture with Battery Backup Replacing CFL	18	6	
LED Exit Sign Replacing CFL or Incandescent Exit Sign	146	12	

MEASURE SUBCATEGORY	*SUM OF UNITS*	*SUM OF MEASURES*	SUM OF SAMPLED MEASURES
LED Fixture	699	34	
LED Interior	20,095	441	12
LED Interior Replacing HID ≤ 175W	166	14	
LED Interior Replacing HID ≤ 175W Replacing HID ≤ 175W	309	11	
LED Interior Replacing HID 1000W	17	1	1
LED Interior Replacing HID 1000W Replacing HID 1000W	1,074	21	4
LED Interior Replacing HID 176-250W	13	2	
LED Interior Replacing HID 251-400W	218	21	4
LED Interior Replacing HID 251-400W Replacing HID 251-400W	2,038	90	
LED Interior Replacing HID176-250W Replacing HID176-250W	46	5	
LED Tube Relamp Replacing T12 Replacing T12	28,926	290	1
LED Tube Relamp Replacing T5	226	6	
LED Tube Relamp Replacing T5HO	41,318	57	1
LED Tube Relamp Replacing T8	8	1	1
LED Tube Relamp Replacing T8 Replacing T8	111,375	392	2
Lighting System Exceeding ASHRAE 90.1-2007	2,272	96	9
Occupancy Sensor >500 W Connected Load Replacing No Existing Controls	234	10	
Occupancy Sensor 100-199W Load Replacing No Existing Controls	1,458	22	
Occupancy Sensor 200-500W Load Replacing No Existing Controls	453	6	
Others (Please Describe)	199	11	
T12 4ft Delamping Replacing T12 Fixture	2,998	26	
T5 Fixture	35	2	1
T8 Fixture - 17W Lamp(s)	-	1	
Exterior Lighting	5,415	779	17
LED Exterior	380	62	2
LED Exterior Replacing HID ≤ 175W	469	71	1
LED Exterior Replacing HID ≤ 175W Replacing HID ≤ 175W	820	125	2
LED Exterior Replacing HID 1000W	222	25	2
LED Exterior Replacing HID 1000W Replacing HID 1000W	357	50	
LED Exterior Replacing HID 176-250W	178	46	4
LED Exterior Replacing HID 251-400W	402	77	3
LED Exterior Replacing HID 251-400W Replacing HID 251-400W	2,027	237	3
LED Exterior Replacing HID176-250W Replacing HID176-250W	560	86	
Total	235,625	2,755	60

Table 200 shows the *ex ante* savings and the measure specific realization rates from the sampled lighting measures in the 2020 C&I programs. The measure specific realization rates from the hand-picked sampled projects were applied to only those specific projects. The realization rates found for random projects are shown below, and for the lighting measure group, those realization rates were extrapolated to the rest of the lighting population by program. The extrapolated lighting realization rates for all programs combined was calculated as 101% and 115%

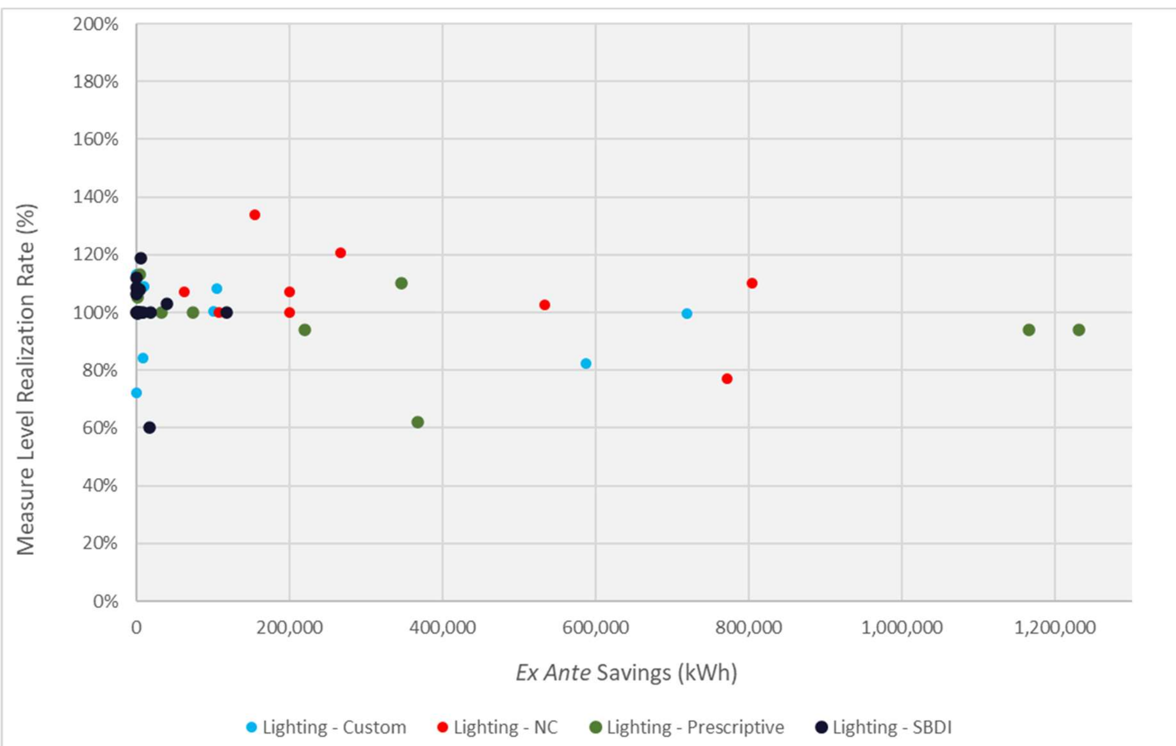
for electricity and demand, respectively. The complete set of extrapolated realization rates by program are shown later in this report in Table 205.

TABLE 200. 2020 C&I PROGRAMS *EX ANTE* SAVINGS & REALIZATION RATES FOR SAMPLED LIGHTING MEASURES

PROGRAM	SAMPLED *EX ANTE*			REALIZATION RATES (KWH)		REALIZATION RATES (KW)	
	KWH	KW	THERMS	HAND PICKED	RANDOM	HAND PICKED	RANDOM
Prescriptive	6,332,683.60	1,088.463	-	96%	101%	110%	117%
Custom	1,556,319.03	242.328	-	92%	104%	126%	110%
SBDI	234,763.20	22.042	-	95%	103%	120%	116%
New Construction	3,101,953.19	553.853	-	99%	114%	117%	118%
Total	11,225,719.02	1,906.69	-	96%	108%	114%	117%

Figure 75 provides measure level results for each project sampled. Each program is represented with a different color. The figure shows the size of the *ex ante* project savings compared with the resulting realization rate. SBDI projects tend to be smaller and performed with a higher realization rate, whereas the other program types had more variability. The three largest lighting projects were from the Prescriptive program and were found to be at or near 100% realized savings.

FIGURE 75. C&I PROGRAMS SAMPLED LIGHTING MEASURES *EX ANTE* IMPACT AND REALIZATION RATES



Note the largest Prescriptive lighting project does not appear on this figure due to scale. This project's impact was 2,871,108 kWh ex ante savings and achieved a realization rate of 100%.

Table 201 summarizes notable differences between *ex ante* and *ex post* gross estimates from the measures sampled.

TABLE 201. 2020 C&I PROGRAMS NOTABLE DIFFERENCES BETWEEN *EX ANTE* & *EX POST* GROSS LIGHTING MEASURES

MEASURE CATEGORY	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST* GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
Lighting	*Ex ante* savings were determined by the Indiana TRM v2.2, calculated through the application excel tool	Indiana TRM v2.2. All inputs were verified through project documentation or interviews conducted.	The electric penalties attributed to waste heat factors were incorporated into the ex-post gross savings values. Interview data also demonstrated different operating hours and coincidence factors than assumed by the *ex-ante* calculations in a few instances. Project documentation demonstrated different installed wattages and lighting type misclassification in a few instances.

Waste Heat Factor Natural Gas Penalties

In 2019, and prior years, the evaluation team applied waste heat factors to lighting measures, representing the heating penalties resulting from more efficient lighting. The program does not report therm waste heat factors in ex-ante calculations. Electric waste heat factor penalties are minor in comparison with therm waste heat factor penalties and have been reported within *ex post* savings.

In discussions with NIPSCO, the evaluation team did not include negative therm waste heat factors in *ex post* therm calculations. However, we present the therm penalties in Table 202 for inclusion in cost-effectiveness calculations. This table shows the therm penalties calculated for both randomly sampled and handpicked projects, and the proportions of those penalties when compared to overall kWh savings. These were applied to the remaining unsampled interior lighting projects, and then summed to come up with total therm penalty estimates for all programs. There was a 150,403 therm penalty from sampled projects. When extrapolated to the remaining population of interior Lighting measures, the total therm penalty is 692,945 therms for the entire C&I portfolio.

TABLE 202. 2020 C&I PROGRAMS WASTE HEAT FACTOR PENALTIES

PROGRAM	*EX ANTE* SAMPLED INTERIOR LIGHTING		WHF PENALTIES			REMAINING INTERIOR LIGHTING POPULATION		TOTAL INTERIOR LIGHTING POPULATION	
	RANDOMLY SAMPLED KWH	HAND PICKED KWH	RANDOMLY SAMPLED THERMS	HAND PICKED THERMS	RATIO WHF PENALTY TO KWH	*EX ANTE* KWH	EXTRAPOLATED THERM PENALTY	*EX ANTE* KWH	EXTRAPOLATED THERM PENALTY
Prescriptive	85,217.00	6,202,171.35	(1,308.16)	(75,164.00)	0.015	19,038,952.00	(292,265.57)	25,326,340.35	(368,737.73)
Custom	227,209.73	1,306,453.38	(5,723.32)	(18,905.45)	0.025	6,640,329.00	(167,267.17)	8,173,992.11	(191,895.94)
New Construction	515,216.03	2,576,737.23	(17,702.01)	(30,230.09)	0.034	2,191,395.00	(75,292.88)	5,283,348.26	(123,224.98)
SBDI	63,274.92	16,723.20	(1,369.76)	-	0.022	356,461.00	(7,716.58)	436,459.12	(9,086.34)
Total	890,917.68	10,102,085.16	(26,103.25) (150,402.79)	(124,299.54)	0	28,227,137.00	(542,542.20)	39,220,139.84	(692,944.99)

NON-LIGHTING MEASURES

Non-lighting measures were present in the 2020 measure population in each of the four C&I programs. The evaluation team sampled at least one measure from each non-lighting measure group across the four C&I programs. Table 203 documents the number of measures, savings, and sample sizes for each program. The team evaluated 55 non-lighting measures representing a host of measure types. HVAC measures constituted the greatest proportion of non-lighting measure types (n=29), followed by refrigeration (n=6).

TABLE 203. 2020 C&I PROGRAMS SAMPLED NON-LIGHTING MEASURES

MEASURE GROUP	PROGRAM	NUMBER OF MEASURES				PROPORTION OF PROGRAM SAVINGS EVALUATED		
		TOTAL	SAMPLED TOTAL	HAND PICKED	RANDOM	KWH	KW	THERMS
HVAC Measures	Custom	62	7	4	3	60%	87%	31%
	Prescriptive	81	6	3	3	43%	7%	20%
	SBDI	8	6	1	5	N/A	N/A	81%
	New Construction	78	10	6	4	46%	87%	36%
VFD Measures	Custom	-	-	-	-	-	-	-
	Prescriptive	55	3	-	3	4%	5%	N/A
	SBDI	-	-	-	-	-	-	-
	New Construction	-	-	-	-	-	-	-
Refrigeration Measures	Custom	4	1	-	1	25%	N/A	N/A
	Prescriptive	19	3	-	3	31%	20%	N/A
	SBDI	2	1	-	1	64%	64%	N/A
	New Construction	8	1	-	1	17%	N/A	N/A
Compressed Air Measures	Custom	14	4	2	2	84%	0%	N/A
	Prescriptive	-	-	-	-	-	-	-
	SBDI	-	-	-	-	-	-	-
	New Construction	3	-	-	-	-	-	-
Process Measures	Custom	6	4	2	2	96%	100%	N/A
	Prescriptive	-	-	-	-	-	-	-
	SBDI	-	-	-	-	-	-	-
	New Construction	11	-	-	-	-	-	-
Water Heat Measures	Custom	-	-	-	-	-	-	-
	Prescriptive	15	2	-	2	N/A	N/A	4%
	SBDI	-	-	-	-	-	-	-
	New Construction	1	-	-	-	-	-	-
Motor Measures	Custom	5	1	1	-	100%	96%	N/A
	Prescriptive	-	-	-	-	-	-	-
	SBDI	-	-	-	-	-	-	-
	New Construction	5	-	-	-	-	-	-
Control Measures	Custom	20	3	2	1	27%	N/A	46%
	Prescriptive	-	-	-	-	-	-	-
	SBDI	-	-	-	-	-	-	-
	New Construction	-	-	-	-	-	-	-
Kitchen Measures	Custom	-	-	-	-	-	-	-
	Prescriptive	2	1	-	1	80%	83%	N/A
	SBDI	-	-	-	-	-	-	-
	New Construction	-	-	-	-	-	-	-
Building Redesign Measures	Custom	-	-	-	-	-	-	-
	Prescriptive	-	-	-	-	-	-	-
	SBDI	-	-	-	-	-	-	-
	New Construction	1	1	-	1	100%	N/A	N/A
Other Measures	Custom	2	1	-	1	N/A	N/A	40%
	Prescriptive	-	-	-	-	-	-	-
	SBDI	-	-	-	-	-	-	-
	New Construction	-	-	-	-	-	-	-

The evaluation team adjusted savings for many of the sampled measures which resulted in realization rates that deviated from 100%. A complete discussion of the adjustments can be found in the Appendix: C&I Program Impact Evaluation Details section of this report.

Below is a summary of the reasons for the most impactful adjustments made in the 2020 evaluation.

HVAC Fan Wall Measure: For one large fan wall measure, the evaluation team made significant modifications to the baseline and proposed case horsepower quantity of motors and operational assumptions. *Ex ante* calculations assumed the existing fans would be replaced with fewer fans and a cumulatively lower horsepower. However, the design of the installed case called for more fans and cumulatively higher horsepower than the original case. The baseline consisted of 12 total fans, two supply, and two return, in each of three AHUs for a total of 1100 HP. The installed consisted of one fan wall array replacing each of the 12 original fans (two arrays in supply, two arrays in return for each AHU) for a total of 1236 HP. The original fans were controlled with a VFD, the installed EC motors do not have VFD control and instead ramp up and down together to the same speed. This configuration was confirmed with a virtual site visit. As a result, the installed case consumes more energy than the baseline case. The result was a 0% realization rate for the large, handpicked project (that was not extrapolated to the population). The deviation between *ex ante* and *ex post* is suspected to be primarily a misunderstanding of the number of fans installed in the proposed case. The type of system installed is typically not installed as an energy saving measure, but as a critical function redundancy measure.

HVAC Steam Pipe Insulation Measures: Steam pipe insulation measures are deemed and resulted in a realization rate of close to 100%; however, tracking data analysis indicates deemed values do not accurately capture savings and are worth revisiting as part of any IN TRM update. The *ex ante* savings for all hot water pipe/ steam pipe insulation measures were deemed based on only measure quantity information (linear feet installed) and pipe diameter. The evaluation team found that project savings varied greatly from the deemed savings when considering all the variables of the project. Modifications were made to the two measures where the operating hours of the building and the heating system were far lower than the operating hours built into the deemed savings values. Unlike the other sampled steam pipe insulation measures, these two projects utilized steam for heating (not process), and the operating hours of the heating system were established in the application and confirmed with the customer through evaluation interviews.

HVAC Furnace Measures: The New Construction, Custom and Prescriptive programs included seven sampled furnace measures which achieved a cumulative realization rate of 88%. The projects included one of two sources of savings documentation: a furnace calculation spreadsheet developed by the implementation team or vendor provided PDF calculations. Aside from the difference in calculators, the following adjustments were made to most furnace measures sampled:

- The evaluation team found that most of the sampled systems were only turned on seasonally to provide heat when a garage door was opened. To model this more accurately, the evaluation team adjusted the hours of use or the occupied temperature setting downward to reflect the equipment being triggered on less frequently. In future years, more customer data may be needed to determine the operation of the equipment beyond what the occupied temperature setpoints are.
- The evaluation team found that several of the sampled systems were installed in industrial or manufacturing settings where there are a lot of process loads heating the space. As a result, the furnace units would not be responsible for most of the heating load and would cycle on less frequently. The evaluation team modified the occupied setpoints downward to better model these situations. In future years, more customer data may be needed to determine the operation of the equipment beyond the occupied temperature setpoints.

VFD Measures: The IN TRM v2.2 does not have a measure to accurately capture VFD savings. *Ex ante* savings were developed from engineering calculations. The evaluation team used the CA TRM VFD Fan Analysis workbook to determine savings on most VFD projects. The analysis using this workbook resulted in zero kW demand savings due to the projection that the motors would run at mid-day based on project data provided in the application and confirmed via customer interview.

Refrigeration Measures: One measure's *ex ante* savings were derived from a baseline figure that incorporated several refrigeration units being removed and replaced with a single, smaller unit. The evaluation team normalized the baseline size to match the final installed case size. There were also several measures where the reported installed volumes differed from the provided specifications.

Water Heat Measures: One measure was adjusted because the baseline water heater was replaced with a much smaller unit, and *ex ante* calculations did not normalize the baseline unit capacity to match the installed unit capacity, resulting in higher *ex ante* savings than *ex post* gross.

Motor Measures: The one sampled measure was handpicked due to its size and impact. This measure represented 99.6% of the total kWh savings amongst the 10 Motor measures. This single measure represented 30% of the *ex ante* savings claimed for the entire Custom program, and 11% of the *ex ante* savings claimed for the entire C&I program portfolio. The following modifications were made to this measure:

- *Ex ante* savings were determined based on engineering calculations and did not include any significant analysis from trend data, metering, sub metering, or ideally a combination of the three. The potential impact of this type of project is sufficiently large that metering and trending should be done before and after measure installation for a sufficient duration to accurately capture complete picture of the operation of the equipment. These specific motors were applied to a system that has robust automation and trending capabilities in place that could have been leveraged to attain more accurate estimates and verification of savings in the *ex ante* calculations. Given limitations to installing metering equipment during the *ex post* evaluation period, the evaluation team computed *ex post* savings by modifying the *ex ante* engineering calculations using data collected through virtual site visits, customer interviews, and short term trend data provided by the customer.
- Modifications were made to the baseline assumptions regarding the motor run times. The *ex ante* baseline assumed that the two motors always ran at 100%. The evaluation found that the motors ran 100% when on, as there was no VFD installed, but they ran only when demand from the system called for them to be on, otherwise they were off. *Ex post* calculations developed an expected baseline case based on the flows observed in the installed case.
- Limited data were provided related to the baseline or installed motor specifications (name plate data) in the project documentation. Further, the name plate data provided by the customer differed from the application data.

Control Measures: Two measures involved hotel guest room occupancy controls (smart thermostats) that used custom calculations to determine savings. The evaluation team deemed the existing TRM measures in the IL TRM and the WI TRM to be a better application to these projects. The team used the WI TRM calculations, replacing Wisconsin-specific with Indiana-specific EFLH assumptions. For one of the sampled measures, the realization rate was closely aligned at 97%. For the other sampled measure, the realization rate was significantly lower at 30%.

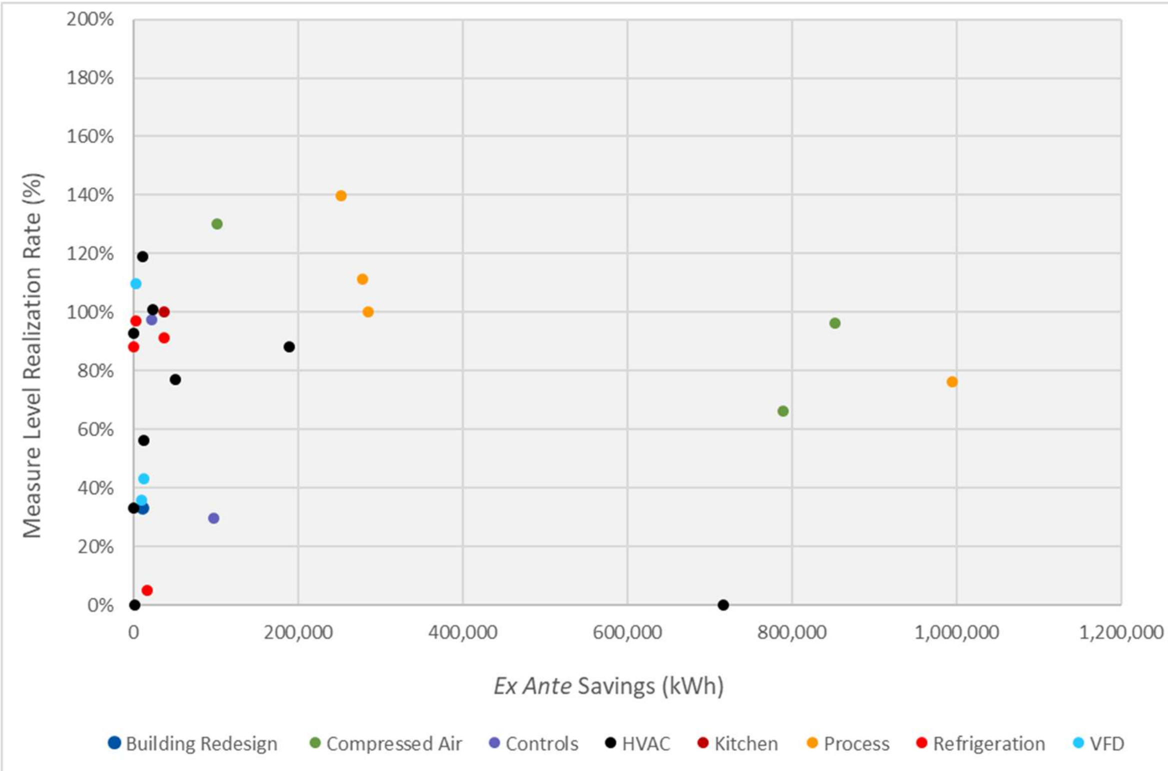
Table 204 shows the *ex ante* savings and the measure specific realization rates from the sampled non-lighting measures in the 2020 C&I programs, by fuel type. The measure specific realization rates from the hand-picked sampled projects were applied to only those specific projects. The realization rates found for randomly sampled projects are shown below, however those realization rates were not extrapolated to the rest of a given population. Non-lighting measure types were aggregated to create realization rates for each program as a full measure category. The non-lighting realization rates were then used for extrapolation to the complete non-lighting population for each program. The extrapolated non-lighting realization rates for all programs combined was calculated as 60%, 70%, and 91% for electricity, demand, and natural gas, respectively. The complete set of extrapolated realization rates are shown in Table 205.

TABLE 204. 2020 C&I PROGRAMS *EX ANTE* SAVINGS & REALIZATION RATES FOR SAMPLED NON-LIGHTING MEASURES

PROGRAM		SAMPLED *EX ANTE*			REALIZATION RATES (KWH)		REALIZATION RATES (KW)		REALIZATION RATES (THERMS)	
		KWH	KW	THERMS	HAND PICKED	RANDOM	HAND PICKED	RANDOM	HAND PICKED	RANDOM
HVAC Measures	Custom	767,829.00	265.157	139,847.00	5%	N/A	12%	N/A	84%	89%
	Prescriptive	37,864.00	2.778	8,282.50	86%	79%	0%	88%	100%	96%
	SBDI	-	-	37,631.02	N/A	N/A	N/A	N/A	32%	99%
	NC	202,990.00	243.830	163,515.00	88%	106%	6%	147%	76%	104%
VFD Measures	Custom	-	-	-	-	-	-	-	-	-
	Prescriptive	26,383.50	4.217	-	N/A	50%	N/A	62%	N/A	N/A
	SBDI	-	-	-	-	-	-	-	-	-
	NC	-	-	-	-	-	-	-	-	-
Refrigeration Measures	Custom	16,330.10	-	-	N/A	5%	N/A	N/A	N/A	N/A
	Prescriptive	38,576.00	5.227	-	N/A	98%	N/A	105%	N/A	N/A
	SBDI	3,937.50	0.538	-	N/A	97%	N/A	75%	N/A	N/A
	NC	935.00	-	-	N/A	88%	N/A	N/A	N/A	N/A
Compressed Air Measures	Custom	1,779,917.00	-	-	82%	160%	N/A	N/A	N/A	N/A
	Prescriptive	-	-	-	-	-	-	-	-	-
	SBDI	-	-	-	-	-	-	-	-	-
	NC	-	-	-	-	-	-	-	-	-
Process Measures	Custom	1,811,068.00	24.536	-	119%	84%	164%	N/A	N/A	N/A
	Prescriptive	-	-	-	-	-	-	-	-	-
	SBDI	-	-	-	-	-	-	-	-	-
	NC	-	-	-	-	-	-	-	-	-
Water Heat Measures	Custom	-	-	-	-	-	-	-	-	-
	Prescriptive	-	-	312.00	N/A	N/A	N/A	N/A	N/A	73%
	SBDI	-	-	-	-	-	-	-	-	-
	NC	-	-	-	-	-	-	-	-	-
Motor Measures	Custom	6,437,360.00	286.260	-	37%	N/A	128%	N/A	N/A	N/A
	Prescriptive	-	-	-	-	-	-	-	-	-
	SBDI	-	-	-	-	-	-	-	-	-
	NC	-	-	-	-	-	-	-	-	-
Control Measures	Custom	120,477.00	-	36,926.00	30%	97%	N/A	N/A	100%	N/A
	Prescriptive	-	-	-	-	-	-	-	-	-
	SBDI	-	-	-	-	-	-	-	-	-
	NC	-	-	-	-	-	-	-	-	-
Kitchen Measures	Custom	-	-	-	-	-	-	-	-	-
	Prescriptive	36,864.00	5.930	-	N/A	100%	N/A	119%	N/A	N/A
	SBDI	-	-	-	-	-	-	-	-	-
	NC	-	-	-	-	-	-	-	-	-
Building Redesign Measures	Custom	-	-	-	-	-	-	-	-	-
	Prescriptive	-	-	-	-	-	-	-	-	-
	SBDI	-	-	-	-	-	-	-	-	-
	NC	12,128.00	-	-	N/A	33%	N/A	N/A	N/A	N/A
Other Measures	Custom	-	-	7,252.00	N/A	N/A	N/A	N/A	N/A	59%
	Prescriptive	-	-	-	-	-	-	-	-	-
	SBDI	-	-	-	-	-	-	-	-	-
	NC	-	-	-	-	-	-	-	-	-

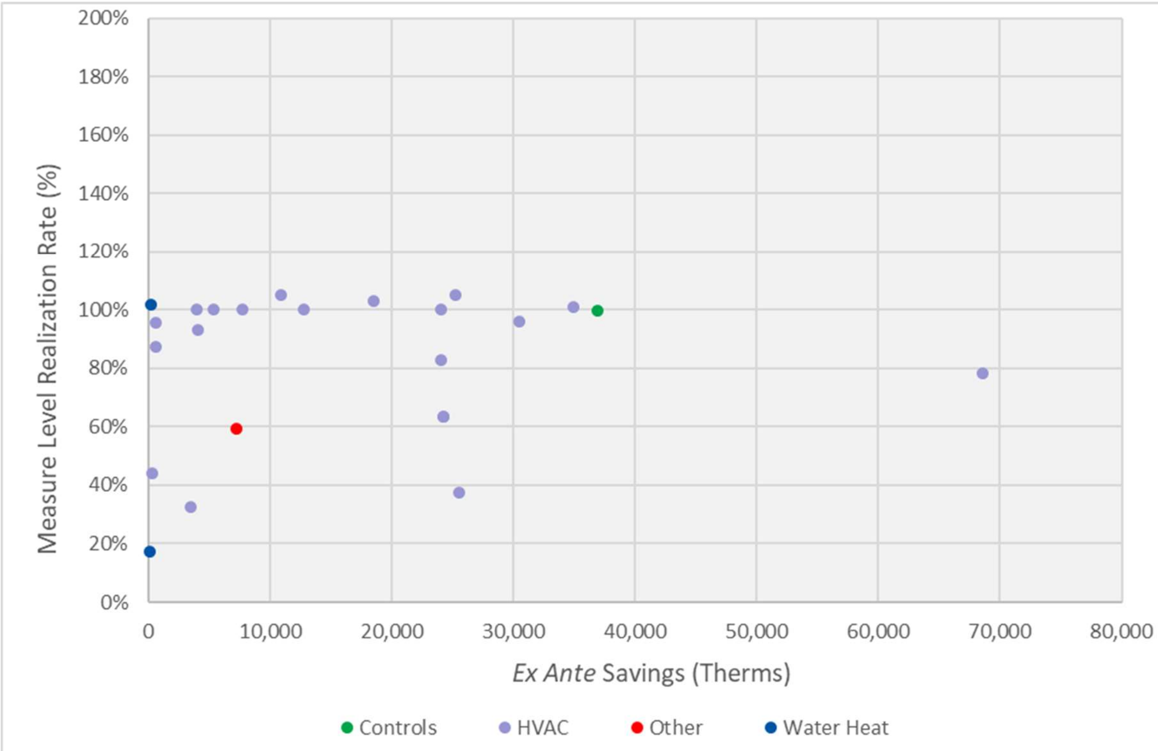
Figure 76 and Figure 77 illustrate the realization rate distribution of the individually sampled projects by program and by fuel source.

FIGURE 76. C&I PROGRAMS SAMPLED NON-LIGHTING ELECTRIC MEASURES *EX ANTE* IMPACT AND REALIZATION RATES



Note one large custom motor project does not appear on the figure due to scale. This project's impact was 6,437,360 kWh ex ante savings and achieved a realization rate of 37%

FIGURE 77. C&I PROGRAMS SAMPLED NON-LIGHTING GAS MEASURES *EX ANTE* IMPACT AND REALIZATION RATES



ALL MEASURES AND ADJUSTMENT SUMMARY

Table 205 provides the realization rates for lighting and non-lighting projects by C&I program and overall. The cumulative realization rates are driven primarily by the random sample realization rates which are extrapolated to the full population. The hand-picked realization rate has a greater effect on the cumulative realization rate when those projects are larger and constitute a greater portion of savings. As an example, this can be seen in the New Construction non-lighting therms realization rate, where relatively low realization rates achieved by three hand-picked HVAC measures affected the overall realization rate.

TABLE 205. 2020 C&I PROGRAMS SAMPLE REALIZATION RATES

MEASURE CATEGORY	HAND PICKED SAMPLE REALIZATION RATE			RANDOM SAMPLE REALIZATION RATE			CUMULATIVE REALIZATION RATE		
	KWH RR	KW RR	THERMS RR	KWH RR	KW RR	THERMS RR	KWH RR	KW RR	THERMS RR
Prescriptive Program									
Lighting	96%	110%	N/A	101%	117%	N/A	100%	115%	N/A
Non-Lighting	86%	0%	100%	86%	98%	88%	86%	97%	90%
Custom Program									
Lighting	92%	126%	N/A	104%	110%	N/A	102%	113%	N/A
Non-Lighting	47%	76%	88%	91%	100%	85%	57%	79%	86%
New Construction Program									
Lighting	99%	117%	N/A	114%	118%	100%	107%	118%	N/A
Non-Lighting	88%	6%	76%	72%	147%	104%	75%	37%	96%
SBDI Program									

Lighting	95%	120%	N/A	103%	116%	100%	102%	116%	N/A
Non-Lighting	N/A	N/A	32%	97%	75%	99%	97%	75%	94%

TABLE 206 summarizes notable differences between *ex ante* and *ex post* gross estimates from the measures sampled.

TABLE 206. 2020 C&I PROGRAMS NOTABLE DIFFERENCES BETWEEN *EX ANTE* & *EX POST* GROSS

MEASURE CATEGORY	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST* GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
HVAC	*Ex ante* savings were determined by the Indiana TRM v2.2, calculated through the application excel tool, or deemed values through the application excel tool. In some furnace projects, PDF engineering calculations provided by the equipment manufacturers.	Indiana TRM v2.2. All inputs were verified through project documentation, virtual site visits or interviews. Steam pipe insulation measures and furnace measures were determined through created calculators.	Installed equipment efficiencies for energy and demand savings calculations. PDF calculations were replaced with evaluator created furnace savings calculation spreadsheets resulting in minor differences in claimed savings. Modifications were made to baseline and installed assumptions based on customer provided measure data gained through customer interview and virtual site visit.
VFD	*Ex ante* savings were deemed through the application excel tool	Indiana TRM v2.2. All inputs were verified through project documentation, virtual site visits or interviews. Engineering calculations with VFD curves adapted from the Bonneville Power Administration ASD Calculator and the CA TRM VFD Fan Analysis workbook.	The deemed savings values do not account for operating hours or loading of the VFDs. The CA TRM VFD Fan Analysis workbook results resulted in 0 kW savings due to projections of motor running at full during mid-day. Changes to installed HP and HOU based on customer data.
Refrigeration	*Ex ante* savings were determined by the Indiana TRM v2.2, or through engineering calculations.	Indiana TRM v2.2. All inputs were verified through project documentation, virtual site visits or interviews.	Modifications to baseline and proposed case volumes and capacities composed most adjustments
Compressed Air	*Ex ante* savings were determined through PDF engineering calculations provided by the equipment vendor.	Indiana TRM v2.2. All inputs were verified through project documentation, virtual site visits or interviews. Engineering calculations and logged power of the air compressors to verify operating hours and average loading conditions.	Modifications based on customer attained data to the load profile, hours of use, and pressure. Clerical errors in data entry of *ex ante* values.
Process	*Ex ante* savings were determined through engineering calculations	Indiana TRM v2.2. All inputs were verified through project documentation, virtual site visits or interviews.	Modifications based on interview customer data to the hours of use, and production levels. Clerical errors in data entry of *ex ante* values.
Water Heat	*Ex ante* savings were determined by the Indiana TRM v2.2, calculated through the application excel tool	Indiana TRM v2.2. All inputs were verified through project documentation, virtual site visits or interviews.	Baseline capacity did not match installed capacity, incorrect baseline energy consumption assumption made
Motors	*Ex ante* savings were determined through engineering calculations	Indiana TRM v2.2. All inputs were verified through project documentation, virtual site visits or interviews. Customer data was requested to supplement and normalize the engineering calculations.	Modifications based on interview customer data to the hours of use, speed of motor, run times of the motors, and HP of the involved equipment. The definition of the baseline case was the primary difference *ex ante* and *ex post* calculations.
Kitchen	*Ex ante* savings were determined through engineering calculations.	Indiana TRM v2.2. All inputs were verified through project documentation, virtual site visits or interviews.	Indiana TRM v2.2 was not utilized for this measure calculation.

MEASURE CATEGORY	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST* GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
Controls	*Ex ante* savings were determined through engineering calculations.	Indiana TRM v2.2, WI and IL TRMs to supplement. All inputs were verified through project documentation, virtual site visits or interviews.	Engineering calculations did not accurately capture the scope or savings resulting from the project. Existing TRM measures were better suited to this measure application.
Other	*Ex ante* savings were determined by the Indiana TRM v2.2, calculated through the application excel tool	Indiana TRM v2.2. All inputs were verified through project documentation, virtual site visits or interviews.	Clerical errors translating savings values from engineering calculation workbooks to application
Building Redesign	*Ex ante* savings were determined by the Indiana TRM v2.2, calculated through the application excel tool	Indiana TRM v2.2. All inputs were verified through project documentation, virtual site visits or interviews.	Clerical errors translating savings values from engineering calculation workbooks to application

SUMMARY C&I PROGRAM REALIZATION RATES AND *EX POST* GROSS SAVINGS

The next three tables (Table 207 through Table 209) show the total C&I program's collective *ex ante* reported savings, verified savings, and *ex post* gross savings. As shown in Table 207 and Table 208, the lighting measure group achieved high electric and demand realization rates (101% electric and 115% demand realization rates). Overall, the non-lighting measures had more variability by fuel type, achieving 60%, 70%, and 91% realization rates for electricity, demand, and natural gas, respectively.

Large custom projects negatively affected electric realization rates in the HVAC, Controls and Motor measure groups.

TABLE 207. 2020 C&I PROGRAMS *EX ANTE* & *EX POST* GROSS ELECTRIC ENERGY SAVINGS

MEASURE GROUP	*EX ANTE*[A] ELECTRIC ENERGY SAVINGS (KWH/YR.)	AUDITED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	*EX POST* GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	REALIZATION RATE
Lighting	46,696,116.03	46,683,919.84	46,381,682.38	47,216,766.51	101%
Non-Lighting	14,332,122.09	14,057,086.62	9,115,427.60	8,616,461.94	60%
Compressed Air	2,305,229.95	2,101,541.37	2,090,741.37	1,908,521.59	83%
Controls	451,236.00	412,772.48	382,012.52	349,419.16	77%
HVAC	1,813,232.74	2,236,309.84	1,057,500.05	929,728.63	51%
Process	2,042,912.00	1,778,095.09	1,939,574.49	1,973,647.50	97%
Refrigeration	203,219.40	199,400.31	186,683.70	177,896.86	88%
VFD	610,364.00	610,545.50	597,216.50	526,021.24	86%
Water Heat	-	-	-	-	N/A
Other	-	-	-	-	N/A
Kitchen	46,076.00	46,076.00	46,076.00	39,709.02	86%
Motors	6,847,724.00	6,668,338.06	2,811,615.00	2,700,529.01	39%
Building Redesign	12,128.00	4,007.97	4,007.97	10,988.94	91%
Total Savings	61,028,238.12	60,741,006.46	55,497,109.98	55,833,228.45	91%

MEASURE GROUP	*EX ANTE*[A] ELECTRIC ENERGY SAVINGS (KWH/YR.)	AUDITED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	*EX POST* GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	REALIZATION RATE

Note: Totals may not sum properly due to rounding.
Note: Non-lighting measure types were aggregated to create realization rates for each program as a full measure category. The non-lighting realization rates were then used for extrapolation to the complete non-lighting population for each program. Realization rates have not been determined at the measure level except for the Lighting measure category level.

The C&I portfolio achieved a 109% demand realization rate, primarily driven by lighting measures adjustments. The non-lighting demand realization rates varied by measure, with compressed air, motor, and process measures achieving the highest realization rates However, several large HVAC measures drove down the realization rate for that measure type, resulting a 70% realization rate for the non-lighting measure category.

TABLE 208. 2020 C&I PROGRAMS *EX ANTE* & *EX POST* GROSS PEAK DEMAND REDUCTION

MEASURE	*EX ANTE*[A] PEAK DEMAND REDUCTION (KW/YR.)	AUDITED GROSS PEAK DEMAND REDUCTION (KW/YR.)	VERIFIED GROSS PEAK DEMAND REDUCTION (KW/YR.)	*EX POST* GROSS PEAK DEMAND REDUCTION (KW/YR.)	REALIZATION RATE
Lighting	7,178.267	7,343.548	7,446.050	8,278.031	115%
Non-Lighting	1,107.886	1,748.910	773.830	776.091	70%
Compressed Air	23.655	43.777	43.777	32.658	138%
Controls	13.838	13.838	13.985	13.985	101%
HVAC	624.194	796.546	174.006	189.803	30%
Process	24.536	43.345	40.252	40.252	164%
Refrigeration	26.581	27.194	26.690	25.907	97%
VFD	89.751	89.629	88.159	87.808	98%
Water Heat	-	-	-	-	N/A
Other	-	-	-	-	N/A
Kitchen	7.106	8.236	8.236	6.952	98%
Motors	298.225	726.346	378.725	378.725	127%
Building Redesign	-	-	-	-	N/A
Total Savings	8,286.153	9,092.458	8,219.879	9,054.122	109%

Note: Totals may not sum properly due to rounding.

As shown in Table 209 below, the therms realization rate was high at 91%, driven by the three largest measure groups: Controls, HVAC, and Process.

TABLE 209. 2020 C&I PROGRAMS *EX ANTE* & *EX POST* GROSS GAS ENERGY SAVINGS

MEASURE	*EX ANTE*[A] NATURAL GAS ENERGY SAVINGS (THERMS/YR.)	AUDITED GROSS NATURAL GAS ENERGY (THERMS/YR.)	VERIFIED GROSS NATURAL GAS ENERGY SAVINGS (THERMS/YR.)	*EX POST* GROSS NATURAL GAS ENERGY SAVINGS (THERMS/YR.)	REALIZATION RATE
Lighting	-	-	-	-	N/A
Non-Lighting	1,117,266.73	1,116,413.69	1,060,216.98	1,011,550.13	91%
Compressed Air	-	-	-	-	N/A
Controls	81,009.00	80,977.00	80,977.00	74,242.94	92%

HVAC	988,580.17	990,795.08	934,598.37	892,856.18	90%
Process	22,194.16	22,194.16	22,194.16	22,648.82	102%
Refrigeration	-	-	-	-	N/A
VFD	-	-	-	-	N/A
Water Heat	7,559.40	7,476.57	7,476.57	6,616.24	88%
Other	17,924.00	14,970.88	14,970.88	15,185.95	85%
Kitchen	-	-	-	-	N/A
Motors	-	-	-	-	N/A
Building Redesign	-	-	-	-	N/A
Total Savings	1,117,266.73	1,116,413.69	1,060,216.98	1,011,550.13	91%

Table 210 shows the realization rates and *ex post* gross savings values for each program and the overall C&I portfolio. The lighting measure group represented a high proportion of electric savings for Prescriptive, New Construction, and SBDI programs. The high electric realization rate for that measure therefore drive the overall electric realization rate for those programs. A higher proportion of Custom program electric savings are from non-lighting measures; therefore, the realization rate skews slightly lower for that program, aligning with lower non-lighting measure realization rates.

TABLE 210. 2020 C&I PROGRAMS *EX POST* GROSS SAVINGS AND REALIZATION RATES

PROGRAM/ MEASURE CATEGORY	KWH			KW			THERMS		
	EX ANTE	*EX POST* GROSS	RR	*EX ANTE*	*EX POST* GROSS	RR	*EX ANTE*	*EX POST* GROSS	RR
Prescriptive Total	30,922,969.13	30,710,230.51	99%	4,998.917	5,734.886	115%	48,674.56	43,567.10	90%
Lighting	30,052,964.90	29,960,651.03	99.7%	4,836.355	5,577.395	115.3%	-	-	N/A
Non-Lighting	870,004.23	749,579.47	86.2%	162.562	157.491	96.9%	48,674.56	43,567.10	89.5%
Custom Total	21,539,803.89	16,425,430.50	76%	1,814.659	1,831.374	101%	545,718.79	467,079.00	86%
Lighting	9,278,250.84	9,456,180.69	101.9%	1,168.699	1,322.988	113.2%	-	-	N/A
Non-Lighting	12,261,553.05	6,969,249.81	56.8%	645.960	508.386	78.7%	545,718.79	467,079.00	85.6%
New Construction Total	6,876,678.04	6,970,012.72	101%	1,358.028	1,354.945	100%	476,200.16	456,873.35	96%
Lighting	5,682,238.23	6,078,319.97	107.0%	1,059.501	1,245.357	117.5%	-	-	N/A
Non-Lighting	1,194,439.81	891,692.76	74.7%	298.527	109.588	36.7%	476,200.16	456,873.35	95.9%
SBDI Total	1,688,787.06	1,727,554.72	102%	114.549	132.917	116%	46,673.22	44,030.68	94%
Lighting	1,682,662.06	1,721,614.82	102.3%	113.712	132.291	116.3%	-	-	N/A
Non-Lighting	6,125.00	5,939.90	97.0%	0.837	0.626	74.7%	46,673.22	44,030.68	94.3%
Total C&I	61,028,238.12	55,833,228.45	91%	8,286.153	9,054.122	109%	1,117,266.73	1,011,550.13	91%

EX POST NET SAVINGS

The evaluation team calculated freeridership and participant spillover using survey data collected from 2020 participants for the Custom and Prescriptive programs. The evaluation team has prioritized estimating NTG every year for the Prescriptive and Custom programs (the largest programs) and will be conducting primary research to reassess NTG for the SBDI and Commercial New Construction programs every other year. For the 2020 SBDI and Commercial New Construction programs, the evaluation team referenced the NTG results from the 2019 evaluation. As shown in Table 211, the evaluation team estimated an 89% NTG ratio for Prescriptive and 92% for Custom.

TABLE 211. 2020 C&I PROGRAM NTG RESULTS

PROGRAM	FREERIDERSHIP (%)[A]	PARTICIPANT SPILLOVER (%)	NTG (%)[a]
Prescriptive	11%	0%	89%
Custom	8%	0%	92%
SBDI[b]	5%	2%	97%
New Construction[b]	33%	0%	67%

a Weighted by survey sample *ex post* gross program MMBtu savings

[b] Primary data collection was not completed for these programs in 2020; these NTG results are referencing the 2019 EM&V results.

FREERIDERSHIP

To determine freeridership, the evaluation team asked respondents questions about whether they would have installed equipment at the same efficiency level, at the same time, and in same amount in the Prescriptive and Custom programs' absence. By combining the previously used *intention* methodology with *influence* methodology, the evaluation team produced a freeridership score for the program by averaging savings-weighted *intention* and *influence* freeridership scores.

INTENTION FREERIDERSHIP

The evaluation team estimated *intention* freeridership scores for all participants, based on their responses to the *intention*-focused freeridership questions. As shown in Table 212, the 2020 Prescriptive and Custom programs *intention* freeridership scores were 11% and 13%, respectively.

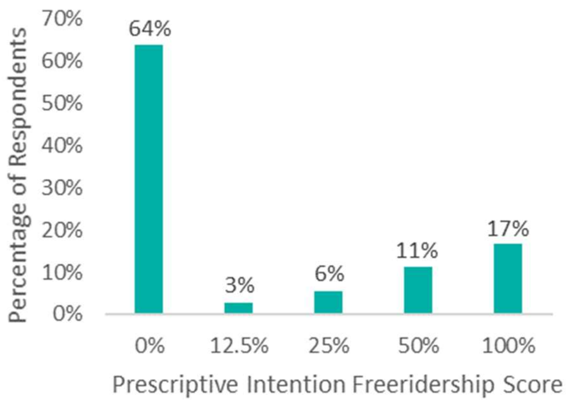
TABLE 212. C&I PROGRAM INTENTION FREERIDERSHIP RESULTS

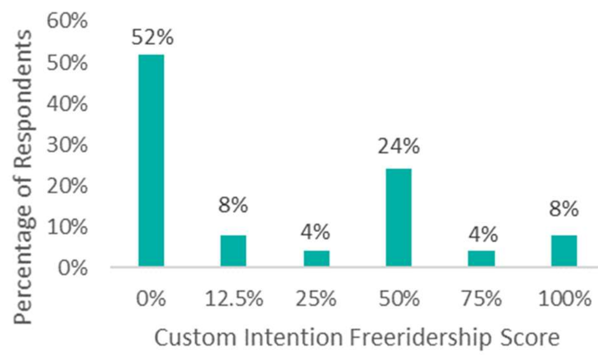
PROGRAM	RESPONSES (N)	INTENTION FREERIDERSHIP SCORE (%)[A]
Prescriptive	72	11%
Custom	25	13%

[a] The freeridership score was weighted by survey sample *ex post* gross program MMBtu savings

Figure 78 shows the distribution of individual intention freeridership scores.

FIGURE 78. 2020 C&I PROGRAM DISTRIBUTION OF INTENTION FREERIDERSHIP SCORES





Source: Participant Survey. Questions: G1 to G9 and G11 are used to estimate an *intention* freeridership score.

INFLUENCE FREERIDERSHIP

Prescriptive

The evaluation team assessed influence freeridership by asking participants how important various Prescriptive program elements were in their purchasing decision-making process.

shows the program elements participants rated for importance, along with a count and average rating for each factor.

TABLE 213. 2020 C&I PRESCRIPTIVE PROGRAM INFLUENCE FREERIDERSHIP RESPONSES

INFLUENCE RATING	INFLUENCE SCORE	THE NIPSCO INCENTIVE	INFORMATION PROVIDED BY NIPSCO ON ENERGY SAVING OPPORTUNITIES	RECOMMENDATION FROM CONTRACTOR OR VENDOR	PREVIOUS PARTICIPATION IN A NIPSCO ENERGY EFFICIENCY PROGRAM
1 - Not at all important	100%	1	7	6	9
2	75%	4	10	4	10
3	25%	5	20	12	6
4 - Very important	0%	62	31	43	23
Not applicable	50%	0	4	7	24
Average		3.8	3.1	3.4	2.9

The evaluation team determined each respondent's influence freeridership rate, using the maximum rating provided for any factor included in

. As shown in Table 214, the respondents' maximum influence ratings ranged from 1 (not at all important) to 4 (very important). A maximum score of 1 meant the customer ranked all factors from the table as not at all important, while a maximum score of 4 means the customer ranked at least 1 factor very important. Counts refer to the number of "maximum *influence*" responses for each factor, or *influence* score, response option.

TABLE 214. 2020 C&I PRESCRIPTIVE PROGRAM INFLUENCE FREERIDERSHIP SCORE

MAXIMUM INFLUENCE RATING	INFLUENCE SCORE	COUNT	TOTAL SURVEY SAMPLE *EX POST* MMBTU SAVINGS	INFLUENCE SCORE MMBTU SAVINGS
1 - Not at all important	100%	1	-	-
2	75%	4	27	20
3	25%	5	980	245
4 - Very important	0%	62	8,075	0
Not applicable	50%	0	0	-
Average Maximum Influence Rating - Simple Average		3.9		
Average Influence Score - Weighted by *Ex Post* Savings				3%

The average influence score of 3% for the 2020 Prescriptive program is weighted by *ex post* gross MMBtu program savings.

Custom

Table 215 shows Custom program elements participants rated for importance, along with a count and average rating for each factor.

TABLE 215. 2020 C&I CUSTOM PROGRAM INFLUENCE FREERIDERSHIP RESPONSES

INFLUENCE RATING	INFLUENCE SCORE	THE NIPSCO INCENTIVE	INFORMATION PROVIDED BY NIPSCO ON ENERGY SAVING OPPORTUNITIES	RECOMMENDATION FROM CONTRACTOR OR VENDOR	PREVIOUS PARTICIPATION IN A NIPSCO ENERGY EFFICIENCY PROGRAM
1 - Not at all important	100%	0	0	2	1
2	75%	3	4	0	2
3	25%	2	5	7	6
4 - Very important	0%	20	15	16	8
Don’t know	50%	0	1	0	8
Not applicable	50%	0	0	0	1
Average		3.7	3.5	3.5	3.2

The evaluation team determined each respondent’s influence freeridership rate for each measure category using the maximum rating provided for any factor above. As shown above, the respondents’ maximum influence ratings ranged from 1 (not at all important) to 4 (very important). A maximum score of 1 meant the customer ranked all factors as not at all important, while a maximum score of 4 means the customer ranked at least 1 factor very important. Counts refer to the number of “maximum influence” responses for each factor, or influence score, response option.

TABLE 216. 2020 C&I CUSTOM PROGRAM INFLUENCE FREERIDERSHIP SCORE

MAXIMUM INFLUENCE RATING	INFLUENCE SCORE	COUNT	TOTAL SURVEY SAMPLE *EX POST* MMBTU SAVINGS	INFLUENCE SCORE MMBTU SAVINGS
1 - Not at all important	100%	0	-	-
2	75%	0	0	0
3	25%	3	789	197
4 - Very important	0%	22	12,308	0
Average Maximum Influence Rating - Simple Average		3.9		
Average Influence Score - Weighted by *Ex Post* Savings				2%

The average influence score of 2% for the 2020 Custom program is weighted by *ex post* gross MMBtu program savings.

FINAL FREERIDERSHIP

The evaluation team calculated the mean of *intention* and the *influence* of freeridership components to estimate final freeridership for the Prescriptive and Custom programs:

$$Final\ Prescriptive\ Freeridership\ (11\%) = \frac{Intention\ FR\ Score\ (18\%) + Influence\ FR\ Score\ (3\%)}{2}$$

$$Final\ Custom\ Freeridership\ (8\%) = \frac{Intention\ FR\ Score\ (13\%) + Influence\ FR\ Score\ (2\%)}{2}$$

A higher freeridership score translates to more savings that are deducted from the gross savings estimates. Table 40 Table 40 lists the intention, influence, and final freeridership scores for the 2020 Prescriptive and Custom programs.

TABLE 217. 2020 C&I PROGRAM FREERIDERSHIP SCORE

PROGRAM	INTENTION SCORE	INFLUENCE SCORE	FREERIDERSHIP SCORE
Prescriptive	18%	3%	11%
Custom	13%	2%	8%

PARTICIPANT SPILLOVER

The evaluation team estimated participant spillover[62] measure savings using specific information about participants determined through the evaluation using the Indiana TRM v2.2 as a baseline reference. The evaluation team estimated the percentage of program participant spillover by dividing the sum of additional spillover savings (as reported by survey respondents) by the total gross savings achieved by all survey respondents.

The evaluation team found no evidence of meaningful spillover savings. Only the Prescriptive program resulted in savings, which were too low compared with program savings, resulting in 0% for both programs, rounded to the nearest whole percent, as shown in Table 218.

TABLE 218. 2020 C&I PROGRAM PARTICIPANT SPILLOVER RESULTS

PROGRAM	SPILLOVER SAVINGS (MMBTU)	PARTICIPANT PROGRAM SAVINGS (MMBTU)	PARTICIPANT SPILLOVER
Prescriptive	44	9,082	0%
Custom	0	0	0%

[62] Non-participant spillover evaluation activities were not conducted for the 2020 program year.

RESULTING NET SAVINGS

Table 219 and Table 220 presents the resulting Prescriptive and Custom net electric savings, demand reduction, and natural gas savings.

TABLE 219. 2020 C&I PRESCRIPTIVE *EX POST* NET SAVINGS

MEASURE CATEGORY	*EX POST* GROSS SAVINGS/REDUCTION			NTG	*EX POST* NET SAVINGS/REDUCTION		
	KWH	KW	THERMS		KWH	KW	THERMS
HVAC	75,053.61	37.732	36,950.86	89%	66,797.71	33.582	32,886.27
Kitchen	39,709.02	6.952	0.00	89%	35,341.03	6.187	0.00
Lighting	29,960,651.03	5,577.395	0.00	89%	26,664,979.42	4,963.882	0.00
Refrigeration	108,795.61	24.998	0.00	89%	96,828.09	22.248	0.00
VFD	526,021.24	87.808	0.00	89%	468,158.90	78.150	0.00
Water Heat	0.00	0.000	6,616.24	89%	0.00	0.000	5,888.45
Total Savings	30,710,230.51	5,734.886	43,567.10	89%	27,332,105.15	5,104.049	38,774.72

TABLE 220. 2020 C&I CUSTOM *EX POST* NET SAVINGS

MEASURE	*EX POST* GROSS SAVINGS/REDUCTION			NTG	*EX POST* NET SAVINGS/REDUCTION		
	KWH	KW	THERMS		KWH	KW	THERMS
Compressed Air	1,769,128.04	4.407	0.00	92%	1,627,597.80	4.054	0.00
Controls	349,419.16	13.985	74,242.94	92%	321,465.63	12.867	68,303.50
HVAC	503,063.72	71.017	375,992.06	92%	462,818.62	65.336	345,912.70
Lighting	9,456,180.69	1,322.988	0.00	92%	8,699,686.24	1,217.149	0.00
Motors	2,422,774.03	378.725	0.00	92%	2,228,952.11	348.427	0.00
Process	1,865,679.33	40.252	1,658.05	92%	1,716,424.98	37.031	1,525.41
Refrigeration	59,185.52	0.000	0.00	92%	54,450.68	0.000	0.00
VFD	0.00	0.000	0.00	92%	0.00	0.000	0.00
Other	0.00	0.000	15,185.95	92%	0.00	0.000	13,971.08
Total Savings	16,425,430.50	1,831.374	467,079.00	92%	15,111,396.06	1,684.864	429,712.68

PROCESS EVALUATION

As part of the process evaluation, the team reviewed the program database and program materials and surveyed Custom and Prescriptive program participants. The team also interviewed NIPSCO's program manager and program implementation staff to gain a better understanding of the program design and delivery process and any associated changes or challenges experienced in 2020. The evaluation team sought to answer the following process-related research questions through these research activities:

- What are the most effective referral sources for C&I customers, and to what extent are those sources being leveraged by the program?
- What are the barriers and challenges to energy efficiency and program participation?
- What are the primary reasons for participation?

- Are participants satisfied with the program and its components, and what opportunities exist to improve participants' experience?
- What type of C&I customers is the program reaching? Is there a segment the program may want to target for future efforts?

PARTICIPANT FEEDBACK

The evaluation team surveyed 97 customers who participated in the Prescriptive (n=72) and Custom (n=25) programs (out of a sample of 636 participants, representing a 15% response rate). The following sections describe the results related to source of awareness, motivations for and barriers to energy efficiency and program participation, satisfaction with the program, and program impacts on customers.

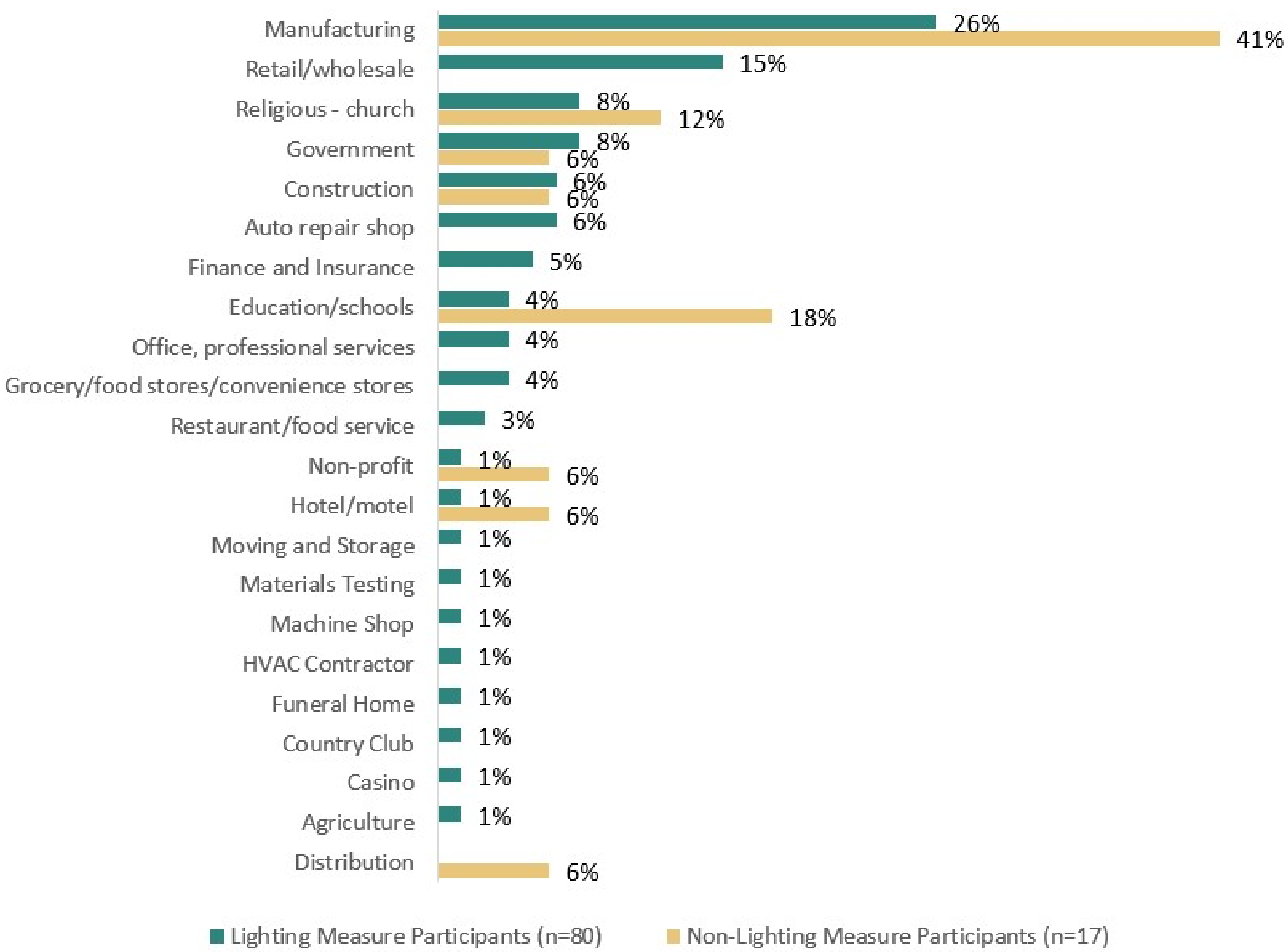
The previous evaluation found that participants were more likely to recall their experience with NIPSCO's commercial energy efficiency programs according to the measures they installed, rather than their specific program participation. For example, customers would recall that they received rebates for lights, but not necessarily that these were prescriptive program rebates. As such, certain survey results are segmented by the type of measures that participants received through the program, broken down into lighting (n=80) and non-lighting (n=17) measures, while other questions related directly to program processes and satisfaction are segmented by program. The relatively low number of responses from non-lighting measure participants prevents any further segmentation, and significant differences are reported where appropriate. The team also re-analyzed the survey data captured for the PY 2019 evaluation using these same segmentations (lighting and non-lighting, and custom and prescriptive); those results are presented in the discussion for context, and statistical differences are discussed where appropriate. Table 221 presents the count of PY 2020 survey respondents by measure type, and their designation as lighting or non-lighting.

TABLE 221: COUNT OF SURVEY RESPONDENTS BY MEASURE TYPE

MEASURE TYPE	TYPE	COUNT
Linear LED	Lighting	33
LED	Lighting	18
Exterior LED	Lighting	14
LED Fixture	Lighting	12
De-lamping (T12)	Lighting	1
Lighting Fixture	Lighting	1
Occupancy Sensor	Lighting	1
Furnace	Non-lighting	6
Air Compressor	Non-lighting	2
Boiler	Non-lighting	2
Energy Management System	Non-lighting	1
HVAC Upgrade	Non-lighting	1
Infrared Heater	Non-lighting	1
Oven	Non-lighting	1
Process Improvement	Non-lighting	1
Steam Trap	Non-lighting	1
Supply Fan	Non-lighting	1

NIPSCO's Commercial Energy Efficiency programs reach a wide variety of business types (Figure 79). Manufacturing was the most common business type surveyed of both non-lighting measure participants (41%) and lighting measure participants (26%). Among non-lighting measure participants, schools (education) were the next most common respondent type (18%), followed by churches (12%). Among lighting measure participants, retail/wholesale was the second most common respondent type (15%) followed by churches (8%), government (8%), construction (6%), and auto repair shops (6%).

FIGURE 79: SURVEY RESPONDENT INDUSTRY TYPE



Analysis of the program's tracking data, which includes an industry indicator, shows that government and industrial organizations made up the greatest portion of the 2020 Prescriptive and Custom programs' electric and therms savings. To assess the distribution of savings across customer segments, the evaluation team compared 2018 to 2020 program participation by building type designation. Although it may be a factor of improvement in designating a building type over time, the following segments exhibited growth in the percentage of total *ex ante* electric savings achieved for the programs from 2018 to 2020: entertainment/recreation, government, healthcare, and office. These segments improved in the percentage of total therm savings achievement for the programs: entertainment/recreation, government, healthcare, industrial, and warehouse. Table 222 shows the proportion of the total Prescriptive and Custom program savings achieved from 2018 to 2020 for all designated customer segments.

TABLE 222. PERCENTAGE *EX ANTE* SAVINGS ACHIEVEMENT BY CUSTOMER SEGMENT

CUSTOMER SEGMENT	2018		2019		2020	
	EX ANTE KWH	*EX ANTE* THERMS	*EX ANTE* KWH	*EX ANTE* THERMS	*EX ANTE* KWH	*EX ANTE* THERMS
Agriculture/Farming	0.0%	0.0%	0.1%	0.0%	1.6%	0.0%
Automotive Services	1.7%	0.0%	3.6%	0.0%	2.6%	0.0%
Education	14.5%	7.6%	10.3%	31.4%	8.5%	14.2%
Entertainment/Recreation	0.6%	0.0%	0.8%	0.1%	3.0%	1.2%
Faith-Based	0.8%	28.0%	2.3%	2.0%	2.0%	4.0%
Food & Beverage Service	0.9%	0.1%	1.8%	0.1%	1.3%	0.0%
Gas Station	2.2%	0.0%	0.5%	0.0%	0.6%	0.0%
Government	3.3%	2.7%	5.5%	2.7%	15.7%	14.1%
Grocery and Convenience	6.3%	0.0%	3.6%	0.0%	5.3%	0.0%
Healthcare	2.1%	0.0%	2.7%	0.1%	5.2%	6.4%
Industrial	6.5%	1.1%	35.2%	33.2%	32.6%	51.5%
IT/Data Center	0.0%	0.0%	0.0%	0.0%	0.4%	0.0%
Lodging	1.3%	0.1%	0.7%	0.0%	1.6%	0.0%
Office	1.6%	0.2%	2.9%	4.0%	4.7%	0.4%
Parking Garage	0.0%	0.0%	0.3%	0.1%	0.0%	0.0%
Retail	12.1%	0.0%	21.7%	0.1%	9.2%	0.1%
Warehouse	0.6%	0.0%	5.9%	6.0%	5.6%	8.2%
Unspecified[1]	45.4%	60.1%	2.0%	20.2%	0.0%	0.0%

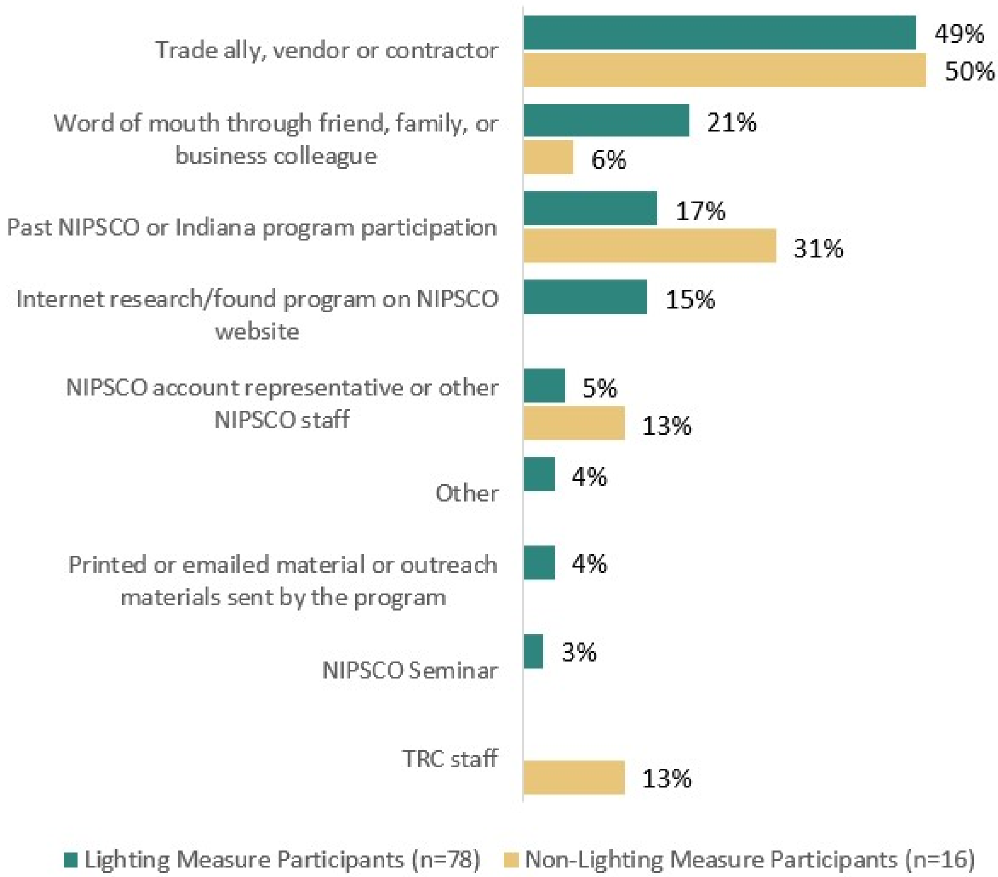
[1] 12% and 100% of the 2018 Prescriptive and Custom electric savings and 3% and 100% of the 2018 Prescriptive and Custom therm savings did not include a building type designation in the project data. Similarly, 3% and 1% of the 2019 Prescriptive and Custom program electric savings, and 19% and 20% of the 2019 Prescriptive and Custom therm savings did not include a building type designation in the project data.

ENERGY EFFICIENCY AWARENESS AND MARKETING

In 2020 the implementer sent 30 marketing emails and newsletters (including reminder emails), hosted three webinars, and provided six trade ally orientation sessions and one trade ally round table to market the C&I programs to trade allies and nonresidential customers. Like the implementer's efforts to target education and lodging industries in 2019, the implementer sent industry-specific emails to office, restaurant, warehouse/manufacturing, and retail industry customers.

Trade allies continued to be the driving force of program awareness in 2020; about 50% of recipients said they learned about the program through their trade allies (Figure 80). This is like 2019 when 48% of respondents (n=100) indicated that trade allies were their primary source of program awareness. Word of mouth was a significant source of awareness for recipients of lighting measures in 2020, however only one recipient of non-lighting measures indicated it was a source of program awareness. Conversely, non-lighting measure participants were more likely (not statistically significant) to report previous program participation as a source of awareness (31% n=16) compared to lighting measure participants (17% n=78). Awareness levels were similarly distributed by program participation, and statistically equivalent across years.

FIGURE 80: HOW PARTICIPANTS LEARNED ABOUT THE PROGRAM

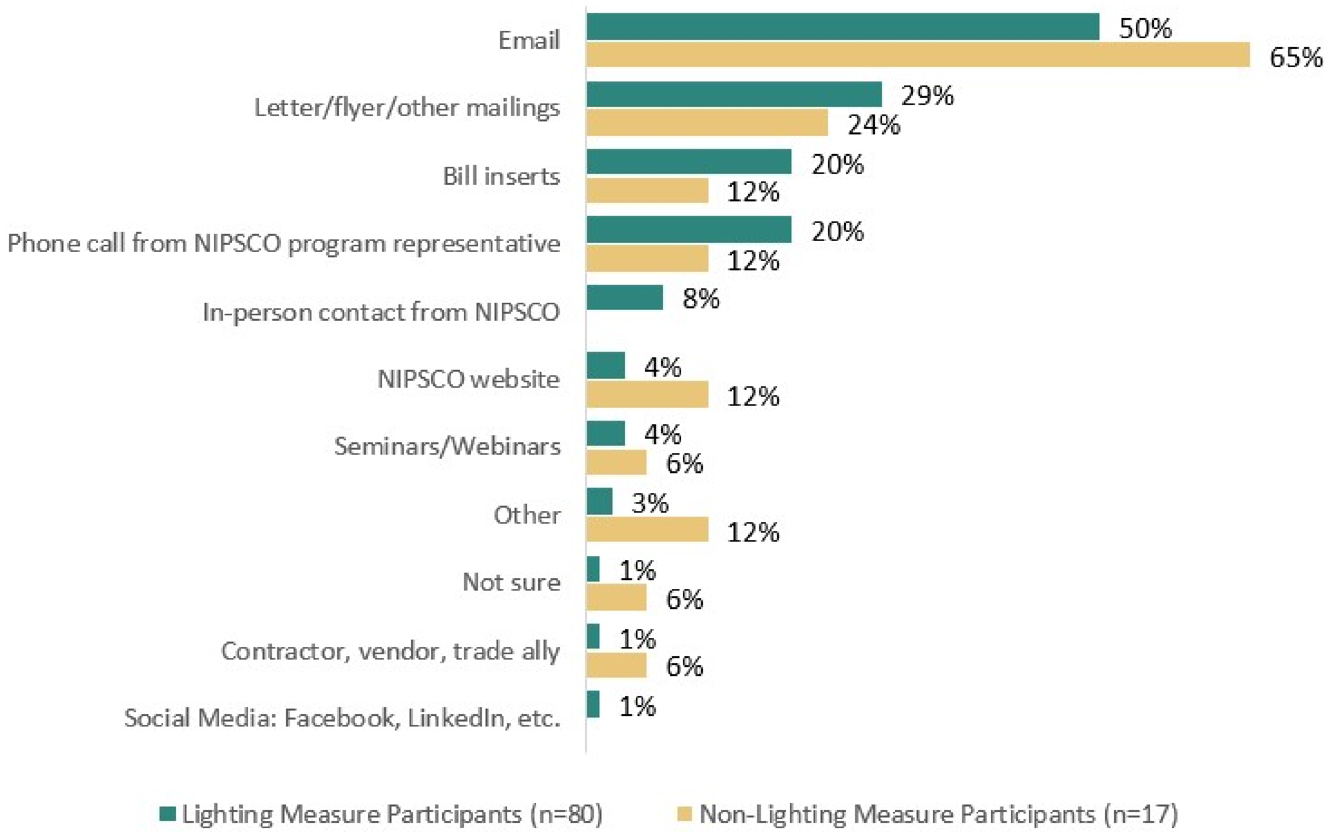


Source: Survey Question B1: “How did you learn about NIPSCO’s incentive program?” Multiple responses allowed.

While trade allies and contractors are currently the leading source of program awareness, they are not the preferred channel from which customers desire to learn about energy efficiency opportunities; in fact, they were the second least commonly cited preferred source of awareness overall among respondents (

Figure 81). Email communication is the preferred way for NIPSCO to keep organizations informed about opportunities to save energy followed by letters, flyers, or other mailings, bill inserts, and direct phone calls from NIPSCO program representatives. This is like 2019, when email was reported as the preferred communication channel (43% n=145), while trade and contractors were one of the least preferred (3%).

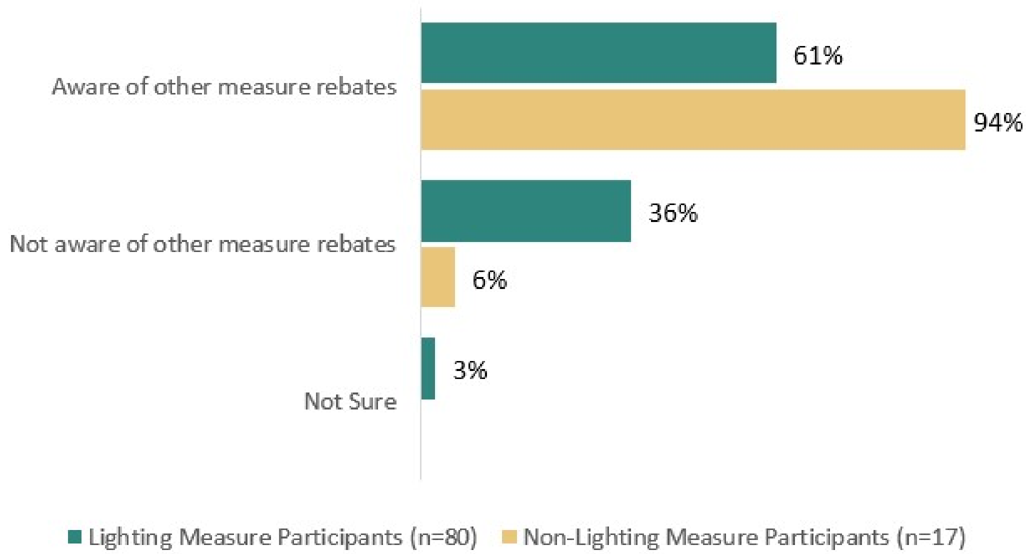
FIGURE 81: PREFERRED ENERGY EFFICIENCY COMMUNICATION CHANNEL



Source: Survey Question B4: "In your opinion, what is the best way for NIPSCO to keep organizations like yours informed about opportunities to save energy?"

Participants who install non-lighting measures are potentially more engaged with NIPSCO's Commercial programs. Of 2020 respondents, significantly more non-lighting measure participants ($p \leq 0.05$) reported that they were aware that NIPSCO offered business customers rebates for other energy efficiency measures besides what they installed (94%), while only 61% of lighting measure participants reported the same awareness (67% total, Figure 82). This aligns with the previous finding that non-lighting measure recipients were more likely (not significantly) to express awareness of the commercial program offerings due to their previous program participation. The most cited other measure among lighting measure participants was HVAC equipment (51%), while the most cited measure among non-lighting measure participants was lighting measures (56%). Appliances were the only measure cited by more than 10% of lighting measure participants (12%), while boiler replacements were the only other measure cited by more than 10% of non-lighting measure participants (13%). Survey respondents were not asked this exact question in 2019.

FIGURE 82: AWARENESS OF OTHER COMMERCIAL ENERGY EFFICIENCY OPPORTUNITIES

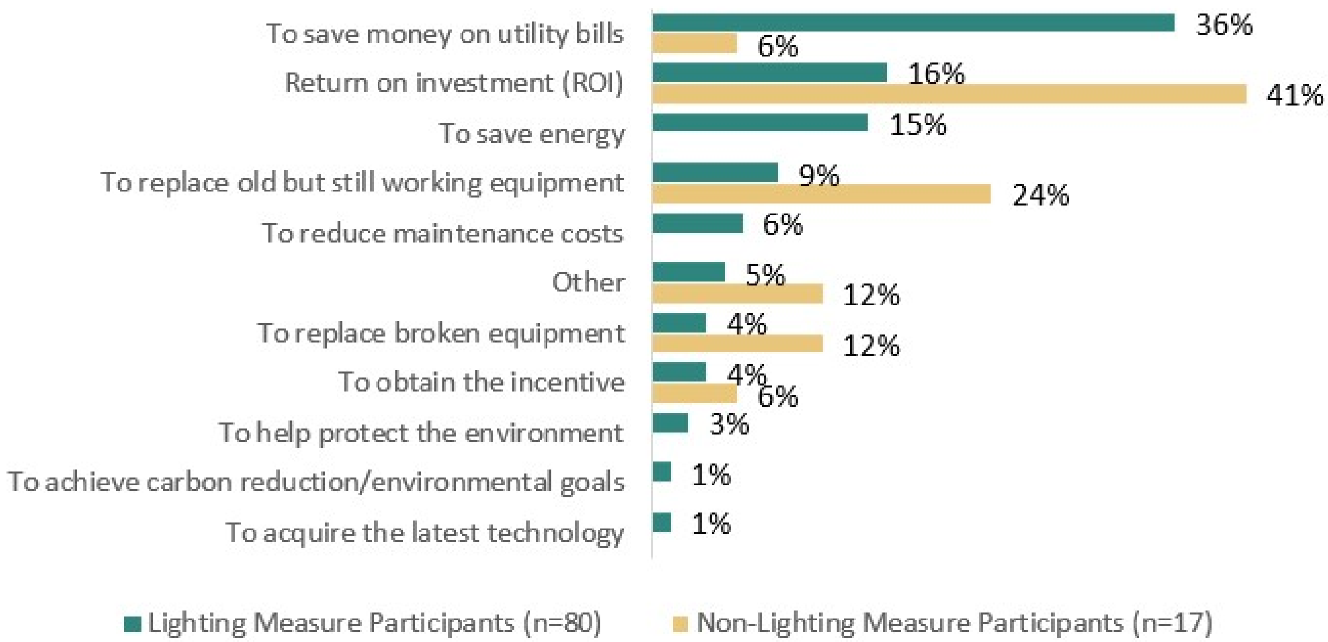


Source: Survey Question B2: "Besides the [MEASURE] rebates, are you aware that NIPSCO offers rebates for other energy-efficient commercial and industrial equipment and services?"

PARTICIPATION DRIVERS AND BARRIERS

Lighting and non-lighting measure participants expressed different motivations for completing an energy efficiency project (Figure 83). Lighting measure participants reported that their primary motivation for completing their project was to save money on utility bills (36%, n=80), while non-lighting measure participants said return on investment (ROI) was their primary motivation (41%, n=17). A desire to reduce operating costs is at the root of both of these drivers; however, the different way that each of these participant types (lighting measure participants and non-lighting measure participants) interpret the benefit of reduced operating costs (reduced energy bills or a strong ROI) may be indicative of a variation in the decision-making process and criteria used by different business types, and may be useful in tailoring marketing and outreach campaigns of these measure types. Additionally, non-lighting measure participants were significantly more likely to report a desire to replace old but still working equipment as their primary motivation ($p \leq 0.10$). Survey respondents were not asked this exact question in 2019.

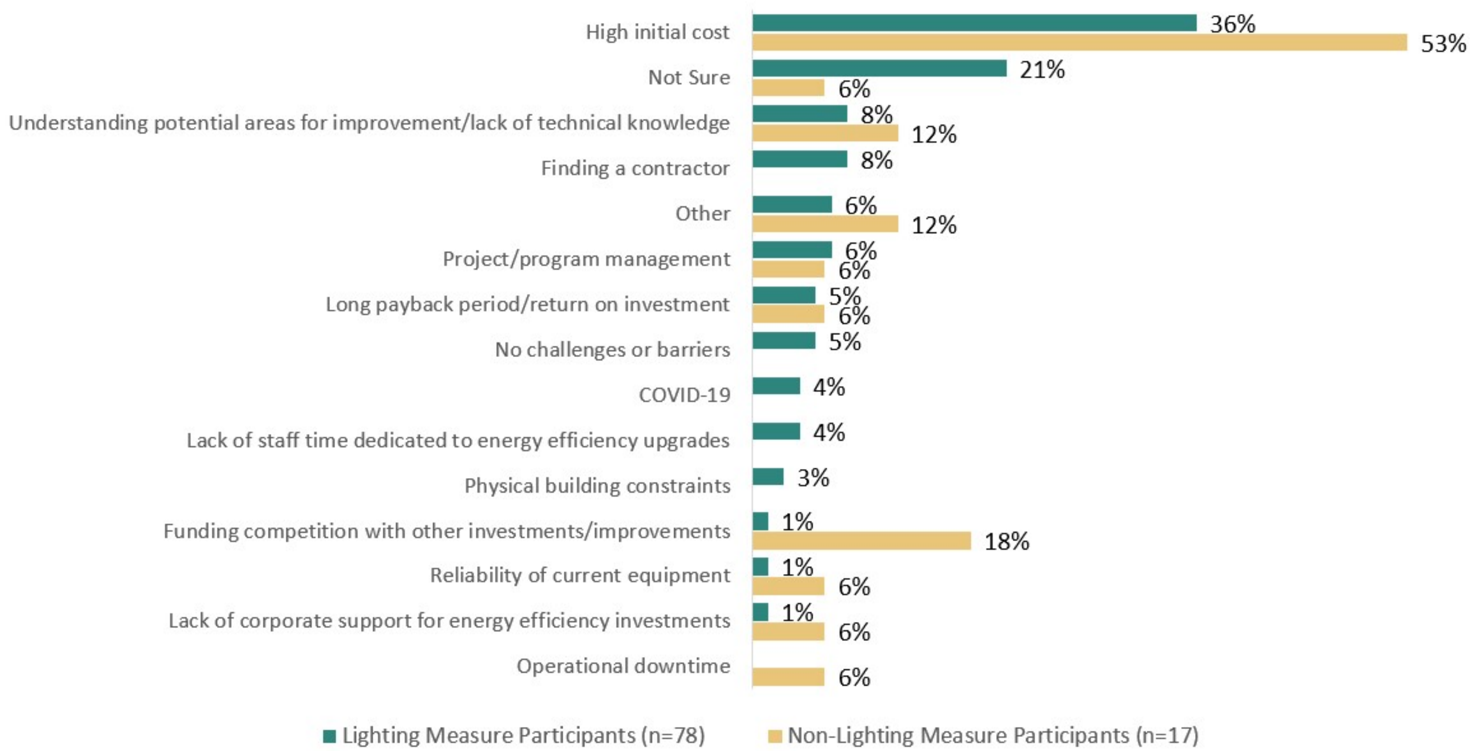
FIGURE 83: PRIMARY MOTIVATION FOR INSTALLING ENERGY EFFICIENT EQUIPMENT



Source: Survey Question C1: "What two factors were most important in your decision to invest in an energy efficiency project at your organization?"

High initial cost is the primary barrier to installing energy efficient equipment for both recipients of lighting and non-lighting measures, which was consistent with 2019 findings. Non-lighting measure participants were significantly more likely ($p \leq 0.05$) to cite funding competition with other investments as a barrier (18%) compared to lighting measure participants (3%). "Other" responses included difficulty making the initial decision (n=1), and objections to replacing still operational equipment (n=1).

FIGURE 84: PRIMARY BARRIER TO INSTALLING ENERGY EFFICIENT EQUIPMENT



Source: Survey Question D1: "When considering improvements to increase commercial and industrial energy efficiency, what are the most significant challenges that organizations face?". Multiple responses allowed.

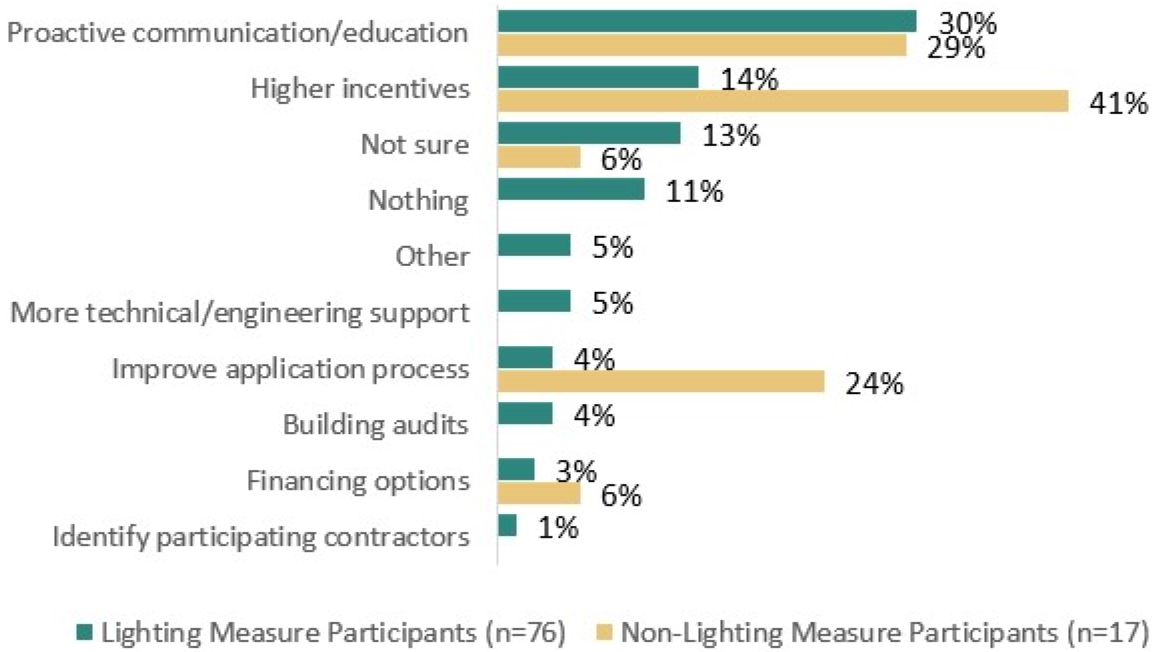
Among lighting measure participants, proactive communication or education regarding available program opportunities was cited as the number one thing NIPSCO could do to help their business overcome the challenges faced when investing in energy efficiency (Figure 85). Recipients of non-lighting measures were equally likely to note proactive communication/education as an opportunity. Specific requests for proactive communication or education included:

- "Continue to provide information on the latest technologies available that help us save money."
- "Be more proactive in making customers aware of programs that they would be eligible for without applying."
- "Be more proactive when we need to find the best products at low cost."

The desire among customers for more proactive communication or education related to program offerings, taken with the previous finding that customers would prefer to learn about programs via communication from NIPSCO rather than their trade ally, indicates that there may be potential for NIPSCO to increase the frequency of, and diversify the types of communication provided to commercial customers.

Non-lighting recipients also noted higher incentives as an opportunity, even more so than proactive communication. These responses may be a result of non-lighting equipment generally being more expensive, with a smaller portion of costs covered by the incentive.

FIGURE 85: OPPORTUNITIES FOR NIPSCO TO SUPPORT ORGANIZATIONS WITH ENERGY EFFICIENCY



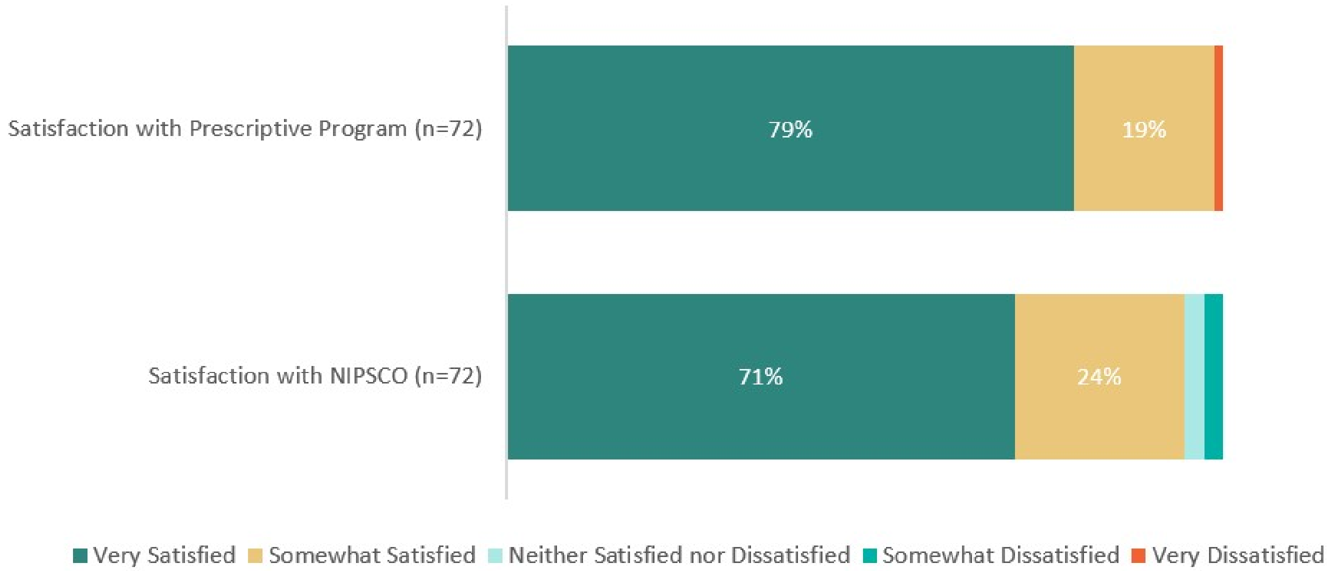
Source: Survey Question D2: "What could NIPSCO do to help organizations like yours overcome the challenges faced when investing in energy efficiency equipment?"

PARTICIPANT SATISFACTION – PRESCRIPTIVE PROGRAM

OVERALL SATISFACTION WITH PROGRAM AND NIPSCO

Respondents expressed high levels of satisfaction with the Prescriptive program in 2020. Nearly all 2020 Prescriptive program respondents (98%, n=72) indicated that they were either *somewhat satisfied* or *very satisfied* with the program overall (Figure 86), statistically equivalent to the responses provided in 2019 (94%, n=70). Participation satisfaction with NIPSCO as a service provider likewise remained high in 2020, with 95% of prescriptive program participants (n=72) indicating that they were either *somewhat satisfied* or *very satisfied* with the program overall, again statistically equivalent to 2019 responses (94%, n =69).

FIGURE 86: OVERALL SATISFACTION WITH PRESCRIPTIVE PROGRAM AND NIPSCO



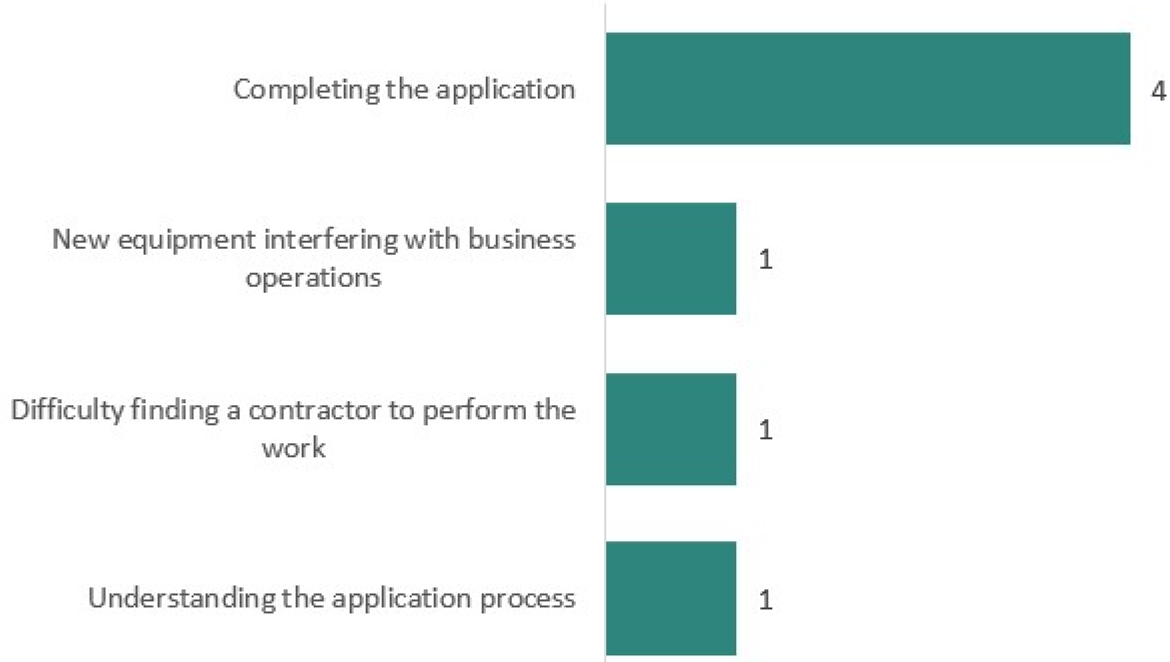
Source: Survey Question F2: "How satisfied are you with NIPSCO's [PROGRAM] program overall?" and Survey Question F7: "How satisfied are you with NIPSCO overall as your organization's utility service provider?"

Further, most Prescriptive program respondents supported their rating with positive comments, specifically concerning the ease of participation and the support provided by TRC:

- "Everything worked with hardly impacting my life at all. It was smooth. The process could not have made me happier."
- "Everything came through. When we went through the actual process I did not hear of any problems. Everything seemed to flow fine."
- "We have participated 5 or 6 times over the last 10 years, and it has helped tremendously."
- "Applying is easy. If I have any questions, I got good help and people respond quickly if I need more information."

A relatively low percentage of respondents indicated that they experienced challenges while participating in the Prescriptive program (n=7). Among these respondents, challenges with completing the application were the most common issue cited (Figure 87).

FIGURE 87: CHALLENGES EXPERIENCED THROUGH PRESCRIPTIVE PROGRAM PARTICIPATION

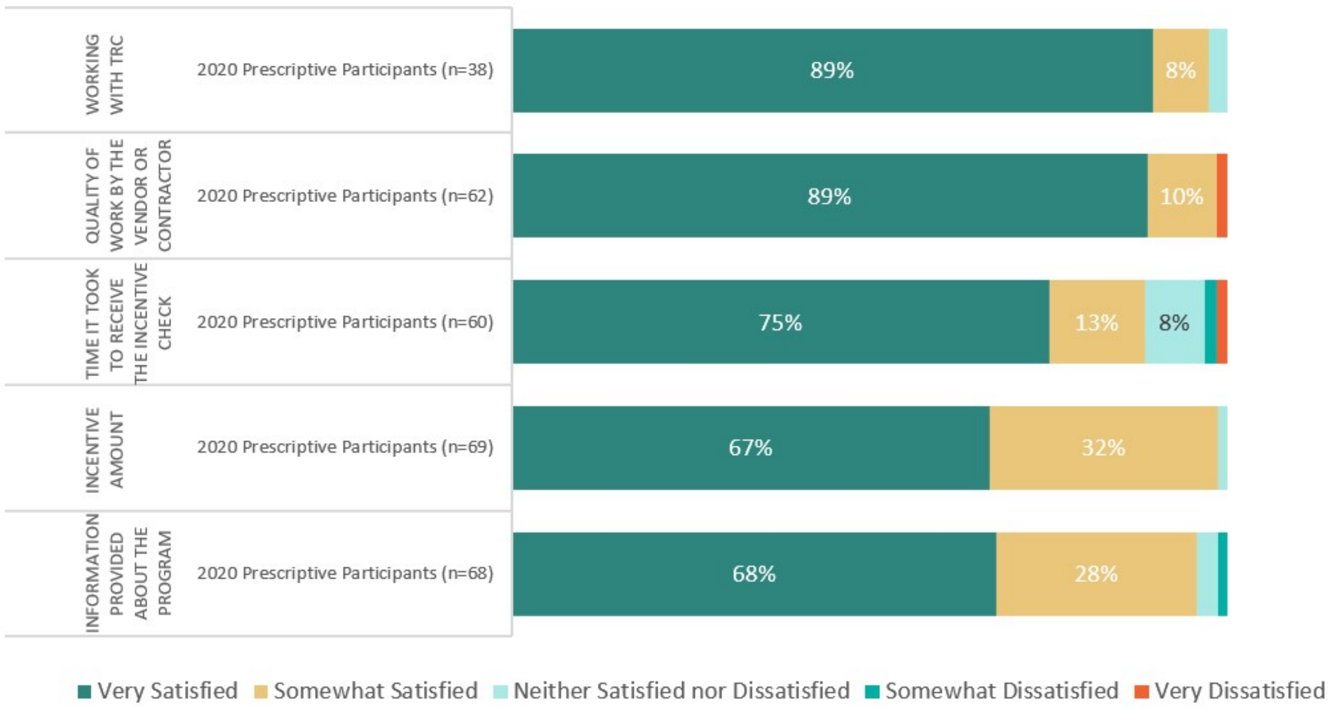


Source: Survey Question F5: “Please describe the challenges you experienced participating in the program.”

SATISFACTION WITH PROGRAM PROCESSES

Respondents were generally satisfied with each of the Prescriptive program components, with a minimum of 88% of respondents rating their satisfaction as either *very satisfied* or *somewhat satisfied* to each question (Figure 88). Based on the percentage of *very satisfied* or *somewhat satisfied* responses, respondents were least satisfied with the time it took to receive the incentive check (88%, n=60) and most satisfied with the incentive amount (99%, n=69). The largest year over year change in satisfaction (*somewhat satisfied* or *very satisfied*) with a component of the Prescriptive program was for satisfaction with the incentive amount, which increased from 94% in 2019 (n=68), though none of the year over year differences in satisfaction were statistically significant for the Prescriptive program.

FIGURE 88: SATISFACTION WITH PRESCRIPTIVE PROGRAM PROCESSES



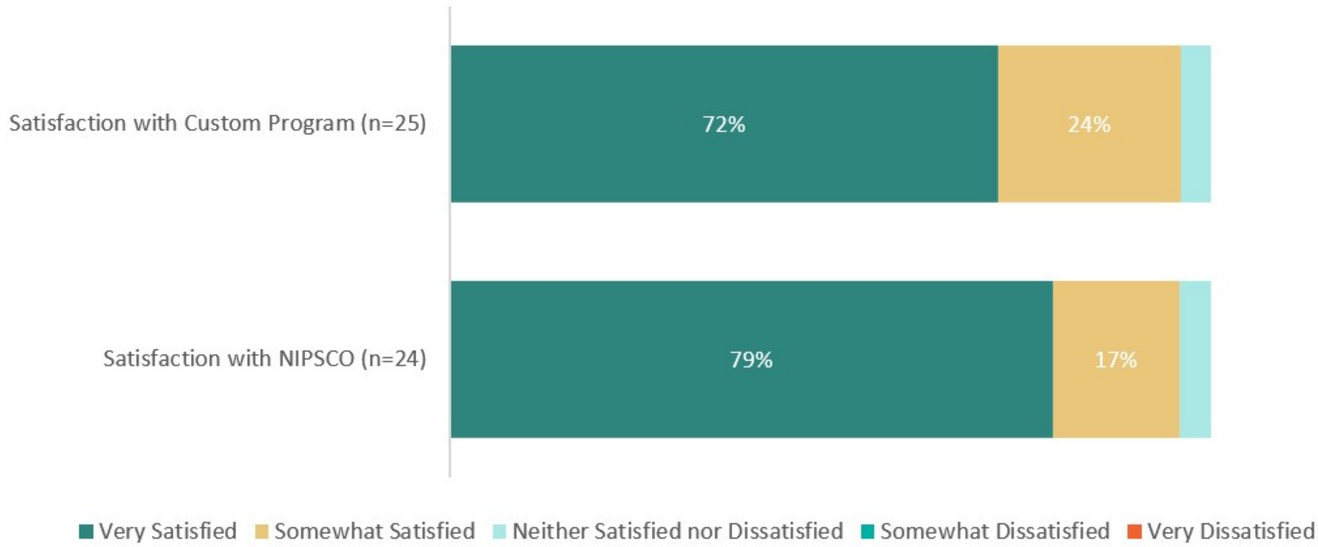
Source: Survey Questions F1.1 through F1.5: "How would you rate your satisfaction with…"

PARTICIPANT SATISFACTION – CUSTOM PROGRAM

OVERALL SATISFACTION WITH PROGRAM AND NIPSCO

Respondents also expressed high levels of satisfaction with the Custom program in 2020. Nearly all (96%) 2020 Custom program respondents (n=25) indicated that they were either *somewhat satisfied* or *very satisfied* with the program overall (Figure 89), statistically equivalent to the responses seen in 2019. As with respondent satisfaction with the Custom program, satisfaction with NIPSCO as a service provider remained high in 2020, with 95% of Custom program participants (n=24) indicating that they were either *somewhat satisfied* or *very satisfied* with the program overall.

FIGURE 89: OVERALL SATISFACTION WITH CUSTOM PROGRAM AND NIPSCO



Source: Survey Question F2: "How satisfied are you with NIPSCO's [PROGRAM] program overall?" and Survey Question F7: "How satisfied are you with NIPSCO overall as your organization's utility service provider?"

As with Prescriptive program participants, most Custom program respondents praised the ease of participation and the support provided by TRC:

- "The experience was great. TRC manages the program very well."
- "I got an email every week saying what needed to be completed so I didn't miss a beat."
- "They don't over complicate the application; it was easy and (we got) a response very quickly when contacting them."
- "They were efficient. They answered questions and gave us additional information, both from NIPSCO and the vendor."

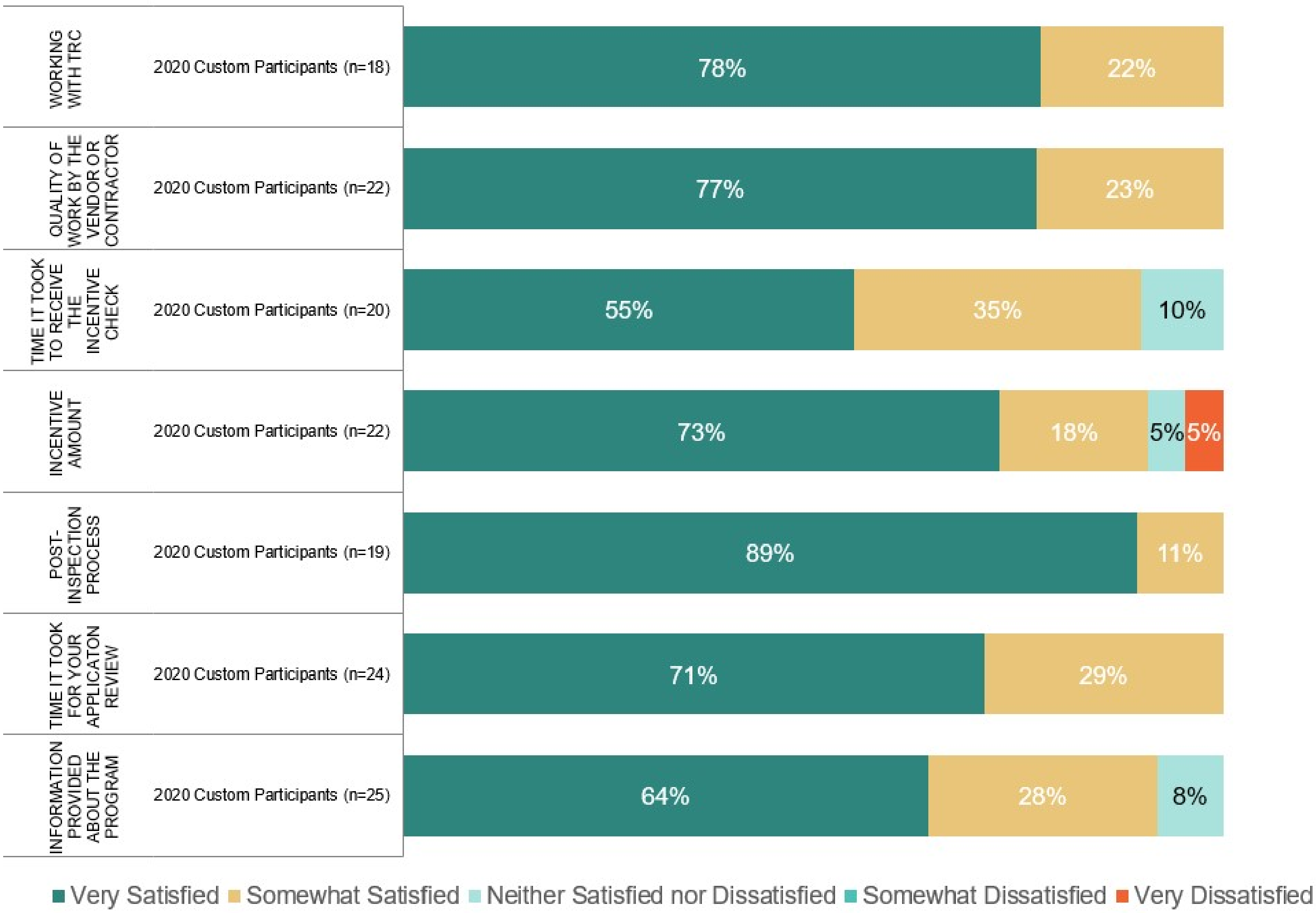
A relatively low percentage of respondents indicated that they experienced challenges while participating in the Custom program (n=4). Among these respondents, one participant each cited: challenges with completing the application, difficulty receiving the rebate, having to wait an extended time for pre-approval, and confusion regarding who to contact for information.

SATISFACTION WITH PROGRAM PROCESSES

Respondents were generally satisfied with each of the Custom program processes, with a minimum of 90% of respondents rating their satisfaction as either *very satisfied* or *somewhat satisfied* to each question (Figure 90). For four questions (satisfaction with working with TRC, satisfaction with quality of contractor or vendor work, satisfaction with the post-inspection process, and satisfaction with time of application review) 100% of respondents indicated they were either *very satisfied* or *somewhat satisfied*. Based on the percentage of *very satisfied* responses, respondents were least satisfied with the time it took to receive the incentive check (55%).

Custom program participants are required to receive pre-approval on all applications submitted, and to receive an inspection of the work performed upon its completion. Satisfaction with this component of the program was the only significant difference from 2019 results, as participants expressed significantly higher satisfaction (*somewhat satisfied* or *very satisfied*) with the application review process (p≤0.10) in 2020 (100%, n=24) compared to 2019 (86%, n=29). Conversely, 2020 participants were less satisfied (not significantly) with the post-inspection process (91%, n=21) compared to 2019 (100%, n=26). One other notable (not significant) year over year difference was participant satisfaction with the time to receive the incentive check (78% in 2019, n=27 to 90% in 2020, n=20).

FIGURE 90: PARTICIPANT SATISFACTION WITH CUSTOM PROGRAM PROCESSES



Source: Survey Questions F1.1 through F1.5: "How would you rate your satisfaction with…"

INCENTIVE SATISFACTION AND LIKELIHOOD TO REPLACE

Prescriptive program participants were significantly more likely (p≤0.10) to report that they were either *somewhat satisfied* or *very satisfied* with the incentive amount (99%, n=69) compared to 2020 Custom program participants (91%, n=22). To investigate the difference in satisfaction, the evaluation team used the implementer's tracking data to compare the portion of project costs offset by incentives by program.

While Prescriptive program participants expressed significantly higher satisfaction with the incentive amount than Custom program participants, the Custom program paid a higher percentage of 2020 project costs than the Prescriptive program overall (Table 223).

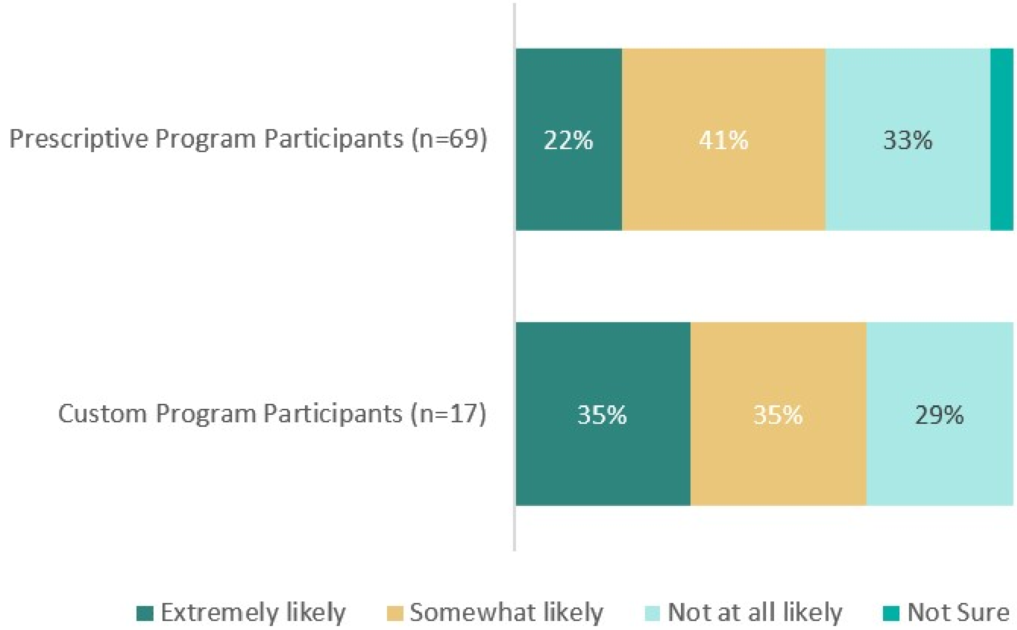
TABLE 223. PERCENT OF PROJECT COST OFFSET BY INCENTIVE

MEASURE CATEGORY	PERCENTAGE
Prescriptive	
Lighting	32%
Refrigeration	11%
Kitchen	11%
VFD	9%
Water Heating	2%
HVAC	1%
Overall	15%
Custom	
Controls	47%
Refrigeration	44%
Process	44%
HVAC	27%
Lighting	21%
Motors	15%
Overall	23%

HVAC measures are important to NIPSCO as they represent a high gas savings opportunity; however, they have one of the highest discrepancies in percent of project cost offset by incentive between programs. Prescriptive HVAC measure incentives paid were the lowest percentage of the project cost (1%), while the Custom program offsets an average of 27% of project costs. The evaluation therefore sought to identify whether participants are likely to replace their HVAC equipment in the future and, if so, the incentive value that would encourage participation.

Participants indicated a moderate potential for HVAC replacements in the next five years; roughly one third of respondents said they are extremely likely to replace their HVAC equipment in the next five years, with 40% reporting they are somewhat likely. Custom program participants were more likely to say they were extremely likely to replace equipment than Prescriptive program participants, though this difference was not statistically significant.

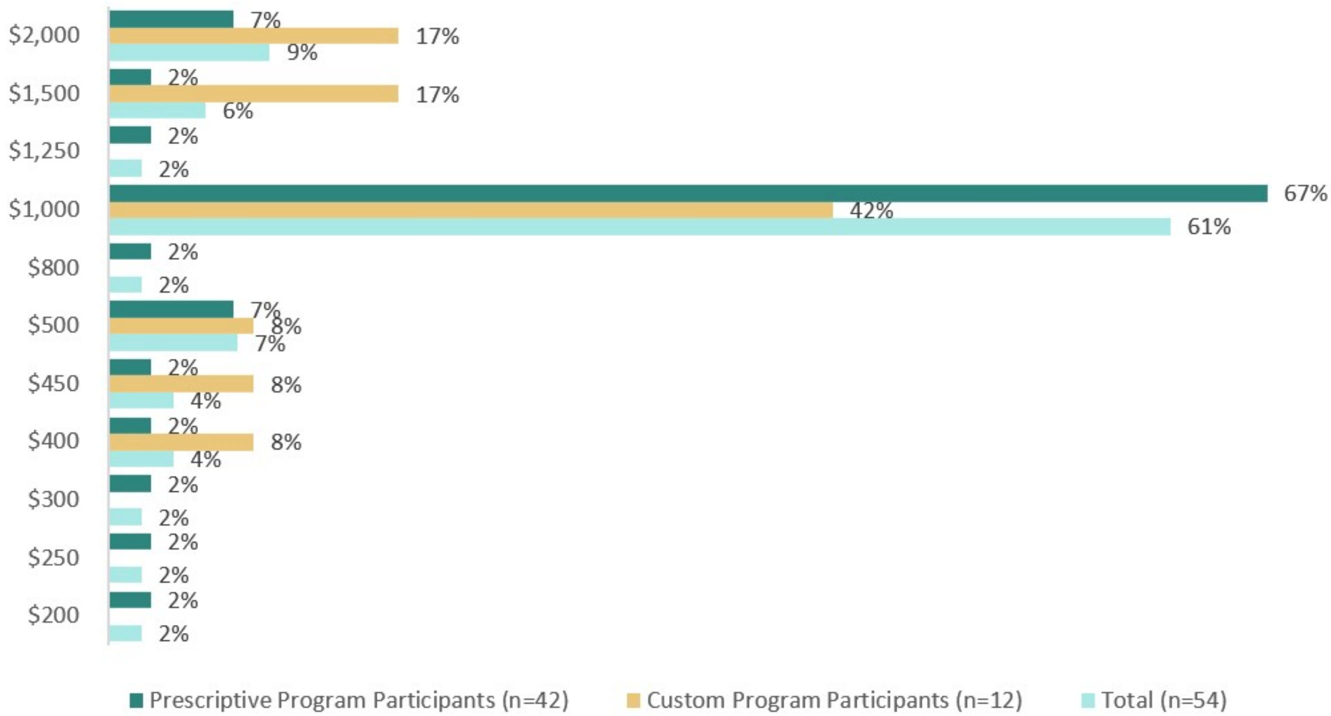
FIGURE 91: LIKELIHOOD TO REPLACE HVAC EQUIPMENT IN NEXT 5 YEARS



Source: Survey Question D3: "Thinking now specifically about your facility's HVAC equipment, how likely is your company to invest in replacing or upgrading any of that equipment in the next 5 years?"

Most respondents (61%. n=54) indicated that an incentive of $1,000 would be enough motivation to purchase high-efficiency equipment that cost $2,000 more than standard efficiency equipment. Almost a quarter (22%) of all respondents indicated that an incentive of less than $1,000 would motivate them to select the high efficiency equipment, while 17% of all respondents indicated they would need an incentive of greater than $1,000.

FIGURE 92: INCENTIVE NEEDED TO OFFSET $2,000 COST DIFFERENCE BETWEEN HIGH AND STANDARD EFFICIENCY HVAC EQUIPMENT

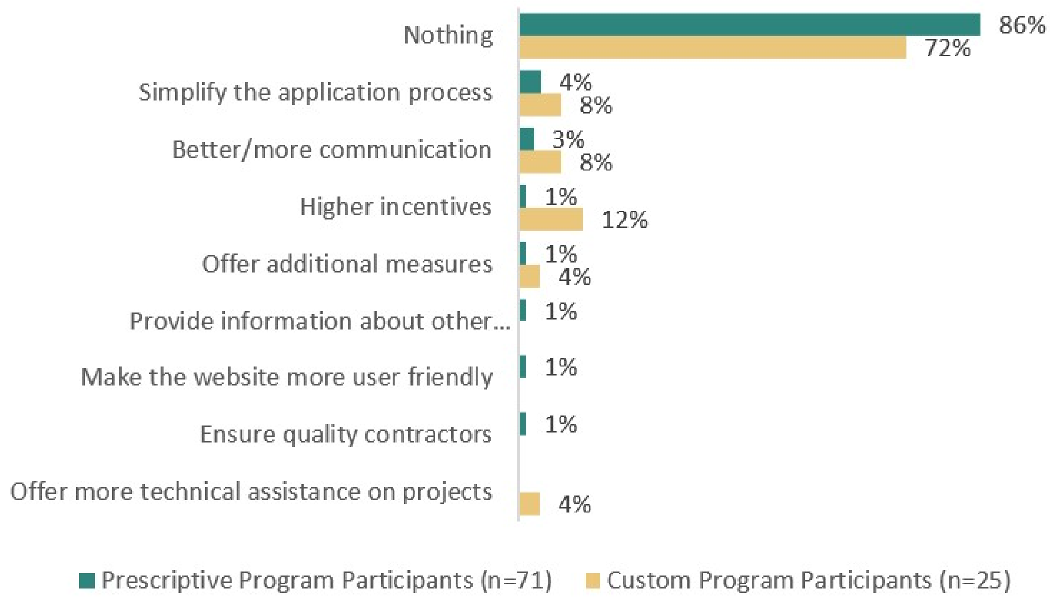


Source: Survey Question D4: "Thinking of the cost difference for high efficiency HVAC equipment compared to standard efficiency equipment, what would a rebate need to be for you to select the high efficiency equipment? For example, if a high efficiency HVAC unit costs $5,000, and a standard efficiency HVAC unit costs $3,000, what would the rebate amount need to be to offset some of that $2,000 cost difference?"

SUGGESTIONS FOR IMPROVEMENT

Most of all program participants indicated that there was nothing that would have improved their overall experience (Figure 93). Requests to simplify the application process were the most frequent suggestion from Prescriptive program participants, while higher incentives were the most common among Custom program participants. Consistent with the opportunities described above, those participants that received non-lighting measures were more likely than lighting recipients to suggest higher incentives (not statistically significant).

FIGURE 93: SUGGESTIONS FOR PROGRAM IMPROVEMENT



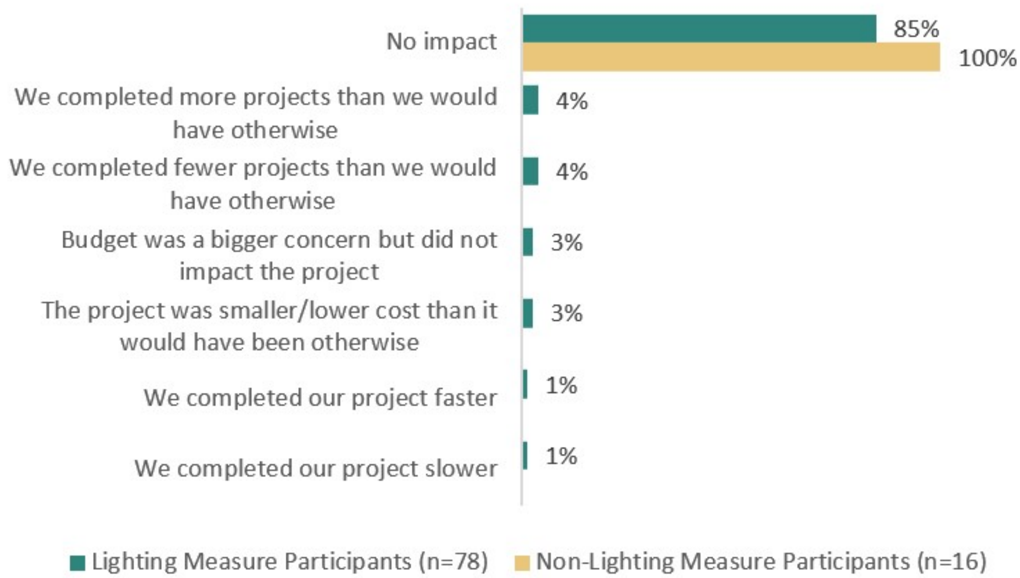
Sources: Survey Question F8: "Is there anything NIPSCO could have done to improve your overall experience with the program?"

COVID-19 IMPACTS

Differences in the impact of the COVID-19 pandemic on customer projects were evident by project type (lighting or non-lighting), but not by program type. Non-lighting measure recipients were significantly more likely ($p \leq 0.10$) to indicate that COVID-19 had no impact on their project decision making (100%, n=16) compared to lighting measure recipients (85%, n=78) (Figure 94). Respondents who indicated that COVID-19 had no impact were evenly distributed across program types, as expressed by 91% of custom program participants (n=23) and 86% of prescriptive program participants (n=71). Among lighting measure participants, three respondents indicated that they completed more projects than they would have otherwise, and three respondents indicated that they completed fewer projects. Two respondents indicated that their project was smaller/lower cost than it would have been otherwise, and two respondents indicated that their budget was a bigger concern but did not impact the project at all.

While COVID-19 seemingly had minimal impact on businesses energy efficiency projects, 73% of all respondents indicated that the pandemic impacted their business in some other way, with 21% indicating they experienced a decrease in business/sales/production, 17% experiencing extended closures, and 17% experiencing a staff illness or death. Responses were equivalently distributed among custom and prescriptive program participants.

FIGURE 94: IMPACT OF COVID-19 ON BUSINESSES DECISION MAKING



Sources: Survey Question D5: "How, if at all, did the COVID-19 pandemic impact your organization's decision-making process with regards to the equipment that received an incentive from NIPSCO's [PROGRAM] program?"

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSION 1: MOST PROGRAMS EXPERIENCED A DECREASE IN PARTICIPATION AND SUBSEQUENTLY DID NOT MEET SAVINGS GOALS, LIKELY A RESULT OF THE COVID-19 PANDEMIC.

Cumulatively, the C&I programs achieved about 70% of savings goal. To better understand areas in which to target incentives and marketing, the evaluation team compared participation in the 2020 C&I program to the 2019 program, specifically reviewing measure count, electric savings impact, gas saving impact and total MMBTU savings impact. This analysis found:

- The New Construction program experienced modest growth in 2020.
- The Custom and Prescriptive programs achieved approximately 10% fewer total savings in 2020 as compared to 2019. Within the Custom program, this trend appears to be driven by reduced electric savings in lighting and controls projects particularly in Q3 of 2020. Within the Prescriptive program, this trend appears to be driven by lower quantity and impact of lighting, HVAC, and VFD projects particularly in Q3 and Q4 of 2020.
- The SBDI program had significantly lower participation in 2020 as compared to 2019, in both measure counts and savings values in all measure groups. Lighting and HVAC projects drive the savings in the SBDI program, and both categories achieved significantly fewer savings in all quarters, but particularly in Q2 and Q4.

It is possible that COVID-19 affected participation, much of which is largely out of NIPSCO's ability to control or curtail.

Recommendations:

- For Custom and Prescriptive programs, closely monitor savings and participation trends throughout Q3 2021 to determine if this trend will persist and identify whether program strategies, such as bonus incentives to trade allies, could help boost participation in the last quarter.
- SBDI experienced lower than anticipated participation year-over-year. Small businesses experience unique challenges which were likely exacerbated by COVID-19. A market study specifically related to SBDI may be valuable to identify participation and savings potential, reasons for lower than targeted savings, and opportunities to boost participation.

CONCLUSION 2: WASTE HEAT FACTORS ARE NOT APPLIED CONSISTENTLY ACROSS THE PORTFOLIO

Currently, the C&I programs do not capture waste heat factor therm penalties. The Indiana technical reference manual (TRM), along with most other state TRMs, include waste heat factors to capture interactive effects that lighting upgrades have on the building HVAC systems. These waste heating effects have real effects on the energy consumption of buildings and should be included in the application calculation tool. Going forward, both NIPSCO and the evaluation team plan to address waste heat factor therm penalties within program cost-effectiveness on the electric side.

Recommendations:

- To be consistent across the portfolio, NIPSCO should calculate waste heat factors for all C&I programs going forward in *ex ante* savings calculations, so these factors can be included in cost-effectiveness and future planning. To do this, NIPSCO should take the following steps:
    - Add extra inputs into the applicable section of the application tool to determine how each area is heated or cooled, per Appendix B of the Indiana TRM. There is a “space conditioning type” variable in the “Project Information” tab of the application, but some areas may be conditioned differently, i.e., warehouses with an attached office area.
    - Add functionality to the application to look up the electricity, demand, and natural gas waste heat factors based on the project site location and the method of heating and cooling.
    - Modify the kWh, kW, and therm calculation methodologies in the application excel tool to include these waste heat factors.
    - Track fuel type by customers to accurately capture applicable waste heat factors for electric-only vs combo customers.

CONCLUSION 3: DEEMED VALUES SHOULD NOT BE USED FOR VFDS

The energy and demand savings of VFDs is strongly tied to site specific loading and operating hour factors. Deemed values result in a very high variation of energy savings, depending on the application of the VFD. As a result, a one-size-fits-all deemed factor results in a high variation in realization rates for this program.

Recommendations:

- Modify the application tool as follows:
- Add inputs for average operating speed and baseline control and use these inputs to determine controlled load factors for the baseline and VFD motors.

- Add a field for application (heating, cooling, ventilation, process, and other). Generally, the coincidence factor will be zero for cooling because the motors are fully loaded, and zero for heating applications because the motors will be off during the utility peak period.
- Accept operating hours for the motor.

CONCLUSION 4: CALCULATE MEASURE SAVINGS, DO NOT RELY ON MANUFACTURER PDF CALCULATIONS WHICH PROVE TO BE UNRELIABLE

Although there has been improvement over PY 2019, some HVAC and furnace measures had the energy savings values taken directly from PDF calculation sheets provided by the installed equipment manufacturers. Each manufacturer tends to follow their own methodology, and their inputs do not follow typical conventions and are difficult to modify without live spreadsheets. It is recommended to only accept live calculation spreadsheets and independently verify all inputs into the calculations or develop new live spreadsheet calculations based on commonly accepted engineering principles.

Recommendations:

- For the purposes of both accuracy in calculations and transparency in the calculations, only accept live spreadsheet calculations from projects. The evaluation team specifically recommends the implementor utilize their measure specific calculation spreadsheets they have developed on all projects to verify *ex ante* savings, particularly for projects with large savings impacts.
- If no calculation spreadsheets currently exist for a measure, develop live calculation spreadsheets based on commonly accepted engineering principles. Review and justify all calculation inputs.
- Clearly document inputs to calculations, providing supporting evidence for those calculations

CONCLUSION 5: LARGE SAVINGS MEASURES NEED MORE RIGOROUS CALCULATIONS AND SUPPORTING DOCUMENTATION.

The implementer determined energy savings for two large saving measures sampled for this evaluation using simple engineering calculations: a sampled motor measure (*ex ante* savings of over 6,400,000 kWh), and a sampled HVAC measure (*ex ante* savings of over 700,000 kWh). The engineering analysis simply compared the nominal horsepower of the baseline system to the nominal horsepower of the installed system. Incorrect assumptions were made about the operation, sequencing, and quantity of system in the baseline and installed cases. Measures that have large energy impacts and/or unique equipment installation/application should use a more detailed approach for estimating savings such as metering and trend data, which is then well documented for review. Even minor changes to equipment load, sequencing, and run times can result in significant impacts to gross savings at the program level, and engineering assumption may not accurately capture the nuance.

Recommendations:

- Equipment loading should be estimated using logged power information of the baseline system, logs of production provided by the facility, or other methods that will realize realistic estimates of energy savings.
- Utilize trend data whenever possible to establish an accurate picture of the baseline sequencing, operation and run times of the equipment.
- Unique equipment with special applications should receive increased review and discussion to determine accurate energy savings estimates before installation. For example, fan wall array systems are rarely utilized as an energy efficiency measure, but more commonly as a critical function redundancy measure.

- Use the established custom calculator more broadly, when possible, particularly on projects where the energy savings are projected to have a large impact.

CONCLUSION 6: STEAM PIPE INSULATION MEASURE DEEMED VALUES ARE TOO BROADLY APPLIED

The savings for all evaluated natural gas measures were deemed values based on only measure quantity information (linear feet installed). The real savings values varied greatly from these deemed values after checking these deemed savings values against simple engineering calculations. However, realization rates for most steam pipe insulation measures were maintained close to 100% since it was the practice this program year to utilize TRC generated deemed values for these measures. We recommend that the TRC generated deemed values currently being used are reevaluated for the 2021 program year, as they do not accurately reflect savings across projects.

Deemed values generated by TRC are currently being used to simplify the application for SBDI and prescriptive application. There are three deemed values being used based on three different pipe diameter selections. However, all three deemed values hold constant the pressure and temperature (hot water system), hours of use (4000 hours per year) and thickness of the insulation (1.5”). Any actual system parameters that differ greatly from these set parameters are not considered and the resulting savings from engineering calculations in some cases are dramatically different than determined by the deemed values. The 2020 sample included facilities will dramatically lower operating hours (800 hrs.), and higher operating hours (8760), and facilities with high pressure steam. None of the projects sampled were well characterized by the deemed values established.

The implementer uses a custom workbook for custom steam pipe insulation measures, which appears to be based on established IN TRM values and 3E Plus values. The calculator allows all variable inputs to be set to actuals and will calculate a more accurate savings profile for the project. Currently this workbook is only used on custom projects given the additional variable inputs required to accurately fill it out.

Recommendations:

- Use the established custom calculator more broadly, when possible, in place of the deemed savings, particularly on projects where the energy savings are projected to have a large impact.
- Evaluate the current deemed values used for natural gas savings for steam pipe insulation measures. If deemed values will continue to be used, it is recommended to have different deemed savings values based on at least (1) steam pressure, and (2) operating hours, in addition to the established existing parameters (1) pipe diameter, and (2) linear feet of installed insulation.
- If actual project values for steam pressure and operating hours are not practical to collect from customers and use in savings calculations, the evaluation team recommends NIPSCO establish tiers for each of these parameters. It might be easiest to break this measure into three different measures based on pressure to reduce the number of deemed values per measure. For example:
    - Measure 1: Hot Water Pipe insulation: Measure has a set average temperature/pressure and insulation thickness. The measure would have three set options for operating hours (low, med, high), and three set options for thickness (currently in place). Final data entry is the linear feet of install.
    - Measure 2: Low Pressure Steam Pipe Insulation: Same pattern as above
    - Measure 3: High Pressure Steam Pipe Insulation: Same pattern as above

CONCLUSION 7: LIMIT DEVIATIONS FROM ESTABLISHED TRM MEASURES

Several measures within the Custom program were submitted with custom calculations when the measure exists as a TRM measure elsewhere. In many of these cases, the IN TRM v2.2 did not have a matching measure defined. But the measure was often well outlined in the IL and WI TRMs instead. There was a hotel smart thermostat measure in the 2020 Custom program and custom calculations were submitted. There is an established hotel room occupancy measure in both the IL and the WI TRMs that were a better fit to the project than the custom calculations created.

Recommendations:

- Given the custom nature of the Custom program, custom calculations are always acceptable, but when there is a well vetted and established TRM measure from a nearby source, we recommend using that measure as a first step toward savings quantification. In some custom calculations, the resulting savings matched closely to the deemed values in other nearby TRMs.
- When the implementation team feels a measure would be best calculated by using TRM values from another state's TRM, the evaluation team would recommend confirming that decision with the evaluation team before proceeding, and to clearly document the sources used and rationale for that decision.

CONCLUSION 8: THE INTENDED USE OF THE BUILDING REDESIGN MEASURE IS NOT CLEAR.

There was one sampled Building Redesign measure within the New Construction program in 2020, and this was the only Building Redesign measure in the entire C&I portfolio population of 2020. The measure was an electric water heater measure. It is not clear that that measure could have been grouped with the rest of the Water Heat measures category given all measures currently in the Water Heat measure category are gas only measures. However, it is not clear why this project could not be classified as Other. In the 2019 program year, the sampled Building Redesign measures included a lighting project and an HVAC project, both of which could have fit well into their respective measure groups instead of Building Redesign.

Recommendations:

- Clarify the intended delineation of measures that fall into the Building Redesign category or close the Building Redesign measure group and reclassify those projects into the other measure groupings.

CONCLUSION 9: AWARENESS OF REBATE OPPORTUNITIES IS SOMEWHAT LOW AMONG LIGHTING MEASURE PARTICIPANTS.

Most participants that received non-lighting measures reported that they were aware that NIPSCO offered business customers rebates for other energy efficiency measures besides what they installed, while only 61% of lighting measure participants reported awareness in other measures. The 2019 SBDI evaluation provides a potential hypothesis why this may be the case. That study found that some contractors – many of whom provided lighting measures - are hesitant to discuss energy saving opportunities with customers for measures which they do not provide. It may be possible that this type of barrier inhibits cross-referrals to other programs or measures.

CONCLUSION 10: COMMERCIAL PROGRAM PARTICIPANTS DESIRE MORE PROACTIVE COMMUNICATION FROM NIPSCO REGARDING ENERGY EFFICIENCY OPPORTUNITIES.

Trade allies and contractors continued to be the driving force of program awareness in 2020, evidenced by the roughly 50% of recipients who stated they learned about the program through their trade allies. While Trade allies and contractors currently drive program awareness, they were the second least commonly cited preferred source of information. Email communication is the preferred way for NIPSCO to keep organizations informed about opportunities to save energy followed by letters, flyers, or other mailings, bill inserts, and direct phone calls from NIPSCO program representatives. Proactive communication or education regarding available program opportunities was cited as the number one thing NIPSCO could do to help businesses overcome the challenges faced when investing in energy efficiency.

The implementer made a concerted effort to educate customers of available rebates in 2020, having sent 30 marketing emails and newsletters (including reminder emails), hosted three webinars, and provided six trade ally orientation sessions and one trade ally round table to market the C&I programs to trade allies and nonresidential customers. However, the desire expressed among customers for more proactive communication or education related to program offerings, taken with the fact that customers would prefer to learn about programs via communication from NIPSCO rather than their trade ally, and again with the 2019 SBDI finding that some contractors are hesitant to discuss energy saving opportunities with customers for measures which they do not provide, indicates that there may be a need for NIPSCO to utilize different types or timing of communication with commercial customers.

Recommendations:

- Continue to proactively communicate information on the latest energy efficient technologies and programs that customers may be eligible for or benefit from using marketing emails and newsletters.
- In program year 2021, integrate research into the evaluation activities to identify barriers to cross-measure promotion and opportunities for overcoming those communication and education barriers. Identify potential opportunities for education and communication and test those opportunities through evaluation-based research. For example, identify the potential to and need to better communicate rebate opportunities at various points of the program process, considering the individual(s) engaged at those points and their decision-making roles. As another example, identify not just the preferred method of communication, but most effective means to provide information about other NIPSCO programs.

CONCLUSION 11: NON-LIGHTING AND LIGHTING PARTICIPANTS CONCEPTUALIZE THE BENEFITS OF ENERGY EFFICIENCY DIFFERENTLY.

Lighting and non-lighting measure participants expressed different motivations for completing an energy efficiency project. Lighting measure participants reported that their primary motivation for completing their project was to save money on utility bills (36%), while non-lighting measure participants said return on investment (ROI) was their primary motivation (41%). A desire to reduce operating costs is at the root of both drivers, however, the different way that each of these participant types (lighting measure participants and non-lighting measure participants) interpret the benefit of reduced operating costs (reduced energy bills or a strong ROI) may be indicative of differences in the decision-making process and criteria used by different business types and may be useful in tailoring marketing and outreach campaigns of these measure types.

Recommendations:

- Draw on the different motivations in the way that the different measures are marketed. Advertise lighting measures as an opportunity to reduce operating costs. Advertise non-lighting measures with a focus on their strong ROI.

CONCLUSION 12: PARTICIPANT SATISFACTION WITH THE PROGRAM AND WITH NIPSCO REMAINED HIGH IN 2020.

Overall satisfaction with NIPSCO's commercial programs remained high and statistically equivalent among participants in 2020 as they were in 2019, with 96% of 2020 custom program participants (n=25) and 98% of prescriptive program participants (n=72) indicating that they were either *somewhat satisfied* or *very satisfied* with the program overall. There were no significant differences between 2019 and 2020 satisfaction. As with participant satisfaction with NIPSCO's programs, overall satisfaction with NIPSCO as a service provider remained high and statistically equivalent among participants in 2020, with 96% of 2020 custom program participants (n=24) and 95% of prescriptive program participants (n=72) indicating that they were either *somewhat satisfied* or *very satisfied* with the program overall.

APPENDIX

APPENDIX 1: HVAC REBATE PROGRAM

ENERGY EFFICIENT REBATES (HVAC REBATES) PROGRAM

FURNACES

The program tracking data contained 692 furnaces without ECM motors and 3,416 furnaces with ECMs but for gas-only customers, totaling 4,108 units.

Per the Indiana TRM (v2.2), the evaluation team used the following natural gas savings algorithm for furnaces:

$$\Delta therms = CAP \times EFLH_H \times \left(\frac{AFUE_{EE}}{AFUE_{BASE}} - 1\right) \times 0.00001$$

Where:

CAP	=	Capacity of the furnace in Btu/h
$EFLH_H$	=	Equivalent full-load heating hours
$AFUE_{EE}$	=	Efficiency of the installed furnace
$AFUE_{BASE}$	=	Efficiency of the baseline furnace
0.00001	=	Factor to convert from Btu/h to therms

The evaluation team obtained CAP and $AFUE_{EE}$ for each unit from the *ex ante* data, $EFLH_H$ from 2020 billing analysis results based on location, and assigned an $AFUE_{BASE}$ of 80% based on the Indiana TRM (v2.2). Evaluated unit therm savings range from 40 to 266 therms, with an average value of 133 therms. The *ex ante* data assigned deemed savings of 196 therms for units without an ECM and 207 therm for units with an ECM, based on 2019 findings. The overall natural gas realization rate for this measure category is 65%. While capacities and efficiencies have shifted little since 2019, the reduced EFLH reduces savings.

FURNACES WITH ECMS

For furnaces with ECMs that are gas and electric customers, we followed the same methodology for evaluated natural gas savings. For this measure category average unit savings were 130 therms, a value reduced versus the past two program years due to the use of updated EFLH values. The reported savings were 187 therms and the natural gas realization rate for this measure category is 63%.

As of July 3, 2019, the U.S. Department of Energy required residential-sized furnace blower motors to meet a fan energy ratio (FER) performance standard that can generally only be met by ECMs. For program year 2019, ECM savings were passed through for the entire program year, assuming six months of sell-through. However, for program year 2020 the team only granted ECM savings for the 744 furnaces with ECMs installed before calendar year 2020. These savings follow the Indiana TRM (v2.2), which follows the 2015 Wisconsin TRM, assigning a deemed electric energy savings value of 415 kWh, which is a composite of savings from motor consumption reduction in heating mode (211 kWh), circulation mode (134 kWh), and of the overall reduction in energy consumed while in cooling mode (71 kWh).[63, 64] The cooling mode energy reduction comes from an assumed slight increase in SEER for HVAC systems with air conditioners because of the ECM installation.

However, 178 pre-2020 installed furnaces with ECMs were installed with new air conditioning units through the program. The savings from ECM installations for these sites is contained in the SEER upgrade for those air conditioner measures. Therefore, pre-2020 installed furnaces with ECMs at sites that also received an air conditioner upgrade are assigned 211 + 134 = 335 kWh of savings.

The *ex ante* data assigns a deemed savings value of 415 kWh (Indiana TRM v2.2) for all units regardless of install year or adjacent air conditioner install. The overall electric energy realization rate for this measure category is 22%.

The TRM (2.2) does not claim any summer peak demand reduction for ECMs. However, the evaluation team did credit savings for summer peak demand reduction since reduced consumption during summer months will reduce fan use. This demand reduction was applied only to sites that only received a new furnace before 2020, and not both a furnace and an A/C. The overall demand reduction realization rate for this measure category is 18%.

Natural gas savings employed EFLH values from the billing analysis and actual installed AFUE and capacity values and leading to an overall gas savings realization rate for this measure category is 63%.

AIR CONDITIONERS

The evaluation team used the following equation from the Indiana TRM (v2.2) to calculate energy savings from the SEER upgrade for air conditioners:

$$\Delta kWh = \frac{CAP}{1{,}000} \times EFLH_C \times \left(\frac{0.23}{SEER_{CODE}} + \frac{0.77}{SEER_{STOCK}} - \frac{1}{SEER_{EE}}\right)$$

Where:

CAP	=	Total cooling capacity in Btu/h
$EFLH_C$	=	Equivalent full-load cooling hours from TRM (2.2)
$SEER_{CODE}$	=	Baseline SEER value for time-of-sale replacements
$SEER_{STOCK}$	=	Baseline SEER value for early replacements
$SEER_{EE}$	=	Installed SEER value

The evaluation team obtained CAP and $SEER_{EE}$ from the *ex ante* data, and $EFLH_C$ from the Indiana TRM (v2.2) based on project location. The 2018 participant survey determined that 23% of participants replaced broken units and

[63] Cadmus. October 22, 2015. *Wisconsin Focus on Energy Technical Reference Manual*. https://focusonenergy.com/sites/default/files/Wisconsin%20Focus%20on%20Energy%20Technical%20Reference%20Manual%20October%202015.pdf

[64] The 2015 WI TRM (and therefore the IN TRM) should have 416 kWh (211 + 134 + 71 = 416). A slight error in the 2015 WI TRM, fixed for the 2016 WI TRM.

77% replaced working units. Based on these percentages and following the Indiana TRM (v2.2) practices for time of sale and early replacement air conditioners, the evaluation team produced a weighted baseline SEER that blends federal code ($SEER_{CODE}$ = 13.0) for broken unit replacements and building stock findings ($SEER_{STOCK}$ = 11.15) for working replacements. Cooling savings range from 156 kWh to 1,176 kWh, averaging 423 kWh.

As discussed, the installation of an ECM also confers savings in heating and circulation mode. Of the 1,271 delivered air conditioner measures, 943 (77%) were installed alongside a furnace measure and these non-cooling ECM savings are accounted for in the furnace measure savings for those sites. For the other 328 units, an additional 335 kWh of savings from ECM operation in heating and circulation mode are added.

The *ex ante* data shows deemed savings values for all air conditioners of 536 kWh; however, the average *ex post* unit energy savings is 423 kWh, so the energy realization rate for this measure category is 61%.

Per the Indiana TRM (v2.2), the evaluation team used the following algorithm to calculate demand reduction for sites that received an air conditioner:

$$\Delta kW = \frac{CAP}{1{,}000} \times \left(\frac{0.23}{EER_{CODE}} + \frac{0.77}{EER_{STOCK}} - \frac{1}{EER_{EE}}\right) \times CF$$

Where:

EER_{CODE}	=	Baseline EER value for time-of-sale replacements
EER_{STOCK}	=	Baseline EER value for early replacements
EER_{EE}	=	Installed efficiency
CF	=	Coincidence factor

Note that this includes sites that received both an air conditioner and a furnace—their demand reduction is accounted for under their air conditioner measure. Sites that received only a furnace with an ECM had separate demand savings, as discussed above for that measure category. The evaluation team obtained CAP from the program data. Per the Indiana TRM (v2.2), the evaluation team assigned a CF value of 0.88 for all units. EER_{EE} was not provided for any units in the program data, but per the Indiana TRM (v2.2), the evaluation team used an EER_{EE} value of 0.9 x $SEER_{EE}$. As with baseline SEER values, the evaluation team also applied a weighting algorithm for baseline EER, based on the fraction of sites reporting replacement of broken or working units. The realization rate for demand reduction in this measure category is 184%. The *ex ante* assumptions for this measure are unknown, but evaluated savings may differ from employing actual EER_{EE} (equal to 0.9 x $SEER_{EE}$, average EER_{EE} of 14), and actual CAP.

AIR CONDITIONER TUNE-UP

Per the Indiana TRM (v2.2), the evaluation team used the following savings algorithm for air conditioner tune-ups:

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

Where:

$EFLH_{COOL}$	=	Equivalent full-load cooling hours from TRM (2.2)
$Btuh_{COOL}$	=	Cooling capacity of equipment in Btuh
$SEER_{CAC}$	=	SEER efficiency of existing central air conditioning unit receiving maintenance
1,000	=	Conversion from Btuh to kBtuh
MFE	=	Maintenance energy savings factor
SEER	=	SEER efficiency of existing air conditioning unit receiving maintenance

The evaluation team obtained $EFLH_C$ from the Indiana TRM (v2.2) based on project location. The Indiana TRM (v2.2) suggests values for $Btuh_{COOL}$ (28,994) and $SEER_{CAC}$ (11.15). But of the 455 units for this measure, 349 listed $Btuh_{COOL}$ with an average of 31,734 Btuh, and 20 listed SEER with an average of 15.8—these values are used for the evaluation. The analysis team calculated the $Btuh_{COOL}$ and $SEER_{CAC}$ by taking the average of the available data and extrapolating it across all tune-ups. $EFLH_H$ was taken from the Indiana TRM (v2.2) based on location. Evaluated savings range from 25 kWh to 82 kWh, averaging 43 kWh—lower than the reported savings of 56 kWh, for a realization rate of 77% for this measure category.

SMART AND WI-FI THERMOSTATS

Several evaluated savings cases exist within this measure category, and each was established within the measure name, with delivered unit population splits shown in Table 224.

TABLE 224. HVAC CONFIGURATIONS FOR THERMOSTAT MEASURES AND *EX ANTE* SAVINGS

MEASURE NAME-DEFINED CONFIGURATION	COUNT OF UNITS[a]	*EX ANTE* UNIT SAVINGS		
		kWh	kW	THERMS
Natural gas heat with no air conditioner	1,683	0.00	0.000	132.55
Natural gas heat with air conditioner	1,716	155.78	0.177	132.55
Air conditioner only, propane / other heat	18	155.78	0.177	0.00
Electric resistance heating with air conditioner	16	4,040.56	0.177	0.00
Electric resistance heating with no air conditioner	3	3,884.78	0.000	0.00
Heat pump	3	1,023.36	0.219	0.00

[a] These quantities reflect physical unit counts, and therefore may not match the scorecard, which counted both fuel types for dual-fuel measures.

The thermostat billing analysis examined all 2018 and 2019 participants, revealing net gas savings of 35 therms (5.4%) for 2019 participants receiving one thermostat. The analysis also revealed net cooling electric energy savings of 8.3%—the savings for sites receiving one thermostat in either 2018 or 2019. More detail on these options can be seen in the Billing Analysis Methodology section of this appendix. The 35 therms gas savings value was applied for all sites with gas heat. In future years it is recommended that the billing analysis findings of 47 therms savings (HSF = 7.1%) are applied, as these may be more representative of behavior not impacted by COVID-19.

To determine energy savings for air conditioning and electric heat sites, the evaluation team used the following equations. For natural gas heating with air conditioning, and for air conditioning alone:

$$\Delta kWh = \frac{CAP_C}{SEER \times 1{,}000} \times EFLH_C \times ESF_C$$

For heat pump systems:

$$\Delta kWh = \left(\frac{CAP_C}{SEER \times 1{,}000} \times EFLH_C \times ESF_C\right) + \left(\frac{CAP_H}{COP \times 3{,}412} \times EFLH_H \times ESF_H\right)$$

Where:

CAP_C	=	System cooling capacity
SEER	=	System SEER
$EFLH_C$	=	Effective full-load cooling hours from TRM (2.2)
ESF_C	=	Savings factor for cooling derived via 2021 billing analysis, 8.3%
CAP_H	=	System heating capacity
COP	=	Heating system coefficient of performance
3,412	=	Conversion from Btu to kWh (3,412 Btu = 1 kWh)
$EFLH_H$	=	Effective full-load heating hours
ESF_H	=	Savings factor for heating derived via 2021 billing analysis, 5.4%

For thermostats serving natural gas heating systems without air conditioning, no electric energy savings are produced from the Indiana TRM (v2.2) calculations. Table 225 lists the values and sources for these variables.

TABLE 225. VARIABLES, VALUES, AND SOURCES USED FOR THERMOSTAT ENERGY SAVINGS CALCULATIONS

VARIABLE	VALUE	SOURCE
CAP_C	Actual when possible or *34,054 Btu/h for* air conditioners and 32,907 Btu/h for heat pumps	Program data or Average of HVAC program air conditioners (2020) Average of HVAC program heat pumps (2020)
SEER	11.15 (Btu/h)/W	2012 *Residential Indiana Baseline Study*
$EFLH_C$	*Varies by location*	Indiana TRM (v2.2)
ESF_C	*8.3%*	2020 billing analysis values
CAP_H	34,054 Btu/h for natural gas or electric furnaces and *24,000 Btu/h for heat pumps*	*Average of HVAC program furnaces (2020)* *Average of HVAC program heat pumps (2020)*
COP	2.26 for heat pumps and *1.0 for electric furnace*	Indiana TRM (v2.2) or Engineering calculation
$EFLH_H$	*Varies by location*	2020 billing analysis values
ESF_H	*5.4% for the 2020 program year* *(7.1% recommended for future years)*	2020 billing analysis values

The Indiana TRM (v2.2) does not provide guidance on claiming demand reduction for these thermostat measures. Currently savings for thermostats in most TRMs and evaluations are derived via analysis of billing data, which generally cannot produce values for demand reduction. However, it is likely that some demand reduction for smart thermostats does exist, and this reduction is accommodated in the Illinois TRM (v7.0).[65] This TRM calculates savings using standard methods for deriving baseline peak load, then applies a smart thermostat ESF and half the CF normally used for cooling. The evaluation team used that same approach. Here, the standard cooling CF of 0.88 is used, but divided by 2:

$$\Delta kW = \frac{CAP_C}{EER \times 1{,}000} \times \frac{CF}{2} \times ESF_C$$

The overall kWh realization rate for this measure category is 57%, the overall kW realization rate is 66%, and the overall therm realization rate is 25%.

AIR SOURCE HEAT PUMPS

The evaluation team used the following algorithm from the Indiana TRM (v2.2) to calculate the total electric energy savings:

$$\Delta kWh = \frac{CAP_C}{1{,}000} \times EFLH_C \times \left(\frac{1}{SEER_{BASE}} - \frac{1}{SEER_{EE}}\right) + \frac{CAP_H}{1{,}000} \times EFLH_H \times \left(\frac{1}{HSPF_{BASE}} - \frac{1}{HSPF_{EE}}\right) + \Delta kWh_{CIRC}$$

Where:

CAP_C	=	Total cooling capacity
$EFLH_C$	=	Effective full-load cooling hours from TRM (2.2)
$SEER_{BASE}$	=	Baseline SEER
$SEER_{EE}$	=	Efficient SEER
CAP_H	=	Total heating capacity
$EFLH_H$	=	Effective full-load heating hours derived via 2021 billing analysis for furnaces
$HSPF_{BASE}$	=	Baseline heating seasonal performance factor
$HSPF_{EE}$	=	Efficient heating seasonal performance factor
ΔkWh_{CIRC}	=	Circulation mode energy savings from an ECM installation

The evaluation team used CAP_C and CAP_H values from model lookups in the AHRI equipment database. The evaluation team also found $SEER_{EE}$ and $HSPF_{EE}$ in the AHRI database and used $EFLH_C$ values from the Indiana TRM (v2.2) and $EFLH_H$ from the billing analysis, based on project location. The evaluation team assumed $SEER_{BASE}$ and $HSPF_{BASE}$ to be 13.0 and 7.7, respectively.

[65] Illinois Energy Efficiency Stakeholder Advisory Group. September 28, 2018. *2019 Illinois Statewide Technical Reference Manual for Energy Efficiency. Version 7.0. Volume 3: Residential Measures*. http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_7/Final_9-28-18/IL-TRM_Effective_010119_v7.0_Vol_3_Res_092818_Final.pdf

Evaluated savings varied from 419 kWh to 1,976 kWh, averaging 1,105 kWh. The *ex ante* savings used a deemed value of 1,187 kWh, and the realization rate for electric energy savings was 93%. Some variance between *ex ante* and *ex post* savings was likely caused by the evaluation team's use of actual values for CAP, $SEER_{EE,}$ and $HSPF_{EE}$.

The evaluation team used the following algorithm to calculate demand reduction:

$$\Delta kW = \frac{CAP_C}{1{,}000} \times \left(\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}\right) \times CF$$

The evaluation team assumed an EER_{BASE} of 11.0 according to the Indiana TRM (v2.2), while CF was 0.88 and the evaluation team calculated EER_{EE} according to EER_{EE} = $SEER_{EE}$ x 0.9, with $SEER_{EE}$ coming from the program data. Evaluated demand reduction ranged from 0 kW to 0.36 kW, averaging 0.15 kW—three units had AHRI-verified EER values that were less than the assumed baseline EER of 11, from the TRM (2.2). *Ex ante* savings were a deemed value of 0.714 kW, and the peak demand realization rate for this measure category was 21%.

WATER HEATERS

The evaluation team used the following algorithm to calculate savings for water heaters:

$$\Delta therms = GPD \times 365 \times 8.3 \times \frac{\Delta T}{100{,}000} \times \left(\frac{1}{UEF_{BASE}} - \frac{1}{UEF_{EE}}\right)$$

Where:

GPD	=	Gallons per day per house
365	=	Days per year
8.3	=	Specific heat of water (Btu/gal-°F
ΔT	=	Change in temperature
UEF_{BASE}	=	Baseline uniform energy factor
UEF_{EE}	=	Efficient uniform energy factor

Following the Indiana TRM (v2.2), the evaluation team assumed 2.47 people per household—the prescribed value for sites unknown to be single family or multifamily. The evaluation team applied this to a linear fit for gallons per day per person based on the "Hot Water Use by Family Size" table in the Indiana TRM (v2.2) to produce a GPD value of 53.2. The evaluation team applied groundwater temperature based on the nearest city, and assumed a water temperature setpoint of 120°F.

The current standard for residential water heater efficiency is uniform energy factor (UEF).[66] The UEF required by code is a function of tank volume, heater type (instant or storage), and draw pattern (very small, low, medium, high). These parameters were looked up in the AHRI database for units delivered for this measure category. Storage heaters comprised 109 of these units, and UEF_{BASE} values for them ranged from 0.58 to 0.96, averaging 0.70. The average UEF_{BASE} for instant water heaters was 0.81. However, the evaluation team assumed the average storage

[66] UEF became the standard on July 13, 2015. https://www.energy.gov/sites/prod/files/2015/03/f20/water_heater_conversionfactor_nopr.pdf

water heater baseline of UEF_{BASE} = 0.635 for instant water heaters. The average UEF_{EFF} was 0.95 for instant water heaters.

The resulting average evaluated unit therm savings were 38 therms, compared to an *ex ante* value of 42 therms, for a realization rate of 89% for this measure category.

BOILERS

There were 77 boiler measures delivered as part of the program in 2020. These measures followed an algorithm identical to furnace measures, including using 2021 furnace billing analysis results for EFLH. The TRM (2.2) assume the same EFLH for boilers and furnaces, and any offset between TRM (2.2) and billing analysis results for furnaces likely applies to boilers as well. The resulting realization rate is 132% for this measure, largely because of the evaluation team using actual AFUE and capacities to calculate savings.

BOILER TUNE-UP

There were six boiler tune-ups as part of the 2020 program. Following the Indiana TRM (v2.2), the evaluation team used the following algorithm to calculate savings for this boiler tune-up:

$$\Delta therms = EFLH_{HEAT} \times \frac{Btuh}{100{,}000} \times ESF$$

Where:

$EFLH_{HEAT}$	=	Equivalent full load heating hours derived via 2021 billing analysis for furnaces
Btuh	=	Size of equipment in Btuh input capacity
ESF	=	Energy savings factor

The evaluation team assumed that the boiler tune-up would have an energy savings factor of 5% and used an $EFLH_{HEAT}$ value based on project location, from the 2021 billing analysis for furnace EFLH. The Indiana TRM (v2.2) uses a boiler size of 77,386 Btuh but the average size of delivered units for the efficient boiler measure category was 106,236 Btuh and this size was used for the evaluation. Evaluated savings are 48 therms, and the overall realization rate for this measure category is 110%.

BILLING ANALYSIS METHODOLOGY

The evaluation team calculated heating and cooling energy savings factors for thermostats and EFLH for furnaces using a billing analysis. We completed the following steps in the billing analysis:

- Collect, review, and prepare billing and tracking data,
- Collect customer weather data,
- Conduct PRISM regression analysis,
- Calculate energy savings factors for thermostats and EFLH's for furnace.

DATA COLLECTION, REVIEW, AND PREPARATION

The evaluation team collected tracking data from 2017 – 2020 for participants who installed thermostats and from 2018 – 2020 for participants who installed furnaces. The evaluation team collected billing data from January 2017

– January 2021 to allow for sufficient pre- and post- installation periods to calculate heating and cooling energy savings factors for thermostats and EFLH values for natural gas furnaces.

For the smart thermostat savings analysis, the evaluation team used 2018 and 2019 participants as treatment groups in the analysis. The evaluation team used 2020 participants as a comparison group for the 2018 treatment group. 2017 participants and some 2020 participants were used to form the comparison group for the 2019 participants. A comparison group was used to detect any non-program related changes in energy, such as economic changes or changes in usage related to the COVID pandemic. For treatment group households, the evaluation team defined the pre-period as 12 months prior to the earliest thermostat installation and the post period as 12 months after the latest thermostat installation. For comparison group households the pre- and post- periods were defined using the 12 months before and after the average installation date of the 2018 and 2019 treatment groups, respectively. Since no measures were installed in the comparison group households during this time period, it allowed the evaluation team to observe any non-program related changes in energy consumption that need to be accounted for in the savings analysis.

For the EFLH analysis the evaluation team used 2017 - 2019 participants. A comparison group was not needed for the EFLH analysis, as the evaluation team was only looking at weather normalized consumption for a specified year and not changes in consumption. The evaluation team did calculate EFLH values for 2019 and 2020 to see if there were any major differences between the two time periods. The evaluation team used 2018 participants for both the 2019 and 2020 EFLH analysis. 2019 participants were largely included only in the 2020 analysis, as they did not have sufficient post-installation data in 2019.

In conducting the billing analysis for both EFLH and smart thermostats, the evaluation team completed the following steps:

- Merged treatment group thermostat data from the tracking database with electric and natural gas billing data.
- Created EFLH and smart thermostat analysis groups. Customers were included in the gas thermostat analysis if they had claimed gas thermostat savings. Customers were included in the electric thermostat analysis if they had claimed electric savings. Households were only included in the thermostat analysis if they were recorded as having only a smart thermostat installed and no other measure. The reason for this was that the billing analysis would not be able to distinguish the thermostat savings from other HVAC savings with reliable precision. All customers that had a natural gas furnace installed in 2018 or 2019 were included in the EFLH analysis.
- Used zip code mapping to determine the nearest weather station for each zip code.
- Obtained daily average temperature weather data (January 2017 through January 2021) for six National Oceanic and Atmospheric Administration (NOAA) weather stations, representing all zip codes associated with participants.
- Used daily average temperatures to determine base 45°F to 85°F HDDs and CDDs for each station. For the gas thermostat and EFLH analyses only base 45°F to 70°F HDDs were used.
- Obtained typical meteorological year (TMY3; 1991–2005) annual normal HDDs and CDDs to weather normalize the billing data.
- Matched billing data periods with CDDs and HDDs from associated stations.

COMPARISON GROUP FOR SMART THERMOSTATS SAVINGS ANALYSIS

As an important aspect of a billing analysis' quasi-experimental design, a billing analysis—whenever possible—should use a comparison group to account for exogenous factors that may have occurred simultaneously with program activity. These factors can include macroeconomic effects, increases, or decreases in energy rates, or other interactions that could affect energy consumption outside the program's influence. The potential effects of COVID-19 on energy consumption are a good example of an exogenous change in energy consumption unrelated to the HVAC program. The evaluation team established a comparison group for the 2018 and 2019 participants using 2017 and 2020 program participants.

Using future participants this way offered several advantages over selecting randomly from the customer population:

- Past and future participants are more representative of the participant treatment group than a random sample of residential customers—they are more likely to closely resemble participants from previous years in terms of energy awareness and pre-period building characteristics.
- As this population received program measures, the evaluation team could control and isolate the comparison group's installation periods to ensure that program impacts did not influence the analysis period.

To account for any exogenous changes in consumption over the treatment period, the evaluation team calculated the heating and cooling energy savings factors in the following manner:

$$ESF\ Heating = \frac{Treatment\ Change\ in\ \ Heating\ Usage}{Pre\ Treatment\ Heating\ Usage} - \frac{Comparison\ Change\ In\ Heating\ Usage}{Pre\ Comparison\ Heating\ Usage}$$

$$ESF\ Cooling = \frac{Treatment\ Change\ in\ Cooling\ Usage}{Pre\ Treatment\ Cooling\ Usage} - \frac{Comparison\ Change\ In\ Cooling\ Usage}{Pre\ Comparison\ Cooling\ Usage}$$

Because the comparison group was created using future participants, it is not guaranteed that the comparison group will have similar heating and cooling loads. There could be a variety of differences between the current and future participants that could drive differences in heating and cooling load such as home size, occupants, and heating/cooling preferences. If any of these differences are statistically significant and correlated with the change in energy consumption from the pre- to post- period, then our energy savings factors could be biased. To see if there were any such differences in baseline heating and cooling loads the evaluation team performed equivalency tests on pre-period weather normalized heating and cooling sensitive consumption. Table 226 presents the results of the equivalency tests by year for baseline electric cooling and natural gas heating loads between the treatment and comparison groups. We can see that for electric cooling there were no statistically significant differences in baseline cooling consumption in either year. For natural gas heating we did see statistically significant differences between the treatment and comparison group with regards to baseline heating consumption. Although the percent savings difference-in-difference estimator controls for differences in magnitude of the baseline consumption, as mentioned the gas energy savings factor could be biased if any of the underlying reasons causing differences in baseline natural gas consumption are related to the change in consumption from the pre- to post- period.

TABLE 226. NATURAL GAS HEATING & ELECTRIC COOLING EQUIVALENCY TESTS

FUEL	YEAR	TREATMENT GROUP PRE-PERIOD WEATHER SENSITIVE USAGE (COOLING/HEATING)	COMPARISON GROUP PRE-PERIOD WEATHER SENSITIVE USAGE (COOLING/HEATING) COMPARISON	DIFFERENCE	P-VALUE

Electric	2018	3,006	2,976	30	0.808
	2019	2,774	2,645	130	0.290
Gas	2018	662	635	27	0.061
	2019	654	602	53	<0.001

To test the robustness of the gas savings factor, the evaluation team performed a simple matching routine. First the evaluation team segmented the treatment group into ten quantiles based on pre-period natural gas heating consumption. Then we selected a random number of comparison group customers, equal to the number of treatment group customers in each treatment group quantile. We ran this procedure 100 times, producing 100 unique gas savings factors based on the 100 unique comparison groups. Table 227 shows a summary of the equivalency after the matching routine. We can see from the average matched p-values that differences in baseline gas heating consumption were no longer significant. We can also see that the average differences in baseline consumption were much smaller after matching.

TABLE 227. COMPARISON GROUP MATCHING RESULTS

YEAR	ORIGINAL COMPARISON GROUP			AVERAGE ACROSS 100 COMPARISON GROUP MATCHES		
	TREATMENT PRE-PERIOD NATURAL GAS HEATING CONSUMPTION	COMPARISON PRE-PERIOD NATURAL GAS HEATING CONSUMPTION	P-VALUE	TREATMENT PRE-PERIOD NATURAL GAS HEATING CONSUMPTION	COMPARISON PRE-PERIOD NATURAL GAS HEATING CONSUMPTION	P-VALUE
2018	662	635	0.061	662	652	0.57
2019	654	602	<0.001	654	658	0.81

Figure 95 and Figure 96 show histograms of the estimated gas energy savings factors across the 100 matched comparison groups. The green lines show our evaluated energy savings factor when we use the full group of future participants as the comparison group (7.1% and 5.4% for 2018 and 2019 respectively). We can see that our estimated energy savings factors using the full non-matched comparison group was in line with the estimates across the 100 matched comparison groups. Because of this we proceeded with the non-matched comparison group to have the largest sample size possible and to be consistent with similar studies in the region.[67]

[67] In a 2020 evaluation of the ComEd Advanced Thermostat program, the evaluation team at Guidehouse found that the future comparison group, without matching, was adequately equivalent. They ran extensive tests on a matched comparison group and ultimately found that the future group, "serve as a high-quality comparison group, and further refinements via matching are not required". Lai, J., & Glinsmann, B. (2020). ComEd Advanced Thermostat Evaluation Final Research Report. Guidehouse.

FIGURE 95. 2018 SAVINGS ROBUSTNESS CHECK

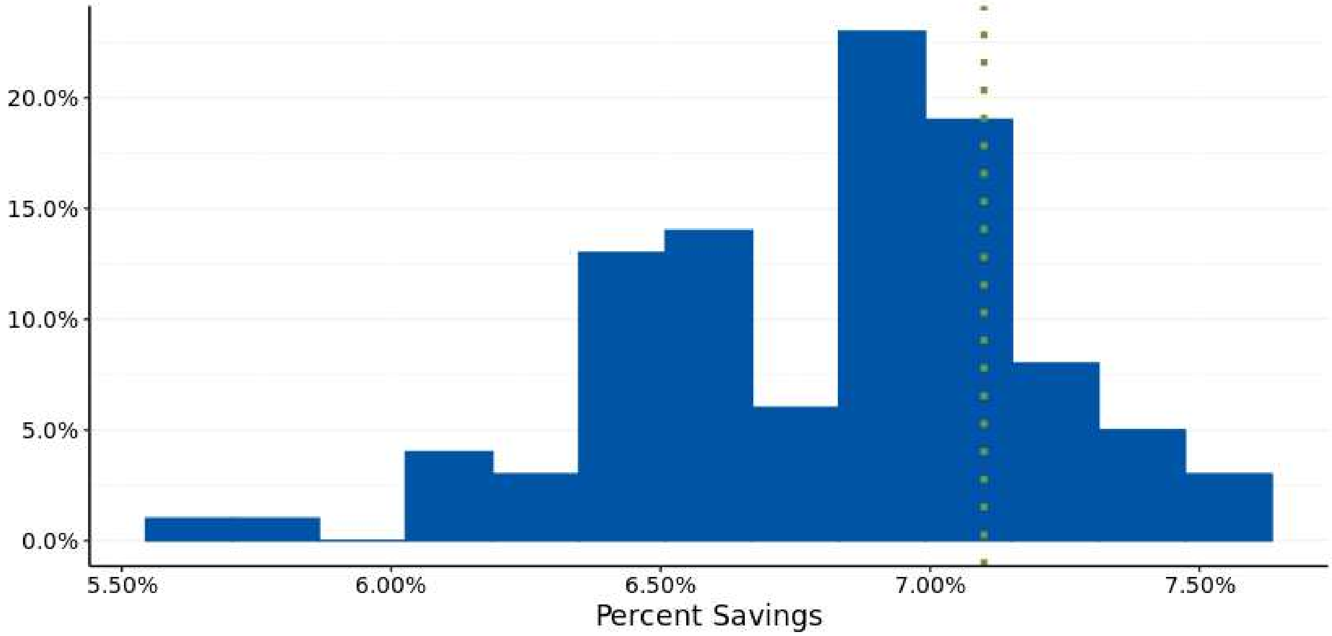
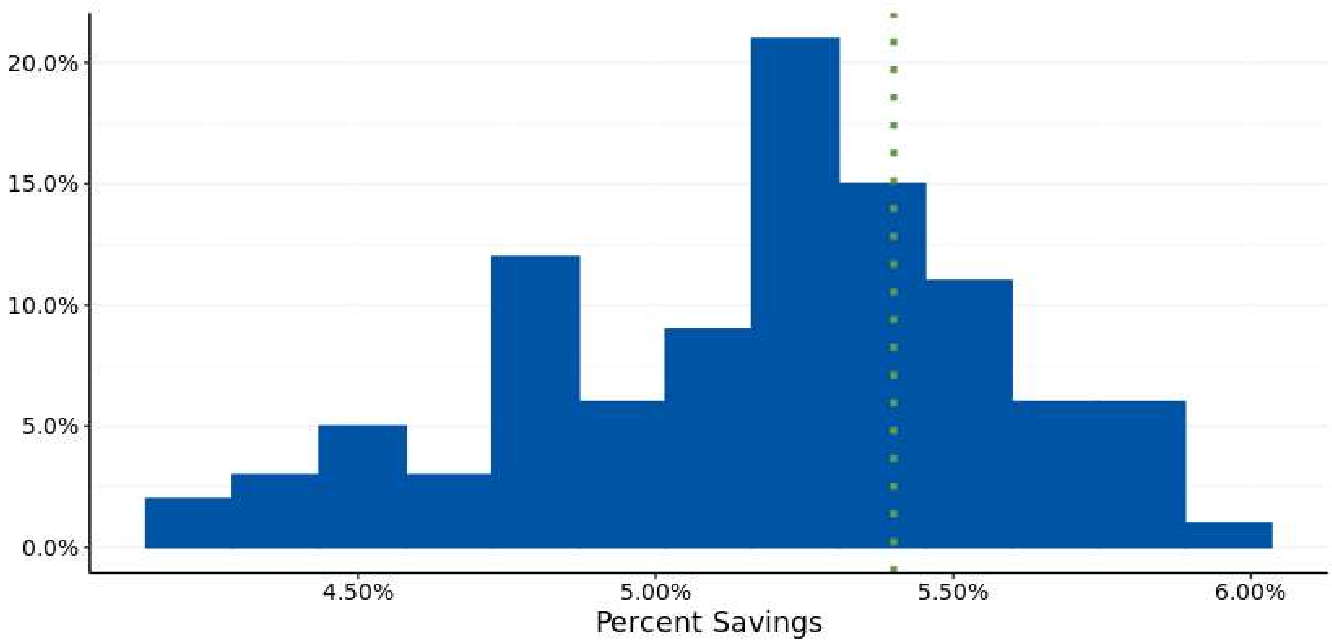


FIGURE 96. 2019 SAVINGS ROBUSTNESS CHECK



DATA SCREENING THERMOSTAT ANALYSIS

The evaluation team removed the following sites from the thermostat savings analysis:

- Households that did not have billing data available.
- Households with fewer than ten months of pre- data or fewer than ten months of post-data (at least 20 months total are needed).
- Households with electric consumption less than 1,000 kWh annually or 150 therms annually.
- Household with changes in energy consumption of more than 70% from the pre- to the post-installation period.

The evaluation team also removed households with outliers, apparent vacancies, seasonal usage, or nonprogrammatic equipment or occupancy changes in the pre- and post-installation periods. To determine this, the evaluation team examined monthly billing data by plotting each participant's monthly usage. Table 228 and Table 229 show the attrition for the treatment and comparison group houses in each step for 2018 and 2019 natural gas thermostat participants.

TABLE 228. 2018 NATURAL GAS SMART THERMOSTAT ATTRITION

SCREEN	TREATMENT GROUP			COMPARISON GROUP		
	N	N DROPPED	% DROPPED	N	N DROPPED	% DROPPED
Original Natural Gas Thermostat Accounts	2,850	0	0%	3,493	0	0%
Only installed thermostats	1,093	1,757	62%	1,282	2,211	63%
Billing data unavailable	1,090	3	0%	1,262	20	2%
Insufficient Pre- and Post-Installation Days (<300 days)	1,011	79	7%	1,171	91	7%
Low Usage (Less than 150 therms annually)	988	23	2%	1,128	43	4%
Changed Usage from the Pre- to Post-Period (>70%)	880	108	11%	1,015	113	10%
Individual Customer Bill Review and incorrect PRISM signs [a]	686	194	22%	893	122	12%
Final Analysis Group	686	2,164	76%	893	2,600	74%

[a] Differences in attrition rates for this step are because a comparison group customer can experience a base load increase since they have not yet received a thermostat – and they would not be dropped from the analysis. However, because a thermostat install, in and of itself, will not affect the base load, any thermostat customers with an increased base load were removed from the analysis. We assume the increase in base load is because something unrelated to thermostat usage.

TABLE 229. 2019 NATURAL GAS SMART THERMOSTAT ATTRITION

SCREEN	TREATMENT GROUP			COMPARISON GROUP		
	N	N DROPPED	% DROPPED	N	N DROPPED	% DROPPED
Original Homes with Gas Thermostat Installation	2,707	0	0%	3,730	0	0%
Homes which only installed thermostats	918	1,789	66%	1,539	2,191	59%
Had available billing data	851	67	7%	1,536	3	0%
Insufficient Pre- and Post-Installation Days (<300 days)	827	24	3%	1,517	19	1%
Low Usage (Less than 150 therms annually)	803	24	3%	1,493	24	2%

Changed Usage from the Pre- to Post-Period (>70%)	710	117	15%	1,337	180	12%
Individual Customer Bill Review and incorrect PRISM signs [a]	520	190	27%	1,204	133	10%
Final Analysis Group	**520**	**2,211**	**82%**	**1,204**	**2,550**	**68%**

[a] Differences in attrition rates for this step are because a comparison group customer can experience a base load increase since they have not yet received a thermostat – and they would not be dropped from the analysis. However, because a thermostat install, in and of itself, will not affect the base load, any thermostat customers with an increased base load were removed from the analysis. We assume the increase in base load is because something unrelated to thermostat usage.

Table 230 and Table 231 show the attrition for the treatment and comparison group houses in each step for 2018 and 2019 electric thermostat participants.

TABLE 230. 2018 ELECTRIC AC SMART THERMOSTAT ATTRITION

SCREEN	TREATMENT GROUP			COMPARISON GROUP		
	N	N DROPPED	% DROPPED	N	N DROPPED	% DROPPED
Original Homes with Electric AC Thermostat Installation	1,300	0	0%	1,725	0	0%
Homes which only installed thermostats	721	579	45%	874	851	49%
Had available billing data	651	70	10%	864	10	1%
Insufficient Pre- and Post-Installation Days (<300 days)	525	126	19%	658	206	24%
Low Usage (Less than 1,000 kWh annually)	520	5	1%	658	0	0%
Changed Usage from the Pre- to Post-Period (>70%)	510	10	2%	644	14	2%
Individual Customer Bill Review and incorrect PRISM signs [a]	411	99	19%	619	25	4%
Final Analysis Group	**411**	**889**	**68%**	**619**	**1,106**	**64%**

[a] Differences in attrition rates for this step are because a comparison group customer can experience a base load increase since they have not yet received a thermostat – and they would not be dropped from the analysis. However, because a thermostat install, in and of itself, will not affect the base load, any thermostat customers with an increased base load were removed from the analysis. We assume the increase in base load is because something unrelated to thermostat usage.

TABLE 231. 2019 ELECTRIC AC SMART THERMOSTAT ATTRITION

SCREEN	TREATMENT GROUP			COMPARISON GROUP		
	N	N DROPPED	% DROPPED	N	N DROPPED	% DROPPED
Original Homes with Electric AC Thermostat Installation	1,272	0	0%	1,897	0	0%
Homes which only installed thermostats	649	623	49%	1,052	845	45%
Had available billing data	619	30	5%	958	94	9%
Insufficient Pre- and Post-Installation Days (<300 days)	492	127	21%	808	150	16%
Low Usage (Less than 1,000 kWh annually)	491	1	0%	808	0	0%
Changed Usage from the Pre- to Post-Period (>70%)	483	8	2%	800	8	1%
Individual Customer Bill Review and incorrect PRISM signs [a]	325	158	33%	771	29	4%
Final Analysis Group	**325**	**947**	**74%**	**771**	**1,126**	**59%**

[a] Differences in attrition rates for this step are because a comparison group customer can experience a base load increase since they have not yet received a thermostat – and they would not be dropped from the analysis. However, because a thermostat install, in and of itself,

SCREEN	TREATMENT GROUP			COMPARISON GROUP		
	N	N DROPPED	% DROPPED	N	N DROPPED	% DROPPED
will not affect the base load, any thermostat customers with an increased base load were removed from the analysis. We assume the increase in base load is because something unrelated to thermostat usage.						

DATA SCREENING EFLH ANALYSIS

The evaluation team removed the following sites from the EFLH analysis:

- Households that did not have billing data available.
- Households with fewer than ten months of post- data during the analysis year.
- Households with normalized annual natural gas consumption of less than 200 therms annually.[68]
- Households where the percentage of heating load was less than 50%.
- Households with zero usage readings winter months.
- Households with adjusted R2 values from the PRISM analysis of less than 0.7.

These filters were applied to ensure that the billing data was representative of a household's heating load. Because there were so many furnaces included in the analysis it was not possible to review the billing data for each individual household to detect any anomalous billing data. We applied these filters to remove households which may have billing data issues that would cause incorrect EFLH calculations for a given household. Table 232 shows the number of households removed for each of the criteria listed above. The evaluation team started with all furnaces in the 2017 – 2020 tracking data that matched the billing data. Furnaces installed after 2019 were removed from the 2019 analysis due to insufficient post, which resulted in large attrition for the 2019 analysis in that category.

TABLE 232. 2019 AND 2020 GAS EFLH ANALYSIS ATTRITION

SCREEN	2019 POST PERIOD			2020 POST PERIOD		
	N	N DROPPED	% DROPPED	N	N DROPPED	% DROPPED
Had available billing data	19,657	0	0%	19,657	0	0%
Insufficient Post-Installation Days (<300 days)	15,241	4,416	29%	19,267	390	2%
Low Usage (Less than 200 therms annually)	15,120	121	1%	19,255	12	0%
Households removed with zero reads in the winter	15,075	45	0%	19,241	14	0%
Households removed with PRISM R^2 less than 0.7	14,337	738	5%	17,615	1,626	9%
Households removed with heating load less than 50% of total load	14,059	278	2%	17,195	420	2%
Final Analysis Group	**14,059**	**5,598**	**28%**	**17,195**	**2,462**	**13%**

[68] This was increased to 200 therms here – because we want to make sure that they have natural gas heating here – and we are not picking up lower usage water heaters. Furthermore, we are not reviewing each EFLH HVAC site's usage graphs – and we increased this to preventively screen out vacancies. Low/ vacant usage estimates would likely skew EFLH results.

PRISM MODELING APPROACH

For both the smart thermostat analysis and EFLH analysis, the evaluation team used the PRISM modeling approach. The evaluation team estimated relevant PRISM models for pre- and post-installation billing data. These models provided weather-normalized, pre- and post-installation annual usage for each account. For each electric savings home, we estimated a heating and cooling PRISM model for both the pre- and post-installation periods to weather normalize raw billing data. For each gas household we only estimated a heating PRISM model. Each model allowed the heating reference temperature to range from 45°F to 85°F and the cooling reference temperature to range from the heating reference temperature to 85°F. For the gas models only heating reference temperatures from 45°F to 70°F were used.

The evaluation team used the following specification for the electric PRISM model:

$$ADC_{it} = \alpha_i + \beta_1 AVGHDD_{it} + \beta_2 AVGCDD_{it} + \epsilon_{it}$$

And the following specification for the gas PRISM model:

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

Where, for each customer *i* and month *t*:

ADC_{it}	=	Average daily kilowatt-hour consumption in the pre- and post-installation period
α_i	=	Participant intercept that represents the average daily energy usage baseload
β_1	=	Model space heating parameter value
$AVGHDD_{it}$	=	Base 45°F to 85°F average daily HDDs for the specific location
β_2	=	Model space cooling parameter value
$AVGCDD_{it}$	=	Base 45°F to 85°F average daily CDDs for the specific location
ϵ_{it}	=	Error term

Using this model, the evaluation team computed weather-normalized annual consumption for each heating and cooling reference temperature:

$$Electric\ NAC_i = \alpha_i * 365 + \beta_1 * LRHDD_i + \beta_2 * LRCDD_i$$

$$Gas\ NAC_i = \alpha_i * 365 + \beta_1 * LRHDD_i + \beta_2 * LRCDD_i$$

Where, for each customer *i*:

NAC_i	=	Normalized annual kilowatt-hour consumption
α_i	=	Intercept; the average daily or baseload for each participant that represents the average daily baseload from the model
$\alpha_i * 365$	=	Annual baseload kilowatt-hour usage (non-weather sensitive)
β_1	=	Heating parameter value; in effect, this is usage per HDD from model above
$LRHDD_i$	=	Annual, long-run HDDs of a TMY3 in the 1991–2005 series from NOAA, based on the home location
$\beta_1 * LRHDD_i$	=	Weather-normalized annual weather-sensitive heating usage
β_2	=	Cooling parameter value; in effect, this is usage per CDD from model above

$LRCDD_i$	=	Annual, long-run CDDs of a TMY3 in the 1991–2005 series from NOAA, based on home location
$\beta_2 * LRCDD_i$	=	Weather-normalized annual weather-sensitive cooling usage

Further, if the heating and cooling models above yielded negative intercepts, negative heating parameters, or negative cooling parameters, the evaluation team estimated additional models that included only the cooling usage (cooling-only models) or only the heating usage (heating-only models). From these models, with correct signs on all parameters, we selected the best model for each participant for the pre- and post-installation periods as the one with the highest R-square value.[69]

SMART THERMOSTAT ENERGY SAVINGS FACTORS

The evaluation team used the PRISM modeling results to create the heating and cooling energy savings factors. The evaluation team calculated the heating energy savings factor using the gas PRISM results, as most participants had gas heating and there were not sufficient electric heating participants to get a separate electric heating energy savings factor. Similarly, the evaluation team calculated the cooling energy savings factor using the electric PRISM results. The evaluation team decided to only look at changes in heating and cooling consumption, as these were the only end uses the smart thermostat should affect. This decision was made as the evaluation team observed large baseload savings that were entirely driven by an increase in comparison group consumption. It was deemed unreasonable that the baseload savings should be attributable to the smart thermostat program. Additionally, the evaluation team used percentage savings as opposed gross savings because percentage savings are more robust to any misallocation of heating and cooling load when using a PRISM modeling approach on monthly billing data, particularly on the electric side. If both the pre- and post-period weather sensitive (heating/cooling) usages are over-estimating the percent change in usage will still be more consistent. Heating and cooling energy savings factors were calculated as follows:

$$Heating\ ESF = \frac{\Delta\, Treatment\ Heating\ Load}{Pre\ Period\ Treatment\ Heating\ Load} - \frac{\Delta\, Comparison\ Heating\ Load}{Pre\ Period\ Comparison\ Heating\ Load}$$

$$Cooling\ ESF = \frac{\Delta\, Treatment\ Cooling\ Load}{Pre\ Period\ Treatment\ Cooling\ Load} - \frac{\Delta\, Comparison\ Cooling\ Load}{Pre\ Period\ Comparison\ Cooling\ Load}$$

Detailed gas heating and electric cooling results for 2018 and 2019 participants are shown in Table 233 and

Table 234. For gas thermostats, percent savings were slightly lower for 2019 participants than 2018 participants. These differences were not statistically significant. Any differences in natural gas savings are unlikely to be driven by the Covid-19 pandemic as most participants had a heating post period from November 2019 – February 2020. On the electric side savings were higher for 2019 participants than 2018 participants. Again, these differences between savings estimates were not statistically significant. Some of this difference could be attributable to the Covid-19 pandemic as the cooling period was based on the 2020 Summer. However, it is more likely that variation in savings estimates due to poorer precision around cooling savings are more likely to account for differences between the two years.

[69] R-square is a measure of statistical fit. In this case it represents the amount of variance in average daily consumption explained by different combinations of HDDs or CDDs. Higher R-square values indicate that more of the variance is explained by a specific model and therefore is considered the best model at explaining consumption relative to weather in each household.

TABLE 233. SMART THERMOSTAT GAS HEATING SAVINGS RESULTS

YEAR	TREATMENT HOUSE-HOLDS (N)	COMPARISON HOUSEHOLDS (N)	TREATMENT PRE-PERIOD HEATING SENSITIVE CONSUMPTION (THERMS)	COMPARISON PRE-PERIOD COMPARISON HEATING SENSITIVE CONSUMPTION (THERMS)	PERCENT CHANGE IN TREATMENT HEATING CONSUMPTION	PERCENT CHANGE IN COMPARISON HEATING CONSUMPTION	PERCENT HEATING SAVINGS	RELATIVE PRECISION AT 90% CONFIDENCE[A]
2018	686	893	681	651	5.3%	-1.2%	6.5%	14.2%
2019	520	1,204	672	623	4.9%	0.0%	4.9%	24.0%
Combined	1,206	2,097	677	635	5.2%	-0.5%	5.7%	12.9%

a. Variation in PRISM results from site to site

TABLE 234. SMART THERMOSTAT ELECTRIC COOLING SAVINGS RESULTS

YEAR	TREATMENT HOUSE-HOLDS (N)	COMPARISON HOUSEHOLDS (N)	PRE-PERIOD TREATMENT COOLING SENSITIVE CONSUMPTION (KWH)	PRE PERIOD COMPARISON COOLING SENSITIVE CONSUMPTION (KWH)	PERCENT CHANGE IN TREATMENT COOLING CONSUMPTION	PERCENT CHANGE IN COMPARISON COOLING CONSUMPTION	PERCENT COOLING SAVINGS	RELATIVE PRECISION AT 90% CONFIDENCE[A]
2018	411	619	3,006	2,976	12.7%	6.1%	6.7%	56.8%
2019	325	771	2,774	2,645	10.5%	1.3%	9.2%	41.2%
Combined	736	1,390	2,904	2,792	11.8%	3.6%	8.2%	32.1%

a. Variation in PRISM results from site to site

SMART THERMOSTAT ENERGY SAVINGS FACTORS

The evaluation team used the PRISM modeling results to create the heating and cooling energy savings factors. The evaluation team calculated the heating energy savings factor using the gas PRISM results, as most participants had gas heating and there were not sufficient electric heating participants to get a separate electric heating energy savings factor. Similarly, the evaluation team calculated the cooling energy savings factor using the electric PRISM results. The evaluation team decided to only look at changes in heating and cooling consumption, as these were the only end uses the smart thermostat should affect. This decision was made as the evaluation team observed large baseload savings that were entirely driven by an increase in comparison group consumption. It was deemed unreasonable that the baseload savings should be attributable to the smart thermostat program. Additionally, the evaluation team used percentage savings as opposed gross savings because percentage savings are more robust to any misallocation of heating and cooling load when using a PRISM modeling approach on monthly billing data, particularly on the electric side. If both the pre- and post-period weather sensitive (heating/cooling) usages are over-estimating the percent change in usage will still be more consistent. Heating and cooling energy savings factors were calculated as follows:

$$Heating\ ESF = \frac{\Delta\ Treatment\ Heating\ Load}{Pre\ Period\ Treatment\ Heating\ Load} - \frac{\Delta\ Comparison\ Heating\ Load}{Pre\ Period\ Comparison\ Heating\ Load}$$

$$Cooling\ ESF = \frac{\Delta\ Treatment\ Cooling\ Load}{Pre\ Period\ Treatment\ Cooling\ Load} - \frac{\Delta\ Comparison\ Cooling\ Load}{Pre\ Period\ Comparison\ Cooling\ Load}$$

Detailed gas heating and electric cooling results for 2018 and 2019 participants are shown in Table 233 and

Table 234. For gas thermostats, percent savings were slightly lower for 2019 participants than 2018 participants. These differences were not statistically significant. Any differences in natural gas savings are unlikely to be driven by the Covid-19 pandemic as most participants had a heating post period from November 2019 – February 2020.

On the electric side savings were higher for 2019 participants than 2018 participants. Again, these differences between savings estimates were not statistically significant. Some of this difference could be attributable to the COVID-19 pandemic as the cooling period was based on the 2020 Summer. However, it is more likely that variation in savings estimates due to poorer precision around cooling savings are more likely to account for differences between the two years.

TABLE 235. SMART THERMOSTAT GAS HEATING SAVINGS RESULTS

YEAR	TREATMENT HOUSE-HOLDS (N)	COMPARISON HOUSEHOLDS (N)	TREATMENT PRE-PERIOD HEATING SENSITIVE CONSUMPTION (THERMS)	COMPARISON PRE-PERIOD COMPARISON HEATING SENSITIVE CONSUMPTION (THERMS)	PERCENT CHANGE IN TREATMENT HEATING CONSUMPTION	PERCENT CHANGE IN COMPARISON HEATING CONSUMPTION	PERCENT HEATING SAVINGS	RELATIVE PRECISION AT 90% CONFIDENCE[A]
2018	686	893	681	651	5.3%	-1.2%	6.5%	14.2%
2019	520	1,204	672	623	4.9%	0.0%	4.9%	24.0%
Combined	1,206	2,097	677	635	5.2%	-0.5%	5.7%	12.9%

a. Variation in PRISM results from site to site

TABLE 236. SMART THERMOSTAT ELECTRIC COOLING SAVINGS RESULTS

YEAR	TREATMENT HOUSE-HOLDS (N)	COMPARISON HOUSEHOLDS (N)	PRE-PERIOD TREATMENT COOLING SENSITIVE CONSUMPTION (KWH)	PRE PERIOD COMPARISON COOLING SENSITIVE CONSUMPTION (KWH)	PERCENT CHANGE IN TREATMENT COOLING CONSUMPTION	PERCENT CHANGE IN COMPARISON COOLING CONSUMPTION	PERCENT COOLING SAVINGS	RELATIVE PRECISION AT 90% CONFIDENCE[A]
2018	411	619	3,006	2,976	12.7%	6.1%	6.7%	56.8%
2019	325	771	2,774	2,645	10.5%	1.3%	9.2%	41.2%
Combined	736	1,390	2,904	2,792	11.8%	3.6%	8.2%	32.1%

a. Variation in PRISM results from site to site

Table 237 and Table 238 show the gas heating and electric cooling savings by the number of thermostats purchased. None of the differences in savings were statistically significant, however there were some interesting observed differences between those that installed one vs two thermostats. Per-household savings were higher for both fuels in homes that installed multiple thermostats. On the gas side homes that purchased two thermostats saved less per thermostat than homes that only installed one. On the electric side homes that installed multiple thermostats saved more per thermostat, but slightly less as a percent of pre-period consumption. Homes which purchased multiple thermostats had higher usage on average, indicating these homes are likely larger in size and it is reasonable to assume both thermostats were typically installed.

TABLE 237. SMART THERMOSTAT GAS HEATING SAVINGS BY TOTAL THERMOSTATS PURCHASED

YEAR	NUMBER OF THERMOSTATS	PRE-PERIOD TREATMENT HEATING CONSUMPTION (THERMS)	PER HOUSEHOLD SAVINGS (THERMS)	HEATING SAVINGS PER THERMOSTAT (THERMS)	PERCENT COOLING SAVINGS	RELATIVE PRECISION AT 90% CONFIDENCE[A]
2018 + 2019	One	659	41	41	6.3%	13%
	Two	888	49	24	2.7%	40%

a. Variation in PRISM results from site to site

TABLE 238. SMART THERMOSTAT ELECTRIC COOLING SAVINGS BY TOTAL THERMOSTATS PURCHASED

YEAR	NUMBER OF THERMOSTATS	PRE-PERIOD TREATMENT COOLING CONSUMPTION (KWH)	PER HOUSEHOLD SAVINGS (KWH)	COOLING SAVINGS PER THERMOSTAT (KWH)	PERCENT COOLING SAVINGS	RELATIVE PRECISION AT 90% CONFIDENCE[A]
2018 + 2019	One	2,771	244	244	8.8%	34%
	Two	4,312	645	322	7.5%	50%

a. Variation in PRISM results from site to site

Table 239 and Table 240 show the savings for homes which only installed one thermostat by year. For gas heating savings we see lower savings in 2019 than 2018, however these differences are not statistically significant. For electric savings we see equal percentage savings from 2018 to 2019, although savings per thermostat are lower due to the pre-period consumption being lower for the 2019 analysis sample.

TABLE 239. GAS HEATING SAVINGS FOR HOMES WITH ONE THERMOSTAT BY YEAR

YEAR	N	PRE-PERIOD HEATING CONSUMPTION (THERMS)	SAVINGS PER THERMOSTAT (THERMS)	PERCENT SAVINGS	RELATIVE PRECISION AT 90% CONFIDENCE[A]
2018	631	662	47	7.1%	15%
2019	479	654	35	5.4%	25%

a. Variation in PRISM results from site to site

TABLE 240. ELECTRIC COOLING SAVINGS FOR HOMES WITH ONE THERMOSTAT BY YEAR

YEAR	N	PRE-PERIOD COOLING CONSUMPTION (KWH)	SAVINGS PER THERMOSTAT (KWH)	PERCENT SAVINGS	RELATIVE PRECISION AT 90% CONFIDENCE[A]
2018	375	2,899	240	8.3%	53%
2019	298	2,610	215	8.3%	50%

a. Variation in PRISM results from site to site

GAS FURNACE EFLH VALUES

The evaluation team used the PRISM modeling results for 2018 and 2019 participants that installed gas furnaces to calculate heating EFLH values. The evaluation team did not use EFLH values for cooling because disaggregation of electric monthly billing data does not always result in precise estimates of heating, cooling, and baseload components. PRISM modeling can often overestimate the cooling component. The primary reason for this is that there are only about three summer months with cooling related usage and the PRISM model cannot always precisely disaggregate the cooling portion of these months from any other changes in energy consumption that may occur in the summer. The evaluation team calculated heating EFLH values as follows:

$$EFLH = \frac{Post\ Period\ Heating\ Usage}{Heating\ Capacity\ of\ Natural\ Gas\ Furnace}$$

The evaluation team mapped each participant household to the nearest TRM city by mapping each zip code to the nearest TRM city. Detailed EFLH results for 2019 and 2020 are presented in Table 241 and Table 242 below.

TABLE 241. 2019 & 2020 HEATING EFLH VALUES

LOCATION	N		HEATING SENSITIVE USAGE (THERMS)		AVERAGE CAPACITY (BTUH)		EFLH	
	2019	2020	2019	2020	2019	2020	2019[A]	2020
Ft. Wayne	4,118	4,954	703	659	71,203	71,701	1,005 (±1%)	936 (±1%)
Indianapolis	736	894	679	680	74,817	74,825	915 (±2%)	917 (±2%)
South Bend	9,177	11,311	660	651	73,931	73,957	910 (±1%)	897(±1%)
Terre Haute	28	36	733	792	74,907	73,344	984 (±9%)	1,124 (±13%)

a. confidence intervals shown at the 90% level.

TABLE 242. HEATING EFLH TRM COMPARISON

LOCATION	2020 FURNACE UNIT COUNT	IN TRM (2.2) EFLH	BILLING ANALYSIS EFLH		PERCENT DECREASE	
			2019	2020	2019	2020
Ft. Wayne	1,789	1,356	1,005	936	26%	31%
Indianapolis	349	1,341	915	917	32%	32%
South Bend	5,125	1,427	910	897	36%	37%
Terre Haute	26	804	984	1,124	-22%	-40%

APPENDIX 2: RESIDENTIAL LIGHTING PROGRAM

RESIDENTIAL LIGHTING ALGORITHMS AND ASSUMPTIONS

LEDS

The evaluation team used the following equations to calculate electric energy and peak demand savings for LEDs:

$$kWh\ savings\ per\ lamp = \frac{(W_{base} - W_{LED}) * (Daily\ hours\ of\ use * 365) * (1 + WHF_e)}{1{,}000}$$

$$kW\ reduction\ per\ lamp = \frac{(W_{base} - W_{LED}) * Coincidence\ Factor * (1 + WHF_d)}{1{,}000}$$

Where:

W_{base} = Wattage of the bulb being replaced, W

W_{LED} = Wattage of the LED bulb, W

Daily hours of use = Average hours of use per day, hr.

WHF_e = Waste heat factor for energy to account for HVAC interactions with lighting (depends on location)

WHF_d = Waste heat factor for demand to account for HVAC interactions with lighting (depends on location)

Coincidence Factor = Summer peak coincidence factor

365 = Number of days per year, days/yr.

1,000 = Constant to convert watts to kW

Table 243 lists the input assumptions and source of each assumption for the LED measure savings calculations.

TABLE 243. *EX POST* VARIABLE ASSUMPTIONS FOR LEDS

INPUT	VALUE	SOURCE
W_{base}	Varies	ENERGY STAR lumens bins
W_{LED}	Varies	Actual wattage from 2020 tracking data
Daily Hours of Use x 365	902	Indiana TRM (v2.2)
WHF_e	-0.07	Indiana TRM (v2.2), South Bend values
WHF_d	0.038	Indiana TRM (v2.2), averaged across participant location
Coincidence Factor	0.11	Indiana TRM (v2.2)

BASELINE WATTAGE FOR PAR AND MR LAMP TYPES

For highly focused directional lamps, Center Beam Candle Power (CBCP) and beam angle measurements are needed for accurate estimate of the equivalent baseline wattage. The formula below is based on the ENERGY STAR Center Beam Candle Power tool.[70] If CBCP and beam angle information are not available or if the equation below returns a negative value (or undefined), use the manufacturer's recommended baseline wattage equivalent.[71] The baseline wattage algorithm below is for reference.

$$Wbase = 375.1 - 4.355(D) - \sqrt{227800} - 937.9(D) - 0.9903(D2) - 1479(BA) - 12.02(D * BA) + 14.69(BA2) - 16720 * ln(CBCP)\, 84$$

Where:

D	=	Bulb diameter (e.g., for PAR20 D = 20)
BA	=	Beam angle
CBCP	=	Center beam candle power

The result of the ENERGY STAR calculator or equation above should be rounded down to the nearest wattage established by ENERGY STAR, presented in Table 244.

TABLE 244. BASELINE WATTAGES FOR PAR AND MR LED LAMPS

LAMP DIAMETER	PERMITTED WATTAGES
16	20, 35, 40, 45, 50, 60, 75
20	50
30S	40, 45, 50, 60, 75
30L	50, 75
38	40, 45, 50, 55, 60, 65, 75, 85, 90, 100, 120, 150, 250

BASELINE WATTAGE FOR NON-PAR AND MR LAMP TYPES

Table 245 shows the distribution of baseline wattages applied using the lumen equivalence method. This approach is specified in the UMP and uses the ENERGY STAR online database to calculate final baseline wattages for all program LEDs except certain PAR and MR lamp types (depending on their stated output).

TABLE 245. BASELINE WATTAGES FOR LED LAMPS BY LUMENS AND SHAPE

LAMP SHAPE	LUMEN RANGE		
	LOWER	UPPER	2017–2020 $WATTS_{BASE}$
Omnidirectional, Medium Screw-Base Lamps (A, BT, P, PS, S or T) See exceptions in gray rows below	250	309	25
	310	749	29
	750	1,049	43
	1,050	1,489	53

[70] http://www.energystar.gov/ia/products/lighting/iledl/IntLampCenterBeamTool.zip

[71] The ENERGY STAR CBCP tool does not accurately model baseline wattages for lamps with certain bulb characteristic combinations – specifically for lamps with very high CBCP.

LAMP SHAPE	LUMEN RANGE LOWER	UPPER	2017–2020 $WATTS_{BASE}$
	1,490	2,600	72
	2,601	3,300	150
	3,301	3,999	200
	4,000	6,000	300
S Shape ≤749 lumens and T Shape ≤749 lumens or T Shape >10-inches long	250	309	25
	310	749	40
Decorative, Medium Screw-Base Lamps (G) See exceptions in gray rows below	250	309	25
	310	749	29
	750	1,049	43
	1,050	1,300	53
G16-1/2, G25, and G30 ≤499 lumens	250	309	25
	310	349	25
	350	499	40
G Shape with diameter ≥5 inches	250	349	25
	350	499	40
	500	574	60
	575	649	75
	650	1,099	100
	1,100	1,300	150
Decorative, Medium Screw-Base Lamps (B, BA, C, CA, DC, F, and ST) See exceptions in gray rows below	70	89	10
	90	149	15
	150	299	25
	300	309	40
	310	499	29
	500	699	29
B, BA, CA, and F ≤499 lumens	70	89	10
	90	149	15
	150	299	25
	300	309	40
	310	499	40
Omnidirectional, Intermediate Screw-Base Lamps (A, BT, P, PS, S or T) See exceptions in gray rows below	250	309	25
	310	749	40
S Shape with a first number ≤12.5 and T Shape with a first number ≤8 and nominal overall length <12 inches	250	309	25
	310	749	40
Decorative, Intermediate Screw-Base Lamps (G) See exceptions in gray rows below	250	309	25
	310	349	25
	350	499	40
G Shape with a first number ≤12.5 or diameter ≥5 inches	250	349	25
	350	499	40
Decorative, Intermediate Screw-Base Lamps (B, BA, C, CA, DC, F, and ST)	70	89	10
	90	149	15
	150	299	25
	300	309	40
	310	499	40
Omnidirectional, Candelabra Screw-Base Lamps (A, BT, P, PS, S, and T) See exceptions in gray rows below	250	309	25
	310	749	40
	750	1,049	60
S Shape with a first number ≤12.5 and T Shape with a first number ≤8 and nominal overall length <12 inches	250	309	25
	310	749	40
	750	1,049	60
Decorative, Candelabra Screw-Base Lamps (G) See exceptions in gray rows below	250	309	25
	310	349	25
	350	499	40
	500	574	60

LAMP SHAPE	LUMEN RANGE LOWER	UPPER	2017–2020 $WATTS_{BASE}$
G Shape with a first number ≤12.5 or diameter ≥5 inches	250	349	25
	350	499	40
	500	574	60
Decorative, Candelabra Screw-Base Lamps (B, BA, C, CA, DC, F, and ST)	70	89	10
	90	149	15
	150	299	25
	300	309	40
	310	499	40
	500	699	60
Directional, Medium Screw-Base Lamps with Diameter ≤2.25 Inches	400	449	40
	450	499	45
	500	649	50
	650	1,199	65
Directional, Medium Screw-Base Lamps (R, ER, BR, BPAR, and similar bulb shapes with diameter >2.5 inches) See exceptions in gray rows below	640	739	40
	740	849	45
	850	1,179	50
	1,180	1,419	65
	1,420	1,789	75
	1,790	2,049	90
	2,050	2,579	100
	2,580	3,300	120
	3,301	3,429	120
	3,430	4,270	150
Directional, Medium Screw-Base Lamps (R, ER, BR, BPAR, and similar bulb shapes with medium screw bases and diameter >2.26 inches and ≤2.5 inches) See exceptions in gray rows below	540	629	40
	630	719	45
	720	999	50
	1,000	1,199	65
	1,200	1,519	75
	1,520	1,729	90
	1,730	2,189	100
	2,190	2,899	120
	2,900	3,300	120
	3,301	3,850	150
ER30, BR30, BR40, or ER40	400	449	40
	450	499	45
	500	649 to 1,179	50
BR30, BR40, or ER40	650	1419	65
R20	400	449	40
	450	719	45
All reflector lamps below lumen ranges specified above	200	299	20
	300	399 to 639	30
Rough Service, Shatter Resistant, 3-Way Incandescent, and Vibration	250	309	25
	310	749	40
	750	1,049	60
	1,050	1,489	75
	1,490	2,600	100
	2,601	3,300	150
	3,301	3,999	200
	4,000	6,000	300

APPENDIX 3: HOME ENERGY ASSESSMENT (HEA) PROGRAM

HOME ENERGY ASSESSMENT (HEA) ALGORITHMS AND ASSUMPTIONS

This appendix contains the assumptions used in electric savings, demand reduction, and gas savings algorithms for the measures within the HEA program. The team examined each assumption behind the algorithms to capture savings and compared it against the Indiana TRM (v2.2), as well as other state and industry approaches. Detailed information on the analysis and supporting assumptions for the following Home Energy Assessment program measures are included within this appendix:

- LEDs (A-Line, Candelabra, and Globe)
- Kitchen faucet aerators
- Bathroom faucet aerators
- Low-flow showerheads
- Shower start
- Pipe wrap
- Water Heater Wrap
- Filter whistles
- Duct sealing
- Attic insulation

Table 246 lists the assumptions of the *ex post* per-measure savings.

TABLE 246. HEA PROGRAM MEASURES

MEASURE	REVIEWED ASSUMPTIONS
LEDs	New and baseline wattages, house of use, waste heat factors, coincidence factors
Kitchen Faucet Aerator	New and baseline flow rates, people per house, minutes of use per day, faucets per home, water temperatures, water heater fuel type and efficiency
Bathroom Faucet Aerator	New and baseline flow rates, people per house, minutes of use per day, faucets per home, water temperatures, water heater fuel type and efficiency
Low-Flow Showerhead	New and baseline flow rates, people per house, minutes of use per day, showerheads per home, water temperatures, water heater fuel type and efficiency
Pipe Wrap	New and baseline R-values, pipe diameter, water heater recovery efficiency
Water Heater Wrap	Deemed values
Filter Whistle	Full load heating and cooling hours, efficiency ratings, efficiency improvement
Duct Sealing	New and baseline distribution efficiencies, full load heating and cooling hours, capacities and efficiencies of heating and cooling equipment
Attic Insulation	Void space and compression factor, pre-install and post-install R-values, square footage of installed insulation

The algorithms and assumptions the evaluation team used to calculate *ex post* savings for each of these measures follow.

LEDS

The team used the following equations to calculate electric energy and peak demand savings, as well as natural gas energy penalties, for LEDs:

$$kWh\ savings\ per\ lamp = \frac{(W_{base} - W_{LED}) * (Daily\ hours\ of\ use * 365) * (1 + WHF_e)}{1{,}000}$$

$$kW\ reduction\ per\ lamp = \frac{(W_{base} - W_{LED}) * Coincidence\ Factor * (1 + WHF_d)}{1{,}000}$$

$$Waste\ heat\ factor\ therm\ penalty\ per\ lamp = \frac{(W_{base} - W_{LED}) * (Daily\ hours\ of\ use * 365) * \left(WHF_g\right)}{1{,}000}$$

Where:

W_{base} = Wattage of the bulb being replaced, W

W_{LED} = Wattage of the LED bulb, W

Daily hours of use = Average hours of use per day, hr

WHF_e = Waste heat factor for energy to account for HVAC interactions with lighting (depends on location)

WHF_d = Waste heat factor for demand to account for HVAC interactions with lighting (depends on location)

WHF_g = Waste heat factor for gas to account for HVAC interactions with lighting (depends on location)

Coincidence Factor = Summer peak coincidence factor

365 = Number of days per year, days/yr.

1,000 = Constant to convert watts to kW

Table 247 lists the input assumptions and source of each assumption for the LED measure savings calculations.

TABLE 247. *EX POST* VARIABLE ASSUMPTIONS FOR LEDS

INPUT	VALUE	SOURCE
W_{base} for 9-watt (LED)	43	Ch. 6 Residential Lighting Evaluation Protocol, UMP
W_{base} for 6-watt (Candelabra LED)	40	Ch. 6 Residential Lighting Evaluation Protocol, UMP
W_{base} for 5-watt (Globe LED)	40	Ch. 6 Residential Lighting Evaluation Protocol, UMP
W_{LED} for 9-watt (LED)	9	Actual installed wattage
W_{LED} for 6-watt (Candelabra LED)	6	Actual installed wattage
W_{LED} for 5-watt (Globe LED)	5	Actual installed wattage
Daily hours of use x 365	902	Indiana TRM (v2.2)
WHF_e (Joint Customers)	-0.071	Indiana TRM (v2.2), Joint customer with gas heat with central air conditioning, averaged across participant location
WHF_e (Electric Only)	-0.071	Indiana TRM (v2.2), Electric customer with electric heat with central air conditioning, averaged across participant location
WHF_d	0.038	Indiana TRM (v2.2), averaged across participant location

WHF_g	-0.0019	Indiana TRM (v2.2), averaged across participant location
Coincidence Factor	0.11	Indiana TRM (v2.2)

KITCHEN AND BATHROOM FAUCET AERATORS

The evaluation team used the following equations to calculate electric energy, peak demand, and natural gas energy savings for Low-Flow Kitchen and Bathroom Faucet Aerators:

$$kWh\ savings = ISR * (GPM_{base} - GPM_{low\ flow}) * MPD * \frac{PH}{FH} * DR * 8.3 * (T_{mix} - T_{inlet}) * \frac{365}{RE * 3412}$$

$$kW\ savings = ISR * (GPM_{base} - GPM_{low\ flow}) * 60 * DR * 8.3 * \frac{T_{mix} - T_{inlet}}{RE * 3412} * CF$$

$$therm\ savings = ISR * (GPM_{base} - GPM_{low\ flow}) * MPD * \frac{PH}{FH} * DR * 8.3 * (T_{mix} - T_{inlet}) * \frac{365}{RG * 100{,}000}$$

Where:

GPM_{base}	=	Gallons per minute of baseline faucet aerator
$GPM_{low\ flow}$	=	Gallons per minute of low-flow faucet aerator
ISR	=	In-service rate, or fraction of units that get installed
MPD	=	Average minutes of faucet use per person per day
PH	=	Average number of people per household
FH	=	Average number of faucets per household
DR	=	Percentage of water flowing down the drain
T_{mix}	=	Mixed water temperature exiting faucet, °F
T_{inlet}	=	Cold water temperature entering the DWH system, °F (depends on location)
RE	=	Recovery efficiency of electric hot water heater
RG	=	Recovery efficiency of natural gas hot water heater
CF	=	Summer peak coincidence factor
60	=	Minutes per Hour
8.3	=	Specific weight of water in pounds per gallon
3,412	=	Constant to convert Btu to kWh
365	=	Days of faucet use per year
100,000	=	Constant to convert Btu to therms

Table 248 lists the assumptions and source of each assumption for kitchen and bathroom faucet aerator measure savings calculations.

TABLE 248. *EX POST* VARIABLE ASSUMPTION FOR KITCHEN AND BATHROOM FAUCET AERATORS

INPUT	VALUE	SOURCE
GPM_{base} (Kitchen)	2.44	Indiana TRM (v2.2)
GPM_{base} (Bathroom)	1.9	Indiana TRM (v2.2)
$GPM_{low\ flow}$ (Kitchen)	1.5	Actual
$GPM_{low\ flow}$ (Bathroom)	1.0	Actual
ISR	1.0	Indiana TRM (v2.2)
MPD (Kitchen)	4.5	Indiana TRM (v2.2)
MPD (Bathroom)	1.6	Indiana TRM (v2.2)
PH	2.64	Indiana TRM (v2.2)
FH (Kitchen)	1.0	Indiana TRM (v2.2)
FH (Bathroom)	2.21	2020 NIPSCO survey results
DR (Kitchen)	0.50	Indiana TRM (v2.2)
DR (Bathroom)	0.70	Indiana TRM (v2.2)
T_{mix} (Kitchen)	93.00	Indiana TRM (v2.2)
T_{mix} (Bathroom)	86.00	Indiana TRM (v2.2)
T_{inlet} (Kitchen, Electric)	56.8	Indiana TRM (v2.2), values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
T_{inlet} (Kitchen, Gas)	57.3	Indiana TRM (v2.2), values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
T_{inlet} (Bathroom, Electric)	57.0	Indiana TRM (v2.2), values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
T_{inlet} (Bathroom, Gas)	57.3	Indiana TRM (v2.2), values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
RE	0.98	Indiana TRM (v2.2)
RG	0.76	Indiana TRM (v2.2)
CF (Bathroom)	0.0012	Indiana TRM (v2.2)
CF (Kitchen)	0.0033	Indiana TRM (v2.2)
Conversion Factor	60	Minutes per hour
Conversion Factor	8.3	Specific weight of water in pounds per gallon
Conversion Factor	3,412	Constant to convert Btu to kWh
Conversion Factor	365	Days of faucet use per year
Conversion Factor	100,000	Constant to convert Btu to therms

LOW-FLOW SHOWERHEADS

The evaluation team used the following equations to calculate electric energy, peak demand, and natural gas energy savings for Low-Flow Showerheads:

$$kWh\ savings = ISR * \left(GPM_{base} - GPM_{low\ flow}\right) * MS * SPD * \frac{PH}{SH} * 8.3 * (T_{mix} - T_{inlet}) * \frac{365}{RE * 3412}$$

$$kW\ savings = ISR * \left(GPM_{base} - GPM_{low\ flow}\right) * 60 * 8.3 * \frac{T_{mix} - T_{inlet}}{RE * 3412} * CF$$

$$therm\ savings = ISR * \left(GPM_{base} - GPM_{low\ flow}\right) * MS * SPD * \frac{PH}{SH} * 8.3 * (T_{mix} - T_{inlet}) * \frac{365}{RG * 100{,}000}$$

Where:

GPM_{base}	=	Gallons per minute of baseline showerhead
$GPM_{low\ flow}$	=	Gallons per minute of low-flow showerhead
ISR	=	In-service rate, or fraction of units that get installed
MS	=	Average number of minutes per shower event
SPD	=	Average number of shower events per person per day
PH	=	Average number of people per household
SH	=	Average number of showerheads per household
T_{mix}	=	Mixed water temperature exiting faucet, °F
T_{inlet}	=	Cold water temperature entering the DWH system, °F (depends on location)
RE	=	Recovery efficiency of electric hot water heater
RG	=	Recovery efficiency of natural gas hot water heater
CF	=	Summer peak coincidence factor
60	=	Minutes per Hour
8.3	=	Specific weight of water in pounds per gallon
3,412	=	Constant to convert Btu to kWh
365	=	Days of faucet use per year
100,000	=	Constant to convert Btu to therms

Table 249 lists the assumptions and source of each assumption for low-flow showerhead measure savings calculations.

TABLE 249. *EX POST* VARIABLE ASSUMPTIONS FOR LOW-FLOW SHOWERHEADS

INPUT	VALUE	SOURCE
GPM_{base}	2.63	Indiana TRM (v2.2)
$GPM_{low\ flow}$	1.5	Actual
ISR	1.0	Indiana TRM (v2.2)
MS	7.8	Indiana TRM (v2.2)
SPD	0.60	Indiana TRM (v2.2)
PH	2.64	Indiana TRM (v2.2)
SH	1.8	2020 NIPSCO survey results
T_{mix}	101	Indiana TRM (v2.2)
T_{inlet} (Electric)	56.8	Indiana TRM (v2.2), values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
T_{inlet} (Gas)	57.3	Indiana TRM (v2.2), values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
RE	0.98	Indiana TRM (v2.2)
RG	0.76	Indiana TRM (v2.2)

INPUT	VALUE	SOURCE
CF	0.0023	Indiana TRM (v2.2)
Conversion Factor	60	Minutes per hour
Conversion Factor	8.3	Specific weight of water in pounds per gallon
Conversion Factor	3,412	Constant to convert Btu to kWh
Conversion Factor	365	Days of faucet use per year

SHOWER START

The evaluation team used the following equations to calculate electric energy, peak demand, and natural gas energy savings for shower start attachments:

$$kWh\ savings = \frac{ISR * GPM_{base}}{60} * \frac{8.3}{3412} * (T_{out} - T_{in}) * \frac{PH * SPD}{SH} * \frac{WS}{RE} * 365$$

$$kW\ savings = kWh\ savings * CF$$

$$therm\ savings = \frac{ISR * GPM_{base}}{60} * \frac{8.3}{100{,}000} * (T_{ou} \quad - T_{in}) * \frac{PH * SPD}{SH} * \frac{WS}{RG} * 365$$

Where:

GPM_{base} = Flow rate (in gallons per minute) of the existing showerhead equipped with a Shower Start attachment. Varies depending on whether the attachment was installed on an existing showerhead or installed along with a new low flow showerhead.

ISR = In-service rate, or fraction of units that get installed
SPD = Average number of shower events per person per day
PH = Average number of people per household
SH = Average number of showerheads per household
WS = Number of shower seconds saved by Shower Start attachment
T_{out} = Mixed water temperature exiting faucet, °F
T_{in} = Cold water temperature entering the DWH system, °F (depends on location)
RE = Recovery efficiency of electric hot water heater
RG = Recovery efficiency of natural gas hot water heater
CF = Summer peak coincidence and energy-to-demand factor
60 = Seconds per Minute
8.3 = Specific weight of water in pounds per gallon
3,412 = Constant to convert Btu to kWh
365 = Days of faucet use per year
100,000 = Constant to convert Btu to therms

Table 250 lists the assumptions and source of each assumption for shower start measure savings calculations.

TABLE 250. *EX POST* VARIABLE ASSUMPTIONS FOR SHOWER START

INPUT	VALUE	SOURCE
GPM_{base}	2.63	Indiana TRM (v2.2). Used for projects where a shower start was installed without a new low flow showerhead.
$GPM_{low\ flow}$	1.5	Actual. Used for projects where a shower start was installed along with a new low flow showerhead.
ISR	1.0	Indiana TRM (v2.2)
SPD	0.60	Indiana TRM (v2.2)
PH	2.64	Indiana TRM (v2.2)
SH	1.8	NIPSCO 2020 survey results
WS	59	PA TRM 2016
T_{mix}	101	Indiana TRM (v2.2)
Tinlet (Electric)	56.8	Indiana TRM (v2.2), values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
Tinlet (Gas)	57.3	Indiana TRM (v2.2), values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
RE	0.98	Indiana TRM (v2.2)
RG	0.76	Indiana TRM (v2.2)
CF	0.00008013	PA TRM 2016
Conversion Factor	60	Seconds per minute
Conversion Factor	8.3	Product of the specific weight of water (pounds per gallon) and the specific heat capacity of water (Btu per pound per °F)
Conversion Factor	3,412	Constant to convert Btu to kWh
Conversion Factor	365	Days of faucet use per year

PIPE WRAP

The evaluation team used the following equations to calculate electric energy, peak demand, and natural gas energy savings for Pipe Wrap:

$$kWh\ savings = \left(\frac{1}{R_{Exist}} - \frac{1}{R_{New}}\right) * \frac{L * C * \Delta T * 8{,}760}{\eta_{DHWE} * 3{,}412}$$

$$kW\ savings = \frac{kWh\ savings}{8{,}760}$$

$$therm\ savings = \left(\frac{1}{R_{Exist}} - \frac{1}{R_{New}}\right) * \frac{L * C * \Delta T * 8{,}760}{\eta_{DHWG} * 100{,}000}$$

Where:

R_{Exist} = Pipe heat loss coefficient (R-value) of uninsulated pipe existing

R_{New} = Pipe heat loss coefficient (R-value) of insulated pipe

L = Feet of pipe from water heating source covered by pipe wrap

C	=	Circumference of pipe in feet
ΔT	=	Average temperature difference between supplied water and ambient air temperature
η_{DHWE}	=	Recovery efficiency of electric water heater
η_{DHWG}	=	Recovery efficiency of gas water heater
8,760	=	Hours per year
3,412	=	Constant to convert Btu to kWh
100,000	=	Constant to convert Btu to therms

Table 251 lists the assumptions and source of each assumption for pipe wrap savings calculations.

TABLE 251. *EX POST* VARIABLE ASSUMPTIONS FOR PIPE WRAP

INPUT	VALUE	SOURCE
R_{Exist}	1.00	Indiana TRM (v2.2)
R_{New}	3.54	Actual. Based on insulation R-value of 2.54 and bare-pipe R-value of 1.0 (per Indiana TRM (v2.2)).
L	1	Indiana TRM (v2.2), calculating savings on a per-foot basis
C	0.196	Actual. Based on assumed pipe diameter of 0.75 inches
ΔT	65	Indiana TRM (v2.2)
η_{DHWE}	.98	Indiana TRM (v2.2)
η_{DHWG}	.75	Indiana TRM (v2.2)
Conversion Factor	3,412	Constant to convert Btu to kWh
Conversion Factor	100,000	Constant to convert Btu to therms

WATER HEATER WRAP

The evaluation team used the following equations to calculate electric energy, peak demand, and natural gas energy savings for water heater wrap:

$$kWh\ savings = kWh_{Base} * \frac{EF_{New} - EF_{Base}}{EF_{New}}$$

$$kW\ savings = \frac{kWh\ savings}{8{,}760}$$

Where:

kWh_{Base}	=	Average kilowatt-hour consumption of electric DHW tank
EF_{New}	=	Assumed efficiency of electric tank with tank wrap installed
EF_{Base}	=	Assumed efficiency of electric tank without tank wrap installed
8,760	=	Hours per year

Table 252 lists the assumptions and source of each assumption for water heater wrap measure savings calculations.

TABLE 252. *EX POST* VARIABLE ASSUMPTIONS FOR WATER HEATER WRAP

INPUT	VALUE	SOURCE
kWh_{Base}	3,460.00	Indiana TRM (v2.2)
EF_{New}	0.88	Indiana TRM (v2.2)
EF_{Base}	0.86	Indiana TRM (v2.2)

FILTER WHISTLE

The team used the following equations to calculate electric energy and peak demand savings for Filter Whistles:

$$kWh\ savings = \Delta kWh_{heat} + \Delta kWh_{cool}$$

$$\Delta kWh_{heat} = kW_{motor} * EFLH_{heat} * EI * ISR$$

$$\Delta kWh_{cool} = kW_{motor} * EFLH_{cool} * EI * ISR * \%CAC$$

$$kW\ reduction = \frac{\Delta kWh_{cool}}{EFLH_{cool}} * CF$$

Where:

kW_{motor} = Average motor full load electric demand, kW

$EFLH_{heat}$ = Estimated full load heating hours

$EFLH_{cool}$ = Estimated full load cooling hours

EI = Efficiency Improvement

CF = Coincidence Factor

%CAC = Percent of homes with air conditioning

ISR = In Service Rate

TABLE 253 lists the input assumptions and source of each assumption for the Filter Whistle measure savings calculations.

TABLE 253. *EX POST* VARIABLE ASSUMPTIONS FOR FILTER WHISTLES

INPUT	VALUE	SOURCE
kW_{motor}	0.5	2016 Pennsylvania TRM
$EFLH_{heat}$	1427	Indiana TRM (v2.2)
$EFLH_{cool}$	431	Indiana TRM (v2.2)
EI	0.15	2016 Pennsylvania TRM
ISR	0.474	2016 Pennsylvania TRM
CF	0.647	2016 Pennsylvania TRM
% CAC	0.83	2020 School HEW

ATTIC INSULATION

The evaluation team used the following equations to calculate electric energy, peak demand, and natural gas energy savings for attic insulation:

$$kWh\ savings = \left(\frac{SF}{1000}\right) * \left(\frac{\Delta kWh}{kSF}\right)$$

$$kW\ savings = \left(\frac{SF}{1000}\right) * \left(\frac{\Delta kW}{kSF}\right) * CF$$

$$therm\ savings = \left(\frac{SF}{1000}\right) * \left(\frac{\Delta MMBtu}{kSF}\right) * 10$$

Where:

SF	=	Total area of wall insulation in square feet
ΔkWh/kSF	=	Energy savings expected for every 1,000 square feet of insulation installed with respect to pre-R and post-R values from data tracking information
ΔkW/kSF	=	Demand savings expected for every 1,000 square feet of insulation installed with respect to pre-R and post-R values from data tracking information
ΔMMBtu/kSF	=	Natural gas savings expected for every 1,000 square feet of insulation installed with respect to pre-R and post-R values from data tracking information
CF	=	Coincidence factor

Electric energy, peak demand, and natural gas energy savings are dependent upon pre-R and post-R measure insulation values, calculated using the following steps:

- Step 1. Determine variables for insulation compression, R_{ratio}, and void factors
- Step 2. Calculate adjusted R-values, R_{adj}
- Step 3. Interpolate with Indiana TRM (v2.2) tables to obtain savings per 1,000 square feet of insulation to obtain values for ΔkWh/kSF, ΔkW/kSF, ΔMMBtu/kSF

Step 1. Determine variables for insulation compression, R_{ratio}, and void factors:

Adjusted pre-installation and post-installation R-values are calculated using the following formula:

$$R_{adj} = R_{nominal} * F_{compression} * F_{void}$$

Where:

$R_{nominal}$	=	Total installed R-value per manufacturers specifications. This value varies across participants and was calculated on an individual level to account for individual savings between pre and post measure.
$F_{compression}$	=	Insulation compression factor, assumed to be 1 for 0% compression (as shown in TRM v2.2), because actual information is unknown.
F_{void}	=	Void factor, dependent on insulation grade level and percent coverage, assumed to be at the 2% grade per the Indiana TRM (v2.2), because the actual information is unknown.

The void factor, F_{void}, varies based on the ration between the full assembly R-value and he nominal R-value, $R_{nominal}$, including compression effects. Pre and post insulation values are determined next, using the following equation:

$$R_{ratio} = \frac{R_{nominal} * F_{compressio}}{R_{nominal} + R_{framing\&airspace}}$$

Where:

$R_{nominal}$ = Total installed R-value per manufacturers specifications. This value varies across participants and was calculated on an individual level to account for individual savings between pre and post measure.

$F_{compression}$ = Insulation compression factor, assumed to be 1 for 0% compression (as shown in TRM v2.2) because actual information is unknown.

$R_{framing\&airspace}$ = R-value for materials, framing, and airspace for the area in which the insulation is installed. Assumed to be R-5, per Indiana TRM (v2.2).

Values for void factors, based on the R_{ratio} calculation are shown in Table 254. The evaluation team assumed a void factor at 2% in accordance with the Indiana TRM (v2.2).

TABLE 254. INSULATION VOID FACTORS

R_{RATIO}	F_{VOID}, 2%
0.50	0.96
0.55	0.96
0.60	0.95
0.65	0.94
0.70	0.94
0.75	0.94
0.80	0.91
0.85	0.88
0.90	0.83
0.95	0.71
0.99	0.33

Step 2. Calculate R_{adj}

Pre-R and post-R values, R_{adj}, are calculated at the participant level using $R_{nominal}$ and R_{ratio}

Step 3. Determine ΔkWh/kSF, ΔkW/kSF, ΔMMBtu/kSF

Electric energy, peak demand, and natural gas savings per thousand square feet values were obtained by interpolating within the Indiana TRM (v2.2) tables and averaging across participant location.

Table 255 lists the assumptions and source for R-values of insulation in the attic insulation measure.

TABLE 255. *EX POST* VARIABLE ASSUMPTIONS FOR ATTIC INSULATION

INPUT	VALUE	SOURCE
$R_{nominal\text{-}pre}$ (Not adjusted for voids / compression)	6.02	Value assigned based on CHA report data. Value shown is a program average which was used for the analysis.

INPUT	VALUE	SOURCE
$R_{nominal\text{-}post}$ (Not adjusted for voids / compression)	40.06	Value assigned based on CHA report data. Value shown is a program average which was used for the analysis.
$R_{framing\&airspace}$	5.0	R-value for materials, framing, and airspace for the area in which the insulation is installed. Assumed to be R-5, per Indiana TRM (v2.2).
$F_{compression}$	1.00	Insulation compression factor, assumed to be 1.0 for 0% compression (as shown in TRM v2.2), because actual information is unknown.
R-ratio$_{pre}$	0.55	Calculated using $R_{nominal\text{-}pre}$, $F_{compression}$, and $R_{framing\&airspace}$
R-ratio$_{post}$	0.89	Calculated using $R_{nominal\text{-}post}$, $F_{compression}$, and $R_{framing\&airspace}$
$F_{void\text{-}pre}$	0.96	Interpolated from insulation void factors from the Indiana TRM (v2.2) based on the ratio of $R_{nominal\text{-}pre}$ to $R_{nominal\text{-}post}$.
$F_{void\text{-}post}$	0.84	Interpolated from insulation void factors from the Indiana TRM (v2.2) based on the ratio of $R_{nominal\text{-}pre}$ to $R_{nominal\text{-}post}$.
$R_{adj\text{-}pre}$ (Adjusted for voids / compression)	5.78	Calculated using $R_{nominal\text{-}pre}$, $F_{compression}$, and $F_{void\text{-}pre}$
$R_{adj\text{-}post}$ (Adjusted for voids / compression)	33.69	Calculated using $R_{nominal\text{-}post}$, $F_{compression}$, and $F_{void\text{-}post}$

Table 256 lists the program-average kWh savings per thousand square feet for the attic insulation measure.

TABLE 256. *EX POST* kWh SAVINGS PER THOUSAND SQUARE FEET OF ATTIC INSULATION

TRM REFERENCE CITY	HVAC SYSTEM TYPE	SAVINGS VALUES
Ft. Wayne	Gas Heating Only	100.20
South Bend	Electric Cooling and Gas Heating	236.00
South Bend	Electric Cooling and Heating	4,942.50
South Bend	Gas Heating Only	102.20

Table 257 lists the program-average KW savings per thousand square feet for the attic insulation measure.

TABLE 257. *EX POST* KW SAVINGS PER THOUSAND SQUARE FEET OF ATTIC INSULATION

TRM REFERENCE CITY	HVAC SYSTEM TYPE	SAVINGS VALUES
Ft. Wayne	Gas Heating Only	0.000
South Bend	Electric Cooling and Gas Heating	0.116
South Bend	Electric Cooling and Heating	0.068
South Bend	Gas Heating Only	0.000

Table 258 lists the program-average MMBtu savings per thousand square feet for the attic insulation measure.

TABLE 258. *EX POST* MMBtu SAVINGS PER THOUSAND PER THOUSAND SQUARE FEET OF ATTIC INSULATION

TRM REFERENCE CITY	HVAC SYSTEM TYPE	SAVINGS VALUES
Ft. Wayne	Gas Heating Only	21.7
South Bend	Electric Cooling and Gas Heating	20.7
South Bend	Electric Cooling and Heating	0.0

DUCT SEALING

The evaluation team used the following equations to calculate electric and natural gas energy savings for duct sealing.

$$kWh\ savings_{cool} = \frac{DE_{coolafter} - DE_{coolbefore}}{DE_{coolafter}} * \frac{EFLH_{cool} * Btuh_{cool}}{SEER * 1{,}000}$$

$$kWh\ savings_{heat} = \frac{DE_{heatafte} \ \ - DE_{heatbefore}}{DE_{heatafte}} * \frac{EFLH_{heat} * Btuh_{heat}}{3{,}412 * N_{heating}}$$

$$kW\ savings = \left(\frac{DE_{pkafter} - DE_{pkbefore}}{DE_{pkafter}}\right) * \left(\frac{Btuh_{cool}}{EER * 1{,}000} * CF\right)$$

$$therm\ savings = \frac{DE_{heatafter} - DE_{heatbefore}}{DE_{heatafter}} * \frac{EFLH_{heat} * Btuh_{FF}}{100{,}000}$$

Where:

$DE_{coolafter}$	=	Distribution efficiency after duct sealing
$DE_{coolbefore}$	=	Distribution efficiency before duct sealing
$DE_{heatafter}$	=	Distribution efficiency after duct sealing
$DE_{heatbefore}$	=	Distribution efficiency before duct sealing
$DE_{pkafter}$	=	Distribution efficiency under peak summer conditions after duct sealing
$DE_{pkbefore}$	=	Distribution efficiency under peak summer conditions before duct sealing
$EFLH_{cool}$	=	Full load cooling hours
$EFLH_{heat}$	=	Full load heating hours
$BtuH_{cool}$	=	Cooling capacity of cooling equipment (Btu per hour)
$BtuH_{heat}$	=	Heating capacity of electric heating equipment (Btu per hour)
$BtuH_{FF}$	=	Heating capacity of gas heating equipment (Btu per hour)
N_{heat}	=	Efficiency in COP of heating equipment
SEER	=	Seasonal average efficiency of air conditioning equipment
EER	=	Peak efficiency of air conditioning equipment
56.4	=	Gas duct sealing savings evaluated through billing analysis in the 2018 program evaluation
CF	=	Coincidence factor

Table 259 lists the assumptions and source of each assumption for the smart duct sealing savings calculations.

TABLE 259. *EX POST* VARIABLE ASSUMPTIONS FOR DUCT SEALING

INPUT	VALUE	SOURCE
$DE_{coolbefore}$	0.75	Indiana TRM (v2.2)
$DE_{coolafter}$	0.84	Indiana TRM (v2.2)
$DE_{heatbefore}$	0.75	Indiana TRM (v2.2)
$DE_{heatafter}$	0.82	Indiana TRM (v2.2)
$DE_{pkbefore}$	0.68	Indiana TRM (v2.2)
$DE_{pkafter}$	0.79	Indiana TRM (v2.2)
$EFLH_{cool}$ (CAC with Gas Heating)	427	Indiana TRM (v2.2). values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
$EFLH_{cool}$ (CAC with Electric Heating)	373	Indiana TRM (v2.2). values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
$EFLH_{cool}$ (Gas Heating Only)	423	Indiana TRM (v2.2). values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
$EFLH_{heat}$ (CAC with Gas Heating)	1,422.0	Indiana TRM (v2.2). values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
$EFLH_{heat}$ (CAC with Electric Heating)	1,356.0	Indiana TRM (v2.2). values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
$EFLH_{heat}$ (Gas Heating Only)	1,417.0	Indiana TRM (v2.2). values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
SEER	11.15	Indiana TRM (v2.2)
EER	10	Indiana TRM (v2.2)
$N_{heating}$	1	Indiana TRM (v2.2)
$BtuH_{cool}$	28,994	Indiana TRM (v2.2)
$BtuH_{heat, elec}$	32,000	Pennsylvania TRM (2016)
$BtuH_{FF}$	77,386	Indiana TRM (v2.2)
CF	0.88	Indiana TRM (v2.2)

APPENDIX 4: APPLIANCE RECYCLING PROGRAM

APPLIANCE RECYCLING ALGORITHMS AND ASSUMPTIONS

This appendix contains the assumptions used in electric savings and demand reduction algorithms for the measures within the Appliance Recycling program. For the 2020 program year, the evaluation team estimated per-unit savings estimates for recycled refrigerators and freezers using meter data and multivariate regression models. The section below details information on the analysis and supporting assumptions for the Appliance Recycling measures in this appendix.

REFRIGERATOR AND FREEZER REGRESSION MODELS

The evaluation team used the regression model recommended in the UMP to estimate savings resulting from the Appliance Recycling program. TABLE 260 lists the UMP model specification used to estimate the annual unit energy consumption (UEC) of refrigerators recycled in 2020, along with the model's estimated coefficients.

TABLE 260. 2020 APPLIANCE RECYCLING REFRIGERATOR UNIT ENERGY CONSUMPTION REGRESSION MODEL ESTIMATES

INDEPENDENT VARIABLES	COEFFICIENT	P-VALUE
Intercept	0.81	0.134
Age (years)	0.021	0.035
Dummy: Manufactured Pre-1990	1.04	0.000
Size (cubic feet)	0.06	0.021
Dummy: Single Door	-1.75	0.000
Dummy: Side-by-Side	1.12	0.000
Dummy: Primary	0.56	0.003
Interaction: Unconditioned Space * HDDs[a]	-0.04	0.000
Interaction: Unconditioned Space * CDDs[a]	0.03	0.239

a. The evaluation team derived HDDs and CDDs from the weighted average from TMY3 data for weather stations mapped to participating appliance zip codes. TMY3 uses median daily values for a variety of weather data collected from 1991 through 2005.
Note: Dependent Variable = Average Daily kWh, R2 = 0.30

The coefficient value indicates the marginal impact on the per-unit energy consumption of a one-point increase in the independent variable. For example, as shown in TABLE 260, an increase of one cubic foot in refrigerator size resulted in an increase of 0.06 kWh in daily consumption. In the case of dummy variables, the coefficient value represented the difference in consumption if the given condition proved true. For example, the evaluation team's refrigerator model used a coefficient of 0.56 for the variable indicating whether a refrigerator was a primary unit; thus, with all else equal, a primary refrigerator consumed 0.56 kWh per day more than a secondary unit.

Table 261 lists the UMP model specification used to estimate the annual UEC of freezers recycled in 2020, along with the model's estimated coefficients. Again, as the UMP only specified a refrigerator model, the evaluation team created an analogous freezer model.

TABLE 261. 2020 APPLIANCE RECYCLING PROGRAM FREEZER UNIT ENERGY CONSUMPTION REGRESSION MODEL ESTIMATES

INDEPENDENT VARIABLES	COEFFICIENT	P-VALUE
Intercept	-0.96	0.236
Age (years)	0.045	0.010
Dummy: Manufactured Pre-1990	0.54	0.202
Size (cubic feet)	0.12	0.001
Dummy: Chest Freezer	0.30	0.273
Interaction: Unconditioned Space * HDDs	-0.03	0.035
Interaction: Unconditioned Space * CDDs	0.08	0.026

Note: Dependent Variable = Average Daily kWh, R2 = 0.45

TABLE 262 lists the UMP model specification used to estimate the annual UEC of refrigerators recycled in 2020, along with the model's estimated coefficients. It also includes our model coefficients and estimates for recycled freezers.

The refrigerator age variable used in the UEC model was calculated by multiplying the tracking data unit age by an adjustment factor of 0.63 that was calculated from 2020 survey results. The freezer age variable used in the UEC model was calculated by multiplying the tracking data unit age by an adjustment factor of 0.71 that was calculated from 2020 survey results. The Evaluation Team used the 2020 survey results to inform appliances ages due to reasons previously discussed in this report.

TABLE 262. APPLIANCE RECYCLING PROGRAM PARTICIPANT MEAN VARIABLES AND MODEL COEFFICIENTS

	INDEPENDENT VARIABLES	2020 MEAN VALUE	2020 MODEL COEFFICIENT
Refrigerator	Intercept	1.00	0.81
	Age (years)	17.16[b]	0.021
	Dummy: Manufactured Pre-1990	0.02[b]	1.04
	Size (cubic feet)	19.52	0.06
	Dummy: Single Door	0.02	-1.75
	Dummy: Side-by-Side	0.25	1.12
	Dummy: Primary	0.58	0.56
	Interaction: Unconditioned Space * HDDs[a]	4.65	-0.04
	Interaction: Unconditioned Space * CDDs[a]	0.85	0.03
Freezer	Intercept	1.00	-0.96
	Age (years)	21.57[c]	0.045
	Dummy: Manufactured Pre-1990	0.13[c]	0.54
	Size (cubic feet)	16.73	0.12
	Dummy: Chest Freezer	0.23	0.30
	Interaction: Unconditioned Space * HDDs	7.47	-0.03
	Interaction: Unconditioned Space * CDDs	1.35	0.08

a. Cooling degree days (CDDs) and heating degree days (HDDs) are weighted averages, based on TMY3 data from weather stations mapped to participating appliance zip codes.

b. Based on tracking data ages multiplied by refrigerator age adjustment factor of 0.63 from 2020 survey results.

c. Based on tracking data ages multiplied by freezer age adjustment factor of 0.71 from 2020 survey results.

PER-UNIT ENERGY CONSUMPTION

The following regression model shows how the UMP-defined model was used. For the refrigerator UEC calculation, this included average appliance characteristics:

$$UEC_{Ref} = 365.25\ days * [0.81 + (0.021 * (17.16\ years\ old)) + \big(1.04 * (2\%\ units\ manufactured\ before\ 1990)\big) + (0.06 * 19.52\ unit\ size\ ft.^3) - (1.75 * 2\%\ single\ door\ units) + (1.12 * 25\%\ side - by - side\ units) - (0.56 * 58\%\ primary\ usage) - (0.04 * 4.65\ unconditioned\ HDDs) + (0.03 * 0.85\ Unconditioned\ CDDs)] = 1{,}012\ kWh\text{year}$$

The following regression model shows how the UMP-defined model was used. For the freezer UEC calculation, this included average appliance characteristics:

$$UEC_{Frz} = 365.25\ days * [0.96 + (0.045 * (21.57\ years\ old)) + \big(0.54 * (13\%\ units\ manufactured\ before\ 1990)\big) + (0.12 * 16.73\ unit\ size\ ft.^3) - (0.30 * 23\%\ units\ that\ are\ chest\ freezers) - (0.03 * 7.47\ unconditioned\ HDDs) + (0.08 * 1.35\ Unconditioned\ CDDs)] = 746\ kWh\text{year}$$

Using the values from TABLE 263 the evaluation team estimated the *ex post* annual UEC for an average program refrigerator and freezer.

TABLE 263. APPLIANCE RECYCLING PROGRAM AVERAGE UNIT ENERGY CONSUMPTION BY APPLIANCE TYPE

MEASURE	AVERAGE PER-UNIT ENERGY CONSUMPTION (KWH/YEAR)
Refrigerators	1,012
Freezers	746

DEMAND IMPACTS

To calculate demand reduction, the team used adjustment factors shown in TABLE 264, drawn from the Indiana TRM (v2.2), to calculate per-measure demand reduction for refrigerators and freezers. The evaluation team used the following equation to calculate demand reduction separately for refrigerator and freezer appliance measures.

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

Where:

TAF = Temperature adjustment factor

LSAF = Load shape adjustment factor

TABLE 264. APPLIANCE RECYCLING DEMAND REDUCTION ASSUMPTIONS FOR APPLIANCE RECYCLING PROGRAM–RECYCLED REFRIGERATORS AND FREEZERS

VARIABLE	RECYCLED APPLIANCE VALUE
Temperature Adjustment Factor	1.21
Load Shape Adjustment Factor	1.06

Using the values from Table 265 the evaluation team estimated the *ex post* annual gross peak demand reduction for an average program refrigerator and freezer.

TABLE 265. APPLIANCE RECYCLING PROGRAM AVERAGE UNIT ENERGY DEMAND REDUCTION BY APPLIANCE TYPE

APPLIANCE	AVERAGE PER-UNIT GROSS PEAK DEMAND REDUCTION (KW/YEAR)
Refrigerators	0.150
Freezers	0.111

PART-USE FACTOR

Part-use, an adjustment factor specific to appliance recycling, is used to convert a UEC into an average per-unit gross savings value. The UEC itself does not equal the gross savings value due to two considerations:

- The UEC model yields an estimate of annual consumption
- Not all recycled refrigerators would have operated year-round if they had not been decommissioned through the program

The part-use methodology applied in 2020 relies on information collected from surveyed customers regarding pre-program usage patterns. It asks them about how many months of the year, prior to recycling, the customer had the appliance plugged in and running.

The final part-use estimate reflects how appliances would likely have been operated, had they not been recycled. For example, a primary refrigerator that is operated year-round could become a secondary appliance that operates part-time.

This methodology accounts for potential shifts in usage; specifically, it calculates part-use with a weighted average of three prospective part-use categories and factors:

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

The evaluation team calculated a weighted average part-use factor representing the three participant usage categories as defined by each appliance's operational status during the year prior to recycling. For example, the team assigned a part-use factor of zero to participants who did not use their appliance at all during the year prior to recycling, as no immediate savings were generated by retiring the appliance. Using information gathered through the 2020 participant surveys, the evaluation team employed the following multistep process to determine part use:

- The team asked respondents whether the refrigerator or freezer that was recycled remained unplugged, operated year-round, or operated for a portion of the preceding year.
- If participants said that their refrigerator or freezer operated for only a portion of the preceding year, the team asked participants for the total number of months that the appliance was plugged in. (In 2020, responses from this participant subset resulted in secondary refrigerators operating an average of 4.8 months and secondary freezers operating an average of 5.3 months.)
- The team divided each value by 12 to convert months of operation into an annual part-use factor for all refrigerators and freezers. In 2020, for those refrigerators and freezers that operated part of the time, the average refrigerator had a part-use factor of 0.40 and the average freezer had a part-use factor of 0.44.
- If participants said that they would have discarded their appliance independently of the program, the team did not follow up about that appliance's future use as those actions would be determined by another customer. Since future use of discarded refrigerators remained unknown, the team applied the 0.91 weighted part-use average of all units (primary and secondary, including those that were expected to be in operation full time) to this subset. It is possible that discarded appliances may be used as primary or secondary units in a would-be recipient's home.

TABLE 266 lists the resulting part-use factor results by category.

TABLE 266. APPLIANCE RECYCLING PROGRAM PART-USE FACTOR BY CATEGORY

USAGE TYPE AND PART-USE CATEGORY	REFRIGERATORS			FREEZERS		
	RECYCLED UNITS (%)	PART-USE FACTOR	PER-UNIT ENERGY SAVINGS (KWH/YR)	RECYCLED UNITS (%)	PART-USE FACTOR	PER-UNIT ENERGY SAVINGS (KWH/YR)
Secondary Units Only	n = 67			N/A		
Not in Use	10%	0.00	-			
Used Part Time	19%	0.40	409			
Used Full Time	70%	1.00	1,012			
Weighted Average	100%	0.78	789			
All Units (Primary and Secondary)	n = 160			n = 32[a]		
Not in Use	4%	0.00	-	3%	0.00	-
Used Part Time	8%	0.40	409	13%	0.44	326
Used Full Time	88%	1.00	1,012	84%	1.00	746
Weighted Average	**100%**	**0.91**	**919**	**100%**	**0.90**	**670**

Note: Totals may not sum properly due to rounding.
a. All freezer units are considered secondary.

Combining the part-use factors shown in TABLE 266 with participants' self-reported likely actions in the program's absence resulted in the distribution of future-use scenarios and corresponding part-use estimates for refrigerators, as shown in TABLE 267. As the table shows, the weighted average of these future scenarios produced a final part-use factor for refrigerators of 0.89 for the 2020 program. The final part-use estimate of 0.90 for freezers, shown in TABLE 268, with all freezer units considered secondary units and no additional weighting needed.

TABLE 267. APPLIANCE RECYCLING PROGRAM REFRIGERATOR WEIGHTED AVERAGE PART-USE

USE PRIOR TO RECYCLING	LIKELY USE INDEPENDENT OF RECYCLING	REFRIGERATORS	
		GROSS SAVINGS FACTOR	PARTICIPANTS (%)
Secondary	Kept	1.00	6%
	Discarded	0.78	7%
Primary	Kept (as primary unit)	0.91	45%
	Kept (as secondary unit)	0.78	13%
	Discarded	0.91	30%
Overall		0.89	100%

Note: Totals may not sum properly due to rounding.

In 2020, the part-use factor for refrigerators decreased slightly from 0.90 in 2018 to 0.89. For freezers, the 2020 part-use factor increased from 0.83 in 2018 to of 0.90.

Applying the part-use factors calculated from the 2020 survey to the modeled annual consumption and demand reduction from TABLE 267 and TABLE 268 yielded average gross, per-unit energy savings and demand reductions. TABLE 269 shows average per-unit gross annual energy consumption and demand reduction values, part-use factors and the part-use adjusted per-unit gross energy savings and demand reduction values used as final *ex post* gross per-unit values for the 2020 evaluation.

TABLE 268. 2020 APPLIANCE RECYCLING *EX POST* PER-UNIT ENERGY SAVINGS AND DEMAND REDUCTION

SAVINGS TYPE	AVERAGE PER-UNIT ANNUAL ENERGY CONSUMPTION (KWH/YEAR)	AVERAGE PER-UNIT ANNUAL ENERGY DEMAND REDUCTION (KWH/YEAR)	PART-USE FACTOR	*EX POST* PER-UNIT GROSS ENERGY SAVINGS (KWH/YEAR)	*EX POST* PER-UNIT ENERGY DEMAND REDUCTION (KWH/YEAR)
Refrigerators	1,012	0.150	0.89	901	0.134
Freezers	746	0.111	0.90	671	0.100

NET-TO-GROSS

In the case of appliance recycling, programs generate net savings only when the recycled appliances would have continued to operate without program intervention (either in the participating customer's home or at the home of another utility customer).

The evaluation team employed a decision-tree approach to calculate net program savings and used a weighted average of these scenarios to calculate net savings attributable to the program. The decision tree—populated by responses from surveyed 2020 participants and by information gathered from local market actors interviewed during other recent evaluations—represents all a program's possible savings scenarios. Discussion of specific portions of the decision tree continue throughout this chapter, highlighting aspects of the net savings analysis.

The decision-tree approach not only accounts for what a participating household would have done independently of the program, but it also addresses the possibility that the recycled unit would have transferred to another household, and whether the recipient of that appliance would have found an alternate unit instead.

FREERIDERSHIP

Independent of program intervention, participant refrigerators and freezers were generally subject to one of three scenarios:

- Scenario One: The participant keeps the refrigerator.
- Scenario Two: The participant discards the refrigerator by a method that transfers it to another customer for continued use.
- Scenario Three: The participant discards the refrigerator by a method that removes the unit from service.

The evaluation team applied freeridership only under Scenario Three, as the unit would have been removed from service and destroyed in the absence of the program, even though it was recycled through the program. As such, the program could not claim energy savings generated by recycling this appliance.

To determine the percentage of participants in each of the scenarios and to assess freeridership, the team asked each surveyed participant what would likely have happened to the appliance had it not been recycled by NIPSCO. Participants provided the following responses:

- Kept it and continued to operate the appliance
- Kept it, but stored it unplugged indefinitely
- Sold it to a private party, either to someone known or by running an ad
- Sold it to a used appliance dealer
- Gave it to a private party, such as a friend or neighbor
- Had it removed by the dealer from whom the new or replacement appliance was purchased
- Hauled it to the dump or recycling center
- Hired someone to haul it away for junking or dumping

To ensure the highest quality of responses possible and to mitigate socially responsible response bias, the evaluation team asked some participants follow-up questions to test the reliability of their initial responses. For example, in previous evaluations the team conducted interviews with local market actors for other evaluations who indicated that used appliance dealers usually do not purchase appliances more than 15 years old. Therefore, the team asked participants who recycled an appliance that was more than 15 years old and who indicated they would have sold their unit to a used appliance dealer, what they would have done had they been unable to carry through with their plans. The evaluation team used the respondent's self-reported unit age during this process.

Upon determining the final assessments of participants' actions independently of the program, the team calculated the percentage of refrigerators and freezers that would have been kept or discarded. TABLE 269 shows the results.

TABLE 269. APPLIANCE RECYCLING PROGRAM FINAL DISTRIBUTION OF KEPT AND DISCARDED APPLIANCES

STATED ACTION ABSENT PROGRAM	INDICATIVE OF FREERIDERSHIP	REFRIGERATORS (N=148) [A]	FREEZERS (N=29) [A]
Kept	No	29%	34%
Discarded	Varies by discard method	71%	66%
Total		100%	100%

a. Does not include "*don't know*" responses and refusals.

SECONDARY MARKET IMPACTS

After determining that a participant would have directly or indirectly (through a market actor) transferred the unit to another customer on the electric grid, the evaluation team addressed what the recipient would have done had the recycled unit been unavailable. Three possible scenarios resulted:

- Scenario One: None of the potential recipients would find another unit. Program participation would result in a one-for-one reduction in the total number of refrigerators operating on the electric grid. In this case, total energy consumption of avoided transfers (participating appliances that otherwise would have been used by another customer) would be credited as program savings. This position is consistent with the theory that participating appliances are essentially convenience goods for would-be acquirers: the recipient would have accepted the refrigerator had it been readily available, but, as the refrigerator was not a necessity, the would-be acquirer would not have sought an alternate unit.
- Scenario Two: All potential recipients would find another unit. Thus, program participation would not affect the total number of refrigerators operating on the grid. This position is consistent with the concept that participating appliances are necessities and customers always seek alternative units when participating appliances are unavailable.
- Scenario Three: Some potential recipients would find another unit, while others would not. This scenario reflects the awareness that some acquirers were in the market for a refrigerator and would acquire another unit, while others were not and would have taken the unit only opportunistically.

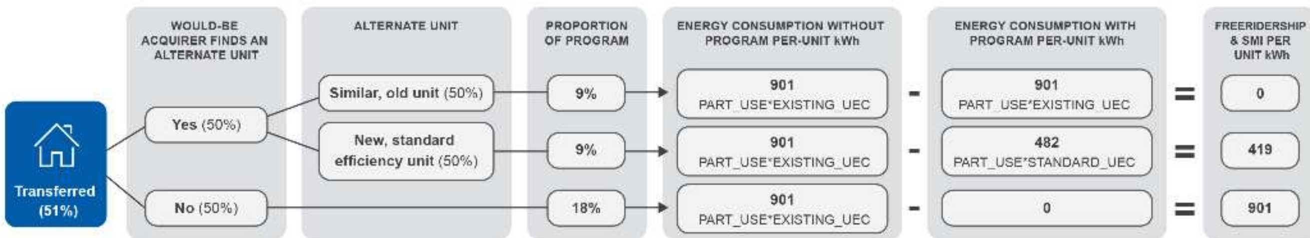
After the team determined if a participant would have directly or indirectly (through a market actor) transferred the unit to another customer on the electric grid, the question became what the potential recipient would have done had the recycled unit been unavailable. We assumed one-half of would-be acquirers of avoided transfers would have found alternate units—an assumption consistent with the UMP.

The evaluation team then addressed the likelihood that the alternate unit would be another used appliance (like those recycled through the program) or—with fewer used appliances presumably available in the market due to program activity—the customer would acquire a new standard-efficiency unit. Even if a would-be acquirer could select a new ENERGY STAR® unit, we assumed it likely that a customer in the market for a used appliance would upgrade to the next lowest price point. For reasons previously discussed, the team applied a midpoint approach, with one-half of potential program unit recipients finding a similar used appliance and one-half acquiring a new standard-efficiency unit.[72]

Figure 97 explains the methodology used for assessing the program's impact on the secondary refrigerator market and the application of recommended midpoint assumptions (when primary data proved unavailable). As shown, accounting for market effects resulted in three savings scenarios:

- Full savings (that is, per-unit gross savings)
- No savings (that is, the difference in energy consumption of the program unit and a similar unit)
- Partial savings (that is, the difference between the energy consumption of the program unit and that of a new, standard-efficiency appliance)

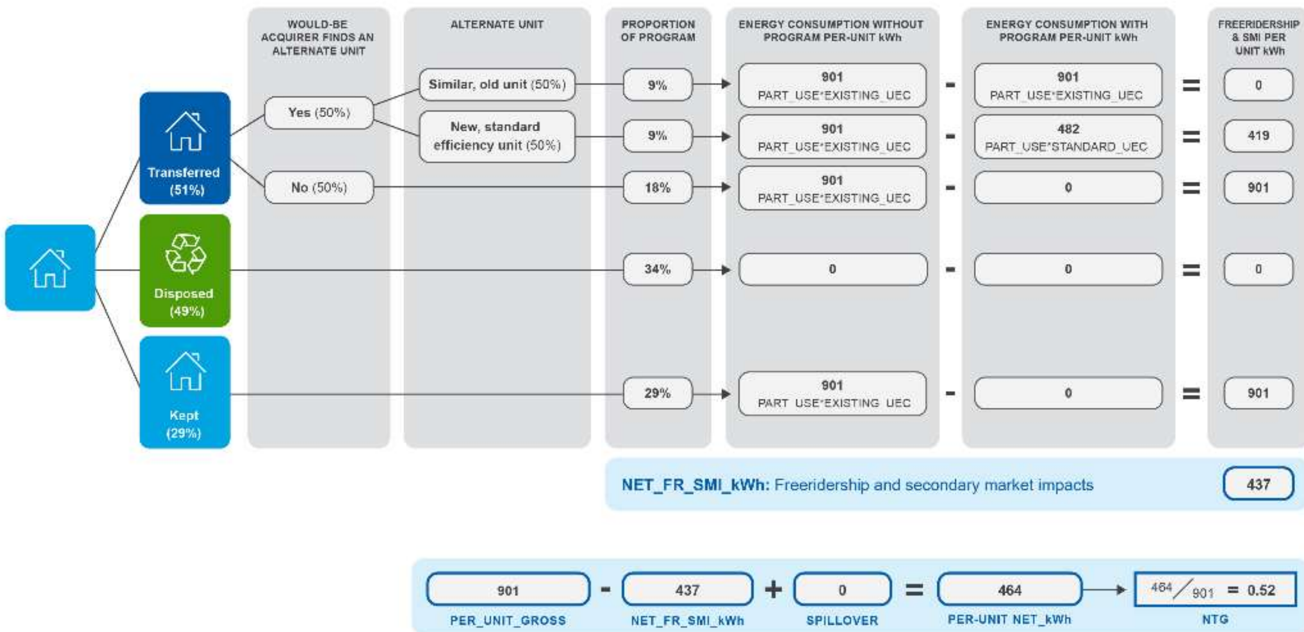
FIGURE 97. SECONDARY MARKET IMPACTS—REFRIGERATORS



After estimating the parameters of freeridership impacts and secondary market impacts, the evaluation team used the UMP decision tree to calculate average per-unit program savings. Figure 98 shows how these values were integrated into a combined savings estimate as a weighted average, net of freeridership and secondary market impacts.

[72] The evaluation team calculated the energy consumption of a new, standard-efficiency appliance using the ENERGY STAR website, taking the average energy consumption of new, comparably sized, and standard-efficiency appliances with similar configurations as the program units. U.S. Environmental Protection Agency. ENERGY STAR. "Refrigerator Retirement Savings Calculator." (http://www.energystar.gov/index.cfm?fuseaction=refrig.calculator)

FIGURE 98. SAVINGS NET OF FREERIDERSHIP AND SECONDARY MARKET IMPACTS—REFRIGERATORS



PARTICIPANT SPILLOVER

As recommended in the UMP, the evaluation team did not include spillover in program net savings estimates for 2020. The UMP suggests that although appliance recycling programs promote enrollment in other energy efficiency programs, spillover of unrelated measures is unlikely to occur because appliance recycling programs do not provide comprehensive energy education like other programs.

SUMMARY OF VERIFIED NET PROGRAM IMPACTS

The evaluation team calculated final verified per-unit net savings using the following equation:

$$Net\ Program\ Savings\ (kWh\ per\ year) = Gross\ Program\ Savings - Freeridership\ \&\ Secondary\ Market\ Impact + Spillover$$

TABLE 270 lists all per-unit net impacts discussed in this chapter, and overall NTG ratios by appliance type.

TABLE 270. 2020 APPLIANCE RECYCLING NET-TO-GROSS RATIOS

SAVINGS TYPE	GROSS PER-UNIT SAVINGS (KWH/YR)	PER-UNIT FREERIDERSHIP AND SECONDARY MARKET IMPACTS (KWH/YR)	ADDITIONAL (SPILLOVER) PER-UNIT ELECTRIC ENERGY SAVINGS (KWH/YR)	NET PER-UNIT ELECTRIC ENERGY SAVINGS (KWH/YR)	NTG RATIO
Refrigerators	901	437	0	464	52%
Freezers	671	160	0	511	76%

AGE OF APPLIANCES ADJUSTMENT IN NET TO GROSS ANALYSIS

The evaluation team calculated the gross impacts of the program using the ages from the tracking data and the prorated ages using the survey data. We found that prorating the appliances ages reduced the per unit kWh savings by 167 kWh for refrigerators and 173 kWh for freezers. Prorating the appliance ages reduced the per unit kW impact by 0.024 kW for refrigerators and 0.025 kW for freezers (Table 271).

TABLE 271. 2020 APPLIANCE RECYCLING *EX POST* GROSS SAVINGS WITH TRACKING AND SURVEY ADJUSTED AGES

MEASURE	SURVEY ADJUSTED *EX POST* GROSS PER-MEASURE SAVINGS		RAW TRACKING DATA *EX POST* GROSS PER-MEASURE SAVINGS	
	KWH	KW	KWH	KW
Refrigerators	901	0.134	1,068	0.158
Freezers	671	0.100	844	0.125

By adjusting the age in the tracking data, we had to adjust other model inputs like age and the dummy for manufactured before 1990 (Table 272). The age in years and the dummy variable both decrease when using the survey adjusted ages.

TABLE 272. 2020 APPLIANCE RECYCLING MODEL COEFFICIENTS WITH TRACKING AND SURVEY ADJUSTED AGES

APPLIANCE	INDEPENDENT VARIABLES	SURVEY ADJUSTED 2020 PARTICIPANT POPULATION MEAN VALUES	TRACKING DATA 2020 PARTICIPANT POPULATION MEAN VALUES
Refrigerator	Age (years)	17.16	27.24
	Dummy: Manufactured Pre-1990	0.02	0.31
Freezer	Age (years)	21.57	30.39
	Dummy: Manufactured Pre-1990	0.13	0.37

In addition, we adjusted the inputs for the net-to-gross calculation that rely on age, like ability to resell the appliance, to incorporate the adjusted survey age (Table 273). For refrigerators, the gross per-unit savings, per-unit freeridership and secondary market impacts, and net per-unit electric savings all decrease slightly when using the survey adjusted ages, which is expected.

TABLE 273. 2020 APPLIANCE RECYCLING NET-TO-GROSS RATIOS WITH TRACKING AND SURVEY ADJUSTED AGES

SAVINGS TYPE	SOURCE OF AGE	GROSS PER-UNIT SAVINGS (KWH/YR)	PER-UNIT FREERIDERSHIP AND SECONDARY MARKET IMPACTS (KWH/YR)	NET PER-UNIT ELECTRIC ENERGY SAVINGS (KWH/YR)	NTG RATIO
Refrigerators	Survey adjusted	901	437	464	52%
	Tracking data	1,068	532	536	50%

Freezers	Survey adjusted	671	160	511	76%
	Tracking data	844	192	652	77%

AGE OF APPLIANCES – TRIANGULATION

Age is one important appliance characteristic that influences the amount of energy used by the appliance. As programs mature, they may deplete the existing stock of old and inefficient appliances available to be recycled in the market. However, in the 2019, the program tracking data indicated that on average, appliances recycled through the program were trending older than in previous years.

Correctly estimating old appliance ages can be difficult, and sometimes imprecise; however, the evaluation team identified this shift in appliance ages as a potential area to explore in the 2020 evaluation to determine if these were being captured accurately, and if so, what was causing the shift. In the 2020 evaluation the evaluation team surveyed customers from 2019 and 2020 to learn more about their recycled appliances and to try to corroborate the trend in reported ages that we saw in 2019. TABLE 274 shows the mean age of each appliance type by program year from the tracking data.

TABLE 274. MEAN AGE FROM TRACKING DATA OF APPLIANCE BY PROGRAM YEAR

MEASURE	2017	2018	2019	2020
Refrigerator	23	21	33	27
Freezer	29	26	35	30

In addition to this shift in the trend of appliance ages in the tracking data, the evaluation team identified a discrepancy between the respondent reported ages and the tracking data reported ages. While we expect that respondents think their appliances are younger, the differences we see are higher than anticipated. Based on a 2015 study by Opinion Dynamics and EMI Consulting, survey respondents generally recall their appliances as five years younger than the tracking data states.[73] The difference between the NIPSCO tracking data and survey respondents is larger.

TABLE 275. AVERAGE REPORTED AND TRACKING DATA AGE OF CUSTOMERS WHO TOOK SURVEY

	SURVEY RESPONDENT REPORTED AGE	TRACKING DATA REPORTED AGE [a]
Refrigerator	17	31
Freezer	22	30

a. Average tracking data ages of those who took the survey

Source: Tracking data and participant survey. Survey questions: “About how old was [UNIT.COLOR] [UNIT.MAKE] refrigerator you recycled (in years)?” & “About how old was [UNIT.COLOR] [UNIT.MAKE] freezer you recycled (in years)?”

The difference between the average respondents’ reported age and the tracking data reported age was slightly higher for 2019 than 2020 participants. (Table 276).

TABLE 276. AVERAGE REPORTED AND TRACKING DATA AGES BY PROGRAM YEAR

	2019 - SURVEY	2019 - TRACKING	2020 - SURVEY	2020 - TRACKING
Refrigerator	18	33	17	27
Freezer	22	35	22	30

[73] Opinion Dynamics and EMI Consulting. (2015). Appliance Recycling program 2015. Columbia: Public Service Commission of South Carolina.

Source: Tracking data and participant survey. Survey questions: "About how old was [UNIT.COLOR] [UNIT.MAKE] refrigerator you recycled (in years)?" & "About how old was [UNIT.COLOR] [UNIT.MAKE] freezer you recycled (in years)?"

REASONS FOR DIFFERENCE

As a means of confirming a respondent's confidence in their reported appliance age, we surveyed respondents about two of the characteristics could affect their recollection of the appliance's age. First, we asked respondents where they obtained the appliance. For example, if they recycled an appliance that was in their home when they moved-in or if they did not purchase it new, they may have a less exact estimate of the appliance age. Most respondents report purchasing their recycled appliance from an appliance store (60% of freezers and 51% of refrigerators). For those who purchased their appliance from the store, the difference between the tracking data age and the age survey respondents reported, for both freezers and refrigerators, is about 12 years (Table 277).

TABLE 277. DIFFERENCE BETWEEN REPORTED AND TRACKING DATA AGES IN YEARS FOR THOSE WHO PURCHASED THEIR RECYCLED APPLIANCE FROM THE STORE

	SURVEY RESPONDENT REPORTED AGE	TRACKING DATA REPORTED AGE
Refrigerator	17	29
Freezer	17	29

Source: Tracking data and participant survey. Survey questions: "About how old was [UNIT.COLOR] [UNIT.MAKE] refrigerator you recycled (in years)?" & "About how old was [UNIT.COLOR] [UNIT.MAKE] freezer you recycled (in years)?"

Only 20% of freezer respondents said the appliance was in their home when they moved in and another 20% of respondents obtained the freezer second hand (free from a family member or friend or via craigslist); 38% of refrigerator respondents said the appliance was in their home when they moved in and 11% of respondents obtained the refrigerator second hand.

The second characteristic that could affect a respondents' recollection of their appliance's age is if the respondent purchased their appliance used or new. Most respondents who purchased their appliances themselves said they had originally purchased their recycled appliances new, for both refrigerators (95%) and freezers (100%). This provides more confidence that respondents can more accurately report the age of the appliance.

During the 2019 program evaluation we interviewed the Recleim implementing team. They mentioned that there was an increase in rural participation and that they hypothesized that they had reached a rural pocket of older units. We categorized the zip codes of survey participants to the Purdue Rural Indiana definitions of metropolitan, micropolitan, and non-core (or rural) counties and compared the average tracking data age for each designation (Table 278).[74] According to the tracking data, freezers in all metropolitan and rural categories were manufactured before 1990; there was no significant difference between the rural categories. According to the tracking data, more refrigerators in rural locations were manufactured before 1990; but there was no significant difference between the categories.

TABLE 278. MEAN APPLIANCE AGE FROM TRACKING DATA BY RURAL CATEGORIES

	FREEZER	REFRIGERATOR
Metropolitan	34	30
Micropolitan	25	28
Rural	33	32

[74] Purdue University - Rural Indiana Stats. (2019). Geographic Classification. Retrieved from Rural Indiana Stats: https://pcrd.purdue.edu/ruralindianastats/geographic-classifications.php#third

SURVEY AND TRACKING DATA

We compared the survey reported and tracking data ages across two categories: appliance color and configuration, to help determine which age was more accurate. For example, the French-door configuration was not used broadly until the 1990s.[75] If the survey respondent reported their appliances as less than 30 years old, these appliances could be French-door. Similarly, while colorful refrigerators are still available, their popularity declined in the 1990 – 2000s when stainless steel appliances became more popular.[76]

Table 279 shows the mean survey and tracking data age of appliances by color. Stainless steel appliances were not popular until the late 1990s (~20 years old).[77] However, the tracking data report the average age of these appliances as 30 years old while the survey respondents reported them as nine years old. While appliance color does not definitively align with appliance age, many of the trends within the survey data align with what we would expect to see from appliance trends over the years (i.e., stainless steel appliances being much younger than other colors).

TABLE 279. AVERAGE AGES BY REFRIGERATOR COLOR

COLOR	SURVEY RESPONDENT REPORTED AGE	TRACKING DATA REPORTED AGE
Almond (n = 2)	59	37
Black (n = 12)	13	28
Brown (n = 1, respondent did not report age)	N/A	47
Cream (n = 5)	20	34
Green (n = 1)	15	44
Stainless Steel (n = 18)	8	30
White (n = 157)	18	29
Yellow (n = 37)	20	35

Source: Tracking data and participant survey. Survey questions: “About how old was [UNIT.COLOR] [UNIT.MAKE] refrigerator you recycled (in years)?” & “About how old was [UNIT.COLOR] [UNIT.MAKE] freezer you recycled (in years)?”

Similarly, the Table 280 describes the configuration of the recycled appliance. Bottom freezer refrigerators became re-popularized in the late 1990’s.[78] In addition, though we only have one French-door refrigerator, the respondent reported that it was almost brand new and the tracking data report it being 40 years old. French-door refrigerators were not popularized until the late 1990s and it is unlikely that this fridge was manufactured before 1995.

TABLE 280. AVERAGE AGES BY REFRIGERATOR CONFIGURATION

MODEL	SURVEY RESPONDENT REPORTED AGE	TRACKING DATA REPORTED AGE
Bottom Freezer (n = 9)	14	26

[75] Boston Appliance. (2013, November 25). The 5 Benefits of a French Door Refrigerator. Retrieved from Boston Appliance: https://blog.bostonappliance.net/french-door-refrigerator-benefits/

[76] Miller, E. (n.d.). Appliance Color Trends Through the Decades. Retrieved from Ashton Woods: https://www.ashtonwoods.com/inspiringspaces/the-studio/appliance-color-trends-decades

[77] Big Chill. (n.d.). Refrigerators Through the Decades. Retrieved from Big Chill: https://bigchill.com/us/blog/refrigerators-through-the-decades/

[78] Universal Appliance and Kitchen Center. (2014, March 16). Advantages of Modern Bottom Freezer Refrigerators. Retrieved from Universal Appliance and Kitchen Center: https://www.uakc.com/blog/bottom-freezer-refrigerators/

Chest (n = 1)	15	17
French Door (n = 1)	2	40
Side-by-Side (n = 64)	15	31
Single Door (n = 9)	26	39
Top Freezer (n = 140)	18	29
Upright (n = 9)	18	35

Source: Tracking data and participant survey. Survey questions: "About how old was [UNIT.COLOR] [UNIT.MAKE] refrigerator you recycled (in years)?" & "About how old was [UNIT.COLOR] [UNIT.MAKE] freezer you recycled (in years)?"

REVIEW OF MODEL NUMBERS FROM RECLEIM DATA

In the 2019 evaluation, we recommended that NIPSCO request their implementer to gather model numbers to allow the evaluation team to QC the appliance ages. Recleim provided TRC with several fields they collect on appliance intake including model number. Two of the largest issues with the 2020 tracking data were missing or incomplete model numbers; 75% of both freezers and refrigerators were either missing model numbers or had an incomplete model number (Table 281). Over one-third of both freezers and refrigerators were missing the model number all together; 37% of freezers and 43% of refrigerators had truncated model numbers. For example, one of the model numbers reported was "FRT2." When we used an appliance lookup and searched for this model number, we saw that the model number should have looked more like, "FRT26HAZ". The partial value returns dozens of models of the appliance and we could not verify the age of the appliance in the data. In addition to these data issues, we also found that some appliances had the same model number but had different ages. We also found that for some of the customers who recycled both a refrigerator and freezer, both units had the same model numbers in the tracking data.

TABLE 281. DESCRIPTION OF ISSUES WITH MODEL NUMBERS BY APPLIANCE TYPE

ISSUE	% OF FREEZERS AFFECTED	% OF REFRIGERATORS AFFECTED
Missing model number	38%	32%
Model number is less than standard character length	37%	43%
Duplicate model numbers with different ages	12%	23%
Same model number for fridge and freezer	13%	3%

In addition to checking the quality of the model numbers, we reviewed a random sample of model numbers for 92 appliances (Table 282). When reviewing the random sample data, we could only locate the manufacturing data for 28% of the appliances. Of the appliances we could locate, we found that 17 of the reported appliance ages were in the correct range. The others were either an underestimate or an overestimate of the age. Therefore, we were not able to accurately corroborate appliance age using model numbers.

TABLE 282. ISSUES WITH MODEL NUMBERS FROM LOOKUP

ISSUE	COUNT
Could not locate using model number	61
Manufacturer reports older age than in tracking data	4
Manufacturer reports younger age than in tracking data	5
Manufacturer and tracking data age matches	3
Tracking data within the range of manufacturer data	14
Other issues with model number	5
TOTAL	92

APPENDIX 5: SCHOOL EDUCATION PROGRAM

RESIDENTIAL SCHOOL EDUCATION PROGRAM ALGORITHMS AND ASSUMPTIONS

This appendix contains the assumptions used in electric savings, demand reduction, and gas savings algorithms for the measures within the School Education program. The team examined each assumption behind the algorithms to capture savings and compared it against the Indiana TRM (v2.2), as well as other state and industry approaches. Detailed information on the analysis and supporting assumptions for the following Residential School Education program measures are included within this appendix:

- LEDs
- LED nightlights
- Kitchen faucet aerators
- Bathroom faucet aerators
- Low-flow showerheads
- Filter whistles

Table 283 lists the assumptions of the *ex post* per-measure savings.

TABLE 283. SCHOOL EDUCATION PROGRAM MEASURES

MEASURE	REVIEWED ASSUMPTIONS
LED Lamps	New and baseline wattages, hours of use, waste heat factors, coincidence factors
LED Night Lights	New and baseline wattages, hours of use, coincidence factors
Kitchen Faucet Aerator	New and baseline flow rates, people per house, minutes of use per day, faucets per home, water temperatures, water heater fuel type and efficiency
Bathroom Faucet Aerator	New and baseline flow rates, people per house, minutes of use per day, faucets per home, water temperatures, water heater fuel type and efficiency
Low-Flow Showerhead	New and baseline flow rates, people per house, minutes of use per day, showerheads per home, water temperatures, water heater fuel type and efficiency
Filter Whistle	Full load heating and cooling hours, efficiency ratings, efficiency improvement

The algorithms and assumptions the evaluation team used to calculate *ex post* savings for each of these measures follow.

LEDS

The team used the following equations to calculate electric energy and peak demand savings, as well as natural gas energy penalties, for LEDs.

$$kWh\ savings\ per\ lamp = \frac{(W_{base} - W_{LED}) * (Daily\ hours\ of\ use * 365) * (1 + WHF_e)}{1{,}000}$$

$$kW\ reduction\ per\ lamp = \frac{(W_{base} - W_{LED}) * Coincidence\ Factor * (1 + WHF_d)}{1{,}000}$$

$$Waste\ heat\ factor\ therm\ penalty\ per\ lamp = \frac{(W_{base} - W_{LED}) * (Daily\ hours\ of\ use * 365) * \left(WHF_g\right) * 10}{1{,}000}$$

Where:

W_{base}	=	Wattage of the bulb being replaced, W
W_{LED}	=	Wattage of the LED bulb, W
Daily hours of use	=	Average hours of use per day, hr
WHF_e	=	Waste heat factor for energy to account for HVAC interactions with lighting (depends on location)
WHF_d	=	Waste heat factor for demand to account for HVAC interactions with lighting (depends on location)
WHF_g	=	Waste heat factor for gas to account for HVAC interactions with lighting (depends on location)
Coincidence Factor	=	Summer peak coincidence factor
365	=	Number of days per year, days/yr
1,000	=	Constant to convert watts to kW
10	=	Constant to convert MMBtu to therm

Table 284 lists the input assumptions and source of each assumption for the LED measure savings calculations.

TABLE 284. *EX POST* VARIABLE ASSUMPTIONS FOR LEDS

INPUT	VALUE	SOURCE
W_{base}	43	206 Residential Lighting Evaluation Protocol, UMP
W_{LED} for 9-watt (LED)	9	Actual installed wattage
Hours per Year	1,135	Indiana TRM (v2.2), for kits
WHF_e	-0.07	Indiana TRM (v2.2), Joint customer with gas heat with central air conditioning, averaged across participant location
WHF_d	0.038	Indiana TRM (v2.2), averaged across participant location
WHF_g	-0.0019	Indiana TRM (v2.2), averaged across participant location
Coincidence Factor	0.11	Indiana TRM (v2.2)
ISR	0.83	NIPSCO 2020 HEW and parent survey

LED NIGHT LIGHT

The team used the following equation to calculate electric energy savings for LED Night Lights:

$$kWh\ savings = \frac{(W_{base} - W_{LED}) * (Hours\ per\ Year) * ISR}{1{,}000} * IRF$$

Where:

W_{base}	=	Wattage of the bulb being replaced, W
W_{LED}	=	Wattage of the LED bulb, W
Hours per Year	=	Average hours of use per year, hr
ISR	=	In Service Rate
1,000	=	Constant to convert watts to kW
IRF	=	Incandescent replacement factor representing the percentage of LED night lights that replaced incandescent night lights.

Table 285 lists the input assumptions and source of each assumption for the LED night lights measure savings calculations.

TABLE 285. *EX POST* VARIABLE ASSUMPTIONS FOR LED NIGHT LIGHTS

INPUT	VALUE	SOURCE
W_{base}	5	Indiana TRM (v2.2)
W_{LED}	0.5	Actual
Hours per Year	2,920	Indiana TRM (v2.2)
IRF	0.25	NIPSCO 2020 parent survey
ISR	0.69	NIPSCO 2020 HEW and parent survey

KITCHEN AND BATHROOM FAUCET AERATORS

The team used the following equations to calculate electric energy and peak demand savings, as well as natural gas energy savings, for kitchen and bathroom aerators:

$$kWh\ savings = (GPM_{base} - GPM_{low\ flow}) * MPD * \frac{PH}{FH} * DR * 8.3 * (T_{mix} - T_{inlet}) * \frac{365}{RE * 3{,}412} * \text{ISR} * \text{WHS}_e$$

$$kW\ reduction = (GPM_{base} - GPM_{low\ flow}) * DR * 60 * 8.3 * \frac{(T_{mix} - T_{inlet})}{RE * 3{,}412} * CF * \text{ISR} * \text{WHS}_e$$

$$therm\ savings = (GPM_{base} - GPM_{low\ flow}) * MPD * \frac{PH}{FH} * DR * 8.3 * (T_{mix} - T_{inlet}) * \frac{365}{RG * 100{,}000} * \text{ISR} * \text{WHS}_g$$

Where:

GPMbase	=	Gallons per minute of baseline faucet aerator
GPMlow flow	=	Gallons per minute of low-flow faucet aerator
MPD	=	Average minutes of faucet use per person per day
PH	=	Average number of people per household
FH	=	Average number of faucets per household

DR	=	Percentage of water flowing down the drain
Tmix	=	Mixed water temperature of existing faucet, °F
Tinlet	=	Cold water temperature entering the DHW system, °F
RE	=	Recovery efficiency of electric hot water heater
RG	=	Recovery efficiency of natural gas water heater
CF	=	Summer peak coincidence factor
8.3	=	Specific weight of water in pounds per gallon, multiplied by specific water temperature (1.0 Btu/lb-°F)
3,412	=	Constant to convert Btu to kWh
365	=	Days per year
100,000	=	Constant to convert therm
ISR	=	In-service rate
WHS_e	=	Electric water heater saturation factor
WHS_g	=	Gas water heater saturation factor

Table 286 lists the input assumptions and source of each assumption for the kitchen and bathroom faucet aerator measure savings calculations.

TABLE 286. *EX POST* VARIABLE ASSUMPTIONS FOR KITCHEN AND BATHROOM FAUCET AERATORS

INPUT	KITCHEN VALUE	BATHROOM VALUE	SOURCE
GPM_{base}	2.44	1.9	Indiana TRM (v2.2)
$GPM_{low\ flow)}$	1.5	1.0	Program data
MPD	4.5	1.6	Indiana TRM (v2.2)
PH	4.71	4.71	NIPSCO 2020 HEW
FH	1	2.61	NIPSCO 2020 parent survey
DR	0.5	0.7	Indiana TRM (v2.2)
T_{mix}	93	86	Indiana TRM (v2.2)
T_{inlet}	57.4	57.4	Indiana TRM (v2.2)
RE	0.98	0.98	Indiana TRM (v2.2)
RG	0.76	0.76	Indiana TRM (v2.2)
CF	0.0033	0.0012	Indiana TRM (v2.2)
ISR	0.34	0.26	NIPSCO 2020 HEW and parent survey
WHS_e	0.23	0.23	NIPSCO 2020 HEW and parent survey
WHS_g	0.64	0.64	NIPSCO 2020 HEW and parent survey

LOW FLOW SHOWERHEADS

The team used the following equations to calculate electric energy and peak demand savings, as well as natural gas energy savings, for low flow showerheads:

$$kWh\ savings = (GPM_{base} - GPM_{low\ flow}) * MS * SPD * \frac{PH}{SH} * 8.3 * (T_{mix} - T_{inlet}) * \frac{365}{RE*3{,}412} * ISR * WHS_e$$

$$kW\ reduction = (GPM_{base} - GPM_{low\ flow}) * 60 * 8.3 * \frac{(T_{mix} - T_{inlet})}{RE*3{,}412} * CF * ISR * WHS_e$$

$$therm\ savings = (GPM_{base} - GPM_{low\ flow}) * MS * SPD * \frac{PH}{SH} * 8.3 * (T_{mix} - T_{inlet}) * \frac{365}{RG*100{,}000} * ISR * WHS_g$$

Where:

GPMbase	=	Gallons per minute of baseline showerhead
GPMlow flow	=	Gallons per minute of low-flow showerhead
MS	=	Average minutes per shower event
SPD	=	Average number of shower events per person per day
PH	=	Average number of people per household
SH	=	Average number of showerheads per household
Tmix	=	Mixed water temperature of existing faucet, °F
Tinlet	=	Cold water temperature entering the DHW system, °F
RE	=	Recovery efficiency of electric hot water heater
RG	=	Recovery efficiency of natural gas water heater
CF	=	Summer peak coincidence factor
8.3	=	Specific weight of water in pounds per gallon, multiplied by specific water temperature (1.0 Btu/lb-°F)
3,412	=	Constant to convert Btu to kWh
365	=	Days per year
100,000	=	Constant to convert therm
ISR	=	In-service rate
WHS_e	=	Electric water heater saturation factor
WHS_g	=	Gas water heater saturation factor

Table 287 lists the input assumptions and source of each assumption for the low flow showerhead measure savings calculations.

TABLE 287. *EX POST* VARIABLE ASSUMPTIONS FOR LOW FLOW SHOWERHEADS

INPUT	VALUE	SOURCE
GPM_{base}	2.63	Indiana TRM (v2.2)
$GPM_{low\ flow}$)	1.5	Program data
MS	7.8	Indiana TRM (v2.2)
SPD	0.6	Indiana TRM (v2.2)
PH	4.71	NIPSCO 2020 HEW
SH	1.97	NIPSCO 2020 parent survey
T_{mix}	101	Indiana TRM (v2.2)
T_{inlet}	57.4	Indiana TRM (v2.2)
RE	0.98	Indiana TRM (v2.2)
RG	0.76	Indiana TRM (v2.2)
CF	0.0023	Indiana TRM (v2.2)
ISR	0.26	NIPSCO 2020 HEW and parent survey
WHS_e	0.23	NIPSCO 2020 HEW and parent survey
WHS_g	0.64	NIPSCO 2020 HEW and parent survey

FILTER WHISTLE

The team used the following equations to calculate electric energy and peak demand savings for Filter Whistles:

$$kWh\ savings = \Delta kWh_{hea} + \Delta kWh_{cool}$$

$$\Delta kWh_{heat} = kW_{motor} * EFLH_{heat} * EI * ISR$$

$$\Delta kWh_{cool} = kW_{motor} * EFLH_{cool} * EI * ISR * \%CAC$$

$$kW\ reduction = \frac{\Delta kWh_{cool}}{EFLH_{cool}} * CF$$

Where:

kWmoto	=	Average motor full load electric demand, kW
EFLHheat	=	Estimated full load heating hours
EFLHcool	=	Estimated full load cooling hours
EI	=	Efficiency Improvement
ISR	=	In Service Rate
%CAC	=	Percent of homes with air conditioning
CF	=	Coincidence Factor

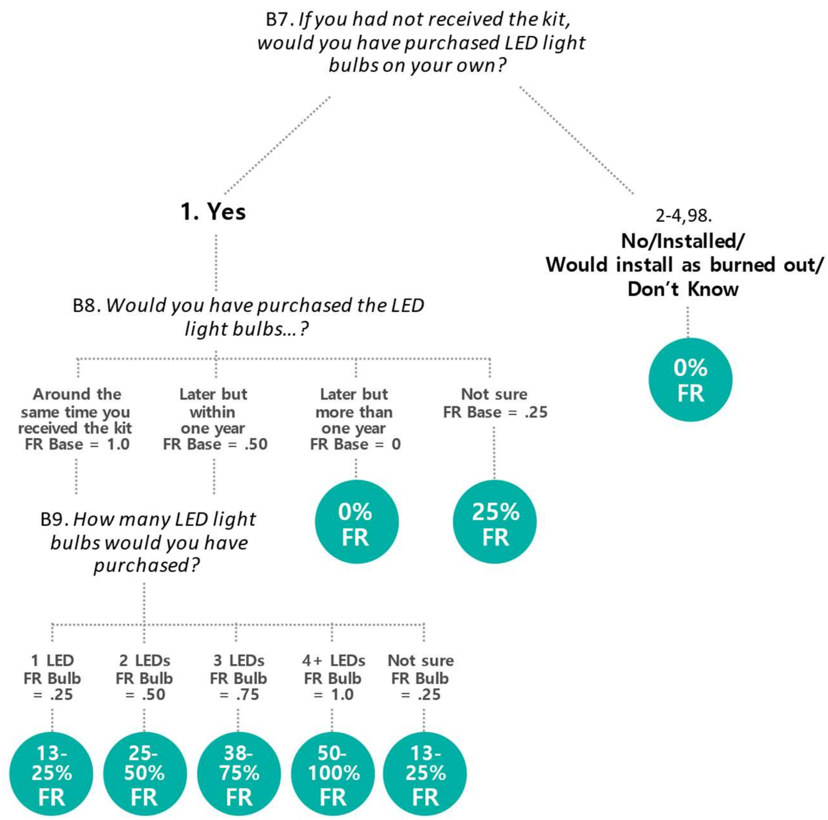
TABLE 288 lists the input assumptions and source of each assumption for the Filter Whistle measure savings calculations.

TABLE 288. *EX POST* VARIABLE ASSUMPTIONS FOR FILTER WHISTLES

INPUT	VALUE	SOURCE
kW_{motor}	0.5	2016 Pennsylvania TRM
$EFLH_{heat}$	1427	Indiana TRM (v2.2)
$EFLH_{cool}$	431	Indiana TRM (v2.2)
EI	0.15	2016 Pennsylvania TRM
CF	0.647	2016 Pennsylvania TRM
% CAC	0.76	2020 School HEW
ISR	0.13	NIPSCO 2020 HEW and parent survey

APPENDIX B. FREE RIDERSHIP AND SPILLOVER

Below is a flow chart detailing the evaluation approach to assessing free ridership for LEDs.



Nine spillover participants installed a total of 14 additional energy efficient measures generating a total of 50.28 MMBtu in energy savings. These additional measures and their respective savings values are summarized below (Table 289). The evaluation team reviewed program tracking data to ensure that spillover participants did in fact not receive a rebate for these additional measures. None of the spillover participants received a rebate for the additional measures installed.

TABLE 289. SCHOOL EDUCATION PROGRAM QUALIFYING SPILLOVER MEASURES

SPILLOVER MEASURE	COUNT OF MEASURES INSTALLED	SOURCE OF ASSIGNED SAVINGS VALUES[A]	MMBTU (KWH) SAVINGS	MMBTU (THERM) SAVINGS	TOTAL MMBTU
Air Sealing	1	NIPSCO IQW	0.29	9.85	10.14
Duct Sealing	1	NIPSCO HEA	0.41	9.40	9.80
ENERGY STAR Clothes Washer	2	Indiana TRM	0.10	0.24	0.34
ENERGY STAR Dishwasher	3	Indiana TRM	0.79	3.90	4.69
ENERGY STAR Windows	1	Indian TRM	0.24	0.00	0.24
Wi-Fi Enable or Smart Thermostat	1	NIPSCO HVAC	0.53	13.26	13.79
Programmable thermostat	1	NIPSCO IQW	0.34	7.45	7.78
Low flow kitchen faucet aerators	1	NIPSCO School Education	0.09	0.31	0.39
Low flow bathroom faucet aerators	1	NIPSCO School Education	0.01	0.03	0.04
Low flow showerheads	1	NIPSCO School Education	0.10	0.37	0.47
ENERGY STAR Refrigerator	1	Indiana TRM	2.60	0.00	2.60
Totals	14		5.48	44.80	50.28

[a]For spillover measures that qualify for a NIPSCO program (e.g., air sealing), adjusted savings values from this year's evaluation were assigned.

Just one spillover participant reported they installed four additional energy efficient measure for which they did not receive rebates. It may be the case that COVID is partially driving such high 2020 spillover as people spend more time in their homes, they may be more inclined to make upgrades and improvements.

APPENDIX 6: BEHAVIORAL

RESIDENTIAL BEHAVIORAL PROGRAM REGRESSION ANALYSIS AND CROSS PROGRAM PARTICIPATION ANALYSIS

REGRESSION ANALYSIS

The evaluation team conducted a regression analysis to determine energy savings for treatment and control respondents using two models: PPR and LFER. Both approaches produced unbiased estimates of program savings. The evaluation team reported the PPR results and used the LFER results as a robustness check. Although structurally different, assuming the RCT is well-balanced with respect to the drivers of energy use, the two models should produce similar program savings estimates. Based on our experience analyzing the impacts of similar programs, the savings estimates produced by the PPR approach tend to be more precisely estimated (smaller standard errors) than those produced from the LFER model. This increase in precision occurs because the PPR accounts for groupwide pre-post consumption differences with a continuous term (ADClag) instead of a categorical term (post). Detailed descriptions of both model types are provided below.

POST-PERIOD REGRESSION

The PPR model controls for anomalous differences in energy usage between treatment and control group respondents by using lagged energy use as an explanatory variable. In other words, the model frames energy use in each calendar month of the post-program period as a function of both the treatment variable and energy use in the same calendar month of the pre-program year. The underlying logic is that any small systematic differences between the control and treatment respondents that remain, despite the randomization, will be reflected in differences in their past energy use, which is highly correlated with their current energy use. Including the lagged energy use in the model serves as a control for any such differences. The version the evaluation team estimated includes monthly fixed effects interacted with the pre-program energy use variable. These interaction terms allow pre-program usage to have a different effect on post-program usage in each calendar month.

Equation 1. Post-Period Regression

$$ADC_{kt} = \beta_0 + \beta_1 ADClag_{kt} + \beta_2 Treatment_k + \sum_j \beta_{3j} Month_{jt} + \sum_j \beta_{4j} Month_{jt} * ADClag_{kt} + \varepsilon_{kt}$$

Where:

ADC_{kt} = The average daily usage in kilowatt-hours or therms for respondent *k* during billing cycle *t*. This is the dependent variable in the model.

$ADClag_{kt}$ = Respondent *k*'s energy use in the same calendar month of the pre-treatment year as calendar month *t*.

$Treatment_k$ = A binary variable indicating whether respondent *k* is in the participant group (taking a value of 1) or the control group (taking a value of 0).

$Month_{jt}$ = A binary variable taking a value of 1 when j=t and 0 otherwise.[79]

ε_{kt} = The cluster-robust error term for respondent k during billing cycle t that accounts for heteroscedasticity and autocorrelation at the respondent level.

In this model, β_2 is the estimate of average daily energy savings due to the program. Program savings are the product of the average daily savings estimate and the total number of participant-days in the analysis.

LINEAR FIXED EFFECTS REGRESSION

As with the PPR model, the LFER model combines cross-sectional and time series data. Unlike the PPR model, however, the LFER models the full set of pre- and post-program usage data. The regression essentially compares the pre- and post-program energy usage of participants to those in the control group to identify the effect of the program. The purpose of the respondent-specific fixed effect is to capture all systematic cross-respondent variation in electric energy usage that is not captured by the model. Like the lagged usage variable in the PPR model, the fixed effect represents an attempt to control for any small systematic differences between the treatment and control respondents that might occur in the data despite the randomization.

Equation 2. Linear Fixed Effects Regression

$$ADC_{kt} = \beta_{0kt} + \beta_1 Post_t + \beta_2 Treatment_k Post_t + \varepsilon_{kt}$$

Where:

ADC_{kt} = The average daily usage in kilowatt-hours or therms for respondent k during billing cycle t. This is the dependent variable in the model.

β_{0kt} = The respondent-specific fixed effect at month-year t.

β_1 = The effect of being in the post-period on energy use to account for non-program effects that impact both the treatment and control groups.

$Post_t$ = A binary variable indicating whether bill cycle t is in the post-program period (taking a value of 1) or in the pre-program period (taking a value of 0).

β_2 = The estimate of treatment effects: the average daily energy savings per household due to behavioral program treatment.

$Treatment_k$ = A binary variable indicating whether respondent k is in the participant group (taking a value of 1) or in the control group (taking a value of 0).

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79 If there are post-program months, the model has monthly dummy variables, with the dummy variable “month” being the only one to take a value of 1 at time t. These are, in other words, monthly fixed effects.

ε_{kt} = The cluster-robust error term for respondent *k* during billing cycle *t*. Cluster-robust errors account for heteroscedasticity and autocorrelation at the respondent level.

CROSS PROGRAM PARTICIPATION ANALYSIS

The HERs sent to treatment respondents included energy saving tips and marketing modules, some of which encouraged respondents to participate in other NIPSCO energy efficiency programs. To assess the interactions between these programs, the evaluation team analyzed both the HER program and the Behavioral program data for participation overlap to address two factors:

- Participation lift: Does the Behavioral program treatment influence participation in other energy efficiency programs?
- Savings lift and adjustment: What portion of savings from the Behavioral program was obtained through NIPSCO's other energy efficiency efforts?

As with the energy savings calculations, the control group acts as the counterfactual, for both participation and savings from other programs, to address the above questions and provide unbiased estimates through the RCT model.

First, the evaluation team assessed whether the Behavioral program increased participation in NIPSCO's other energy efficiency programs by comparing participation rates between control and treatment groups. If participation rates in other residential energy efficiency programs were the same across HER treatment and control groups, the savings estimates for HERs from the regression analysis were already net of savings from the other programs and indicates that the Behavioral program had no effect on participation in other energy efficiency programs.

However, if the Behavioral program channeled participants into other energy efficiency programs, then savings detected in the HER billing analysis would include savings that are also counted by those other energy efficiency programs. For instance, if the Behavioral program increased participation in the HEA program, the increase in savings could be allocated to either the HER program or to HEAs provided through the Behavioral program (or some portion to each), but it could not be fully allocated to both programs simultaneously.

The evaluation team then calculated participant lift and savings lift and adjustment:

- Participant lift: Using participation flags, the evaluation team calculated a participation rate based on the number of accounts (either by individual or by household) that initiated participation in other tracked energy efficiency programs after the first report date. The difference in treatment and control participation in the post-treatment period is participation lift.
- Savings lift and adjustment: The evaluation team estimated the energy savings associated with participation lift in other NIPSCO energy efficiency programs:
    - First the evaluation team calculated annual savings for all measures installed in the post-period.
    - Then the evaluation team adjusted annual savings for each measure installation by the number of days per year in the post-period in which the measure was installed while the account was active; this step is necessary to most accurately estimate the savings that would be captured by the billing analysis.

- Next the evaluation team determined the average household net savings per participant day (the number of days a household was active in each period) from other programs in the post-period for both the treatment and control groups.
- Last, the evaluation team multiplied the average savings per participant day by the number of treatment group participant days in the post-period to identify the incremental savings attributable to other energy efficiency programs.

APPENDIX 7: RESIDENTIAL NEW CONSTRUCTION PROGRAM

RESIDENTIAL NEW CONSTRUCTION ALGORITHMS AND ASSUMPTIONS

PROGRAM SAVINGS METHODOLOGY

The evaluation team's impact evaluation of the Residential New Construction program included homes with attributable electric savings and gas savings, including the following:

- Silver Star Homes (gas and electric)
- Gold Star Homes (gas and electric)
- Platinum Star Homes (gas and electric)

The evaluation team evaluated gross savings for Residential New Construction program homes by drawing a random sample of 124 builder applications from PY 2020 participants and recording critical home data, such as square footage, insulation levels, and HVAC efficiencies from HERS certificates. Cadmus modeled program home savings for this sample using the REM/Rate data then applied the sample's realization rate to the overall deemed program savings to estimate *ex post* program per-unit and program-level savings.

Cadmus developed energy models using REM/Rate V16.0.6 to evaluate the electric and gas savings of the homes built under program requirements and found that electric savings were lower than the *ex ante* savings, while gas savings were significantly higher than ex-ante assumed savings.

Cadmus reviewed 124 random REM/Rate and Ekotrope-generated HERS reports (74 of these reports were for electric homes, and all 123 were for gas homes). Based on these reports, Cadmus compiled the homes' characteristics, such as insulation levels and square footage, into a database for energy modeling. Table 290 shows the sample of the PY 2020 homes.

TABLE 290. HERS CERTIFICATE SAMPLE[80]

NIPSCO FUEL	SAMPLE	PY 2020 PARTICIPATING HOMES
Electric	74	814
Gas	123	1,475

Table 291 shows the number of homes that participated in the 2020 program year as well as the sample homes that were used for the evaluation in each category.

TABLE 291. 2020 PROGRAM YEAR PARTICIPANTS

MEASURE	PARTICIPANTS	SAMPLE

[80] Electric sampled homes were gas and electric homes. There were a total of 814 electric homes, and 1475 gas homes in the 2020 program year. Cadmus calculates precision estimates based on each year's population and sample size, assuming standard variability. Cadmus expected most metrics to be estimated at 90% confidence. Note that we did not calculate confidence and precision for individual metrics.

Silver Star (HERS 66-75) Electric	200	18
Silver Star (HERS 66-75) Gas	249	23
Gold Star (HERS 57-65) Electric	544	49
Gold Star (HERS 57-65) Gas	1,027	84
Platinum Star (HERS <=56) Electric	70	7
Platinum Star (HERS <=56) Gas	199	16

Table 292 presents the average home characteristics from the PY 2020 sample homes as found in the HERS certificates the evaluator received. The table shows that electric and gas homes had similar characteristics. All homes in the sample had gas furnaces, although some homes had electric water heaters. While 12 homes had tankless water heaters, no homes had electric heat pump water heaters. Most of the homes had tank water heaters. HERS certificates generated with the Ekotrope modeling software do not provide information about the percentage of efficient lighting in rated homes. Since 122 of the 124 HERS certificates were generated using Ekotrope, the evaluation team did not have sufficient data to estimate the percentage of efficient lightbulbs for the energy models. Instead, the team used benchmarked efficient lighting data from the most recently published Vectren Indiana program evaluation.[81] This study showed that 86% of interior, 59% of garage, and 100% of exterior lightbulbs were efficient.

TABLE 292. 2020 RESIDENTIAL NEW CONSTRUCTION PROGRAM HOME CHARACTERISTICS

HOME CHARACTERISTIC	ELECTRIC HOMES	GAS HOMES
Sample Size	74	123
Participants	814	1475
Home Size (sq ft)	3,153	2,723
Ceiling R Value	40	42
Walls R Value	17	16
Basement Wall R Value	11	11
Windows U Factor3	0.304	0.300
Home Tightness ACH50	3.30	3.37
Duct Tightness CFM25/100 sq. ft.	2.14	2.51
Furnace AFUE	93	94
Air Conditioner SEER	13.1	13.4
Gas Water Heat Energy Factor	0.64	0.68
Electric Water Heat Energy Factor	NA	0.95

To evaluate electric and gas savings for the participating homes, the evaluation team developed prototype energy models, using the characteristics of the homes documented in the HERS certificates. The models represented typical characteristics of the sampled participant home as they varied by water heater type, foundation type, and nearest weather station. Some assumptions were made for the prototype energy models when the HERS certificates lacked the information necessary to complete the model in REM/Rate. For each prototype these are some of the assumptions made; homes had 2 stories above grade, were single-family detached, had un-insulated slabs for basements, had R-10 sub slab insulation for slab-on-grade homes, had 2x6 16" on center wall framing, and

[81] https://www.vectren.com/assets/downloads/planning/irp/IRP-2018-vectren-electric-dsm-evaluation.pdf

the heating and cooling setpoints assumed at 68 and 78, respectively. These assumptions have an impact on the overall energy consumption of the home but reflect typical construction methods in the industry.

The evaluation team developed eight prototypes for gas homes and four prototypes for electric homes, reflecting the characteristics of gas home participants and electric home participants. The number of prototypes developed were based on differences in foundation type, water heater fuel, water heater type, and weather station information for both gas and electric homes. The team then developed an average weighted therms, kWh, and kW savings based on the number of sampled homes that fit in to each prototype. Then based the program-wide realization rate on this savings estimate versus the weighted ex-ante savings value for the modeled homes.

Table 293 shows the gas prototypes, as well as the modeled savings using the Indiana Statewide Residential Energy Code for baseline home characteristics.

TABLE 293. 2020 RESIDENTIAL NEW CONSTRUCTION PROGRAM GAS PROTOTYPE MODELS

FOUNDATION TYPE	WATER HEATER FUEL	WATER HEATER TYPE	NEAREST WEATHER STATION	NUMBER OF HOMES	MODELED THERMS SAVINGS
Conditioned Basement	Gas	Tank	South Bend	65	408
Conditioned Basement	Gas	Tankless	South Bend	1	141
Slab on Grade	Gas	Tank	South Bend	13	176
Slab on Grade	Gas	Tankless	South Bend	2	135
Conditioned Basement	Gas	Tank	Fort Wayne	3	402
Slab on Grade	Electric	Tank	Fort Wayne	13	214
Slab on Grade	Gas	Tank	Fort Wayne	18	268
Slab on Grade	Gas	Tankless	Fort Wayne	9	194

Table 294 shows the electric prototypes and modeled savings. As with gas homes, the evaluation team weighted the prototype home savings by the number of homes in the sample and then created a program wide realization rate based on the weighted *ex ante* savings.

TABLE 294. 2020 RESIDENTIAL NEW CONSTRUCTION PROGRAM ELECTRIC PROTOTYPE MODELS

FOUNDATION TYPE	WATER HEATER FUEL	WATER HEATER TYPE	NEAREST WEATHER STATION	NUMBER OF HOMES	MODELED KWH SAVINGS	MODELED KW SAVINGS
Conditioned Basement	Gas	Tank	South Bend	57	1,183	0.5
Conditioned Basement	Gas	Tankless	South Bend	1	526	0.2
Slab on Grade	Gas	Tank	South Bend	13	597	0.2
Slab on Grade	Gas	Tankless	South Bend	2	665	0.1

Table 295 shows the realization rates for therms, kWh, and kW. These realization rates are based on the average weighted evaluated savings based on the as-built prototype models compared to the weighted *ex ante* savings for those homes. As illustrated in the savings *ex ante* savings significantly underestimated therms savings, while over estimating kWh and kW savings, compared to modeled results.

TABLE 295. 2020 RESIDENTIAL NEW CONSTRUCTION PROGRAM REALIZATION RATES

METRIC	AVERAGE WEIGHTED EVALUATED	AVERAGE WEIGHTED REPORTED (*EX*	REALIZATION RATE

	SAVINGS OF SAMPLE	*ANTE*) SAVINGS OF SAMPLE	
Therms (Sample size: 124)	321	54	599%
kWh (Sample: 75)	1,055	1,558	68%
kW (Sample: 75)	0.4	1.2	36%

ESTIMATING 2021 PROGRAM IMPACTS

Table 296 shows our estimated energy savings for 2021 using 2020 program home data. The team estimated the program impacts of the Indiana 2020 energy code on current program homes. We utilized the same prototype models developed from the program homes and estimating savings using the Indiana 2020 energy code as the baseline. The new 2020 energy code increases the baseline for efficiency lighting, air sealing. and insulation. These code changes have a significant impact on electric energy savings in program homes. Electric energy savings drops to less than 20kWh per home, with less than 0.2 kwh of demand savings. Gas savings have a more limited impact dropping to 246 therms per home.

TABLE 296. ESTIMATED SAVINGS FOR 2021 WITHOUT PROGRAM CHANGES

METRIC	ESTIMATED SAVINGS	ESTIMATED REALIZATION RATE
Therms	246	456%
kWh	16	1%
kW	0.2	11%

APPENDIX 8: HOME LIFE ENERGY EFFICIENCY CALCULATOR PROGRAM

HOMELIFE CALCULATOR ALGORITHMS AND ASSUMPTIONS

This appendix contains the assumptions used in electric savings, demand reduction, and gas savings algorithms for the measures within the HomeLife Calculator program. The team examined each assumption behind the algorithms to capture savings and compared it against the Indiana TRM (v2.2), as well as other state and industry approaches. Detailed information on the analysis and supporting assumptions for the following HomeLife Calculator program measures are included within this appendix:

- LEDs
- LED nightlights
- Kitchen faucet aerators
- Bathroom faucet aerators
- Low-flow showerheads
- Filter whistles

Table 297 lists the assumptions of the *ex post* per-measure savings.

TABLE 297. 2020 HOMELIFE CALCULATOR PROGRAM MEASURES

MEASURE	REVIEWED ASSUMPTIONS
LEDs	New and baseline wattages, hours of use, waste heat factors, coincidence factors
LED Night Lights	New and baseline wattages, hours of use, waste heat factors, coincidence factors
Kitchen Faucet Aerator	New and baseline flow rates, people per house, minutes of use per day, faucets per home, water temperatures, water heater fuel type and efficiency
Bathroom Faucet Aerator	New and baseline flow rates, people per house, minutes of use per day, faucets per home, water temperatures, water heater fuel type and efficiency
Low-Flow Showerhead	New and baseline flow rates, people per house, minutes of use per day, showerheads per home, water temperatures, water heater fuel type and efficiency
Filter Whistle	Full load heating and cooling hours, efficiency ratings, efficiency improvement

The algorithms and assumptions the evaluation team used to calculate *ex post* savings for each of these measures follow.

LEDS

The team used the following equations to calculate electric energy and peak demand savings, as well as natural gas energy penalties, for kit LEDs:

$$kWh\ savings\ per\ lamp = \frac{(W_{base} - W_{LED}) * (Daily\ hours\ of\ use * 365) * (1 + WHF_e) * ISR}{1{,}000}$$

$$kW\ reduction\ per\ lamp = \frac{(W_{base} - W_{LED}) * Coincidence\ Factor * (1 + WHF_d) * ISR}{1{,}000}$$

$$Waste\ heat\ factor\ therm\ penalty\ per\ lamp = \frac{(W_{base} - W_{LED}) * (Daily\ hours\ of\ use * 365) * \left(WHF_g\right) * 10 * ISR}{1{,}000}$$

Where:

W_{base}	=	Wattage of the bulb being replaced, W
W_{LED}	=	Wattage of the LED bulb, W
Daily hours of use	=	Average hours of use per day, hr
WHF_e	=	Waste heat factor for energy to account for HVAC interactions with lighting (depends on location)
WHF_d	=	Waste heat factor for demand to account for HVAC interactions with lighting (depends on location)
WHF_g	=	Waste heat factor for gas to account for HVAC interactions with lighting (depends on location)
Coincidence Factor	=	Summer peak coincidence factor
365	=	Number of days per year, days/yr
1,000	=	Constant to convert watts to kW
10	=	Constant to convert MMBtu to therm
ISR	=	In-service rate

Table 298 lists the input assumptions and source of each assumption for the LED measure savings calculations.

TABLE 298. *EX POST* VARIABLE ASSUMPTIONS FOR LEDS

INPUT	VALUE	SOURCE
W_{base}	43	206 Residential Lighting Evaluation Protocol, UMP
W_{LED} for 9-watt (LED)	9	Actual installed wattage
Daily hours of use x 365	1,135	Indiana TRM (v2.2)
WHF_e (Joint Customers)	-0.0709	Indiana TRM (v2.2), Joint customer with gas heat with central air conditioning, averaged across participant location
WHF_e (Electric Only)	-0.0709	Indiana TRM (v2.2), Electric customer with electric heat with

		central air conditioning, averaged across participant location
WHF_d	0.038	Indiana TRM (v2.2), averaged across participant location
WHF_g	-0.0019	Indiana TRM (v2.2), averaged across participant location
Coincidence Factor	0.11	Indiana TRM (v2.2)
ISR	0.87	NIPSCO 2020 survey

LED NIGHT LIGHTS

The team used the following equation to calculate electric energy savings for LED Night Lights:

$$kWh\ savings = \frac{(W_{base} - W_{LED}) * (Hours\ per\ Year) * ISR}{1{,}000} * IRF$$

Where:

W_{base}	=	Wattage of the bulb being replaced, W
WLED	=	Wattage of the LED bulb, W
Hours per Year	=	Average hours of use per year, hr
ISR	=	In-Service Rate
1,000	=	Constant to convert watts to kW
IRF	=	Incandescent replacement factor representing the percentage of LED night lights that replaced incandescent night lights.

TABLE 299 lists the input assumptions and source of each assumption for the LED night lights measure savings calculations.

TABLE 299. *EX POST* VARIABLE ASSUMPTIONS FOR LED NIGHT LIGHTS

INPUT	VALUE	SOURCE
W_{base}	5	Indiana TRM (v2.2)
W_{LED}	0.5	Indiana TRM (v2.2)
Hours per Year	2,920	Indiana TRM (v2.2)
IRF	0.13	NIPSCO 2020 survey
ISR	0.85	NIPSCO 2020 HEW and parent survey

KITCHEN AND BATHROOM FAUCET AERATORS

The team used the following equations to calculate electric energy and peak demand savings, as well as natural gas energy savings, for kitchen and bathroom aerators:

$$kWh\ savings = \left(GPM_{base} - GPM_{low\ flow}\right) * MPD * \frac{PH}{FH} * DR * 8.3 * (T_{mix} - T_{inlet}) * \frac{365}{RE * 3{,}412} * \mathrm{ISR} * \mathrm{WHS_e}$$

$$kW\ reduction = \left(GPM_{base} - GPM_{low\ flow}\right) * DR * 60 * 8.3 * \frac{(T_{mix} - T_{inlet})}{RE * 3{,}412} * CF * \mathrm{ISR} * \mathrm{WHS_e}$$

$$therm\ savings = (GPM_{base} - GPM_{low\ flow}) * MPD * \frac{PH}{FH} * DR * 8.3 * (T_{mix} - T_{inlet}) * \frac{365}{RG*100{,}000} * ISR * WHS_g$$

Where:

GPMbase	=	Gallons per minute of baseline faucet aerator
GPMlow flow	=	Gallons per minute of low-flow faucet aerator
MPD	=	Average minutes of faucet use per person per day
PH	=	Average number of people per household
FH	=	Average number of faucets per household
DR	=	Percentage of water flowing down the drain
Tmix	=	Mixed water temperature of existing faucet, °F
Tinlet	=	Cold water temperature entering the DHW system, °F
RE	=	Recovery efficiency of electric hot water heater
RG	=	Recovery efficiency of natural gas water heater
CF	=	Summer peak coincidence factor
8.3	=	Specific weight of water in pounds per gallon, multiplied by specific water temperature (1.0 Btu/lb-°F)
3,412	=	Constant to convert Btu to kWh
365	=	Days per year
100,000	=	Constant to convert therm
ISR	=	In-service rate
WHS_e	=	Electric water heater saturation factor
WHS_g	=	Gas water heater saturation factor

TABLE 300 lists the input assumptions and source of each assumption for the kitchen and bathroom faucet aerator measure savings calculations.

TABLE 300. *EX POST* VARIABLE ASSUMPTIONS FOR KITCHEN AND BATHROOM FAUCET AERATORS

INPUT	KITCHEN VALUE	BATHROOM VALUE	SOURCE
GPM_{base}	2.44	1.9	Indiana TRM (v2.2)
$GPM_{low\ flow}$)	1.5	1.0	Program data
MPD	4.5	1.6	Indiana TRM (v2.2)
PH	2.64	2.64	Indiana TRM (v2.2)
FH	1	2.21	NIPSCO 2020 survey
DR	0.5	0.7	Indiana TRM (v2.2)
T_{mix}	93	86	Indiana TRM (v2.2)
T_{inlet} (Joint Customers)	57.27	57.27	Indiana TRM (v2.2), averaged across participant location
T_{inlet} (Electric Only)	56.70	56.70	Indiana TRM (v2.2), averaged across participant location
T_{inlet} (Gas Customers)	56.59	56.59	Indiana TRM (v2.2), averaged across participant location
RE	0.98	0.98	Indiana TRM (v2.2)
RG	0.76	0.76	Indiana TRM (v2.2)
CF	0.0033	0.0012	Indiana TRM (v2.2)

ISR	0.44	0.33	NIPSCO 2020 survey
WHS_e	0.23	0.23	NIPSCO 2020 HEW and parent survey
WHS_g	0.64	0.64	NIPSCO 2020 HEW and parent survey

LOW FLOW SHOWERHEADS

The team used the following equations to calculate electric energy and peak demand savings, as well as natural gas energy savings, for low flow showerheads:

$$kWh\ savings = (GPM_{base} - GPM_{low\ flow}) * MS * SPD * \frac{PH}{SH} * 8.3 * (T_{mix} - T_{inlet}) * \frac{365}{RE*3,412} * \text{ISR} * \text{WHS}_e$$

$$kW\ reduction = (GPM_{base} - GPM_{low\ flow}) * 60 * 8.3 * \frac{(T_{mix} - T_{inlet})}{RE*3,412} * CF * \text{ISR} * \text{WHS}_e$$

$$therm\ savings = (GPM_{base} - GPM_{low\ flow}) * MS * SPD * \frac{PH}{SH} * 8.3 * (T_{mix} - T_{inlet}) * \frac{365}{RG*100,000} * \text{ISR} * \text{WHS}_g$$

Where:

GPMbase	=	Gallons per minute of baseline showerhead
GPMlow flow	=	Gallons per minute of low-flow showerhead
MS	=	Average minutes per shower event
SPD	=	Average number of shower events per person per day
PH	=	Average number of people per household
SH	=	Average number of showerheads per household
Tmix	=	Mixed water temperature of existing faucet, °F
Tinlet	=	Cold water temperature entering the DHW system, °F
RE	=	Recovery efficiency of electric hot water heater
RG	=	Recovery efficiency of natural gas water heater
CF	=	Summer peak coincidence factor
8.3	=	Specific weight of water in pounds per gallon, multiplied by specific water temperature (1.0 Btu/lb-°F)
3,412	=	Constant to convert Btu to kWh
365	=	Days per year
100,000	=	Constant to convert therm
ISR	=	In-service rate
WHS_e	=	Electric water heater saturation factor
WHS_g	=	Gas water heater saturation factor

TABLE 301 lists the input assumptions and source of each assumption for the low flow showerhead measure savings calculations.

TABLE 301. *EX POST* VARIABLE ASSUMPTIONS FOR LOW FLOW SHOWERHEADS

INPUT	VALUE	SOURCE
GPM_{base}	2.63	Indiana TRM (v2.2)
$GPM_{low\ flow}$)	1.5	Program data
MS	7.8	Indiana TRM (v2.2)
SPD	0.6	Indiana TRM (v2.2)
PH	2.64	Indiana TRM (v2.2)
SH	1.77	NIPSCO 2020 survey
T_{mix}	101	Indiana TRM (v2.2)
T_{inlet} (Joint Customers)	57.27	Indiana TRM (v2.2), averaged across participant location
T_{inlet} (Electric Only)	56.70	Indiana TRM (v2.2), averaged across participant location
T_{inlet} (Gas Customers)	56.59	Indiana TRM (v2.2), averaged across participant location
RE	0.98	Indiana TRM (v2.2)
RG	0.76	Indiana TRM (v2.2)
CF	0.0023	Indiana TRM (v2.2)
ISR	0.43	NIPSCO 2020 survey
WHS_e	0.23	NIPSCO 2020 HEW and parent survey
WHS_g	0.64	NIPSCO 2020 HEW and parent survey

FILTER WHISTLE

The team used the following equations to calculate electric energy and peak demand savings for Filter Whistles:

$$kWh\ savings = \Delta kWh_{heat} + \Delta kWh_{cool}$$

$$\Delta kWh_{heat} = kW_{motor} * EFLH_{heat} * EI * ISR$$

$$\Delta kWh_{cool} = kW_{motor} * EFLH_{cool} * EI * ISR * \%CAC$$

$$kW\ reduction = \frac{\Delta kWh_{cool}}{EFLH_{cool}} * CF$$

Where:

kWmotor	=	Average motor full load electric demand, kW
EFLHheat	=	Estimated full load heating hours
EFLHcool	=	Estimated full load cooling hours
EI	=	Efficiency Improvement
CF	=	Coincidence Factor
%CAC	=	Percent of homes with air conditioning
ISR	=	In-Service Rate

TABLE 302 lists the input assumptions and source of each assumption for the Filter Whistle measure savings calculations.

TABLE 302. *EX POST* VARIABLE ASSUMPTIONS FOR FILTER WHISTLES

INPUT	VALUE	SOURCE

kW_{motor}	0.5	2016 Pennsylvania TRM
$EFLH_{heat}$	1427	Indiana TRM (v2.2)
$EFLH_{cool}$	431	Indiana TRM (v2.2)
EI	0.15	2016 Pennsylvania TRM
CF	0.647	2016 Pennsylvania TRM
% CAC	0.83	2020 School HEW
ISR	0.30	NIPSCO 2020 survey

SPILLOVER

Below is a flow chart detailing the evaluation approach to assessing free ridership for LEDs.

Three spillover participants installed a total of six additional energy efficient measures generating a total of 40.83 MMBtu in energy savings. These additional measures and their respective savings values are summarized below (Table 303). The evaluation team reviewed program tracking data to ensure that spillover participants did in fact not receive a rebate for these additional measures. None of the spillover participants received a rebate for the additional measures installed.

TABLE 303. 2020 HOMELIFE CALCULATOR PROGRAM QUALIFYING SPILLOVER MEASURES

SPILLOVER MEASURE	COUNT OF MEASURES INSTALLED	SOURCE OF ASSIGNED SAVINGS VALUESA	MMBTU (KWH) SAVINGS	MMBTU (THERM) SAVINGS	TOTAL MMBTU
Duct Sealing	1	NIPSCO HEA	0.41	9.41	9.82
ENERGY STAR Dishwasher	1	Indiana TRM	0.29	0.83	1.12
Programmable thermostat	1	NIPSCO IQW	0.34	7.45	7.78
ENERGY STAR Refrigerator	1	Indiana TRM	2.60	0.00	2.60
ENERGY STAR Dehumidifier	1	Indiana TRM	0.18	0.00	0.18
Furnace	1	Indiana TRM	0.00	19.33	19.33
Totals	6		3.81	37.02	40.83

[a] For spillover measures that qualify for a NIPSCO program (e.g., duct sealing), adjusted savings values from this year's evaluation were assigned.

APPENDIX 9: EMPLOYEE EDUCATION PROGRAM

EMPLOYEE EDUCATION ALGORITHMS AND ASSUMPTIONS

This appendix contains the assumptions used in electric savings, demand reduction, and gas savings algorithms for the measures within the Employee Education program. The team examined each assumption behind the algorithms to capture savings and compared it against the Indiana TRM (v2.2), as well as other state and industry approaches. Detailed information on the analysis and supporting assumptions for the following Employee Education program measures are included within this appendix:

- LEDs
- LED nightlights
- Kitchen faucet aerators
- Bathroom faucet aerators
- Low-flow showerheads
- Filter whistle

Table 304 lists the assumptions of the *ex post* per-measure savings.

TABLE 304. 2020 EMPLOYEE EDUCATION MEASURES

MEASURE	REVIEWED ASSUMPTIONS
LEDs	New and baseline wattages, hours of use, waste heat factors, coincidence factors
LED Night Lights	New and baseline wattages, hours of use, waste heat factors, coincidence factors
Kitchen Faucet Aerator	New and baseline flow rates, people per house, minutes of use per day, faucets per home, water temperatures, water heater fuel type and efficiency
Bathroom Faucet Aerator	New and baseline flow rates, people per house, minutes of use per day, faucets per home, water temperatures, water heater fuel type and efficiency
Low-Flow Showerhead	New and baseline flow rates, people per house, minutes of use per day, showerheads per home, water temperatures, water heater fuel type and efficiency
Filter Whistle	Full load heating and cooling hours, efficiency ratings, efficiency improvement

The algorithms and assumptions the evaluation team used to calculate *ex post* savings for each of these measures follow.

LEDS

The team used the following equations to calculate electric energy and peak demand savings, as well as natural gas energy penalties, for kit LEDs:

$$kWh\ savings\ per\ lamp = \frac{(W_{base} - W_{LED}) * (Daily\ hours\ of\ use * 365) * (1 + WHF_e)}{1{,}000} * \text{ISR}$$

$$kW\ reduction\ per\ lamp = \frac{(W_{base} - W_{LED}) * Coincidence\ Factor * (1 + WHF_d)}{1{,}000} * \text{ISR}$$

$$Waste\ heat\ factor\ therm\ penalty\ per\ lamp = \frac{(W_{base} - W_{LED}) * (Daily\ hours\ of\ use * 365) * (WHF_g) * 10}{1{,}000} * \text{ ISR}$$

Where:

W_{base} = Wattage of the bulb being replaced, W

W_{LED} = Wattage of the LED bulb, W

Daily hours of use = Average hours of use per day, hr

WHF_e = Waste heat factor for energy to account for HVAC interactions with lighting (depends on location)

WHF_d = Waste heat factor for demand to account for HVAC interactions with lighting (depends on location)

WHF_g = Waste heat factor for gas to account for HVAC interactions with lighting (depends on location)

Coincidence Factor = Summer peak coincidence factor

365 = Number of days per year, days/yr

1,000 = Constant to convert watts to kW

10 = Constant to convert MMBtu to therm

ISR = In-service rate

Table 305lists the input assumptions and source of each assumption for the LED measure savings calculations.

TABLE 305. *EX POST* VARIABLE ASSUMPTIONS FOR LEDS

INPUT	VALUE	SOURCE
W_{base}	43	206 Residential Lighting Evaluation Protocol, UMP
W_{LED} for 9-watt (LED)	9	Actual installed wattage
Daily hours of use x 365	1,135	Indiana TRM (v2.2)
WHF_e (Joint Customers)	-0.0709	Indiana TRM (v2.2), Joint customer with gas heat with central air conditioning, averaged across participant location
WHF_e (Electric Only)	-0.0749	Indiana TRM (v2.2), Electric customer with electric heat with central air conditioning, averaged across participant location
WHF_d	0.038	Indiana TRM (v2.2), averaged across participant location
WHF_g	-0.0019	Indiana TRM (v2.2), averaged across participant location
Coincidence Factor	0.11	Indiana TRM (v2.2)
ISR	0.87	NIPSCO 2020 Homelife survey

LED NIGHT LIGHTS

The team used the following equation to calculate electric energy savings for kit LED Night Lights:

$$kWh\ savings = \frac{(W_{base} - W_{LED}) * (Hours\ per\ Year) * ISR}{1{,}000} * IRF$$

Where:

W_{base} = Wattage of the bulb being replaced, W

WLED = Wattage of the LED bulb, W

Hours per Year = Average hours of use per year, hr

ISR = In Service Rate

1,000 = Constant to convert watts to kW

IRF = Incandescent replacement factor representing the percentage of LED night lights that replaced incandescent night lights.

TABLE 306 lists the input assumptions and source of each assumption for the LED night lights measure savings calculations.

TABLE 306. *EX POST* VARIABLE ASSUMPTIONS FOR LED NIGHT LIGHTS

INPUT	VALUE	SOURCE
W_{base}	5	Indiana TRM (v2.2)
W_{LED}	0.5	Indiana TRM (v2.2)
Hours per Year	2,920	Indiana TRM (v2.2)
IRF	0.13	NIPSCO 2020 Homelife survey
ISR	0.85	NIPSCO 2020 Homelife survey

KITCHEN AND BATHROOM FAUCET AERATORS

The team used the following equations to calculate electric energy and peak demand savings, as well as natural gas energy savings, for kitchen and bathroom kit aerators:

$$kWh\ savings = \left(GPM_{base} - GPM_{low\ flow}\right) * MPD * \frac{PH}{FH} * DR * 8.3 * (T_{mix} - T_{inlet}) * \frac{365}{RE*3{,}412} * \text{ISR} * \text{WHS}_e$$

$$kW\ reduction = \left(GPM_{base} - GPM_{low\ flow}\right) * DR * 60 * 8.3 * \frac{(T_{mix} - T_{inlet})}{RE*3{,}412} * CF * \text{ISR} * \text{WHS}_e$$

$$therm\ savings = \left(GPM_{base} - GPM_{low\ flow}\right) * MPD * \frac{PH}{FH} * DR * 8.3 * (T_{mix} - T_{inlet}) * \frac{365}{RG*100{,}000} * \text{ISR} * \text{WHS}_g$$

Where:

GPMbase = Gallons per minute of baseline faucet aerator

GPMlow flow = Gallons per minute of low-flow faucet aerator

MPD = Average minutes of faucet use per person per day

PH = Average number of people per household

FH = Average number of faucets per household

DR = Percentage of water flowing down the drain

Tmix = Mixed water temperature of existing faucet, °F

Tinlet = Cold water temperature entering the DHW system, °F

RE = Recovery efficiency of electric hot water heater

RG = Recovery efficiency of natural gas water heater

CF = Summer peak coincidence factor

8.3 = Specific weight of water in pounds per gallon, multiplied by specific water temperature (1.0 Btu/lb-°F)

3,412 = Constant to convert Btu to kWh

365 = Days per year

100,000 = Constant to convert therm

ISR = In-service rate

WHF_e = Electric water heater saturation factor

WHF_g = Gas water heater saturation factor

TABLE 307 lists the input assumptions and source of each assumption for the kitchen and bathroom faucet aerator measure savings calculations.

TABLE 307. *EX POST* VARIABLE ASSUMPTIONS FOR KITCHEN AND BATHROOM FAUCET AERATORS

INPUT	KITCHEN VALUE	BATHROOM VALUE	SOURCE
GPM_{base}	2.44	1.9	Indiana TRM (v2.2)
$GPM_{low\ flow}$)	1.5	1.0	Program data
MPD	4.5	1.6	Indiana TRM (v2.2)
PH	2.64	2.64	Indiana TRM (v2.2)
FH	1	2.21	NIPSCO 2020 survey
DR	0.5	0.7	Indiana TRM (v2.2)
T_{mix}	93	86	Indiana TRM (v2.2)
T_{inlet} (Joint Customers)	57.27	57.27	Indiana TRM (v2.2), averaged across participant location
T_{inlet} (Electric Only)	56.70	56.70	Indiana TRM (v2.2), averaged across participant location
T_{inlet} (Gas Customers)	56.59	56.59	Indiana TRM (v2.2), averaged across participant location
RE	0.98	0.98	Indiana TRM (v2.2)
RG	0.76	0.76	Indiana TRM (v2.2)
CF	0.0033	0.0012	Indiana TRM (v2.2)
ISR	0.44	0.33	NIPSCO 2020 Homelife survey
WHF_e	0.23	0.23	NIPSCO 2020 HEW and parent survey
WHF_g	0.64	0.64	NIPSCO 2020 HEW and parent survey

LOW FLOW SHOWERHEADS

The team used the following equations to calculate electric energy and peak demand savings, as well as natural gas energy savings, for kit low flow showerheads:

$$kWh\ savings = \left(GPM_{base} - GPM_{low\ flow}\right) * MS * SPD * \frac{PH}{SH} * 8.3 * (T_{mix} - T_{inlet}) * \frac{365}{RE*3{,}412} * \text{ISR} * \text{WHF}_e$$

$$kW\ reduction = \left(GPM_{base} - GPM_{low\ flow}\right) * 60 * 8.3 * \frac{(T_{mix} - T_{inlet})}{RE*3{,}412} * CF * \text{ISR} * \text{WHF}_e$$

$$therm\ savings = \left(GPM_{base} - GPM_{low\ flow}\right) * MS * SPD * \frac{PH}{SH} * 8.3 * (T_{mix} - T_{inlet}) * \frac{365}{RG*100{,}000} * \text{ISR} * \text{WHF}_g$$

Where:

GPMbase = Gallons per minute of baseline showerhead

GPMlow flow = Gallons per minute of low-flow showerhead

MS = Average minutes per shower event

SPD = Average number of shower events per person per day

PH = Average number of people per household

SH = Average number of showerheads per household

Tmix = Mixed water temperature of existing faucet, °F

Tinlet = Cold water temperature entering the DHW system, °F

RE = Recovery efficiency of electric hot water heater

RG = Recovery efficiency of natural gas water heater

CF = Summer peak coincidence factor

8.3 = Specific weight of water in pounds per gallon, multiplied by specific water temperature (1.0 Btu/lb-°F)

3,412 = Constant to convert Btu to kWh

365 = Days per year

100,000 = Constant to convert therm

ISR = In-service rate

TABLE 308 lists the input assumptions and source of each assumption for the low flow showerhead measure savings calculations.

TABLE 308. *EX POST* VARIABLE ASSUMPTIONS FOR LOW FLOW SHOWERHEADS

INPUT	VALUE	SOURCE
GPM_{base}	2.63	Indiana TRM (v2.2)
$GPM_{low\ flow}$)	1.5	Program data
MS	7.8	Indiana TRM (v2.2)
SPD	0.6	Indiana TRM (v2.2)
PH	2.64	Indiana TRM (v2.2)
SH	1.77	NIPSCO 2020 survey
T_{mix}	101	Indiana TRM (v2.2)
T_{inlet} (Joint Customers)	57.27	Indiana TRM (v2.2), averaged across participant location
T_{inlet} (Electric Only)	56.70	Indiana TRM (v2.2), averaged across participant location
T_{inlet} (Gas Customers)	56.59	Indiana TRM (v2.2), averaged across participant location
RE	0.98	Indiana TRM (v2.2)
RG	0.76	Indiana TRM (v2.2)
CF	0.0023	Indiana TRM (v2.2)
ISR	0.43	NIPSCO 2020 Homelife survey
WHF_e	0.23	NIPSCO 2020 HEW and parent survey
WHF_g	0.64	NIPSCO 2020 HEW and parent survey

FILTER WHISTLE

The team used the following equations to calculate electric energy and peak demand savings for kit Filter Whistles:

$$kWh\ savings = \Delta kWh_{heat} + \Delta kWh_{cool}$$

$$\Delta kWh_{heat} = kW_{motor} * EFLH_{heat} * EI * ISR$$

$$\Delta kWh_{cool} = kW_{motor} * EFLH_{cool} * EI * ISR * \%CAC$$

$$kW\ reduction = \frac{\Delta kWh_{cool}}{EFLH_{cool}} * CF$$

Where:

kWmotor = Average motor full load electric demand, kW
EFLHheat = Estimated full load heating hours
EFLHcool = Estimated full load cooling hours
EI = Efficiency Improvement
CF = Coincidence Factor
%CAC = Percent of homes with air conditioning
ISR = In Service Rate

TABLE 309 lists the input assumptions and source of each assumption for the Filter Whistle measure savings calculations.

TABLE 309. *EX POST* VARIABLE ASSUMPTIONS FOR FILTER WHISTLES

INPUT	VALUE	SOURCE
kW_{motor}	0.5	2016 Pennsylvania TRM
$EFLH_{heat}$	1427	Indiana TRM (v2.2)
$EFLH_{cool}$	431	Indiana TRM (v2.2)
EI	0.15	2016 Pennsylvania TRM
CF	0.647	2016 Pennsylvania TRM
% CAC	0.83	2020 School HEW
ISR	0.30	NIPSCO 2020 survey

APPENDIX 10: INCOME-QUALIFIED (IQW) WEATHERIZATION PROGRAM

IQW ALGORITHMS AND ASSUMPTIONS

This appendix contains the assumptions used in electric savings, demand reduction, and gas savings algorithms for the measures within the HEA program. The team examined each assumption behind the algorithms to capture savings and compared it against the Indiana TRM (v2.2), as well as other state and industry approaches. Detailed information on the analysis and supporting assumptions for the following Home Energy Assessment program measures are included within this appendix:

- LEDs (A-Line, Candelabra, and Globe)
- Kitchen faucet aerators
- Bathroom faucet aerators
- Low-flow showerheads
- Shower start
- Pipe wrap
- Water heater wrap
- Programmable Thermostats
- Filter whistles
- Duct sealing
- Air Sealing
- Attic insulation

Table 310 lists the assumptions of the *ex post* per-measure savings.

TABLE 310. IQW PROGRAM MEASURES

MEASURE	REVIEWED ASSUMPTIONS
LEDs	New and baseline wattages, house of use, waste heat factors, coincidence factors
Kitchen Faucet Aerator	New and baseline flow rates, people per house, minutes of use per day, faucets per home, water temperatures, water heater fuel type and efficiency
Bathroom Faucet Aerator	New and baseline flow rates, people per house, minutes of use per day, faucets per home, water temperatures, water heater fuel type and efficiency
Low-Flow Showerhead	New and baseline flow rates, people per house, minutes of use per day, showerheads per home, water temperatures, water heater fuel type and efficiency
Pipe Wrap	New and baseline R-values, pipe diameter, water heater recovery efficiency
Water Heater Wrap	Deemed values
Filter Whistle	Full load heating and cooling hours, efficiency ratings, efficiency improvement
Duct Sealing	New and baseline distribution efficiencies, full load heating and cooling hours, capacities and efficiencies of heating and cooling equipment
Air Sealing	Pre- and post- installation infiltration rates, N-factor, coincidence factor
Attic Insulation	Void space and compression factor, pre-install and post-install R-values, square footage of installed insulation
Refrigerator replacement	New and baseline energy use

The algorithms and assumptions the evaluation team used to calculate *ex post* savings for each of these measures follow.

LEDS

The team used the following equations to calculate electric energy and peak demand savings, as well as natural gas energy penalties, for LEDs:

$$kWh\ savings\ per\ lamp = \frac{(W_{base} - W_{LED}) * (Daily\ hours\ of\ use * 365) * (1 + WHF_e)}{1{,}000}$$

$$kW\ reduction\ per\ lamp = \frac{(W_{base} - W_{LED}) * Coincidence\ Factor * (1 + WHF_d)}{1{,}000}$$

Where:

W_{base} = Wattage of the bulb being replaced, W

W_{LED} = Wattage of the LED bulb, W

Daily hours of use = Average hours of use per day, hr

WHF_e = Waste heat factor for energy to account for HVAC interactions with lighting (depends on location)

WHF_d = Waste heat factor for demand to account for HVAC interactions with lighting (depends on location)

Coincidence Factor = Summer peak coincidence factor

365 = Number of days per year, days/yr

1,000 = Constant to convert watts to kW

Table 311 lists the input assumptions and source of each assumption for the LED measure savings calculations.

TABLE 311. *EX POST* VARIABLE ASSUMPTIONS FOR LEDS

INPUT	VALUE	SOURCE
W_{base} for 9-watt (LED)	43	Ch. 6 Residential Lighting Evaluation Protocol, UMP
W_{base} for 6-watt (Candelaba LED)	40	Ch. 6 Residential Lighting Evaluation Protocol, UMP
W_{base} for 5-watt (Globe LED)	40	Ch. 6 Residential Lighting Evaluation Protocol, UMP
W_{LED} for 9-watt (LED)	9	Actual installed wattage
W_{LED} for 6-watt (CandelabraLED)	5	Actual installed wattage
W_{LED} for 5-watt (Globe LED)	6	Actual installed wattage
Daily hours of use x 365	902	Indiana TRM (v2.2)
WHF_e (Joint Customers)	-0.07017	Indiana TRM (v2.2), Joint customer with gas heat with central air conditioning, averaged across participant location
WHF_e (Electric Only)	-0.07331	Indiana TRM (v2.2), Electric customer with electric heat with central air conditioning, averaged across participant location
WHF_d	0.038	Indiana TRM (v2.2), averaged across participant location
Coincidence Factor	0.11	Indiana TRM (v2.2)

KITCHEN AND BATHROOM FAUCET AERATORS

The evaluation team used the following equations to calculate electric energy, peak demand, and natural gas energy savings for Low-Flow Kitchen and Bathroom Faucet Aerators:

$$kWh\ savings = ISR * \left(GPM_{base} - GPM_{low\ flow}\right) * MPD * \frac{PH}{FH} * DR * 8.3 * (T_{mix} - T_{inlet}) * \frac{365}{RE * 3412}$$

$$kW\ savings = ISR * \left(GPM_{base} - GPM_{low\ flow}\right) * 60 * DR * 8.3 * \frac{T_{mix} - T_{inlet}}{RE * 3412} * CF$$

$$therm\ savings = ISR * \left(GPM_{base} - GPM_{low\ flow}\right) * MPD * \frac{PH}{FH} * DR * 8.3 * (T_{mix} - T_{inlet}) * \frac{365}{RG * 100{,}000}$$

Where:

GPM_{base}	=	Gallons per minute of baseline faucet aerator
$GPM_{low\ flow}$	=	Gallons per minute of low-flow faucet aerator
ISR	=	In-service rate, or fraction of units that get installed
MPD	=	Average minutes of faucet use per person per day
PH	=	Average number of people per household
FH	=	Average number of faucets per household
DR	=	Percentage of water flowing down the drain
T_{mix}	=	Mixed water temperature exiting faucet, °F
T_{inlet}	=	Cold water temperature entering the DWH system, °F (depends on location)
RE	=	Recovery efficiency of electric hot water heater
RG	=	Recovery efficiency of natural gas hot water heater
CF	=	Summer peak coincidence factor
60	=	Minutes per Hour
8.3	=	Specific weight of water in pounds per gallon
3,412	=	Constant to convert Btu to kWh
365	=	Days of faucet use per year
100,000	=	Constant to convert Btu to therms

Table 312 lists the assumptions and source of each assumption for kitchen and bathroom faucet aerator measure savings calculations.

TABLE 312. *EX POST* VARIABLE ASSUMPTION FOR KITCHEN AND BATHROOM FAUCET AERATORS

INPUT	VALUE	SOURCE
GPM_{base} (Kitchen)	2.44	Indiana TRM (v2.2)
GPM_{base} (Bathroom)	1.9	Indiana TRM (v2.2)
$GPM_{low\ flow}$ (Kitchen)	1.5	Actual
$GPM_{low\ flow}$ (Bathroom)	1.0	Actual
ISR	1.0	Indiana TRM (v2.2)
MPD (Kitchen)	4.5	Indiana TRM (v2.2)
MPD (Bathroom)	1.6	Indiana TRM (v2.2)
PH	2.64	Indiana TRM (v2.2)
FH (Kitchen)	1.0	Indiana TRM (v2.2)
FH (Bathroom)	2.21	2020 NIPSCO survey results
DR (Kitchen)	0.50	Indiana TRM (v2.2)
DR (Bathroom)	0.70	Indiana TRM (v2.2)
T_{mix} (Kitchen)	93.00	Indiana TRM (v2.2)
T_{mix} (Bathroom)	86.00	Indiana TRM (v2.2)
T_{inlet} (Kitchen, Electric)	57.0	Indiana TRM (v2.2), values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
T_{inlet} (Kitchen, Gas)	57.3	Indiana TRM (v2.2), values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
T_{inlet} (Bathroom, Electric)	56.5	Indiana TRM (v2.2), values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
T_{inlet} (Bathroom, Gas)	57.3	Indiana TRM (v2.2), values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
RE	0.98	Indiana TRM (v2.2)
RG	0.76	Indiana TRM (v2.2)
CF (Bathroom)	0.0012	Indiana TRM (v2.2)
CF (Kitchen)	0.0033	Indiana TRM (v2.2)
Conversion Factor	60	Minutes per hour
Conversion Factor	8.3	Specific weight of water in pounds per gallon
Conversion Factor	3,412	Constant to convert Btu to kWh
Conversion Factor	365	Days of faucet use per year
Conversion Factor	100,000	Constant to convert Btu to therms

LOW-FLOW SHOWERHEADS

The evaluation team used the following equations to calculate electric energy, peak demand, and natural gas energy savings for Low-Flow Showerheads:

$$kWh\ savings = ISR * \left(GPM_{base} - GPM_{low\ flow}\right) * MS * SPD * \frac{PH}{SH} * 8.3 * (T_{mix} - T_{inlet}) * \frac{365}{RE * 3412}$$

$$kW\ savings = ISR * \left(GPM_{base} - GPM_{low\ flow}\right) * 60 * 8.3 * \frac{T_{mix} - T_{inlet}}{RE * 3412} * CF$$

$$therm\ savings = ISR * (GPM_{base} - GPM_{low\ flow}) * MS * SPD * \frac{PH}{SH} * 8.3 * (T_{mix} - T_{inlet}) * \frac{365}{RG * 100{,}000}$$

Where:

GPM_{base}	=	Gallons per minute of baseline showerhead
$GPM_{low\ flow}$	=	Gallons per minute of low-flow showerhead
ISR	=	In-service rate, or fraction of units that get installed
MS	=	Average number of minutes per shower event
SPD	=	Average number of shower events per person per day
PH	=	Average number of people per household
SH	=	Average number of showerheads per household
T_{mix}	=	Mixed water temperature exiting faucet, °F
T_{inlet}	=	Cold water temperature entering the DWH system, °F (depends on location)
RE	=	Recovery efficiency of electric hot water heater
RG	=	Recovery efficiency of natural gas hot water heater
CF	=	Summer peak coincidence factor
60	=	Minutes per Hour
8.3	=	Specific weight of water in pounds per gallon
3,412	=	Constant to convert Btu to kWh
365	=	Days of faucet use per year
100,000	=	Constant to convert Btu to therms

Table 313 lists the assumptions and source of each assumption for low-flow showerhead measure savings calculations.

TABLE 313. *EX POST* VARIABLE ASSUMPTIONS FOR LOW-FLOW SHOWERHEADS

INPUT	VALUE	SOURCE
GPM_{base}	2.63	Indiana TRM (v2.2)
$GPM_{low\ flow}$	1.5	Actual
ISR	1.0	Indiana TRM (v2.2)
MS	7.8	Indiana TRM (v2.2)
SPD	0.60	Indiana TRM (v2.2)
PH	2.64	Indiana TRM (v2.2)
SH	1.8	2020 NIPSCO survey results
T_{mix}	101	Indiana TRM (v2.2)
T_{inlet} (Electric)	56.8	Indiana TRM (v2.2), values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
T_{inlet} (Gas)	57.3	Indiana TRM (v2.2), values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
RE	0.98	Indiana TRM (v2.2)
RG	0.76	Indiana TRM (v2.2)
CF	0.0023	Indiana TRM (v2.2)

INPUT	VALUE	SOURCE
Conversion Factor	60	Minutes per hour
Conversion Factor	8.3	Specific weight of water in pounds per gallon
Conversion Factor	3,412	Constant to convert Btu to kWh
Conversion Factor	365	Days of faucet use per year

SHOWER START

The evaluation team used the following equations to calculate electric energy, peak demand, and natural gas energy savings for shower start attachments:

$$kWh\ savings = \frac{ISR * GPM_{base}}{60} * \frac{8.3}{3412} * (T_{mix} - T_{in}) * \frac{PH * SPD}{SH} * \frac{WS}{RE} * 365$$

$$kW\ savings = kWh\ savings * CF$$

$$therm\ savings = \frac{ISR * GPM_{base}}{60} * \frac{8.3}{100{,}000} * (T_{out} - T_{in}) * \frac{PH * SPD}{SH} * \frac{WS}{RG} * 365$$

Where:

GPM_{base}	=	Flow rate (in gallons per minute) of the existing showerhead equipped with a Shower Start attachment.
ISR	=	In-service rate, or fraction of units that get installed
SPD	=	Average number of shower events per person per day
PH	=	Average number of people per household
SH	=	Average number of showerheads per household
WS	=	Number of shower seconds saved by Shower Start attachment
T_{mix}	=	Mixed water temperature exiting faucet, °F
T_{in}	=	Cold water temperature entering the DWH system, °F (depends on location)
RE	=	Recovery efficiency of electric hot water heater
RG	=	Recovery efficiency of natural gas hot water heater
CF	=	Summer peak coincidence and energy-to-demand factor
60	=	Seconds per Minute
8.3	=	Specific weight of water in pounds per gallon
3,412	=	Constant to convert Btu to kWh
365	=	Days of faucet use per year
100,000	=	Constant to convert Btu to therms

Table 314 lists the assumptions and source of each assumption for shower start measure savings calculations.

TABLE 314. *EX POST* VARIABLE ASSUMPTIONS FOR SHOWER START

INPUT	VALUE	SOURCE
GPM_{base}	2.63	Indiana TRM (v2.2). Used for projects where a shower start was installed without a new low flow showerhead.
$GPM_{low\ flow}$	1.5	Actual. Used for projects where a shower start was installed along with a new low flow showerhead.
ISR	1.0	Indiana TRM (v2.2)
SPD	0.60	Indiana TRM (v2.2)
PH	2.64	Indiana TRM (v2.2)
SH	1.8	NIPSCO 2020 survey results
WS	59	PA TRM 2016
T_{mix}	101	Indiana TRM (v2.2)
Tinlet (Electric)	56.8	Indiana TRM (v2.2), values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
Tinlet (Gas)	57.3	Indiana TRM (v2.2), values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
RE	0.98	Indiana TRM (v2.2)
RG	0.76	Indiana TRM (v2.2)
CF	0.00008013	PA TRM 2016
Conversion Factor	60	Seconds per minute
Conversion Factor	8.3	Product of the specific weight of water (pounds per gallon) and the specific heat capacity of water (Btu per pound per °F)
Conversion Factor	3,412	Constant to convert Btu to kWh
Conversion Factor	365	Days of faucet use per year

PIPE WRAP

The evaluation team used the following equations to calculate electric energy, peak demand, and natural gas energy savings for Pipe Wrap:

$$kWh\ savings = \left(\frac{1}{R_{Exist}} - \frac{1}{R_{New}}\right) * \frac{L * C * \Delta T * 8{,}760}{\eta_{DHWE} * 3{,}412}$$

$$kW\ savings = \frac{kWh\ savings}{8{,}760}$$

$$therm\ savings = \left(\frac{1}{R_{Exist}} - \frac{1}{R_{New}}\right) * \frac{L * C * \Delta T * 8{,}760}{\eta_{DHWG} * 100{,}000}$$

Where:

R_{Exist} = Pipe heat loss coefficient (R-value) of uninsulated pipe existing

R_{New} = Pipe heat loss coefficient (R-value) of insulated pipe

L = Feet of pipe from water heating source covered by pipe wrap

C	=	Circumference of pipe in feet
ΔT	=	Average temperature difference between supplied water and ambient air temperature
η_{DHWE}	=	Recovery efficiency of electric water heater
η_{DHWG}	=	Recovery efficiency of gas water heater
8,760	=	Hours per year
3,412	=	Constant to convert Btu to kWh
100,000	=	Constant to convert Btu to therms

Table 315 lists the assumptions and source of each assumption for pipe wrap savings calculations.

TABLE 315. *EX POST* VARIABLE ASSUMPTIONS FOR PIPE WRAP

INPUT	VALUE	SOURCE
R_{Exist}	1.00	Indiana TRM (v2.2)
R_{New}	3.54	Actual. Based on insulation R-value of 2.54 and bare-pipe R-value of 1.0 (per Indiana TRM (v2.2)).
L	1	Indiana TRM (v2.2), calculating savings on a per-foot basis
C	0.196	Actual. Based on assumed pipe diameter of 0.75 inches
ΔT	65	Indiana TRM (v2.2)
η_{DHWE}	.98	Indiana TRM (v2.2)
η_{DHWG}	.75	Indiana TRM (v2.2)
Conversion Factor	3,412	Constant to convert Btu to kWh
Conversion Factor	100,000	Constant to convert Btu to therms

WATER HEATER WRAP

The evaluation team used the following equations to calculate electric energy, peak demand, and natural gas energy savings for water heater wrap:

$$kWh\ savings = kWh_{Base} * \frac{EF_{New} - EF_{Base}}{EF_{New}}$$

$$kW\ savings = \frac{kWh\ savings}{8{,}760}$$

Where:

kWh_{Base}	=	Average kilowatt-hour consumption of electric DHW tank
EF_{New}	=	Assumed efficiency of electric tank with tank wrap installed
EF_{Base}	=	Assumed efficiency of electric tank without tank wrap installed
8,760	=	Hours per year

Table 316 lists the assumptions and source of each assumption for water heater wrap measure savings calculations.

TABLE 316. *EX POST* VARIABLE ASSUMPTIONS FOR WATER HEATER WRAP

INPUT	VALUE	SOURCE
kWh_{Base}	3,460	Indiana TRM (v2.2)
EF_{New}	0.88	Indiana TRM (v2.2)
EF_{Base}	0.86	Indiana TRM (v2.2)

FILTER WHISTLE

The team used the following equations to calculate electric energy and peak demand savings for Filter Whistles:

$$kWh\ savings = \Delta kWh_{hea} + \Delta kWh_{cool}$$

$$\Delta kWh_{heat} = kW_{motor} * EFLH_{heat} * EI * ISR$$

$$\Delta kWh_{cool} = kW_{motor} * EFLH_{cool} * EI * ISR * \%CAC$$

$$kW\ reduction = \frac{\Delta kWh_{cool}}{EFLH_{cool}} * CF$$

Where:

kWmotor = Average motor full load electric demand, kW
EFLHheat = Estimated full load heating hours
EFLHcool = Estimated full load cooling hours
EI = Efficiency Improvement
CF = Coincidence Factor
%CAC = Percent of homes with air conditioning
ISR = In Service Rate

TABLE 317 lists the input assumptions and source of each assumption for the Filter Whistle measure savings calculations.

TABLE 317. *EX POST* VARIABLE ASSUMPTIONS FOR FILTER WHISTLES

INPUT	VALUE	SOURCE
kW_{motor}	0.5	2016 Pennsylvania TRM
$EFLH_{heat}$	1427	Indiana TRM (v2.2)
$EFLH_{cool}$	431	Indiana TRM (v2.2)
EI	0.15	2016 Pennsylvania TRM
CF	0.647	2016 Pennsylvania TRM
% CAC	0.83	2020 School HEW

ATTIC INSULATION

The evaluation team used the following equations to calculate electric energy, peak demand, and natural gas energy savings for attic insulation:

$$kWh\ savings = \left(\frac{SF}{1000}\right) * \left(\frac{\Delta kWh}{kSF}\right)$$

$$kW\ savings = \left(\frac{SF}{1000}\right) * \left(\frac{\Delta kW}{kSF}\right) * CF$$

$$therm\ savings = \left(\frac{SF}{1000}\right) * \left(\frac{\Delta MMBtu}{kSF}\right) * 10$$

Where:

SF = Total area of wall insulation in square feet

ΔkWh/kSF = Energy savings expected for every 1,000 square feet of insulation installed with respect to pre-R and post-R values from data tracking information

ΔkW/kSF = Demand savings expected for every 1,000 square feet of insulation installed with respect to pre-R and post-R values from data tracking information

ΔMMBtu/kSF = Natural gas savings expected for every 1,000 square feet of insulation installed with respect to pre-R and post-R values from data tracking information

CF = Coincidence factor

Electric energy, peak demand, and natural gas energy savings are dependent upon pre-R and post-R measure insulation values, calculated using the following steps:

- **Step 1.** Determine variables for insulation compression, R_{ratio}, and void factors
- **Step 2.** Calculate adjusted R-values, R_{adj}
- **Step 3.** Interpolate with Indiana TRM (v2.2) tables to obtain savings per 1,000 square feet of insulation to obtain values for ΔkWh/kSF, ΔkW/kSF, ΔMMBtu/kSF

Step 1. Determine variables for insulation compression, R_{ratio}, and void factors:

Adjusted pre-installation and post-installation R-values are calculated using the following formula:

$$R_{adj} = R_{nominal} * F_{compressio} \quad * F_{void}$$

Where:

$R_{nominal}$ = Total installed R-value per manufacturers specifications. This value varies across participants and was calculated on an individual level to account for individual savings between pre and post measure.

$F_{compression}$ = Insulation compression factor, assumed to be 1 for 0% compression (as shown in TRM v2.2), because actual information is unknown.

F_{void} = Void factor, dependent on insulation grade level and percent coverage, assumed to be at the 2% grade per the Indiana TRM (v2.2), because the actual information is unknown.

The void factor, F_{void}, varies based on the ration between the full assembly R-value and he nominal R-value, $R_{nominal}$, including compression effects. Pre and post insulation values are determined next, using the following equation:

$$R_{ratio} = \frac{R_{nominal} * F_{compression}}{R_{nominal} + R_{framing\&airspace}}$$

Where:

$R_{nominal}$	=	Total installed R-value per manufacturers specifications. This value varies across participants and was calculated on an individual level to account for individual savings between pre and post measure.
$F_{compression}$	=	Insulation compression factor, assumed to be 1 for 0% compression (as shown in TRM v2.2), because actual information is unknown.
$R_{framing\&airspace}$	=	R-value for materials, framing, and airspace for the area in which the insulation is installed. Assumed to be R-5, per Indiana TRM (v2.2).

Values for void factors, based on the R_{ratio} calculation are shown in Table 318. The evaluation team assumed a void factor at 2% in accordance with the Indiana TRM (v2.2).

TABLE 318. INSULATION VOID FACTORS

R_{RATIO}	F_{VOID}, 2%
0.50	0.96
0.55	0.96
0.60	0.95
0.65	0.94
0.70	0.94
0.75	0.94
0.80	0.91
0.85	0.88
0.90	0.83
0.95	0.71
0.99	0.33

Step 2. Calculate R_{adj}

Pre-R and post-R values, R_{adj}, are calculated at the participant level using $R_{nominal}$ and R_{ratio}

Step 3. Determine ΔkWh/kSF, ΔkW/kSF, ΔMMBtu/kSF

Electric energy, peak demand, and natural gas savings per thousand square feet values were obtained by interpolating within the Indiana TRM (v2.2) tables and averaging across participant location.

Table 319 lists the assumptions and source for R-values of insulation in the attic insulation measure.

TABLE 319. *EX POST* VARIABLE ASSUMPTIONS FOR ATTIC INSULATION

INPUT	VALUE	SOURCE
$R_{nominal-pre}$ (Not adjusted for voids / compression)	5.96	Value assigned based on CHA report data. Value shown is a program average which was used for the analysis.
$R_{nominal-post}$ (Not adjusted for voids / compression)	39.43	Value assigned based on CHA report data. Value shown is a program average which was used for the analysis.
$R_{framing\&airspace}$	5.0	R-value for materials, framing, and airspace for the area in which the insulation is installed. Assumed to be R-5, per Indiana TRM (v2.2).

INPUT	VALUE	SOURCE
$F_{compression}$	1.00	Insulation compression factor, assumed to be 1.0 for 0% compression (as shown in TRM v2.2), because actual information is unknown.
R-ratio$_{pre}$	0.54	Calculated using $R_{nominal\text{-}pre}$, $F_{compression}$, and $R_{framing\&airspace}$
R-ratio$_{post}$	0.89	Calculated using $R_{nominal\text{-}post}$, $F_{compression}$, and $R_{framing\&airspace}$
$F_{void\text{-}pre}$	0.96	Interpolated from insulation void factors from the Indiana TRM (v2.2) based on the ratio of $R_{nominal\text{-}pre}$ to $R_{nominal\text{-}post}$.
$F_{void\text{-}post}$	0.84	Interpolated from insulation void factors from the Indiana TRM (v2.2) based on the ratio of $R_{nominal\text{-}pre}$ to $R_{nominal\text{-}post}$.
$R_{adj\text{-}pre}$ (Adjusted for voids / compression)	5.72	Calculated using $R_{nominal\text{-}pre}$, $F_{compression}$, and $F_{void\text{-}pre}$
$R_{adj\text{-}post}$ (Adjusted for voids / compression)	33.12	Calculated using $R_{nominal\text{-}post}$, $F_{compression}$, and $F_{void\text{-}post}$

Table 320 lists the program-average kWh savings per thousand square feet for the attic insulation measure.

TABLE 320. *EX POST* kWh SAVINGS PER THOUSAND SQUARE FEET OF ATTIC INSULATION

TRM REFERENCE CITY	HVAC SYSTEM TYPE	SAVINGS VALUES
Ft. Wayne	Gas Heating Only	1007
South Bend	Electric Cooling and Gas Heating	237.5
South Bend	Gas Heating Only	102.8

Table 321 lists the program-average KW savings per thousand square feet for the attic insulation measure.

TABLE 321. *EX POST* KW SAVINGS PER THOUSAND SQUARE FEET OF ATTIC INSULATION

TRM REFERENCE CITY	HVAC SYSTEM TYPE	SAVINGS VALUES
Ft. Wayne	Gas Heating Only	0.000
South Bend	Electric Cooling and Gas Heating	0.15
South Bend	Gas Heating Only	0.000

Table 322 lists the program-average MMBtu savings per thousand square feet for the attic insulation measure.

TABLE 322. *EX POST* MMBtu SAVINGS PER THOUSAND PER THOUSAND SQUARE FEET OF ATTIC INSULATION

TRM REFERENCE CITY	HVAC SYSTEM TYPE	SAVINGS VALUES
Ft. Wayne	Gas Heating Only	21.1
South Bend	Electric Cooling and Gas Heating	20.7
South Bend	Gas Heating Only	21.0

PROGRAMMABLE THERMOSTAT

The evaluation team used the following equations to calculate electric and natural gas energy savings for programmable thermostats. There are no summer peak coincidence demand savings associated with this measure.

$$kWh\ savings\_cool = \frac{1}{SEER} * EFLH_{cool} * \frac{Btuh_{cool}}{1{,}000} * ESF_{cool}$$

$$kWh\ savings\_heat = EFLH_{heat} * \frac{BtuH_{heat}}{N_{heat} * 3412} * ESF_{heat}$$

$$therm\ savings = EFLH_{heat} \frac{BtuH_{FF} * ESF_{heat}}{100{,}000}$$

Where:

SEER	=	Seasonal average efficiency ratio
$EFLH_{cool}$	=	Full load cooling hours
$BtuH_{cool}$	=	Cooling system capacity in Btu per hour
ESF_{cool}	=	Cooling energy savings fraction
$EFLH_{heat}$	=	Full load heating hours
$BtuH_{heat}$	=	Heating system capacity in Btu per hour
N_{heat}	=	Efficiency in COP of heating equipment
$BtuH_{FF}$	=	Heating capacity of gas equipment

Table 323 lists the assumptions and source of each assumption for the smart thermostat measure savings calculations.

TABLE 323. *EX POST* VARIABLE ASSUMPTIONS FOR PROGRAMMABLE THERMOSTATS

INPUT	VALUE	SOURCE
SEER	11.15	Indiana TRM (v2.2)
$EFLH_{cool}$	426.79	Indiana TRM (v2.2), values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
$Btuh_{cool}$	28,994	Indiana TRM (v2.2)
ESF_{cool}	0.09	Indiana TRM (v2.2)
$EFLH_{heat}$	1427	Indiana TRM (v2.2), values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
$Btuh_{FF}$	77,386	Indiana TRM (v2.2)
ESF_{heat}	0.068	Indiana TRM (v2.2)

DUCT SEALING

The evaluation team used the following equations to calculate electric and natural gas energy savings for duct sealing.

$$kWh\ savings_{cool} = \frac{DE_{coolafter} - DE_{coolbefore}}{DE_{coolafter}} * \frac{EFLH_{cool} * Btuh_{cool}}{SEER * 1{,}000}$$

$$kWh\ savings_{heat} = \frac{DE_{heatafter} - DE_{heatbefore}}{DE_{heatafter}} * \frac{EFLH_{heat} * Btuh_{heat}}{3{,}412 * N_{heati}}$$

$$kW\ savings = \left(\frac{DE_{pkafter} - DE_{pkbefore}}{DE_{pkafter}}\right) * \left(\frac{Btuh_{cool}}{EER * 1{,}000} * CF\right)$$

$$therm\ savings = \frac{DE_{heatafter} - DE_{heatbefore}}{DE_{heatafter}} * \frac{EFLH_{heat} * Btuh_{FF}}{100{,}000}$$

Where:

$DE_{coolafter}$ = Distribution efficiency after duct sealing

$DE_{coolbefore}$ = Distribution efficiency before duct sealing

$DE_{heatafter}$ = Distribution efficiency after duct sealing

$DE_{heatbefore}$ = Distribution efficiency before duct sealing

$DE_{pkafter}$ = Distribution efficiency under peak summer conditions after duct sealing

$DE_{pkbefore}$ = Distribution efficiency under peak summer conditions before duct sealing

$EFLH_{cool}$ = Full load cooling hours

$EFLH_{heat}$ = Full load heating hours

$BtuH_{cool}$ = Cooling capacity of cooling equipment (Btu per hour)

$BtuH_{heat}$ = Heating capacity of electric heating equipment (Btu per hour)

$BtuH_{FF}$ = Heating capacity of gas heating equipment (Btu per hour)

N_{heat} = Efficiency in COP of heating equipment

SEER = Seasonal average efficiency of air conditioning equipment

EER = Peak efficiency of air conditioning equipment

56.4 = Gas duct sealing savings evaluated through billing analysis in the 2018 program evaluation

CF = Coincidence factor

Table 324 lists the assumptions and source of each assumption for the smart duct sealing savings calculations.

TABLE 324. *EX POST* VARIABLE ASSUMPTIONS FOR DUCT SEALING

INPUT	VALUE	SOURCE
$DE_{coolbefore}$	0.75	Indiana TRM (v2.2)
$DE_{coolafter}$	0.84	Indiana TRM (v2.2)
$DE_{heatbefore}$	0.75	Indiana TRM (v2.2)
$DE_{heatafter}$	0.82	Indiana TRM (v2.2)
$DE_{pkbefore}$	0.68	Indiana TRM (v2.2)
$DE_{pkafter}$	0.79	Indiana TRM (v2.2)
$EFLH_{cool}$ (CAC with Gas Heating)	427	Indiana TRM (v2.2). values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
$EFLH_{cool}$ (CAC with Electric Heating)	373	Indiana TRM (v2.2). values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
$EFLH_{cool}$ (Gas Heating Only)	423	Indiana TRM (v2.2). values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
$EFLH_{heat}$ (CAC with Gas Heating)	1,422.0	Indiana TRM (v2.2). values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
$EFLH_{heat}$ (CAC with Electric Heating)	1,356.0	Indiana TRM (v2.2). values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant
$EFLH_{heat}$ (Gas Heating Only)	1,417.0	Indiana TRM (v2.2). values assigned based on nearest TRM city. Value shown is the program average, not the value used to calculate savings for each participant

INPUT	VALUE	SOURCE
SEER	11.15	Indiana TRM (v2.2)
EER	10	Indiana TRM (v2.2)
$N_{heating}$	1	Indiana TRM (v2.2)
$BtuH_{cool}$	28,994	Indiana TRM (v2.2)
$BtuH_{heat,}$	32,000	Pennsylvania TRM (2016)
BtuHFF	77,386	Indiana TRM (v2.2)
CF	0.88	Indiana TRM (v2.2)

AIR SEALING

The evaluation team used the following equations to calculate electric and natural gas energy savings for air sealing.

$$kWh\ savings_{cool} = \frac{CFM50_{Exist} - CFM50_{New}}{N - factor} * \frac{\Delta kWh}{CFM}$$

$$kW\ savings = \frac{CFM50_{Exist} - CFM50_{New}}{N - factor} * \frac{\Delta kW}{CFM} * CF$$

$$therm\ savings = \frac{CFM50_{Exist} - CFM50_{New}}{N - factor} * \frac{\Delta MMBtu}{CFM} * 10$$

Where:

$CFM50_{Exist}$ = Existing cubic feet per minute at 50 Pascal pressure differential as measured by the blower door before air sealing

$CFM50_{New}$ = New cubic feet per minute at 50 Pascal pressure differential as measured by the blower door after air sealing

N-factor = Conversion factor from 50 Pascal airflows to natural airflow

ΔkWh/CFM = kWh impacts per CFM of infiltration rate reduction

ΔkW/CFM = kW impacts per CFM of infiltration rate reduction

CF = Coincidence factor

ΔMMBTU/CFM = MMBTU impacts per CFM of infiltration rate reduction

Table 325 lists the assumptions and source of each assumption for the smart duct sealing savings calculations.

TABLE 325. *EX POST* VARIABLE ASSUMPTIONS FOR DUCT SEALING

INPUT	VALUE	SOURCE
ΔCFM50 - Electric Cooling and Gas Heating Savings	823	Average of NIPSCO 2019 tracking data
ΔCFM50 - Electric Cooling and Heating Savings	690	Average of NIPSCO 2019 tracking data
ΔCFM50 - Electric Cooling Only Savings	795	Average of NIPSCO 2019 tracking data
ΔCFM50 - Electric Heating Only Savings	764	Average of NIPSCO 2019 tracking data
ΔCFM50 - Gas Heating Only Savings	900	Average of NIPSCO 2019 tracking data
N-Factor	16.7	Indiana TRM (v2.2)

INPUT	VALUE	SOURCE
kWh/cfm - AC Natural Gas Heat	1.7	Indiana TRM (v2.2)
kWh/cfm - Heat Pump	30	Indiana TRM (v2.2)
kWh/cfm - AC Electric Heat	47.6	Indiana TRM (v2.2)
kWh/cfm - Natural Gas Heat Only	10	Indiana TRM (v2.2)
kWh/cfm - Electric Heat Only	46.5	Indiana TRM (v2.2)
kW/cfm - AC Natural Gas Heat	0	Indiana TRM (v2.2)
kW/cfm - Heat Pump	0	Indiana TRM (v2.2)
kW/cfm - AC Electric Heat	0	Indiana TRM (v2.2)
kW/cfm - Natural Gas Heat Only	0	Indiana TRM (v2.2)
kW/cfm - Electric Heat Only	0	Indiana TRM (v2.2)
MMBtu/cfm - AC Natural Gas Heat	0	Pennsylvania TRM (2016)
MMBtu/cfm - Natural Gas Heat Only	0.21	Indiana TRM (v2.2)
CF	0.88	Indiana TRM (v2.2)

APPENDIX 11: C&I PROGRAM APPENDIX

C&I PROGRAM IMPACT EVALUATION DETAILS

HEATING VENTILATION AND AIR CONDITIONING (HVAC)

All four C&I programs provided HVAC measures in 2020. The number of measures, savings and sampling amongst the programs are shown below. The team evaluated 29 HVAC measures across the C&I programs, representing over half of the electric savings, and over a third of gas savings were evaluated. The evaluation team made adjustments that resulted in a net decrease of 760,178 kWh, 450 kW, and 55,871 therms for the sampled HVAC measure population.

TABLE 326. 2020 C&I PROGRAMS SAMPLED HVAC MEASURES

PROGRAM	NUMBER OF MEASURES				PROPORTION OF PROGRAM SAVINGS EVALUATED		
	TOTAL	SAMPLED TOTAL	HAND PICKED	RANDOM	KWH	KW	THERMS
Custom	62	7	4	3	60%	87%	31%
Prescriptive	81	6	3	3	43%	7%	20%
SBDI	8	6	1	5	N/A	N/A	81%
New Construction	78	10	6	4	46%	87%	36%
Total	229	29	14	15	56%	56%	35%

Eleven of the 29 measures resulted in a 100% realization rate. The remaining measures were adjusted for the following types of issues:

General HVAC Measures:

- The IN TRM v2.2 was followed for most measures, but other non-IN TRM v2.2 sources were used for a couple measures without a clear reason why the differing source was deemed more appropriate than the IN TRM v2.2 calculations. The evaluation team referenced the IN TRM v2.2 to recalculate the savings for these select HVAC measures, as the IN TRM v2.2 modeled the measure best and most consistently.
- Several measures had adjustments to capacity, efficiency, operating hours, and coincidence factors based on review of documentation, values used in the *ex ante* calculations, or in cases where the customer provided data that differed from the application data.
- In one sampled case, the installed six AC units were of equal efficiency to the IN TRM v2.2 baseline efficiency, resulting in a 0% realization rate.
- In one measure type, the incorrect IN TRM v2.2 measure category was used to determine *ex ante* savings. The implementation team had utilized a TRM measure corresponding to a larger AC unit than the size

matching the installed equipment. The evaluation team utilized the actual installed equipment size to determine the correct measure category for the *ex post* calculations, resulting in a realization rate of 33%.

- In several measures, modifications were made to the *ex ante* sequence of operation assumptions. Specifically, how many pieces of equipment were running together versus in lead/lag configuration.
- In one measure, *ex ante* savings were determined based on the assumption that the facility had electric heating. The application states the facility is heated with natural gas, which was confirmed with the customer via interview. Different IN TRM v2.2 measure deemed values were used between *ex ante* and *ex post* given the modification to the conditioning type, resulting in a realization rate of 56%.
- For one large fan wall measure, the evaluation team made significant modifications to the baseline and proposed case horsepower quantity of motors and operational assumptions. *Ex ante* calculations assumed the existing fans would be replaced with fewer fans and a cumulatively lower horsepower. However, the design of the installed case called for more fans and cumulatively higher horsepower than the original case. Additionally, the installed case had more limited control to vary the speed of the drives. This configuration was confirmed with a virtual site visit. As a result, the installed case consumes more energy than the baseline case. The result was a 0% realization rate for the large, hand-picked project. The deviation between *ex ante* and *ex post* is suspected to be primarily a misunderstanding of the number of fans installed in the proposed case. The type of system installed is typically not installed as an energy saving measure, but as a critical function redundancy measure.

Steam Pipe Insulation Measures: Steam pipe insulation measures are deemed and resulted in a realization rate of close to 100%; however, tracking data analysis indicates deemed values do not accurately capture savings and worth revisiting as part of any IN TRM update. The *ex ante* savings for all hot water pipe/ steam pipe insulation measures were deemed based on only measure quantity information (linear feet installed) and pipe diameter. The evaluation team found that project savings varied greatly from the deemed savings when considering all the variables of the project. However, realization rates for most steam pipe insulation measures were maintained close to 100% since it was the established practice to use deemed values for these measures. It is notable that the 2020 sample included facilities will dramatically lower operating hours (800 hrs.), and higher operating hours (8760), and facilities with high pressure steam. None of the projects sampled were well characterized by the deemed values established.

- Modifications were made to the two measures where the operating hours of the building and the heating system were far lower than the operating hours built into the deemed savings values. Unlike the other sampled steam pipe insulation measures, these two projects utilized steam for heating (not process), and the operating hours of the heating system were established in the application and confirmed with the customer through evaluation interviews.

Furnace Measures: The New Construction, Custom and Prescriptive programs included seven sampled furnace measures which achieved a cumulative realization rate of 88%. The projects included one of two sources of savings documentation: a furnace calculation spreadsheet developed by the implementation team or vendor provided PDF calculations. To independently calculate and validate the savings from each source, the evaluation team developed and used a separate furnace measure savings calculation spreadsheet for all projects. The evaluation team found the savings results to be very similar compared against the implementor calculation spreadsheet and more significant deviations when compared against the vendor provided PDF calculations. Aside from the difference in calculators, the following adjustments were made to most furnace measures sampled:

- Customer interview data revealed differences in occupied and unoccupied setback temperatures than what were specified in the *ex ante* calculations. Adjustments were made to reflect actual temperature settings.
- The evaluation team found that most of the sampled systems were only turned on seasonally to provide heat when a garage door was opened. To model this more accurately, the evaluation team adjusted the hours of use or the occupied temperature setting downward to reflect the equipment being triggered on less frequently. In future years, more customer data may be needed to determine the operation of the equipment beyond what the occupied temperature setpoints are.
- The evaluation team found that several of the sampled systems were installed in industrial or manufacturing settings where there are a lot of process loads heating the space. As a result, the furnace units would not be responsible for most of the heating load and would cycle on less frequently. The evaluation team modified the occupied setpoints downward to better model these situations. In future years, more customer data may be needed to determine the operation of the equipment beyond the occupied temperature setpoints.

TABLE 327 shows the *ex ante* savings and the measure specific realization rates from the sampled HVAC measures in the 2020 C&I programs, by fuel type. The measure specific realization rates from the hand-picked sampled projects were applied to only those specific projects. The actual realization rates found for randomly sampled projects are shown below, however those realization rates were not extrapolated to the rest of the HVAC population. Non-lighting measure types were aggregated to create realization rates for each program as a full measure category. The non-lighting realization rates were then used for extrapolation to the complete non-lighting population for each program.

TABLE 327. 2020 C&I PROGRAMS *EX ANTE* SAVINGS VALUES FOR HVAC MEASURES & REALIZATION RATES FOR SAMPLED HVAC MEASURES

PROGRAM	SAMPLED *EX ANTE*			REALIZATION RATES (KWH)		REALIZATION RATES (KW)		REALIZATION RATES (THERMS)	
	KWH	KW	THERMS	HAND PICKED	RANDOM	HAND PICKED	RANDOM	HAND PICKED	RANDOM
Custom	767,829.00	265.157	139,847.00	5%	N/A	12%	N/A	84%	89%
Prescriptive	37,864.00	2.778	8,282.50	86%	79%	0%	88%	100%	96%
SBDI	-	-	37,631.02	N/A	N/A	N/A	N/A	32%	99%
New Construction	202,990.00	243.830	163,515.00	88%	106%	6%	147%	76%	104%
Total	1,008,683.00	511.765	349,275.52	24%	103%	9%	141%	79%	97%

FIGURE 99 and FIGURE 100 below illustrate the realization rate distribution of the individually sampled projects by program and by fuel source. Most electric savings projects were small, and many had low realization rates. Many therm savings projects achieved nearly 100%, with the remaining lower.

FIGURE 99. C&I PROGRAMS SAMPLED HVAC MEASURES KWH *EX ANTE* IMPACT AND REALIZATION RATES

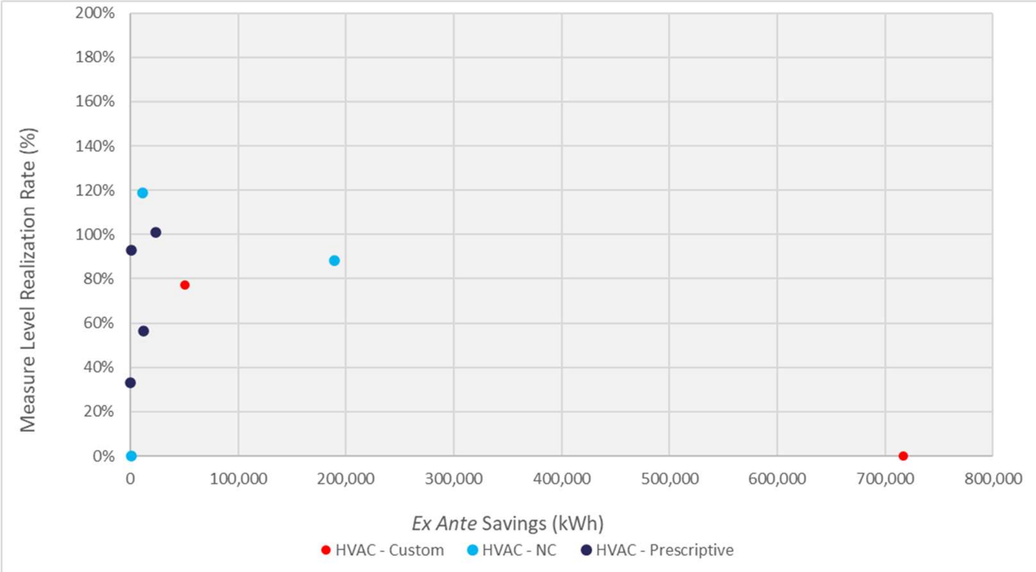


FIGURE 100. C&I PROGRAMS SAMPLED HVAC MEASURES THERM *EX ANTE* IMPACT AND REALIZATION RATES

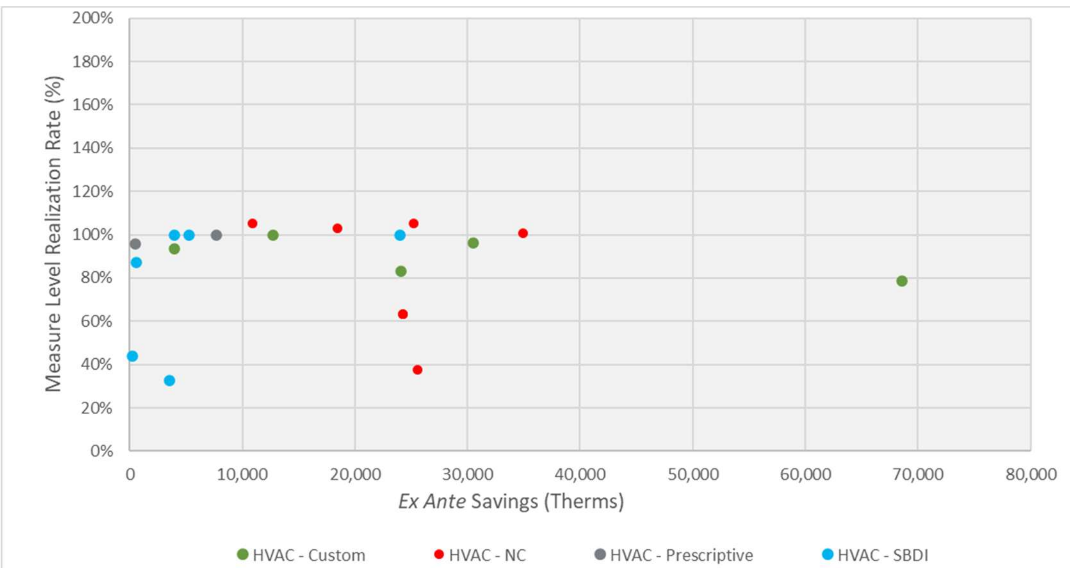


TABLE 328 summarizes notable differences between *ex ante* and *ex post* gross estimates from the measures sampled.

TABLE 328. C&I PROGRAMS NOTABLE DIFFERENCES BETWEEN *EX ANTE* & *EX POST* GROSS HVAC MEASURES

MEASURE CATEGORY	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST* GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
HVAC	*Ex ante* savings were determined by the Indiana TRM v2.2, calculated through the application excel tool, or deemed values through the application excel tool. In some	Indiana TRM v2.2. All inputs were verified through project documentation, virtual site visits or interviews. Steam pipe insulation measures and	Installed equipment efficiencies for energy and demand savings calculations. PDF calculations were replaced with evaluator created furnace savings calculation spreadsheets resulting in minor differences in

MEASURE CATEGORY	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST* GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
	furnace projects, PDF engineering calculations provided by the equipment manufacturers. Steam pipe insulation measures were determined through deemed values determined by calculated values.	furnace measures were determined through created calculators.	claimed savings. Modifications were made to baseline and installed assumptions based on customer provided measure data gained through customer interview and virtual site visit.

VARIABLE FREQUENCY DRIVES (VFD)

Only the Prescriptive C&I program rebated VFD measures in 2020. TABLE 329 below documents the number of measures, savings, and sample size in the program. In total, the team sampled 3 VFD measures. The engineering analysis decreased VFD savings by 3,646 kWh and 0.1 kW in the sampled population.

TABLE 329. 2020 C&I PROGRAMS SAMPLED VFD MEASURES

PROGRAM	NUMBER OF MEASURES				PROPORTION OF PROGRAM SAVINGS EVALUATED		
	TOTAL	SAMPLED TOTAL	HAND PICKED	RANDOM	KWH	KW	THERMS
Custom	-	-	-	-	-	-	-
Prescriptive	55	3	-	3	4%	5%	N/A
SBDI	-	-	-	-	-	-	-
New Construction	-	-	-	-	-	-	-
Total	55	3		3	4%	5%	

None of the measures received a 100% realization rate. The measures were adjusted for the following types of issues:

- The IN TRM v2.2 does not have a measure to accurately capture VFD savings. *Ex ante* savings were developed from engineering calculations. The evaluation team used the CA TRM VFD Fan Analysis workbook to determine savings in most VFD projects. The analysis using this workbook resulted in zero kW demand savings due to the projection that the motors would run at mid-day based on project data provided in the application and confirmed via customer interview.
- Changes in operating hours, coincidence factor, and load changes based on a review of the energy management systems and interview data for some sites.
- In one measure, the overall motor horsepower for the installed case was incorrect based on a virtual site inspection.

TABLE 330 shows the *ex ante* savings and the measure specific realization rates from the sampled VFD measures in the 2020 C&I programs. The measure specific realization rates from the hand-picked sampled projects were applied to only those specific projects. The actual realization rates found for randomly sampled projects are shown below, however those realization rates were not extrapolated to the rest of the VFD population. Non-lighting measure types were aggregated to create realization rates for each program as a full measure category. The non-lighting realization rates were then used for extrapolation to the complete non-lighting population for each program.

TABLE 330. 2020 C&I PROGRAMS *EX ANTE* SAVINGS & REALIZATION RATES FOR SAMPLED VFD MEASURES

PROGRAM	SAMPLED *EX ANTE*			REALIZATION RATES (KWH)		REALIZATION RATES (KW)		
	KWH	KW	THERMS	HAND PICKED	RANDOM	HAND PICKED	RANDOM	
Custom	-	-	-	-	-	-	-	-
Prescriptive	26,383.50	4.217	-	N/A	50%	N/A	62%	-
SBDI	-	-	-	-	-	-	-	-
New Construction	-	-	-	-	-	-	-	-
Total	26,383.50	4.217	-		50%		62%	

FIGURE 101 below illustrates the realization rate distribution of the individually sampled projects by program.

FIGURE 101. C&I PROGRAMS SAMPLED VFD MEASURES *EX ANTE* IMPACT AND REALIZATION RATES

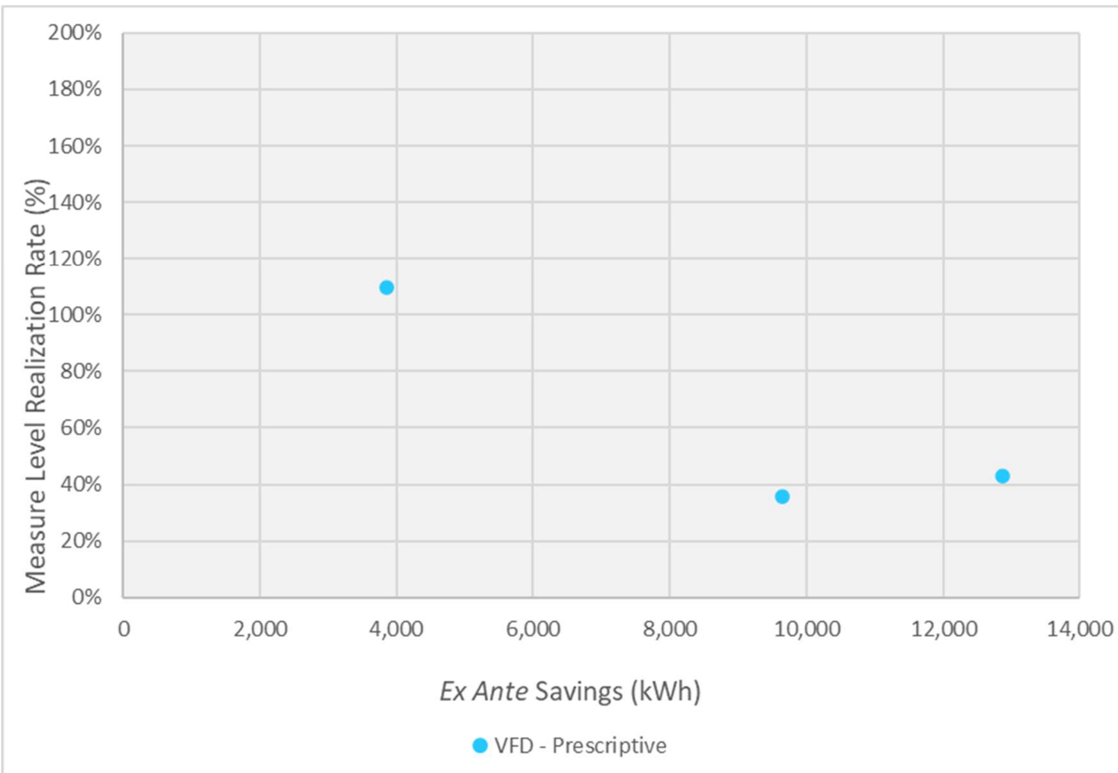


TABLE 331 summarizes notable differences between *ex ante* and *ex post* gross estimates from the measures sampled.

TABLE 331. 2020 C&I PROGRAMS NOTABLE DIFFERENCES BETWEEN *EX ANTE* & *EX POST* GROSS VFD MEASURES

MEASURE CATEGORY	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST* GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
VFD	*Ex ante* savings were deemed through the application excel tool	Indiana TRM v2.2. All inputs were verified through project documentation, virtual site visits or interviews. Engineering calculations with VFD curves adapted from the	The deemed savings values do not account for operating hours or loading of the VFDs. The CA TRM VFD Fan Analysis workbook results resulted in 0 kW savings due to projections of motor running at full during

MEASURE CATEGORY	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST* GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
		Bonneville Power Administration ASD Calculator and the CA TRM VFD Fan Analysis workbook.	mid-day. Changes to installed HP and HOU based on customer data.

REFRIGERATION

All four C&I programs reported savings for refrigeration measures in 2020. TABLE 332 below details the number of measures, savings, and sample sizes for refrigeration measures. The team evaluated 6 refrigeration measures across the C&I programs. The engineering analysis decreased total refrigeration savings by 7,247 kWh and 0.2 kW.

TABLE 332. 2020 C&I PROGRAMS SAMPLED REFRIGERATION MEASURES

PROGRAM	NUMBER OF MEASURES				PROPORTION OF PROGRAM SAVINGS EVALUATED		
	TOTAL	SAMPLED TOTAL	HAND PICKED	RANDOM	KWH	KW	THERMS
Custom	4	1	-	1	25%	N/A	N/A
Prescriptive	19	3	-	3	31%	20%	N/A
SBDI	2	1	-	1	64%	64%	N/A
New Construction	8	1	-	1	17%	0%	N/A
Total	33	6		6	29%	21%	

Two of the six measures resulted in near to a 100% realization rate. The remaining measures were adjusted for the following types of issues:

- One measure's *ex ante* savings were derived from a baseline figure that incorporated several refrigeration units being removed and replaced with a single, smaller unit. The evaluation team normalized the baseline size to match the final installed case size.
- Several measures reported refrigeration installed volumes that differed from the provided specifications. The analysis modified the volume to match specifications, which were also confirmed with the customer via interview.
- In one case, the customer confirmed that they installed a different unit than was reported, which considerably affected the resulting savings for that project.
- Ex-ante savings followed the IN TRM v2.2 for most refrigeration measures with several exceptions which used other sources without a clear documentation describing the decision to deviate from the IN TRM. The evaluation team recalculated the savings for this measure using the IN TRM.

TABLE 333 shows the *ex ante* savings and the measure specific realization rates from the sampled Refrigeration measures in the 2020 C&I programs. The measure specific realization rates from the hand-picked sampled projects were applied to only those specific projects. The actual realization rates found for randomly sampled projects are shown below, however those realization rates were not extrapolated to the rest of the Refrigeration population. Non-lighting measure types were aggregated to create realization rates for each program as a full measure category. The non-lighting realization rates were then used for extrapolation to the complete non-lighting population for each program.

TABLE 333. 2020 C&I PROGRAMS *EX ANTE* SAVINGS & REALIZATION RATES FOR SAMPLED REFRIGERATION MEASURES

PROGRAM	SAMPLED *EX ANTE*			REALIZATION RATES (KWH)		REALIZATION RATES (KW)	
	KWH	KW	THERMS	HANDPICKED	RANDOM	HANDPICKED	RANDOM
Custom	16,330.10	-	-	N/A	5%	N/A	N/A
Prescriptive	38,576.00	5.227	-	N/A	98%	N/A	105%
SBDI	3,937.50	0.538	-	N/A	97%	N/A	75%
New Construction	935.00	-	-	N/A	88%	N/A	N/A
Total	59,778.60	5.765	-		72%		102%

FIGURE 102 below illustrates the realization rate distribution of the individually sampled projects by program.

FIGURE 102. C&I PROGRAMS SAMPLED REFRIGERATION MEASURES *EX ANTE* IMPACT AND REALIZATION RATES

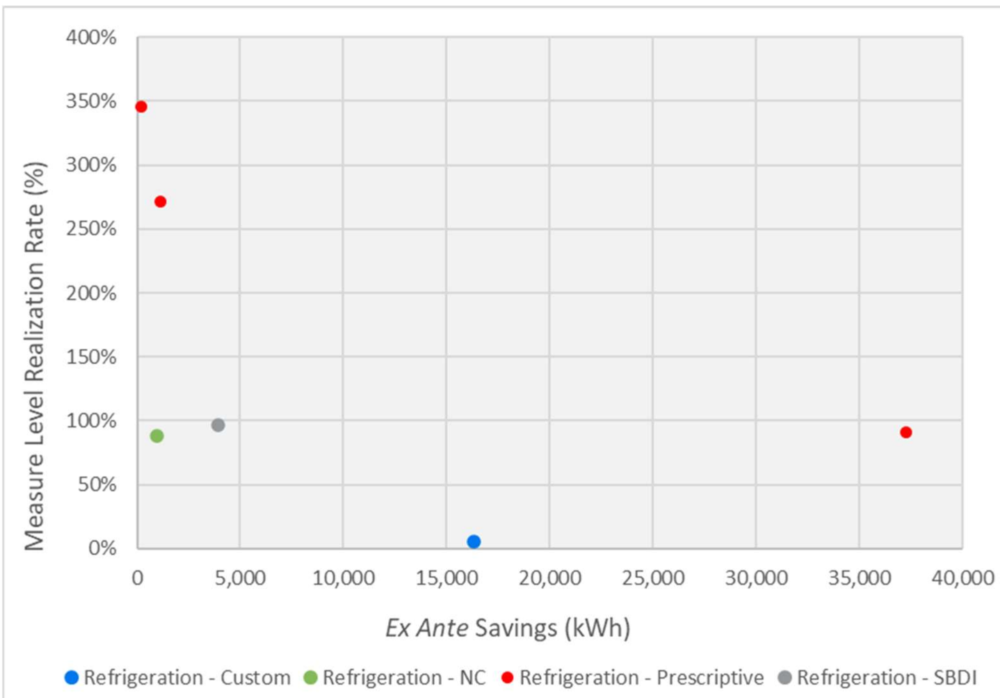


TABLE 334 summarizes notable differences between *ex ante* and *ex post* gross estimates from the measures sampled.

TABLE 334. 2020 C&I PROGRAMS NOTABLE DIFFERENCES BETWEEN *EX ANTE* & *EX POST* GROSS REFRIGERATION MEASURES

MEASURE CATEGORY	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST* GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
Refrigeration	*Ex ante* savings were determined by the Indiana TRM v2.2, or through engineering calculations.	Indiana TRM v2.2. All inputs were verified through project documentation, virtual site visits or interviews.	Modifications to baseline and proposed case volumes and capacities composed most adjustments

COMPRESSED AIR

The C&I Custom and New Construction programs installed compressed air measures in 2020. TABLE 335 details the number of measures, savings, and sample sizes by program. The team evaluated four compressed air measures across the C&I programs. The engineering analysis decreased compressed air savings by 310,964 kWh.

TABLE 335. 2020 C&I PROGRAMS SAMPLED COMPRESSED AIR MEASURES

PROGRAM	NUMBER OF MEASURES				PROPORTION OF PROGRAM SAVINGS EVALUATED		
	TOTAL	SAMPLED TOTAL	HAND PICKED	RANDOM	KWH	KW	THERMS
Custom	14	4	2	2	84%	0%	N/A
Prescriptive	-	-	-	-	-	-	-
SBDI	-	-	-	-	-	-	-
New Construction	3	-	-	-	0%	0%	N/A
Total	17	4	2	2	77%	0%	

One of the four measures resulted in a 100% realization rate. The remaining measures were adjusted for the following issues:

- Changes in hours of use based on customer provided usage data in several measures.
- *Ex ante* calculations used incorrect HP values for the baseline equipment in one measure.
- Modifications to the load profile assumptions based on customer provided data in one measure.
- Data entry error in the final claimed *ex ante* value in one measure.

TABLE 336 shows the *ex ante* savings and the measure specific realization rates from the sampled Compressed Air measures in the 2020 C&I programs. The measure specific realization rates from the hand-picked sampled projects were applied to only those specific projects. The actual realization rates found for randomly sampled projects are shown below, however those realization rates were not extrapolated to the rest of the Compressed Air population. Non-lighting measure types were aggregated to create realization rates for each program as a full measure category. The non-lighting realization rates were then used for extrapolation to the complete non-lighting population for each program.

TABLE 336. 2020 C&I PROGRAMS *EX ANTE* SAVINGS & REALIZATION RATES FOR SAMPLED COMPRESSED AIR MEASURES

PROGRAM	SAMPLED *EX ANTE*			REALIZATION RATES (KWH)		REALIZATION RATES (KW)	
	KWH	KW	THERMS	HAND PICKED	RANDOM	HAND PICKED	RANDOM
Custom	1,779,917.00	-	-	82%	160%%	N/A	N/A
Prescriptive	-	-	-	-	-	-	-
SBDI	-	-	-	-	-	-	-
New Construction	-	-	-	-	-	-	-
Total	1,779,917.00	-	-	82%	160%	N/A	N/A

FIGURE 103 below illustrates the realization rate distribution of the individually sampled projects by program.

FIGURE 103. C&I PROGRAMS SAMPLED COMPRESSED AIR MEASURES *EX ANTE* IMPACT AND REALIZATION RATE

TABLE 337 summarizes notable differences between *ex ante* and *ex post* gross estimates from the measures sampled.

TABLE 337. 2020 C&I PROGRAMS NOTABLE DIFFERENCES BETWEEN *EX ANTE* & *EX POST* GROSS COMPRESSED AIR MEASURES

MEASURE CATEGORY	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST* GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
Compressed Air	*Ex ante* savings were determined through PDF engineering calculations provided by the equipment vendor.	Indiana TRM v2.2. All inputs were verified through project documentation, virtual site visits or interviews. Engineering calculations and logged power of the air compressors to verify operating hours and average loading conditions.	Modifications based on customer attained data to the load profile, hours of use, and pressure. Clerical errors in data entry of *ex ante* values.

PROCESS

The C&I Custom and New Construction program installed process measures in 2020. TABLE 338 below details the number of measures, savings, and sizes by program. The team evaluated four process measures across the C&I programs. The engineering analysis decreased process measure electric savings by 19,290 kWh and increased demand savings by 16 kW.

Note that there were no projects selected from the New Construction program. The sample from the New Construction program was limited, and process measures were not selected to be sampled given their relatively small impact in the New Construction program as a whole and against other Process measures found in the Custom program.

TABLE 338. 2020 C&I PROGRAMS SAMPLED PROCESS MEASURES

PROGRAM	TOTAL	NUMBER OF MEASURES SAMPLED TOTAL	HAND PICKED	RANDOM	PROPORTION OF PROGRAM SAVINGS EVALUATED KWH	KW	THERMS
Custom	6	4	2	2	96%	100%	0%
Prescriptive	-	-	-	-	-	-	-
SBDI	-	-	-	-	-	-	-
New Construction	11	-	-	-	0%	N/A	0%
Total	17	4	2	2	89%	89%	0%

Two of the measures resulted in a 100% realization rate. The remaining two measures were adjusted for the following types of issues:

- Modification to the production level the equipment is serving based on customer provided data
- Modifications to the hours of use reported based on customer provide data
- Data entry error of *ex ante* values

TABLE 339 shows the *ex ante* savings and the measure specific realization rates from the sampled Process measures in the 2020 C&I programs. The measure specific realization rates from the hand-picked sampled projects were applied to only those specific projects. The actual realization rates found for randomly sampled projects are shown below, however those realization rates were not extrapolated to the rest of the Process population. Non-lighting measure types were aggregated to create realization rates for each program as a full measure category. The non-lighting realization rates were then used for extrapolation to the complete non-lighting population for each program.

TABLE 339. 2020 C&I PROGRAMS *EX ANTE* SAVINGS & REALIZATION RATES FOR SAMPLED PROCESS MEASURES

PROGRAM	SAMPLED *EX ANTE* KWH	KW	THERMS	REALIZATION RATES (KWH) HAND PICKED	RANDOM	REALIZATION RATES (KW) HAND PICKED	RANDOM
Custom	1,811,068.00	24.536	-	119%	84%%	164%	N/A
Prescriptive			-	-	-	-	-
SBDI			-	-	-	-	-
New Construction			-	-	-	-	-
Total	1,811,068.00	24.536	-	119%	84%	164%	

FIGURE 104 below illustrates the realization rate distribution of the individually sampled electric savings projects by program.

FIGURE 104. C&I PROGRAMS SAMPLED PROCESS MEASURES *EX ANTE* IMPACT AND REALIZATION RATES

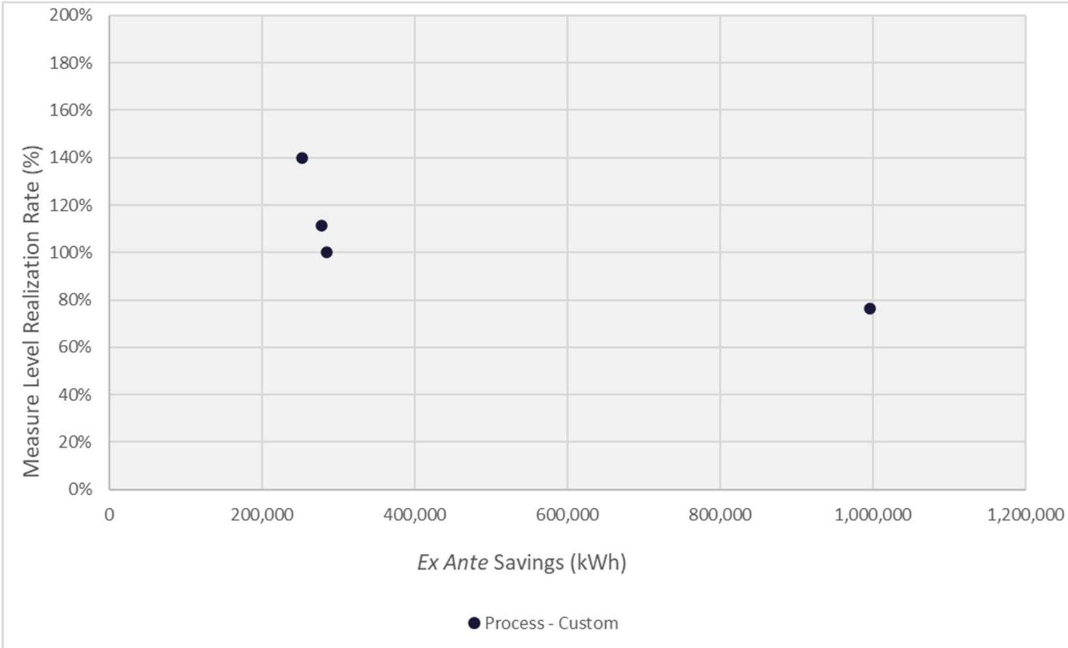


TABLE 340 summarizes notable differences between *ex ante* and *ex post* gross estimates from the measures sampled.

TABLE 340. 2020 C&I PROGRAMS NOTABLE DIFFERENCES BETWEEN *EX ANTE* & *EX POST* GROSS PROCESS MEASURES

MEASURE CATEGORY	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST* GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
Process	*Ex ante* savings were determined through engineering calculations	Indiana TRM v2.2. All inputs were verified through project documentation, virtual site visits or interviews.	Modifications based on interview customer data to the hours of use, and production levels. Clerical errors in data entry of *ex ante* values.

WATER HEAT

The C&I Prescriptive program installed water heat measures in 2020. Table 341 below details the number of measures, savings, and sample size. The team evaluated two water heat measures across the C&I programs. The engineering analysis decreased savings by 39 therms.

TABLE 341. 2020 C&I PROGRAMS SAMPLED WATER HEAT MEASURES

PROGRAM	NUMBER OF MEASURES				PROPORTION OF PROGRAM SAVINGS EVALUATED		
	TOTAL	SAMPLED TOTAL	HAND PICKED	RANDOM	KWH	KW	THERMS
Custom	-	-	-	-	-	-	-
Prescriptive	15	2	-	2	N/A	N/A	4%
SBDI	-	-	-	-	-	-	-
New Construction	-	-	-	-	-	-	-
Total	15	2		2			4%

One measure achieved a 100% realization rate. The remaining measure was adjusted because the baseline water heater was replaced with a much smaller unit, and *ex ante* calculations did not normalize the baseline unit capacity to match the installed unit capacity, resulting in higher *ex ante* savings than *ex post* gross.

TABLE 342 shows the *ex ante* savings and the measure specific realization rates from the sampled water heat measures in the 2020 C&I programs. The measure specific realization rates from the hand-picked sampled projects were applied to only those specific projects. The actual realization rates found for randomly sampled projects are shown below, however those realization rates were not extrapolated to the rest of the water heat population. Non-lighting measure types were aggregated to create realization rates for each program as a full measure category. The non-lighting realization rates were then used for extrapolation to the complete non-lighting population for each program. Table 342 below illustrates the realization rate distribution of the individually sampled projects by program.

TABLE 342. 2020 C&I PROGRAMS *EX ANTE* SAVINGS & REALIZATION RATES FOR SAMPLED WATER HEAT MEASURES

PROGRAM	SAMPLED *EX ANTE*			REALIZATION RATES (THERMS)	
	KWH	KW	THERMS	HAND PICKED	RANDOM
Custom	-	-	-		
Prescriptive	-	-	312.00	N/A	73%
SBDI	-	-	-		
New Construction	-	-	-		
Total Realization Rate			312.00		73%

FIGURE 105 below illustrates the realization rate distribution of the individually sampled projects by program.

FIGURE 105. C&I PROGRAMS SAMPLED WATER HEAT MEASURES *EX ANTE* IMPACT AND REALIZATION RATES

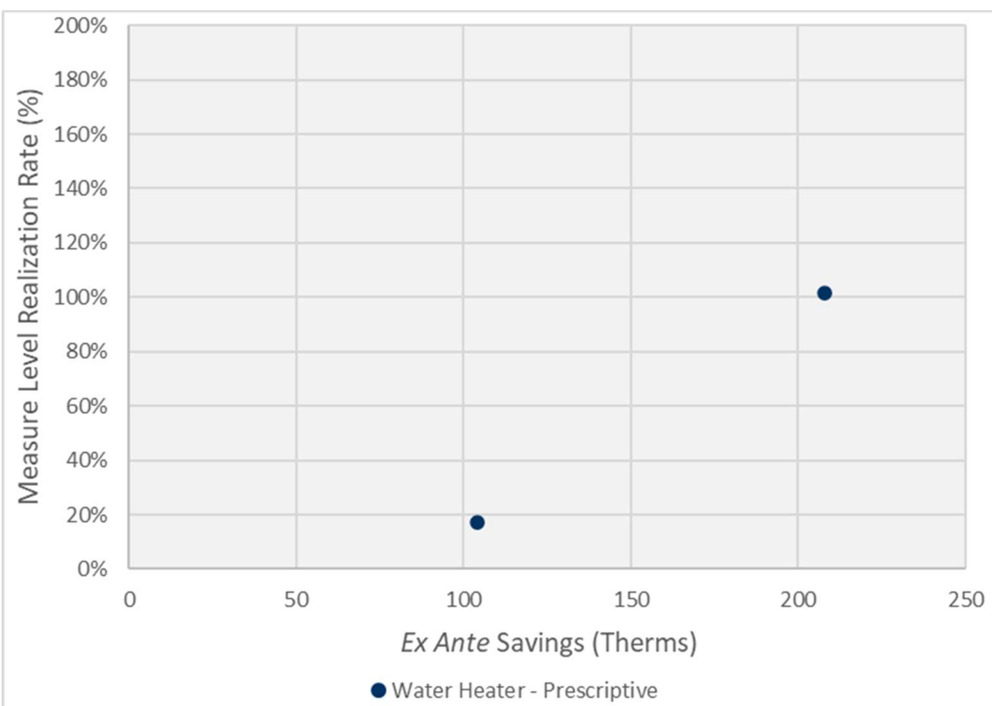


TABLE 343 summarizes notable differences between *ex ante* and *ex post* gross estimates from the measures sampled.

TABLE 343. 2020 C&I PROGRAMS NOTABLE DIFFERENCES BETWEEN *EX ANTE* & *EX POST* GROSS WATER HEAT MEASURES

MEASURE CATEGORY	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST* GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
Water Heat	*Ex ante* savings were determined by the Indiana TRM v2.2, calculated through the application excel tool	Indiana TRM v2.2. All inputs were verified through project documentation, virtual site visits or interviews.	Baseline capacity did not match installed capacity, incorrect baseline energy consumption assumption made

MOTORS

The Custom and New Construction programs reported savings from motor measures in 2020. TABLE 344 below details the number of measures, savings, and sample size. The team evaluated one very large Custom Motor measure. The engineering analysis decreased electric savings by 4,036,109 kWh and increased demand savings by 81 kW.

TABLE 344. 2020 C&I PROGRAMS SAMPLED MOTOR MEASURES

PROGRAM	NUMBER OF MEASURES				PROPORTION OF PROGRAM SAVINGS EVALUATED		
	TOTAL	SAMPLED TOTAL	HAND PICKED	RANDOM	KWH	KW	THERMS
Custom	5	1	1	-	99.6%	96%	N/A
Prescriptive	-	-	-	-	-	-	-
SBDI	-	-	-	-	-	-	-
New Construction	5	-	-	-	0%	N/A	N/A
Total	10	1	1		94%	94%	

The one sampled measure was handpicked due to its size and impact and represented 99.6% of the total kWh savings amongst the 10 Motor measures. This single measure represented 30% of the *ex ante* savings claimed for the entire Custom program, and 11% of the *ex ante* savings claimed for the entire C&I program portfolio. The following modifications were made to this measure:

- *Ex ante* savings were determined based on engineering calculations and did not include any significant analysis from trend data, metering, sub metering, or ideally a combination of the three. The potential impact of this type of project is sufficiently large that metering and trending should be done before and after measure installation for a sufficient duration to accurately capture complete picture of the operation of the equipment. These specific motors were applied to a system that has robust automation and trending capabilities in place that could have been leveraged to attain more accurate estimates and verification of savings in the *ex ante* calculations. Given limitations to installing metering equipment during the *ex post* evaluation period, the evaluation team computed *ex post* savings by modifying the *ex ante* engineering calculations using data collected through virtual site visits, customer interviews, and short term trend data provided by the customer.
- Modifications were made to the baseline assumptions regarding the motor run times. The *ex ante* baseline assumed that the two motors always ran at 100%. The evaluation found that the motors ran 100% when on, as there was no VFD installed, but they ran only when demand from the system called for them to be

on, otherwise they were off. *Ex post* calculations developed an expected baseline case based on the flows observed in the installed case.

- Limited data was provided related to the baseline or installed motor specifications (name plate data) in the project documentation. Further, the name plate data provided by the customer differed from the application data.

TABLE 345 shows the *ex ante* savings and the measure specific realization rates from the sampled Motor measures in the 2020 C&I programs. The measure specific realization rates from the hand-picked sampled projects were applied to only those specific projects. The actual realization rates found for randomly sampled projects are shown below, however those realization rates were not extrapolated to the rest of the Motors population. Non-lighting measure types were aggregated to create realization rates for each program as a full measure category. The non-lighting realization rates were then used for extrapolation to the complete non-lighting population for each program.

TABLE 345. 2020 C&I PROGRAMS *EX ANTE* SAVINGS & REALIZATION RATES FOR SAMPLED MOTOR MEASURES

PROGRAM	SAMPLED *EX ANTE*			REALIZATION RATES (KWH)		REALIZATION RATES (KW)	
	KWH	KW	THERMS	HAND PICKED	RANDOM	HAND PICKED	RANDOM
Custom	6,437,360.00	286.260	-	37%	N/A	128%	N/A
Prescriptive	-	-	-	-	-	-	-
SBDI	-	-	-	-	-	-	-
New Construction	-	-	-	-	-	-	-
Total	6,437,360.00	286.260	-	37%		128%	

FIGURE 106 below illustrates the realization rate distribution of the individually sampled projects by program.

FIGURE 106. C&I PROGRAMS SAMPLED MOTOR MEASURES *EX ANTE* IMPACT AND REALIZATION RATES

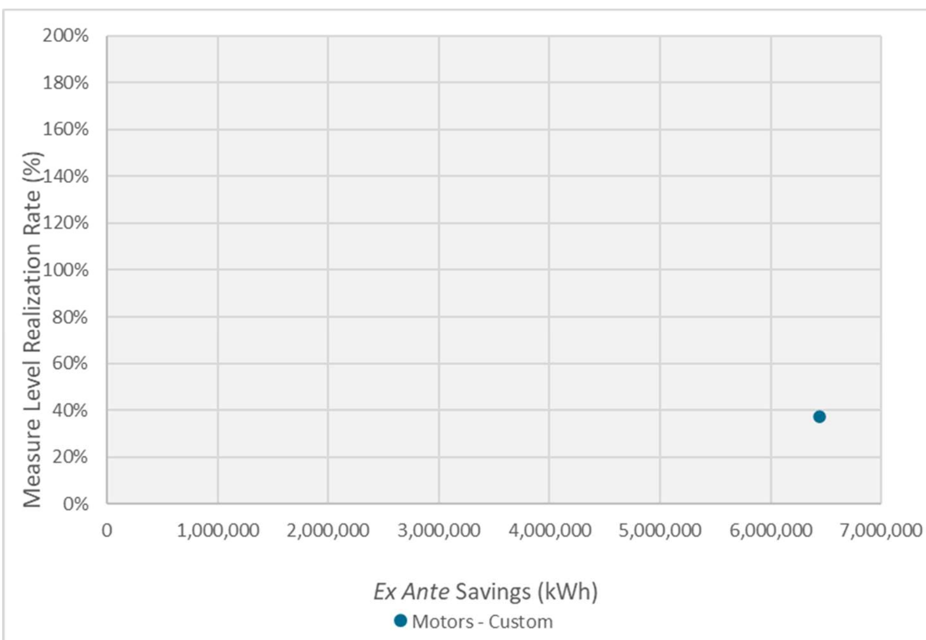


TABLE 346 summarizes notable differences between *ex ante* and *ex post* gross estimates from the measure sampled.

TABLE 346. 2020 C&I PROGRAMS NOTABLE DIFFERENCES BETWEEN *EX ANTE* & *EX POST* GROSS MOTOR MEASURES

MEASURE CATEGORY	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST* GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
Motors	*Ex ante* savings were determined through engineering calculations	Indiana TRM v2.2. All inputs were verified through project documentation, virtual site visits or interviews. Customer data was requested to supplement and normalize the engineering calculations.	Modifications based on interview customer data to the hours of use, speed of motor, run times of the motors, and HP of the involved equipment. The definition of the baseline case was the primary difference *ex ante* and *ex post* calculations.

OTHER CATEGORY

Measures that had low participation and low savings impact have been grouped into the "Other" category. These measures include Other, Controls, Kitchen, and Building Redesign. TABLE 347 below detail the number of measures, savings, and sampling sizes within the "other" category.

TABLE 347. 2020 C&I PROGRAMS SAMPLED OTHER CATEGORY MEASURES

PROGRAM	NUMBER OF MEASURES				PROPORTION OF PROGRAM SAVINGS EVALUATED		
	TOTAL	SAMPLED TOTAL	HAND PICKED	RANDOM	KWH	KW	THERMS
Controls Measures							
Custom	20	3	2	1	27%	0%	46%
Prescriptive	-	-	-	-	-	-	-
SBDI	-	-	-	-	-	-	-
New Construction	-	-	-	-	-	-	-
Kitchen Measures							
Custom	-	-	-	-	-	-	-
Prescriptive	2	1	-	1	80%	83%	N/A
SBDI	-	-	-	-	-	-	-
New Construction	-	-	-	-	-	-	-
Building Redesign Measures							
Custom	-	-	-	-	-	-	-
Prescriptive	-	-	-	-	-	-	-
SBDI	-	-	-	-	-	-	-
New Construction	1	1	-	1	100%	N/A	N/A
Other Measures							
Custom	2	1	-	1	N/A	N/A	40%
Prescriptive	-	-	-	-	-	-	-
SBDI	-	-	-	-	-	-	-
New Construction	-	-	-	-	-	-	-

Controls. The team evaluated 3 (of 20) Controls measures from the Custom program. The engineering analysis decreased savings by 70,752 kWh and 32 therms.

One measure received a 100% realization rate while the analysis adjusted two measures. These two measures involved hotel guest room occupancy controls (smart thermostats) that used different and custom calculations to determine savings. The evaluation team deemed the existing TRM measures in the IL TRM and the WI TRM to be a better application to these projects. The team used the WI TRM calculations, replacing Wisconsin-specific with Indiana-specific EFLH assumptions. For one of the sampled measures, the realization rate was closely aligned at 97%. For the other sampled measure, the realization rate was significantly lower at 30%. For this project, *ex ante* methodology determined savings based on replacement of the existing conditioning units with more efficient units.

However, the new control system rather than unit replacement was the scope of the project and should be the basis of the savings calculations.

Kitchen. The team evaluated one (of two) Kitchen measures from the Custom program. The engineering analysis decreased savings by 5,094 kWh. The sampled measure was adjusted to align with IN TRM v2.2 measure savings outlined for combo ovens. The *ex ante* savings were based on a different source. The evaluation team deemed the existing IN TRM v2.2 measure to be the best source to determine savings.

Building Redesign: The team evaluated 1 (of 1) building redesign measure from the New Construction program. The engineering analysis decreased savings by of 1,139 kWh, representing a 91% kWh realization rate.

The sampled measure was an electric water heater project. A unit conversion error was made in converting from kW to MBH from the unit specification. Modifications were also made to the space type assumptions from the IN TRM values to match the building type more appropriately.

Other. The team evaluated 1 (of 2) Other measures from the Custom program, decreasing savings by 1,108 kWh. The sampled measure was an envelope insulation measure. It appears that a data entry error and/or a unit conversion error was made between the final calculated savings and the *ex ante* reported values, as they do not match. The total area of the facility was modified to match the customer reported data collected.

TABLE 348 shows the *ex ante* savings and the measure specific realization rates from the sampled "Other" measures in the 2020 C&I programs. The measure specific realization rates from the hand-picked sampled projects were applied to only those specific projects. The actual realization rates found for randomly sampled projects are shown below, however those realization rates were not extrapolated to the rest of the "Other" population. Non-lighting measure types were aggregated to create realization rates for each program as a full measure category. The non-lighting realization rates were then used for extrapolation to the complete non-lighting population for each program.

TABLE 348. 2020 C&I PROGRAMS *EX ANTE* SAVINGS & REALIZATION RATES FOR SAMPLED OTHER MEASURES

PROGRAM	SAMPLED *EX ANTE*			REALIZATION RATES (KWH)		REALIZATION RATES (KW)		REALIZATION RATES (THERMS)	
	KWH	KW	THERMS	HAND PICKED	RANDOM	HAND PICKED	RANDOM	HAND PICKED	RANDOM
Control Measures									
Custom	120,477.00	0	36,926.00	30%	97%	N/A	N/A	100%	N/A
Prescriptive	-	-	-						
SBDI	-	-	-						
New Construction	-	-	-						
Kitchen Measure									
Custom	-	-	-						
Prescriptive	36,864.00	5.930	-	N/A	100%	N/A	119%	N/A	N/A
SBDI	-	-	-						
New Construction	-	-	-						
Building Redesign Measures									
Custom	-	-	-						
Prescriptive	-	-	-						
SBDI	-	-	-						
New Construction	12,128.00	-	-	N/A	33%	N/A	N/A	N/A	N/A
Other									
Custom	-	-	7,252.00	N/A	N/A	N/A	N/A	N/A	59%
Prescriptive	-	-	-						
SBDI	-	-	-						
New Construction	-	-	-						
Total	169,469.00	5.930	44,178.00						

FIGURE 107 below illustrate the realization rate distribution of the individually sampled electric savings projects by program, and Figure 108 below illustrates the realization rate distribution of the individually sampled gas savings projects by program.

FIGURE 107. C&I PROGRAMS SAMPLED OTHER MEASURES KWH *EX ANTE* IMPACT AND REALIZATION RATES

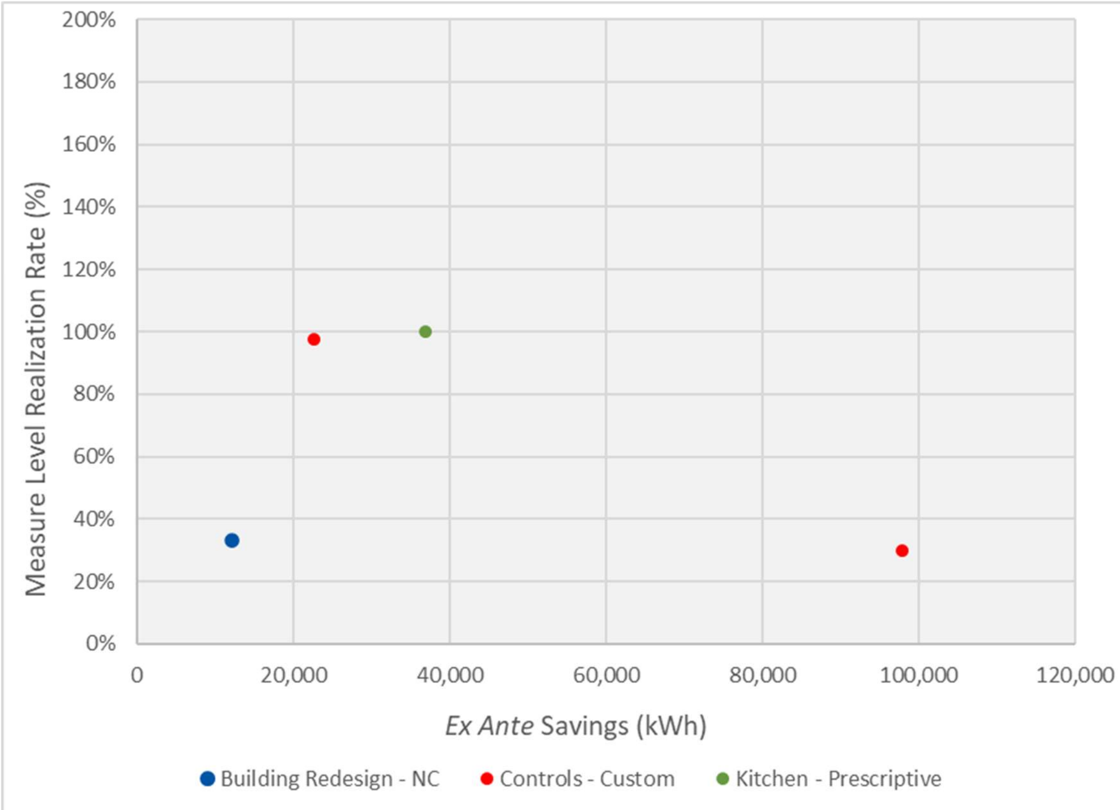


FIGURE 108. C&I PROGRAMS SAMPLED OTHER MEASURES THERM *EX ANTE* IMPACT AND REALIZATION RATES

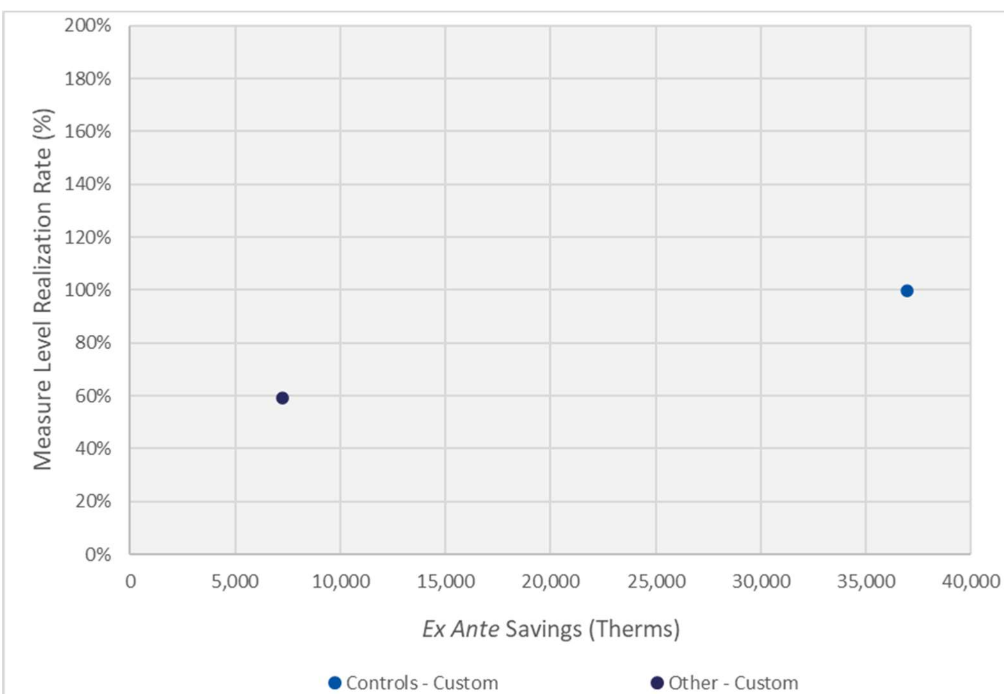


TABLE 349 summarizes notable differences between *ex ante* and *ex post* gross estimates from the measures sampled.

TABLE 349. 2020 C&I PROGRAMS NOTABLE DIFFERENCES BETWEEN *EX ANTE* & *EX POST* GROSS OTHER MEASURES

MEASURE CATEGORY	*EX ANTE* SOURCES AND ASSUMPTIONS	*EX POST* GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
Kitchen	*Ex ante* savings were determined through engineering calculations.	Indiana TRM v2.2. All inputs were verified through project documentation, virtual site visits or interviews.	Indiana TRM v2.2 was not utilized for this measure calculation.
Controls	*Ex ante* savings were determined through engineering calculations.	Indiana TRM v2.2, WI and IL TRMs to supplement. All inputs were verified through project documentation, virtual site visits or interviews.	Engineering calculations did not accurately capture the scope or savings resulting from the project. Existing TRM measures were better suited to this measure application.
Other	*Ex ante* savings were determined by the Indiana TRM v2.2, calculated through the application excel tool, or through engineering calculations.	Indiana TRM v2.2. All inputs were verified through project documentation, virtual site visits or interviews.	Clerical errors translating savings values from engineering calculation workbooks to application
Building Redesign	*Ex ante* savings are either: (1) Indiana TRM v2.2, calculated through the application excel tool, or (2) from Manufacturer PDF calculations of natural gas furnace savings	Indiana TRM v2.2. All inputs were verified through project documentation, virtual site visits or interviews.	Clerical errors translating savings values from engineering calculation workbooks to application

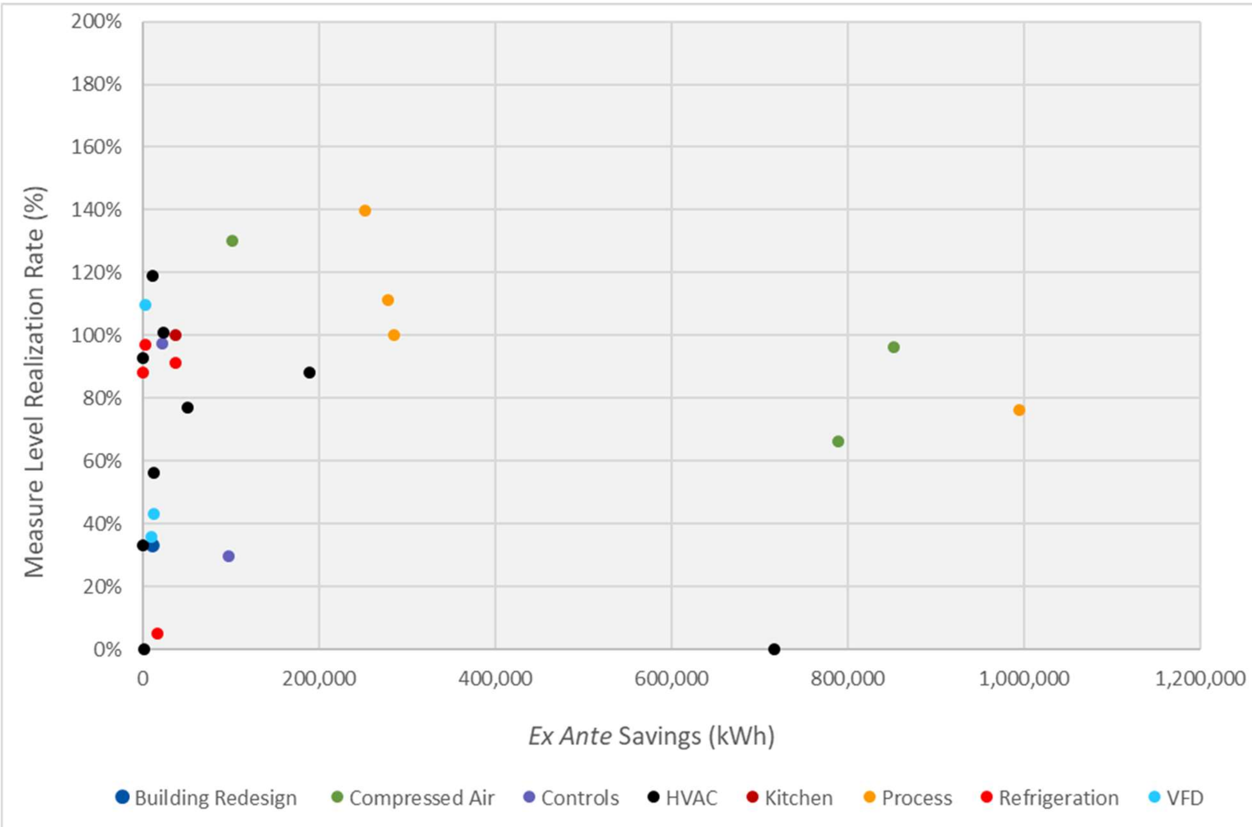
NON-LIGHTING ADJUSTMENT SUMMARY

TABLE 350. 2020 C&I PROGRAMS *EX ANTE* SAVINGS & REALIZATION RATES FOR SAMPLED NON-LIGHTING MEASURES

	PROGRAM	SAMPLED *EX ANTE*			REALIZATION RATES (KWH)		REALIZATION RATES (KW)		REALIZATION RATES (THERMS)	
		KWH	KW	THERMS	HAND PICKED	RANDOM	HAND PICKED	RANDOM	HAND PICKED	RANDOM
HVAC Measures	Custom	767,829.00	265.157	139,847.00	5%	N/A	12%	N/A	84%	89%
	Prescriptive	37,864.00	2.778	8,282.50	86%	79%	0%	88%	100%	96%
	SBDI	-	-	37,631.02	N/A	N/A	N/A	N/A	32%	99%
	NC	202,990.00	243.830	163,515.00	88%	106%	6%	147%	76%	104%
VFD Measures	Custom	-	-	-	-	-	-	-	-	-
	Prescriptive	26,383.50	4.217	-	N/A	50%	N/A	62%	N/A	N/A
	SBDI	-	-	-	-	-	-	-	-	-
	NC	-	-	-	-	-	-	-	-	-
Refrigeration Measures	Custom	16,330.10	-	-	N/A	5%	N/A	N/A	N/A	N/A
	Prescriptive	38,576.00	5.227	-	N/A	98%	N/A	105%	N/A	N/A
	SBDI	3,937.50	0.538	-	N/A	97%	N/A	75%	N/A	N/A
	NC	935.00	-	-	N/A	88%	N/A	N/A	N/A	N/A
Compressed Air Measures	Custom	1,779,917.00	-	-	82%	160%	N/A	N/A	N/A	N/A
	Prescriptive	-	-	-	-	-	-	-	-	-
	SBDI	-	-	-	-	-	-	-	-	-
	NC	-	-	-	-	-	-	-	-	-
Process Measures	Custom	1,811,068.00	24.536	-	119%	84%	164%	N/A	N/A	N/A
	Prescriptive	-	-	-	-	-	-	-	-	-
	SBDI	-	-	-	-	-	-	-	-	-
	NC	-	-	-	-	-	-	-	-	-
Water Heat Measures	Custom	-	-	-	-	-	-	-	-	-
	Prescriptive	-	-	312.00	N/A	N/A	N/A	N/A	N/A	73%
	SBDI	-	-	-	-	-	-	-	-	-
	NC	-	-	-	-	-	-	-	-	-
Motor Measures	Custom	6,437,360.00	286.260	-	37%	N/A	128%	N/A	N/A	N/A
	Prescriptive	-	-	-	-	-	-	-	-	-
	SBDI	-	-	-	-	-	-	-	-	-
	NC	-	-	-	-	-	-	-	-	-
Control Measures	Custom	120,477.00	-	36,926.00	30%	97%	N/A	N/A	100%	N/A
	Prescriptive	-	-	-	-	-	-	-	-	-
	SBDI	-	-	-	-	-	-	-	-	-
	NC	-	-	-	-	-	-	-	-	-
Kitchen Measures	Custom	-	-	-	-	-	-	-	-	-
	Prescriptive	36,864.00	5.930	-	N/A	100%	N/A	119%	N/A	N/A
	SBDI	-	-	-	-	-	-	-	-	-
	NC	-	-	-	-	-	-	-	-	-
Building Redesign Measures	Custom	-	-	-	-	-	-	-	-	-
	Prescriptive	-	-	-	-	-	-	-	-	-
	SBDI	-	-	-	-	-	-	-	-	-
	NC	12,128.00	-	-	N/A	33%	N/A	N/A	N/A	N/A
Other Measures	Custom	-	-	7,252.00	N/A	N/A	N/A	N/A	N/A	59%
	Prescriptive	-	-	-	-	-	-	-	-	-
	SBDI	-	-	-	-	-	-	-	-	-
	NC	-	-	-	-	-	-	-	-	-

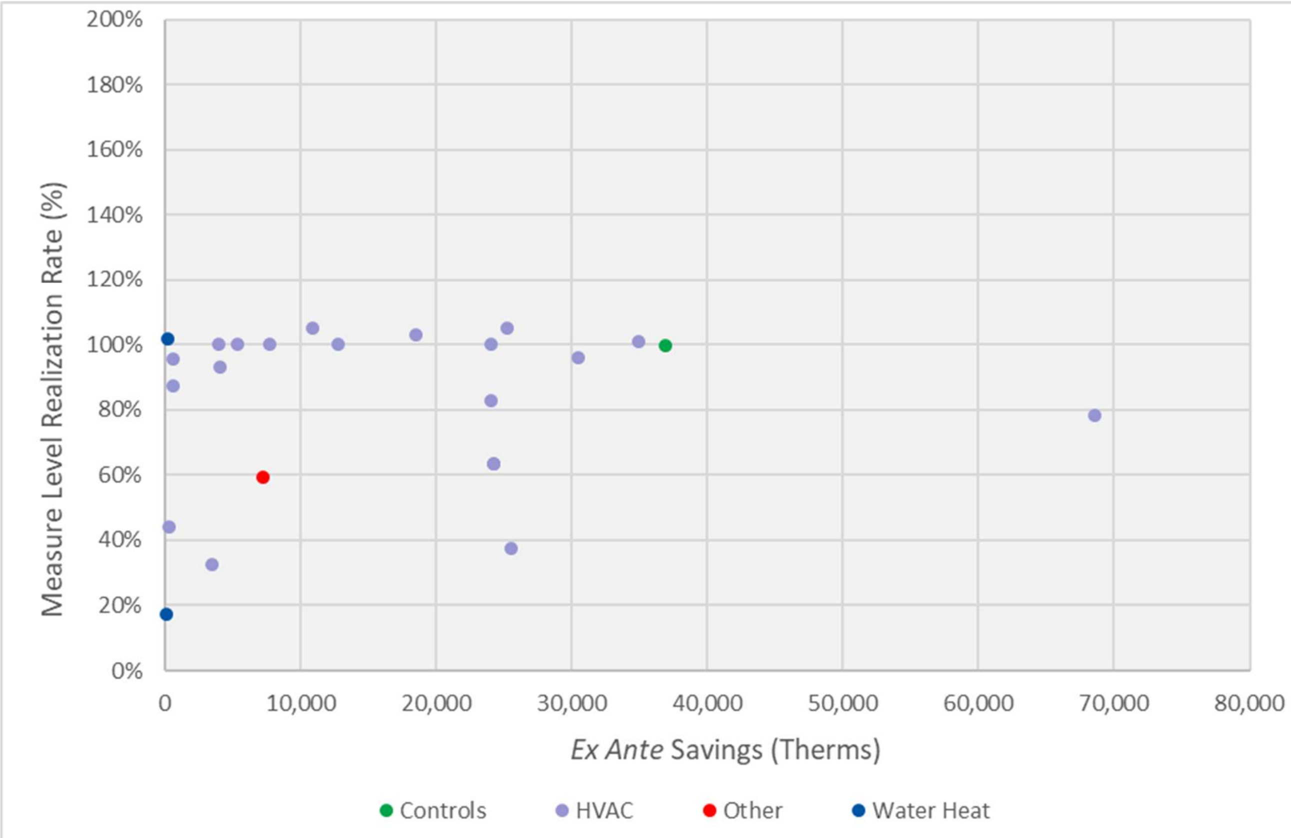
Figure 109 and Figure 110 illustrate the realization rate distribution of the individually sampled projects by program and by fuel source.

FIGURE 109. C&I PROGRAMS SAMPLED NON-LIGHTING ELECTRIC MEASURES *EX ANTE* IMPACT AND REALIZATION RATES



Note one large custom motor project does not appear on the figure due to scale. This project's impact was 6,437,360 kWh ex ante savings and achieved a realization rate of 37%

FIGURE 110. C&I PROGRAMS SAMPLED NON-LIGHTING GAS MEASURES *EX ANTE* IMPACT AND REALIZATION RATES



ALL MEASURES AND ADJUSTMENT SUMMARY

provides the realization rates for lighting and non-lighting projects by C&I program and overall. The cumulative realization rates are driven primarily by the random sample realization rates which are extrapolated to the full population. The hand-picked realization rate has a greater effect on the cumulative realization rate when those projects are larger and constitute a greater portion of savings. As an example, this can be seen in the New Construction non-lighting therms realization rate, where relatively low realization rates achieved by three hand-picked HVAC measures affected the overall realization rate.

TABLE 351. 2020 C&I PROGRAMS SAMPLE REALIZATION RATES

MEASURE CATEGORY	HAND PICKED SAMPLE REALIZATION RATE			RANDOM SAMPLE REALIZATION RATE			CUMULATIVE REALIZATION RATE		
	KWH RR	KW RR	THERMS RR	KWH RR	KW RR	THERMS RR	KWH RR	KW RR	THERMS RR
Prescriptive Program									
Lighting	96%	110%	N/A	101%	117%	N/A	100%	115%	N/A
Non-Lighting	86%	0%	100%	86%	98%	88%	86%	97%	90%
Custom Program									
Lighting	92%	126%	N/A	104%	110%	N/A	102%	113%	N/A
Non-Lighting	47%	76%	88%	91%	100%	85%	57%	79%	86%
New Construction Program									
Lighting	99%	117%	N/A	114%	118%	100%	107%	118%	N/A
Non-Lighting	88%	6%	76%	72%	147%	104%	75%	37%	96%
SBDI Program									
Lighting	95%	120%	N/A	103%	116%	100%	102%	116%	N/A
Non-Lighting	N/A	N/A	32%	97%	75%	99%	97%	75%	94%

C&I MEASURES ALGORITHMS AND ASSUMPTIONS

This appendix contains the assumptions used in electric savings, demand reduction, and gas savings algorithms for the measures within the C&I programs. The team examined each assumption behind the algorithms to capture savings and compared it against the Indiana TRM v2.2, as well as other state and industry approaches. Detailed information on the *ex post* savings analysis and supporting assumptions for the following C&I program measures are included within this appendix. TABLE 352 lists the assumptions of the *ex post* per-measure savings.

TABLE 352. C&I MEASURES

MEASURE	REVIEWED ASSUMPTIONS
Lighting Replacement	New and baseline wattages, house of use, waste heat factors, coincidence factors
Lighting Power Density Reduction	Square footage, baseline allowed watts, installed watts, operating hours, waste heating factors
Lighting Controls	New and baseline wattages, house of use, waste heat factors, coincidence factors
Refrigeration LED Case Lighting	New and baseline wattages, number of doors, house of use, waste heat factors, coincidence factors
HVAC – Package Unit Replacement	Full load heating and cooling hours, equipment capacities, equipment efficiencies
HVAC – Hydronic Unit Replacement	Full load heating and cooling hours, equipment capacities, equipment efficiencies
HVAC – VFDs Pumps and Fans	Motor size, motor efficiency, average equipment speed, operating hours, power consumption under baseline and VFD control
HVAC – Programmable Thermostats	Equipment heating and cooling capacities, equipment heating and cooling efficiencies, equivalent full load hours
HVAC Furnaces	Methodology for calculating shell heat loss, infiltration heat loss, stratification rates, setback controls, equipment efficiencies.
HVAC – Pipe Insulation	New and baseline R-values, pipe diameter, water heater recovery efficiency
HVAC – Steam Traps	Steam pressure, trap orifice diameter
VFD Air Compressors	Equipment capacity, equipment performance, average CFM load, operating hours
Kitchen Equipment	Pounds of food cooked per day, equipment efficiency, idle energy rate, production capacity, preheat time, preheat energy
Water Heating	Gallons per day of plant, equipment efficiency, equipment hot water temperature setpoint

LIGHTING – REPLACEMENT

The team used the following equations to calculate electric energy and peak demand savings for interior and exterior lighting replacement measures, as well as natural gas energy penalties:

$$kWh\ savings = \frac{(W_{base} - W_{EE}) * (Hours) * (1 + WHF_e)}{1{,}000}$$

$$kW\ reduction = \frac{(W_{base} - W_{LED}) * Coincidence\ Factor * (1 + WHF_d)}{1{,}000}$$

$$therm\ savings = (kWh\ savings) * \left(1 + WHF_g\right) * 10\ therms/MMBtu$$

Where:

W_{base} = Total wattage of the baseline lighting system, W

W_{EE} = Total wattage of the installed lighting system, W

Hours = Annual operating hours of system from TRM or posted site schedules, hrs/yr

WHF_e = Waste heat factor for energy to account for HVAC interactions with lighting (depends on location, building type, and HVAC system type)

WHF_d = Waste heat factor for demand to account for HVAC interactions with lighting (depends on location, building type, and HVAC system type)

WHF_g = Waste heat factor for gas to account for HVAC interactions with lighting (depends on location, building type, and HVAC system type)

Coincidence Factor = Summer peak coincidence factor from TRM based on building type

1,000 = Constant to convert watts to kW

10 = Constant to convert MMBtu to therm

TABLE 353 lists the input assumptions and source of each assumption for the lighting replacement measure savings calculations.

TABLE 353. *EX POST* VARIABLE ASSUMPTIONS FOR LIGHTING REPLACEMENTS

INPUT	VALUE	SOURCE
W_{base}	Varies	Based on existing number of fixtures and fixture type
W_{EE}	Varies	Based on installed number of fixtures and fixture type
Hours	Varies	Indiana TRM v2.2 or posted operating hours of business
WHF_e (Electric Only)	Varies	Indiana TRM v2.2, dependent on building type, location, and HVAC system type
WHF_d	Varies	Indiana TRM v2.2, dependent on building type, location, and HVAC system type
WHF_g	Varies	Indiana TRM v2.2, dependent on building type, location, and HVAC system type
Coincidence Factor	Varies	Indiana TRM v2.2, dependent on building type

LIGHTING POWER DENSITY REDUCTION

The team used the following equations to calculate electric energy and peak demand savings, as well as natural gas energy penalties, for interior and exterior lighting power density reduction measures:

$$kWh\ savings = \frac{(LPD_{base} - LPD_{EE}) * (AREA) * (HOURS) * (1 + WHF_e)}{1{,}000}$$

$$kW\ reduction = \frac{(LPD_{base} - LPD_{EE}) * (AREA) * (CF) * (1 + WHF_d)}{1{,}000}$$

$$therm\ savings\ per\ lamp = (kWh\ savings) * \ (WHF_g)$$

Where:

LPD_{base} = Allowed lighting power density (watts per square foot) based on energy code requirements for building or space type, from ASHRAE 90.1-2007 Table 9.5.1 or Table 9.6.1

LPD_{EE} = Installed lighting wattage per square foot of the efficient lighting system for building type as determined by site-surveys or design diagrams

1000 = Conversion factor from watts to kilowatts

AREA = Square footage of building, determined from site-specific information

HOURS = Annual operating hours of lighting system, from TRM or actual building schedules

WHF_e = Waste heat factor for energy to account for HVAC interactions with lighting (depends on location, building type, and HVAC system type)

CF = Summer peak coincidence factor, dependent on building type from TRM

WHF_d = Waste heat factor for demand to account for HVAC interactions with lighting (depends on location, building type, and HVAC system type)

WHF_g = Waste heat factor for gas to account for HVAC interactions with lighting (depends on location, building type, and HVAC system type)

TABLE 354 lists the input assumptions and source of each assumption for the lighting power density reduction measure savings calculations.

TABLE 354. *EX POST* VARIABLE ASSUMPTIONS FOR LIGHTING POWER DENSITY REDUCTION

Input	Value	Source
LPD_{base}	Varies	ASHRAE 90.1-2007 Table 9.5.1 or Table 9.6.1
LPD_{EE}	Varies	Actual installed wattage
AREA	Varies	Actual building square footage
HOURS	Varies	Indiana TRM (v2.2), or actual operating hours of building
WHF_e	Varies	Indiana TRM (v2.2), based on location, building type, and HVAC system type
WHF_d	Varies	Indiana TRM (v2.2), based on location, building type, and HVAC system type
WHF_g	Varies	Indiana TRM (v2.2), based on location, building type, and HVAC system type
CF	Varies	Indiana TRM (v2.2), based on building type

LIGHTING CONTROLS – OCCUPANCY SENSORS

The team used the following equations to calculate electric energy and peak demand savings for occupancy sensor measures, as well as natural gas energy penalties:

$$kWh\ savings = kW_{controlled} * Hours * (1 + WHF_e) * ESF$$

$$kW\ reduction = kW_{controlled} * (1 + WHF_d) * CF$$

$$therm\ savings = (kWh\ savings) * \left(1 + WHF_g\right) * 10\ therms/MMBtu$$

Where:

$kW_{controlled}$ = Total wattage controlled per sensor, kW

Hours = Annual operating hours of system from TRM or posted site schedules, hrs/yr

WHF_e = Waste heat factor for energy to account for HVAC interactions with lighting (depends on location, building type, and HVAC system type)

ESF = Energy savings factor, dependent on the percentage of operating hours reduced due to installing occupancy lighting controls or time clocks, or the percentage of wattage reduction multiplied by the hours of dimming for dimming lighting controls and multilevel switching, from TRM

WHF_d = Waste heat factor for demand to account for HVAC interactions with lighting (depends on location, building type, and HVAC system type)

WHF_g	=	Waste heat factor for gas to account for HVAC interactions with lighting (depends on location, building type, and HVAC system type)
CF	=	Summer peak coincidence factor from TRM based on building type
10	=	Constant to convert MMBtu to therm

TABLE 355 lists the input assumptions and source of each assumption for the lighting occupancy sensor measure savings calculations.

TABLE 355. *EX POST* VARIABLE ASSUMPTIONS FOR LEDS

INPUT	VALUE	SOURCE
$kW_{controlled}$	Varies	Based on actual wattage controlled per sensor
Hours	Varies	Indiana TRM v2.2 or posted operating hours of business
ESF	Varies	Indiana TRM v2.2, dependent on control type
WHF_e	Varies	Indiana TRM v2.2, dependent on building type, location, and HVAC system type
WHF_d	Varies	Indiana TRM v2.2, dependent on building type, location, and HVAC system type
WHF_g	Varies	Indiana TRM v2.2, dependent on building type, location, and HVAC system type
CF	Varies	Indiana TRM v2.2, dependent on building type

LIGHTING – REFRIGERATION LED CASE LIGHTING

The team used the following equations to calculate electric energy and peak demand savings for refrigeration case lighting replacement measures. There are no natural gas energy penalties for this measure:

$$kWh\ savings = \frac{(W_{base} - W_{EE}) * (Hours) * (N+1) * (1 + WHF_e) * ESF_{MC}}{1{,}000}$$

$$kW\ reduction = \frac{(W_{base} - W_{EE}) * (N+1) * CF * \ (1 + WHF_d) * DSF_{MC}}{1{,}000}$$

Where:

W_{base}	=	Wattage per door of the baseline lighting system, W
W_{EE}	=	Wattage per door of the installed lighting system, W
Hours	=	Annual operating hours of system from TRM or posted site schedules, hrs/yr
N	=	Number of doors (= l; note: N+1 accounts for the additional fixture that is present in a row of case lighting doors)
ESF_{MC}	=	Energy savings factor; additional savings percentage achieved with a motion sensor (= 1.0 if no motion sensor is installed; = 1.43 if motion sensor installed)
WHF_e	=	Waste heat factor for energy to account for cooling savings from efficient lighting (= 0.41 for refrigerated space; = 0.52 for freezer space)
WHF_d	=	Waste heat factor for energy to account for cooling savings from efficient lighting (= 0.41 for prescriptive refrigerated lighting measures; = 0.52 for freezer space)

DSF_{MC}	=	Demand savings factor; additional savings percentage achieved with a motion sensor (= 1.0 if no motion sensor is installed; = 1.43 if motion sensor installed)
CF	=	Summer peak coincidence factor (= 0.92)
1,000	=	Constant to convert watts to kW

TABLE 356 lists the input assumptions and source of each assumption for the LED case lighting measure savings calculations.

TABLE 356. *EX POST* VARIABLE ASSUMPTIONS FOR LED CASE LIGHTING MEASURES

INPUT	VALUE	SOURCE
W_{base}	Varies	Based on baseline number of lamps and lamp wattage
W_{EE}	Varies	Based on installed number of lamps and lamp wattage
Hours	Varies	Indiana TRM v2.2 or posted operating hours of business
WHF_e	Varies	Indiana TRM v2.2, = 0.41 for refrigerated space; = 0.52 for freezer space
WHF_d	Varies	Indiana TRM v2.2, dependent on building type, location, and HVAC system type, = 0.41 for refrigerated space; = 0.52 for freezer space
ESF_{MC}	Varies	Indiana TRM v2.2, = 1.0 if no motion sensor is installed; = 1.43 if motion sensor installed
DSF_{MC}	Varies	Indiana TRM v2.2, = 1.0 if no motion sensor is installed; = 1.43 if motion sensor installed
CF	0.92	Indiana TRM v2.2

HVAC – PACKAGE UNITS REPLACEMENT

The evaluation team used the following equations to calculate electric and natural gas energy savings for HVAC package units.

$$kWh\ savings_{cool} = Btuh_{cool} * (\frac{1}{SEER_{base}} - \frac{1}{SEER_{EE}}) * \frac{EFLH_{cool}}{1{,}000}$$

$$kW\ reduction = Btuh_{cool} * (\frac{1}{EER_{base}} - \frac{1}{EER_{EE}}) * \frac{CF}{1{,}000}$$

$$therm\ savings = Btuh_{heat} * (\frac{1}{EFF_{base}} - \frac{1}{EFF_{EE}}) * \frac{EFLH_{heat}}{100{,}000}$$

Where:

$Btuh_{cool}$	=	actual capacity of the cooling equipment installed, Btu/hr
$SEER_{base}$	=	seasonal energy efficiency ratio of the baseline equipment, from TRM or ASHRAE 90.1 2007, Btu/W-hr
$SEER_{EE}$	=	actual seasonal energy efficiency ratio of installed equipment, Btu/W-hr
$EFLH_{cool}$	=	equivalent full load hours for cooling, from TRM based on building type and location, hrs/yr
1000	=	conversion from watts to kilowatts
EER_{base}	=	full load energy efficiency ratio of the baseline equipment, from TRM or ASHRAE 90.1 2007, Btu/W-hr
EER_{EE}	=	actual energy efficiency ratio of installed equipment, Btu/W-hr
CF	=	summer coincidence factor, from TRM

$Btuh_{heat}$ = actual capacity of the natural gas heating equipment installed, Btu/hr
EFF_{base} = baseline heating efficiency, 80%
EFF_{EE} = actual heating efficiency of installed equipment
$EFLH_{heat}$ = equivalent full load hours for heating, from TRM based on building type and location, hrs/yr
100,000 = conversion factor from Btu to therm

Table 357 lists the assumptions and source of each assumption for the HVAC package unit measure savings calculations.

TABLE 357. *EX POST* VARIABLE ASSUMPTIONS FOR HVAC PACKAGE UNITS

INPUT	VALUE	SOURCE
$Btuh_{cool}$	varies	Equipment specifications
$SEER_{base}$	varies	Indiana TRM (v2.2), ASHRAE 90.1 2007
$SEER_{EE}$	varies	Equipment specifications
$EFLH_{cool}$	varies	Indiana TRM (v2.2)
EER_{base}	varies	Indiana TRM (v2.2), ASHRAE 90.1 2007
EER_{EE}	varies	Equipment specifications
CF	varies	Indiana TRM (v2.2)
$Btuh_{heat}$	varies	Equipment specifications
EFF_{base}	80%	ASHRAE 90.1 2007
EFF_{EE}	varies	Equipment specifications
$EFLH_{heat}$	varies	Indiana TRM (v2.2)

HVAC – HYDRONIC UNIT REPLACEMENT

The evaluation team used the following equations to calculate electric and natural gas energy savings for HVAC hydronic units.

$$kWh\ savings_{cool} = TONS * \left(\frac{3.516}{IPLV_{base}} - \frac{3.516}{IPLV_{EE}}\right) * EFLH_{cool}$$

$$kW\ reduction = TONS * \left(\frac{3.516}{COP_{base}} - \frac{3.516}{COP_{EE}}\right) * CF$$

$$therm\ savings = Btuh_{heat} * \left(\frac{1}{EFF_{base}} - \frac{1}{EFF_{EE}}\right) * \frac{EFLH_{heat}}{100{,}000}$$

Where:

TONS = Actual cooling capacity of chiller, tons
$IPLV_{base}$ = Integrated part load value efficiency of the baseline equipment, from TRM or ASHRAE 90.1 2007, COP
$IPLV_{EE}$ = Integrated part load value efficiency of actual installed equipment, COP
$EFLH_{cool}$ = Equivalent full load hours for cooling, from TRM based on building type and location, hrs/yr
COP_{base} = Coefficient of performance of the baseline equipment, from TRM or ASHRAE 90.1 2007, unitless
COP_{EE} = Actual coefficient of performance of installed equipment, unitless
CF = Summer coincidence factor, from TRM
$Btuh_{heat}$ = Actual capacity of the boiler installed, Btu/hr

EFF_{base} = Baseline heating efficiency, 80%

EFF_{EE} = Actual heating efficiency of installed equipment

$EFLH_{heat}$ = Equivalent full load hours for heating, from TRM based on building type and location, hrs/yr

100,000 = Conversion factor from Btu to therm

Table 358lists the assumptions and source of each assumption for the HVAC hydronic unit measure savings calculations.

TABLE 358. *EX POST* VARIABLE ASSUMPTIONS FOR HVAC HYDRONIC UNITS

INPUT	VALUE	SOURCE
TONS	Varies	Equipment specifications
$IPLV_{base}$	Varies	Indiana TRM (v2.2), ASHRAE 90.1 2007
$IPLV_{EE}$	Varies	Equipment specifications
$EFLH_{cool}$	Varies	Indiana TRM (v2.2)
COP_{base}	Varies	Indiana TRM (v2.2), ASHRAE 90.1 2007
COP_{EE}	varies	Equipment specifications
CF	varies	Indiana TRM (v2.2)
$Btuh_{heat}$	varies	Equipment specifications
EFF_{base}	80%	ASHRAE 90.1 2007
EFF_{EE}	varies	Equipment specifications
$EFLH_{heat}$	varies	Indiana TRM (v2.2)

HVAC – VFD PUMPS AND FANS

The evaluation team used the following equations to calculate electrical energy savings and summer coincidence peak demand savings associated with this measure. There are no natural gas savings associated with this measure.

$$kWh\ savings = HP * \left(\frac{CLF_{base} - CLF_{VFD}}{EFF_m}\right) * HOURS * 0.746$$

$$kW\ reduction = HP * \left(\frac{CLF_{base} - CLF_{VFD}}{EFF_m}\right) * CF * 0.746$$

Where:

HP = Motor horsepower of installed equipment, hp

CLF_{base} = Controlled load factor of baseline equipment at average flow conditions, adapted from the Bonneville Power Administration ASD Calculator curves, %

CLF_{VFD} = Controlled load factor of VFD controlled equipment at average flow conditions, adapted from the Bonneville Power Administration ASD Calculator curves, %

EFF_M = Motor efficiency, actual or from NEMA guidelines, %

HOURS = Operating hours of equipment, from facility interviews or logged data, hrs/yr

0.746 = Conversion from hp to kW

CF = Summer peak coincidence factor, varies depending on operating schedule and loading of pump or fan during the utility peak period

Table 359 lists the assumptions and source of each assumption for the VFD air compressor measure savings calculations.

TABLE 359. *EX POST* VARIABLE ASSUMPTIONS FOR VFD PUMPS AND FANS

INPUT	VALUE	SOURCE
HP	Varies	Equipment specifications
CLF_{base}	Varies	Adapted from the Bonneville Power Administration ASD Calculator curves at average flow conditions, varies depending on baseline control method
CLF_{VFD}	Varies	Adapted from the Bonneville Power Administration ASD Calculator curves at average flow conditions
EFF_M	Varies	Equipment specifications, typical NEMA values at equipment horsepower
HOURS	Varies	Facility staff interviews, logged run time
CF	Varies	Facility staff interviews, logged run time and loading of equipment during utility peak period

HVAC – PROGRAMMABLE THERMOSTATS

The evaluation team would have used the following equations to calculate energy savings for programmable thermostat replacements if enough information was available in the project documentation. There are no peak coincident demand savings for this measure.

$$kWh\ savings = \frac{Btuh_{cool} * EFLH_{cool} * ESF_{cool}}{SEER * \ 1{,}000}$$

$$therm\ savings = \frac{Btuh_{ff} * EFLH_{heat} * ESF_{heat}}{SEER * \ 100{,}000}$$

Where:

$Btuh_{cool}$ = Cooling system capacity, actual, Btu/hr

$EFLH_{cool}$ = Equivalent full load cooling hours, from TRM dependent on location, hrs/yr

ESF_{cool} = Cooling energy savings fraction, 0.09 from TRM

SEER = Seasonal average energy efficiency ratio, actual or from TRM, Btu/W-hr

1,000 = Constant to convert W to kW

$Btuh_{ff}$ = Heating system capacity, actual, Btu/hr

$EFLH_{heat}$ = equivalent full load heating hours, from TRM dependent on location, hrs/yr

ESF_{heat} = Heating energy savings fraction, 0.068 from TRM

100,000 = Constant to convert Btu to therm

Table 360 lists the assumptions and source of each assumption for the programmable thermostat measure savings calculations.

TABLE 360. EX POST VARIABLE ASSUMPTIONS FOR PROGRAMMABLE THERMOSTATS

INPUT	VALUE	SOURCE
$Btuh_{cool}$	Varies	Project application, invoices, spec sheets
$EFLH_{cool}$	Varies	Indiana TRM v2.2, dependent on location
ESF_{cool}	0.09	Indiana TRM v2.2
SEER	Varies	Actual or Indiana TRM v2.)
$Btuh_{ff}$	Varies	Project application, invoices, spec sheets
$EFLH_{heat}$	Varies	Indiana TRM v2.2, dependent on location
ESF_{heat}	0.068	Indiana TRM v2.2

HVAC – FURNACES

The evaluation team used a calculation workbook developed by the implementer to determine the energy savings for furnace measures in large warehouses and manufacturing facilities. In future program years, using Trane TRACE 700 to estimate savings is also an acceptable methodology. Figure 111 shows an example of this calculation spreadsheet.

FIGURE 111. FURNACE CALCULATION SPREADSHEET

Schedule (Imported from Standardized)			
Day	# Shifts	Occ Hours	UnOcc Hours
Monday	2.0	16	8
Tuesday	2.0	16	8
Wednesday	2.0	16	8
Thursday	2.0	16	8
Friday	2.0	16	8
Saturday	1.0	8	16
Sunday	0.0	0	24

Weighted Variable Table					
Climate Zone - Weather Station/City			1 - Rockford AP / Rockford		
	Hour Factor	t_{stat}	TRM t_{eff}	Weighted t_{eff}	Weighted t_{stat}
Occupied	0.5224	65	6436	3362	34.0
Night time	0.2374	55	4880	1159	13.1
Weekend (Unocc)	0.2374	55	4880	1159	13.1
			Sum	5679	60.1

Should have Northern Indiana Values

*TRM Climate Zone 2 - Chicago O'Hare AP/Chicago

0.9973

Inputs (Imported from project info input tab)			
Variable	Value	Units	
A_r	45,000	Roof Area (ft²)	
Wall Length 1	300	ft	
Wall Length 2	150	ft	
Roof Height	35	ft	
A_w	31500	Wall Area (ft²)	
Thermostat Location	Floor	(from equipment type)	
T_{tstat}	60.1	Weighted Temperature Set Point (°F)	
$T_{f,s}$	60.1	Inside air at floor (if tstat is on wall assume 5ft height)	
Outdoor Temp	0	°F	
Stratification Factor	0.8	°F/ft	
R_r	15.38	Overall Thermal Resistance (Roof) (hr*ft²*°F/Btu)	Table 5.5-5 ASHRAE 90.1-2007
R_w	8.85	Overall Thermal Resistance (Wall) (hr*ft²*°F/Btu)	Table 5.5-5 ASHRAE 90.1-2007
t_{eff}	5,679	Weighted Effective Annual Operation Time (hr)	
η	88.3%	Thermal Efficiency of Heating Equipment (calc from eqpt schedule)	*Applicance device efficiency*

Destratification 1.0+ ACH Continuous, prorate less than 1.0 ACH (ACH x 1.0 Cont)

	Year	U	Assembly U
Roof	2016	0.082	0.037 (est.)
Wall	2016	0.162	0.05 (est.)
Roof	2007	0.065	0.065
Wall	2007	0.113	0.113
Roof	2013	0.082	0.037
Wall	2013	0.162	0.05

Outputs - Assuming Thermostat Located on Floor		
Variable	Value	Units
$T_{r,s}$	88.1	Indoor Temperature at Roof Deck, Stratified (°F)
$T_{r,d}$	61.1	Indoor Temperature at Roof Deck, Destratified (°F)
$T_{w,s}$	74.1	Average Indoor Air Temp for Wall Heat Loss, Stratified (°F)
$T_{w,d}$	60.6	Average Indoor Air Temp for Wall Heat Loss, Destratified (°F)
ΔQ_r	78,975	Heat Loss Through the Roof
ΔQ_w	48,053	Heat Loss Through the Walls

Transmisson Heat Loss @ Daytime Temp		
Variable	Value	Units
A_r	45,000	area roof
A_w	31,500	area walls
P	900	perimeter
U_r	0.07	transmission coefficient roof
U_w	0.11	transmission coefficient walls
F	0.8	transmission coefficient floor
T_{set}	65	thermostat set point
T_i	79	integrated inside air, stratified
T_o	0	outside air
T_f	61	inside air at floor
H_r	265,736	transmission heat loss roof
H_w	281,201	transmission heat loss walls
H_f	43,920	transmission heat loss floor
H_t	590,857	transmission heat loss (BTUh)

Infiltration Heat Loss		
Variable	Value	Units
c_p	0.24028	specific heat air
p	0.0736	density of air lb/ft3 (at 60°F and 1 atm)
n	0.09	air shift (1/hr) (.09 New, .20 existing)
V_{ACH}	2,363	volumetric air flow (cfm) (Use Roof sq ft)
T_i	79	integrated inside air, stratified
T_o	0	outside air
H_i	198,063.57	infilitration heat loss (BTUh)

Ventilation		
$V_{combustion}$	-	required combustion air flow (cfm)
$V_{scheduled}$	500	volumetric air flow, if known (cfm)
R_a	0.06	cfm/ft² (for occupancy category) (infiltration?)
R_p	-	cfm/person (for occupancy category)
P_z	-	zone population
V_{ASHRAE}	2,700	volumetric air flow (cfm)
T_i	79	integrated inside air, stratified
T_o	0	outside air
H_v	226,358.36	ventilation heat loss (BTUh)

Ventilation		
$V_{combustion}$	-	required combustion air flow (cfm)
$V_{scheduled}$	500	volumetric air flow, if known (cfm)
R_a	0.06	cfm/ft² (for occupancy category) (infiltration?)
R_p	-	cfm/person (for occupancy category)
P_z	-	zone population
V_{ASHRAE}	2,700	volumetric air flow (cfm)
T_i	79	integrated inside air, stratified
T_o	0	outside air
H_v	226,358.36	ventilation heat loss (BTUh)

Overhead Doors Heat Loss		
Variable	Value	Units
Area	248	total door area (ft²)
V_{door}	4	volumetric air flow (cfm/ft²) (4 Cfm Infreq)
H_D	83,165.74	door heat loss (BTUh)

Total Building Heat Loss		
Variable	Value	Units
H_{total}	1,098,444	Builidng heat loss (BTUh)
BLC	13,904	BTUh/°F

Transmisson Heat Loss @ Set Back Temp		
Variable	Value	Units
A_r	45,000	area roof
A_w	31,500	area walls
P	900	perimeter
U_r	0.07	transmission coefficient roof
U_w	0.11	transmission coefficient walls
F	0.8	transmission coefficient floor
T_{set}	55	thermostat set point
T_i	69	integrated inside air, stratified
T_o	0	outside air
T_f	51	inside air at floor
H_r	232,099	transmission heat loss roof
H_w	245,606	transmission heat loss walls
H_f	36,720	transmission heat loss floor
H_t	514,424	transmission heat loss (BTUh)

Infiltration Heat Loss		
Variable	Value	Units
c_p	0.24028	specific heat air
p	0.0763	density of air lb/ft3 (at 60°F and 1 atm)
n	0.09	air shift (1/hr)
V_{ACH}	2,363	volumetric air flow (cfm)
T_i	69	integrated inside air, stratified
T_o	0	outside air
H_i	179,338	infilitration heat loss (BTUh)

Ventilation		
$V_{combustion}$	-	required combustion air flow (cfm)
$V_{scheduled}$		volumetric air flow, if known (cfm)
R_a	-	cfm/ft² (for occupancy category) (0 Unoccup)
R_p	-	cfm/person (for occupancy category)
P_z	-	zone population
V_{ASHRAE}	-	volumetric air flow (cfm)
T_i	69	integrated inside air, stratified
T_o	0	outside air
H_v	-	ventilation heat loss (BTUh)

Ventilation		
$V_{combustion}$	-	required combustion air flow (cfm)
$V_{scheduled}$		volumetric air flow, if known (cfm)
R_a	-	cfm/ft² (for occupancy category) (0 Unoccup)
R_p	-	cfm/person (for occupancy category)
P_z	-	zone population
V_{ASHRAE}	-	volumetric air flow (cfm)
T_i	69	integrated inside air, stratified
T_o	0	outside air
H_v	-	ventilation heat loss (BTUh)

Overhead Doors Heat Loss		
Variable	Value	Units
Area	-	total door area (ft²)
V_{door}	4	volumetric air flow (cfm/ft²)
Q_{Door}	-	heat loss per door (BTUh)*

Total Building Heat Loss		
Variable	Value	Units
H_{total}	693,762	Builidng heat loss (BTUh)
BLC	10,055	BTUh/°F

Setback Calcs					
		24/7	1 shift/5 day Original EFF	1 shift/5 day New Eff	
BLC @65 (btuh/deg)		13,904	13,904	13,904	
BLC @55 (btuh/deg)		10,055	10,055	10,055	
DTDD (F*day)		6,343	6,343	6,343	
NTDD (F*day)		6,343	4,308	4,308	
FUL (BTU/therm)		100,000	100,000	100,000	
EFF		0.8	0.8	85.4%	
	Hour Factor				
Daytime	0.5224	13,821	13,821	12,945	therms
Night time	0.2374	6,282	3,085	2,890	therms
Weekend	0.2374	6,282	3,085	2,890	therms
	Usage	26,386	19,992	18,724	therms

**from Overall Systematic Eff*

Project Summary		
Baseline Usage	19,992	therms
Efficient Usage	10,549	therms
Efficiency Savings	1,268	therms
Destrat Savings	8,175	therms
Total Savings	9,443	therms
Percent Savings	0.36	

New	Existing
#NAME?	0.20

Door Inputs			
QTY	Height (ft)	Width (ft)	Total Area (ft²)
1	8	10	80
1	12	14	168

TABLE 361 lists the assumptions and source of each assumption for the HVAC furnace measure savings calculations.

TABLE 361. *EX POST* VARIABLE ASSUMPTIONS FOR HVAC FURNACES

INPUT	VALUE	SOURCE
T_{SET}	Varies	Temperature setpoint during occupied and setback operation from equipment control screens
Schedule	Varies	Operating hours for occupied and setback operation from equipment control screens
Baseline Stratification Factor	0.8 °F/ft	Approved value for this type of measure
Infiltration air shift	0.9 ACH new construction, 0.20 existing construction	Approved values for these type of measures
Efficiency	Varies	80% for baseline efficiency, actual equipment efficiency for installed unit

HVAC – PIPE INSULATION

The evaluation team used the following equations to calculate natural gas energy savings for hot water and steam pipe insulation. There are no electrical energy or summer peak coincident demand savings associated with this measure.

$$therm\ savings = \frac{(Btu_{base} - Btu_{ee}) * Hours * LF}{EFF * 100{,}000}$$

Where:

Btu_{base}	=	Energy loss per linear foot from uninsulated pipe, calculated using 3E Plus, Btu/hr-ft
Btu_{ee}	=	Energy loss per linear foot from insulated pipe, calculated using 3E plus, Btu/hr-ft
Hours	=	Annual operating hours of steam or hot water system, actual, hrs/yr
LF	=	Linear feet of piping, actual, ft
EFF	=	Efficiency of hot water or steam boilers, actual or assumed 80%
100,000	=	constant to Btu to therm

Table 362 lists the assumptions and source of each assumption for the HVAC pipe insulation savings calculations.

TABLE 362. *EX POST* VARIABLE ASSUMPTIONS FOR HVAC PIPE INSULATION

INPUT	VALUE	SOURCE
Btu_{base}	Varies	3E Plus. Calculated based on process fluid temperature, pipe diameter, insulation material, and insulation thickness
Btu_{EE}	Varies	3E Plus. Calculated based on process fluid temperature, pipe diameter, insulation material, and insulation thickness
LF	Varies	Project application, invoices, spec sheets
Hours	Varies	Dependent on operating hours of heating system
EFF	Varies	Assumed 80% unless information on the actual heating efficiency of the boiler system is available

HVAC – STEAM TRAP REPLACEMENT

The evaluation team used the following equations to calculate natural gas energy savings for steam trap replacements. There are no electrical energy or summer peak coincident demand savings associated with this measure.

$$therm\ savings = \frac{24.24 \ * P_{Abs} * D^2 * h_{fg} * HOU * DF}{EFF * \ 100{,}000}$$

Where:

INPUT	VALUE	SOURCE
24.24	=	Constant from napier equation when unites for absolute system pressure are in psia and units of the steam trap diameter are in inches
P_{Abs}	=	System absolute pressure in pounds per square inch (= steam gauge pressure at trap inlet + atmospheric pressure of 14.7 psi)
D	=	Steam trap orifice diameter in inches
h_{fg}	=	Latent heat of vaporization for water at P_{Abs} , Btu/lb
DF	=	Derating factor to account for the average percentage open a trap fails vs. theoretical energy loss, assumed 32%
EFF	=	Efficiency of heating system, assumed 80% if specifications of heating system were not available
100,000	=	Constant to convert Btu to therm

Table 363 lists the assumptions and source of each assumption for the steam trap replacement measure savings calculations.

TABLE 363. *EX POST* VARIABLE ASSUMPTIONS FOR STEAM TRAP REPLACEMENTS

INPUT	VALUE	SOURCE
P_{Abs}	Varies	From project specific operating pressure
D	Varies	From steam trap specifications
h_{fg}	Varies	From steam tables, dependent on P_{Abs}
DF	32%	From 2019 Wisconsin Focus on Energy Technical Reference Manual
EFF	Varies	Assumed 80% unless information on the actual heating efficiency of the boiler system is available

KITCHEN EQUIPMENT

The evaluation team used the following equations to calculate electric energy savings for kitchen equipment measures.

$$kWh\ savings = \ kWh_{base} - \ kWh_{EE}$$

$$kWh_{base} = \left(\frac{LB * \ E_{FOOD}}{EFF_{base}} + IE_{base} * \left(H - \frac{LB}{PC_{base}} - \frac{T_P}{60}\right) + E_{p,base}\right) * DAYS$$

$$kkWh_{EE} = \left(\frac{LB * \ E_{FOOD}}{EFF_{EE}} + IE_{EE} * \left(H - \frac{LB}{PC_{EE}} - \frac{T_P}{60}\right) + E_{p,EE}\right) * DAYS$$

$$kW\ reduction = \ kWh\ Savings * \frac{CF}{HOURS}$$

Where:

LB	=	Pounds of food cooked per day, actual or assumed 100 lbs/day
E_{FOOD}	=	Amount of energy absorbed by the food during cooking, 0.139 kWh/lb
EFF_{BASE}	=	Cooking efficiency of baseline equipment
EFF_{EE}	=	Cooking efficiency of installed equipment

IE_{BASE}	=	Idle energy rate of baseline equipment
IE_{EE}	=	Idle energy rate of installed equipment
H	=	Daily operating hours, actual or assumed 12 hrs/day
PC_{BASE}	=	Production capacity of baseline equipment, lbs/hr
PC_{EE}	=	Production capacity of installed equipment, lbs/hr
T_P	=	Preheat time for equipment to reach operating temperature, actual or assumed 15 min/day
$E_{P,BASE}$	=	Preheat energy per day for baseline equipment, kWh/day
$E_{P,EE}$	=	Preheat energy per day for installed equipment, kWh/day
DAYS	=	Operating days per year
CF	=	Summer peak coincidence factor, 0.84
HOURS	=	Annual operating hours of kitchen, actual or 4,380 hrs/yr

TABLE 364 lists the assumptions and source of each assumption for the kitchen equipment measure savings calculations.

TABLE 364. EX POST VARIABLE ASSUMPTIONS FOR KITCHEN EQUIPMENT

INPUT	VALUE	SOURCE
LB	Varies	Actual or from Indiana TRM v2.2
EFOOD	0.139	Indiana TRM v2.2
EFFBASE	0.6	Indiana TRM v2.2
EFFEE	Varies	Actual or from Indiana TRM v2.2
IEBASE	2.4	Indiana TRM v2.2
IEEE	Varies	Actual or from Indiana TRM v2.2
H	Varies	Actual or from Indiana TRM v2.2
PCBASE	35	Indiana TRM v2.2
PCEE	Varies	Actual or from Indiana TRM v2.2
TP	Varies	Actual or from Indiana TRM v2.2
EP,BASE	4	Indiana TRM v2.2
EP,EE	Varies	Actual or from Indiana TRM v2.2
DAYS	Varies	Actual or from Indiana TRM v2.2
CF	0.84	Indiana TRM v2.2
HOURS	Varies	Actual or from Indiana TRM v2.2

VFD AIR COMPRESSORS

VFD air compressor projects should be calculated using the methodologies outlined in the National Renewable Energy Laboratory's Chapter 22: Compressed Air Evaluation Protocol document.[82]

DOMESTIC HOT WATER HEATERS

The evaluation team used the following equations to calculate natural gas energy savings for water heater measures. There are no electrical energy savings or summer peak coincidence demand savings associated with this measure.

$$therm\ savings = GPD * 365 * 8.3 * \left(\frac{1}{EFF_{base}} - \frac{1}{EFF_{EE}}\right) * \frac{TD}{100{,}000}$$

[82] From: https://www.nrel.gov/docs/fy17osti/68577.pdf

Where:

GPD	=	Average daily hot water consumption, gallons per day
365	=	Days per year
8.3	=	Constant, Btu/gal-°F
EFF_{base}	=	Baseline heating efficiency, 80%
EFF_{EE}	=	Actual heating efficiency of installed equipment
TD	=	Temperature differential between the hot water setpoint and average groundwater temperature for the region, °F
100,000	=	Conversion factor from Btu to therms

TABLE 365 lists the assumptions and source of each assumption for the water heater measure savings calculations.

TABLE 365. *EX POST* VARIABLE ASSUMPTIONS FOR WATER HEATERS

INPUT	VALUE	SOURCE
GPD	varies	From TRM or based on actual usage of site
EFF_{base}	80%	ASHRAE 90.1 2007
EFF_{EE}	varies	Equipment specifications
TD	varies	Hot water setpoint is actual temperature the water heater operates at. The groundwater temperature is from Indiana TRM v2.2 based on the region the site is located.

APPENDIX 12: MARKETPLACE MEASURE REVIEW

NIPSCO launched an online marketplace in late 2020, serving both residential and C&I customers. As these offerings launched late in the year, neither program had any participants in 2020 and both programs expected to ramp up primarily in 2021.

However, to provide early feedback, the evaluation team conducted a preliminary review of measure offerings and *ex ante* savings assumptions. Below, the evaluation team details our initial feedback and preliminary recommendations. The team expects to complete a full evaluation for program year 2021.

RESIDENTIAL MARKETPLACE

The Residential Marketplace offering was introduced in late 2020, however all participants in the program have been included in program year 2021 rather than 2020, and therefore no Marketplace projects were evaluated as part of the 2020 program year evaluation report. Through the Residential Marketplace program, instant discounts on energy-efficient products are available to all NIPSCO residential natural gas and electric customers. The discounts are offered on an array of products typically used in households to help reduce consumption in primarily lighting and domestic hot water. The types of products listed in the marketplace are as follows:

- Advanced Power Strip Tier 1 & 2
- Smart Wi-Fi Programmable Thermostat
- Low Flow Showerhead 1.5 GPM
- Showerstart
- Low-Flow Showerhead 1.5 GPM + Showerstart
- Bathroom Aerator 1.0 GPM
- Kitchen Aerator 1.5 GPM
- Pipe Wrap 15 ft
- Smart LEDs
- LEDs

Ex ante savings estimates have been assessed for each of the products listed using several sources including: the Indiana TRM version 2.2 released in 2015, Illinois TRM version 8.0 (2019) and version 9.0 (2020), and the 2019 NIPSCO residential evaluation findings. Cadmus reviewed the *ex ante* savings assumptions, checking them against the Indiana TRM version 2.2 and the methodologies used to evaluate the Home Energy Assessment (HEA) and Income Qualified Weatherization (IQW) during the 2019 evaluation. In addition, Cadmus also compared the *ex ante* savings approach for the Residential Marketplace measures against similar measures offered through other NIPSCO programs in 2020.

RECOMMENDED CONSIDERATIONS:

- Reference the evaluation or TRM source page directly and provide reasoning when using an alternate value from the TRM.
- Use thermostat savings estimates consistent with recommendations for the 2020 HVAC program evaluation.

- If it is easy to implement, gathering and utilizing location information during the checkout process for geographically dependent variables (such as water inlet temperature) will allow for more accurate estimations of savings.
- Collect the rated lumen output, wattage, SKU, lamp shape, and ENERGY STAR unique ID number for all lighting products rebated through the Marketplace.
- Maintain consistency with other NIPSCO programs when determining the most appropriate lighting baseline approach.
- Consider a mid-year EM&V survey to assess measure ISRs and customer satisfaction with the marketplace.

MEASURE LEVEL FINDINGS

The following section details the review findings of the current *ex ante* savings estimates.

1. All Measures: For many measures in the residential marketplace, savings assumptions were sourced without accompanying page numbers (either in evaluation report or TRMs). In addition, there was a lack in reasoning for using assumptions from the 2019 NIPSCO Residential Evaluation in place of what was documented in either the Indiana or Illinois TRM.

2. Advanced Power Strips: The savings assumptions used for advanced power strips were pulled from the IL TRM version 8.0 and appear to be applied appropriately and savings for this measure calculated accurately. The IL TRM v8.0 is more appropriate than the Indiana TRM v2.2 for this measure because the Marketplace products offers two tiers of smart strips—Tier 1 and Tier 2—and the IN TRM only provides savings estimates for Tier 1 units.

3. Smart Wi-Fi Programmable Thermostats: The savings algorithms used for Smart Wi-Fi Programmable Thermostats were primarily pulled from the IN TRM version 2.2 and used appropriately for energy savings, however, as part of the 2020 evaluation, thermostat savings were updated with a billing analysis, so a more regional, recent value is now available.

4. Low Flow Showerheads 1.5 GPM: The savings assumptions and algorithms used for Low flow showerheads were primarily pulled from the IN TRM version 2.2, though Cadmus noticed that some savings inputs were incorrectly sourced (such as the showerheads per household being listed as the IN TRM, whereas it came from the 2019 evaluation). The savings assumption used for the cold-water inlet temperature entering the DHW system (Tin) was pulled from the 2019 NIPSCO Residential Evaluation as an overall average, which is a reasonable assumption for program implementation. A new average value will be calculated during the next evaluation.

5. Showerstart: The savings assumptions and algorithms used for shower start were pulled from a combination of IL TRM version 8.0, IN TRM version 2.2, and the 2019 NIPSCO Residential Evaluation. The savings assumption used for the cold-water inlet temperature entering the DHW system (Tin) was pulled from the 2019 NIPSCO Residential Evaluation as an overall average, which is a reasonable assumption for program implementation. A new average value will be calculated during the next evaluation.

6. Bathroom Aerator 1.0 GPM: The savings assumptions and algorithms used for Bathroom Aerators were primarily pulled from the IN TRM version 2.2. Like low-flow showerheads and showerstart, the savings

assumption used for the cold-water inlet temperature entering the DHW system (Tin) was pulled from the 2019 NIPSCO Residential Evaluation as an overall average, which is a reasonable assumption for program implementation. A new average value will be calculated during the next evaluation. All other savings assumptions appear to be applied appropriately.

7. Kitchen Aerator 1.5 GPM: The savings assumptions and algorithms used for Kitchen Aerators were primarily pulled from the IN TRM version 2.2. Like low-flow showerheads, showerstart, and Bathroom Aerators, the savings assumption used for the cold-water inlet temperature entering the DHW system (Tin) was pulled from the 2019 NIPSCO Residential Evaluation as an overall average, which is a reasonable assumption for program implementation. A new average value will be calculated during the next evaluation. All other savings assumptions appear to be applied appropriately.

8. 15 ft Pipe Wrap: Savings assumptions are primarily from the IN TRM version 2.2 and appear to be applied appropriately. *Ex ante* savings for this measure appear reasonable and accurate based on methodologies used in the 2019 HEA and IQW.

9. LEDs: The savings assumptions used for LEDs were pulled from the IL TRM version 8.0 and appear to be applied appropriately and savings for this measure calculated are reasonable and accurate compared against the IN TRM, 2019 IQW, and 2019 HEA. The IL TRM is preferable to the IN TRM for theis equipment because the IL TRM implements a lumen equivalence-based approach to baseline estimation, rather than a deemed wattage multiplier.

10. Smart LED: The savings assumptions used for smart LEDs were pulled from the IL TRM version 8.0 and appear to be applied correctly. The evaluation team recommends maintaining consistency with other lighting offerings in the portfolio when determining key impact factors, such as baselines. The current recommended savings approach is outlined below:

$$kWh = \frac{\left(Watts_{base} - (Watts_{ee} * SVG_e)\right) * Hours * ISR * WHF_e - Standby_{kW}}{1000}$$

$$kW = \frac{\left(Watts_{base} - (Watts_{ee} * SVG_d)\right) * CF * ISR * WHF_d}{1000}$$

Where:

SAVINGS INPUT	DESCRIPTION	RECOMMENDED VALUE	RECOMMENDED SOURCE
$Watts_{base}$	Input wattage of the baseline or existing system	Varies	IL TRM Version 9: "LED Screw Based Omnidirectional Bulbs". Based on lumen output and lamp type.
$Watts_{ee}$	Input wattage of the Smart LED lamp	Actual	Program tracking data
$Hours$	Annual hours of use	902	IN TRM Version 2.2: "Residential ENERGY STAR Lighting (CFL and LED)"
CF	Summer peak coincidence factor	0.11	IN TRM Version 2.2: "Residential ENERGY STAR Lighting (CFL and LED)"

WHF_e	Waste heat factor for energy to account for HVAC interactions with efficient lighting	Varies(CFL and LED)". Varies by geography.	IN TRM Version 2.2: "Residential ENERGY STAR Lighting
WHF_d	Waste heat factor for energy to account for HVAC interactions with efficient lighting	Varies(CFL and LED)". Varies by geography.	IN TRM Version 2.2: "Residential ENERGY STAR Lighting
SVG_e	Percentage of annual lighting energy saved by lighting control	0.30	IL TRM Version 9: "Connected LED Lamps"
SVG_d	Percentage of annual lighting demand saved by lighting control	0.30	IL TRM Version 9: "Connected LED Lamps"
$Standby_{kWh}$	Standby power draw of the controlled lamp. Use actual value from manufacturer specification.	Actual (0.35 if unknown)	IL TRM Version 9: "Connected LED Lamps"
1000	Conversion factor	1000	Engineering assumption

C&I MARKETPLACE

The C&I Marketplace offering was introduced in late 2020, however all participants in the program have been included in program year 2021 rather than 2020, and therefore no Marketplace projects were evaluated as part of the 2020 program year evaluation report.

Through the C&I Marketplace program, trade allies provide small business participants prepackaged energy efficiency kits specific to their industry (restaurant, office, or retail). The kits offer an array of equipment to reduce consumption in primarily lighting and domestic hot water using equipment typically used in small business operations. NIPSCO electric only and dual fuel subscribing customers billed under electric Rates 820, 821, 822, 822, 823, 824, 825, 826, 831 Tier 1, 832, 833, 841 or 844 and natural gas Rates 121, 125, and 151 are eligible to participate. Gas only customers are not eligible to participate. Kits are offered at no cost to the customer. Customers are allowed to receive up to five kits per commercial account. There are three unique kits (restaurant, retail, and office) and two fuel designations (dual fuel and electric only), for a total of six unique measure combinations in the Marketplace.

A summary of the measures associated with Marketplace is outlined in Table 366 below. As illustrated below, the only difference between the dual fuel and the electric measure is the therms value attributed to the kit. NIPSCO electric only subscribing customers are not attributed any therms savings to the kits received, however, the electric savings of these kits are unchanged.

TABLE 366. SUMMARY ENERGY SAVINGS BY KIT TYPE

CUSTOMER CATEGORY	MEASURE ID	EX ANTE KWH (PER KIT)	EX ANTE KW (PER KIT)	EX ANTE THERMS (PER KIT)	INCENTIVE VALUE OF KIT ($)*
Dual Fuel Kit – Restaurant	650000	2,593	0.5	170	$89.84
Dual Fuel Kit – Retail	650001	2,472	0.7	4	$90.06
Dual Fuel Kit – Office	650002	2,329	0.4	8	$78.75
Electric Only Kit – Restaurant	650003	2,593	0.5	0	$89.84
Electric Only Kit – Retail	650004	2,472	0.7	0	$90.06
Electric Only Kit – Office	650005	2,329	0.4	0	$78.75

**Shipping costs are included as part of the total incentive value of the kit*

CURRENT DESIGN OF THE MARKETPLACE PROGRAM

Savings estimates have been determined for each individual element contained within the kits. The Illinois TRM version 9.0 released in 2020 is the primary reference used to determine savings estimates for each kit element. The IL TRM referenced measures are formulated for Commercial Direct Install applications. The Marketplace kits are shipped to the customer and are self-installed. To account for self-install, the TRM savings calculations have been adjusted with much lower in-service rate (ISR) values, as determined by the 2019 NIPSCO residential program evaluation findings. The calculations have also been adjusted to account for the average prevalence of gas versus electric fired domestic hot water heaters, as determined by the 2019 NIPSCO residential program evaluation findings.

The calculations assume that on average, 22% of DHW heaters are electric and 78% are gas, and they expect to realize that same ratio across the customers that receive these kits. Building specific data regarding the fuel source of the DHW equipment is not gathered from the customers receiving the Marketplace kits. Electric and gas savings resulting from water consumption reductions have not been incorporated into the claimed savings.

Lastly, waste heat factors have not been incorporated into the final savings calculations for any of the lighting elements contained within the kits. The contents of the kits appear be well aligned with the needs of the space type they are designed for. The savings assumptions have been calculated by a reasonable methodology. There are a few additional pieces of data that could be collected from the customer, survey and research that would be helpful in generating more accurate project specific savings assumptions, cost effectiveness calculations, and ISR values. Table 367 outlines the composition of each kit.

TABLE 367. MARKETPLACE KIT CONTENTS AND SUMMARY METRICS

PRODUCTS	QTY	INCENTIVE VALUE ($)	EUL	KWH SAVINGS	KW SAVINGS	THERMS SAVINGS *(DUAL FUEL ONLY)*
Restaurant Kit						
LED Filament A19 Bulb Model FA19D6027EC	12	$17.40	3	1,790	0.38	0
LED Filament Candle E12 Bulb Model FB11D4027EE12C	6	$10.44	3	537	0.11	0
LED Exit Sign Retrofit Model 20715	2	$30.00	5	47	0.01	0
Power Pre-Rinse Spray Valve Model N2180 1.1 GPM	1	$25.00	5	32	0.00	138
Bathroom Aerator Model N3115P 1.0 GPM	2	$4.00	10	56	0.01	9
Kitchen Aerator Model N3115P 1.5 GPM	1	$3.00	10	131	0.02	23
Retail Kit						
LED Filament A19 Bulb Model L60A19D1527KUT	6	$8.70	5	553	0.15	0
LED Filament BR30 Bulb Model LED9BR30D50K Daylight	12	$42.36	9	1,806	0.50	0
LED Exit Sign Retrofit Model 20715	2	$30.00	5	49	0.00	0
Tier 1 Advanced Power Strip Model TS1104	1	$5.00	7	43	0.00	0

Bathroom Aerator Model N3210B-PC 1.0 GPM	2	$4.00	10	21	0.00	4
Office Kit						
LED Filament A19 Bulb Model L60A19D1527KUT	6	$8.70	5	572	0.11	0
LED Filament BR30 Bulb Model LED9BR30D50K Daylight	10	$35.30	8	1555	0.30	0
LED Exit Sign Retrofit Model 20715	2	$30.00	5	48	0.00	0
Tier 1 Advanced Power Strip Model TS1104	1	$5.00	7	45	0.00	0
LED Desk Lamp Model 31710	1	$1.45	12	61	0.01	0
Bathroom Aerator Model N3210B-PC 1.0 GPM	2	$4.00	10	15	0.00	2
Kitchen Aerator Model N3115P 1.5 GPM	1	$3.00	10	34	0.01	6

RECOMMENDED CONSIDERATIONS:

1. For each kit element, the savings calculations reference an ISR. The ISR notations appear to reference the Residential Evaluation of 2019. The specific source of this value is unclear. It is also unclear that the results of a residential evaluation would be appropriate to apply to a commercial population. The evaluation team would recommend the following:
    - Survey a sample of the customers receiving the commercial Marketplace kits to determine the actual ISR for each element contained in the kit, and to collect general feedback about how the customers are interacting with the equipment. The survey would provide a more accurate ISR for a commercial setting and would provide timely feedback about each element of the kits. The evaluation team would recommend making modifications to the contents of the kits based on customer feedback to ensure each element maintains a high ISR, and the kit contents reflect the needs of the customers. To inform any needed early action items, perhaps perform the survey with an early cohort in summer 2021 if enough participation has occurred, then again at the end of the program year.
2. The calculations specific to the water heater elements, including the aerators and pre-rinse spray valves, reference the Residential Evaluation of 2019 to determine the 22%/78% split in electric/gas fired water heaters prevalent in the population on average. The specific source of this value is unclear. It is also unclear that the results of a residential evaluation would be appropriate to apply to a commercial population. The evaluation team would recommend the following:
    - If an estimated split between electric and gas fired water heaters will continue to be used, the evaluation team would recommend surveying a commercial population to determine a more accurate ratio specific to commercial facilities. Until that survey of kit participants is complete, the evaluation team can assist in determining a baseline ratio from commercial surveys from prior evaluation years to use in place of the residential assumption.

- The ratio appears to be applied because project specific data is not collected from the participants receiving the kits. It is noted that the residential Marketplace offerings collect project specific data on the heating type, water heating type and cooling type directly from the customers when the kit or equipment is purchased on the NIPSCO residential marketplace website. The evaluation team would recommend collecting this data directly from the customers receiving the kits through a similar online selection method as the residential kits. The water heating type selection made by the customer would then determine how the savings are calculated for these elements. Using an estimated split to derive savings instead of basing the savings on project specific details results in savings that do not closely align with actual savings achieved on a project level or a portfolio level. Collecting data on the fuel type of the water heater would allow for a more accurate reflection of savings achieved by the individual customer.
- Collecting data on the water heater fuel type is particularly important for customers that have gas fired water heating but are not NIPSCO gas subscribing customers. The kits they receive are not tailored to this configuration and have a higher cost impact to NIPSCO since no savings from the domestic hot water using measures can be claimed. Gathering additional data from customers regarding their water heating types will assist in determining the true cost effectiveness of these kits.

3. Waste heat factors (WHF) have not been incorporated into the final savings calculations for the lighting elements of the kits.
    - The evaluation team assumes WHF have not been incorporated because project specific data regarding the heating and cooling system types and fuel sources have not been collected. It is noted that the residential Marketplace offerings collect project specific data on the heating and cooling type directly from the residential customers when the kit or equipment is purchased on the NIPSCO marketplace website. The evaluation team would recommend collecting this data directly from the customers receiving the kits through a similar online selection method as the residential kits. The heating and cooling selection made by the customer would then determine how the savings are calculated for these elements. Given the facility types receiving the kits, it would be reasonable to assume that all customers will have air conditioning in their spaces, to streamline the savings calculations and quantity of measure IDs needed.
    - Waste heat factors will primarily apply to facilities heated by gas and should be incorporated into the cost effectiveness calculations. This becomes particularly important for customers that have gas space heating but are not NIPSCO gas subscribing customers. The kits they receive potentially have a higher cost impact to NIPSCO. Gathering additional data from customers regarding their space heating fuel type will assist to determine the true cost effectiveness of these kits.

Based on the above recommendations, more accurate and project specific savings calculations could be determined by collecting more data from the customers ordering the kits regarding their heating and cooling system type, and water heating type. This project specific information would determine which measure ID the project would fit into. It is also important data to collect for cost effectiveness calculations, and for project level saving evaluation analysis. The number of measure IDs would need to expand beyond the current six measure IDs to fully capture the possible combinations of fuel sources. A possible measure breakdown in shown in Table 368 below.

TABLE 368. POSSIBLE MEASURE EXPANSION FOR COMMERCIAL MARKETPLACE KITS

CUSTOMER CATEGORY	LIGHTING MEASURES	DHW MEASURES
Dual Fuel Customer – Restaurant Selection 1: Electric Heat Selection 2: Electric Water Heat	WHF determined using AC with electric heat	Savings determined using electric water heater
Dual Fuel Customer – Restaurant Selection 1: Gas Heat Selection 2: Gas Water Heat	WHF determined using AC with natural gas heat. Gas penalty not claimed but factored into Cost Effectiveness	Savings determined using Gas Water Heater
Electric Only Customer – Restaurant Selection 1: Electric Heat Selection 2: Electric Water Heat	WHF determined using AC with electric heat	Savings determined using electric water heater
Electric Only Customer – Restaurant Selection 1: Gas Heat Selection 2: Gas Water Heat	WHF determined using AC with natural gas heat. Gas penalty not claimed but factored into Cost Effectiveness	No savings claimed for these measures
Dual Fuel Customer – Office Selection 1: Electric Heat Selection 2: Electric Water Heat	WHF determined using AC with electric heat	Savings determined using electric water heater
Dual Fuel Customer – Office Selection 1: Gas Heat Selection 3: Gas Water Heat	WHF determined using AC with natural gas heat. Gas penalty not claimed but factored into Cost Effectiveness	Savings determined using Gas Water Heater
Electric Only Customer – Office Selection 1: Electric Heat Selection 2: Electric Water Heat	WHF determined using AC with electric heat	Savings determined using electric water heater
Electric Only Customer – Office Selection 1: Gas Heat Selection 2: Gas Water Heat	WHF determined using AC with natural gas heat. Gas penalty not claimed but factored into Cost Effectiveness	No savings claimed for these measures
Dual Fuel Customer – Retail Selection 1: Electric Heat Selection 2: Electric Water Heat	WHF determined using AC with electric heat	Savings determined using electric water heater
Dual Fuel Customer – Retail Selection 1: Gas Heat Selection 2: Gas Water Heat	WHF determined using AC with natural gas heat. Gas penalty not claimed but factored into Cost Effectiveness	Savings determined using Gas Water Heater
Electric Only Customer – Retail Selection 1: Electric Heat Selection 2: Electric Water Heat	WHF determined using AC with electric heat	Savings determined using electric water heater
Electric Only Customer – Retail Selection 1: Gas Heat Selection 2: Gas Water Heat	WHF determined using AC with natural gas heat. Gas penalty not claimed but factored into Cost Effectiveness	No savings claimed for these measures

APPENDIX 13: COST-EFFECTIVENESS RESULTS

This appendix discusses the cost-effectiveness for NIPSCO's portfolio of electric and gas energy efficiency programs for the 2020 program year. Using the methodology detailed in the *Indiana Evaluation Framework* and the *California Standard Practice Manual*, net savings impacts verified through evaluation activities were used to quantify the cost-effectiveness of the efficiency programs, using each of the following standard tests:

- The Total Resource Cost Test (TRC)
- The Program Administrator Cost Test (PACT), or Utility Cost Test (UCT)
- The Participant Cost Test (PCT)
- The Rate Impact Measure Test (RIM)

The definitions and descriptions of each test are provided below. The Societal Cost Test (SCT) is not included in the analysis because Indiana has not quantified environmental externalities that would differentiate this test from the TRC.

There are two circumstances that affected cost-effectiveness in 2020 which are worth raising:

- As described in the report, COVID-19 affected program progress and participation, and for some programs inhibited participation altogether. Kits, MFDI, and Marketplace programs were most affected. Even with lower than projected participation, the gas and electric portfolios were cost-effective from the TRC, UCT, and PCT tests.Only one individual program – the Employee Education program – was not cost effective in 2020 due to low participation.
- The 2020 evaluation integrated waste heat factor (WHF) as a natural gas penalty for lighting measures when running the electric cost-effectiveness tests. Integrating the WHF reduced cost-effectiveness for programs that offered lighting measures. The programs remained cost-effective with this adjustment.

PROGRAM AND PORTFOLIO COST-EFFECTIVENESS TEST RESULTS

Optimal Energy (Optimal) led the cost-effectiveness analysis. Using the inputs provided by NIPSCO and obtained through the EM&V process, Optimal ran the analysis using their Portfolio Screening Tool (PST), an Excel-based tool developed and refined over decades of cost-effective analyses for energy efficiency and renewable energy programs for utilities across the country. The PST is specifically tailored to cost-effectiveness analyses in the energy efficiency sector, and can readily handle many of the subtleties involved in these types of screenings, including time differentiated avoided costs, inputs and outputs by sector, early retirement retrofit baseline shifts, and non-resource benefits. The PST is also designed to look at all commonly used cost-effectiveness tests, including the TRC, electric and gas UCT, electric and gas RIM, and the PCT.

Table 369 (electric) and Table 370 (gas) summarize the results of each cost-effectiveness test by program and sector, as well as for the total portfolio. The differences of each test will be further explained in the next section.

The electric efficiency programs are highly cost-effective, from each of societal, utility, and participant perspectives. All programs have a RIM test result below 1.0 except for the electric residential HVAC and Home Energy Analysis programs. In those programs, the utility savings from significant peak demand reduction are larger than the lost revenue from reduced energy sales.

TABLE 369. COST-EFFECTIVENESS RESULTS FOR NIPSCO'S ELECTRIC EFFICIENCY PROGRAMS, 2020

PROGRAM	COST-EFFECTIVENESS			
	TRC	UCT	PCT	RIM
Residential				
HVAC Rebate	4.87	4.22	1.91	1.81
Lighting	1.87	1.93	3.28	0.58
Home Energy Analysis	4.22	3.23	3.13	1.06
Appliance Recycling	4.07	2.77	15.50	0.63
School Education	3.46	2.72	10.48	0.56
Multifamily Direct Install	n/a (no program activities in 2020)			
Behavioral*	1.33	1.31	n/a	0.45
New Construction	2.74	1.82	2.78	0.79
Home Life	3.89	2.94	12.45	0.61
Employee Education	0.47	0.39	9.72	0.26
Income-Qualified Weatherization	2.29	1.72	2.50	0.74
Residential Marketplace	n/a (limited program activities in 2020)			
Total Residential	**2.23**	**2.05**	**4.43**	**0.65**
Commercial and Industrial				
Prescriptive	4.76	7.62	3.84	0.81
Custom	2.07	4.79	1.77	0.66
Small Business Direct Install	2.30	2.98	2.98	0.54
New Construction	4.32	5.91	3.65	0.82
Commercial Marketplace	n/a (limited program activities in 2020)			
Total Commercial and Industrial	**3.32**	**6.12**	**2.75**	**0.75**
Total 2020 Electric Portfolio	2.99	4.18	3.08	0.72

* This program has no participant costs, so the PCT result is n/a, because the value is not able to be calculated due to a denominator of zero.

The gas programs are also highly cost-effective, with a total portfolio TRC of 2.2, meaning that the programs yield $2.20 of benefits for each $1 of cost. Further, the results of TRC, UCT, and PCT tests on most individual programs are over 1.0. This demonstrates that the efficiency programs are yielding the intended benefits to NIPSCO rate payers and Indiana as a whole.

TABLE 370. COST-EFFECTIVENESS RESULTS FOR NIPSCO'S GAS EFFICIENCY PROGRAMS, 2020

PROGRAM	COST-EFFECTIVENESS			
	TRC	UCT	PCT*	RIM
Residential				
HVAC Rebate	1.59	1.89	1.56	0.86
Home Energy Analysis	2.66	1.82	2.76	0.87
School Education	1.18	0.89	2.16	0.80
Multifamily Direct Install	n/a (limited program activities in 2020)			
Behavioral*	2.94	2.89	n/a	0.75
New Construction	23.00	18.59	17.36	0.99
Home Life	1.02	0.81	2.05	0.72
Employee Education	0.40	0.33	2.20	0.30
Income-Qualified Weatherization	1.64	1.21	2.18	0.77
Residential Marketplace	n/a (limited program activities in 2020)			
Total Residential	**2.11**	**2.26**	**2.26**	**0.86**
Commercial and Industrial				
Prescriptive	2.28	3.22	1.88	0.89
Custom	2.05	4.79	1.34	0.95
Small Business Direct Install	2.47	3.41	1.93	0.93
New Construction	2.86	3.89	2.11	0.95
Commercial Marketplace	n/a (limited program activities in 2020)			
Total Commercial and Industrial	**2.33**	**4.25**	**1.61**	**0.94**
Total 2020 Gas Portfolio	2.20	2.82	1.96	0.89

* This program has no participant costs, so the PCT result is n/a, because the value is not able to be calculated due to a denominator of zero.

COST-EFFECTIVENESS TESTS

Cost-effectiveness screening, at its core, evaluates whether the net present value (NPV) of the benefits of energy efficiency programs outweigh the costs of the programs. Cost-effectiveness can be evaluated from a variety of different perspectives, including:

- Utility's or program administrator's perspective – using the Program Administrator Cost Test (UCT)
- Societal perspective – using the Total Resource Cost (TRC) Test
- Participant's perspective – using the Participant Cost Test (PCT)
- Nonparticipant's perspective – using the Rate Impact Measure Test (RIM)

Each test result is expressed as a ratio of the NPV of benefits divided by the NPV of costs. A value greater than 1.0 indicates that benefits exceed costs, and the program is cost-effective. The costs and benefits included in each test are summarized in Table 371, which is abstracted from a guide to best practices in cost-effectiveness testing from the U.S. Environmental Protection Agency.[83]

[83] National Action Plan for Energy Efficiency. *Understanding Cost-Effectiveness of Energy Efficiency Programs: Best Practices, Technical Methods, and Emerging Issues for Policy Makers*. Energy and Environmental Economics, Inc., and Regulatory Assistance Project. 2008. https://www.epa.gov/sites/production/files/2015-08/documents/cost-effectiveness.pdf

TABLE 371. COSTS AND BENEFITS BY TEST TYPE

COSTS AND BENEFITS	UCT	TRC	PCT	RIM
Avoided energy costs (fuel and operation and maintenance of power plants and transmission and distribution [T&D] lines)*	Benefit	Benefit		Benefit
Avoided capacity costs (constructing power plants, T&D lines, pipelines)*	Benefit	Benefit		Benefit
Other benefits (fossil fuel savings, water savings, equipment operation and maintenance)		Benefit	Benefit	
Participants' incremental cost (above baseline) of efficient equipment		Cost	Cost	
Program administration costs (staff, marketing)	Cost	Cost		Cost
Incentives and value of energy saving measures provided to customers at no cost (including direct install and kits)	Cost		Benefit	Cost
Lost utility revenue / lower energy bills (due to lower sales)			Benefit	Cost

*Avoided energy and capacity costs are net of free rider impacts.

The TRC evaluates costs and benefits from a societal perspective. Cost-effectiveness results may be lower for TRC than UCT and PCT as it includes all costs, whereas the UCT and PCT only include costs incurred by the utility or program participant, respectively. Incentives and measure costs paid by NIPSCO are excluded from TRC calculations as it is a *transfer* cost – a benefit to the participant and a cost to the program.

Additionally, RIM test results are nearly always below one, because utilities incur the costs of lower electric sales, thus resulting in a need for higher rates in the short term. Energy efficiency is typically the least-cost resource when compared to energy supply costs. Energy efficiency will likely reduce the need for new generation, and thus push rates downward in the long term.

INPUTS TO COST-EFFECTIVENESS ANALYSIS

Below describes the various inputs that inform the cost-effectiveness test results in two categories: global inputs (which are globally applied to all programs, and are not program specific) and program and measure inputs.

GLOBAL INPUTS

Global inputs instruct how to translate the energy savings into dollar benefits, and how to discount the value of future costs and benefits. Global inputs include the following.

DISCOUNT RATES

Because money today is worth more than money tomorrow, a discount rate is used to compare the present value of future costs and benefits. Most of the costs of energy efficiency are incurred up front while the benefits accrue over time. Benefits are discounted more than costs, so that a lower discount rate will result in higher cost-effectiveness.

The discount rate can vary from test to test and jurisdiction to jurisdiction. For this analysis, the discount rate for the TRC is the yield on 30-year U.S. Treasury bonds; the discount rates used in the UCT are utility-specific weighted average costs of capital; and, the discount rate used in the PCT a typical credit card interest rate. The values used for discount rate were:

- 2.79% for the TRC
- 6.53% for the electric UCT and RIM
- 6.24% for the gas UCT and RIM
- 15% for the PCT

AVOIDED ELECTRIC ENERGY COSTS

These are the variable costs associated with producing a marginal unit of electricity. The main component of this is typically the avoided fuel cost. NIPSCO provided year one costs and escalators to project into the future.

AVOIDED GENERATION CAPACITY COSTS

These are the costs of building new generation capacity that are avoided by reducing peak demand and thereby lowering the need to buy expensive power from the Midwest Independent Service Operator (MISO) during peak summer hours. NIPSCO provided year one costs and escalators to project into the future.

AVOIDED TRANSMISSION AND DISTRIBUTION (T&D) COSTS

This represents the value of the avoided or delayed expenditures to upgrade the T&D system to meet peak demand. These values came from a 2017 study looking at NIPSCO's T&D costs.

AVOIDED GAS COSTS

This represents the variable costs associated with procuring and delivering a marginal unit of gas and is generally the commodity cost of gas. NIPSCO provided year one costs and escalators to project into the future.

ELECTRIC AND GAS LINE LOSSES

Line losses are the energy losses incurred as the electricity or gas is delivered through the T&D system. If electric line losses are 5%, then for every 100 kWh saved at the customer meter, 105 kWh is saved in generation. NIPSCO provided the average line losses which were used in this analysis. For electricity, the analysis uses a line loss factor of 2.97% in the residential sector, 2.65% in the commercial and industrial sector, and 4.11% during peak times. For gas, the analysis uses a line loss factor of 0.66%.

PROGRAM AND MEASURE INPUTS

Program and measure inputs are the costs, effective useful measure lives (EUL), savings, and net-to-gross (NTG) ratios used in calculating cost-effectiveness. These inputs come directly from the evaluation, measurement, and verification activities detailed in the main report, as well as NIPSCO's program design files provided by TRC, and the Indiana Technical Reference Manual (TRM) v2.2. Below details the program-level inputs and sources of inputs.

- Program administrative costs: Program expenditures provided by NIPSCO
- Measure incentive costs: Program tracking data and program design files provided by TRC, confirmed by the program expenditures provided by NIPSCO
- Measure incremental costs: Program design files provided by TRC
- Measure EUL: Program design files provided by TRC, which primarily reference the Indiana TRM values
- Verified savings: Evaluation results using *ex post gross* values
- NTG ratio: Evaluation results, accounting for free-ridership only (NTG ratio =100% — free ridership rate)

DETAILED RESULTS

Table 372 through Table 379 show the discounted benefits, costs, net benefits, and benefit cost ratio for each test (UCT, TRC, PCT, and RIM).

TABLE 372. PRESENT VALUE OF ELECTRIC PROGRAM NET BENEFITS: UCT

PROGRAM	UCT		
	TOTAL BENEFITS	TOTAL COSTS	PRESENT VALUE OF NET BENEFITS
Residential			
HVAC Rebate	$2,601,827	$615,866	$1,985,961
Lighting	$5,758,531	$2,988,587	$2,769,944
Home Energy Analysis	$127,147	$39,311	$87,837
Appliance Recycling	$461,298	$166,796	$294,502
School Education	$1,075,892	$395,455	$680,437
Multi-Family Direct Install	$-	$30,048	$(30,048)
Behavioral	$2,074,511	$1,588,821	$485,690
New Construction	$786,836	$432,479	$354,357
Home Life	$33,657	$11,440	$22,217
Employee Education	$916	$2,323	$(1,407)
Income Qualified Weatherization	$162,868	$94,833	$68,035
Residential Marketplace	$-	$25,000	$(25,000)
Total Residential	**$13,083,482**	**$6,390,959**	**$6,692,523**
Commercial and Industrial			
Prescriptive	$24,484,700	$3,213,414	$21,271,286
Custom	$12,671,202	$2,646,393	$10,024,809
Small Business Direct Install	$1,059,577	$354,988	$704,590
New Construction	$4,714,786	$797,668	$3,917,118
Commercial Marketplace	$0	$3,500	$(3,500)
Total Commercial and Industrial	**$42,930,265**	**$7,015,963**	**$35,914,302**
Total 2020 Electric Portfolio	$56,013,747	$13,406,922	$42,606,825

Note: Totals may not properly sum due to rounding

TABLE 373. NET PRESENT VALUE OF GAS PROGRAM BENEFITS: UCT

PROGRAM	UCT TOTAL BENEFITS	TOTAL COSTS	PRESENT VALUE OF NET BENEFITS
Residential			
HVAC Rebate	$5,021,580	$2,660,590	$2,360,990
Home Energy Analysis	$125,122	$68,603	$56,519
School Education	$401,933	$453,806	$(51,873)
Multi-Family Direct Install	$0	$11,705	$(11,705)
Behavioral	$1,081,393	$374,544	$706,849
New Construction	$1,990,839	$107,073	$1,883,767
Home Life	$12,224	$15,072	$(2,849)
Employee Education	$1,193	$3,653	$(2,461)
Income Qualified Weatherization	$310,361	$255,966	$54,395
Total Residential	**$8,944,645**	**$3,951,012**	**$4,993,632**
Commercial and Industrial			
Prescriptive	$296,322	$91,970	$204,352
Custom	$3,478,894	$726,027	$2,752,867
Small Business Direct Install	$323,021	$94,815	$228,206
New Construction	$2,431,596	$624,640	$1,806,956
Total Commercial and Industrial	**$6,529,833**	**$1,537,452**	**$4,992,380**
Total 2020 Gas Portfolio	$15,474,477	$5,488,464	$9,986,013

Note: Totals may not properly sum due to rounding

TABLE 374. PRESENT VALUE OF ELECTRIC PROGRAM NET BENEFITS: TRC

PROGRAM	TRC		
	TOTAL BENEFITS	TOTAL COSTS	PRESENT VALUE OF NET BENEFITS
Residential			
HVAC Rebate	$3,492,056	$717,666	$2,774,391
Lighting	$7,087,211	$3,793,830	$3,293,382
Home Energy Analysis	$172,251	$40,860	$131,391
Appliance Recycling	$572,115	$140,602	$431,513
School Education	$1,287,918	$372,232	$915,686
Multi-Family Direct Install	$0	$30,048	$(30,048)
Behavioral	$2,111,914	$1,588,821	$523,093
New Construction	$1,023,468	$373,789	$649,679
Home Life	$40,259	$10,358	$29,901
Employee Education	$1,095	$2,311	$(1,215)
Income Qualified Weatherization	$221,269	$96,505	$124,764
Residential Marketplace	$0	$25,000	$(25,000)
Total Residential	**$16,009,557**	**$7,192,021**	**$8,817,535**
Commercial and Industrial			
Prescriptive	$30,806,742	$6,469,080	$24,337,662
Custom	$16,634,868	$8,049,964	$8,584,905
Small Business Direct Install	$1,316,760	$573,519	$743,242
New Construction	$6,168,742	$1,427,098	$4,741,645
Commercial Marketplace	$0	$3,500	$(3,500)
Total Commercial and Industrial	**$54,927,112**	**$16,523,160**	**$38,403,952**
Total 2020 Electric Portfolio	$70,936,669	$23,715,181	$47,221,488

Note: Totals may not properly sum due to rounding

TABLE 375. NET PRESENT VALUE OF GAS PROGRAM BENEFITS: TRC

PROGRAM	TRC		
	TOTAL BENEFITS	TOTAL COSTS	PRESENT VALUE OF NET BENEFITS
Residential			
HVAC Rebate	$6,403,211	$4,029,150	$2,374,060
Home Energy Analysis	$169,045	$63,453	$105,593
School Education	$473,296	$399,591	$73,705
Multi-Family Direct Install	$0	$11,705	$(11,705)
Behavioral	$1,099,391	$374,544	$724,847
New Construction	$2,536,002	$110,272	$2,425,731
Home Life	$14,465	$14,149	$316
Employee Education	$1,423	$3,599	$(2,175)
Income Qualified Weatherization	$413,953	$252,510	$161,443
Total Residential	$11,110,787	$5,258,972	$5,851,815
Commercial and Industrial			
Prescriptive	$376,407	$165,355	$211,052
Custom	$4,496,014	$2,192,069	$2,303,945
Small Business Direct Install	$411,476	$166,743	$244,732
New Construction	$3,124,159	$1,090,945	$2,033,214
Total Commercial and Industrial	$8,408,056	$3,615,112	$4,792,943
Total 2020 Gas Portfolio	$19,518,842	$8,874,084	$10,644,758

Note: Totals may not properly sum due to rounding

TABLE 376. PRESENT VALUE OF ELECTRIC PROGRAM NET BENEFITS: PCT

PROGRAM	PCT		
	TOTAL BENEFITS	TOTAL COSTS	PRESENT VALUE OF NET BENEFITS
Residential			
HVAC Rebate	$966,367	$505,749	$460,618
Lighting	$7,928,282	$2,413,777	$5,514,505
Home Energy Analysis	$82,241	$26,310	$55,931
Appliance Recycling	$495,189	$31,956	$463,233
School Education	$1,498,181	$142,933	$1,355,248
Multi-Family Direct Install	$0	$0	$0
Behavioral	$3,357,929	$0	$3,357,929
New Construction	$723,102	$260,410	$462,692
Home Life	$41,853	$3,362	$38,491
Employee Education	$1,118	$115	$1,003
Income Qualified Weatherization	$144,793	$57,872	$86,921
Residential Marketplace	$0	$0	$0
Total Residential	**$15,239,055**	**$3,442,484**	**$11,796,571**
Commercial and Industrial			
Prescriptive	$20,523,418	$5,339,994	$15,183,424
Custom	$12,631,570	$7,134,249	$5,497,322
Small Business Direct Install	$1,362,453	$457,879	$904,574
New Construction	$4,188,954	$1,146,630	$3,042,323
Commercial Marketplace	$0	$0	$0
Total Commercial and Industrial	**$38,706,395**	**$14,078,752**	**$24,627,643**
Total 2020 Electric Portfolio	$53,945,450	$17,521,236	$36,424,214

Note: Totals may not properly sum due to rounding

TABLE 377. NET PRESENT VALUE OF GAS PROGRAM BENEFITS: PCT

PROGRAM	PCT		
	TOTAL BENEFITS	TOTAL COSTS	PRESENT VALUE OF NET BENEFITS
Residential			
HVAC Rebate	$4,967,231	$3,179,467	$1,787,764
Home Energy Analysis	$121,098	$43,821	$77,277
School Education	$644,924	$298,065	$346,859
Multi-Family Direct Install	$0	$0	$-
Behavioral	$1,079,174	$0	$1,079,174
New Construction	$1,327,322	$76,449	$1,250,873
Home Life	$18,979	$9,238	$9,742
Employee Education	$1,653	$751	$902
Income Qualified Weatherization	$343,051	$157,345	$185,706
Total Residential	**$8,503,433**	**$3,765,136**	**$4,738,298**
Commercial and Industrial			
Prescriptive	$243,411	$129,200	$114,211
Custom	$2,657,798	$1,985,203	$672,595
Small Business Direct Install	$272,945	$141,395	$131,550
New Construction	$1,984,808	$941,470	$1,043,338
Total Commercial and Industrial	**$5,158,962**	**$3,197,268**	**$1,961,694**
Total 2020 Gas Portfolio	$13,662,396	$6,962,403	$6,699,992

Note: Totals may not properly sum due to rounding

TABLE 378. PRESENT VALUE OF ELECTRIC PROGRAM NET BENEFITS: RIM

PROGRAM	RIM		
	TOTAL BENEFITS	TOTAL COSTS	PRESENT VALUE OF NET BENEFITS
Residential			
HVAC Rebate	$2,601,827	$1,435,795	$1,166,032
Lighting	$6,845,938	$11,723,489	$(4,877,550)
Home Energy Analysis	$131,212	$123,392	$7,821
Appliance Recycling	$461,298	$735,085	$(273,787)
School Education	$1,207,597	$2,153,860	$(946,262)
Multi-Family Direct Install	$0	$30,048	$(30,048)
Behavioral	$2,074,511	$4,660,971	$(2,586,461)
New Construction	$786,836	$999,531	$(212,695)
Home Life	$36,904	$60,413	$(23,509)
Employee Education	$923	$3,549	$(2,625)
Income Qualified Weatherization	$171,728	$230,673	$(58,945)
Residential Marketplace	$0	$25,000	$(25,000)
Total Residential	**$14,318,775**	**$22,181,806**	**$(7,863,031)**
Commercial and Industrial			
Prescriptive	$26,670,284	$32,891,931	$(6,221,646)
Custom	$14,008,781	$21,165,957	$(7,157,176)
Small Business Direct Install	$1,114,074	$2,045,970	$(931,897)
New Construction	$5,340,303	$6,519,091	$(1,178,788)
Commercial Marketplace	$0	$3,500	$(3,500)
Total Commercial and Industrial	**$47,133,443**	**$62,626,449**	**$(15,493,006)**
Total 2020 Electric Portfolio	$61,452,218	$84,808,255	$(23,356,037)

Note: Totals may not properly sum due to rounding

TABLE 379. NET PRESENT VALUE OF GAS PROGRAM BENEFITS: RIM

PROGRAM	RIM		
	TOTAL BENEFITS	TOTAL COSTS	PRESENT VALUE OF NET BENEFITS
Residential			
HVAC Rebate	$5,021,580	$5,848,797	$(827,218)
Home Energy Analysis	$125,122	$144,194	$(19,072)
School Education	$401,933	$501,661	$(99,728)
Multi-Family Direct Install	$0	$11,705	$(11,705)
Behavioral	$1,081,393	$1,451,099	$(369,706)
New Construction	$1,990,839	$2,015,755	$(24,916)
Home Life	$12,224	$17,080	$(4,856)
Employee Education	$1,193	$4,035	$(2,842)
Income Qualified Weatherization	$310,361	$404,137	$(93,776)
Total Residential	**$8,944,645**	**$10,398,464**	**$(1,453,819)**
Commercial and Industrial			
Prescriptive	$296,322	$331,150	$(34,828)
Custom	$3,478,894	$3,670,196	$(191,302)
Small Business Direct Install	$323,021	$346,924	$(23,903)
New Construction	$2,431,596	$2,570,193	$(138,597)
Total Commercial and Industrial	**$6,529,833**	**$6,918,464**	**$(388,631)**
Total 2020 Gas Portfolio	$15,474,477	$17,316,928	$(1,842,450)

Note: Totals may not properly sum due to rounding

CONCLUSIONS

NIPSCO's energy efficiency programs were highly cost-effective, creating $53 million in net benefits for NIPSCO, $43 million for program participants, and $58 million on a societal (TRC) basis. Further, most electric and gas programs passed the TRC, UCT, and PCT, and those that did not pass has lower than anticipated participation, in large part due to COVID.

Finally, as expected, the electric and gas RIM test is below 1.0, and residential electric HVAC and Home Energy Analysis are the only programs with a RIM higher than 1.0. This is because the program yields enough peak demand savings to compensate the utility for the lost revenue from lower electric sales. Other programs get a RIM score of below 1.0, which means that utilities will have to raise short term rates in order to recover their fixed costs with lower sales.