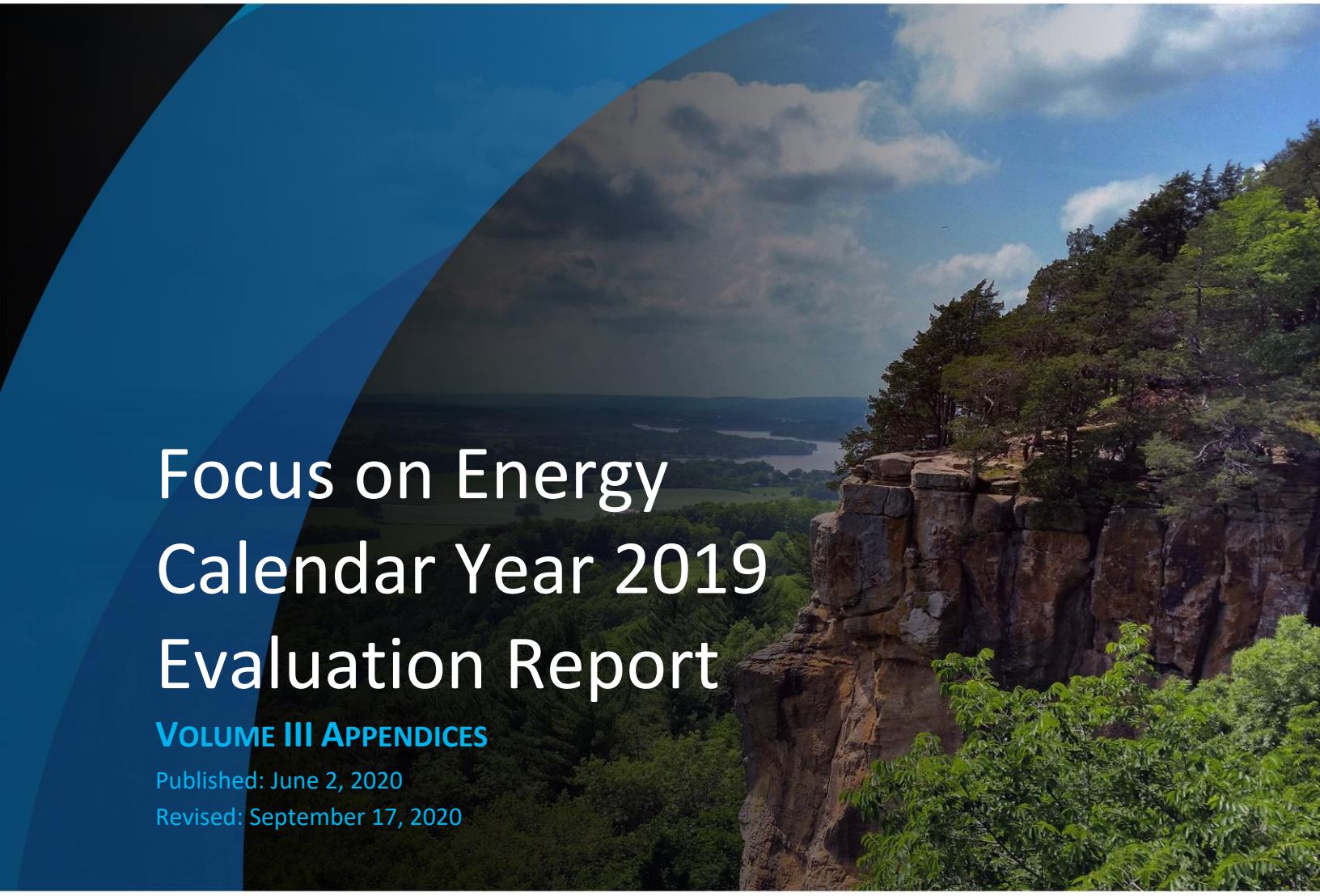
CADMUS



Focus on Energy Calendar Year 2019 Evaluation Report

VOLUME III APPENDICES

Published: June 2, 2020
Revised: September 17, 2020

Prepared for:

Public Service Commission of Wisconsin
4822 Madison Yards Way
North Tower—6th Floor
Madison, WI 53705-9100

Prepared by:
Cadmus
Apex Analytics
Nexant

CADMUS

Table of Contents

Figures

Tables

Appendix A. Key Achievements and Figures for State of Wisconsin and Focus on Energy

Program Participants

- CY 2019 Residential: 113,497
  - Upstream Lighting Participation: 821,414
- CY 2019 Nonresidential: 6,992
- CY 2019 Total Participants: 120,489

Total Electric and Natural Gas Energy Usage

- CY 2018 Electric Sales to Wisconsin Retail Customers megawatt hours (MWh): 70,959,549[1]
- CY 2018 Wisconsin Aggregated Electric Utilities Noncoincident Peak Demand megawatts (MW): 15,516
- CY 2019 Natural Gas Consumption (MThms): 4,283,933[2]

Total Verified Gross Lifecycle Savings

- CY 2019 Energy Savings (MWh): 11,692,416
- CY 2019 Demand Reduction (MW): 100
- CY 2019 Natural Gas Savings (therms): 390,237,486

Total Verified Net Annual Savings

- CY 2019 Energy Savings (MWh): 471,803
- CY 2019 Demand Reduction (MW): 61
- CY 2019 Natural Gas Savings (therms): 18,303,738

---

1 U.S. Energy Information Administration. "Independent Statistics and Analysis Electricity Consumption." https://www.eia.gov/electricity/state/Wisconsin/

2 U.S. Energy Information Administration. "Independent Statistics and Analysis Natural Gas Consumption by End Use." https://www.eia.gov/dnav/ng/ng_cons_sum_dcu_SWI_a.htm

Population Numbers (CY 2019)

- Statewide Census Population: 5,822,434[3]
- Wisconsin Residential Electric Accounts: 2,700,245[4]
- Wisconsin Residential Gas Accounts: 1,775,242[5]
- Wisconsin Nonresidential Electric Accounts: 354,557
- Wisconsin Nonresidential Gas Accounts: 170,770

Table A-1. CY 2019 Costs, Benefits, and Modified TRC Test Results by Sector Combined

	Residential	Nonresidential	Total
Administrative Costs	$2,775,789	$2,162,569	$4,938,358
Delivery Costs	$10,438,711	$22,652,104	$33,090,816
Incremental Measure Costs	$62,647,981	$134,864,170	$197,512,151
Total Non-Incentive Costs	**$75,862,481**	**$159,678,843**	**$235,541,325**
Electric Benefits	$77,102,530	$263,470,010	$340,572,539
Gas Benefits	$26,257,735	$121,062,212	$147,319,948
Emissions Benefits	$25,422,131	$93,381,759	$118,803,890
Total TRC Benefits	**$128,782,396**	**$477,913,981**	**$606,696,377**
TRC Benefits Minus Costs	**$52,919,915**	**$318,235,137**	**$371,155,052**
TRC Ratio[a]	**1.70**	**2.99**	**2.58**

Note: Residential and Nonresidential totals include pilots and rural programs.

[a] The total resource cost (TRC) test ratio equals total TRC benefits divided by non-incentive costs.

[3] QuickFacts Wisconsin. https://www.census.gov/quickfacts/fact/table/WI/PST045216

[4] Electric power sales, revenue, and energy efficiency Form EIA-861 detailed data files. https://www.eia.gov/electricity/data/eia861/

[5] Number of Natural Gas Consumers. https://www.eia.gov/dnav/ng/ng_cons_num_dcu_SWI_a.htm

Appendix B. Glossary of Terms

Term	Definition
Attribution	The establishment of a causal relationship between action(s) taken by a group or program and an outcome. Being attributable to a program means that energy savings and demand reduction can be viewed as a result of the program influence, and the savings would not have been achieved in the program's absence.
Avoided Costs	Costs to the utility avoided by implementing an energy efficiency measure, program, or practice.
Administrative Costs	Costs not directly associated with a specific program activity but necessary to the development and administration of programs, including record keeping, payroll, accounting, auditing, billing, business management, budgeting and related activities, overhead allocation, and other costs necessary to direct the organization of the program.
Baseline	Conditions (including energy consumption) that would have occurred without implementing the measure or project. These conditions can be either as-found (prior to the energy efficiency retrofit or to conditions that meet the state or federal efficiency codes) or a combination of efficient and nonefficient conditions derived from data.
Benefit/Cost Ratio	Mathematical relationship between the benefits and costs associated with implementing energy efficiency measures, programs, or practices or including emission reduction benefits resulting from such implementation.
Claimed Savings	Energy savings the Program Administrator or Program Implementer reports before verification by the Evaluation Team (also called *ex ante* savings, reported savings, or tracked savings).
Cost-Effectiveness	Comparison of the benefits and costs associated with implementing energy efficiency measures and programs. The actual benefits and costs included can vary based on the design and intent of different cost-effectiveness tests.
Custom Savings	Savings for nonprescriptive measures that do not meet the criteria for deemed savings as calculated by the Program Administrator or Program Implementer at the time of project completion. The result reflects savings for the specific project based on pre- and post-installation energy use.
Deemed Savings	An estimate of energy, demand, or natural gas savings for a single unit of an installed energy efficiency measure. Deemed savings are typically developed from data sources and analytical methods that are widely considered acceptable for the measure and are applicable to the situation.
Downstream Program	An efficiency program that provides incentives to the end user by directly offsetting the first cost of the equipment and reducing the payback period.
Ex Ante Savings	Energy savings the Program Administrator or Program Implementer reports before verification by the Evaluation Team (also called claimed savings, reported savings, or tracked savings).
Ex Post Evaluation	An assessment of an activity's impact(s) after completion.
Estimated Savings	Savings estimated by an evaluator after conducting an energy impact evaluation.
Freeriders	Participants who took part in an efficiency program but would have adopted the energy-efficient measure in the program's absence. Freeriders can be total, partial, or deferred.
Gross Savings	The unadjusted program-reported change in energy consumption or demand resulting from efficiency program–related actions taken by participants.
Interactive Effects	The influence of one technology application on the energy required to operate another application.
Locational Marginal Price	The marginal cost to serve a unit of energy at a specific location at the time of delivery.
Lifecycle Savings	Energy savings—expressed as verified gross or verified net—generated from measures installed in the current program cycle over each measure's effective useful life.

Term	Definition
Lifetime Savings	Energy savings—expressed as verified gross or verified net—produced as a result of measures installed in the current and previous program cycles, provided that the reporting period falls within each measure's useful life. This incorporates annual savings and each measure's effective useful life.
Market Effects	Changes in marketplace practices, services, and promotional efforts that induce businesses and consumers to buy energy-saving products and services without direct program assistance. Evaluators generally consider these effects as resulting from program impacts on the market.
Market Lift	An increase in efficient product sales above a pre-established baseline in response to program incentives, promotion, or advertising.
Measure Life	The life of an energy consuming measure, including its equipment life and savings persistence.
Midstream Program	An efficiency program that targets retailers, distributors, or both. Midstream programs are designed to encourage the targeted audience to stock, promote, and sell more energy-efficient products. Incentives are paid directly to the retailer or distributor.
Net Savings	Savings net of what would have occurred in the program's absence (observed impacts attributable to the program). Net savings are typically calculated by applying the net-to-gross ratio to the verified gross savings.
Net-to-Gross Ratio	The ratio of verified net savings (attributed to the program after evaluation) to the verified gross savings.
Non-Energy Benefits	An array of valued attributes, such as increased property values or reduced water usage, that were derived from energy-efficient measures in addition to energy savings.
Nonparticipant Spillover	The effect on eligible general consumers who did not participate in an efficiency program yet adopted energy saving products or practices because of program influence.
Participant Spillover	The effect of participants who, after an initial program experience, adopt more energy saving products or practices without program assistance.
Precision	The degree to which repeated measurements under unchanged conditions produce the same results.
Realization Rate	The ratio of gross savings to verified gross savings.
Reported Savings	Energy savings the Program Administrator or Program Implementer reports before verification by the Evaluation Team (also called tracked savings, *ex ante* savings, or claimed savings).
Resource Acquisition Program	An efficiency program designed to directly achieve energy savings and/or demand reduction, as well as avoided emissions.
Standard Error	The measure of a data sample's variability (that is, the distance of a typical data point from the sample mean).
Tracked Savings	Energy savings the Program Administrator or Program Implementer reports before verification by the Evaluation Team (also called reported savings, *ex ante* savings, or claimed savings).
Unclaimed Rewards	Incentives set aside for customers who fail to submit paperwork to claim program incentives.
Upstream Program	An efficiency program designed to encourage retailers and manufacturers to promote and sell more energy-efficient products. These programs provide incentives to retailers or manufacturers, which are passed through to customers.
Verified Gross Savings	Energy savings that are verified by an independent Evaluation Team and are based on inspections and reviews of the number and types of implemented energy efficiency measures and the engineering calculations used to estimate the energy saved. Verified gross savings reflect total calculated savings based on changes in energy consumption or demand resulting from program-related actions taken by participants in an efficiency program without considering the influence of freeridership or spillover.
Verified Net Savings	Energy savings that evaluators can confidently attribute to program efforts. To calculate verified net savings, the Evaluation Team makes adjustments for outside influences, such as freeridership and spillover.

Appendix C. Acronyms and Abbreviations

Acronym	Term
ACS	American Community Survey
AVERT	AVoided Emissions and generaTion Tool
BPK	Benefits per kilowatt-hour
Btu	British thermal unit
CDD	Cooling degree day
cfm	Cubic feet per minute
COBRA	Co-Benefits Risk Assessment
CREED	Consortium for Retail Energy Efficiency Data
CY	Calendar year
DDC	Digital direct control
DSM	Demand-side management
EISA	Energy Independence and Security Act
EPA	U.S. Environmental Protection Agency
EUL	Expected useful life
HDD	Heating degree day
LMP	Locational marginal price
MMBtu	Thousand British thermal units
MMID	Master measure identification
MThms	Megatherms
MW	Megawatt
MWh	Megawatts per hour
NAC	Normalized annual consumption
NCP	National Consumer Panel
NOAA	National Atmospheric and Oceanographic Administration
NTG	Net-to-gross
NTGR	Net-to-gross ratio
OLS	Ordinary least squares
POS	Point-of-sale
PRISM	PRInceton Scorekeeping Method
PSC	Public Service Commission of Wisconsin
PWC	People Working Collaboratively
PV	Photovoltaic
RIM	Ratepayer impact measure test
ROI	Return on investment
SEER	Seasonal energy efficiency rating
SEM	Strategic Energy Management
SNF	Skilled nursing facility
SPECTRUM	Statewide Program for Energy Customer Tracking, Resource Utilization, and Data Management
TRC	Total resource cost test
TRM	Technical reference manual
UAT	Utility administrator cost test
UEC	Unit energy consumption
UMP	Uniform Methods Project
UPC	Universal product code
VFD	Variable frequency drive

Appendix D. CY 2019 Statewide Total Energy Efficiency Savings and Participation

Table D-1 presents the CY 2019 program savings and participation for Focus on Energy, Northern States Power (Xcel Energy), and We Energies.

Northern States Power and We Energies ran voluntary programs, with authorization from the Public Service Commission of Wisconsin (PSC), using funds in addition to the funding they contribute to Focus on Energy.

Northern States Power and We Energies complemented Focus on Energy programs in CY 2019 by adding bonus incentives. Therefore, these programs' kilowatt, kilowatt-hour, and therms savings do not represent additive savings but instead are represented as Focus on Energy portfolio savings achieved by the projects that received the bonus incentives.

Table D-1. CY 2019 Wisconsin Total Energy Efficiency Verified Gross Annual Savings and Participation

Program	Participation	kW	kWh	therms
Focus on Energy	941,903	100,481	781,037,822	24,865,652
Northern States Power [a]	3,168	TBD	TBD	TBD
We Energies [b]	195	N/A	N/A	42,054

[a] Northern States Power offers the Community Conservation Program, which is designed to complement Focus on Energy programs by adding bonus incentives for both residential and business customers throughout the service territory. The report savings for this utility will be published later in the year See Docket 4220-GF-123 for additional details. http://apps.psc.wi.gov/vs2015/ERF_view/viewdoc.aspx?docid=386318

[b] We Energies Residential Natural Gas Assistance Program. See Dockets 6630-GF-136 and 6630-EE-2019 for additional details. http://apps.psc.wi.gov/pages/viewdoc.htm?docid=386590

Appendix E. Detailed Findings

This section contains detailed first-year annual gross savings and lifecycle savings for the nonresidential and residential segments as well as savings organized by program and measure category.

Overview of Savings

Table E-1 lists the CY 2019 gross, verified gross, and verified net savings claimed basis prior to verification.

Table E-1. CY 2019 First-Year Annual Savings Split Between Residential and Nonresidential

Savings Type	Unit	Residential	Nonresidential	Total
Gross	MMBtu	1,199,375	4,030,516	**5,229,891**
	kWh	258,518,345	521,656,531	**780,174,876**
	kW	32,908	68,219	**101,127**
	therms	3,173,106	22,506,239	**25,679,345**
Verified Gross	MMBtu	1,197,845	3,953,622	**5,151,466**
	kWh	257,798,406	523,239,416	**781,037,822**
	kW	32,950	67,532	**100,481**
	therms	3,182,364	21,683,288	**24,865,652**
Verified Net	MMBtu	582,347	2,857,821	**3,440,169**
	kWh	102,989,753	368,814,108	**471,803,861**
	kW	13,480	47,828	**61,307**
	therms	2,309,463	15,994,275	**18,303,738**

Table E-2 lists the lifecycle savings achieved by Focus on Energy in CY 2019. Lifecycle savings represent the savings a program can realize through measures over these measures' effective useful life.

Table E-2. CY 2019 Lifecycle Savings Split between Residential and Nonresidential

Savings Type	Unit	Residential	Nonresidential	Total
Gross	MMBtu	19,886,037	60,485,168	**80,371,205**
	kWh	4,132,290,830	7,630,386,270	**11,762,677,100**
	kW	32,908	68,219	**101,127**
	therms	57,866,604	344,502,902	**402,369,506**
Verified Gross	MMBtu	19,866,612	59,051,663	**78,918,274**
	kWh	4,120,568,612	7,571,848,059	**11,692,416,671**
	kW	32,950	67,532	**100,481**
	therms	58,072,316	332,165,170	**390,237,486**
Verified Net	MMBtu	9,308,457	42,841,675	**52,150,133**
	kWh	1,616,543,906	5,371,467,184	**6,988,011,090**
	kW	13,480	47,828	**61,307**
	therms	37,928,097	245,142,292	**283,070,389**

Summary of Savings by Program

Table E-3 summarizes the first-year annual savings by program.

Table E-3. Summary of First-Year Annual Savings by Program, CY 2019

Program Name	Gross			Verified Gross			Verified Net		
	kWh	kW	therms	kWh	kW	therms	kWh	kW	therms
Residential Programs									
Appliance Recycling	8,440,556	988	0	8,191,038	960	0	3,560,424	418	0
Home Performance with ENERGY STAR	26,124,127	6,213	1,547,119	26,044,996	6,411	1,544,998	18,912,426	4,470	1,308,724
Multifamily Energy Savings	11,439,379	1,099	420,303	11,317,631	1,068	427,000	8,375,047	790	315,980
New Homes	2,859,673	765	466,695	2,859,673	765	466,695	0	0	23,335
Online Marketplace	642,937	0	44,234	630,107	0	43,349	548,197	0	37,714
Retail Lighting and Appliance	197,458,697	22,736	289,133	197,156,641	22,621	283,369	59,995,340	6,677	206,759
Simple Energy Efficiency	11,552,975	1,108	405,622	11,598,320	1,125	416,952	11,598,320	1,125	416,952
Residential Total	**258,518,345**	**32,908**	**3,173,106**	**257,798,406**	**32,950**	**3,182,364**	**102,989,753**	**13,480**	**2,309,463**
Nonresidential Programs									
Agriculture, Schools and Government	106,007,170	13,122	2,744,430	106,987,447	13,035	2,625,975	71,681,589	8,733	1,759,403
Business Incentives	142,918,881	19,272	1,790,486	145,782,240	19,273	1,275,295	82,918,886	10,933	723,413
Design Assistance	36,921,573	5,664	1,515,140	36,813,277	5,562	1,526,440	26,505,559	4,005	1,099,037
Large Energy Users	168,979,282	19,553	16,068,299	167,650,317	19,400	15,867,694	127,414,241	14,744	12,059,448
Renewable Energy Competitive Incentive	10,471,810	3,827	0	11,412,526	3,686	0	10,613,650	3,428	0
Small Business	56,357,815	6,781	387,884	54,593,609	6,575	387,884	49,680,184	5,984	352,974
Nonresidential Total	**521,656,531**	**68,219**	**22,506,239**	**523,239,416**	**67,532**	**21,683,288**	**368,814,108**	**47,828**	**15,994,275**
Total All Programs	**780,174,876**	**101,127**	**25,679,345**	**781,037,822**	**100,481**	**24,865,652**	**471,803,861**	**61,307**	**18,303,738**

Table E-4 summarizes the lifecycle savings by program.

Table E-4. Summary of Lifecycle Savings by Program, CY 2019

Program Name	Gross		Verified Gross		Verified Net	
	kWh	therms	kWh	therms	kWh	therms
Residential Programs						
Appliance Recycling	84,405,560	0	81,910,377	0	35,604,236	0
Home Performance with ENERGY STAR	530,182,022	28,040,491	528,297,451	28,022,854	379,282,368	24,123,799
Multifamily Energy Savings	124,904,316	7,148,620	123,034,672	7,237,708	91,045,658	5,355,904
New Homes	85,789,920	14,000,850	85,789,920	14,000,850	0	700,043
Online Marketplace	6,428,818	442,340	6,300,416	433,493	5,481,382	377,139
Retail Lighting and Appliance	3,137,514,414	3,235,896	3,132,312,462	3,162,593	942,206,949	2,156,394
Simple Energy Efficiency	163,065,780	4,998,407	162,923,313	5,214,818	162,923,313	5,214,818
Residential Total	**4,132,290,830**	**57,866,604**	**4,120,568,612**	**58,072,316**	**1,616,543,906**	**37,928,097**
Nonresidential Programs						
Agriculture, Schools and Government	1,521,869,237	41,386,654	1,542,008,090	40,304,904	1,033,145,420	27,004,286
Business Incentives	1,900,860,699	26,800,880	1,938,986,375	18,031,670	1,103,217,884	10,235,989
Design Assistance	738,431,460	30,302,800	736,287,341	30,411,616	530,126,886	21,896,364
Large Energy Users	2,434,251,212	239,287,155	2,354,215,406	236,691,987	1,789,203,709	179,885,910
RECIP	272,657,485	0	272,700,754	0	253,611,701	0
Small Business	762,316,177	6,725,413	727,650,093	6,724,993	662,161,585	6,119,743
Nonresidential Total	**7,630,386,270**	**344,502,902**	**7,571,848,059**	**332,165,170**	**5,371,467,184**	**245,142,292**
Total All Programs	**11,762,677,100**	**402,369,506**	**11,692,416,671**	**390,237,486**	**6,988,011,090**	**283,070,389**

Summary of Savings by Measure

Table E-5 summarizes CY 2019 residential savings by measure category.

Table E-5. Summary of First-Year Annual Savings by Measure Category, Residential Sector

Measure Category	Verified Gross						Incentive Dollars	Incentive Dollars %
	kWh	kWh %	kW	kW %	Therms	Therms %		
Boilers & Burners-Boiler	0	0.00%	0	0.00%	298,148	9.37%	$396,030.00	1.72%
Boilers & Burners-Controls	0	0.00%	0	0.00%	5,446	0.17%	$7,375.00	0.03%
Boilers & Burners-Tune-up / Repair / Commissioning	0	0.00%	0	0.00%	222	0.01%	$858.37	0.00%
Building Shell-Air Sealing	6,086	0.00%	11	0.03%	25,184	0.79%	$612,290.65	2.65%
Building Shell-Insulation	780,303	0.30%	357	1.08%	201,086	6.32%	$652,562.35	2.83%
Building Shell-Window	3,686	0.00%	0	0.00%	3,531	0.11%	$2,967.10	0.01%
Domestic Hot Water-Aeration	254,789	0.10%	25	0.08%	60,385	1.90%	$39,454.68	0.17%
Domestic Hot Water-Insulation	1,571,210	0.61%	245	0.74%	198,551	6.24%	$157,614.73	0.68%
Domestic Hot Water-Other	40,228	0.02%	5	0.02%	65,392	2.05%	$69,817.18	0.30%
Domestic Hot Water-Showerhead	856,440	0.33%	41	0.13%	171,009	5.37%	$159,637.06	0.69%
Domestic Hot Water-Variable Speed Drive	56,686	0.02%	10	0.03%	0	0.00%	$2,700.00	0.01%
Domestic Hot Water-Water Heater	4,534	0.00%	0	0.00%	15,778	0.50%	$25,550.00	0.11%
HVAC-Air Conditioner - Residential	473	0.00%	1	0.00%	0	0.00%	$741.05	0.00%
HVAC-Controls	8,486,469	3.29%	0	0.00%	581,357	18.27%	$1,804,593.94	7.82%
HVAC-Energy Recovery	-244	0.00%	1	0.00%	1,401	0.04%	$562.50	0.00%
HVAC-Furnace	7,861,953	3.05%	1,541	4.68%	664,658	20.89%	$2,809,675.00	12.17%
HVAC-Motor	7,535	0.00%	1	0.00%	0	0.00%	$100.00	0.00%
HVAC-Other	2,998,867	1.16%	890	2.70%	129,294	4.06%	$1,088,848.60	4.72%
HVAC-Packaged Terminal Unit (PTAC, PTHP)	143,967	0.06%	8	0.02%	0	0.00%	$7,000.00	0.03%
HVAC-Rooftop Unit / Split System AC	89,282	0.03%	65	0.20%	0	0.00%	$101,913.40	0.44%
HVAC-Steam Trap	0	0.00%	0	0.00%	45,067	1.42%	$10,420.00	0.05%
HVAC-Tune-up / Repair / Commissioning	0	0.00%	0	0.00%	1,414	0.04%	$15,095.10	0.07%
HVAC-Variable Speed Drive	125,363	0.05%	18	0.05%	0	0.00%	$7,880.00	0.03%
Lighting-Controls	87,866	0.03%	4	0.01%	0	0.00%	$1,100.00	0.00%
Lighting-Light Emitting Diode (LED)	211,978,938	82.23%	24,123	73.21%	0	0.00%	$10,252,174.67	44.41%
Motors & Drives-Motor	41,500	0.02%	8	0.02%	0	0.00%	$10,000.00	0.04%
New Construction-Whole Building	2,859,673	1.11%	765	2.32%	466,695	14.67%	$1,386,950.00	6.01%

Measure Category	Verified Gross						Incentive Dollars	Incentive Dollars %
	kWh	kWh %	kW	kW %	Therms	Therms %		
Other-Bonus	0	0.00%	0	0.00%	0	0.00%	$18,444.00	0.08%
Other-Controls	0	0.00%	0	0.00%	0	0.00%	$2,475.00	0.01%
Other-Other	385,641	0.15%	157	0.48%	214,857	6.75%	$982,555.01	4.26%
Refrigeration-Other	8,191,038	3.18%	960	2.91%	0	0.00%	$218,825.00	0.95%
Renewable Energy-Geothermal	339,791	0.13%	71	0.22%	0	0.00%	$49,400.00	0.21%
Renewable Energy-Photovoltaics	9,840,300	3.82%	3,490	10.59%	0	0.00%	$1,803,276.69	7.81%
Training & Special-Other	27,811	0.01%	0	0.00%	0	0.00%	$0.00	0.00%
Vending & Plug Loads-Controls	701,470	0.27%	93	0.28%	0	0.00%	$155,911.33	0.68%
Window	57,264	0.02%	60	0.18%	32,890	1.03%	$230,193.79	1.00%

Table does not include adjustment measure records. As a result, this sum will not match with other CY 2019 totals.

Table E-6 lists CY 2019 nonresidential savings by measure category.

Table E-6. Summary of First-Year Annual Savings by Measure Category, Nonresidential Sector

Measure Category	Verified Gross						Incentive Dollars	Incentive Dollars %
	kWh	kWh %	kW	kW %	Therms	Therms %		
Aeration	696,540	0.13%	70	0.10%	6,231	0.03%	$22,563.98	0.05%
Air Sealing	35,756	0.01%	6	0.01%	105,236	0.49%	$85,489.90	0.20%
Boiler	93,256	0.02%	8	0.01%	2,323,646	10.72%	$2,254,176.64	5.27%
Bonus	0	0.00%	0	0.00%	0	0.00%	$1,150,862.26	2.69%
Chiller	10,256,281	1.96%	1,076	1.59%	0	0.00%	$818,214.35	1.91%
Compressor	4,961,164	0.95%	906	1.34%	0	0.00%	$346,050.00	0.81%
Controls	27,589,086	5.27%	2,427	3.59%	537,749	2.48%	$2,396,731.87	5.61%
Delamping	1,791,938	0.34%	360	0.53%	0	0.00%	$55,502.31	0.13%
Design	36,813,277	7.04%	5,562	8.24%	1,526,440	7.04%	$4,155,925.49	9.72%
Dishwasher, Commercial	456,333	0.09%	1	0.00%	3,031	0.01%	$17,610.00	0.04%
Door	137,400	0.03%	0	0.00%	0	0.00%	$4,154.67	0.01%
Dryer	600,411	0.11%	98	0.14%	66,685	0.31%	$155,772.50	0.36%
Economizer	12,884	0.00%	0	0.00%	0	0.00%	$1,000.00	0.00%
Energy Recovery	9,973,784	1.91%	1,864	2.76%	8,134,377	37.51%	$3,290,523.52	7.70%
Fan	1,845,592	0.35%	363	0.54%	20,036	0.09%	$206,686.85	0.48%
Filtration	377,013	0.07%	49	0.07%	135,957	0.63%	$151,780.81	0.36%
Fryer	10,398	0.00%	2	0.00%	51,509	0.24%	$28,050.00	0.07%
Furnace	247,523	0.05%	47	0.07%	123,482	0.57%	$220,520.52	0.52%
Geothermal	26,814	0.01%	0	0.00%	0	0.00%	$6,151.00	0.01%
Greenhouse	0	0.00%	0	0.00%	7,403	0.03%	$760.32	0.00%
Griddle	24,847	0.00%	5	0.01%	200	0.00%	$1,170.00	0.00%
Heat Exchanger	1,024,403	0.20%	0	0.00%	0	0.00%	$65,392.74	0.15%
Hot Holding Cabinet	15,614	0.00%	3	0.00%	0	0.00%	$480.00	0.00%
Ice Machine	26,177	0.01%	3	0.00%	0	0.00%	$900.00	0.00%
Infrared Heater	0	0.00%	0	0.00%	27,516	0.13%	$38,160.00	0.09%
Insulation	21,676	0.00%	12	0.02%	253,361	1.17%	$155,425.56	0.36%
Irrigation	83,295	0.02%	44	0.07%	0	0.00%	$6,500.00	0.02%
Light Emitting Diode (LED)	262,801,867	50.23%	35,427	52.46%	0	0.00%	$15,501,227.32	36.26%
Livestock Waterer	478,319	0.09%	0	0.00%	0	0.00%	$14,000.00	0.03%

Measure Category	Verified Gross						Incentive Dollars	Incentive Dollars %
	kWh	kWh %	kW	kW %	Therms	Therms %		
Motor	7,899,457	1.51%	928	1.37%	0	0.00%	$535,555.97	1.25%
Nozzle	146,880	0.03%	54	0.08%	0	0.00%	$240.00	0.00%
Other	49,616,628	9.48%	4,448	6.59%	7,398,628	34.12%	$4,965,827.66	11.62%
Oven	63,920	0.01%	15	0.02%	23,459	0.11%	$18,440.00	0.04%
Packaged Terminal Unit (PTAC, PTHP)	1,134,470	0.22%	49	0.07%	0	0.00%	$45,900.00	0.11%
Photovoltaics	11,371,174	2.17%	3,658	5.42%	0	0.00%	$2,681,024.47	6.27%
Pre-Rinse Sprayer	0	0.00%	0	0.00%	100	0.00%	$125.00	0.00%
Pump	1,392,504	0.27%	134	0.20%	0	0.00%	$48,268.10	0.11%
Reconfigure Equipment	1,693,183	0.32%	315	0.47%	0	0.00%	$57,332.84	0.13%
Refrigerated Case Door	4,229,788	0.81%	187	0.28%	46,119	0.21%	$104,240.00	0.24%
Refrigerator / Freezer - Commercial	162,772	0.03%	18	0.03%	0	0.00%	$41,130.00	0.10%
Rooftop Unit / Split System AC	1,331,014	0.25%	872	1.29%	136,097	0.63%	$455,057.22	1.06%
Scheduling	311,658	0.06%	25	0.04%	34,370	0.16%	$22,047.65	0.05%
Specialty Pulp & Paper	1,373,586	0.26%	164	0.24%	0	0.00%	$98,400.00	0.23%
Steam Trap	0	0.00%	0	0.00%	376,834	1.74%	$46,490.00	0.11%
Steamer	113,601	0.02%	195	0.29%	3,851	0.02%	$8,240.00	0.02%
Strip Curtain	107,290	0.02%	12	0.02%	0	0.00%	$3,014.00	0.01%
Study	0	0.00%	0	0.00%	0	0.00%	$24,548.95	0.06%
Supporting Equipment	307,590	0.06%	35	0.05%	0	0.00%	$32,487.47	0.08%
System Isolation	338,024	0.06%	0	0.00%	0	0.00%	$6,814.00	0.02%
Tune-up / Repair / Commissioning	10,789,842	2.06%	0	0.00%	290,053	1.34%	$146,174.51	0.34%
Unit Heater	0	0.00%	0	0.00%	4,527	0.02%	$12,600.00	0.03%
Variable Speed Drive	70,338,772	13.44%	8,044	11.91%	0	0.00%	$2,164,015.83	5.06%
Water Heater	26,583	0.01%	0	0.00%	38,515	0.18%	$63,487.00	0.15%
Welder	74,419	0.01%	15	0.02%	0	0.00%	$4,500.36	0.01%
Wind Electric	14,538	0.00%	29	0.04%	0	0.00%	$5,685.00	0.01%
Window	73	0.00%	0	0.00%	7,877	0.04%	$9,050.76	0.02%

Table does not include adjustment measure records. As a result, this sum will not match with other CY 2019 totals.

Table E-7 lists CY 2019 residential lifecycle savings by measure category.

Table E-7. Summary of First-Year Lifecycle Savings by Measure Category, Residential Sector

Measure Category	Verified Gross			
	kWh	kWh %	Therms	Therms %
Boilers & Burners-Boiler	0	0.00%	5,951,867	10.25%
Boilers & Burners-Controls	0	0.00%	39,276	0.07%
Boilers & Burners-Tune-up / Repair / Commissioning	0	0.00%	444	0.00%
Building Shell-Air Sealing	90,884	0.00%	376,469	0.65%
Building Shell-Insulation	15,983,763	0.39%	4,259,763	7.34%
Building Shell-Window	73,405	0.00%	70,386	0.12%
Domestic Hot Water-Aeration	2,547,795	0.06%	603,044	1.04%
Domestic Hot Water-Insulation	23,568,146	0.57%	2,978,007	5.13%
Domestic Hot Water-Other	603,416	0.01%	978,370	1.68%
Domestic Hot Water-Showerhead	8,564,398	0.21%	1,710,091	2.94%
Domestic Hot Water-Variable Speed Drive	846,596	0.02%	0	0.00%
Domestic Hot Water-Water Heater	58,799	0.00%	236,138	0.41%
HVAC-Air Conditioner - Residential	946	0.00%	0	0.00%
HVAC-Controls	84,858,086	2.06%	5,813,134	10.01%
HVAC-Energy Recovery	-3,650	0.00%	20,943	0.04%
HVAC-Furnace	157,110,688	3.81%	13,220,416	22.77%
HVAC-Motor	135,031	0.00%	0	0.00%
HVAC-Other	60,517,819	1.47%	2,585,879	4.45%
HVAC-Packaged Terminal Unit (PTAC, PTHP)	2,150,067	0.05%	0	0.00%
HVAC-Rooftop Unit / Split System AC	1,333,382	0.03%	0	0.00%
HVAC-Steam Trap	0	0.00%	269,477	0.46%
HVAC-Tune-up / Repair / Commissioning	0	0.00%	2,828	0.00%
HVAC-Variable Speed Drive	1,872,310	0.05%	0	0.00%
Lighting-Controls	699,769	0.02%	0	0.00%
Lighting-Light Emitting Diode (LED)	3,326,668,581	80.73%	0	0.00%
Motors & Drives-Motor	747,000	0.02%	0	0.00%
New Construction-Whole Building	85,789,920	2.08%	14,000,850	24.11%
Other-Bonus	0	0.00%	0	0.00%
Other-Controls	0	0.00%	0	0.00%
Other-Other	7,712,812	0.19%	4,297,140	7.40%
Refrigeration-Other	81,910,377	1.99%	0	0.00%
Renewable Energy-Geothermal	5,096,863	0.12%	0	0.00%
Renewable Energy-Photovoltaics	246,007,488	5.97%	0	0.00%
Training & Special-Other	276,892	0.01%	0	0.00%
Vending & Plug Loads-Controls	4,208,818	0.10%	0	0.00%
Window	1,145,278	0.03%	657,797	1.13%

Table E-8 lists CY 2019 nonresidential lifecycle savings by measure category.

Table E-8. Summary of First-Year Lifecycle Savings by Measure Category, Nonresidential Sector

Measure Category	Verified Gross			
	kWh	kWh %	Therms	Therms %
Aeration	12,831,647	0.17%	293,664	0.09%
Air Sealing	791,062	0.01%	1,838,326	0.54%
Boiler	1,363,568	0.02%	48,972,514	14.43%
Bonus	0	0.00%	0	0.00%
Chiller	198,129,940	2.57%	0	0.00%
Compressor	73,427,400	0.95%	0	0.00%
Controls	324,642,900	4.22%	6,590,539	1.94%
Delamping	17,893,543	0.23%	0	0.00%
Design	736,287,341	9.57%	30,411,616	8.96%
Dishwasher, Commercial	4,567,541	0.06%	30,529	0.01%
Door	2,678,712	0.03%	0	0.00%
Dryer	8,861,757	0.12%	1,018,048	0.30%
Economizer	129,349	0.00%	0	0.00%
Energy Recovery	145,991,482	1.90%	121,405,714	35.77%
Fan	28,765,198	0.37%	293,866	0.09%
Filtration	2,490,776	0.03%	1,979,897	0.58%
Fryer	124,780	0.00%	592,091	0.17%
Furnace	8,040,785	0.10%	3,044,532	0.90%
Geothermal	369,119	0.00%	0	0.00%
Greenhouse	0	0.00%	43,950	0.01%
Griddle	298,166	0.00%	2,400	0.00%
Heat Exchanger	15,426,730	0.20%	0	0.00%
Hot Holding Cabinet	187,373	0.00%	0	0.00%
Ice Machine	261,459	0.00%	0	0.00%
Infrared Heater	0	0.00%	411,090	0.12%
Insulation	2,362,383	0.03%	5,508,273	1.62%
Irrigation	1,254,351	0.02%	0	0.00%
Light Emitting Diode (LED)	3,778,598,298	49.11%	0	0.00%
Livestock Waterer	4,802,076	0.06%	0	0.00%
Motor	122,833,640	1.60%	0	0.00%
Nozzle	2,203,200	0.03%	0	0.00%
Other	706,941,474	9.19%	110,134,143	32.45%
Oven	766,670	0.01%	274,175	0.08%
Packaged Terminal Unit (PTAC, PTHP)	19,081,376	0.25%	0	0.00%
Photovoltaics	272,064,793	3.54%	0	0.00%
Pre-Rinse Sprayer	0	0.00%	479	0.00%
Pump	18,041,010	0.23%	0	0.00%
Reconfigure Equipment	21,617,273	0.28%	0	0.00%
Refrigerated Case Door	31,426,228	0.41%	655,870	0.19%
Refrigerator / Freezer - Commercial	1,953,201	0.03%	0	0.00%
Rooftop Unit / Split System AC	21,218,285	0.28%	1,998,148	0.59%
Scheduling	2,986,259	0.04%	172,138	0.05%

Measure Category	Verified Gross			
	kWh	kWh %	Therms	Therms %
Specialty Pulp & Paper	20,084,298	0.26%	0	0.00%
Steam Trap	0	0.00%	2,526,644	0.74%
Steamer	1,364,295	0.02%	46,512	0.01%
Strip Curtain	427,715	0.01%	0	0.00%
Study	0	0.00%	0	0.00%
Supporting Equipment	5,991,908	0.08%	0	0.00%
System Isolation	4,942,530	0.06%	0	0.00%
Tune-up / Repair / Commissioning	21,416,761	0.28%	295,214	0.09%
Unit Heater	0	0.00%	67,908	0.02%
Variable Speed Drive	1,047,258,952	13.61%	0	0.00%
Water Heater	400,365	0.01%	570,134	0.17%
Welder	943,056	0.01%	0	0.00%
Wind Electric	266,842	0.00%	0	0.00%
Window	74,864	0.00%	224,461	0.07%

Appendix F. Cost-Effectiveness and Emissions Methodology and Analysis

For the current year (CY 2019) and past quadrennium (CY 2015-CY 2018), the Focus on Energy Program Administrator developed a specific calculator for itself and Program Implementers to assess the cost-effectiveness of program designs prior to their implementation each year. The cost-effectiveness calculator was developed with the oversight of, and in collaboration with, the Public Service Commission of Wisconsin (PSC) and the Evaluation Team.

Because maintaining consistency between planning and evaluation approaches is critical to understanding program performance compared with expectations, the Evaluation Team used the same calculator to evaluate the cost-effectiveness of the Focus on Energy programs in CY 2019. Its findings are presented in this appendix.

The PSC considers the modified total resource cost (TRC) test to be the primary test in assessing the cost-effectiveness of both individual programs and the entire Focus on Energy portfolio of programs.[6] The PSC also directs that four additional tests be conducted for advisory purposes. These are an expanded TRC test that also includes net economic benefits, the utility administrator cost test (UAT), the ratepayer impact measure (RIM) test, and the societal test.

Net-to-gross (NTG) ratios can be a significant driver in the results of the tests. NTG ratios are applied to adjust the impacts of the programs so they reflect only the gains resulting from the programs. Therefore, NTG ratios take into account energy savings that would have been achieved without the efficiency programs as well as participant spillover (that is, when NTG is less than 1, savings are removed; when NTG is greater than 1, savings are added). In all cases, the savings are multiplied by NTG.

On the cost side, expenditures that would have occurred without the efficiency effort are also removed. These expenditures include the incremental measure costs and lost revenues, both of which are multiplied by the NTG. Costs that would not have occurred in the absence of the programs are not impacted by NTG (such as delivery and administrative costs).

Test Descriptions

The Evaluation Team—as well as the Program Administrator in developing its calculator—uses methods adapted from the California Standard Practice Manual, the conventional standard of cost-effectiveness

[6] The use of the modified TRC test as the primary cost-effectiveness test is directed by the PSC. Public Service Commission of Wisconsin. September 3, 2014. *Quadrennial Planning Process II – Scope.* Order PSC Docket 5-FE-100, REF#: 215245. http://psc.wi.gov/apps35/ERF_view/viewdoc.aspx?docid=215245. This order was updated on June 6, 2018. *Quadrennial Planning Process III.* Order PSC Docket 5-FE-101, REF#: 343509. http://apps.psc.wi.gov/vs2015/ERF_view/viewdoc.aspx?docid=343909.

analysis for energy efficiency programs in the United States.[7] Four tests—the modified TRC test, the expanded TRC test, the UAT, and the RIM test—are described in the next sections.

Modified Total Resource Cost Test

The TRC test is the most commonly applied test for evaluating the cost-effectiveness of energy efficiency and renewable resource programs around the country. Applications range across states and utility jurisdictions, from the standard TRC test to the societal test, which expands the test inputs to account for a more holistic societal perspective. Modifications to the standard TRC test often include reducing the discount rate or including various environmental and non-energy benefits. The test includes total participant and Program Administrator costs. The test also includes some non-energy benefits (such as emission reduction benefits).

The modified TRC test used for the CY 2019 evaluation determines if programs are cost-effective from a regulatory perspective (as directed by the PSC) and is intended to measure the overall impacts of program benefits and costs on the state of Wisconsin. The test compares all benefits and costs that can be measured with a high degree of confidence, including any net avoided emissions that are regulated and that have either well-defined market or commission-established values. The test's purpose here is to determine if the total costs incurred by residents, businesses, and Focus on Energy for operating the programs are outweighed by the total benefits they receive.

In simple terms, the benefit/cost value of the modified TRC test is the ratio of avoided utility and environmental costs from avoided energy consumption to the combination of program administrative costs, program delivery costs, and net participant incremental measure costs.

The benefit/cost equation used for the modified TRC test is:

$$TRC\frac{B}{C} = \frac{[Value\ of\ Gross\ Saved\ Energy + Value\ of\ Gross\ Avoided\ Emissions] * NTG}{[Adminstrative\ Costs\ +\ Delivery\ Costs + (Incremental\ Measure\ Cost\ * NTG)]}$$

Where:

$$Value\ of\ Gross\ Saved\ Energy = Net\ Gross\ Savings\ \times Utility\ Avoided\ Costs$$

Expanded Total Resource Cost Test with Net Economic Benefits

The Evaluation Team investigated the impact of expanding the TRC to include net economic benefits for the CY 2019 programs. The analysis of economic benefits is conducted every two years, and the Evaluation Team issues the results separately from the evaluation reports.

The benefit/cost equation used for the expanded TRC test with net economic benefits is:

$$TRC\frac{B}{C} = \frac{[(Value\ of\ Gross\ Saved\ Energy + Value\ of\ Gross\ Avoided\ Emissions) * NTG + Net\ Economic\ Benefits]}{[Adminstrative\ Costs\ +\ Delivery\ Costs + (Incremental\ Measure\ Cost\ * NTG)]}$$

[7] California Public Utilities Commission. July 2002. *California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects*. http://www.calmac.org/events/SPM_9_20_02.pdf

Utility Administrator/Program Administrator Cost Test

The Evaluation Team also assessed the portfolio's cost-effectiveness using the UAT, which measures the net benefits and costs of the programs as a resource option from the perspective of the Focus on Energy Program Administrator. In Wisconsin, the UAT effectively represents the collective perspectives of the participating utilities that hire and fund the Program Administrator.

The UAT, previously called the revenue requirements test, effectively estimates the impacts on utility revenue requirements (the costs of providing service) by comparing the benefits of avoided utility costs from avoided energy consumption to the combined costs of operating the program, such as incentive payments, administrative costs, and delivery costs. A positive benefit/cost ratio, therefore, indicates that the program improves an energy system's overall efficiency.

For this evaluation, the UAT's benefit/cost value indicates whether the combined revenue requirements from all participating utilities increase or decrease as a result of the Focus on Energy programs. The net benefits determined with the UAT indicate the estimated dollar value of the change in the combined revenue requirements from all participating utilities. The NTG ratio impacts only the benefit side of the UAT because none of the costs would have occurred absent the effort and, therefore, all are kept in the test (not subtracted from denominator).

The benefit/cost equation used for the UAT is:

$$UAT\,\frac{B}{C} = \frac{[Value\ of\ Gross\ Saved\ Energy * NTG]}{[Participant\ Incentives + Adminstrative\ Costs + Delivery\ Costs]}$$

Ratepayer Impact Measure Test

Generally, the RIM test indicates the isolated and marginal effect on utility energy rates from changes in revenues and operating costs caused by energy efficiency and renewable resource programs, all else being equal. It does not, however, provide a comprehensive picture of ratepayer impacts. The RIM test's estimated effects are theoretical and assume annual rate cases that may, in fact, not take place. Furthermore, the RIM test does not account for non-energy benefits enjoyed by ratepayers, nor does it clearly distinguish the difference between rate and total bill impacts.

From the RIM test perspective, the relatively expansive view of program costs, particularly the inclusion of lost revenues—which are foregone revenues as opposed to new costs—from avoided energy consumption, leads most energy efficiency and renewable energy programs to not be cost-effective. Exceptions include demand response programs or programs targeted to the highest marginal cost hours (when marginal costs are greater than rates). In simple terms, the RIM test benefit/cost value is the ratio of avoided utility costs and the combination of participant incentives, administrative costs, and lost utility revenue.

The benefit/cost equation used for the RIM test is:

$$RIM\,\frac{B}{C} = \frac{[Value\ of\ Gross\ Saved\ Energy * NTG]}{[Participant\ Incentives + Adminstrative\ Costs + Lost\ Revenue * NTG]}$$

For this evaluation, a RIM test benefit/cost value less than 1 indicates that Focus on Energy will induce theoretical upward pressure on rates because the decrease in utility revenues caused by its programs is greater than the avoided utility costs (net benefits are negative) and *vice versa*. Conversely, a value greater than 1 indicates that Focus on Energy will induce theoretical downward pressure on rates because the decrease in revenues is less than the avoided utility costs.

Results from the RIM test are better understood within the context of UAT results. The most common combination of results involves a UAT benefit/cost value greater than 1 and a RIM test benefit/cost value less than 1. Passing the UAT means that revenue requirements (revenue needed to operate the utility business and deliver energy services) will decrease as a result of the programs; in other words, the utilities are running more efficiently because of their programs.

However, if the programs do not pass the RIM test, it means the improvement in efficiency and the associated decrease in revenue requirements were not sufficient to offset the lost revenues. As a result, the programs will put upward pressure on rates. Rates are roughly estimated as in this formula:

$$\frac{revenue\ requirement}{sales\ (kWh\ or\ therms)}$$

The numerator (revenue requirement) decreases, but so does the denominator (sales). If the denominator decreases more than the numerator, the ratio of the two will increase. In this scenario, although all *rates* may theoretically increase, the energy *bills* for participants will decrease and the energy *bills* for nonparticipants will increase. The decrease in revenue requirement means that the decrease in participant bills will exceed the increase in nonparticipant bills such that the average bills across the two customer groups will decrease.

In essence, the RIM test is not a cost-effectiveness (efficiency) test in an economic sense but, rather, an analysis of the distributional (equity) impacts on energy bills.[8] Because Focus on Energy programs are designed to meet a statutory requirement to make program benefits available to all ratepayers, the RIM test results for Focus are influenced by its programs' success in meeting that requirement, its ability to meet that requirement within existing resources, and its customers' individual willingness to participate.

The RIM test assumes that a true-up will occur every year through rate cases. The test as applied could be considered the worst-case scenario. The RIM test also does not consider any societal or system benefits that accrue to *all* customers.

Societal Test

In addition to the expanded TRC, the Evaluation Team investigated the impact of several previously not included non-energy benefits such as health, water, purchase deferral, property value, and arrearage benefits for the CY 2019 programs.

[8] The RIM test assumes annual rate cases that may not take place. If there is not an annual rate adjustment, there is a transfer payment to participants from utility shareholders rather than from nonparticipants.

The benefit/cost equation used for the societal test is:

$$SOC\,\frac{B}{C} = \frac{[(Value\ of\ Gross\ Saved\ Energy + Value\ of\ Gross\ Avoided\ Emissions) * NTG + Net\ Economic\ Benefits + NEBs]}{[Adminstrative\ Costs\ +\ Delivery\ Costs + (Incremental\ Measure\ Cost\ * NTG)]}$$

A more detailed discussion of the various non-energy benefits included in the societal test are presented below.

Non-Energy Benefits

Health Benefits

The Evaluation Team estimated the value of health benefits accumulated by reduced emissions attributable to program activity using the method recommended by the U.S. Environmental Protection Agency (EPA) using the benefits per kilowatt-hour (BPK) tool. This tool, recently developed to help interested parties estimate health benefits from reduced emissions, was introduced in late fall 2019. The tool relies on the AVoided Emissions and generaTion Tool (AVERT) regional inputs, which specify the blend of electric generation sources (coal, natural gas, hydroelectric, other renewables, etc.) and the downstream effects of particulate generation from those sources as determined in the Co-Benefits Risk Assessment (COBRA) health impacts screening and mapping tool.

BPK values are determined using the following equation:

$$BPK_{t,r} = \frac{HealthBenefits_{t,US}}{GenerationChange_{t,r}}$$

Where:

$BPK_{t,r}$ = Monetized public health benefits per kilowatt-hour (c/kWh) for each energy efficiency/renewable energy technology type (t) and AVERT region (r)

$Health\ Benefits_{t,US}$ = Aggregated monetized public health benefits from emissions reductions for each type of energy efficiency/renewable energy technology (t) for the contiguous United States (US)

$Generation\ Change_{t,r}$ = Change in electricity generation for each energy efficiency/renewable energy technology type (t) and AVERT region (r)

The effects of these emissions are then tied to the negative health outcomes associated with inhalation of those particulates. A list of these included health factors, and the associated savings associated with each input, is presented in Table F-1.

The in-depth methodology for the calculation of these benefits is available in a 2019 report on public health and energy from the U.S. Environmental Protection Agency.[9]

Table F-1. Included Health Inputs

Health Endpoint	Age Range
Mortality[a]	25–99
Infant Mortality[b]	0–0
Acute Myocardial Infarction, Nonfatal[c]	0–24
Acute Myocardial Infarction, Nonfatal[c]	25–44
Acute Myocardial Infarction, Nonfatal[c]	45–54
Acute Myocardial Infarction, Nonfatal[c]	55–64
Acute Myocardial Infarction, Nonfatal[c]	65–99
Acute Myocardial Infarction, Nonfatal[d]	0–24
Acute Myocardial Infarction, Nonfatal[d]	25–44
Acute Myocardial Infarction, Nonfatal[d]	45–54
Acute Myocardial Infarction, Nonfatal[d]	55–64
Acute Myocardial Infarction, Nonfatal[d]	65–99
Hospital Admissions, All Cardiovascular (less-acute myocardinal infraction)	18–64
Hospital Admissions, All Cardiovascular (less-acute myocardinal infraction)	65–99
Hospital Admissions, All Respiratory	65–99
Hospital Admissions, Asthma	0–17
Hospital Admissions, Chronic Lung Disease	18–64
Asthma Emergency Room Visits (Smith et al. 1997)	0–99
Asthma Emergency Room Visits (Stanford et al. 1999)	0–99
Acute Bronchitis	8–12
Lower Respiratory Symptoms	7–14
Upper Respiratory Symptoms	9–11
Minor Restricted Activity Days	18–64
Work Loss Days	18–64
Asthma Exacerbation (cough, shortness of breath, or wheeze)	6–18

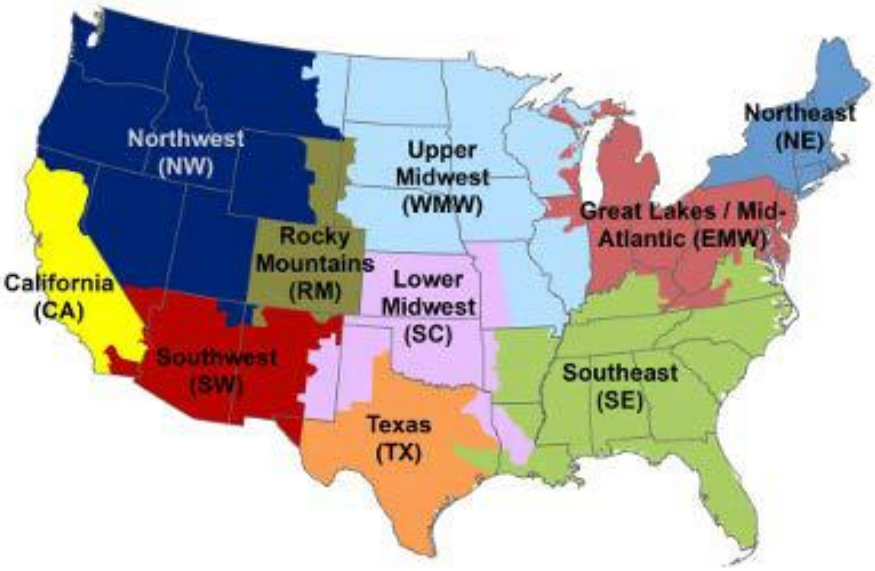
[a] Mortality value after adjustment for 20-year lag.
[b] Infant mortality value is not adjusted for 20-year lag.
[c] Based on Russell (1998).
[d] Based on Wittels (1990).

Source: U.S. Environmental Protection Agency.

To determine Wisconsin-specific values, the Evaluation Team took a weighted average of the cost of emissions generated across the two AVERT regions that cover the state (Upper Midwest and Great Lakes/Mid-Atlantic, as shown in Figure F-1). The Team assumed a 2% discount rate to comply with decisions by the PSC for Quadrennial Planning Process III, the current Focus on Energy period.

[9] U.S. Environmental Protection Agency. July 2019. *Public Health Benefits per kWh of Energy Efficiency and Renewable Energy in the United States: A Technical Report*. https://www.epa.gov/sites/production/files/2019-07/documents/bpk-report-final-508.pdf

Figure F-1. U.S. EPA AVERT Regions



Source: U.S. Environmental Protection Agency.

The two regional inputs specific to Wisconsin are a 54.2% weighted value of 4.22 cents/kWh and a 45.8% weighted value of 3.74 cents/kWh. The cents/kWh by technology for each region is presented in Table F-2. The Team determined that the lower of the two value ranges were the most appropriate to use because they provide the most conservative estimate of program-induced health benefits. The Team blended these regional inputs to create a single weighted uniform energy efficiency value of 3.96 cents/kWh.

Table F-2. Wisconsin Specific Health Benefits

Region	Technology	Cents/kWh (Low Estimate)	Cents/kWh (High Estimate)
Great Lakes/Mid Atlantic	**Uniform energy efficiency**	**4.22**	**9.54**
Great Lakes/Mid Atlantic	Peak energy efficiency	4.30	9.70
Great Lakes/Mid Atlantic	Solar	4.39	9.95
Great Lakes/Mid Atlantic	Wind	4.02	9.11
Upper Midwest	**Uniform energy efficiency**	**3.74**	**8.45**
Upper Midwest	Peak energy efficiency	3.29	7.44
Upper Midwest	Solar	3.46	7.82
Upper Midwest	Wind	3.83	8.65
Weighted Average	**Uniform energy efficiency**	**3.96**	**8.94**

Aggregated health benefits are subsequently generated by applying the 3.96 cents/kWh to the first five years of lifecycle program savings. This is in line with EPA recommendations not to extend savings beyond that threshold because of the uncertainty in the share of generation each region is expected to draw from various fuel sources during that period. For example, coal generation is expected to start being supplanted by natural gas and renewable sources, which are less polluting than coal.

Water Benefits

The Evaluation Team estimated participant water delivery and wastewater bill savings attributed to reductions in volumetric water consumption accrued over the lifetime of efficient measures installed. These benefits are estimated for each program by the following equation:

$$\sum_{Measure=1}^{n} Units_{Measure} \times PV(Water\ Savings\ Per\ Unit_{Measure} \times Marginal\ Cost\ of\ Water, EUL_{Measure})$$

Where PV indicates a present value function that takes annual bill savings and number of periods as inputs and n indicates the count of unique measures installed within a particular program.

The marginal cost of water is then shown in this equation:

$$Marginal\ Cost\ of\ Water = (Marginal\ Cost\ of\ Water\ Delivery\ + Marginal\ Cost\ of\ Wastewater\ Service).$$

The Evaluation Team acquired input data from various sources:

- Measure quantity ($Units_{Measure}$) data was provided directly by Focus on Energy on a program-by-program basis.
- Volumetric water savings attributed to the efficient measure relative to some baseline measure ($Water\ Savings\ Per\ Unit_{Measure}$) was acquired from the Wisconsin Technical Reference Manual (TRM).
- The water delivery rate ($Marginal\ Cost\ of\ Water\ Delivery$) was estimated using a weighted averaging algorithm from a sample of 25 water utilities in Wisconsin. This sample includes the 10 largest water utilities in Wisconsin, a random sample of 10 utilities from the smallest 50% of utilities in Wisconsin, and a random sample of five additional utilities in Wisconsin, where size is measured by average number of customers served.[10]

  From these 25 utilities, the Evaluation Team calculated average marginal (volumetric) delivery rates for each utility for both residential and commercial sectors by taking the arithmetic mean of the highest and lowest rate tiers charged by each utility.[11] The Team then calculated overall rate estimates by taking weighted averages of these utility-wise averages for both residential and commercial sectors, where each utility's weight is proportional to the utility's average number of customers relative to the sum of each utility's average number of customers for all utilities included in the sample. The final water delivery rate estimates for Wisconsin are $2.50 and $2.89 per 100 cubic feet for residential and commercial sectors, respectively.

[10] Utility sales data was acquired from the PSC's E-Services Portal. Public Service Commission of Wisconsin. April 2020. *E-Services Portal: Municipal Annual Report Data*. http://apps.psc.wi.gov/vs2015/WEGS/default.aspx

[11] Utility tariff data was acquired from the Public Service of Wisconsin's E-Services Portal. PSC of Wisconsin. April 2020. *E-Services Portal: Utility Tariffs*. http://apps.psc.wi.gov/vs2010/tariffs/default.aspx?tab=4

Table F-3 summarizes the weighted averaging algorithm applied to residential rates in Wisconsin by showing intermediate calculation outputs.[12]

- The wastewater service rate ($Marginal\ Cost\ of\ Wastewater\ Service$) estimate was constructed from a population-weighted average of marginal (volumetric) wastewater charges for 326 (41%) Wisconsin wastewater service territories. The Evaluation Team acquired population and volumetric charge data from the *Wisconsin Sewer User Charge Survey Report*.[13] The final water wastewater estimate is $3.11 per 100 cubic feet for both residential and commercial. This estimate accounts for the prevalence of utilities with no volumetric wastewater charge.
- The expected useful life of an efficient measure ($EUL_{Measure}$) was provided by the TRM.
- Lastly, the Evaluation Team assumed a real annual interest rate of 2%.

Table F-3. Residential Water Rate Algorithm Example

Utility Size Bracket	Rank by Gallons Sold	Utility Name	Average Number of Customers	Weight (Number of Utility Customers/ Customers in Sample)	Highest/ Lowest Tier Rates	Rate Average
Top 10	1	Milwaukee Water Works	163,794	26.5%	$2.14	$2.14
	2	Green Bay Water Utility	72,262	11.7%	**Low:** $2.59; **High:** $1.81	$2.20
	3	Madison Water Utility	71,191	11.5%	**Low:** $2.55; **High:** $7.03	$4.79
	4	Appleton Water Department	56,179	9.1%	**Low:** $4.55; **High:** $3.50	$4.02
	5	Eau Claire Municipal Water Utility	54,902	8.9%	$1.65	$1.65
	6	Janesville Water Utility	47,504	7.7%	**Low:** $1.64; **High:** $2.77	$2.20
	7	West Allis Municipal Water Utility	39,324	6.4%	**Low:** $2.42; **High:** $2.08	$2.25
	8	Sheboygan Water Utility	38,035	6.2%	**Low:** $1.50; **High:** $1.13	$1.32
	9	Racine Water Works Commission	34,862	5.6%	**Low:** $2.58; **High:** $1.75	$2.17
	10	La Crosse Water Utility	33,040	5.3%	**Low:** $1.11; **High:** $1.59	$1.35

[12] Some Large Energy User Program participants obtain water from sources outside of conventional water delivery from a water utility, such as from natural bodies of water. These participants are not subject to the same marginal cost of delivery charged by water utilities. Because of an inability to reliably identify the source of water saved by program participants, the Evaluation Team conservatively assumes a water bill savings of $0 for Large Energy User Program customers.

[13] MSA Professional Services, Inc. October, 2019. *The Cost of Clean: Wisconsin Sewer User Charge Survey Report*.

Utility Size Bracket	Rank by Gallons Sold	Utility Name	Average Number of Customers	Weight (Number of Utility Customers/ Customers in Sample)	Highest/ Lowest Tier Rates	Rate Average
Random Sample of 10 from Smallest 50%	577	East Troy Sanitary District #3	20	0.0%	$2.39	$2.39
	442	Birnamwood Municipal Water Utility	286	0.1%	**Low:** $2.13; **High:** $1.38	$1.76
	310	Delafield Municipal Water Utility	671	0.1%	$2.43	$2.43
	540	Linden Tn of Sanitary Dist #1	122	0.0%	**Low:** $3.76; **High:** $2.19	$2.98
	…	…	…	…	…	…
	281	Mazomanie Water Utility	834	0.1%	**Low:** $1.98; **High:** $1.19	$1.59
Random Sample of Five from Throughout	284	Oakfield Village of Mun Wtr Uty	815	0.1%	**Low:** $4.88; **High:** $4.88	$4.88
	…	…	…	…	…	…
	373	Redgranite Water Utility	444	0.1%	**Low:** $1.50; **High:** $1.31	$1.40
Final Rate Estimate						**$2.50**

Purchase Deferral

Purchase deferral benefits account for the avoided costs of future baseline measure replacement in cases where the useful life of an efficient measure exceeds the useful life of the baseline measure it replaces. The Evaluation Team estimated purchase deferral benefits for lighting, where the expected useful life (EUL) of efficient measures (fixtures and lamps) tends to exceed those of their corresponding baseline measures.

The Evaluation Team assumes that program participants would have replaced each baseline measure with an identical baseline or equivalent at regular intervals equal to the baseline measure's useful life. Purchase deferral benefits are estimated for each program by the following generalized expression:

$$\sum_{Measure=1}^{n} Units_{Measure} \times PV(Avoided\ Replacement\ Costs_{Measure})$$

Where PV indicates a present value function and $Avoided\ Replacement\ Costs$ refers to the value of avoided baseline measure replacements over the lifetime of the efficient measure $Measure$.

For each efficient measure installed, the Evaluation Team attempted to identify a corresponding baseline measure from the Mid-Atlantic TRM because this TRM contains a study of purchase deferral benefits for lighting measures.[14] Where available, the Evaluation Team used the present value of purchase deferral benefits provided explicitly by the Mid-Atlantic TRM.

[14] Northeast Energy Efficiency Partnerships. October 2019. *Mid-Atlantic Technical Reference Manual, Version 9.* https://neep.org/sites/default/files/resources/Mid_Atlantic_TRM_V9_Final_clean_wUpdateSummary%20-%20CT%20FORMAT.pdf

In cases where the Mid-Atlantic TRM did not provide purchase deferral benefit estimates or the efficient measure installed through a Focus on Energy program was not an exact match, the Evaluation Team conducted research to identify the EUL (in life-hours and years) and the cost of the baseline measure indicated in the TRM. These two inputs were used to estimate benefits accrued from each avoided baseline replacement over the lifetime of the efficient measure, discounted by the Focus on Energy discount rate of 2%.

Property Values

Participating in energy-efficiency programs can increase the value of a home and the associated property. Customers who participate in whole-home programs, such as Home Performance with ENERGY STAR, are most likely to see increases in property values.

Cadmus completed a study for People Working Cooperatively (PWC), a provider of whole-home weatherization for low-income individuals in Cincinnati that researched the impact of low-income whole-home weatherization programs on home value.[15] Through this study, Cadmus found a $7,000 increase in property value for participants in the PWC program compared with similar homes for nonparticipants. Though the study was specific to low-income customers, Cadmus believes the increase in property value can be applied to all customers who complete a whole-home weatherization project.

Many factors can impact home value, which makes it difficult to measure this benefit. Therefore, the Evaluation Team used a net present value benefit of $7,000 per whole-home program participant (both Tier 1 and Tier 2) in the Home Performance with ENERGY STAR Program.

Arrearages

Outstanding customer debt incurs a cost on utility and customer, including costs associated with financing (carrying costs, bad debt write-offs) shutoffs, reconnections, sending notices, and collecting debts. Low-income programs provide customers the opportunity to reduce monthly bills, which in turn lowers the probability they will carry debt and, among those who do, helping to reduce the overall total.

Several utilities have included the reduced arrearage costs associated with providing low-income program benefits in their societal tests. However, there does not appear to be a universally agreed-upon per-participant value associated with these benefits. Limited primary research is available, and what does exist is not recent. Nevertheless, the Evaluation Team reviewed a benchmarking analyses from the Skumatz Economic Research Associates, Inc. and Cadmus in 2010 and 2014,[16,17] which compiled several potential inputs related to utility benefits associated with low-income programs.

---

[15] Cadmus. December 2012. *PWC 2009 Ohio Program Services Evaluation Report.* Prepared for People Working Cooperatively. http://www.pwchomerepairs.org/Assets/PWC_2009_Evaluation_FINAL_DEC12.pdf

[16] Skumatz Economic Research Associates, Inc. & The Cadmus Group. 2010. *Non Energy Benefits: Status, Findings, Next Steps, and Implications for Low Income Program Analyses in California – Revised Report.*

[17] Skumatz Economic Research Associates, Inc. 2014. *Non-Energy Benefits / Non-Energy Impacts (NEBS/NEIS) and Their Role & Values In Cost-Effectiveness Tests: State Of Maryland*.

As presented in Table F-4, the study found a typical arrearage-related carrying cost of $2.50 per participant, with an additional $1.75 cost associated with paying of bad debt and $2.15 in total costs from shutoffs and reconnects, notices, and customer calls/collections. In total, these direct arrearage costs sum to $6.40. An additional $13 per customer was also attributed to reduced low-income subsidy payments and discounts if the program was strictly low-income. Therefore, the Evaluation Team recommends that a per-participant value of $19.40 be applied to customers in the Low-Income Weatherization component of the Home Performance with ENERGY STAR Program based on the results of the most direct benchmarking research available.

Table F-4. Typical Utility Costs Associated with Customer Debt

NEB Estimates from Multiple Weatherization Studies: Dollar and Percentage Analysis	Dollar NEB Values Range Low-High	Typical Value	Percent NEB Values Range Low-High	Typical Value	Notes
UTILITY PERSPECTIVE					
Payment-related					
Carrying cost on arrearages	$1.50 - $4.00	$2.50	0.6% - 4.4%	2.0%	Total arrearages $2-$100; $20-30 typical
Bad Debt Write-offs	$0.50 - $3.75	$1.75	0.4% - 2.0%	0.7%	
Reduced LI subsidy pymt/discounts	$3.00 - $25.00	$13.00	3.9% - 29.0%	16.4%	IF low income program
Shutoffs / Reconnects	$0.10 - $3.65	$0.65	0.1% - 4.4%	0.5%	
Notices	$0.05 - $1.50	$0.60	0.1% - 1.8%	0.9%	
Customer calls / collections	$0.40 - $1.60	$0.90	0.2% - 1.9%	0.6%	

Source: Skumatz Economic Research Associates, Inc. 2014. *Non-Energy Benefits / Non-Energy Impacts (NEBS/NEIS) and Their Role & Values In Cost-Effectiveness Tests: State Of Maryland*.

The Evaluation Team reviewed other, more recent evaluations of the impact of various program designs on the amount of debt carried by participants. One of these programs, a pre-payment program in the upper Midwest, showed evidence that customers were able to eliminate approximately $68 in total debt after participating in the program for at least a calendar year. However, key differences between that program design and the low-income program offerings in Wisconsin make direct comparisons difficult. These differences include the targeting and/or opening of that program to customers who are not low-income. However, the total debt paid off through that program does not necessarily reflect the debt held by strictly low-income customers in Wisconsin's programs.

Interpreting Test Results

No single benefit/cost test can provide a comprehensive understanding of program performance or impacts in isolation. The results of tests that measure overall program cost-effectiveness, such as the modified TRC test, should be reviewed along with the results of other tests such as the UAT. Such a multi-perspective approach warrants a clear understanding of the tradeoffs among the tests.

Because of changes in avoided electric energy and natural gas costs and in emissions allowance prices for the current quadrennium (CY 2019-CY 2022), the cost-effectiveness results reported here are not directly comparable with results from the previous quadrennium (CY 2015-CY 2018). The changes to avoided costs tended to decrease the benefit/cost test results across all programs, when compared to the avoided costs used in the previous quadrennium.

Additionally, changes in the calculation of incremental measure costs further reduce the comparability between quadrenniums, as many measures, including most custom measures, saw their measure cost calculation approach revised between CY 2018 and CY 2019. As with avoided costs, these changes often

decreased the benefit/cost ratio at the portfolio level compared to the previous quadrennium. These externalities have an impact on program and overall portfolio cost-effectiveness; however, they do not directly reflect the overall performance of the Focus on Energy program.

Energy Avoided Costs

The PSC established the methodology to estimate electric and natural gas avoided energy costs for the CY 2019-CY 2022 Focus quadrennium under PSC docket 5-FE-101 (PSC REF#: 343909). The approach represents a continuation of the avoided cost methodology used for the CY 2015-CY 2018 quadrennium. The source for electric energy avoided costs are based on the Midcontinent Independent Transmission System Operator (MISO) forecasted locational marginal price (LMP), that is, the average of LMPs across Wisconsin nodes. Avoided natural gas costs are calculated based on Energy Information Administration 2018 Annual Energy Outlook forecasts of Henry Hub prices, adjusted using Wisconsin City Gate prices and retail prices. Compared to the previous quadrennium, avoided costs calculated using updated price forecasts for the current quadrennium evaluation are lower by approximately 30%, on average.

The PSC established the step-by-step methodology to estimate avoided electric capacity costs for the CY 2019-CY 2022 Focus quadrennium under PSC docket 5-FE-101 (PSC REF#: 390566).[18] The approach relies upon MISO-established Cost of New Entry (CONE) values as well as MISO Narrow Constrained Area net revenues to calculate avoided capacity costs. This methodology aligns with the PSC's decision for the CY 2019-CY 2022 Focus quadrennium that, for the purposes of evaluating Focus on Energy, avoided capacity costs shall be based on the unit costs of a peaker plant.

The forecast model decreases the verified gross energy savings by the conventional attribution factor of NTG to derive net savings. The net savings are then increased by the line loss factor of 8% to account for avoided distribution losses. Table F-5 shows the assumptions for the CY 2018 and CY 2019 evaluation avoided cost used for the cost-effectiveness tests.

Table F-5. Avoided Costs

Avoided Cost	CY 2018	CY 2019
Electric Energy ($/kWh)[a]	$0.04747–$0.06871	$0.03093–$0.04878
Electric Capacity ($/kW year)	$130.26	$117.43–$174.17
Gas ($/therms)[b]	$0.802–$1.278	$0.538–$0.764
Avoided Cost Inflation	0%	0%
Real Discount Rate	2%	2%
Line Loss	8%	8%

[a] The CY 2019 cost-effectiveness analyses used a time series that grows from $0.03093 to $0.06871 over 14 years in the forecast model.
[b] The natural gas avoided costs grow from $0.625 to $1.278 over a 25-year period based on growth rates from U.S. Energy Information Administration. May 7, 2014. *Annual Energy Outlook 2014*. https://www.eia.gov/outlooks/archive/aeo14/

[18] Public Service Commission of Wisconsin. June 1, 2020. *Quadrennial Planning Process III.* Order PSC Docket 5-FE-101, REF#: 390566. http://apps.psc.wi.gov/vs2015/ERF_view/viewdoc.aspx?docid=390566

Emissions Benefits

The modified TRC benefit/cost calculations include the benefit of avoiding three air pollutants that are regulated under the Clean Air Act. These are carbon dioxide, sulfur dioxide, and nitrogen oxide. Determining the emissions benefits requires three key parameters: lifecycle net energy savings, emissions factors or a tool that utilizes emissions factors, and the dollar value of the displaced emissions.

Emissions factors are the rate at which the criteria pollutants are emitted per unit of energy generated and are most often expressed in tons of pollutant per energy unit—electric is in tons/megawatt hour (MWh), and gas is in tons/thousand therms (MThm). The product of the emissions factor and the net energy savings is the total weight of air pollutant offset or avoided by the program.

The product of the total tonnage of pollutant saved and the dollar value of the reduced emissions per ton is, therefore, the avoided emissions benefit, as shown in this equation:

$$Value\ of\ Avoided\ Emissions\ = [Net\ Saved\ Energy\ x\ Emissions\ Factor\ x\ Value\ of\ Emissions\ Allowance]$$

For CY 2019, the Evaluation Team assessed the electric emissions benefits using a tool developed by the EPA to calculate avoided emissions from renewable energy and energy efficiency programs (the tool is officially called AVERT, or the AVoided Emissions and geneRation Tool). AVERT is a spreadsheet-based model that uses historical hourly generation and emissions data to determine the individual power plants that are likely to be displaced by energy efficiency or renewable energy during each hour of the year.

To use AVERT to calculate electric emissions benefits, the lifecycle net electric savings needed to be attributed to an AVERT region. These regions are well defined by the EPA—two cover Wisconsin at roughly 55% of the state's population in one region and 45% in the other. A mapping tool was created that uses zip code and the electric utility associated with the savings to identify the AVERT region for associated savings. In cases where savings could not be mapped to a region, the savings were attributed to each region by the ratio stated previously. Once savings could be organized by AVERT region, the program savings per AVERT region could be run through a region-specific version of AVERT, calculating the electric emissions benefits by region per program. By adding the benefits from both regions per program together, the program level electric emissions benefits were obtained.

In this way, AVERT uses a model from the previous year to compare the electricity generation avoided by the Focus on Energy programs during each hour of the year with the hourly generation information to determine the quantity of emissions displaced.

Table F-6 lists the gas emissions factor and allowance prices.

Table F-6. Emissions Factors and Allowance Price

Service Fuel Type	Carbon Dioxide	Nitrogen Oxide	Sulfur Dioxide
Gas Emissions Factor (Tons/MThm)	5.85	N/A	N/A
Allowance Price ($/Ton)	$15	$7.50	$2

The Evaluation Team continued to obtained nitrogen oxide and sulfur dioxide emissions allowance prices from the EPA's Cross State Air Pollution Rule, most recently updated in 2018.[19] The Team used the carbon dioxide emissions price in the PSC's Order, docket 5-5-FE-101, PSC REF#: 343909, which states, "The Commission finds it reasonable for Focus cost-effectiveness tests to continue valuing avoided carbon dioxide emissions using a market-based value of $15.00 per ton."[20] The natural gas emissions factor has remained constant since the CY 2011 evaluation report and is derived from a best-practice greenhouse gas inventory method developed by the California Energy Commission.[21]

Table F-7 lists the emissions benefits for all programs by residential and nonresidential segment.

Table F-7. Total Program Emissions Benefits by Segment

Program Year	Residential	Nonresidential	Pilots	Rural	Total
CY 2018 Emissions Benefits	$34,598,669	$67,349,281	$4,915,161	$2,838,264	$109,701,374
CY 2019 Emissions Benefits	$25,422,131	$91,289,103	N/A	$2,092,656	$118,803,890

Program Costs

The CY 2019 program costs were provided to the Evaluation Team from Focus on Energy's contract fiscal agent, the accounting firm Wipfli. The program costs represent all costs associated with running the efficiency programs (including administration and delivery costs). Note that incentive costs are not included as TRC costs because they are deemed transfer payments, which is consistent with industry guidelines defining the TRC test. Incentive costs are however used for other costs tests such as the UAT.

Incremental Costs

The gross incremental costs are the additional costs incurred as a result of purchasing efficient equipment over and above a baseline nonqualified product. The Evaluation Team derived the gross incremental cost values used in this CY 2019 evaluation from the incremental cost study conducted by the Program Administrator, Program Implementers, and Evaluation Team. This established up-to-date incremental costs for all measures based on the best available data, including historical Focus on Energy program data and independent research from other state programs. The gross incremental costs, like the energy savings values used in the cost-effectiveness tests, required the application of attribution factors to account for freeridership. Similar to the previous quadrennium's evaluation effort, the Evaluation Team assigned actual project cost values from the program tracking databases to the renewable energy projects.

---

19 U.S. Environmental Protection Agency. December 14, 2018. "Cross-State Air Pollution Rule." https://www.epa.gov/csapr

20 Public Service Commission of Wisconsin. June 6, 2018. *Quadrennial Planning Process III.* Order PSC Docket 5-FE-101, REF#: 343909. http://apps.psc.wi.gov/vs2015/ERF_view/viewdoc.aspx?docid=343909

21 California Air Resources Board. 2019. *California Greenhouse Gas Emissions for 2000 to 2017.* https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2017/ghg_inventory_trends_00-17.pdf

Cost-Effectiveness Results by Test

Table F-8 presents the inputs and results from the modified TRC test for the Focus on Energy CY 2019 energy efficiency and renewable resource program portfolio. Application of the modified TRC test showed that net statewide benefits to residents, businesses, and Focus on Energy from the CY 2019 programs were $371,155,052 overall. The benefits from the residential programs were 1.70 times greater than the costs, while the benefits from the nonresidential programs outweighed the costs by a factor of 2.99.

Table F-8. CY 2019 Sector-Level and Overall Results, Modified Total Resource Cost Test

	Residential	Nonresidential	Total
Administrative Costs	$2,775,789	$2,162,569	$4,938,358
Delivery Costs	$10,438,711	$22,652,104	$33,090,816
Incremental Measure Costs	$62,647,981	$134,864,170	$197,512,151
Total TRC Costs	**$75,862,481**	**$159,678,843**	**$235,541,325**
Electric Benefits	$77,102,530	$263,470,010	$340,572,539
Gas Benefits	$26,257,735	$121,062,212	$147,319,948
Emissions Benefits	$25,422,131	$93,381,759	$118,803,890
Total TRC Benefits	**$128,782,396**	**$477,913,981**	**$606,696,377**
TRC Benefits Minus Costs	**$52,919,915**	**$318,235,137**	**$371,155,052**
TRC Benefit/Cost Ratio	**1.70**	**2.99**	**2.58**

Table F-9 resents the inputs and results from the expanded TRC test for the Focus on Energy CY 2019 energy efficiency and renewable resource program portfolio. The expanded TRC test includes economic benefits from the portfolio.

Table F-9. CY 2019 Overall Results, Expanded Total Resource Cost Test

	Total
Administrative Costs	$4,938,358
Delivery Costs	$33,090,816
Incremental Measure Costs	$197,512,151
Total TRC Costs	**$235,541,325**
Electric Benefits	$340,572,539
Gas Benefits	$147,319,948
Emissions Benefits	$118,803,890
Economic Benefits	$347,613,194
Total TRC Benefits	**$954,309,571**
TRC Benefits Minus Costs	**$718,768,246**
TRC Benefit/Cost Ratio	**4.05**

Table F-10 presents the inputs and results from the UAT for the CY 2019 Focus on Energy portfolio. The benefits from the residential programs were 2.82 times greater than the costs, while the benefits from the nonresidential programs outweighed the costs by a factor of 5.74.

Table F-10. CY 2019 Overall Results, Utility Administrator Cost Test

	Residential	Nonresidential	Total
Incentive Costs	$23,490,150	$42,220,856	$65,711,006
Administrative Costs	$2,775,789	$2,162,569	$4,938,358
Delivery Costs	$10,438,711	$22,652,104	$33,090,816
Total UAT Costs	**$36,704,651**	**$67,035,529**	**$103,740,180**
Electric Benefits	$77,102,530	$263,470,010	$340,572,539
Gas Benefits	$26,257,735	$121,062,212	$147,319,948
Total UAT Benefits	**$103,360,265**	**$384,532,222**	**$487,892,487**
UAT Benefits Minus Costs	**$66,655,614**	**$317,496,693**	**$384,152,307**
UAT Benefit/Cost Ratio	**2.82**	**5.74**	**4.70**

Table F-11 shows the inputs and results from the RIM test for CY 2019 energy efficiency and renewable resource programs. As expected, estimated benefit/cost value from the RIM test is less than 1. When interpreted within the context of the UAT test results, these findings indicate that although annual Focus on Energy activities will probably induce theoretical upward pressure on future energy rates, total ratepayer energy costs will go down.

Table F-11. CY 2019 Sector-Level and Overall Results, Ratepayer Impact Measure Test

	Residential	Nonresidential	Total
Incentive Costs	$23,490,150	$42,220,856	$65,711,006
Electric Lost Revenues	$160,497,012	$308,375,968	$468,872,980
Gas Lost Revenues	$15,502,058	$78,582,905	$94,084,963
Admin Costs	$2,775,789	$2,162,569	$4,938,358
Delivery Costs	$10,438,711	$22,652,104	$33,090,816
Total RIM Costs	**$212,703,721**	**$453,994,402**	**$666,698,123**
Electric Benefits	$77,102,530	$263,470,010	$340,572,539
Gas Benefits	$26,257,735	$121,062,212	$147,319,948
Total RIM Benefits	**$103,360,265**	**$384,532,222**	**$487,892,487**
RIM Benefits Minus Costs	**($109,343,456)**	**($69,462,180)**	**($178,805,636)**
RIM Benefit/Cost Ratio[a]	**0.49**	**0.85**	**0.73**

[a] For the CY 2019 cost-effectiveness analysis, the lost revenue portion of the RIM test assumes a fixed utility rate that does not escalate over time, while the avoided energy costs are escalated on a yearly basis resulting in greater benefits than costs for the nonresidential portfolio.

Table F-12 shows the inputs and results from the societal test for CY 2019 energy efficiency and renewable resource programs. As expected, estimated benefit/cost value from the societal test is the highest of all the tests, including the same costs as the modified TRC, with additional non-energy benefits. When interpreted within the context of the modified TRC test results, these findings suggest that substantial additional benefits are provided by Focus on Energy activities, generating additional value in terms of personal health cost savings, water savings, lighting purchase deferrals, property values and arrearage repayment assistance. The benefits from the residential programs were 2.23 times greater than the costs, while the benefits from the nonresidential programs outweighed the costs by a factor of 3.43.

Table F-12. CY 2019 Sector-Level and Overall Results, Societal Test

	Residential	Nonresidential	Total
Incentive Costs	$23,490,150	$42,220,856	$65,711,006
Administrative Costs	$2,775,789	$2,162,569	$4,938,358
Delivery Costs	$10,438,711	$22,652,104	$33,090,816
Incremental Measure Costs	$62,647,981	$134,864,170	$197,512,151
Total Non-Incentive Costs	**$75,862,481**	**$159,678,843**	**$235,541,325**
Electric Benefits	$77,102,530	$263,470,010	$340,572,539
Gas Benefits	$26,257,735	$121,062,212	$147,319,948
Emissions Benefits	$25,422,131	$93,381,759	$118,803,890
Health Benefits	$18,465,088	$69,342,664	$87,807,752
Water Benefits	$3,582,811	$318,092	$3,900,903
Other Non Energy Benefits [a]	$18,467,651	$470,378	$18,938,029
Economic Benefits			$347,613,194
Total SOC Benefits	**$169,297,946**	**$548,045,115**	**$1,064,956,255**
SOC Benefits Minus Costs	**$93,435,464**	**$388,366,272**	**$829,414,930**
SOC Ratio	**2.23**	**3.43**	**4.52**

[a] Includes Purchase Deferral for Lighting Measures, Property Values, and Arrearages

Cost-Effectiveness Results by Program

Table F-13 and Table F-14 provide the sector-level and overall results of the cost-effectiveness analysis shown by core efficiency programs, pilots, and renewables. In CY 2019, cost-effectiveness is presented in more detail because of the presence of new pilot and rural programs. Incentive costs are provided below, but they are not included in the TRC calculation. The TRC ratio equals the total TRC benefits divided by total non-incentive costs. Table F-15 provides UAT rest results. Table F-16 provides RIM test results. Table F-17 provides societal test results.

Table F-13. CY 2019 Overall Cost-Effectiveness Analysis with Portfolio Breakout

Focus on Energy Benefits and Costs		Portfolio Breakout	Core Efficiency	Pilots	Rural	Renewables
Incentives	$65,711,006		$59,293,753	N/A	$2,075,570	$4,341,683
Modified TRC Benefits	$606,696,377		$558,745,917	N/A	$9,960,916	$37,989,543
Modified TRC Costs	$235,541,325		$206,395,446	N/A	$4,043,144	$25,102,735
Portfolio TRC Ratio	**2.58**	Alone	**2.71**	**N/A**	**2.46**	**1.51**
		With Core		**N/A**	**2.70**	**2.58**
		With Core and Pilots (All Efficiency)			**2.70**	**2.58**
		With Core, Pilots, and Rural				**2.58**

Table F-14. CY 2019 Overall with Renewables Separate Cost-Effectiveness Analysis, Modified Total Resource Cost Test

	Residential	Nonresidential	Renewables	Total
Incentive Costs	$22,066,771	$39,302,551	$4,341,683	$65,711,006
Administrative Costs	$2,735,394	$2,146,389	$56,575	$4,938,358
Delivery Costs	$10,169,225	$22,355,880	$565,710	$33,090,816
Incremental Measure Costs	$51,614,297	$121,417,404	$24,480,450	$197,512,151
Total Non-Incentive Costs	**$64,518,917**	**$145,919,673**	**$25,102,735**	**$235,541,325**
Electric Benefits	$65,367,532	$242,708,751	$32,496,256	$340,572,539
Gas Benefits	$26,257,735	$121,062,212	$0	$147,319,948
Emissions Benefits	$23,863,428	$89,447,175	$5,493,287	$118,803,890
Total TRC Benefits	**$115,488,695**	**$453,218,138**	**$37,989,543**	**$606,696,377**
TRC Benefits Minus Costs	**$50,969,778**	**$307,298,465**	**$12,886,808**	**$371,155,052**
TRC Ratio	**1.79**	**3.11**	**1.51**	**2.58**

Table F-15. CY 2019 Overall with Renewables Separate Cost-Effectiveness Analysis, Utility Administrator Cost Test

	Residential	Nonresidential	Renewables	Total
Incentive Costs	$22,066,771	$39,302,551	$4,341,683	$65,711,006
Administrative Costs	$2,735,394	$2,146,389	$56,575	$4,938,358
Delivery Costs	$10,169,225	$22,355,880	$565,710	$33,090,816
Total Non-Incentive Costs	**$34,971,390**	**$63,804,821**	**$4,963,968**	**$103,740,180**
Electric Benefits	$65,367,532	$242,708,751	$32,496,256	$340,572,539
Gas Benefits	$26,257,735	$121,062,212	$0	$147,319,948
Total UAT Benefits	**$91,625,267**	**$363,770,963**	**$32,496,256**	**$487,892,487**
UAT Benefits Minus Costs	**$56,653,877**	**$299,966,143**	**$27,532,288**	**$384,152,307**
UAT Ratio	**2.62**	**5.70**	**6.55**	**4.70**

Table F-16. CY 2019 Overall with Renewables Separate Cost-Effectiveness Analysis, Ratepayer Impact Measure Test

	Residential	Nonresidential	Renewables	Total
Incentive Costs	$22,066,771	$39,302,551	$4,341,683	$65,711,006
Electric Lost Revenues	$160,497,012	$284,955,134	$23,420,834	$468,872,980
Gas Lost Revenues	$15,502,058	$78,582,905	$0	$94,084,963
Admin Costs	$2,735,394	$2,146,389	$56,575	$4,938,358
Delivery Costs	$10,169,225	$22,355,880	$565,710	$33,090,816
Total RIM Costs	**$210,970,460**	**$427,342,860**	**$28,384,803**	**$666,698,123**
Electric Benefits	$65,367,532	$242,708,751	$32,496,256	$340,572,539
Gas Benefits	$26,257,735	$121,062,212	$0	$147,319,948
Total RIM Benefits	**$91,625,267**	**$363,770,963**	**$32,496,256**	**$487,892,487**
RIM Benefits Minus Costs	**($119,345,193)**	**($63,571,896)**	**$4,111,453**	**($178,805,636)**
RIM B/C Ratio	**0.43**	**0.85**	**1.14**	**0.73**

Table F-17. Overall with Renewables Separate Cost-Effectiveness Analysis, Societal Test

	Residential	Nonresidential	Renewables	Total
Incentive Costs	$22,066,771	$39,302,551	$4,341,683	$65,711,006
Administrative Costs	$2,735,394	$2,146,389	$56,575	$4,938,358
Delivery Costs	$10,169,225	$22,355,880	$565,710	$33,090,816
Incremental Measure Costs	$51,614,297	$121,417,404	$24,480,450	$197,512,151
Total Non-Incentive Costs	**$64,518,917**	**$145,919,673**	**$25,102,735**	**$235,541,325**
Electric Benefits	$65,367,532	$242,708,751	$32,496,256	$340,572,539
Gas Benefits	$26,257,735	$121,062,212	$0	$147,319,948
Emissions Benefits	$23,863,428	$89,447,175	$5,493,287	$118,803,890
Health Benefits	$17,275,804	$67,054,135	$3,477,814	$87,807,752
Water Benefits	$3,582,811	$318,092	$0	$3,900,903
Other Non Energy Benefits[1]	$18,467,651	$470,378	$0	$18,938,029
Economic Benefits				$347,613,194
Total SOC Benefits	**$154,814,960**	**$521,060,744**	**$41,467,357**	**$1,064,956,255**
SOC Benefits Minus Costs	**$90,296,044**	**$375,141,071**	**$16,364,622**	**$829,414,930**
SOC Ratio	**2.40**	**3.57**	**1.65**	**4.52**

[1] Includes Purchase Deferral for Lighting Measures, Property Values, and Arrearages

Table F-18 provides the residential program cost-effectiveness analysis. Incentive costs are provided below, but they are not included in the TRC calculation. The TRC ratio equals the total TRC benefits divided by total non-incentive costs. The program values provided are exclusive of pilot, and rural programs and sub-programs.

Table F-18. CY 2019 Residential Programs Cost-Effectiveness Analysis

	Multifamily		Appliance Recycling	Home Performance with ENERGY STAR	New Homes	Retail Lighting and Appliance	Simple Energy Efficiency	Design Assistance Residential	Renewable Rewards Residential	Online Marketplace
	Energy Savings	New Construction								
Incentive Costs	$1,365,740	$0	$218,725	$7,300,875	$1,386,950	$1,423,379	$1,337,525	$939,978	$1,423,379	$75,480
Administrative Costs	$880,282	$0	$0	$174,980	$468,188	$40,395	$0	$0	$40,395	$0
Delivery Costs	$896,793	$0	$1,119,630	$3,044,229	$535,495	$269,486	$1,062,904	$207,711	$269,486	$114,000
Incremental Measure Costs	$3,338,070	$0	$506,893	$34,964,090	$1,113,765	$11,033,684	$717,505	$4,957,527	$11,033,684	$289,118
Total Non-Incentive Costs	**$5,115,145**	**$0**	**$1,626,523**	**$38,183,300**	**$2,117,447**	**$11,343,565**	**$1,780,410**	**$5,165,238**	**$11,343,565**	**$403,118**
Electric Benefits (kWh)	$3,105,224	$0	$1,134,851	$8,720,195	$0	$5,125,473	$5,321,907	$2,968,968	$5,125,473	$280,946
Electric Benefits (kW)	$1,132,767	$0	$511,083	$7,931,590	$0	$6,609,524	$1,974,134	$1,345,135	$6,609,524	$17
Gas Benefits	$2,948,947	$0	$0	$13,525,323	$358,326	$0	$2,873,491	$5,110,377	$0	$278,910
Emissions Benefits	$1,720,294	$0	$486,949	$3,923,387	$61,429	$1,558,704	$2,665,387	$2,019,594	$1,558,704	$106,024
Total TRC Benefits	**$8,907,232**	**$0**	**$2,132,884**	**$34,100,495**	**$419,754**	**$13,293,701**	**$12,834,919**	**$11,444,075**	**$13,293,701**	**$665,897**
TRC Benefits Minus Costs	**$3,792,087**	**$0**	**$506,360**	**($4,082,804)**	**($1,697,693)**	**$1,950,136**	**$11,054,509**	**$6,278,837**	**$1,950,136**	**$262,779**
TRC Ratio	**1.74**	**N/A**	**1.31**	**0.89**	**0.20**	**4.75**	**7.21**	**2.22**	**1.17**	**1.65**

Table F-19 provides nonresidential program cost-effectiveness analysis. Incentive costs are provided below, but they are not included in the TRC calculation. The TRC ratio equals the total TRC benefits divided by total non-incentive costs. The program values provided are exclusive of pilot, and rural programs and sub-programs.

Table F-19. CY 2019 Nonresidential Programs Cost-Effectiveness Analysis

	Small Business	Renewable Energy Competitive Incentive	Design Assistance Nonres.	Business Incentive	Agriculture, Schools, and Government	Large Energy Users	Emerging Technology	Renewable Rewards Business	Midstream Commercial Industrial Lighting	Midstream Commercial Kitchen Equipment
Incentive Costs	$4,931,497	$2,564,784	$3,198,288	$7,936,674	$9,192,951	$12,105,098	$0	$231,237	$18,104	$44,350
Administrative Costs	$111,057	$10,499	$0	$228,570	$611,077	$988,987	$179,587	$821	$0	$0
Delivery Costs	$2,331,175	$197,990	$2,172,234	$4,652,334	$4,378,158	$6,940,102	$493,472	$77,455	$0	$0
Incremental Measure Costs	$9,275,204	$13,446,767	$19,884,491	$18,101,876	$34,525,010	$36,988,707	$0	**$0**	$29,106	$55,904
Total Non-Incentive Costs	**$11,717,437**	**$13,655,255**	**$22,056,725**	**$22,982,780**	**$39,514,246**	**$44,917,797**	**$673,059**	**$78,275**	**$29,106**	**$55,904**
Electric Benefits (kWh)	$18,834,452	$9,482,792	$14,907,233	$31,907,096	$32,102,961	$59,000,320	$0	**$0**	$43,428	$29,263
Electric Benefits (kW)	$8,894,942	$11,278,467	$8,748,012	$16,960,668	$16,586,707	$26,935,705	$0	**$0**	$31,531	$68,082
Gas Benefits	$3,018,131	$0	$6,577,340	$2,822,054	$14,594,977	$93,839,800	$0	**$0**	$0	$0
Emissions Benefits	$8,479,641	$3,282,255	$7,253,514	$15,149,643	$16,578,973	$39,856,543	$0	$545,332	$15,157	$21,048
Total TRC Benefits	**$39,227,166**	**$24,043,514**	**$37,486,100**	**$66,839,461**	**$79,863,619**	**$219,632,368**	**$0**	**$545,332**	**$90,115**	**$118,394**
TRC Benefits Minus Costs	**$27,509,729**	**$10,388,259**	**$15,429,375**	**$43,856,681**	**$40,349,373**	**$174,714,571**	**($673,059)**	**$467,057**	**$61,009**	**$62,490**
TRC Ratio	**3.35**	**1.76**	**1.70**	**2.91**	**2.02**	**4.89**	**N/A**	**6.97**	**3.10**	**2.12**

Table F-20 provides results of the cost-effectiveness analysis for programs targeted to customers in rural areas.

Table F-20. CY 2019 Rural Cost-Effectiveness Analysis

	Farmhouse Kits	Residential Pop-Up at Large Employers	Community Small Business Offering	Communications Providers Initiative	Business Incentive Rural Industrial	Rural Outreach and Equipment	Rural Training
Incentive Costs	$22,499	$282,129	$1,075,549	$166,155	$329,256	$0	$0
Administrative Costs	$0	$2,487	$1,466	$3,000	$13,875	$6,283	$0
Delivery Costs	$10,679	$124,436	$65,342	$57,000	$488,625	$421,307	$221,016
Incremental Measure Costs	$16,101	$0	$1,010,592	$654,637	$875,773	$0	$0
Total Non-Incentive Costs	**$26,780**	**$126,923**	**$1,077,401**	**$714,637**	**$1,378,273**	**$427,589**	**$221,016**
Electric Benefits (kWh)	$24,090	$0	$2,400,864	$1,581,037	$1,475,278	$0	$0
Electric Benefits (kW)	$120,563	$0		$283,601	$608,428	$0	$0
Gas Benefits	$59,709	$0	$1,164,488	$0	$3,273	$0	$0
Emissions Benefits	$39,121	$200,934	$146,929	$322,935	$432,310	$0	$0
Total TRC Benefits	**$243,483**	**$200,934**	**$1,097,356**	**$2,187,573**	**$2,519,289**	**$0**	**$0**
TRC Benefits Minus Costs	**$216,703**	**$74,011**	**$4,809,637**	**$1,472,936**	**$1,141,016**	**($427,589)**	**($221,016)**
TRC Ratio	**9.09**	**1.58**	**4.46**	**3.06**	**1.83**	**N/A**	**N/A**

Cost-Effectiveness Results for Renewables

Table F-21 lists the CY 2018 and CY 2019 cost-effectiveness results, with renewables excluded and with renewables included.

Table F-21. Cost-Effectiveness Results for Focus on Energy Portfolio

Calendar Year	Residential	Nonresidential	Renewables	Total
CY 2018: Modified TRC Test Result with Renewables	2.37	4.95	N/A	**3.66**
CY 2018: Modified TRC Test Result Renewables Excluded	2.52	5.6	1.45	**3.66**
CY 2019: Modified TRC Test Result with Renewables	1.70	2.99	N/A	**2.58**
CY 2019: Modified TRC Test Result Renewables Excluded	1.79	3.11	1.51	**2.58**

Appendix G. Summary of Confidence and Precision

Focus on Energy gives significant consideration to evaluation design to ensure that its programs achieve the most accurate and reliable results possible under the available evaluation budget. The evaluation uses statistical confidence and precision standards as a key driver in determining the scale and scope of the evaluation design for each program for which the target for net savings over the CY 2019-CY 2022 quadrennium is 90% confidence and 10% precision.

The Evaluation Team calculated the precision of final net first-year and lifetime energy savings estimates (MMBtu) at 90% confidence for each program in the Focus on Energy portfolio. The precision reflects the uncertainty in the savings estimates because of measurement error, regression error, and sampling error. Measurement error refers to the uncertainty around engineering parameters derived from simulation or professional judgment, regression error refers to uncertainty around estimates derived from regression analysis, and sampling error refers to uncertainty introduced by estimating population parameters based on a sample.

After calculating standard errors, the Evaluation Team calculated the precision of the final estimates using the following formula:

$$relative\ precision = \frac{z\text{-}statistic * SE}{total\ net\ savings}$$

Where:

z-statistic	=	Critical value at a specific confidence level
SE	=	Standard error of the total net savings estimate
total net savings	=	Total net savings estimated based on the evaluation results

This appendix provides details on how the Evaluation Team calculated total net savings estimates and their standard errors.

Introduction to Statistical Uncertainty

The Evaluation Team collected data from surveys, billing histories, meters, and secondary sources including the technical resource manual (TRM) to estimate net savings for each program and the portfolio. Statistical uncertainty is inherent in all activities for which samples or models are used to estimate a property of a population. Using sampled data is often preferred to save on costs and time associated with studying an entire population and because random samples of the population provide sufficiently reliable results. The strength of an estimate is related to the amount of uncertainty or error around it, which is determined based on the statistical properties of sampled data and how they are used to make inferences about a population.

Statistical uncertainty comprises two parts: the confidence and the precision of the estimate. Confidence intervals show the range of values within which one expects the unknown population

parameter to fall. Confidence refers to the probability that the true value of the metric of interest (such as kilowatt-hours saved) will fall within some level of precision.

A statement of precision without a statement of confidence is misleading. For example, if energy savings is estimated as 24 kWh with precision of ±5 kWh at 90% confidence, the interpretation is that one is 90% confident that the true energy savings is between 19 kWh and 29 kWh. Narrower confidence intervals indicate that the savings estimate is very precise, and wider confidence intervals indicate that the variability in the data is large and that more information would be required to produce a more precise estimate.

For the Focus on Energy evaluation, the general standard for uncertainty is to achieve evaluation results with 90% confidence and 10% precision over the CY 2019-CY 2022 quadrennium. Evaluation activities are defined and prioritized to align with this standard. This standard is in line with nationwide best practices for the evaluation of energy efficiency programs, as documented in the U.S. Environmental Protection Agency's National Action Plan for Energy Efficiency and elsewhere.[22]

Combining Net Uncertainty with Gross Uncertainty

When two estimates are based on different evaluation activities and combined to produce a final estimate, the uncertainty from each estimate must be considered in calculating the uncertainty of the final estimate. For example, if one set of data collected from surveys, billing analyses, metering, and/or TRM review is used to estimate gross savings and another set of data collected from a separate survey is used to estimate spillover, freeridership, and net-to-gross (NTG) ratios and then that NTG ratio is applied to the gross savings to estimate net savings, the standard error of total net savings should be based on the standard error of gross savings and the NTG ratio. Details are provided below, specific to each set of programs.

When the Evaluation Team estimated NTG ratios using survey data collected from an independent simple random sample of participants, it used a ratio estimator and its standard error formula to quantify the uncertainty in the NTG ratios where net savings are represented by y_i, *ex post* savings are represented by x_i, and the standard error of the NTG ratio estimate is represented by SE_{NTG}, in the following formulas:

$$NTG\ Ratio = \frac{\sum_{sample} y_i}{\sum_{sample} x_i}$$

$$SE_{NTG} = \sqrt{\sum_{i=1}^{n} \frac{(y_i - NTG\ Ratio * x_i)^2}{\bar{x}^2 * n(n-1)}}$$

[22] U.S. Environmental Protection Agency. Accessed April 2019. "Energy and the Environment. National Action Plan for Energy Efficiency." https://www.epa.gov/energy/national-action-plan-energy-efficiency

The Evaluation Team then multiplied the NTG ratio to the total *ex post* gross savings to estimate total net savings and used the formula for the standard error of the product of two independent random variables to calculate precision, as shown in this formula:

$$SE_{total\ net\ savings} = \sqrt{NTG^2 * SE^2_{total\ ex\ post\ gross\ savings} + total\ ex\ post\ gross\ savings^2 * SE^2_{NTG} + SE^2_{NTG} * SE^2_{total\ ex\ post\ gross\ savings}}$$

The Evaluation Team used this method for all programs unless otherwise noted.

Nonresidential Programs

The Evaluation Team selected a sample of projects in each nonresidential program to estimate *ex post* verified gross savings. It used a probability proportional to size sample design to increase the likelihood of selecting projects with the highest *ex ante* MMBtu savings. It then assessed *ex post* verified gross savings for sampled projects and calculated program level realization rates.

The Evaluation Team applied the realization rates to the population total *ex ante* savings in each program to estimate the population total *ex post* gross savings. It calculated realization rates and standard errors using the formulas presented in the Uniform Methods Project (UMP) sampling chapter where the weights (w_i) are proportional to the sampling probabilities (contribution to savings), *ex ante* savings are represented by x_i, and *ex post* savings are represented by y_i:[23]

$$RR = \frac{\sum_{sample} w_i y_i}{\sum_{sample} w_i x_i}$$

$$total\ ex\ post\ gross\ savings = RR * \sum_{population} w_i x_i$$

$$SE_{total\ ex\ post\ gross\ savings} = \sqrt{\sum_{i=1}^{n} w_i (w_i - 1)(y_i - RR * x_i)^2}$$

The Team estimated nonresidential NTG ratios using survey data collected from an independent simple random sample of participants then multiplied these ratios with the total *ex post* gross savings to estimate total net savings for each program. It used a ratio estimator and standard error formula described above to quantify the uncertainty in the NTG ratios.

Table G-1 presents the precision of total net first and cumulative year MMBtu savings estimates at 90% confidence for each nonresidential program. The sources of uncertainty in all nonresidential savings estimates were due to estimating the realization rate and NTG values based on samples.

[23] National Renewable Energy Laboratory. April 2013. *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.* "Chapter 11: Sample Design Cross-Cutting Protocols." Prepared by Cadmus. http://energy.gov/sites/prod/files/2013/11/f5/53827-11.pdf

Table G-1. Nonresidential Net First-Year MMBtu Energy Savings Precision

Nonresidential Programs	Precision at 90% Confidence				
	CY 2019	CY 2020	CY 2021	CY 2022	Cumulative
Agriculture, Schools and Government	17%	TBD	TBD	TBD	17%
Business Incentive	33%	TBD	TBD	TBD	33%
Design Assistance	19%	TBD	TBD	TBD	19%
Large Energy Users	17%	TBD	TBD	TBD	17%
Small Business	10%	TBD	TBD	TBD	10%
Renewable Energy Competitive Incentive	10%	TBD	TBD	TBD	10%

Residential Programs

The Evaluation Team used various methods to evaluate the residential programs. It applied the methods described above for the nonresidential programs to the Multifamily Direct Install and Multifamily Energy Savings programs. Methods for the remaining programs are described below. Table G-2 presents the precision of total net savings estimates and the sources of uncertainty for each residential program, by program year as well as cumulative.

Table G-2. Residential Net First-Year MMBtu Energy Savings Precision (90% Confidence)

Residential Programs	Precision at 90% Confidence					Sources of Uncertainty
	CY 2019	CY 2020	CY 2021	CY 2022	Cumulative	
Appliance Recycling	38%	TBD	TBD	TBD	38%	UEC Model, Part Use, and NTG ratio
Multifamily Energy Savings	12%	TBD	TBD	TBD	12%	Realization rate and NTG ratio
Home Performance with ENERGY STAR—Whole Home Tier 1, Electric	19%	TBD	TBD	TBD	19%	PRISM model
Home Performance with ENERGY STAR—Whole Home Tier 1, Gas	9%	TBD	TBD	TBD	9%	PRISM model
Home Performance with ENERGY STAR –Whole Home Tier 2, Electric	28%	TBD	TBD	TBD	28%	PRISM model
Home Performance with ENERGY STAR—Whole Home Tier 2, Gas	15%	TBD	TBD	TBD	15%	PRISM model
Home Performance with ENERGY STAR—HVAC Path	1%	TBD	TBD	TBD	1%	NTG ratio
Home Performance with ENERGY STAR— Renewables	12%	TBD	TBD	TBD	12%	NTG ratio
New Homes Program	122%[1]	N/A	N/A	N/A	122%	PRISM model
Retail Lighting and Appliances	53%	TBD	TBD	TBD	53%	ISR and NTG ratio
Simple Energy Efficiency	2%	TBD	TBD	TBD	2%	Survey estimated ISRs
Online Marketplace	10%	TBD	TBD	TBD	10%	ISR and NTG ratio

[1] High relative precision around first-year MMBtu savings in the New Homes Program resulted from a small savings estimate (0.004 therms/sqft).

Appendix H. Measure Analysis

This appendix describes the analyses of measures offered for specific Focus on Energy programs during CY 2019. It includes the methodologies the Evaluation Team followed and describes the results applied to the CY 2019 program evaluations.

This appendix describes how the Evaluation Team estimated per-unit savings for recycled refrigerators and freezers in the Appliance Recycling Program and LED per-bulb savings in the Retail Lighting and Appliance Program.

This appendix also describes the Team's analysis of realization rates for a sample of projects from these nonresidential programs—Agriculture, Schools and Government, Business Incentive, Large Energy Users, Renewable Energy Competitive Incentive, and Small Business—and one residential program, Multifamily Energy Savings.

Appliance Recycling Program

In CY 2019, the Evaluation Team estimated the per-unit savings for recycled refrigerators and freezers using the same meter data and multivariate regression models as in the CY 2013–CY 2018 evaluations.

Regression Models

Table H-1 shows the model specification the Team used to estimate the annual energy consumption of refrigerators recycled in CY 2019 along with the model's estimated coefficients.

Table H-1. Refrigerator Unit Energy Consumption Regression Model Estimates (Dependent Variable = Average Daily kWh, R-squared = 0.30)

Independent Variables	Coefficient	p-Value
Intercept	0.80	0.134
Age (years)	0.02	0.035
Dummy: Manufactured Pre-1990	1.04	0.000
Size (square 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 x Heating Degree Days (HDDs)	-0.04	0.000
Interaction: Unconditioned Space x Cooling Degree Days (CDDs)	0.03	0.239

Table H-2 details the final model specifications the Team used to estimate the energy consumption of participating freezers recycled in CY 2019 along with the model's estimated coefficients.

Table H-2. Freezer Unit Energy Consumption Regression Model Estimates (Dependent Variable = Average Daily kWh, R-squared = 0.38)

Independent Variables	Coefficient	p-Value
Intercept	-0.95	0.236
Age (years)	0.05	0.010
Dummy: Manufactured Pre-1990	0.54	0.202
Size (square feet)	0.12	0.001
Dummy: Chest Freezer	0.30	0.273
Interaction: Unconditioned Space x HDDs	-0.03	0.035
Interaction: Unconditioned Space x CDDs	0.08	0.026

Extrapolation

After estimating the final regression models, the Evaluation Team analyzed the corresponding characteristics (independent variables) for participating appliances as they were captured in the Program Administrator's Program database.[24] Table H-3 summarizes Appliance Recycling Program averages or proportions for each independent variable.

Table H-3. CY 2019 Participant Mean Explanatory Variables

Appliance	Independent Variables	Participant Population Mean Value
Refrigerator	Age (years)	21.93
	Dummy: Manufactured Pre-1990	0.17
	Size (square feet)	18.67
	Dummy: Single Door	0.03
	Dummy: Side-by-Side	0.13
	Dummy: Primary	0.38
	Interaction: Unconditioned Space x HDDs[a]	7.11
	Interaction: Unconditioned Space x CDDs[a]	0.5
Freezer	Age (years)	24.68
	Dummy: Manufactured Pre-1990	0.29
	Size (square feet)	16.50
	Dummy: Chest Freezer	0.31
	Interaction: Unconditioned Space x HDDs[a]	8.13
	Interaction: Unconditioned Space x CDDs[a]	0.58

[a] CDDs and HDDs derive from the weighted average from typical meteorological year data for weather stations the Evaluation Team mapped to participating appliance zip codes. Typical meteorological year data uses median daily values for a variety of weather data collected from 1991–2005.

[24] These data were not available in SPECTRUM. The Evaluation Team requested and received these data from ARCA, the Program Implementer, in February 2019.

Using the values from Table H-1, Table H-2, and Table H-3, the Evaluation Team estimated the *ex post* annual unit energy consumption (UEC) of the average refrigerator and freezer participating in the Appliance Recycling Program. Table H-4 shows the estimated *ex post* estimates.

Table H-4. Average UEC by Appliance Type

Appliance	*Ex Post* Annual UEC (kWh/year)	Relative Precision (90% Confidence)
Refrigerators	1,014	±11%
Freezers	881	±22%

Part-Use Factor

Part-use is an adjustment factor specific to appliance recycling that is used to convert the UEC into an average per-unit gross savings. The UEC itself is not equal to the gross savings for these two reasons:

- The UEC model yields an estimate of annual consumption.
- Not all recycled refrigerators would have operated year-round had they not been decommissioned through the program.

The part-use methodology relies on information from surveyed participants regarding how the unit was used prior to participating in the program, that is, how many months of the year the appliance was plugged in and running prior to recycling.

The final estimate of part-use reflects how appliances were likely to operate had they not been recycled (rather than how they previously operated). For example, it is possible that a primary refrigerator operated year-round would have become a secondary appliance and operated part-time.

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

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

The Evaluation Team calculated a weighted average part-use factor, representing the three participant usage categories as defined by the appliance's operational status during the year before recycling. For example, the Team gave participants who did not use their appliance at all during the year prior to its recycling a part-use factor of zero, as no immediate savings were generated by the appliance's retirement.

Using information gathered through participant surveys, the Team took the following steps to determine part-use:

1. Determined whether recycled refrigerators were primary or secondary units (treating all stand-alone freezers as secondary units).
2. Asked participants who indicated they had recycled a secondary refrigerator or freezer if the appliance had operated year-round, operated for a portion of the preceding year, or was unplugged and not operated. All primary units were assumed to have operated year-round.
3. Asked participants who indicated they operated their secondary refrigerator or freezer for only a portion of the preceding year to estimate the total number of months that the appliance remained plugged in. This allowed the calculation of the portion of the year in which the appliance remained in use. The Team determined that the average refrigerator, operating part-time, had a part-use factor of 0.11, or 1.3 months. Freezers operating part of the time had a part use factor of 0.08, or one month.

The part use factor for part-time units was much lower than in CY 2017 (the most recent year surveys were fielded to measure part use). Part-time refrigerators had a part use factor of 0.46 in 2017, compared with 0.11 in 2019. And part-time freezers had a part use factor of 0.26 in 2017 compared to 0.08 in 2019. This decrease is likely due to lower program incentives in 2019 as households that use their appliance more are less likely to respond to lower incentives.

These three steps resulted in information about how refrigerators and freezers operated prior to recycling, as shown in Table H-5.

Table H-5. Historical Part-Use Factors by Category

Usage Type and Part-Use Category	Percent of Recycled Units	Part-Use Factor	Per-Unit Energy Savings (kWh/Yr)
Secondary Refrigerators Only		**n = 50**	
Not in Use	10%	0	0
Used Part Time	32%	0.11	112
Used Full Time	58%	1.00	1,014
Weighted Average		**0.62**	**624**
All Refrigerators (Primary and Secondary)		**n = 99**	
Not in Use	5%	0	0
Used Part Time	16%	0.11	112
Used Full Time	79%	1.00	1,014
Weighted Average		**0.81**	**819**
All Freezers		**n = 73**	
Not in Use	10%	0	0
Used Part Time	6%	0.08	70
Used Full Time	84%	1.00	881
Weighted Average		**0.84**	**744**

In many cases, the way an appliance was used historically (prior to being recycled) is not indicative of how the appliance would have been used had it not been recycled. To account for this, the Team next asked surveyed participants how they would have (likely) operated their appliances had they not recycled them through the program. For example, if surveyed participants indicated they would have kept a primary refrigerator in the program's absence, the Team asked if they would have continued to use the appliance as their primary refrigerator or would have relocated it, using it as a secondary refrigerator.

Participants who said they would have discarded their appliance independent of the program were not asked about the future usage of that appliance, as that would be determined by another customer. Since the future use type of discarded refrigerators is unknown, the Team applied the weighted part-use average of all units (0.77) for all refrigerators that would have been discarded independent of the program. By using this approach, the Team acknowledges that the discarded appliances might be used as either primary or secondary units in the would-be recipient's home.

The Evaluation Team then combined the part-use factors shown in Table H-5 with participants' self-reported actions had the program *not* been available. This resulted in the distribution of likely future usage scenarios and corresponding part-use estimates.

The weighted average of these future scenarios, shown in Table H-6, produced the CY 2017 part-use factor for refrigerators (0.77, down slightly from 0.86 in CY 2018) and freezers (0.84, up from 0.76 in CY 2018). Changes in both refrigerator and freezer part-use were statistically different from CY 2018.

Table H-6. Part Use Factors by Appliance Type

Use Prior to Recycling	Likely Use Independent of Recycling	Part-Use Factor	Percentage of Participants
Primary Refrigerators	Kept (as primary unit)	1	6%
	Kept (as secondary unit)	0.62	7%
	Discarded	0.81	35%
Secondary Refrigerators	Kept	0.62	19%
	Discarded	0.81	33%
Overall		**0.77**	**100%**
Freezers	Kept	0.84	37%
	Discarded	0.84	63%
Overall		**0.84**	**100%**

Applying the part-use factors from to the modeled annual consumption from Table H-6 yields the average gross per-unit energy savings. Table H-7 shows that the average gross savings for refrigerators is 783 kWh and the average gross savings for freezers is 744 kWh.

Table H-7. Per Unit Gross Savings by Measure

Appliance	UEC (kWh/Year)	Part-Use Factors	Gross Energy Savings (kWh/Year)	Relative Precision (90% Confidence)*
Refrigerators	1,014	0.77	783	14%
Freezers	881	0.84	744	24%

Retail Lighting and Appliance Program

In CY 2019, the Evaluation Team estimated LED per-bulb savings using the lumen equivalence methodology to determine baseline wattages and other inputs from the 2019 Wisconsin Technical Reference Manual (TRM).

Unit Energy Savings Input Details

The Evaluation Team used the values shown in Table H-8 to calculate verified gross savings. The Team used items in the rows under the heading Unit Savings Inputs to calculate savings for individual bulbs and applied items in the rows under the heading Total Savings Inputs to aggregated savings.

Table H-8. CY 2019 Lighting Verified Gross Inputs

Input	Description	Residential Value	Nonresidential Value	Units	Source
Unit Savings Inputs					
HOU	Hours of use: daily average use LEDs	2.20	10.20	Hours/ day	2019 TRM
ISR_{LED}	In-service rate: percentage of LEDs installed	87	87	%	2019 TRM
ΔWatts	Delta watts: difference in wattage between the efficient and baseline bulb	Varies	Varies	W	Wisconsin CY 2019 lumen equivalence analysis
CF	Coincidence factor: summer peak coincidence factor	0.070	0.770	-	2019 TRM
365	Days per year: conversion to annualize the daily hours of use	365	365	Days/ year	2019 TRM
Total Savings Inputs					
Cross-Sector Sales	Cross-sector sales: percentage of bulbs sales allocated to the residential and nonresidential sector	93.4	6.6	%	Wisconsin CY 2015 cross-sector sales analysis
EUL_{LED}	Effective useful life: average life of a LED bulb	15, 17 (long lifetime)	15, 17 (long lifetime)	Years	2019 TRM, MMIDs 3553, 3557, 4306-4313

The verified inputs include 6.6% cross-sector sales because, in order to determine verified savings, the Team calculated residential and nonresidential savings independently then weighted the savings for each residential and nonresidential measure using this percentage. Table H-9 shows the verified residential, nonresidential, and weighted savings for the Retail Lighting and Appliance Program.

Table H-9. CY 2019 Retail Lighting and Appliance Program Verified Gross Unit Savings

Measure	Residential		Nonresidential		Residential/ Nonresidential Weighted [a]	
	kWh	kW	kWh	kW	kWh	kW
LED, Reflector	37	0.003	169	0.035	45	0.005
LED, Omnidirectional, 310–749 Lumens	19	0.002	90	0.019	24	0.003
LED, Omnidirectional, 750–1,049 Lumens	24	0.002	110	0.023	29	0.003
LED, Omnidirectional, 1,050–1,489 Lumens	29	0.003	137	0.028	37	0.004
LED, Omnidirectional, 1,490–2,600 Lumens	39	0.003	181	0.037	48	0.006

Note: no natural gas savings are claimed for the Program.
[a] Residential and nonresidential unit savings are weighted by the evaluated cross-sector sales percentage.

Table H-10 shows the verified residential, nonresidential, and weighted savings for the Rural Pop-Up Events.

Table H-10. CY 2019 Rural Pop-Up Events Verified Gross Unit Savings

Measure	Residential		Nonresidential		Residential/ Nonresidential Weighted [a]	
	kWh	kW	kWh	kW	kWh	kW
LED, Reflector	39	0.003	179	0.037	48	0.006
LED, Omnidirectional, 310–749 Lumens	20	0.002	93	0.019	25	0.003
LED, Omnidirectional, 750–1,049 Lumens	24	0.002	109	0.023	29	0.003
LED, Omnidirectional, 1,050–1,489 Lumens	29	0.003	136	0.028	36	0.004
LED, Omnidirectional, 1,490–2,600 Lumens	39	0.003	182	0.038	49	0.006

Note: No natural gas savings are claimed for the Program.
[a] Residential and nonresidential unit savings are weighted by the evaluated cross-sector sales percentage.

Table H-11 provides baseline and efficient wattages and the corresponding delta watts for the Retail Lighting and Appliance Program *ex ante* and verified savings.

Table H-11. Retail Lighting and Appliance Program *Ex Ante* and Verified Delta Watts Comparison

Measure	*Ex Ante* Baseline	Average Evaluated Baseline	Bulb Wattage		Delta Watts	
			Ex Ante	Average	*Ex Ante*	Average Evaluated
LED, Reflector	65	61	12	9	53	52
LED, Omnidirectional, 310–749 Lumens	29	33	7	5	22	28
LED, Omnidirectional, 750–1,049 Lumens	43	43	11	9	32	34
LED, Omnidirectional, 1,050–1,489 Lumens	53	53	13	11	40	42
LED, Omnidirectional, 1,490–2,600 Lumens	72	71	17	16	55	56

Table H-12 provides baseline and efficient wattages and the corresponding delta watts for the Rural Pop-Up Events *ex ante* and verified savings.

Table H-12. Rural Pop-Up Events *Ex Ante* and Verified Delta Watts Comparison

Measure	*Ex Ante* Baseline	Average Evaluated Baseline	Bulb Wattage		Delta Watts	
			Ex Ante	Average	*Ex Ante*	Average Evaluated
LED, Reflector	65	61	12	10	53	55
LED, Omnidirectional, 310–749 Lumens	29	33	7	4	22	29
LED, Omnidirectional, 750–1,049 Lumens	43	43	11	9	32	34
LED, Omnidirectional, 1,050–1,489 Lumens	53	53	13	11	40	42
LED, Omnidirectional, 1,490–2,600 Lumens	72	72	17	16	55	56

Delta Watts Lumens Bins

This section provides details related to lumen bins, which the Evaluation Team used for calculating verified delta watts inputs. The lumen bins for specialty bulbs shown in Table H-13, Table H-14, and Table H-15 are derived from the U.S. Department of Energy Uniform Methods Project (UMP).[25] The baselines are derived from the Energy Independence and Security Act (EISA).

Table H-13. Globe Lumen Bins

Bin	Baseline (EISA-Impacted Bulbs)
250–349	25
350–499	29
500–574	43
575–649	53
650–1,099	72
1,100–1,300	72

Table H-14 Decorative Shape (Candles) Lumen Bins

Bin	Baseline (EISA-Impacted Bulbs)
70–89	10
90–149	15
150–299	25
300–499	29
500–699	43

[25] National Renewable Energy Laboratory. 2015. "Chapter 21: Residential Lighting Evaluation Protocol." *Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.* https://www.energy.gov/sites/prod/files/2015/02/f19/UMPChapter21-residential-lighting-evaluation-protocol.pdf

Table H-15. Three-Way, Post Lamps, and Other Similar Bulbs Lumen Bins

Bin	Baseline (EISA-Exempt Bulbs)
0–309	25
310–449	25
450–799	40
800–1099	60
1,100–1,599	75
1,600–1,999	100
2,000–2,600	150
2,601–3,300	150
3,301–4,815	200

Project Details from Sampled Projects

The Evaluation Team performed desk and onsite verification reviews of a sample of projects in each nonresidential program—Agriculture, Schools and Government, Business Incentive, Large Energy Users, Renewable Energy Competitive Incentive, and Small Business—and in the Multifamily Energy Savings. Measure level realization rates were calculated based on the analysis completed for these sample projects, which informed the program level realization rates for CY 2019. A more detailed description of the sampled projects follows.

Agriculture, Schools and Government Program

There were very few discrepancies in realization rates for sampled projects in the CY 2019 Agriculture, Schools and Government Program. Thirty-six of 42 projects in the impact sample achieved a 100% energy realization rate. This shows that the Program Implementer is applying the TRM methodology consistently. Two sites had realization rates greater than 120%, and one site had a realization rate below 80%. Specific details related to these three projects are provided in Table H-16.

Table H-16. CY 2019 Agriculture, Schools, and Government Program Sample Detailed Projects

MMID	Project Measure	Savings (MMBtu)		Real. Rate	Share of Program	Notes
		Ex Ante	*Ex Post*			
3091	LED Fixture, <155 Watts, Replacing 250 Watt HID, High Bay	65,757	88,208	**134%**	0.7%	2018 TRM deemed energy savings for agriculture was 865 kWh per unit. The 2019 TRM deemed energy savings is 879 kWh per unit, but this is based on the standard hours of use (4,698 hrs/yr) for MMID 3093, 3095, and 3096. MMID 3091 is for the long day lighting applications with 6,205 hrs/yr, which results in 1,160 kWh/unit.
3386	Grain Dryer, Energy Efficient, Hybrid	14,837	19,783	**133%**	0.2%	*Ex ante* calculations used 15-year EUL but the 2019 TRM specifies a 20-year EUL. The Evaluation Team applied an EUL of 20 years, which resulted in higher kWh lifecycle savings.
2422	Infrared Heating Units, High or Low Intensity	19,500	4,134	**21%**	0.2%	SPECTRUM value was 5 therms/MBH in CY 2018. The TRM value was reduced to 1.06 therms/MBH in 2019.

Business Incentive Program

There were very few discrepancies in realization rates for sampled projects in the CY 2019 Business Incentive Program. One site had a realization rate greater than 120%, and three sites had realization rates below 80%. Table H-17 provides specific details related to these four projects. Three projects resulted in low realization rates for therms at the project level, which was a large influencing factor for the overall therms first year and lifecycle realization rates.

The Evaluation Team made minor adjustments to *ex ante* savings for these additional projects:

- There were three sites (MMID 2648) where the installed motor efficiencies varied slightly from the motor efficiency specified in the application. The Team modified the *ex post* savings to reflect the savings resulting from the actual installed motor specifications.
- There was one site (MMID 3277) where the origin of the *ex ante* savings calculations could not be readily determined, nor did they match the TRM deemed savings for this measure. The Team adjusted the *ex post* savings calculations to the appropriate TRM valid at the time of the project date range.
- There was one site (MMID 2520) that had a major failure issue with the new equipment; however, the Team could later confirm that the equipment was fixed and operational by the end of the evaluation period. The *ex ante* savings reflect a 100% realization rate.

Table H-17. CY 2019 Business Incentive Program Sample Detailed Projects

MMID	Project Measure	Savings (MMBtu)		Real. Rate	Share of Program	Notes
		Ex Ante	*Ex Post*			
4338	Hybrid Interior New Construction Lighting LPD 40% Below Code	42,140	74,224	**176%**	8.3%	During the site visit, the Evaluation Team installed light loggers for 50 days to determine the actual lighting schedule. Actual hours of use (HOU) resulted in 6570 hours of use annually, which is significantly higher than the deemed HOU commercial value of 3730 annual HOU used in *ex ante* savings. *Ex post* savings use the actual HOU determined.
2218	Prescriptive Hot Water Boiler, Modulating >=90% AFUE, >300 mbh	1,560	0	**0%**	0.3%	From information gathered at the site visit, it appears this system is redundant. This project also installed furnaces sized to meet 100% of the heating requirement, which was provided with incentives. The site contact indicated wanting to have this system installed for demonstration purposes. The current programming of both systems effectively runs the equipment 24/7, so savings will result from one or the other system but not both. *Ex post* savings reflect a realization rate of 0% due to redundant savings from redundant systems.
3276	Prescriptive Hot Water Boiler, Modulating >=90% AFUE, >300 mbh	6,840	0	**0%**	0.1%	At the site, the Team found four boilers instead of the two in the incentive application. These four boilers also did not match the specifications. The installed boilers are not condensing and have an AFUE of less than 85%. The facility must have decided to install different equipment. Because there are no TRM measures for boilers less than 85% AFUE, no energy savings can be attributed to these installed boilers.

MMID	Project Measure	Savings (MMBtu)		Real. Rate	Share of Program	Notes
		Ex Ante	*Ex Post*			
2279	Custom Destratification	10,819	5,191	**48%**	0.2%	The Team reduced savings because the roof and wall R-values were underestimated in the application (R-4.5 for both roof and walls). During the site visit, the Team collected exterior wall detailed drawings that show a wall assembly with R-10 continuous insulation at 16" OC, which is equivalent to an effective R-12.82 based on ASHRAE 90.1, Appendix A. The roof has an average 2" continuous insulation, with a R-5/inch, which is equivalent to an effective R-10. *Ex post* savings reflect actual installed product and R values.

Large Energy Users Program

There were a few discrepancies in realization rates among sampled projects for the CY 2019 Large Energy Users Program. One site had a realization rate greater than 120%, and eight sites had realization rates below 80%. Table H-18 provides specific details related to these projects.

Table H-18. CY 2019 Large Energy Users Program Sample Detailed Projects

MMID	Project Measure	Savings (MMBtu)		Real. Rate	Share of Program	Notes
		Ex Ante	*Ex Post*			
2497	Process Heat Recovery, Condensing Heat Exchanger	65,820	46,074	**70.0%**	0.50%	Savings lowered due to a reduction in hours of operations from 24/7, or 8760, to 24/5, or 6240 hours per year. This was confirmed during site visit and discussions with site contact.
2386	HVAC, Not Otherwise Specified	66,379	32,364	**48.8%**	0.49%	Fan load changed based on amperage reading on variable frequency drive (VFD) at site. This reading was a snapshot; however, based on discussions with site contact, it seems typical of the exhaust fan operation. This amp load reduced the estimated horsepower in reported savings; however, based on the standard fan curve, the cubic feet per minute (cfm) load increased. At the horsepower observed, cfm extraction from exhaust is significantly more than reported, which reduces the heating savings at the facility.
4678	SEM Operational Savings, Industrial	15,703	7,851	**50.0%**	0.12%	Adjusted the EUL based on the TRM control adjustment measures. Most control adjustment measures in the TRM have a five-year EUL. *Ex ante* savings use an EUL of 10 years, which is high. This is especially the case since the operator has capability to adjust controls manually depending on rain and other factors.
2499	Process, Not Otherwise Specified	112,905	38,584	**34.2%**	0.83%	Run hours were reduced to 24/5 (6048 hours) and boiler load was reduced from 70% to 30%. This resulted in a reduction in *ex post* savings. Boiler load of 30% is a very conservative percentage and is the maximum load expected from the two extruders currently operational. The system was designed for seven extruders; however, based on discussions with site contact, only two are currently installed and site is unsure when remaining five will be installed. Furthermore, observed boiler load was 6%. Site contact followed up with a second reading a couple of weeks later, which showed a load of 1.1%. Based on these two readings, the boilers are running

MMID	Project Measure	Savings (MMBtu)		Real. Rate	Share of Program	Notes
		Ex Ante	*Ex Post*			
						significantly lower than reported in *ex ante* savings; again, the 30% used in the e*x post* savings is very conservative. Unfortunately, there is no trending capability on the boiler and the Team could not obtain a larger data sample.
2520	Refrigeration, Not Otherwise Specified	114,740	89,070	**78%**	0.84%	Motor efficiency was observed to be 94% instead of the 84% used to model the baseline consumption. This reduced the potential for energy savings. The Team updated the *ex post* motor efficiency to 94%. *Ex ante* uses 16 years to calculate lifecycle savings; however, SPECTRUM reports 15 years, which is figure used in the *ex post* savings calculation.
2499	Process, Not Otherwise Specified	121,560	66,366	**55%**	0.89%	**Electric savings:** The load factor was changed based on data collected on site. Reported savings assume all 18 machines were online. During the site visit, the Team observed only nine machines online and calculated a load factor from the trend data collected on site. Construction was underway for the foundations of the other nine machines (18 total). Notes in the project file indicated that the load factor was 100% and that a reviewer changed this to 85%. **Gas savings:** The Team modified gas savings based on setpoint difference found on site. Reported savings calculations used 60°F. According to the site contact and the setpoint, air is only tempered to 45°F. The plant generates so much heat, no other heat is provided. The Team took pictures of setpoints during site visit. The Team adjusted gas savings to account for the temperature change, which results in less savings.
2265	Compressed Air, Not Otherwise Specified	20,489	15,414	**75%**	0.15%	Savings are reduced because the newly installed compressor runs at a higher load than was estimated during *ex ante*. The Team calculated the power needed to provide 1,400 cfm using the technical information of the variable speed ZE4VSD newly installed compressor operating at 40psi. The compressor would run at 179.62 kW instead of 168.3 kW estimated in the *ex ante*.
2470	Motor, Not Otherwise Specified	31,574	20,998	**67%**	0.23%	Savings were reduced because the uptime of the central broke rotor is higher than the customer's estimate of 25%. The Team installed data loggers and monitored the electric power draw at one-minute intervals for 22 for the broke and 27 days for the trim motors. During this period, the broke motor uptime was higher than 90%. The reviewer had previously raised concerns regarding the central broke motor, and the customer clarified that the drive will provide a signal back to the operating area to assure that this pulper is indeed shut down between batches. Therefore, the VFD is more of a monitoring device and soft start.

MMID	Project Measure	Savings (MMBtu)		Real. Rate	Share of Program	Notes
		Ex Ante	*Ex Post*			
2196	Air Compressor, Variable Speed Drive, Constant Speed Replacement	2,236	3,652	**163%**	0.02%	The Team metered the new 40HP VFD compressor. The Team was not provided with baseline data or compressor type so used the metered data from the post-install period to simulate the performance of a 40 hp load/unload compressor using standard NREL load/unload curve equation. CFM was calculated using the CAGI sheet of the installed 40 hp air compressor. The Team assumed that CFM demand would be the same for both baseline and post periods. Using these data, the Team created a pivot table to provide hourly data per day of both CFM and kW. The difference in savings was mainly because the metered data suggest that the compressor operates at a much lower load than reported in the project files. Compressor load was reported as approximately 50% per shift; however, metered data suggest that the air compressor load is actually approximately 23%. This resulted in a significant increase in demand kW savings because the VFD compressor operates more efficiently at lower loads and can adjust to match the loads versus a load/unload compressor that would, in an unload position, normally still draw at about 30% of the rated compressor power. This also resulted in a higher kWh savings since the air compressors were operating at a much lower load resulting in a higher efficiency on the newly installed VFD compressor.

Renewable Energy Competitive Incentive Program

For the Renewable Energy Competitive Incentive Program, one site had a realization rate greater than 120%, and one site had a realization rate less than 80%. All sample projects had realization rates greater than or less than 100% (not equal to 100%). These atypical measure-level realization rates can be explained by the systemic difference between methods used to calculate *ex ante* and *ex post* savings estimates. All projects calculated *ex ante* savings using a hybrid approach.

This method required the Program Implementer to collect site-specific data (e.g., panel orientation, site location, system size, and power) and enter the data into the PVWatts software. The Evaluation Team calculated *ex post* savings estimates using the deemed per-unit TRM values based on the project location and panel orientation.

Table H-19 provides specific details related to these projects.

Table H-19. CY 2019 Renewable Energy Competitive Incentive Program Sample Detailed Projects

MMID	Project Measure	Savings (MMBtu)		Real. Rate	Share of Program	Notes
		Ex Ante	*Ex Post*			
2819	Solar PV	87,044	113,589	**130%**	4.8%	Difference between application methodology (site specific PVWatts AC kWh/DCkW factor of 1,050) method and TRM (deemed values based on typical PVWatts - 1,370 AC kWh/DCkW)
2819	Solar PV	42,340	4,829	**11%**	2.3%	The value of lifetime kWh savings in SPECTRUM is off by a factor of 10 (12,409,000). The application documentation provided the correct lifetime kWh savings estimate (1,240,900); the Team suspects this is a data entry error into SPECTRUM. The verified estimate is based on TRM methodology. The difference between application methodology (site-specific PVWatts AC kWh/DCkW factor of 1,182) method and TRM (deemed values based on typical PVWatts - 1,348 AC kWh/DCkW)

Small Business Program

In general, there were very few discrepancies in realization rates among sampled projects for the CY 2019 Small Business Program. The majority of sampled projects have realization rates ranging from 80% to 120%. Three projects had realization rates below 80%. Table H-20 provides specific details related to these three projects.

Table H-20. CY 2019 Small Business Program Sample Detailed Projects

MMID	Project Measure	Savings (MMBtu)		Real. Rate	Share of Program	Notes
		Ex Ante	*Ex Post*			
16H77Y	Anti-Sweat Heater Controls, Refrigerated Case, Standard Door, SBP	541	0	**0%**	0.4%	The site visit found that the anti-sweat heater controller has been installed but is disconnected. Owner reported that the controller was unhooked last summer and not reconnected. If the controls are not operating, no energy savings can be verified.
16GTER	LED, Reach-In Refrigerated Case, Replaces T12 or T8, SBP	355	124	**35%**	0.3%	The *ex ante* lifetime kWh savings were built on an EUL of 20 years (TRM 2017). SPECTRUM creation date of 4/23/2019. *Ex post* lifetime kWh savings have been modified to be calculated using the 2018 and 2019 TRM EUL value of seven years. This is a duplicate master measure ID created for the Community Small Business Offering that was overlooked when its corresponding base MMID's EUL was updated.
16H3ON	LED Replacement of 4 ft T8 Lamps Utilizing Existing Ballast, SBP	1,624	1,116	**69%**	1.2%	The *ex ante* lifetime kWh savings were built on a EUL of 16 years (2016 TRM). SPECTRUM creation date of 5/9/2019. *Ex post* lifetime kWh savings value has been calculated based on an EUL of 11 years (2017 TRM to present), resulting in lower lifetime electric savings. This is a duplicate master measure ID created for the Community Small Business Offering that was overlooked when its corresponding base master measure ID's EUL was updated.

Multifamily Energy Savings Program

In general, there were very few discrepancies in realization rates among CY 2019 sampled projects. No sites had realization rates greater than 120% or below 80%. Table H-21 provides specific details related to projects with realization rates not equal to 100%. The more atypical measure-level realization rates can be explained by minor differences between the deemed parameters in the 2019 TRM and the values applied in the SPECTRUM database to calculate *ex ante* savings estimates. Most of the differences in parameters between the two sources of information are a result of rounding errors.

Table H-21. CY 2019 Sample Detailed Measures

MMID	Project Measure	Savings (MMBtu)		Real. Rate	Share of Program	Notes
		Ex Ante	*Ex Post*			
4355	LED Fixture, Downlights, In Unit	426	397	**93%**	0.02%	*Ex ante* savings values used incorrect efficient fixture wattage of 15 W instead of 14 W, as verified by spec sheet, in calculation of wattage reduction.
4385	Faucet Aerator, 1.5 GPM, Kitchen, NG	639	680	**106%**	0.04%	*Ex ante* savings used 7.52 therms/aerator, but the 2019 TRM deems 8.0 therms per aerator.
4354	LED Fixture, Downlights, Interior	512	507	**99%**	0.02%	Small difference between SPECTRUM therm savings values and TRM values due to rounding. TRM value were used to calculate *ex post* savings.
4393	Faucet Aerator, 1.5 GPM, Bath, NG	139	150	**108%**	0.01%	Small difference between SPECTRUM therm savings values and TRM values due to rounding. TRM value were used to calculate *ex post* savings.

Appendix I. Net Savings Analysis

For the CY 2019 evaluation of Focus on Energy's programs, the Evaluation Team applied net-to-gross (NTG) adjustments drawn mostly from primary research. This appendix presents three general approaches used to assess net savings—national sales data modeling, self-report NTG, and sales lift (low-E storm windows)—and how they were applied to each program.

Net Savings Overview

As described in Volume II, the evaluation of a program involves reviewing the reported gross savings to ensure that the measures installed have remained installed and are working as intended. The Evaluation Team then applies any adjustments found during the review to calculate the verified gross savings.

Net savings are the final savings attributed to a program, as determined by an independent evaluator. This means that the savings would not have been achieved in the absence of that program.

In deriving these savings, the evaluators deduct reported savings that are associated with freeriders (participants who would have undertaken the same action and achieved the same savings in the absence of a program) and add spillover savings (savings that are the result of a program's influence but for which no incentive was paid and for which no program has recorded savings).

Net savings represent the total savings achieved from the investment of ratepayer dollars into the program. These net savings are the primary benefits factored into the benefit/cost analysis used to design programs and ensure that they are operating in a manner that returns a net positive benefit to ratepayers. Focus on Energy also uses net savings to track progress toward the savings targets established for Focus on Energy by the Public Service Commission of Wisconsin (PSC).

This appendix discusses the specific approaches the Evaluation Team used to derive the net savings for the CY 2019 Focus on Energy programs. Since CY 2013, the Evaluation Team has incorporated net savings estimation approaches that are driven by sales data or an experimental design, as well as survey results. One example of a data-driven approach is national sales data modeling, which measures the lift in retail sales resulting from program influence.

Focus on Energy's long-term goals are to use these data-driven approaches as broadly as possible and to limit reliance on self-reporting methods. The Evaluation Work Group approved the use of these approaches and supports expanding their use when evaluators can obtain reliable data with reasonable cost and effort.

The Evaluation Team conducted various NTG analysis methods to assess the performance of measures offered throughout the portfolio. In some cases, the Team combined methods to determine savings-weighted average program NTG ratios. Table I-1 shows the evaluation method(s) used to determine net savings for each program for the CY 2019 evaluation.

Table I-1. CY 2019 Net Savings Methodology by Program

CY 2019 Programs	Net Savings Methodologies
Residential	
Appliance Recycling Program	CY 2019 Self-Report
Design Assistance - Residential	CY 2015–CY 2017 Self-Report
Home Performance with ENERGY STAR (Whole Home)	CY 2017 Billing Analysis
Home Performance with ENERGY STAR (HVAC Standard Track)	CY 2017 Standard Market Practice and CY 2015 Self-Report
Home Performance with ENERGY STAR (Renewable Energy)	CY 2019 Self-Report
Home Performance with ENERGY STAR (HVAC Income-Qualified Track)	Stipulated NTG = 1.0
Multifamily Energy Savings	CY 2019 Self-Report
Multifamily New Construction	CY 2019 Self-Report for Multifamily Energy Savings Program
New Homes Construction	CY 2019 Billing Analysis
Retail Lighting and Appliance Program	National Sales Data Modeling and CY 2018 Self-Report
Simple Energy Efficiency	Stipulated NTG = 1.0
Nonresidential	
Agriculture, Schools, and Government	CY 2015, CY 2016 and CY 2018 Self-Report
Business Incentive Program	CY 2015, CY 2016 and CY 2018 Self-Report
Design Assistance	CY 2015–CY 2017 Self-Report
Large Energy Users	CY 2015, CY 2016 and CY 2018 Self-Report
Midstream Commercial Kitchen Equipment	CY 2017 and CY 2018 End User Self-Report
Midstream Commercial Lighting Initiative	Stipulated NTG = 0.31 Based on Two Other Focus on Energy Midstream Programs
Renewable Energy Competitive Incentive Program	CY 2019 Self-Report
Small Business	CY 2015, CY 2016 and CY 2018 Self-Report
Training Program	CY 2015–CY 2018 Self-Report

National Sales Data Modeling

The Evaluation Team estimated the CY 2019 NTG for LEDs for the Retail Lighting and Appliance Program using a national sales data model, the same approach it used in CY 2017. The underlying theory for this model is that states with strong upstream lighting program activity—compared to those with little to no program activity—should have a higher market share (via sales) of efficient lighting. The model relies on full-category lighting sales data to estimate market lift as a function of program activity, while also controlling for other factors (e.g., household and demographic characteristics) that might impact efficient-lighting sales. Using this model, the Evaluation Team determined a comprehensive NTG estimate that captured freeridership, participant spillover, and nonparticipant spillover/market effects for Focus on Energy.

Study Objectives

The primary objective of the national sales data model is to quantify the relationship between program intensity (e.g., program spending per household) and LED sales (the percentage of light bulb purchases that are LEDs), which the model then uses to estimate an NTG ratio (NTGR) for the Retail Lighting and Appliance Program. This is the fourth year Focus on Energy has used this modeling approach for

estimating lighting NTG. Note that for CY 2015, the model included all efficient lighting technologies (CFLs and LEDs), but for CY 2016, CY 2017, and CY 2019, modeling focused exclusively on sales and market shares of LEDs.[26] This reflects the dominance of LEDs as the preferred energy-efficient lighting technology and the substantial decrease in CFL sales.

In addition to estimating NTG, the data provide helpful insights into what other factors drive LED purchases and opportunities for benchmarking Wisconsin lighting efficiency shares and program spending against other states. This section presents these additional analyses as well.

Data Sources

The Evaluation Team drew on a variety of data sources for the analysis, though it relied primarily on sales data prepared by the Consortium for Retail Energy Efficiency Data (CREED).[27] CREED members are program administrators, retailers, and manufacturers who work together to collect the data necessary for better planning and evaluation of energy efficiency programs. LightTracker, CREED's first initiative, focused on acquiring full-category lighting data including incandescent, halogen, CFL, and LED bulb types for all distribution channels in the entire United States. CREED speaks as one voice for program administrators nationwide as they request, collect, and report on the sales data needed by the energy efficiency community.

Sales data were generated primarily from two sources: point-of-sale (POS) state sales data (representing grocery, drug, dollar, discount, mass merchandiser, and selected club stores) and National Consumer Panel (NCP) state sales data (representing home improvement, hardware, online, and selected club stores). The Evaluation Team also purchases raw datasets from third-party vendors and through a CREED initiative. The Team then cleans and processes all data for analysis.[28,29]

---

[26] Focus on Energy did not update lighting NTG based on the CY 2018 analysis.

[27] Consortium for Retail Energy Efficiency Data. Accessed February 2020. creedlighttracker.com

[28] The information contained in this appendix is based in part on data reported by IRI, Inc., through its Advantage service for, and as interpreted solely by, LightTracker, Inc. Any opinions expressed herein reflect the judgment of LightTracker, Inc., and are subject to change. IRI disclaims liability of any kind arising from the use of this information.

[29] Data presented include LightTracker calculations based in part on data reported by Nielsen through its Strategic Planner and Homescan Services for the lighting category for the 52-week period ending approximately on December 31, 2019, for the available state level markets and Expanded All Outlets Combined (xAOC) and Total Market Channels. Copyright © 2019, Nielsen.

Besides the sales data made available through LightTracker, the model inputs are a combination of program data collected by the Evaluation Team and household and demographic data collected through various publicly available websites. These are the sources for the primary model input data:

- National bulb sales
  - POS data (grocery, drug, dollar, discount, mass merchandiser, and selected club stores)
  - NCP data (home improvement, hardware, online, and selected club stores)
- U.S. Census Bureau import data (CFL and LED imports)
- DSM Insights, an E Source database of utility program data
- ENERGY STAR Lighting Program data (utility lighting program budgets)
- ENERGY STAR shipment data (released by the U.S. Environmental Protection Agency)
- North American Electrical Manufacturers Association shipment data
- American Community Survey (ACS) data (household characteristics and demographic data)
- Retailer square footage per state (based on Internet searches)
- General population surveys, lighting saturation studies, and other secondary data collection made publicly available through evaluation reports

Lighting Sales

The LightTracker POS dataset includes lighting sales data for grocery, drug, dollar, club, and mass market distribution channels. These data represent actual sales that are scanned at the cash register for participating retailers.

The NCP represents a panel of approximately 100,000 residential households that are provided a handheld scanner for their homes and instructed to scan every purchase they make that has a bar code. For Wisconsin, the NCP collected data from approximately 1,600 households in 2019. The use of a scanner avoids potential "recall bias," which is prevalent in self-report methods that ask about lighting purchases. IRI's analysis of scanner sales patterns estimates that approximately 60% of the homes are in full compliance and scan all purchases; NCP removes from the analysis any homes in which all products were not scanned.

Although the dataset included detailed records of lighting data purchases, the Evaluation Team spent considerable time ensuring data integrity and inclusion of all the necessary bulb attributes. For example, not all records were populated with some of the more critical variables such as bulb type, style, and wattage or the data had clearly erroneous values (e.g., 60-watt LEDs).

After thorough review and quality control of the dataset, the Evaluation Team reclassified, standardized, and populated missing records, created additional variables, and performed general enhancements to

the data. To populate missing records, validate existing records, and include additional bulb attributes, CREED created a Universal Product Code (UPC) database from three sources:

- Manufacturer and retailer product databases provided to CREED or product catalogs downloaded from manufacturer and retailer web sites via "web scraping"
- Automated lookups of online UPC databases, such as www.upcitemdb.com
- Bulb attributes entered as part of shelf-stocking studies from research conducted in California and the Northwest

CREED then merged the UPC database with the POS data, populating fields based on a hierarchy of data sources believed to be most reliable. Prioritization was typically in the following order: manufacturer specifications, UPC lookups, and original POS-based database values. The CREED Team also conducted manual website lookups on over 200 high-volume bulbs to verify final assignments.

Additionally, the CREED Team investigated the bulb assignment and the quantity of bulbs per package by examining the average price per unit and identifying outliers in terms of per-bulb prices. This process helped identify misclassification of certain bulb types (e.g., bulbs that were flagged as low-cost LEDs but were really LED nightlights and needed to be moved to the "other" lamp type bin), as well as bulb counts that sometimes represented box shipments (e.g., a package identified as having 36 bulbs was really a six-pack of LEDs that was shipped with six packages per box), or high-cost LEDs that were really Wi-Fi-enabled smart LEDs. The sales model is restricted to screw-based bulbs, so any bulbs classified as type "other" were not included in the model.

CREED estimated missing lumen values and missing lamp styles. Regarding lumens, CREED applied ordinary least squares (OLS) regression models that predicted lumens based on the type of light and the wattage of the bulb. Regarding style (e.g., A-line, reflector, globe, candelabra), CREED used classification and regression trees (CART), a method commonly used for classification problems, to populate the style attribute for lamps that were missing data.

After accounting for the smaller states that lacked sufficient sample size from the panel data or had incomplete program data available, the final model contained 42 states. The lighting dataset included these key aspects:

- 2019 sales volume and pricing for CFLs, LEDs, halogens, and incandescent bulbs for all channels combined, and broken out by the POS and non-POS channels
- Data reporting by state (with 42 states included in both POS and non-POS) and bulb type
- Inclusion of all bulb styles (A-lamps, reflectors, globes, and candelabras)

As detailed below, the dependent variable of the model was the percentage of LED sales, rather than total LED sales, to normalize for states with greater or lesser bulb sales (LED or standard) because of differences in number of households, number of sockets, existing saturation, and other factors that drive lighting sales.

Program Activity

To research lighting program activity in the 42 states, the Evaluation Team used internal resources and conducted a literature review of publicly available reports found on the internet or provided by program administrators or their evaluators.[30] The Evaluation Team contacted local utilities in areas where reports with relevant information were not available. Additionally, the Team accessed DSM Insights, an E Source product that provides a detailed breakdown of program-level spending, including incentives, marketing, and delivery for over 100 program administrators around the country.[31]

The Evaluation Team collected these program data:

- Total number of claimed LED upstream program bulbs reported by each program (where possible, broken out by bulb style)
- Upstream LED incentives
- Total upstream program budget

The Evaluation Team used actual program expenditures and, where unavailable, used ENERGY STAR reported expenditures as a proxy.[32] After accounting for the states with incomplete program data, the final model included 42 states.

To determine Retail Lighting and Appliance Program activity in Wisconsin, the Evaluation Team used the SPECTRUM database to determine the number of program-supported bulbs sold in the state. Year-end Focus on Energy expense reports provided the incentives and the overall program expenditures (summarized in Table I-2).[33]

Table I-2. 2019 Focus on Energy Program Statistics

Program Expenses	LED Quantity	LED Incentives
$11,538,914	5,621,136	$8,702,484

[30] In particular, the Evaluation Team began by searching the ENERGY STAR Summary of Lighting Programs website, accessed February 2020: ENERGY STAR Summary of Lighting Programs) and referenced the Database of State Incentives for Renewables & Efficiency, accessed February 2020: dsireusa.org.

[31] E Source. "DSM Insights." Accessed February 1, 2020: esource.com/dsminsights

[32] ENERGY STAR. "ENERGY STAR Summary of Lighting Programs: August 2019 Update." 2019. Available online: https://www.energystar.gov/productfinder/downloads/2019/2019%20ENERGY%20STAR%20Summary%20of%20Lighting%20Programs.pdf. Note that because the ENERGY STAR report included only expenditure ranges, the Evaluation Team used the midpoints of the ranges as a proxy to represent the expenditures.

[33] Total Program expenses exclude costs for non-LED measures in the Retail Lighting and Appliance Program.

Presence and Absence of Retailers (Channel Variables)

The Evaluation Team conducted secondary internet research to determine the number and total square footage of store locations in each state for five primary energy-efficient bulb retailers—The Home Depot, Lowe's, Walmart, Costco, and Menards. The Team used these data as explanatory variables in the model since these retailers sell a large quantity of energy-efficient bulbs and the percentage of efficient bulb sales could differ in states with more or fewer retail locations. The non-POS data (derived from the NCP) does include purchases made through online retailers.

State-Level Household and Demographic Characteristics

The Evaluation Team gathered state-level demographic data from the ACS, including annual state-level data for the population, total number of households, household tenure (own versus rent), home age, education, income, and average number of rooms in the home. As explained below, the Team then combined these data with other possible explanatory variables, including political index, average cost of living, and average electric retail rates.

Analysis of the Combined Dataset (Descriptive Statistics)

The primary objective of this model was to determine the impacts of program spending on the market share of LEDs to derive state-level NTG estimates. A secondary, but no less important, objective was to relate these national lighting sales and program activity data to an assessment of some of the key factors driving LED market share specifically in Wisconsin. By accessing national lighting sales data and researching the largest known compilation of state program activity (incentives, overall expenditures, bulb volumes), the Evaluation Team could analyze and summarize lighting program activity in a way that has not been possible before.

These were some of the key lighting program attributes the Evaluation Team developed:

- **Market share distribution.** LED market share distribution for the U.S., Wisconsin vs. the U.S., as well as across each state and across retail channels.
- **Program intensity.** LED lighting market share relative to overall program expenditures per household.
- **Program incentives.** Average LED lighting program incentives per bulb.
- **ENERGY STAR market share distribution.** LED market share distribution in Wisconsin compared to states that do not run an upstream lighting program.

Figure I-1 shows the national market share of the four bulb types (incandescent, halogen, CFL, and LED) across the past five years. LEDs continue to gain substantial market share, rising from 19% in 2015 to 60% in 2019. From 2015 to 2017, LEDs largely displaced sales of CFLs only. In 2018 and 2019, LEDs began to displace inefficient bulbs. Still, inefficient lighting (incandescent bulbs and halogens) represents almost 40% of the market.

Figure I-1. Year-Over-Year Total U.S. Market Share by Lamp Type

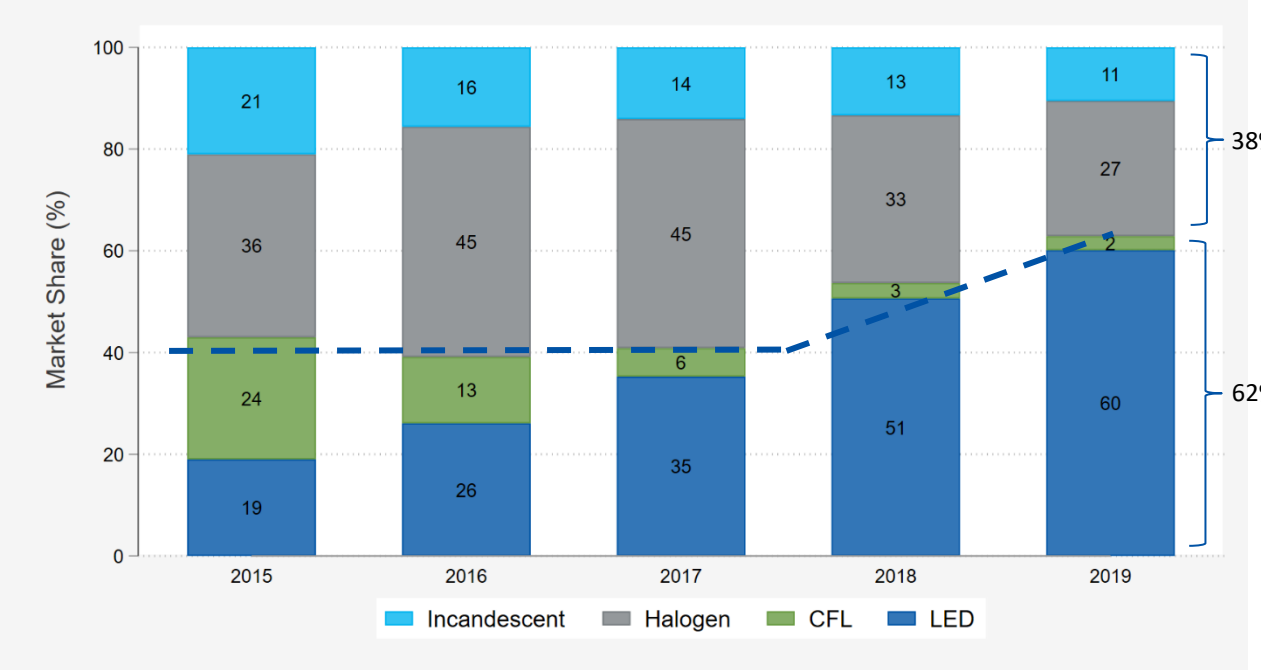


Figure I-2 compares the data shown in Figure I-1 to Wisconsin market shares. In terms of LED market share, Wisconsin distanced itself from the national market share in 2016. Since then, Wisconsin LED market share has consistently been greater than national market share. In 2019, LED market share in Wisconsin was nearly 14.5 percentage points greater (74.5%) than the national market share (60.1%).

Figure I-2. Wisconsin and Total U.S. Year-Over-Year Market Share by Bulb Type

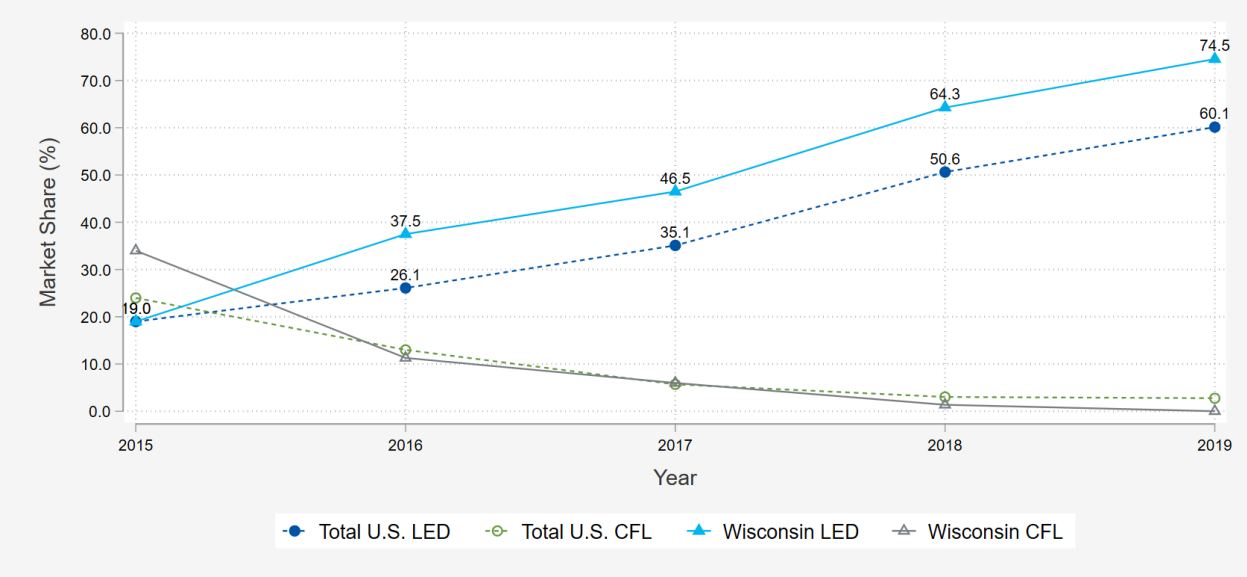
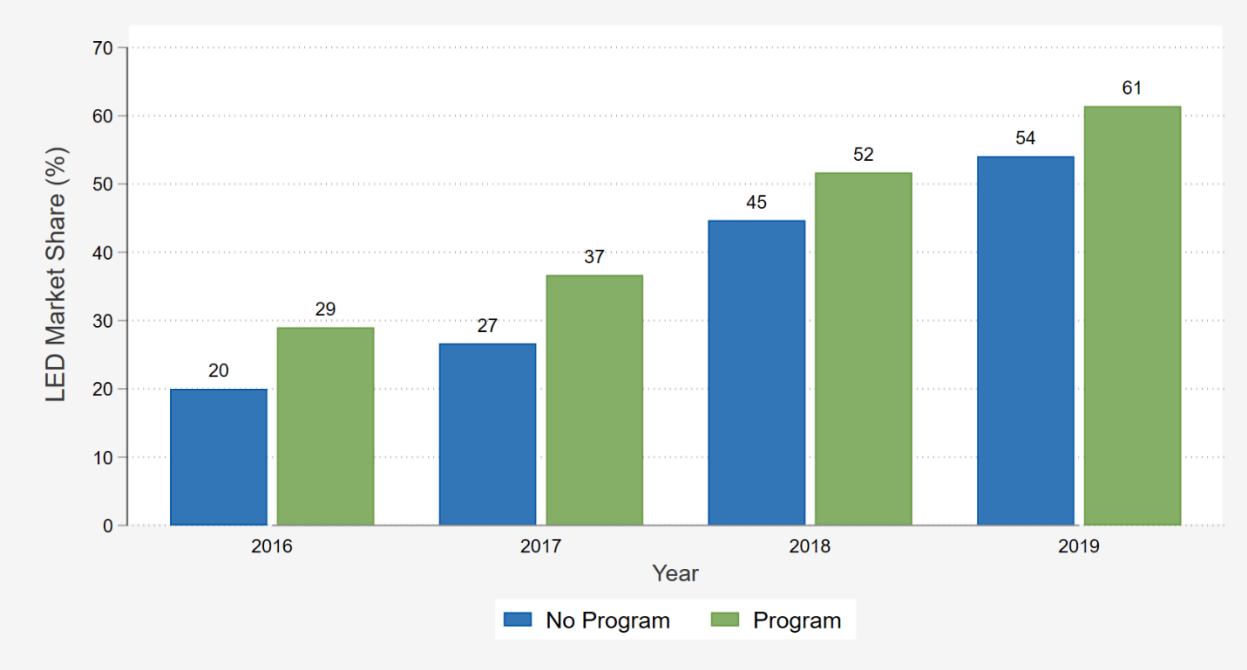


Figure I-3 shows the state-level LED share as a function of program activity (program state or non-program state). It is important to note that the number of states in each bin varies by year. In 2019, there were 11 states in the no program bin and 33 states in the program moderate bin.[34]

Figure I-3. Relationship Between Program Activity and LED Sales



There are two key takeaways from Figure I-3. First, LED share is higher in program states, although the gap has decreased from about 10 percentage points in 2016 and 2017 to about seven percentage points in 2018 and 2019. Second, LED share in "no program" states typically lags LED share in program states by about one year (e.g., in 2018 the average LED market share was 52%, and in 2019 the no program states had an LED market share of about 54%).

Similarly, Figure I-4 shows how LED sales in Wisconsin compare to the 42 modeled states. States highlighted in blue represent states with programs. Green bars represent states that did not offer a lighting program. There are a handful of program states with low LED market shares, but the overall trend is clear: states with programs generally have higher LED market shares. Indeed, of the top 12 states in terms of LED market share, all have upstream lighting programs. Note that for most of the no program states, the LED market share is below 60% (the national average). Also note that Nevada, one of the no program states that is above 60% LED market share (61%) ended programs in 2017.

[34] The "no program" states in 2019 are Alabama, Delaware, Kansas, Kentucky, Mississippi, Nebraska, Nevada, Tennessee, Utah, Virginia, and Wyoming. Note that Nevada ran an upstream lighting program through 2017.

Figure I-4. LED Sales Distribution Across States (2019)

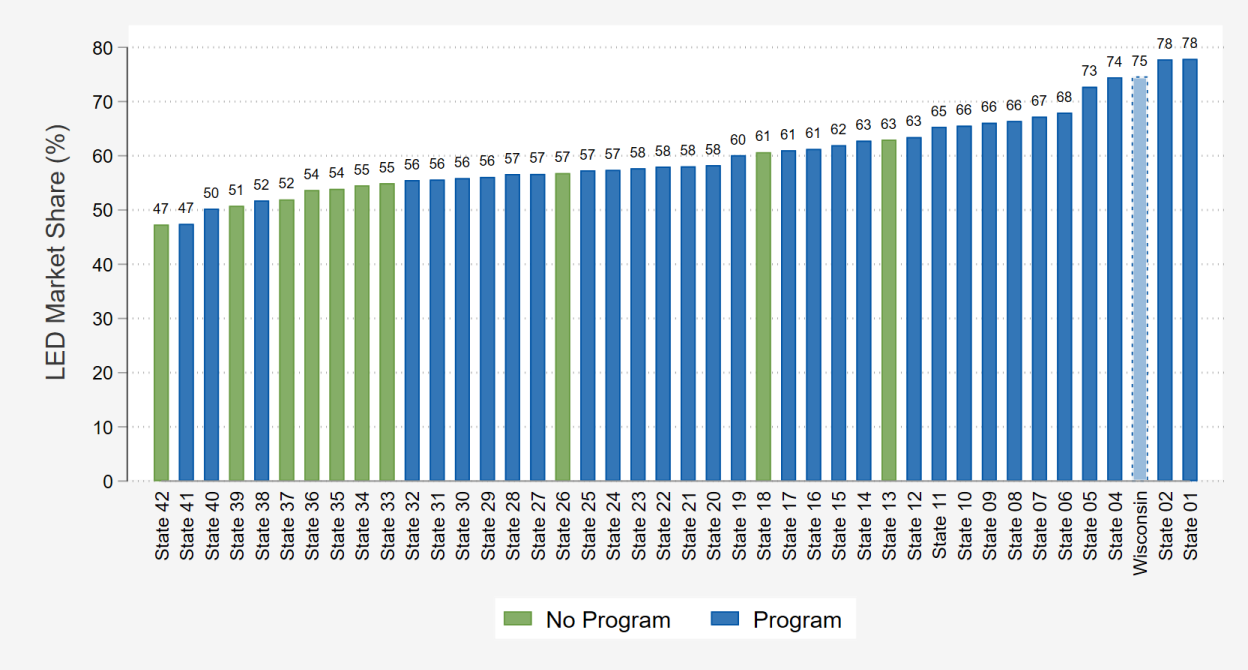
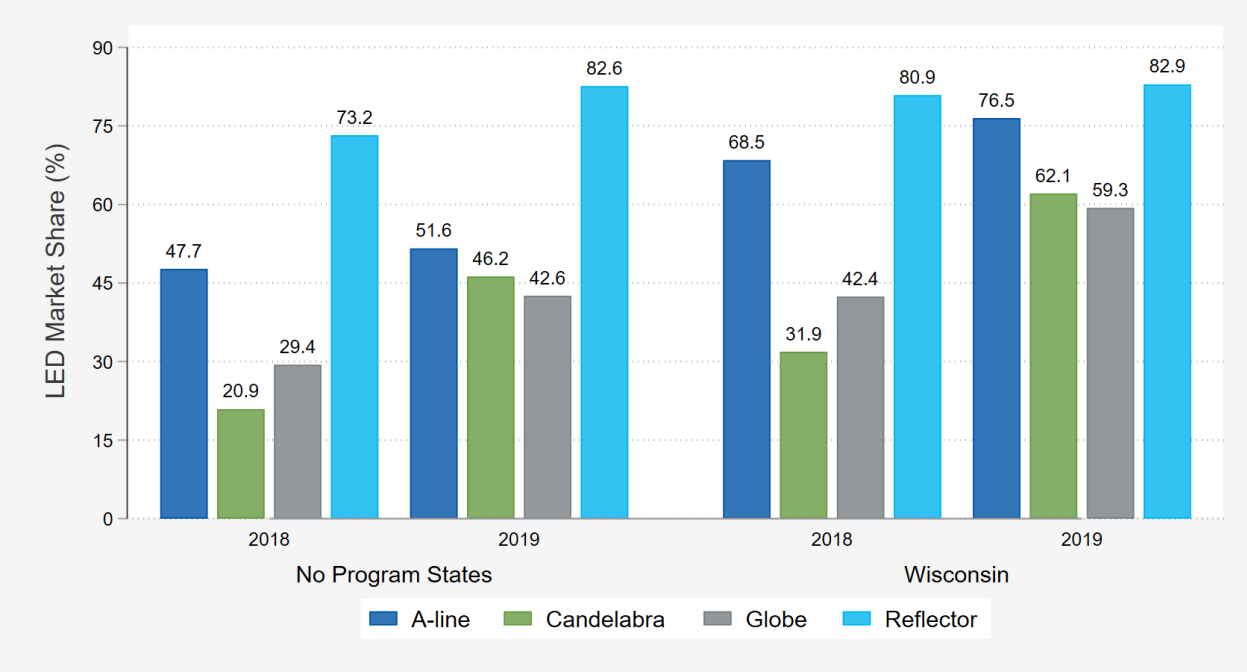


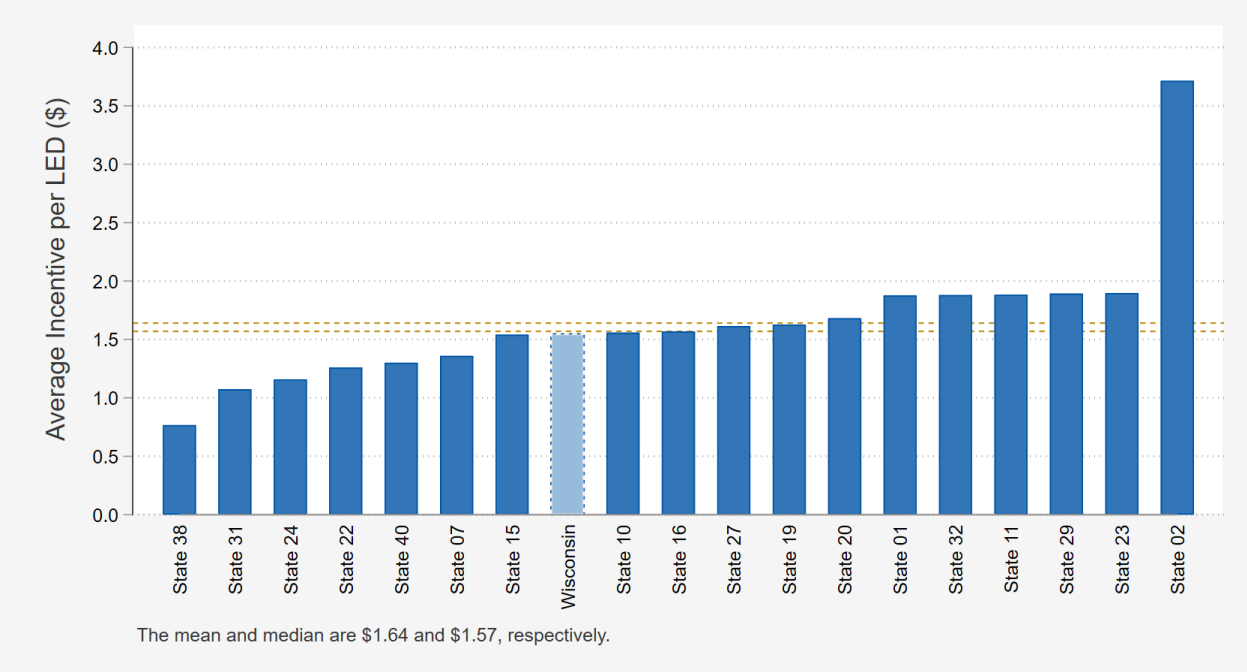
Figure I-5 shows the LED market share by lamp style and by no program states and Wisconsin across 2018 and 2019. The market shares differ substantially by style, with LEDs representing a majority of A-line and reflector sales in 2019, even in states without programs (52% and 83%, respectively). Candelabras and globes had the smallest LED market share of all lamp styles. In both years, LED market shares in Wisconsin exceed LED market shares in no program states, typically by several percentage points. For A-line lamps in particular, the LED market share in Wisconsin is more than 20 percentage points higher than the share in no program states in 2019. Reflectors are on the other end of the spectrum, where the 2019 LED market share in Wisconsin is only slightly greater than the market share in states without upstream lighting programs.

Figure I-5. LED Market Share by Lamp Style (2018-2019)



The Evaluation Team also compared the average incentive offered per LED across states in which LED incentive information was collected. A simple calculation of incentive dollars divided by bulb units yielded average incentives per state. As shown in Figure I-6, in the 19 states that had sufficient data, LED incentives ranged from approximately $1 to $4 per LED bulb, with most of these states offering between $1.50 and $2 per LED. The mean and median LED incentive are $1.64 and $1.57, respectively. At $1.55 per LED, Wisconsin is just slightly below the average incentive.

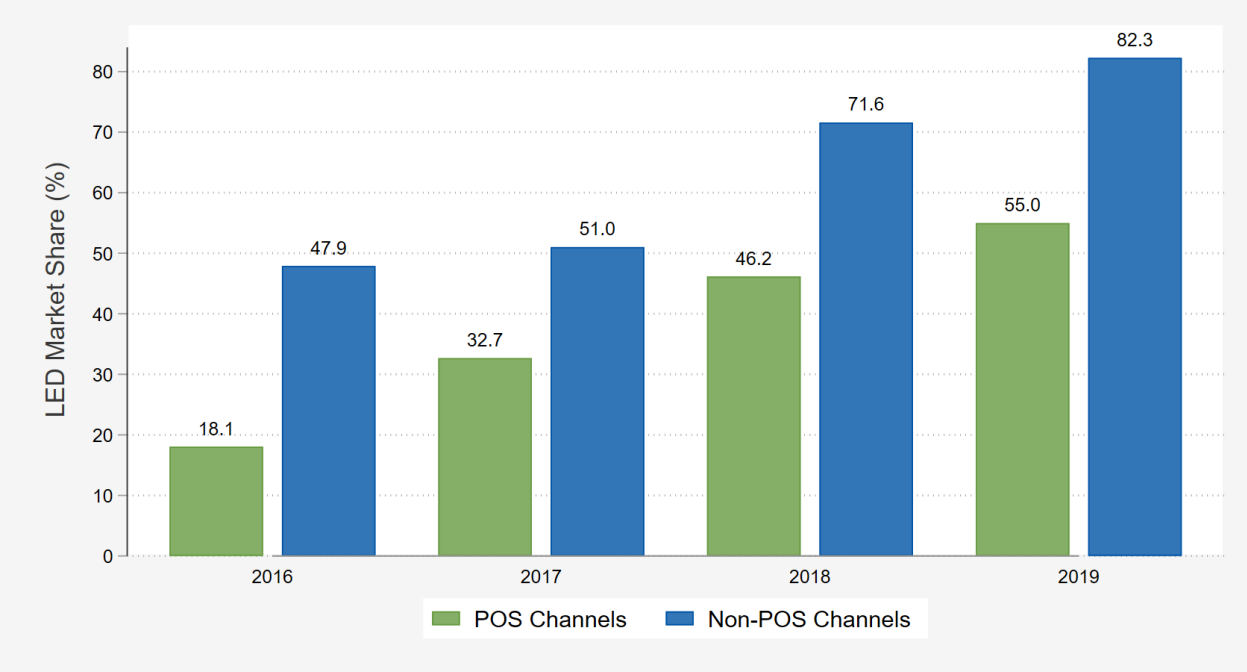
Figure I-6. Average Upstream Lighting Incentive Per LED (2019)



Analysis of the sales data model showed that sales of LEDs had greater market share in the non-POS retail channels than the POS retail channels, as shown in Figure I-7.[35] In 2019, more than 80% of the lighting purchases made in the non-POS channel were LEDs, compared to approximately half (55%) market share for LEDs in the POS channel. LED market share has increased in both retail channels since 2016.

[35] In total, approximately 80% of bulbs were purchased in the non-POS channels.

Figure I-7. Wisconsin LED Market Share by Retail Channel

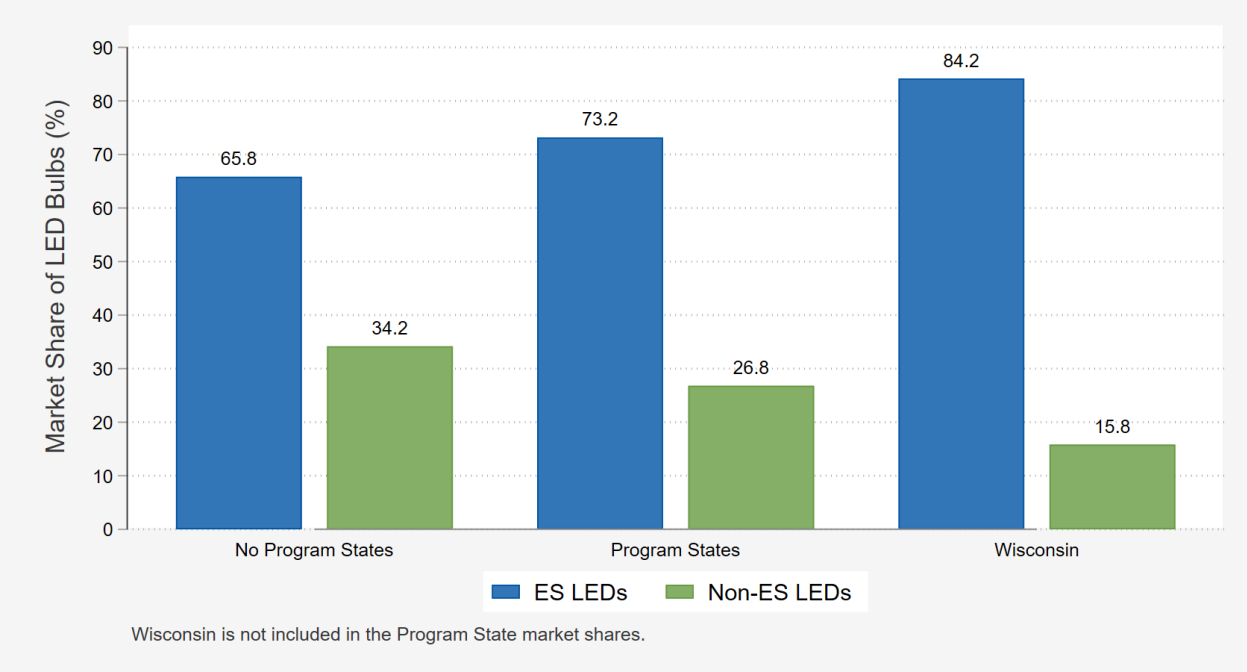


The Evaluation Team looked at ENERGY STAR LED distribution when there was sufficient resolution.[36] As shown in Figure I-8, the POS retail channel shows that 84% of LED purchases in Wisconsin were ENERGY STAR LEDs, whereas only 74% of LED purchases in other program states (excluding Wisconsin) were ENERGY STAR LEDS. States that did not run programs had the lowest share of ENERGY STAR LEDs of the three groups (66%).

It is clear from the data used for the national sales model that program spending was at least partially responsible for an increased market share of LED sales and, in particular, ENERGY STAR LEDs. Although these figures help illustrate program activity in relation to LED sales, the regression analysis provided information about what other factors could be influencing the marketplace and a better understanding of the programmatic impacts. The next section presents the key findings from the national sales model.

[36] Because the ENERGY STAR website does not include the UPCs of qualifying lamps, the Evaluation Team had to identify ENERGY STAR-qualified lamps using make, model, and rated lifetime. In total, the Team was successful at attributing 96.5% of LED sales with an ENERGY STAR attribute (that is, whether or not an LED was designated ENERGY STAR). The Team could not identify the remaining 3.5% of LEDs, which are excluded in Figure I-8. In addition, the Team conducted this analysis using only the POS data, as the panel data did not contain sufficient sample size to stratify by ENERGY STAR designation.

Figure I-8. ENERGY STAR LED Wisconsin Share (2019 POS Channels)



Modeling Methods

As previously stated, the primary objective of the model was to quantify the impact of state-level retail lighting program activity on the sales of LEDs, while controlling for demographic, household characteristics, and retail channel variables that could affect consumers' uptake of efficient lighting products.

The general form of the model is specified below, followed by a more detailed discussion of the data sources for each variable. The Evaluation Team considered the comprehensive set of variables listed here; the final model, presented in Table I-3, lists the variables ultimately selected for inclusion based on their statistical significance and ability to improve the model specification (see the *Multivariate Regression Model* section under *Key Findings* for more information).

$$LED\ Market\ Share_i = \beta_0 + \beta_1 * Program\ Spending\ per\ HH + \beta_2 * Program\ Age + \beta_3 * \sum_{1}^{3} Channel\ Variables + \beta_4 * \sum_{1}^{4} Demographic\ Variables$$

Where:

$LED\ Market\ Share_i$	=	Proportion of total LED sales in state 'i'. Equal to [LED sales/total bulb sales].
β_0	=	The model intercept.

β_1	=	The primary coefficient of interest. This represents the marginal effect of program intensity or the expected increase in the market share of LEDs for each $1 in additional program spending per household.
β_2	=	Another coefficient of interest. This represents the marginal effect in additional program years since inception.
Pgm Spending/ HH$_i$	=	The number of 2019 retail lighting program dollars per household in state 'i'. Equal to total retail lighting program expenditures in state 'i' (incentive and non-incentive) divided by the number of households in state 'i'.
Program Age	=	The number of years state 'i' has been running an upstream lighting program.
β_3 *and* β_4	=	Array of regression coefficients for the channel and demographic variables.
Channel Variables	=	Numeric variables summarizing state-level retailer characteristics (Table I-3. lists additional detail).
Demographic Variables	=	Numeric variables that summarize state-level population, housing, and economic attributes in (additional detail is provided in Table I-3).
ϵ_i	=	Error term.

Table I-3. Program Intensity, Channel, and Demographic Variable Descriptions

Type of Variable	Description
Program Intensity Variables	
Program Spending per Household	Total upstream program budget in state 'i' divided by the number of households in state 'i'.
SQRT (Program Spending per Household)	Square root of the program spending per household.
Program Age	Number of years program administrators in state 'i' have operated upstream lighting programs (CFL or LED).
Channel Variables	
Sqft NonPOS per HH$_i$	Average non-POS retail square footage per household in state 'i.' Equal to non-POS square footage divided by the number of households in state 'i'.
Percent Sqft NonPOS$_i$	Percentage of total retail square footage belonging to non-POS retailers in state 'i.' Equal to non-POS square footage divided by (POS sqft + non-POS sqft).
Sqft POS per HH$_i$	Average POS retail square footage per household in state 'i.' Equal to POS square footage divided by the number of households in state 'i'.

Type of Variable	Description
Demographic Variables	
Political Index$_i$	A state-level partisan voter index developed by Gallup[a] using presidential election voting results as a state-level partisan proxy. A higher than 1.0 value represents greater democratic influence and a value less than 1.0 indicates greater republican influence.
Average Electricity Cost$_i$	State-level average residential retail rate of electricity sourced directly from the Energy Information Agency.[b]
Cost of Living$_i$	State-level cost of living indices developed by the Missouri Economic Research and Information Center.[c]
Percentage of Renters Paying Utilities$_i$	All state-level demographic and household variables were derived from the most current U.S. Census ACS.[d]
Median Income$_i$	
Percentage Owner Occupied$_i$	
Percentage of Population with College Degree$_i$	

[a] Gallup. "State of the States." Accessed February, 2020: news.gallup.com/poll/125066/state-states.aspx
[b] US Electricity Information Association. "Electricity." Accessed February 2020. eia.gov/electricity/data/state/
[c] Missouri Economic Research and Information Center. "Cost of Living Data Series 2019 Annual Average." Accessed February 2020: https://meric.mo.gov/data/cost-living-data-series
[d] US Census Bureau. "American Fact Finder." Accessed February 2020: factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t

Correlation of the Independent (Explanatory) Variables

Table I-4 shows the correlation between the dependent variable (LED market share) and 13 potential explanatory variables—the three program intensity variables (spending per household, square root of spending per household, and program age) and 10 channel and demographic/household variables.

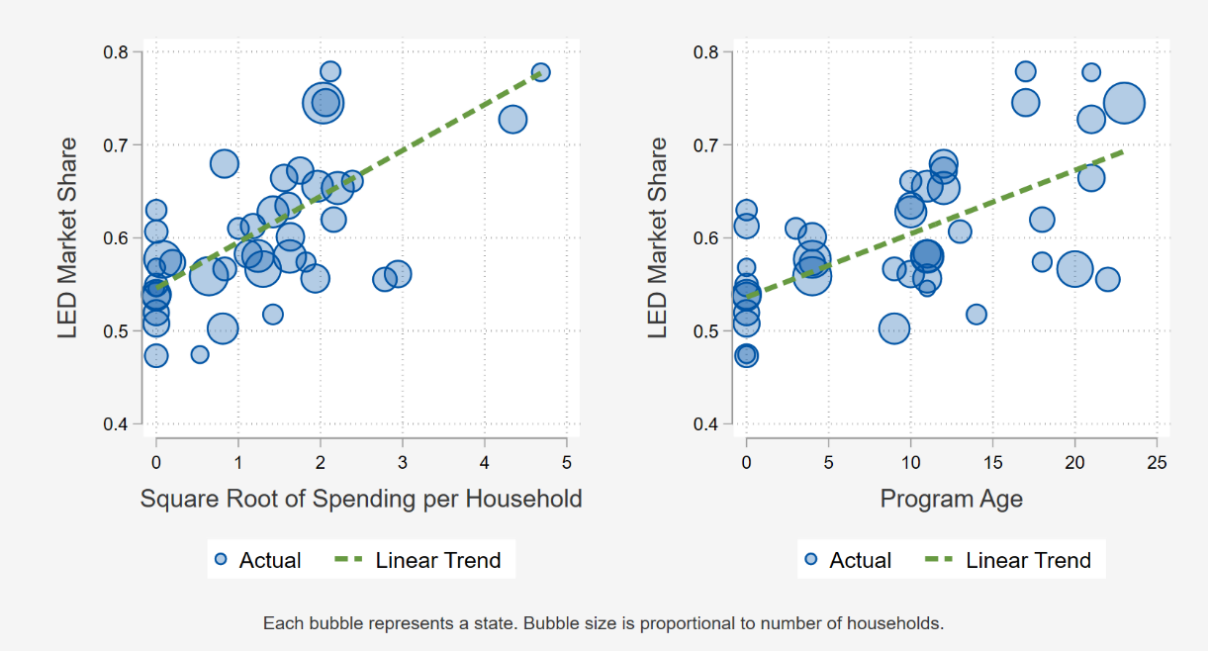
Ten of the variables are positively correlated with LED market share (green bars) and three are negatively correlated (red). The absolute value of the correlation coefficient indicates the strength of the linear correlation. As expected, of the 13 variables, program age and the square root of program spending per household show the strongest correlation with LED market share (i.e., higher LED market shares typically occurring in states with more program spending and longer-running programs).

Figure I-9 visualizes the correlation between these two key variables and LED market share.

Table I-4. Independent Variable Correlation Table

Explanatory Variable	Correlation with LED Market Share
Spending per Household	0.532
Square Root of Spending per Household	0.634
Program Age	0.688
Non-POS Square Footage per Household	0.076
POS Square Footage per Household	-0.467
Percentage of Square Footage in Non-POS	0.499
Political Index	0.493
Median Income	0.432
Average Electricity Cost	0.587
Cost of Living	0.503
Percentage of Renters Paying Utilities	-0.090
Percentage Owner Occupied	-0.279
Percentage of Population with College Degree	0.307

Figure I-9. LED Market Share against Program Intensity



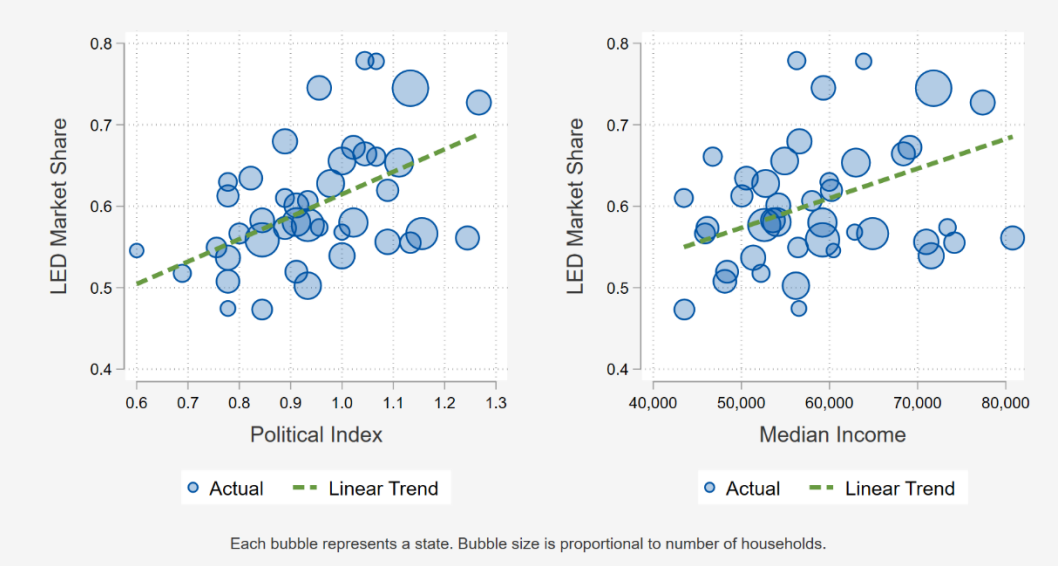
In addition to being correlated with LED market share, many of the explanatory variables are correlated with each other. Table I-5 shows a pairwise correlation matrix among the potential independent variables. When multiple independent variables that are correlated with one another are included in a regression model, the model will have difficulty precisely estimating the effect of either term. This issue is compounded by the relatively low number of observations in the dataset.

Table I-5. Covariance Table of Potential Independent Variables

	LED Market Share	Spending per Household	Square Root of Spending per Household	Program Age	Non-POS Square Footage per Household	POS Square Footage per Household	Percentage of Square Footage in Non-POS	Political Index	Median Income	Average Electricity Cost	Cost of Living	Percentage of Renters Paying Utilities	Percentage Owner Occupied
Spending per Household	0.53												
Square Root of Spending per Household	0.63	0.90											
Program Age	0.69	0.54	0.72										
Non-POS Square Footage per Household	0.08	-0.11	-0.04	-0.09									
POS Square Footage per Household	-0.47	-0.50	-0.58	-0.77	0.11								
Percentage of Square Footage in Non-POS	0.50	0.50	0.60	0.80	0.04	-0.97							
Political Index	0.49	0.65	0.72	0.75	-0.13	-0.86	0.85						
Median Income	0.43	0.57	0.60	0.64	0.13	-0.71	0.77	0.78					
Average Electricity Cost	0.59	0.58	0.58	0.79	-0.17	-0.74	0.79	0.70	0.65				
Cost of Living	0.50	0.46	0.52	0.80	-0.22	-0.83	0.87	0.80	0.76	0.84			
Percentage of Renters Paying Utilities	-0.09	-0.45	-0.44	-0.40	0.43	0.45	-0.36	-0.47	-0.41	-0.38	-0.38		
Percentage Owner Occupied	-0.28	-0.09	-0.13	-0.55	0.28	0.53	-0.58	-0.46	-0.48	-0.60	-0.75	0.05	
Percentage of Population with College Degree	0.31	0.58	0.57	0.53	0.03	-0.65	0.65	0.76	0.88	0.55	0.62	-0.52	-0.32

Because of the complexity of the relationships and numerous combinations of these channel, demographic, and household characteristic variables, the Evaluation Team tested several different model options. In general, the models provided similar results, with square root of program spending and program age being the two most significant predictors of LED market share. As discussed in more detail in the *Key Findings* section, the Team ultimately selected the model used in the CY 2016 and CY 2017 evaluations for consistency. Figure I-10 visualizes the relationship between LED market share and two of the key variables from the CY 2017 model (political index and median income).

Figure I-10. LED Market Share against Political Index and Median Income



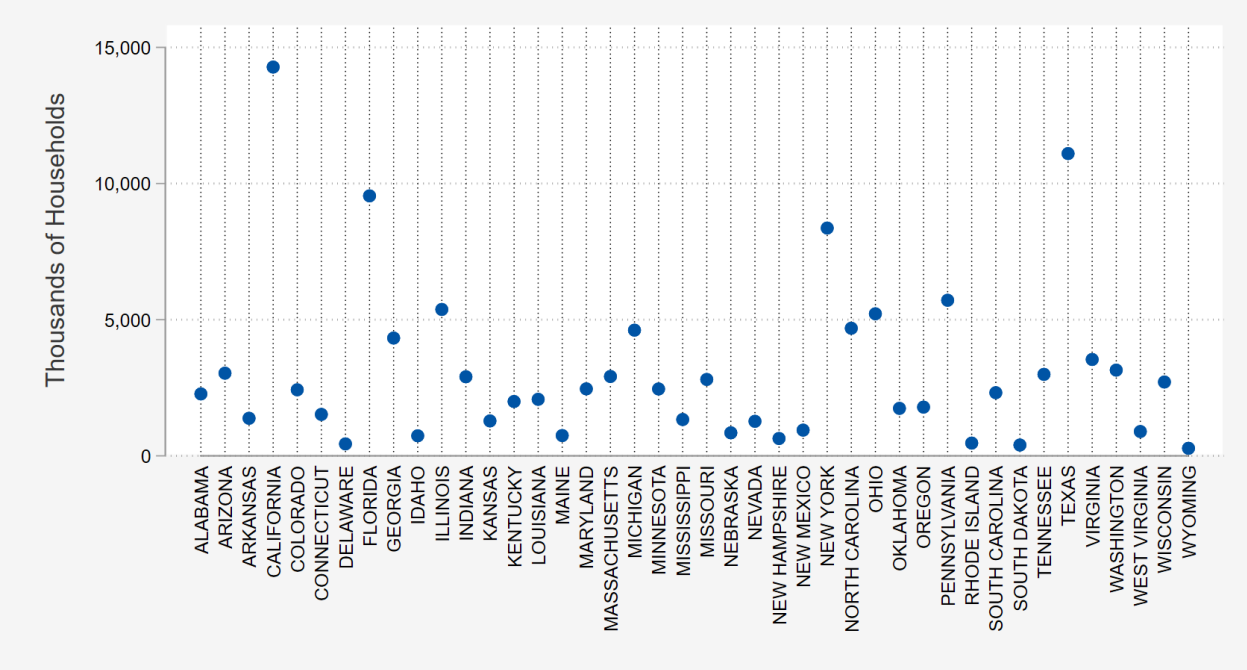
Model Weighting

Another key consideration in developing the model was how to weight each of the states. Each state is a single observation in the model, but the data for that state comprise summarized observations from sales and panel data. Weighting each state equally would not have accounted for larger states having larger sample sizes in the panel data and bigger impacts on the lighting market as a whole. To capture these differences, the Evaluation Team considered using either the number of households or total bulb sales as the weight. The Team determined that using total bulb sales as analytic weights in the model was inappropriate because sales are correlated with the dependent variable. Specifically, states with high LED market share tend to have lower total lamp sales because efficient lamps have longer measure lives than inefficient lamps so the sockets turn over less frequently.

In the NCP data, the sample size was generally proportional to number of households, and large states represented a larger share of the overall U.S. lighting market than smaller states. Given the difference in panel sizes, the average lighting share in large states was based on more measurements than small states, with a commensurate increase in aggregate measurement precision. Therefore, the Evaluation Team used number of households per state as the weight.

Figure I-11 shows the distribution of households for each of the 42 states in the model.

Figure I-11. Number of Households by State



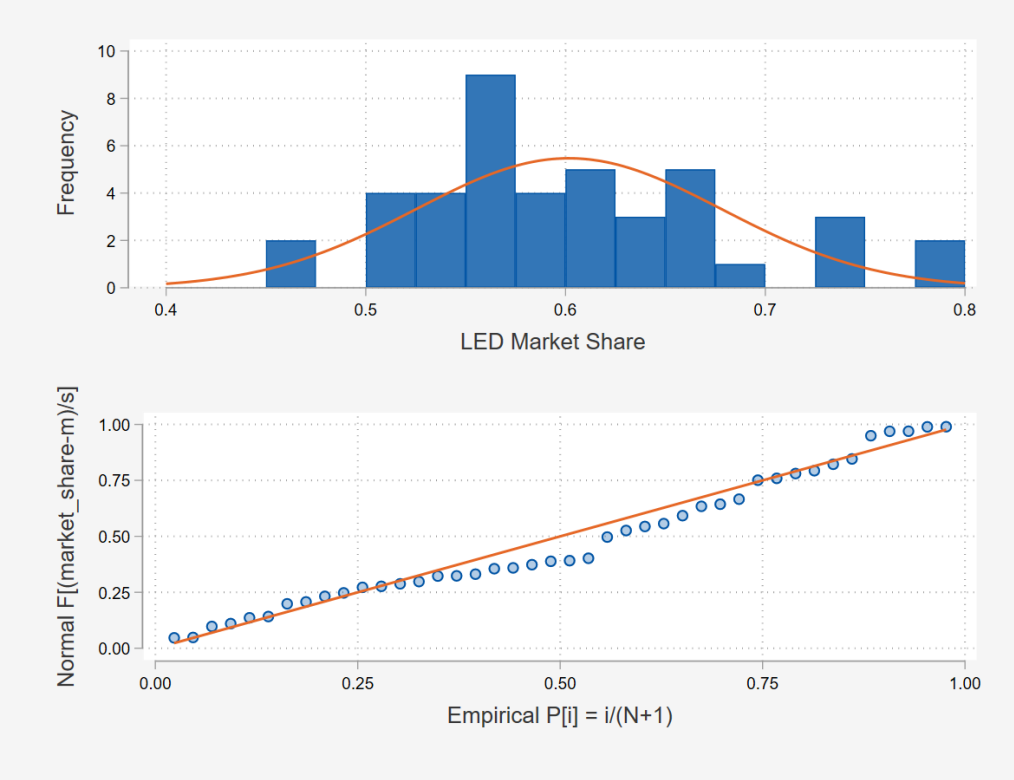
Model Functional Form

Another critical decision in the modeling process is the selection of the functional form of the model. A key input in this decision is the distribution of the dependent variable. Figure I-12 contains a histogram and a standardized normal probability plot for the LED market share of the 42 states in the analysis dataset and indicates that the data are approximately normally distributed.[37]

LED market share is constrained by 0 and 1. In other words, it cannot be less than 0% and it cannot be greater than 100%. The Team looked at functional forms that impose these limits to produce the top half of an S-curve. Since the LED market share values range only from 47% to 78%, and so much of that variation is explained by program intensity and program age, the Team elected to estimate the model using ordinary least squares (OLS) regression. Using OLS did not result in any unrealistic predictions (e.g., less than 0% or greater than 100%).

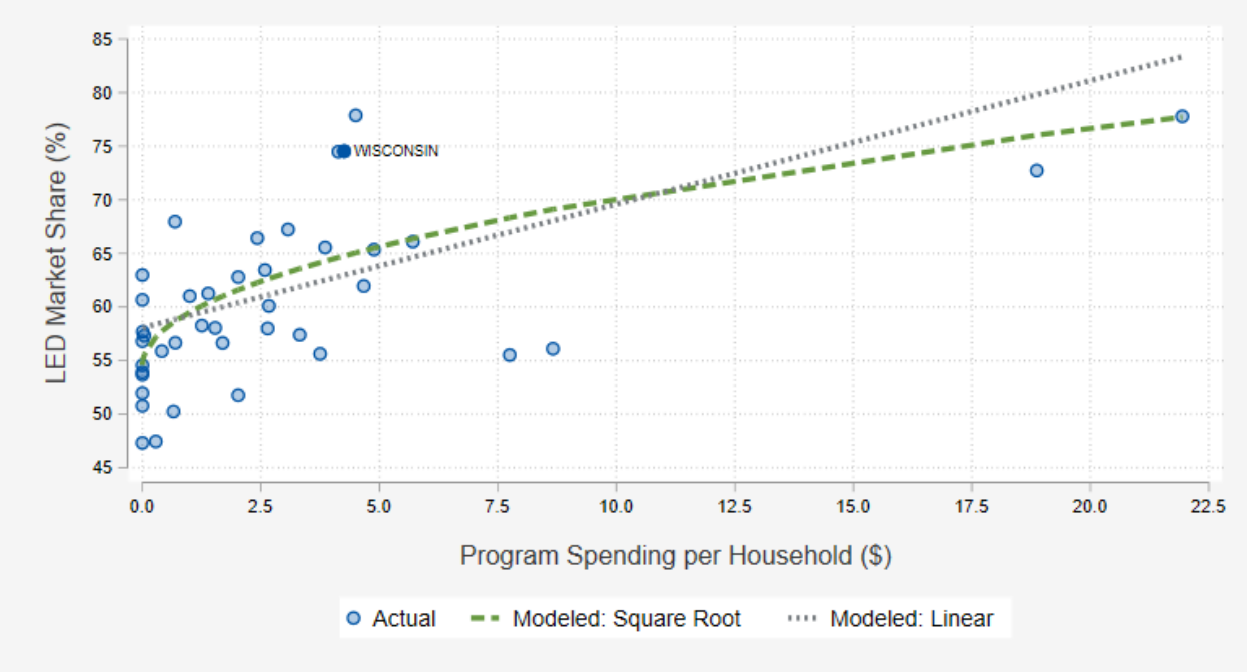
[37] The Evaluation Team also ran a Shapiro-Wilk test for normality, where the null hypothesis is that the data are normally distributed. The p-value of this test was 0.06. At the 95% confidence level, there is no reason to reject the hypothesis that LED market share is normally distributed.

Figure I-12. Histogram and Standardized Normal Probability Plot



The Evaluation Team also explored transformations of independent variables, including the square root of spending as the program intensity variable. Figure I-13 shows that the square root model tapers LED market share as the square root of spending increases. This reflects diminishing returns in terms of market share as program spending increases and graphically provides a good fit for the data.

Figure I-13. Linear vs. Non-Linear Modeling



NTG Estimates

Using the results of the regression models, efficient bulb sales data, and the program tracking databases, the Evaluation Team estimated NTG ratios for LEDs in 2019. The Team derived NTG ratios by first using the model to predict the share of efficient bulbs with and without a program (determining the counterfactual of no program activity by setting the program spending variable to zero). This change in share represents the program lift, or net increase in the share of efficient bulbs resulting from program activity.

To then calculate NTG, the Evaluation Team multiplied the change in share by the total number of bulbs—for all bulb types—sold in 2019, as determined by the sales data analysis described above. This value represents the net impact of the program (i.e., the total lift in the number of LEDs sold), which the Team then divided by the total number of program bulbs sold (the gross number of bulbs) to determine NTG:

$$NTGR = \frac{(\#\ LED\ bulbs\ sold\ with\ program - \#\ LED\ bulbs\ sold\ with\ no\ program)}{\#\ of\ program\ incented\ LED\ bulbs\ sold}$$

Key Findings

The following section presents the findings from applying the multivariate regression model to estimate NTG savings for LEDs sold through the Retail Lighting and Appliance Program.

Multivariate Regression Model

The regression coefficients for the program intensity variables, and subsequent estimates of the NTG ratio, proved relatively stable across a number of model specifications. Table I-6 displays the relevant statistics for the 2019 model. As has been noted, this is the same model that was used in 2016 and 2017. Though some of the independent variables are not statistically significant, the Evaluation Team thought it was important to be consistent with prior modeling efforts. Changing the model also raises a question as to whether changes in NTG estimates reflect changes in the lighting landscape or changes in the functional form of the model.

Table I-6. Model Summary Statistics (n=42 States)

Independent Variables	Model Coefficient	P-Value of Coefficient
Intercept	0.3243	0.539
Program Spending per Household (Sqrt)	0.0296	0.052
Program Age	0.0057	0.005
Political Index	0.1466	0.783
Median Income	0.0000	0.717
Political Index * Median Income	-0.0000	0.668
Non-POS Square Feet per Household	0.0174	0.387
Model Adjusted R-squared		**0.469**

There are a few potential limitations to the model that are worth noting. Though the R-squared value of 0.469 is considered a reasonable fit, it is possible that the model omitted variables that might better explain LED market share. In addition, the use of comparison states in the baseline will not reflect any potential interstate influence on non-program states.

In other words, to the extent that the Focus on Energy Retail Lighting and Appliance Program, combined with the millions of dollars spent on lighting in other program states, has impacted the retailer sales of lamps in non-program (or even moderate program) states, that would increase the baseline and/or comparison area sales and mean that the program spending coefficient was being underestimated (and the resulting NTG would be a conservative estimate).

The positive and significant coefficient for program age indicates that prior program activity does positively influence current-year efficient market share. This may reflect a number of factors, including "momentum" in terms of customer awareness, education, and preference for efficient lighting as well as retailer knowledge and promotion of efficient lighting. Program age might also be thought of as an indicator for market effects, meaning the portion of efficient lighting sales from potentially permanent changes in the market are a result of ongoing program activity.

The Evaluation Team determined NTG using a "modeled:modeled" calculation as opposed to a "modeled:actual" calculation. This means the Team compared the counterfactual scenario (which can

only be modeled) to a *modeled* energy-efficient market share rather than to the actual energy-efficient market share for Wisconsin in the dataset.[38,39] The NTG calculations are shown in Table I-7.

Table I-7. Wisconsin NTG Calculations

Calculation Term	Current and Past Influence	Current Program Spending and Age Influence
Total (All technologies) Wisconsin Bulbs 2019 (A)	24,795,586	24,795,586
Program $ per HH Actual (B)	$4.26	$4.26
Program $ per HH Counterfactual (C)	$0.00	$0.00
Program Age Actual (D)	17	17
Program Age Counterfactual (E)	0	16
LED Market Share Counterfactual (F)	51.2%	60.2%
LED Market Share Modeled (G)	66.9%	66.9%
LED Qty Counterfactual (H=A*F)	12,688,945	14,937,640
LED Qty Modeled (I=A*G)	16,594,042	16,594,042
Net LEDs Modeled (J=I-H)	3,905,097	1,656,402
Program Bulbs 2019 (K)	5,621,136	5,621,136
NTGR Modeled (L=J/K)	69.5%	29.5%
Market Effects (M=Difference of NTGR of columns)	40.0%	N/A
Market Effects Lamps (N=M*K)	2,248,694	N/A

In assessing NTG, the Evaluation Team presented one way for treating the program spending counterfactual: by setting it to zero. However, the Evaluation Team presents two options for treating the program age counterfactual:

- Programs have never existed (program age is set to 0).
- Programs did not exist in the year 2019 (subtract 1 year from the program age).

Table I-7 shows the two options to treating the program age counterfactual and calculates NTG ratios for each option. In the "Current and Past Influence" scenario (i.e., the "programs never existed" scenario), the counterfactual LED market share is 51.2% (Row F), implying that LED share would be

[38] The ratio of modeled:actual LED market share is 90%. The model predicts 66.9% LED market share for 2019 in Wisconsin, whereas the national dataset reports Wisconsin with 74.5% LED market share.

[39] For the Focus on Energy Retail Lighting and Appliance Program scenario, the Evaluation Team included Program and manufacturer incentives, consistent with the demand elasticity modeling approach. As noted in the 2015 evaluation report, "Program incentives did not account for the entire markdown in HTR [hard-to-reach] and grocery retailers. The Evaluation Team assumed that manufacturers would probably not have provided the additional incentives, which effectively doubled the markdown, absent the Program. Therefore, the Evaluation Team attributed the entire markdown to the Program."

about half of all bulbs sold (or 12,688,945 bulbs, Row H) if the Focus on Energy upstream lighting programs had never existed.

With the programs, however, LED share is estimated at 66.9% (Row G), with a total of 16,594,042 LEDs sold (both program and non-program LEDs). The "lift" resulting from the program is the difference of these two figures, or 3,905,097 LEDs (Row J). Since the program claimed 5,621,136 LEDs in 2019, the NTG is 69.5% (the net "lift" in LED sales divided by the gross number of bulbs claimed). Using a similar approach, but examining the influence of the current program under the assumption that influences up to one year prior would have continued if the current program was terminated, the net "lift" in LED sales is only 1,656,402, with a NTG ratio is 29.5%.

Incorporation of Market Effects

As noted in the CY 2017 analysis, the Evaluation Team recommends including past program influence (market effects) when calculating program savings and adding it in at the end of the quadrennium. The Team recommends this for the following reasons:

- **The program seeks to have long-term market effects impacts that are likely being reflected in the program age variable**. The program incentives, and marketing and outreach, seek to impact customer awareness and demand for energy-efficient lighting, as well as retailer stocking and promotion of efficient lighting. Program age can be thought of as a proxy for these effects, measuring long-term trends due to multiple years of running programs. These effects, therefore, should reflect positively, rather than negatively, in the NTG estimate.
- **The savings are new estimates realized in 2019**. The change in market share due to prior program activities was realized in 2019 (i.e., prior program activities helped bump up the current market share). This represents increased sales of LEDs in 2019 that were not counted in prior years (i.e., they were not being double-counted), and if they are not claimed in the current year they are program-induced impacts that are never credited at any time to program spending (past or present).
- **The timing of expenditures and savings is already modified for the Retail Lighting and Appliance Program**. The gross savings analysis already accounts for the future installation of Program lamps in the current program year (i.e., although the first-year in-service rate is less than 100%, an installation trajectory is used to model and claim discounted savings for lamps that are installed in future years). Rather than accelerating future savings, as is done with the in-service rate, claiming impacts from prior expenditures is effectively using a lagged impact savings analysis. Savings that accrue today from programs in previous years, along with the savings from current programs, together comprise a reasonable estimate of energy efficiency program impacts over the long term.

Applying Market Effects

To apply these market effects, the Evaluation Team recommends calculating the energy savings, incremental cost, expected useful life, and any other cost-effectiveness inputs for the year in which the market effects occurred, and then adding these benefits and costs back in at the end of the program

quadrennium. This is particularly important because the LED market is extremely dynamic and these parameters can vary from year to year.

As shown above, the additional lamps due to market effects for 2019 is 2,248,694 (the difference in net "lift" between the two scenarios), and the Team recommends that the final average gross savings and incremental cost be applied to this total. The Team recommends a similar calculation be done for 2020 and future years in the current quadrennium, using the appropriate inputs in place for each specific calendar year (i.e., the 2019 market effects lamps would use the gross savings and incremental cost in place for 2019, and any market effects lamps determined for 2020 would use the gross savings and incremental cost for 2020). Summing the totals for each year will determine the total additional market effects savings and costs over the quadrennium that can be applied to quadrennial impact and cost-effectiveness analysis.

Comparison to Prior Years

As shown in Table I-8, the NTGR excluding market effects held fairly steady between 2016 and 2017, but dropped steeply from CY 2017 to CY 2019. Looking at the LED market share trends above in the *Analysis of the Combined Dataset (Descriptive Statistics)* section, it is clear that 2018 was a "watershed" year in which LEDs began to displace sales of inefficient lamps, and in 2019 the trend continued along with substantial gains in LED market share in non-program states. Interestingly, the predicted market "lift" in LED share in CY 2019 (15.7%) was actually greater than the "lift" in CY 2017 (12.8%), but as shown in the table the baseline (counterfactual) share was much higher in CY 2019, plus the program claimed approximately 900,000 more bulbs in 2019 vs. 2017.

Table I-8. CY 2016 – CY 2019 Program Intensity and NTG Results

Program Expenses	CY 2016	CY 2017	CY 2018 (No Model Run)	CY 2019
Program Intensity				
Program $ per HH Actual	$4.13	$4.23	N/A	$4.26
Gross Program LEDs	3,405,692	4,732,792	N/A	5,621,136
Total Bulb Sales (All technologies)	3,405,692	4,732,792	N/A	5,621,136
Predicted Market "Lift"				
LED counterfactual share (market effects scenario)	23.5%	28.9%	N/A	51.2%
LED modeled share	33.0%	41.7%	N/A	66.9%
"Lift" in LED share	9.5%	12.8%	N/A	15.7%
Net-to-Gross				
NTG – No Market Effects	46.7%	51.0%	N/A	29.5%
NTG with Market Effects	**71.0%**	**71.6%**	N/A	**69.5%**

The NTGR, including market effects, dropped only slightly from CY 2017. As noted above, program age was the most significant predictor of LED market share in the model, reflecting the importance of ongoing, sustained influence of the retail efficient lighting market through retailer engagement and consumer education.

Self-Report Net-to-Gross Methodology

Two components—freeridership and participant spillover—constitute NTG. True freeriders are customers who would have purchased a measure without a program's influence. Participant spillover is the savings obtained by customers investing in additional energy-efficient measures or activities because of their program participation.

This section presents the self-report approaches the Evaluation Team used to determine NTG for residential and nonresidential programs. In summary, the Team conducted participant surveys and used self-reported findings to calculate NTG ratios. It then applied these results to measure categories and programs for which adequate baseline data were unavailable. In some cases, the Evaluation Team combined the measure-level results from the standard market practice and the self-report methods to determine weighted average program NTG ratios.

Survey Design

When assessing NTG for programs where participating customer surveys were conducted in the CY 2019 evaluation, the Evaluation Team asked a series of freeridership and spillover questions. These programs are listed above in Table I-1.

For CY 2019, the Evaluation Team implemented a modification of past freeridership measurements. Prior freeridership research relied on customers' self-reported intention to purchase a measure in the absence of the program. Survey items for this approach addressed the program's effect on the efficiency, quantity, and timing of purchases. This portion of the freeridership measurement did not change in CY 2019 and is referred to *intention* freeridership in this report.

Starting with the 2019 evaluation, the Evaluation Team integrated an *influence* freeridership component to align with industry best practices. An *intention* freeridership score and *influence* freeridership score are estimated for each surveyed participant on a range from 0% to 100%. Program-level *intention* and *influence* freeridership scores are then calculated by weighting the individual freeridership component scores by respondents' verified lifecycle gross savings.

By savings-weighting the previously used *intention* methodology with an *influence* methodology, the Evaluation Team produced a program freeridership score. The Team calculated the arithmetic mean of *intention* and *influence* freeridership components to estimate final program freeridership, as shown in the following equation:

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

The Evaluation Team designed the *intention* freeridership questions to elicit as accurately as possible the impact of particular programs on the respondent's decision to purchase high-efficiency equipment. Programs can influence customer decisions in a variety of ways: participants may decide to purchase an energy-efficient measure sooner than planned, to purchase a higher efficiency measure than planned, or to purchase more units than planned without the program. To understand the influence of the program, the survey asked questions about what decision-makers might have done in its absence.

Direct questions such as, "Would you have installed measure X without the program incentive?" tend to result in exaggerated *yes* responses. Participants often provide answers they believe surveyors seek, so such a question becomes the equivalent of asking: "Would you have done the right thing on your own?" Effectively avoiding such bias involves asking a question in several different ways and checking for consistent responses.

Basing *intention* freeridership estimates on a series of questions, rather than a single question, helped the Evaluation Team recognize and minimize response biases. Not all questions were weighted equally. For example, respondents who would not have installed the measure(s) to the same level of efficiency without the program were automatically 0% *intention* freeriders. If nonresidential program participants would not have installed the measure(s) within two years without the program, they were automatically 0% *intention* freeriders. The Team assigned other questions included in the *intention* freeridership analysis partial weights for responses that were indicative of a non-freerider.

The survey questions addressed five core dimensions of *intention* freeridership for residential programs and six core intention freeridership dimensions for nonresidential programs, as listed below:

- Would participants have installed measures without the program?
- Were participants planning on ordering or installing the measures before learning about the program?
- Would participants have installed the measures at the same efficiency levels without the program incentive?
- Would participants have installed the same quantity of measures without the program?
- In the program's absence, would participants have installed the measures at a different time?
- Was the purchase of the measures in the organization's most recent capital budget (nonresidential only)?

Specific intention freeridership questions used for the programs are presented in their individual analysis sections in this appendix.

Persistent conjecture in the industry, however, indicates intention self-reports may be subject to biases, yielding an inflated freeridership value. To address this possibility and to provide a triangulation of approaches to the estimate, in CY 2019 the Evaluation Team integrated a second set of survey questions designed to measure the program's perceived influence on the respondents' purchasing decisions.

To estimate program influence, the survey asked respondents to rate the influence of five program elements on their purchasing decisions. Responses were captured using a 1 to 4 scale, with 1 meaning *not at all important* and 4 meaning *very important*. A surveyed participant's overall influence rating equaled the maximum influence of any single program element. This drew upon an underlying principle: if a single element had a substantial influence on a respondent's purchasing decision, the program successfully influenced the respondent.

Intention Freeridership Methodology

The Evaluation Team used a probability matrix to assign a single *intention* freeridership score to each participant, using his or her responses to targeted survey questions.[40] The Evaluation Team applied *intention* freeridership scores to question response patterns in the probability matrix.

This matrix approach provides these key benefits:

- Derivation of a partial *intention* freeridership score, based on the likelihood of a respondent taking similar actions in the program's absence
- Use of a rules-based approach for consistency among multiple respondents
- Ability to change weightings in a what if exercise, testing the response set's stability

The Evaluation Team's method offered the advantage of partial *intention* freeridership. Experience has shown that program participants do not fall neatly into freerider and non-freerider categories. For example, the Team assigned partial *intention* freeridership scores to participants who had plans to install a measure; that is, although the program exerted some influence over their decisions, these respondents were also influenced by other market characteristics outside of the program. Further, the Team could assign partial credit to "don't know" and "refused" responses, rather than removing respondents entirely from the analysis.

The Evaluation Team converted each participant survey response into *intention* freeridership matrix terminology, combined each participant's converted responses to assign an *intention* freeridership score from the matrix, and aggregated all participants into an average *intention* freeridership score for the entire program category, ultimately assessing *intention* freeridership at three different levels.

Response Conversion to Matrix Terminology

The Evaluation Team independently evaluated each response, assessed it for *intention* freeridership, and converted it into one of these values:

- Yes (indicative of freeridership)
- No (indicative of non-freeridership)
- Partial (partially indicative of freeridership)

[40] Khawaja, M. S. 2007 edition. *The NAPEE Handbook on DSM Evaluation.* p. 5-1.

Participant Intention Freeridership Scoring

Following conversion of survey responses into matrix terminology, the Team created an *intention* freeridership matrix for each program. The Team's process for determining an *intention* freeridership score is as follows:

- Customers were categorized as 0% intention freeriders in these instances:
  - They had no plans to install the measure in the absence of the program's incentives and would not have installed the measure within a year for residential programs and within two years for nonresidential programs.
  - They had specific plans to install the measure before learning about the program but would not have done so without program incentives.
  - In the absence of program incentives, the customer would not have purchased or installed equipment to the same level of efficiency.
- Customers were categorized as 100% intention freeriders if they would have installed the measure without the program or if they had installed the measure before learning about the program.
- Customers received a partial *intention* freeridership score (ranging from 12% to 75%) if they had plans to install the measure and their decision was influenced by the program. (This influence may have been installation 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 influence over their decision, the Team applied a higher *intention* freeridership percentage.

Measure Category *Intention* Freeridership Scoring

After assigning an *intention* freeridership score to every survey respondent, the Evaluation Team calculated a savings-weighted average *intention* freerider score for the measure category. For each program, the respondents' *intention* freerider scores were individually weighted by estimated savings of equipment installed using the following calculation:

$$\text{Savings Weighted } \textit{Intention} \text{ Freeridership} = \frac{\sum[\text{Respondent } \textit{Intention} \text{ Freerider Score}] * [\text{Verified Measure Lifcycle Gross Energy Savings}]}{\sum[\text{All Respondents Verified Measure Lifcycle Gross Energy Savings}]}$$

Influence Freeridership Methodology and Scoring

To estimate an *influence* freeridership score for the 2019 evaluation, the Evaluation Team asked respondents to rate the importance of program elements on their purchasing decisions. The surveys captured responses using a four-point scale, with 1 meaning *not important* and 4 meaning *very important*. A surveyed participant's overall influence rating equaled the maximum importance of any single program element. This methodology was based on an underlying principle: if a single element had a substantial influence on a respondent's purchasing decision, the program successfully influenced the respondent.

For example, the Team included the survey question shown in Table I-9 to capture respondents' perspectives on elements driving them to take energy-efficient actions.[41] A rating of 4 represents the program's maximum influence, which determined the influence freeridership component score.

Table I-9. Example of Influence Freeridership Component Question

I'm going to read a list of possible factors that could have contributed to your decision. For each of the factors listed, please rate how important it was in your decision. Use a scale from 1 to 4, with 1 meaning the factor was "not at all important" and 4 meaning the factor was "very important" in your decision to purchase the energy-efficient [MEASURE][s].						
Rate Influence of Program Elements						
	Not at all important	***Not too important***	***Somewhat important***	***Very important***	**Don't Know**	**Not Applicable**
The Focus on Energy incentive or discount	1	2	3	(4)	DK	N/A
Recommendation from Focus on Energy Staff	1	2	3	4	(DK)	N/A
Information provided by Focus on Energy on energy-savings opportunities	1	2	3	4	(DK)	N/A
Recommendation from contractor or vendor	1	(2)	3	4	DK	N/A
Previous participation in a Focus on Energy energy efficiency program	1	2	(3)	4	DK	N/A

High program-influence levels and influence freeridership maintain an inverse relationship: the greater the program's influence, the lower the participant's final influence freeridership score. Table I-10 presents the freeridership level implied by each influence rating.

Table I-10. *Influence* Freeridership Implied by Response to Influence Items

Influence Rating	*Influence* Freeridership Score
1 (*not at all important*)	100%
2 (*not too important*)	75%
3 (*somewhat important*)	25%
4 (*very important*)	0%
Don't know	50%
Not applicable	50%

Measure Category *Influence* Freeridership Scoring

After assigning an *influence* freeridership score to every survey respondent, the Evaluation Team calculated a savings-weighted average *influence* freerider score for the measure category. For each

[41] The question wording and program factors included in surveys may vary slightly depending on the specific program component. The *Influence Freeridership Analysis* sections in the specific program sections list program factors included for each specific program component.

program, the respondents' *influence* freerider scores were individually weighted by estimated savings of equipment installed using the following calculation:

$$\text{Savings Weighted Influence Freeridership} = \frac{\sum[\text{Respondent } Influence \text{ Freerider Score}] * [\text{Verified Measure Lifcycle Gross Energy Savings}]}{\sum[\text{All Respondents Verified Measure Lifcycle Gross Energy Savings}]}$$

Spillover Methodology

Spillover refers to additional savings generated by program participants following their participation but not captured by program records. Spillover occurs when participants choose to purchase energy-efficient measures or adopt energy-efficient practices because of a program's influence but do not receive program incentives from a utility or another organization.

The Evaluation Team measured spillover by asking a sample of participants who purchased and received an incentive for a particular measure if they installed another efficient measure or undertook another energy efficiency activity because of the program. Respondents were asked to rate the program's (and incentive's) relative influence (either *very important*, *somewhat important*, *not too important*, or *not at all important*) on their decisions to pursue additional savings.

Participant Spillover Analysis

The Evaluation Team used a top-down approach to calculate spillover savings. Analysis began with a subset comprising only the survey respondents who indicated they had installed additional energy-saving measures after participating in the program. The Evaluation Team screened out any respondents who received an incentive for these additional measures. It also removed respondents if they indicated the program had little influence on their decisions to purchase additional measures, thus retaining only those respondents who rated the program as *very important*.

The Evaluation Team applied evaluated and deemed savings to the spillover measures respondents said they had installed as a result of their program participation.

The Team calculated spillover percentage per program category by dividing the sum of additional spillover savings reported by respondents for a given program category by total gross savings achieved by all respondents in the program category:

$$Spillover\ \% = \frac{\sum \text{Spillover Measure Lifecycle Gross Energy Savings for All Survey Respondents}}{\sum \text{Program Measure Verified Lifcycle Gross Energy Savings}}$$

Net-to-Gross Analysis

The Evaluation Team combined this spillover information with the program-level freeridership results to achieve the NTG ratio, using the following calculation:

NTG = 1 – Freeridership + Spillover

Table I-11 summarizes the self-report CY 2019 participant freeridership, spillover, and NTG results by program.

Table I-11. CY 2019 Self-Report Participant Freeridership, Spillover and NTG by Program

Program	n	Freeridership	Spillover	NTG
Home Performance with ENERGY STAR (Renewable Energy)	94	42%[a]	1%[a]	59%
Multifamily Energy Savings Program	70	27%[b]	1%	74%
Renewable Energy Competitive Incentive Program	10	7%[b]	0%	93%

[a] Weighted by CY 2019 population verified lifecycle MMBtu gross energy savings for the Renewable Energy Program. NTG ratios are applied at the measure level; therefore, the Program-level NTG ratio will vary annually based on the measure mix.
[b] Weighted by CY 2019 verified lifecycle MMBtu gross energy savings.

Four programs—Agriculture, Schools and Government, Business Incentive, Small Business Direct Install, and Large Energy Users—did not include participant surveys in CY 2019. The Evaluation Team calculated the overall program NTG for CY 2019 using the CY 2015, CY 2016, and CY 2018 net savings data (sum of net savings from CY 2015, CY 2016, and CY 2018 divided by the sum of the gross savings from CY 2015, CY 2016, and CY 2018), which were based on participant surveys. Table I-12 lists the overall CY 2019 NTG for these programs.

Table I-12. CY 2019 Net-to-Gross for Design Assistance and Renewable Energy Competitive Incentive Programs

Program	CY 2015, CY 2016 & CY 2018 Total Lifecycle		CY 2019 NTG
	Gross Verified Savings (MMBtu)	Net Verified Savings (MMBtu)	
Agriculture, Schools, and Government	29,046,322	19,505,332	67%
Business Incentive	28,417,891	16,080,286	57%
Small Business	5,632,672	5,144,249	91%
Large Energy Users	80,883,064	61,245,363	76%

The Design Assistance Program also did not include participant surveys in CY 2019. The Evaluation Team calculated the overall program NTG for CY 2019 using the CY 2015, CY 2016, and CY 2017 net savings data (sum of net savings from CY 2015, CY 2016, and CY 2017 divided by the sum of the gross savings from CY 2015, CY 2016, and CY 2017), which were based on participant surveys. Table I-13 summarizes the overall CY 2019 NTG for these programs.

Table I-13. CY 2019 Net-to-Gross for Design Assistance Program

Program	CY 2015, CY 2016 & CY 2017 Total Lifecycle		CY 2019 NTG
	Gross Verified Savings (MMBtu)	Net Verified Savings (MMBtu)	
Design Assistance Program	758,403	545,654	72%

The Community Small Business Offering also did not include participant surveys in 2019. The Evaluation Team calculated the overall program NTG for CY 2019 using the CY 2018 net savings data (net savings from CY 2018 divided by the gross savings from CY 2018), which were based on participant surveys. Table I-14 summarizes the overall CY 2019 NTG for Community Small Business Offering.

Table I-14. CY 2019 NTG for Community Small Business Offering

Program	CY 2018 Total Lifecycle		CY 2019 NTG
	Gross Verified Savings (MMBtu)	Net Verified Savings (MMBtu)	
Community Small Business Offering	384,346	357,442	93%

Appliance Recycling Program Self-Report NTG Methodology and Findings

The Evaluation Team used the following formula to estimate net savings for recycled refrigerators and freezers:

$$Net\ savings = Gross\ Savings - Freeridership\ and\ Secondary\ Market\ Impacts$$

Where:

Evaluated Gross Savings	=	The evaluated *in situ* UEC for the recycled unit, adjusted for part-use
Freeridership and Secondary Market Impacts	=	Program savings that would have occurred in the program's absence

Secondary market impacts require a decision-tree approach for calculating and presenting net savings for the Appliance Recycling Program. The decision tree—populated by the responses of surveyed participants—presents savings under all possible scenarios concerning the participants' actions regarding the recycled equipment. Through these scenarios, the Evaluation Team used a weighted average of savings to calculate net savings attributable to the program. This section includes specific portions of the decision tree to highlight specific aspects of the net savings analysis. Figure I-16 and Figure I-17 at the end of the section illustrate the full decision trees.

Freeridership

The Appliance Recycling Program survey first asked participants if they considered discarding the appliance prior to learning of the Program. If participants did not previously consider appliance disposal, the Evaluation Team categorized them as non-freeriders and excluded them from subsequent freeridership analysis.

Next, the survey asked all remaining participants (i.e., those who considered discarding their existing appliance before learning about the Appliance Recycling Program) a series of questions to determine, in the Program's absence, the distribution of participating units likely to have been kept or discarded. Actions independent of Program intervention follow three scenarios:

- Unit is discarded and transferred to someone else
- Unit is discarded and destroyed
- Unit is kept in the home

To determine the percentage of participants following each scenario, the survey asked participants about the likely fate of their recycled appliance had it not been decommissioned through the Appliance Recycling Program. The Evaluation Team grouped their responses into these categories:

- Kept the appliance
- Sold the appliance to a private party (i.e., via an acquaintance or through a posted advertisement)
- Sold or gave the appliance to a used appliance dealer

- Gave the appliance to a private party, such as a friend or neighbor
- Gave the appliance to a charity organization
- Left the appliance on the curb with a "free" sign
- Had the appliance removed by the dealer from whom the new or replacement appliance had been obtained
- Hauled the appliance to a landfill or recycling center
- Had the appliance picked up by a local waste management company

Using the survey responses, the Evaluation Team determined the participants' actions independent of the Program. Using these results, the Team then calculated the percentage of refrigerators and freezers participants kept or discarded (Table I-15).

Table I-15. Final Distribution of Kept and Discarded Appliance

Stated Action Absent Program	Indicative of Freeridership	Refrigerators (n=94)	Freezer (n=68)
Kept	No	35%	40%
Discarded	Varies by Discard Method	65%	60%
Total		**100%**	**100%**

As shown in Table I-15, 65% of respondents would not have kept their refrigerator. Of these, 82% would have discarded it by one of these actions:

- Taking their appliance to the dump
- Hiring someone to take the appliance to the dump
- Having a retailer pick up their appliance

Having the retailer pick up the appliance is not necessarily indicative of freeridership. This depends on the retailer's decision whether or not to resell the unit. Not all appliances would be viable for resale. The Evaluation Team used age as a proxy for secondary market viability and assumed any appliance over 15 years old is unlikely to be resold by a retailer. All of the respondents who said they would have had their appliance picked up by a retailer recycled an appliance over 15 years old. Together these actions resulted in a 53% reduction in gross savings due to freeridership for refrigerators.[42]

Freeridership for freezer recyclers was lower. Of the 60% of respondents who would not have kept their freezer, 72% would have taken one of the three actions above that would have led to the appliance being removed from the grid. Thus, freeridership for freezers was 45%.

Secondary Market Impacts

If, in the absence of the Appliance Recycling Program, a participant would have directly or indirectly (through a market actor) transferred the Program-recycled unit to another customer, the Evaluation

[42] Sixty-five percent of respondents not keeping their appliance multiplied by 82% of respondents who reported one of the three actions leading to freeridership equals 53% freeridership. For freezers, 60% * 72% = 45%.

Team estimated what actions the would-be acquirer might have taken, given the unit would be unavailable without the Program.

Some would-be acquirers in the market for a refrigerator or freezer would find another unit. Others would not (only taking the unit opportunistically). Difficulties arise in trying to quantify the change in the total number of refrigerators and freezers (overall and used) in use before and after Appliance Recycling Program implementation and what effect the Program has on the total. Without this information, the Uniform Methods Project (UMP) recommends that evaluators assume one-half of would-be acquirers would find an alternate unit.[43] Without information to the contrary, the Evaluation Team applied the UMP recommendation to this evaluation.

The Evaluation Team then determined whether the alternate unit would likely be another used appliance (similar to those recycled through the Program) or a new standard-efficiency unit (presuming that fewer used appliances would be available due to Program activity).[44]

Again, as discussed, definitively estimating this distribution proves difficult. The UMP recommends adopting a midpoint approach when primary research is unavailable: evaluators should assume one-half of the would-be acquirers who would have acquired an alternate unit would find a similar used appliance, and one-half would acquire a new, standard-efficiency unit.

The Evaluation Team used the ENERGY STAR website to determine energy consumption for new, standard-efficiency appliances,[45] then averaged the reported energy consumption of new, standard-efficiency appliances with sizes and configurations comparable to the Program units.

Figure I-14 details the Evaluation Team's methodology for assessing the Appliance Recycling Program's impact on the secondary refrigerator market and for applying the recommended midpoint assumptions when primary data were unavailable (Figure I-17 provides a freezer-specific diagram). As is evident, accounting for market effects results in three savings scenarios:

- Full per-unit gross savings
- No savings

---

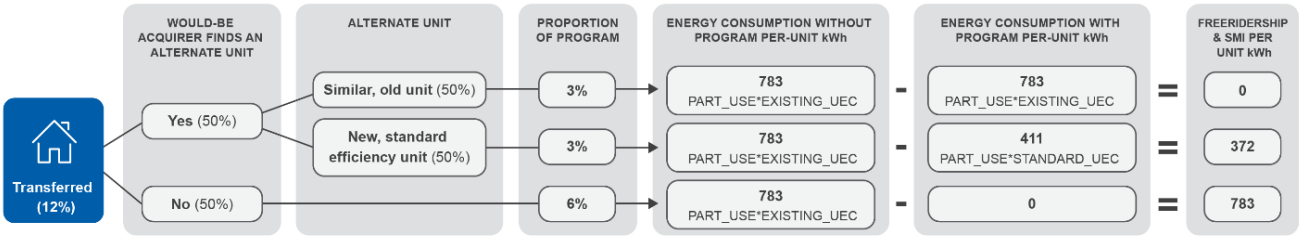
[43] National Renewable Energy Laboratory. *Uniform Methods Project for Determining Energy Efficiency Program Savings for Specific Measures.* "Chapter 7: Refrigerator Recycling Evaluation Protocol." September 2017. Available online: https://www.nrel.gov/docs/fy17osti/68563.pdf

[44] It is also possible that the would-be acquirer would select a new ENERGY STAR unit. However, the Evaluation Team assumed most customers who are in the market for a used appliance would upgrade to the next lowest price point (a baseline, standard-efficiency unit).

[45] The Evaluation Team calculated energy consumption of a new, standard-efficiency appliance using the ENERGY STAR calculator (http://www.energystar.gov/index.cfm?fuseaction=refrig.calculator). The Team took the average energy consumption of new comparably sized, standard-efficiency appliances with similar configurations as the Program units.

- Partial savings (i.e., the difference between energy consumption of the program unit and the new, standard-efficiency appliance acquired alternatively)

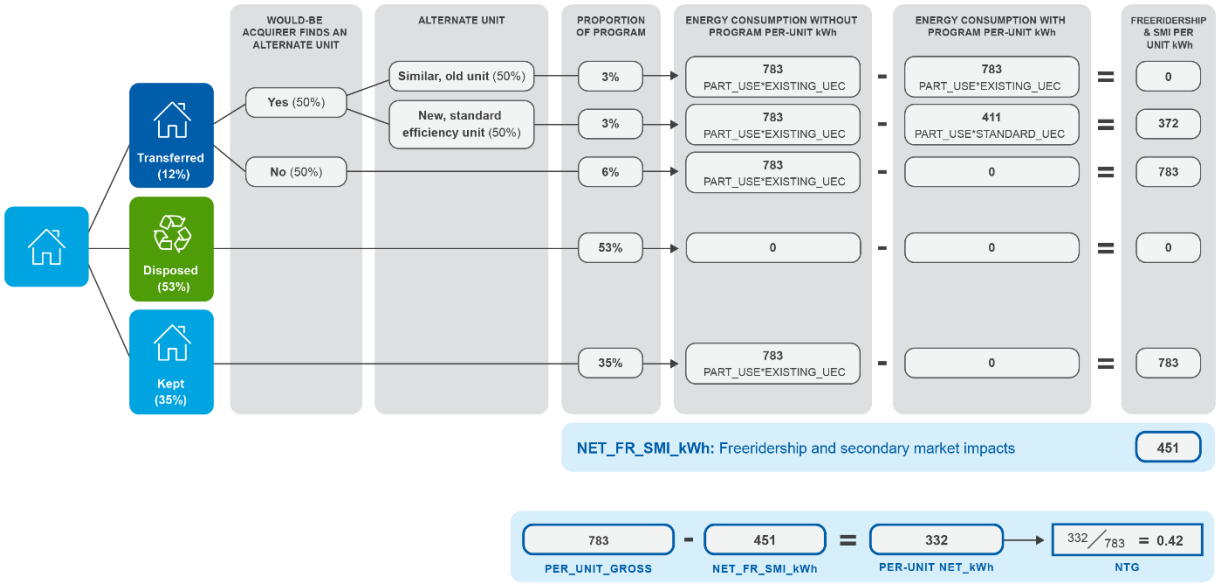
Figure I-14. Secondary Market Inpacts—Refrigerators



Integration of Freeridership and Secondary Market Impacts

After estimating the parameters of freeridership and secondary market impacts, the Evaluation Team used the UMP decision tree to calculate average per-unit savings, net of their combined effect. As shown in Figure I-15, the Evaluation Team integrated these values into an estimate of savings net of freeridership and secondary market impacts. The final savings net of freeridership and secondary market impacts is calculated as the weighted average of the savings for each of the decision tree categories.

Figure I-15. Savings Net of Freeridership and Secondary Market Impacts—Refrigerators



Spillover

As previously described, spillover refers to additional savings generated by participants but not captured in program records. Spillover occurs when participants choose to purchase energy-efficient measures or adopt energy-efficient practices after being influenced by a program or marketing activity, but they do not apply for an incentive and are therefore not captured through any other programs offered through Focus on Energy.

The UMP protocol recommends against spillover for appliance recycling programs. This is because recycling programs are unlikely to generate like spillover (participants are unlikely to have additional appliances that they recycle without getting an incentive) and opportunities for non-like spillover are limited because recycling programs do not provide comprehensive energy education, as with a whole-home audit.

Additional savings from appliance recycling programs are most likely generated by the greater likelihood of participants to participate in other available residential programs (particularly upstream lighting where participants cannot be tracked via upstream delivery), though these savings are captured in other program evaluations. Therefore, the Evaluation Team did not include spillover questions in the participant survey for CY 2019.

Final Net-to-Gross Analysis

As shown in Table I-16, the Evaluation Team determined final net savings as evaluated gross per-unit savings, less per-unit freeridership and secondary market impacts.

Table I-16. CY 2019 NTG Ratios

Appliance	Gross Per-Unit Savings (kWh)	Freeridership and Secondary Market Impacts (kWh)	Net Per-Unit (kWh)	NTG
Refrigerator	783	451	332	42%
Freezer	744	394	350	47%

The decision trees used to calculate NTG are shown in Figure I-16 for refrigerators and Figure I-17 for freezers.

Figure I-16. Refrigerator NTG Combined Decision Tree

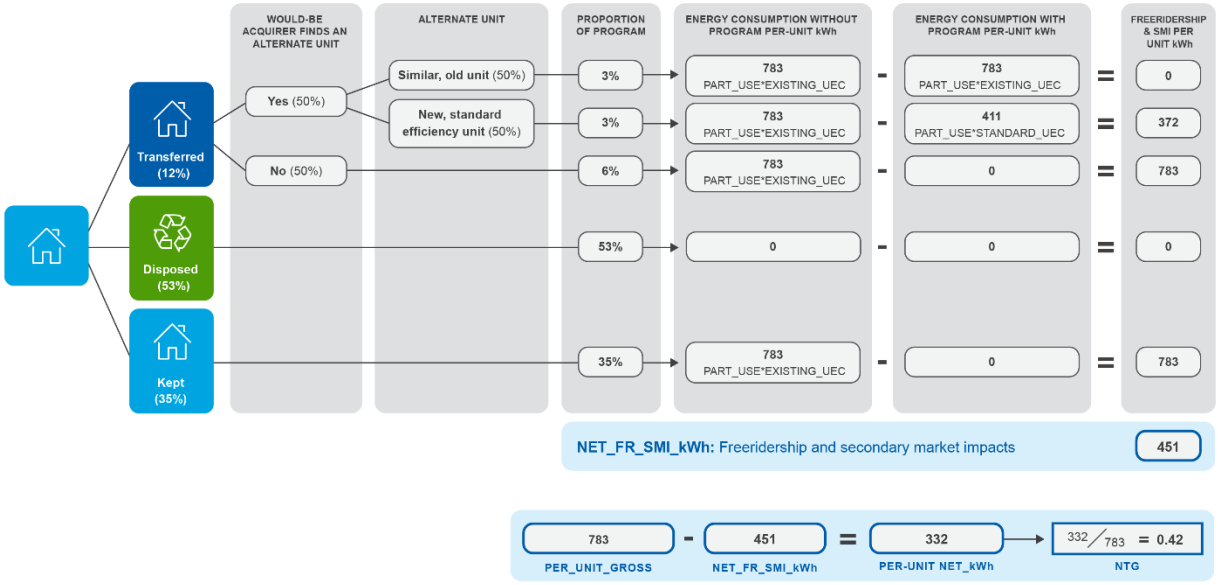
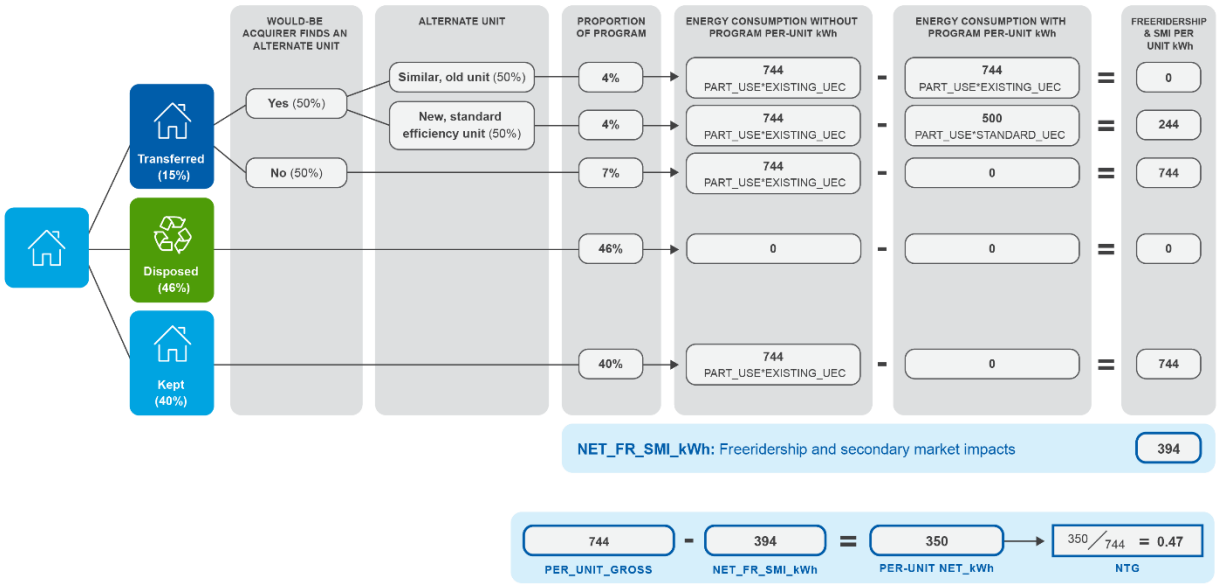


Figure I-17. Freezer NTG Combined Decision Tree



New Homes Program Billing Analysis

The Evaluation Team requested billing data from Wisconsin utilities that had a New Homes Program-certified home built in CY 2018. Utilities provided gas and electric billing data for all new home connect customers from June 2017 through December 2018. These data were from most of the utilities in Wisconsin.[46,47] Focus on Energy also provided detailed tracking data for New Homes Program participants from CY 2018. Additional tracking data for CY 2019 were also used to remove customers who may have later participated in the Program from the non-Program homes group.

The Evaluation Team conducted a billing analysis to establish the verified net *ex post* gas and electric savings of the New Homes Program. The Team used a nonparticipant group composed of new hookup

---

46 The gas utilities included Alliant (Wisconsin Power & Light), Madison Gas and Electric Company, Northern States Power Company (Xcel Energy-Wis), Wisconsin Electric Power Company (We Energies), and Wisconsin Public Service Corporation. City Gas provided only program home data.

47 The electric utilities included Alliant (Wisconsin Power & Light), Dahlberg Light and Power Company, Hartford City of Utilities, Kaukauna Utilities , Lake Mills Light and Water Department, Madison Gas and Electric Company, Manitowoc Public Utilities, Menasha Electric & Water Utilities, Mount Horeb Electric Utility, New Holstein Public Utility, Northern States Power Company (Xcel Energy-Wis), Oconomowoc City of Utilities, Reedsburg Utility Commission, Rice Lake Municipal Water & Electric Utility, River Falls Municipal Utilities, Rock Energy Cooperative, Sheboygan Falls Utilities. Sun Prairie Utilities, Waunakee Water and Light Commission, Waupun Public Utilities, Wisconsin Electric Power Company (WE Energies), and Wisconsin Public Service Corporation. Adams-Columbia Electric Cooperative, Kiel Electric Utility, and Plymouth Utilities provided only program home data.

customers who did not participate in the New Homes Program to provide a representative group of homes to establish the current market baseline energy use to establish the Programs' net savings.

For each participant, the Evaluation Team obtained these data:

- SPECTRUM ID and customer ID
- Customer name and address including zip code
- Home Builder
- Space heating type
- Water heating type
- Participant tier level
- Percentage efficiency above code
- Incentive amount
- Total *ex ante* gas therm savings
- Total *ex ante* electric kWh savings

The Evaluation Team then combined the customer-level tracking information with the electric and gas billing data by customer address.

Next, the Team followed these steps to conduct the billing analysis of the New Homes Program:

1. Check each 2018 participant account against the complete list of new connects received from the utilities. All matching addresses were assigned to the participant group, all non-matching addresses were assigned to the nonparticipant group.
2. Match addresses to the REM/Rate database, which the Team created from historical Program homes (see New Homes Program chapter of Volume II for more information). Any nonparticipant homes that matched these data were removed from the nonparticipant group. For participants, the information in the REM/Rate database was added for later summaries and comparisons.
3. Match addresses with the 2019 New Homes participant tracking data. Any nonparticipant homes that matched were removed from the nonparticipant group.
4. Use zip code mapping to determine the nearest weather station for each zip code
5. Obtain daily average temperature weather data from January 2017 through January 2020 for 30 National Oceanic and Atmospheric Administration (NOAA) weather stations, representing all zip codes associated with the participants
6. Use daily average temperatures to determine base 45 through base 85 heating degree days (HDDs) and cooling degree days (CDDs) for each station
7. Obtain typical meteorological year 3 (TMY3; 1991–2005) annual normal and cooling degree days to weather normalize the billing data
8. Match billing data periods with the CDDs and HDDs from the associated stations

Comparison Group

An important aspect of the CY 2019 billing analysis quasi-experimental design is to compare the participant, or treatment group, to a group with new homes but who did not participate in the New Homes Program.

Adjusted gross savings are obtained from the differences in usage per square foot for participant homes with nonparticipant homes built during a similar period.

Furthermore, since all Program participants fell into the category of single-family homes, the Team removed all apartments from the nonparticipant group. Some utilities also provided commercial type accounts. The Team verified that each account was a residential home account built in the 2017-2019 period.

The Evaluation Team defined the analysis period for both participants and nonparticipants as from January 2019 through December 2019. This was the latest annual period of billing data with the most complete data for all utilities. Furthermore, selecting the latest period allows more time for the homes to become occupied after they are built.

The Team relied on the PRInceton Scorekeeping Method (PRISM) to develop estimates of the participant and nonparticipant usages and savings.

Data Screening

The Evaluation Team removed billing data months or customers from the analysis based on the following billing data related screens:

- Billing data readings that spanned less than 15 days or more than 65 days
- Electric billing data monthly readings where the use was less than 1 kWh per day
- Participant customers with fewer than nine analysis period months
- Nonparticipant customers with fewer than nine analysis period months

This ensured that the pre- and post-installation periods were well balanced and that all seasons were represented in the PRISM models.

PRISM Modeling Approach

In the next step of the screening process, the Evaluation Team estimated PRISM models for the analysis period billing data. These models provided weather-normalized annual use for each account. The PRISM electric model used the following specification:

$$ADC_{it} = \alpha_i + \beta_1 AVGHDD_{it} + \beta_2 AVGCDD_{it} + \varepsilon_{it}$$

Where for each customer *i* and month *t*:

ADC_{it}	=	Average daily kWh consumption in the analysis period
α_i	=	Participant intercept; represents the average daily kWh base load
β_1	=	Model space heating parameter value
β_2	=	Model cooling parameter value
$AVGHDD_{it}$	=	Base 45° to 65° average daily HDDs for the specific location
$AVGCDD_{it}$	=	Base 65° to 85° average daily CDDs for the specific location
ε_{it}	=	Error term

Using this model, the Evaluation Team computed weather-normalized annual consumption (NAC) for each heating and cooling reference temperature, as follows:

$$NAC_i = \alpha_i * 365 + \beta_1 LRHDD_i + \beta_2 LRCDD_i$$

Where for each customer 'i':

NAC_i	=	Normalized annual kWh consumption
α_i	=	Intercept is the average daily or base load for each participant; it represents the average daily base load from the model
$\alpha_i * 365$	=	Annual base load kWh usage (non-weather sensitive)
β_1	=	Heating parameter value; in effect, this is usage per heating degree day from the model above
$LRHDD_i$	=	Annual, long-run HDDs of a typical meteorological year (TMY3) in the 1991–2005 series from NOAA, based on the home location
$\beta_1 * LRHDD_i$	=	Weather-normalized annual weather sensitive heating usage, also known as HEATNAC
β_2	=	Cooling parameter value; in effect, this is usage per CDD from the model above
$LRCDD_i$	=	Annual, long-run CDDs of a typical meteorological year (TMY3) in the 1991–2005 series from NOAA, based on home location
$\beta_2 * LRCDD_i$	=	Weather-normalized annual weather sensitive cooling usage, also known as COOLNAC

Furthermore, 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 the heating usage (heating-only models). From these models with correct signs on all of the parameters, the best model chosen for each customer was the model that had the highest R-square.

The PRISM gas models used the following specification:

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

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

ADC_{it}	=	Average daily therms consumption in the analysis period
α_i	=	Participant intercept; represents the average daily therms base load
β_1	=	Model space heating parameter value
$AVGHDD_{it}$	=	Base 45-65 average daily HDDs for the specific location
ε_{it}	=	Error term

Using this model, the Evaluation Team computed NAC for each heating and cooling reference temperature, as follows:

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

Where for each customer 'i':

NAC_i	=	Normalized annual therms consumption
α_i	=	Intercept is the average daily or base load for each participant; it represents the average daily base load from the model
$\alpha_i * 365$	=	Annual base load therms usage (non-weather sensitive)
β_1	=	Heating parameter value; in effect, this is usage per heating degree day from the model above
$LRHDD_i$	=	Annual, long-run HDDs of a typical month year (TMY3) in the 1991–2005 series from NOAA, based on the home location
$\beta_1 * LRHDD_i$	=	Weather-normalized annual weather sensitive heating usage, also known as HEATNAC

Once the Team obtained analysis period weather normalized usages for each customer, it applied other PRISM-based screening steps and excluded these items:

- Accounts that had missing post-installation analysis (POSTNAC) estimates (because of negative heating/cooling slopes or negative intercepts) because they probably indicated problems with the billing data
- Electric accounts where POSTNAC was less than 1,000 kWh or greater than 95,000 kWh
- Gas accounts where the POSTNAC was less than 150 therms or more than 8,500 therms

The Evaluation Team also performed a billing data screen that examined the gas and electric monthly billing data for each home by plotting the average analysis period monthly use. To avoid confounding the billing analysis, the Evaluation Team removed accounts with outliers, vacancies, or seasonal use in the post-period analysis period.

Also, for better comparability between participants and nonparticipants, as mentioned earlier, the Team removed nonparticipant non-single-family homes from the analysis. Some utilities provided apartment unit, commercial, and miscellaneous service (barns, garages, wells) type accounts. Other utilities included billing data for homes that were built before 2017. In the process of obtaining square footage estimates, each account was verified to ensure it was a residential home built in 2017, 2018, or 2019.[48] For these large utilities—Alliant, Northern States Power, WE Energies, and Wisconsin Public Service—only non-program homes in the participant zip codes were looked up. This also ensured better comparability between Program home and non-Program homes. There were 6,300 homes in the initial group of non-program homes outside participant zip codes, so this also considerably simplified the analysis by reducing the number of homes for which square footage needed to be looked up.

Lastly, since it was very important to obtain a normalized usage per-square-foot estimate—customers with missing square footage data were removed from the analysis, as can be seen in the attrition tables

[48] Not many 2019 homes were included in the analysis because they do not have enough post-construction period billing data. Only a few very early in 2019 were included.

below—the Evaluation Team was able to find square footage estimates for 99% of the 2018 participant homes and approximately 75% of the eligible non-program homes passing all the screens.[49]

Table I-17 lists attrition for the New Homes Program gas account participants from the various screens. The data showed 2,299 gas New Homes Program participants from January 2018 through December 2018. Attrition removed approximately 9% because of insufficient months of analysis billing data or the participant's address was not matched by the utilities. The Team removed another 5% following individual billing review. The Team was unable to find accurate square footage estimates for only eight homes (0.3%). Lastly, 3% were removed because the accounts were for certification-only customers under 25% above code and therefore their *ex ante* estimate was 0. The final gas analysis group was 1,895 participants.

Table I-17. CY 2019 New Homes Program Gas Participant Account Attrition

Screen	Participants Remaining	Percentage Remaining	Number Dropped	Percentage Dropped
Original Gas Accounts	**2,299**	**100%**	**0**	**0%**
Less than 10 months of billing data or address not matched by utility	2,095	91%	204	9%
Homes with missing square footage	2,087	91%	8	0.3%
Usage/percent change screens + PRISM Screening	2,087	91%	0	0%
Individual Customer Bill Review: Outliers, vacancies, seasonal usage. Remove extreme therm/sqft usages after additional review	1,969	86%	118	5%
Participants <25% above code that are certified only - 0 *ex ante*. Also utilities that provided only participant billing data - no non-program homes.[a]	1,895	82%	74	3%
Final Analysis Group	**1,895**	**82%**	**404**	**18%**

[a] City Gas provided billing data for only one participant home and no non-program home new hookups.

Table I-18 lists the attrition of New Homes Program gas account nonparticipants from the various screens. The utilities provided new home hookup billing data for 15,653 gas accounts. Attrition removed 22% because the homes were in non-program zip codes for large utilities. Approximately 19% were removed because they were not single-family homes or the homes were missing square footage. Another 13% were dropped because the homes were built before 2017 or matched the 2019 participant tracking data or REM/Rate database. Another 12% were dropped because of insufficient months of billing data (likely homes built in 2019). Another 8% of the nonparticipants were removed because of

[49] The Evaluation Team obtained the square footage primarily from Zillow and county assessors for Program and non-Program homes. If the square footage was not available from these sources online lookups were performed. For each search the year built of the home was verified to ensure that the homes were truly built in 2017 or 2018. To simplify the process of obtaining square footage, any home with less than 10 months of billing data did not receive a square footage lookup since that home fails the minimum number of month screens. Furthermore, the Team looked up only non-Program homes in the participant zip codes for the following large utilities: Alliant, Northern States Power, WE Energies, and Wisconsin Public Service.

PRISM and usage screening or from individual billing review problems and other outliers. The final gas analysis group was 4,242 nonparticipants.

Table I-18. New Homes Program Gas Nonparticipant Account Attrition

Screen	Nonparticipants Remaining	Percentage Remaining	Number Dropped	Percentage Dropped
Original Gas Accounts	**15,653**	**100%**	**0**	**0%**
Less than 10 months of billing data	13,828	88%	1,825	12%
For large utilities' homes that were not in participant zip codes	10,397	66%	3,431	22%
Not single-family homes – i.e., apartments, manufactured homes, commercial sites, or miscellaneous service (barns, garages, wells, etc.)	8,872	57%	1,525	10%
Homes built before 2017	8,140	52%	732	5%
Homes that matched 2019 participant tracking data or REM/Rate database	6,867	44%	1,273	8%
Homes with missing square footage	5,516	35%	1,351	9%
Usage/percentage change screens + PRISM screening	5,168	33%	348	2%
Individual customer bill review: outliers, vacancies, seasonal usage.	4,287	27%	881	6%
Homes with extreme therms/sqft or square footage estimates outside the participant home ranges after additional review	4,242	27%	45	0.3%
Final Analysis Group	**4,242**	**27%**	**11,411**	**73%**

Table I-19 summarizes the attrition for the New Homes Program electric account participants from the various screens. The data showed 2,403 electric New Homes Program participants from January 2018 through December 2018. Attrition removed approximately 18% because of insufficient months of analysis billing data or the participant addresses were not matched by the utilities. The Team removed another 7% following individual billing review and 0.3% due to missing square feet. The Team removed 4% because they were certification-only customers under 25% above code and therefore their *ex ante* estimate was 0. The final electric analysis group was 1,700 participants.

Table I-19. New Homes Program Electric Participant Account Attrition

Screen	Participants Remaining	Percentage Remaining	Number Dropped	Percentage Dropped
Original Electric Accounts	**2,403**	**100%**	**0**	**0%**
Less than 10 months of billing data or address not matched by utility	1,959	82%	444	18%
Homes with missing square footage	1,951	81%	8	0.3%
Usage/percent change screens + PRISM screening	1,951	81%	0	0%
Individual customer bill review: outliers, vacancies, seasonal usage. Extreme kwh/sqft usages after additional review	1,793	75%	158	7%
Participants <25% above code that are certified only - 0 ex ante. Also utilities that provided only participant billing data - no non-program homes.[a]	1,700	71%	93	4%
Final Analysis Group	**1,700**	**71%**	**703**	**29%**

[a] Adams-Columbia Electric Cooperative, Kiel Electric Utility, and Plymouth Utilities provided only participant data for 2,3,16 participants, respectively; and no non-program home new hookups.

Table I-20 lists the attrition of New Homes Program electric account nonparticipants from the various screens. The utilities provided new home hookup billing data for 17,710 electric accounts. The Evaluation Team removed approximately 25% because they were not single-family homes or were missing square footage. Another 23% were in non-program zip codes for large utilities. Another 13% were dropped because of insufficient months of billing data (likely homes built in 2019). Another 9% were dropped because homes were built before 2017 or matched the 2019 participant tracking data or REM/Rate database. Another 7% were removed because of PRISM and usage screening or individual billing review problems and other outliers. The final electric analysis group was 3,863 nonparticipants.

Table I-20. New Homes Program Electric Nonparticipant Account Attrition

Screen	Nonparticipants Remaining	Percentage Remaining	Number Dropped	Percentage Dropped
Original Electric Accounts	**17,710**	**100%**	**0**	**0%**
Less than 10 months of billing data	15,353	87%	2,357	13%
Large utilities homes not in participant zip codes	11,272	64%	4,081	23%
Not single-family homes – i.e., apartments, manufactured homes, commercial sites, or miscellaneous service (barns, garages, wells, etc.)	8,649	49%	2,623	15%
Homes that were built before 2017	8,160	46%	489	3%
Homes that matched 2019 participant tracking data or REM/Rate database	7,022	40%	1,138	6%
Homes with missing square footage	5,213	29%	1,809	10%
Usage/percentage change screens + PRISM screening	4,962	28%	251	1%
Individual customer bill review: outliers, vacancies, seasonal usage.	3,892	22%	1,070	6%
Homes with extreme kWh/sqft or square footage estimates outside the participant home ranges after additional review	3,863	22%	29	0.2%
Final Analysis Group	**3,863**	**22%**	**13,847**	**78%**

Following these screens, the final gas analysis groups for the New Homes Program included 1,895 participants (82% of the original total) and 4,242 nonparticipants (27% of the original total). The final electric analysis groups for New Homes Program included 1,700 participants (71% of the original total) and 3,863 nonparticipants (22% of the original total).

From the screened billing analysis samples, the Evaluation Team summarized the analysis period PRISM post-period usage and divided it by the square footage to obtain a kWh per square foot estimate for each customer. The difference between the participant and nonparticipant kWh per square foot yielded the adjusted gross savings.

Billing Analysis Results – Electric Savings

Table I-21 shows certification level and overall program electric PRISM usages and summaries for the New Homes Program.[50] Because nonparticipant distribution may vary from participant distribution, the Evaluation Team weighted all nonparticipant usages by the participant sample size to remove potential bias. The participant utility mix varied for each certification level, so nonparticipant averages varied as well. The table shows the final group of 3,863 nonparticipants and 1,700 participants. Nonparticipant usage estimates ranged from 3.8 kWh to 4.0 kWh per square foot. Typical nonparticipant home square footage varied but was around the 2,400 to 2,500 square-foot range. Participant homes were approximately 2,300 square feet.

The difference between participant and nonparticipant kWh per square foot yielded the NTG rate. Overall, the average participant had negative savings of 0.226 kWh per square foot.[51] Program tracking data showed average expected savings of 0.337 kWh per square foot. The NTG rate estimated by the billing analysis was -67%. Based on the *ex ante* savings, the Program was expected to save approximately 8% from the theoretical baseline usage. However, kWh usage through the Program was 6% higher than the actual baseline usage. The theoretical baseline usage overall was expected to be 10,243 kWh; however, the nonparticipant homes built in the same period showed a considerably lower usage of approximately 8,950 kWh.

As expected, the savings per square foot increased from -0.524 kWh per square foot in Level 1 (25% to 29.9% better than code) to 0.055 kWh per square foot in Level 3 (35% to 99.9% better than code). The NTG rates also improved as the certification level increased, that is, -181% NTG rate in in Level 1 compared to 14% NTG rate in Level 3. Similarly, the percentage of savings above the actual nonparticipant baseline usage per square foot increased from -14% in Level 1 to 1.4% in Level 3. Because the Evaluation Team did not expect Program homes to have a higher usage than the nonparticipant baseline homes, it applied a 0% NTG rate for the electric component of the Program.

---

[50] The table shows overall summaries across all the utilities; results are weighted across each separate electric utility.

[51] An alternate methodology pairing Program and non-Program homes by similar square footage quartiles instead of weighting across utilities showed an increase of 0.11 kWh per square foot.

Table I-21. New Homes Program Electric Net Adjustment by Certification Level

Participation	Certification Level/ Percent Better than Code	N	Average Usage kWh	Average SQFT	Actual Consumption kWh/SQFT	Expected Savings kWh	Expected Savings kWh/SQFT	Expected Baseline Consumption kWh	Actual Baseline Consumption kWh	Actual Savings kWh	Actual Savings kWh/SQFT	Expected % Savings	Actual % Savings	Net Adjustment
No	Level 1: 25% to 29.9%	3,666	9,555	2,507	3.812									
No	Level 2: 30% to 34.9%	3,834	9,462	2,405	3.935									
No	Level 3: 35% to 99.9%	3,577	9,466	2,391	3.959									
No	**All**	**3,863**	**9,493**	**2,435**	**3.898**									
Yes	Level 1: 25% to 29.9%	551	8,600	1,984	4.335	573	0.289	9,173	7,561	-1,039	-0.524	6%	-13.7%	-181%
Yes	Level 2: 30% to 34.9%	843	9,661	2,357	4.099	814	0.345	10,475	9,274	-387	-0.164	8%	-4.2%	-48%
Yes	Level 3: 35% to 99.9%	306	10,507	2,691	3.904	1,025	0.381	11,531	10,655	148	0.055	9%	1.4%	14%
Yes	**All**	**1,700**	**9,469**	**2,296**	**4.124**	**774**	**0.337**	**10,243**	**8,950**	**-519**	**-0.226**	**8%**	**-5.8%**	**-67%**

Billing Analysis Results – Gas Savings

Table I-22 shows certification level and overall gas PRISM usages and summaries for the New Homes Program.[52] Because the nonparticipant distribution may vary from the participant distribution, the Evaluation Team weighted all nonparticipant usages by the participant sample size to remove potential bias. The participant utility mix varied for each certification level, so nonparticipant averages varied for each as well.

The table shows the final group of 4,242 nonparticipants and 1,895 participants. Nonparticipant usage estimates were between 0.39 therms and 0.40 therms per square foot. Typical nonparticipant home square footage was approximately 2,300 to 2,400 square feet. Participant homes averaged approximately 2,300 square feet.

The difference between participant and nonparticipant kWh per square foot yielded the NTG rate. Overall, the average participant achieved savings of 0.004 therms per square foot.[53] The Program tracking data showed average expected savings of 0.089 therms per square foot. The NTG rate estimated by the billing analysis was 5%.

Based on the *ex ante* savings, the Program was expected to save approximately 19% from the theoretical baseline usage. However, the Program achieved a savings of only 1% of the actual baseline usage. Overall, the theoretical baseline usage was expected to be approximately 1,100 therms; however, the nonparticipant homes built in the same time period showed a considerably lower usage of approximately 900 therms.

Table I-22 also summarizes the results by certification level. As expected, the savings per square foot increased by level from -0.019 therms per square foot in Level 1 (25% to 29.9% better than code) to 0.023 therms per square foot Level 3 (35% to 99.9% better than code). The NTG rates also improve as the certification level increases, that is, -19% NTG rate in Level 1 compared to 23% NTG rate in Level 3. Similarly, the percentage of savings over the actual nonparticipant baseline usage per square foot increased from -5% in Level 1 to 6% in Level 3.

[52] The table show the overall summaries across all the utilities; results are weighted across each separate gas utility.

[53] An alternate methodology pairing Program homes and non-Program homes by similar square footage quartiles instead of weighting across utilities showed similar savings of 0.005 kWh per square foot.

Table I-22. New Homes Program Gas Net Adjustment by Measure

Participation	Certification Level/ Percent Better than Code	N	Average Usage Therms	Average SQFT	Actual Consumption therms/SQFT	Expected Savings Therms	Expected Savings Therms/ SQFT	Expected Baseline Consumption Therms	Actual Baseline Consumption Therms	Actual Savings Therms	Actual Savings Therms/ SQFT	Expected % Savings	Actual % Savings	Net Adjustment
No	Level 1: 25% to 29.9%	4,242	952	2422	0.393									
No	Level 2: 30% to 34.9%	4,242	926	2340	0.396									
No	Level 3: 35% to 99.9%	4,242	917	2320	0.396									
No	**All**	**4,242**	**933**	**2364**	**0.395**									
Yes	Level 1: 25% to 29.9%	623	816	1980	0.412	162	0.082	978	779	-37	-0.019	17%	-4.8%	-19%
Yes	Level 2: 30% to 34.9%	966	909	2353	0.387	207	0.088	1117	932	22	0.009	19%	2.4%	11%
Yes	Level 3: 35% to 99.9%	306	1017	2731	0.372	275	0.101	1292	1080	63	0.023	21%	5.9%	23%
Yes	**All**	**1,895**	**896**	**2291**	**0.391**	**203**	**0.089**	**1099**	**905**	**9**	**0.004**	**19%**	**1.0%**	**5%**

Home Performance with ENERGY STAR, Renewable Energy Program Self-Report NTG Methodology and Findings

Freeridership

Intention Freeridership Survey Questions

The participant survey's *intention* freeridership section included six questions, addressing the five core freeridership dimensions:

- D1. When did you first hear about the availability of the Focus on Energy Renewable Rewards Program incentive for [RESPONSE FROM B1] systems? [54]
- D2. [Ask IF D1=3, 4 OR 5] So just to be clear, you purchased your [RESPONSE FROM B1] system before you heard anything about the Focus on Energy Renewable Rewards Program incentive. Is that correct?
- D3. Before you heard about the program, had you already considered installing a [RESPONSE FROM B1] system?
- D4. [Ask IF B1=1] Without the rebate from Focus on Energy, what would you have installed instead of the ground source heat pump? Would you have…
- D5. [Ask IF B1=2] What would you have done differently if the Focus on Energy Renewable Rewards Program had not been available to you? Would you have…
- D6. Thinking about timing, without the Focus on Energy rebate, would you have installed the [RESPONSE FROM B1] system… [READ LIST AND RECORD ONE RESPONSE]

Convert Responses to Matrix Terminology

Table I-23 shows how the initial survey responses were translated into the responses *yes, no*, or *partially*, indicative of *intention* freeridership (in parentheses).

[54] The Program updated its name from "Renewable Rewards" to "Renewable Energy" in CY 2019.

Table I-23. Renewable Energy Raw Survey Response Translation to *Intention* Freeridership Scoring Matrix Terminology

D1. When did you first hear about the availability of the Focus on Energy Renewable Rewards Program incentive for [RESPONSE FROM B1] systems? Was it….	D2. [ASK IF D1=3, 4 OR 5] So just to be clear, you purchased your [RESPONSE FROM B1] system before you heard anything about the Focus on Energy Renewable Rewards Program incentive. Is that correct?	D3. Before you heard about the program, had you already considered installing a [RESPONSE FROM B1] system?	D4. [ASK IF B1=1] Without the rebate from Focus on Energy, what would you have installed instead of the ground source heat pump? Would you have…	D5. [ASK IF B1=2] What would you have done differently if the Focus on Energy Renewable Rewards Program had not been available to you? Would you have…	D7. Thinking about timing, without the Focus on Energy rebate, would you have installed the [RESPONSE FROM B1] system…
Before you contacted your contractor to purchase a system (No)	Yes, that's correct (Yes)	Yes (Yes)	Installed a smaller, less expensive ground source heat pump (Partial)	Installed a smaller, less expensive PV system (Yes)	At the same time (Yes)
When the contractor provided the quote for purchase and installation (No)	No, that's not correct (No)	No (No)	Installed same size, same-cost ground source heat pump (Yes)	Installed same size, same-cost PV system (Yes)	Later, but within 12 months (Partial)
After your contractor installed your system (Yes)	Don't Know (Partial)	Don't Know (Partial)	Installed a larger, more expensive ground source heat pump (Yes)	Installed a larger, more expensive PV system (Yes)	One to two years out (No)
When you received your incentive check from Focus on Energy (Yes)			Not installed a ground source heat pump at all (No)	Not installed a PV system at all (No)	More than two years out (No)
You had not heard of Focus on Energy before this (Yes)			Don't Know (Partial)	Don't Know (Partial)	Never (No)
Don't Know (No)					Don't Know (Partial)

Participant Intention *Freeridership Scoring*

The *intention* freeridership score started with 100%, which the Evaluation Team decremented based on the participant's responses to the six questions, as shown in Table I-24.

Table I-24. Renewable Energy *Intention* Freeridership Scoring Legend

Q#	Decrement
F1	0% decrement for "No", Partial level not needed
F2	100% FR if "Yes", "Partial" level not needed
F3	50% decrement for "No", 25% decrement for "Partial"
F4	100% decrement for "No", 25% decrement for "Partial"
F5	100% decrement for "No", 25% decrement for "Partial"
F6	100% decrement for "No", 25% decrement for "Partial"

Intention Freeridership Analysis

Table I-25 and Table I-26 show the unique response combinations from solar PV and ground source heat pump participants, respectively, answering the Renewable Energy Program *intention* freeridership questions (actual responses mapped to yes, no, or partial, as indicative of freeridership), the *intention* freeridership score assigned to each combination, and the number of responses. The Evaluation Team calculated an *intention* freeridership score for the Program based on the distribution of scores within the matrix.

Table I-25. Renewable Energy Program Frequency of *Intention* Freeridership Scoring Combinations – Solar PV

D1. When did you first hear about the availability of the Focus on Energy Renewable Rewards Program incentive for [RESPONSE FROM B1] systems? Was it….	D2. [ASK IF D1=3, 4 OR 5] So just to be clear, you purchased your [RESPONSE FROM B1] system before you heard anything about the Focus on Energy Renewable Rewards Program incentive. Is that correct?	D3. Before you heard about the program, had you already considered installing a [RESPONSE FROM B1] system?	D4. [ASK IF B1=1] Without the rebate from Focus on Energy, what would you have installed instead of the ground source heat pump? Would you have…	D5. [ASK IF B1=2] What would you have done differently if the Focus on Energy Renewable Rewards Program had not been available to you? Would you have…	D7. Thinking about timing, without the Focus on Energy rebate, would you have installed the [RESPONSE FROM B1] system…	*Intention* Freerider Score	Count
Yes	Yes	x	x	x	x	100%	3
No	x	Yes	x	Yes	Yes	100%	33
No	x	Yes	x	Yes	Partial	75%	4
No	x	Yes	x	Yes	No	0%	5
No	x	Yes	x	Partial	x	75%	3
No	x	Yes	x	No	x	0%	11
No	x	No	x	Yes	Yes	50%	5
No	x	No	x	Yes	Partial	25%	1
No	x	No	x	No	x	0%	4

Table I-26. Renewable Energy Program Frequency of *Intention* Freeridership Scoring Combinations – Ground Source Heat Pump

D1. When did you first hear about the availability of the Focus on Energy Renewable Rewards Program incentive for [RESPONSE FROM B1] systems? Was it….	D2. [ASK IF D1=3, 4 OR 5] So just to be clear, you purchased your [RESPONSE FROM B1] system before you heard anything about the Focus on Energy Renewable Rewards Program incentive. Is that correct?	D3. Before you heard about the program, had you already considered installing a [RESPONSE FROM B1] system?	D4. [ASK IF B1=1] Without the rebate from Focus on Energy, what would you have installed instead of the ground source heat pump? Would you have…	D5. [ASK IF B1=2] What would you have done differently if the Focus on Energy Renewable Rewards Program had not been available to you? Would you have…	D7. Thinking about timing, without the Focus on Energy rebate, would you have installed the [RESPONSE FROM B1] system…	*Intention* Freerider Score	Count
Yes	Yes	x	x	x	x	100%	1
No	x	Yes	Yes	x	Yes	100%	17
No	x	Yes	Yes	x	No	0%	1
No	x	Yes	Partial	x	Partial	50%	1
No	x	Yes	No	x	x	0%	4
No	x	Yes	x	Yes	Yes	100%	1

Influence *Freeridership Analysis*

The Evaluation Team assessed *influence* freeridership by asking participants how important various Program elements were in their purchasing decisions. Table I-27 shows how participants rated importance, along with a count and average rating for each factor.

Table I-27. Renewable Energy Program *Influence* Freeridership Responses

Influence Rating	Influence FR Score	The Focus on Energy program rebate or discount		Recommendation from Focus on Energy Staff		Information provided by Focus on Energy on energy savings opportunities		Previous participation in a Focus on Energy energy efficiency program	
		Solar PV	GSHP	Solar PV	GSHP	Solar PV	GSHP	Solar PV	GSHP
1 - Not at all important	100%	7	5	44	16	22	9	22	9
2	75%	9	8	10	4	20	6	20	6
3	25%	14	5	4	1	16	7	16	7
4 - Very important	0%	39	7	8	2	11	3	11	3
Don't know	50%	0	0	3	2	0	0	0	0
Average Rating		**3.2**	**2.6**	**1.6**	**1.5**	**2.2**	**2.2**	**2.2**	**2.2**

The Evaluation Team determined each respondent's *influence* freeridership score for each measure category, using the maximum rating provided for any factor included in Table I-27. As shown in Table I-28, 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 one factor *very important*. Counts refer to the number of "maximum influence" responses for each factor, or *influence* freeridership score, response option.

Table I-28. Renewable Energy Program *Influence* Freeridership Score

Maximum Influence Rating	*Influence* FR Score	Solar PV - Count	Ground Source Heat Pump - Count
1 - Not at all important	100%	6	3
2	75%	7	5
3	25%	11	7
4 - Very important	0%	45	10
Don't know	50%	0	0
Average Maximum Influence Rating - Simple Average		**3.4**	**3.0**
Average Influence Score - Weighted by Verified Lifecycle MMBtu Gross Savings		**21%**	**34%**

Final Freeridership

The Evaluation Team calculated the mean of the overall *intention* and the overall *influence* of freeridership components to estimate final freeridership for the measure categories. A higher freeridership score translates to more savings that are deducted from the gross savings estimates. Table I-29 lists the *intention*, *influence*, and final freeridership scores by measure category for the Renewable Energy Program.

Table I-29. Renewable Energy Program Freeridership Score

Measure Category	n	*Intention* FR Score	*Influence* FR Score	Final FR Score
Solar PV	69	59%[a]	21%[a]	40%
Ground Source Heat Pump	25	78%[a]	34%[a]	56%

[a] Weighted by verified lifecycle MMBtu gross energy savings.

Participant Spillover Analysis

The Evaluation Team estimated participant spillover based on answers from respondents who purchased additional high-efficiency equipment or appliances following their participation in the Renewable Energy Program. The Team applied evaluated and deemed savings to the spillover measures that customers said they had installed as a result of their Program participation, presented in Table I-30.

Table I-30. Renewable Energy Program Participant Spillover Measures and Savings

Measure Category	Spillover Measure	Quantity	Total MMBtu Lifecycle Gross Savings Estimate
Ground Source Heat Pump	Heat Pump Water Heater	1	73.65

Next, the Team divided the sample spillover savings by the Program measure category gross savings from the entire survey sample, as shown in this equation:

$$Spillover\ \% = \frac{\sum \text{Spillover Measure EnergySavings for All Survey Respondents}}{\sum \text{Program Measure Energy Savings for All Survey Respondents}}$$

This yielded a 1% spillover estimate for the ground source heat pump measure category, when rounded to the nearest whole percentage, for the Renewable Energy Program respondents (Table I-31).

Table I-31. Renewable Energy Program Participant Spillover Percentage Estimate

Variable	Total MMBtu Savings Estimate
Spillover Savings	73.65
Program Savings	6,528.01
Spillover Estimate	**1%**

Final Net-to-Gross Analysis

The Evaluation Team combined the spillover information with the freeridership results to achieve the NTG ratios, using the following calculation, as shown in Table I-32:

NTG = 1 – Freeridership + Spillover

Table I-32. Renewable Energy Program NTG Estimates

Measure Category	n	Freeridership	Spillover	NTG
Solar PV	69	40%[a]	1%	60%
Ground Source Heat Pump	25	56% [a]	1%	45%
CY 2019 Renewable Energy Program	94	42%[b]	1%[b]	59%

[a] Weighted by verified lifecycle MMBtu gross energy savings.
[b] Weighted by CY 2019 population verified lifecycle MMBtu gross energy savings for the Renewable Energy Program. NTG ratios are applied at the measure level; therefore, the Program-level NTG ratio will vary annually based on the measure mix.

Multifamily Energy Savings Program Self-Report NTG Methodology and Findings

Freeridership

Intention Freeridership Survey Questions

The *intention* freeridership sections of the participant survey included two separate sets of questions, which addressed the six core *intention* freeridership dimensions.

One set of *intention* freeridership questions was asked of participants who said they were the decision makers. A second set was asked of participants whose contractor helped them make decisions. Participants were asked only one of the two sets of questions.

The two sets of *intention* freeridership questions were directly comparable—the difference was that one was oriented toward counterfactual behavior without the Program incentive and one toward counterfactual behavior if there was no involvement from the contractors.

The *intention* freeridership questions oriented toward the Program incentive and information or education participants received (asked in the survey format) were these:

- G1. First, did your organization have specific plans to install the [MEASURE][s] before learning about the incentive?
- G2. Prior to learning about the incentive, was the purchase of the [MEASURE[s]] included in your organization's capital budget?
- G3. Had your organization ALREADY ordered or purchased the [MEASURE[s]] BEFORE your organization heard about the [PROGRAM] incentive?
- G4. Would you have purchased and installed the same [MEASURE[s]] without the incentive?
- G5. Would you have installed something without the incentive?
- G6. When you say you would have installed something, would you have installed something that was just as energy efficient as the [MEASURE[s]] you installed?
- G7. [ASK FOR MEASURE WITH ACTUAL UNIT GREATER THAN 1] And without the incentive, would you have installed the same amount of [MEASURE1[s]]?
- G8. Without the [INCENTIVE FOR MEASURE], would you have installed the [MEASURE[s]]?
- G9. When you say you would not have installed the same [MEASURE1 OR C_MEASURE1][s] without the incentive, would you have installed anything at all?
- G10. Without the incentive, would you have installed something that was just as energy-efficient as the [MEASURE[s]] you installed?
- G11. [ASK FOR MEASURE WITH ACTUAL UNITS GREATER THAN 1] Without the incentive, would you have installed the same amount of [MEASURE[s]]?
- G12. And, would you have installed the same [MEASURE1[s]?

The *intention* freeridership questions oriented toward the involvement of the contractor (as asked in the survey format) were these:

- H1. At the time that you first started working with your contractor on this project, had you already purchased or installed the [MEASURE][s]?
- H2. Did your organization have specific plans to install the [MEASURE][s] before you began working with your contractor?
- H3. [Ask if question H1 is Yes] Before you began working with your contractor, was the purchase of the [MEASURE][s] included in your organization's capital budget?
- H4. Would you have purchased and installed the same [MEASURE][s] without the assistance from your contractor?
- H5. [Ask if question H4 is Don't Know or Refused] Would you have installed something without the involvement of your contractor?
- H6. [Ask if H5 is Yes] When you say you would have installed something, would you have installed something that was just as energy efficient as the [MEASURE1 OR C_MEASURE1][s] you installed?
- H7. [Ask if QTY>1 and question H4 is Yes or H5 is Yes] And without the assistance from your contractor, would you have installed the same amount of [MEASURE]?
- H8. Without the assistance from your contractor, would you have installed the [MEASURE][s]?
- H9. [Ask if question H4 is No or if H5 is No] When you say you would not have installed the same [MEASURE][s] without the assistance from your contractor, would you have installed anything at all?
- H10. [Ask if question H9 is Yes] Without the assistance from your contractor, would you have installed something that was just as energy efficient as the [MEASURE][s] you installed?
- H11. [Ask if QTY>1 and H11 is Yes] And without the contractor, would you have installed the same amount of [MEASURE][s]?
- H12. [Ask if H9 is Yes] And, when would you have installed the same [MEASURE][s]?

Convert Responses to Matrix Terminology

Table I-33 shows how the initial participant received incentive-focused survey responses were translated into the responses *yes, no*, or *partially*, indicative of *intention* freeridership (in parentheses). Table I-34 shows how initial contractor-focused survey responses were translated into the responses yes, no, or partially, indicative of *intention* freeridership (in parentheses).

Table I-33. Incentive—Raw Survey Response Translation to *Intention* Freeridership Scoring Matrix Terminology

G1. First, did your organization have specific plans to install the [MEASURE CATEGORY] before learning about the incentive?	G2. Prior to learning about the incentive, was the purchase of the [MEASURE CATEGORY] included in your property's capital budget?	G3. Had your property ALREADY ordered or purchased the [MEASURE CATEGORY] BEFORE your property heard about the Business Incentive Program incentive?	G4. Would you have purchased and installed the same [MEASURE CATEGORY] without the incentive and information or education from Focus on Energy?	G5. Would you have installed something without the incentive and information or education from Focus on Energy?	G6. When you say you would have installed something, would you have installed something that was just as energy efficient as the [MEASURE] you installed?	G7. And without the incentive and information or education from Focus on Energy, would you have installed the same amount of [MEASURE CATEGORY]?	G8. Without the [INCENTIVE FOR MEASURE CATEGORY1 OR C_MEASURE1] and information or education from Focus on Energy, would you have installed the [MEASURE CATEGORY]?	G9. When you say you would not have installed the same [MEASURE] without the incentive and information or education from Focus on Energy, would you have installed anything at all?	G10. Without the incentive and information or education from Focus on Energy, would you have installed something that was just as energy efficient as the [MEASURE][s] you installed?	G11. Without the incentive and information or education from Focus on Energy, would you have installed the same amount of [MEASURE]?	G12. And, would you have installed the same [MEASURE CATEGORY]?
Yes (Yes)	Yes (Yes)	Yes (Yes)	Yes (Yes)	Yes, would have installed something (Yes)	Yes (Yes)	Yes (Yes)	Within the same year? (Yes)	Yes, would have installed something (Yes)	Yes (Yes)	Yes, the same amount (Yes)	Within the same year? (Yes)
No (No)	No (No)	No (No)	No (No)	No, would not have installed anything (No)	No (No)	No (No)	Within one to two years? (Partial)	No, would not have installed anything at all (No)	No (No)	No, would have installed less (No)	Within one to two years? (Partial)
Don't Know (Partial)	Don't Know (Partial)	Don't Know (No)	Don't Know (Partial)	Don't Know (Partial)	Don't Know (Partial)	Don't Know (Partial)	Within three to five years? (No)	Don't Know (Partial)	Don't Know (Partial)	No, would have installed more (Yes)	Within three to five years? (No)
Refused (Partial)	Refused (Partial)	Refused (No)	Refused (Partial)	Refused (Partial)	Refused (Partial)	Refused (Partial)	In more than five years? (No)	Refused (Partial)	Refused (Partial)	Don't Know (Partial)	In more than five years? (No)
							Don't Know (Partial)			Refused (Partial)	Don't Know (Partial)
							Refused (Partial)				Refused (Partial)

Table I-34. Contractor—Raw Survey Response Translation to *Intention* Freeridership Scoring Matrix Terminology

H1. At the time that you first started working with your contractor on this project, had you already purchased or installed the [MEASURE][s]?	H2. Did your organization have specific plans to install the [MEASURE][s] before you began working with your contractor?	H3. [Ask if question H2 is Yes] Before you began working with your contractor, was the purchase of the [MEASURE][s] included in your organization's capital budget?	H4. Would you have purchased and installed the same [MEASURE][s] without the assistance from your contractor?	H5. [Ask if question H4 is Don't Know or Refused] Would you have installed something without the involvement of your contractor?	H6. [Ask if H5 is Yes] When you say you would have installed something, would you have installed something that was just as energy efficient as the [MEASURE][s] you installed?	H7. [Ask if QTY>1 and question H4 is Yes or H5 is Yes] And without the assistance from your contractor, would you have installed the same amount of [MEASURE]?	H8. Without the assistance from your contractor, would you have installed the [MEASURE][s]?	H9. [Ask if question H4 is No or if H5 is No] When you say you would not have installed the same [MEASURE][s] without the assistance from your contractor, would you have installed anything at all?	H10. [Ask if question H9 is Yes] Without the assistance from your contractor, would you have installed something that was just as energy efficient as the [MEASURE][s] you installed?	H11. [Ask if QTY>1 and H11 is Yes] And without the contractor, would you have installed the same amount of [MEASURE][s]?	H12. [Ask if H9 is Yes] And, when would you have installed the same [MEASURE][s]?
Yes (Yes)	Yes (Yes)	Yes (Yes)	Yes (Yes)	Yes, would have installed something (Yes)	Yes (Yes)	Yes, the same amount (Yes)	Within the same year? (Yes)	Yes, would have installed something (Yes)	Yes (Yes)	Yes, the same amount (Yes)	thin the same year? (Yes)
No (No)	No (No)	No (No)	No (No)	No, would NOT have installed anything (No)	No (No)	No, would have installed less (No)	Within one to two years? (Partial)	No, would not have installed anything at all (No)	No (No)	No, would have installed less (No)	Within one to two years? (Partial)
Don't Know (Partial)	Don't Know (Partial)	Don't Know (No)	Don't Know (Partial)	Don't Know (Partial)	Don't Know (Partial)	o, would have installed more (Yes)	Within three to five years? (No)	Don't Know (Partial)	Don't Know (Partial)	o, would have installed more (Yes)	Within three to five years? (No)
Refused (Partial)	Refused (Partial)	Refused (No)	Refused (Partial)	Refused (Partial)	Refused (Partial)	Don't Know (Partial)	In more than five years? (No)	Refused (Partial)	Refused (Partial)	Don't Know (Partial)	In more than five years? (No)
						Refused (Partial)	Don't Know (Partial)			Refused (Partial)	Don't Know (Partial)
							Refused (Partial)				Refused (Partial)

Participant Intention *Freeridership Scoring*

For each incentive focused path, the *intention* freeridership score started with 100%, which the Evaluation Team decremented based on participant's responses to 12 incentive questions (Table I-35).

Table I-35. Incentive—*Intention* Freeridership Scoring Legend

Q#	Decrement
G1	50% decrement for "No", 25% decrement for "Partial"
G2	50% decrement for "No, 25% decrement for Partial
G3	100% FR if "Yes", 0% decrement for "No" level, "Partial" level not needed
G4	25% decrement for "No", 0% decrement for "Partial"
G5	25% decrement for "No", 100% decrement for "Partial"
G6	100% decrement for "No", 25% decrement for "Partial"
G7	50% decrement for "No", 25% decrement for "Partial"
G8	100% decrement for "No", 25% decrement for "Partial"
G9	100% decrement for "No", 25% decrement for "Partial"
G10	100% decrement for "No", 25% decrement for "Partial"
G11	50% decrement for "No", 25% decrement for "Partial"
G12	100% decrement for "No", 25% decrement for "Partial"

For each contractor focused path, the *intention* freeridership score started with 100%, which the Evaluation Team decremented based on participant's responses to 12 questions for the contractor path (Table I-36).

Table I-36. Contractor—*Intention* Freeridership Scoring Legend

Q#	Decrement
H1	100% FR if "Yes", 0% decrement for "No" level, "Partial" level not needed
H2	50% decrement for "No", 25% decrement for "Partial"
H3	50% decrement for "No", 25% decrement for "Partial"
H4	25% decrement for "No", 0% decrement for "Partial"
H5	25% decrement for "No", 100% decrement for "Partial"
H6	100% decrement for "No", 25% decrement for "Partial"
H7	50% decrement for "No", 25% decrement for "Partial"
H8	100% decrement for "No", 25% decrement for "Partial"
H9	100% decrement for "No", 25% decrement for "Partial"
H10	100% decrement for "No", 25% decrement for "Partial"
H11	50% decrement for "No", 25% decrement for "Partial"
H12	100% decrement for "No", 25% decrement for "Partial"

Intention Freeridership Analysis

Table I-37 and Table I-38 show the unique response combinations from participants answering the Multifamily Energy Savings Program *intention* freeridership incentive and contractor freeridership questions (actual responses mapped to yes, no, or partial, as indicative of freeridership), the *intention* freeridership score assigned to each combination, and the number of responses. The Evaluation Team calculated an *intention* freeridership score for the Program based on the distribution of scores within the matrix.

Table I-37. Incentive – Multifamily Energy Program Frequency of *Intention* Freeridership Scoring Combinations

G1. First, did your organization have specific plans to install the [MEASURE CATEGORY] before learning about the incentive?	G2. Prior to learning about the incentive, was the purchase of the [MEASURE CATEGORY] included in your property's capital budget?	G3. Had your property ALREADY ordered or purchased the [MEASURE CATEGORY] BEFORE your property heard about the Business Incentive Program incentive?	G4. Would you have purchased and installed the same [MEASURE CATEGORY] without the incentive and information or education from Focus on Energy?	G5. Would you have installed something without the incentive and information or education from Focus on Energy?	G6. When you say you would have installed something, would you have installed something that was just as energy efficient as the [MEASURE] you installed?	G7. And without the incentive and information or education from Focus on Energy, would you have installed the same amount of [MEASURE CATEGORY]?	G8. Without the [INCENTIVE FOR MEASURE CATEGORY1 OR C_MEASURE1] and information or education from Focus on Energy, would you have installed the [MEASURE CATEGORY]?	G9. When you say you would not have installed the same [MEASURE] without the incentive and information or education from Focus on Energy, would you have installed anything at all?	G10. Without the incentive and information or education from Focus on Energy, would you have installed something that was just as energy efficient as the [MEASURE][s] you installed?	G11. Without the incentive and information or education from Focus on Energy, would you have installed the same amount of [MEASURE]?	G12. And, would you have installed the same [MEASURE CATEGORY]?	*Intention* FR Score	Count
Yes	Yes	Yes	x	x	x	x	x	x	x	x	x	100%	5
Yes	Yes	Partial	Yes	x	x	Yes	Yes	x	x	x	x	100%	1
Yes	Yes	Partial	Yes	x	x	Yes	No	x	x	x	x	0%	1
Yes	Yes	Partial	Yes	x	x	No	No	x	x	x	x	0%	1
Yes	Yes	No	Yes	x	x	Yes	Yes	x	x	x	x	100%	8
Yes	Yes	No	Yes	x	x	Yes	No	x	x	x	x	0%	1
Yes	Yes	No	Yes	x	x	No	No	x	x	x	x	0%	1
Yes	Yes	No	Partial	Yes	Yes	Yes	Yes	x	x	x	x	100%	1
Yes	Yes	No	Partial	Yes	No	x	x	x	x	x	x	0%	1
Yes	Yes	No	No	x	x	x	x	Yes	Yes	x	Yes	75%	1
Yes	Yes	No	No	x	x	x	x	Yes	Yes	No	Partial	12.5%	1
Yes	Partial	x	Yes	x	x	Yes	Yes	x	x	x	x	75%	5
Yes	Partial	x	Yes	x	x	Yes	Partial	x	x	x	x	50%	1
Yes	No	x	Yes	x	x	Yes	Yes	x	x	x	x	50%	1
Yes	No	x	No	x	x	x	x	Yes	Yes	Yes	No	0%	1
Yes	No	x	No	x	x	x	x	Yes	Yes	No	No	0%	1
Yes	No	x	No	x	x	x	x	Partial	Partial	Yes	Partial	0%	1
Partial	x	x	Yes	x	x	Yes	Yes	x	x	x	x	75%	1
Partial	x	x	Partial	Yes	Partial	Yes	Yes	x	x	x	x	50%	1
Partial	x	x	Partial	No	x	x	x	No	x	x	x	0%	1
Partial	x	x	No	x	x	x	x	Yes	No	x	x	0%	1
No	x	x	Yes	x	x	Yes	Yes	x	x	x	x	50%	5
No	x	x	Yes	x	x	Yes	No	x	x	x	x	0%	1

G1. First, did your organization have specific plans to install the [MEASURE CATEGORY] before learning about the incentive?	G2. Prior to learning about the incentive, was the purchase of the [MEASURE CATEGORY] included in your property's capital budget?	G3. Had your property ALREADY ordered or purchased the [MEASURE CATEGORY] BEFORE your property heard about the Business Incentive Program incentive?	G4. Would you have purchased and installed the same [MEASURE CATEGORY] without the incentive and information or education from Focus on Energy?	G5. Would you have installed something without the incentive and information or education from Focus on Energy?	G6. When you say you would have installed something, would you have installed something that was just as energy efficient as the [MEASURE] you installed?	G7. And without the incentive and information or education from Focus on Energy, would you have installed the same amount of [MEASURE CATEGORY]?	G8. Without the [INCENTIVE FOR MEASURE CATEGORY1 OR C_MEASURE1] and information or education from Focus on Energy, would you have installed the [MEASURE CATEGORY]?	G9. When you say you would not have installed the same [MEASURE] without the incentive and information or education from Focus on Energy, would you have installed anything at all?	G10. Without the incentive and information or education from Focus on Energy, would you have installed something that was just as energy efficient as the [MEASURE][s] you installed?	G11. Without the incentive and information or education from Focus on Energy, would you have installed the same amount of [MEASURE]?	G12. And, would you have installed the same [MEASURE CATEGORY]?	*Intention* FR Score	Count
No	x	x	Yes	x	x	No	Yes	x	x	x	x	12.5%	1
No	x	x	Yes	x	x	No	No	x	x	x	x	0%	1
No	x	x	Partial	Yes	Partial	Yes	Yes	x	x	x	x	25%	2
No	x	x	Partial	Yes	Partial	No	No	x	x	x	x	0%	1
No	x	x	Partial	Partial	x	x	x	x	x	x	x	0%	1
No	x	x	No	x	x	x	x	Yes	Yes	Yes	Yes	25%	1
No	x	x	No	x	x	x	x	Yes	Yes	Yes	Partial	12.5%	1
No	x	x	No	x	x	x	x	Yes	Yes	No	No	0%	1
No	x	x	No	x	x	x	x	Yes	No	x	x	0%	4
No	x	x	No	x	x	x	x	Partial	No	x	x	0%	1
No	x	x	No	x	x	x	x	No	x	x	x	0%	3

Table I-38. Contractor - Multifamily Energy Program Frequency of *Intention* Freeridership Scoring Combinations

H1. At the time that you first started working with your contractor on this project, had you already purchased or installed the [MEASURE][s]?	H2. Did your organization have specific plans to install the [MEASURE][s] before you began working with your contractor?	H3. [Ask if question H2 is Yes] Before you began working with your contractor, was the purchase of the [MEASURE][s] included in your organization's capital budget?	H4. Would you have purchased and installed the same [MEASURE][s] without the assistance from your contractor?	H5. [Ask if question H4 is Don't Know or Refused] Would you have installed something without the involvement of your contractor?	H6. [Ask if H5 is Yes] When you say you would have installed something, would you have installed something that was just as energy efficient as the [MEASURE][s] you installed?	H7. [Ask if QTY>1 and question H4 is Yes or H5 is Yes] And without the assistance from your contractor, would you have installed the same amount of [MEASURE]?	H8. Without the assistance from your contractor, would you have installed the [MEASURE][s]?	H9. [Ask if question H4 is No or if H5 is No] When you say you would not have installed the same [MEASURE][s] without the assistance from your contractor, would you have installed anything at all?	H10. [Ask if question H9 is Yes] Without the assistance from your contractor, would you have installed something that was just as energy efficient as the [MEASURE][s] you installed?	H11. [Ask if QTY>1 and H11 is Yes] And without the contractor, would you have installed the same amount of [MEASURE][s]?	H12. [Ask if H9 is Yes] And, when would you have installed the same [MEASURE][s]?	*Intention* FR Score	Count
Yes	x	x	x	x	x	x	x	x	x	x	x	100%	1
No	Yes	Yes	No	x	x	x	x	Yes	No	x	x	0%	1
No	Yes	Partial	Yes	x	x	Yes	No	x	x	x	x	0%	1
No	Yes	No	Yes	x	x	Yes	No	x	x	x	x	0%	1
No	No	x	Yes	x	x	Yes	Yes	x	x	x	x	50%	1
No	No	x	Partial	Yes	Yes	x	Yes	x	x	x	x	50%	1
No	No	x	Partial	Yes	Yes	Yes	No	x	x	x	x	0%	1
No	No	x	No	x	x	x	x	Yes	Yes	No	No	0%	2
No	No	x	No	x	x	x	x	No	x	x	x	0%	1
No	No	x	Partial	No	x	x	x	No	x	x	x	0%	1

The Evaluation Team estimated *intention* freeridership scores for all participants based on the responses of 70 participants to the *intention*-focused freeridership questions. As shown in Table I-39, the Multifamily Energy Savings Program had an *intention* freeridership score of 42%.

Table I-39. Multifamily Energy Savings Program *Intention* Freeridership Results

Analysis Category	n	*Intention* FR Score	Percentage of Total Analysis Sample Gross Savings
Incentive	59	45% [a]	90%
Contractor	11	13% [a]	10%
Overall	**70**	**42%[b]**	**100%**

[a] Weighted by verified lifecycle MMBtu gross energy savings.

[b] Percentage of Total Analysis Sample Gross Savings.

Influence *Freeridership Analysis*

The Evaluation Team assessed *influence* freeridership by asking participants how important various program elements were in their purchasing decisions. Table I-40 shows the program elements participants rated for importance, along with a count and average rating for each factor.

Table I-40. Multifamily Energy Savings Program *Influence* Freeridership Responses

Influence Rating	Influence FR Score	The Focus on Energy program incentive or discount		Recommendation from contractor or vendor		Information provided by Focus on Energy on energy savings opportunities		Recommendation from a contractor or vendor		Previous participation in a Focus on Energy energy efficiency program	
		Incentive	Contractor	Incentive	Contractor	Incentive	Contractor	Incentive	Contractor	Incentive	Contractor
1 - Not at all important	100%	7	0	28	2	20	0	9	0	21	3
2	75%	7	0	7	2	8	2	4	0	7	0
3	25%	12	1	9	3	12	2	12	4	12	0
4 - Very important	0%	30	10	9	4	14	7	29	7	14	8
Don't know	50%	3	0	6	0	5	0	5	0	5	0
Average Rating		**3.2**	**3.9**	**2.0**	**2.8**	**2.4**	**3.5**	**3.1**	**3.6**	**2.4**	**3.2**

The Team determined each respondent's *influence* freeridership score for each analysis category, using the maximum rating provided for any factor included in Table I-40. As shown in Table I-41, 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 one factor *very important*. Counts refer to the number of "maximum influence" responses for each factor, or *influence* freeridership score, response option.

Table I-41. Multifamily Energy Savings Program *Influence* Freeridership Score

Maximum Influence Rating	*Influence* FR Score	Incentive - Count	Contractor - Count
1 - Not at all important	100%	1	0
2	75%	1	0
3	25%	5	0
4 - Very important	0%	50	11
Don't know	50%	2	0
Average Maximum Influence Rating - Simple Average		**3.8**	**4.0**
Average Influence Score - Weighted by Verified Lifecycle MMBtu Gross Savings		**13%**	**0%**
Percentage of Total Analysis Sample Gross Savings		**90%**	**10%**
Average Program Influence FR Score - Weighted by Percentage of Total Analysis Sample Gross Savings		**12%**	

The average overall *influence* freeridership score of 12% for the Multifamily Energy Savings Program is weighted by the percentage of total analysis sample gross savings that the incentive focused and contractor focused analysis category respondents represented out of the overall analysis sample.

Final Freeridership

The Evaluation Team calculated the mean of the overall *intention* and the overall *influence* of freeridership components to estimate final freeridership for the program at 27%:

$$Final\ Freeridership\ (27\%) = \frac{Intention\ FR\ Score\ (42\%) + Influence\ FR\ Score\ (12\%)}{2}$$

A higher freeridership score translates to more savings that are deducted from the gross savings estimates. Table I-42 lists the *intention*, *influence*, and final freeridership scores for Multifamily Energy Savings Program.

Table I-42. Multifamily Energy Savings Program Freeridership Score

Analysis Category	n	*Intention* FR Score	*Influence* FR Score	Final Freeridership Score	Percentage of Total Analysis Sample Gross Savings
Incentive	59	42%[a]	1%	72%	90%
Contractor	11	12%[a]	1%	94%	10%
Overall	**70**	**27%[b]**	**1%**	**74%[b]**	**100%**

[a] Weighted by verified lifecycle MMBtu gross energy savings.

[b] Percentage of total analysis sample gross savings.

Participant Spillover Analysis

The Evaluation Team estimated participant spillover based on answers from respondents who purchased additional high-efficiency equipment or appliances following their participation in the Multifamily Energy Savings Program. The Evaluation Team applied evaluated and deemed savings to the spillover measures that customers said they had installed as a result of their Program participation, presented in Table I-43.

Table I-43. Multifamily Energy Savings Program Participant Spillover Measures and Savings

Spillover Measure	Quantity	Total MMBtu Lifecycle Gross Savings Estimate
LED Lighting	300	569
Showerheads	7	127

Next, the Evaluation Team divided the sample spillover savings by the Program gross savings from the entire survey sample, as shown in this equation:

$$Spillover\ \% = \frac{\sum \text{Spillover Measure EnergySavings for All Survey Respondents}}{\sum \text{Program Measure Energy Savings for All Survey Respondents}}$$

This yielded a 1% spillover estimate, when rounded to the nearest whole percentage, for the Multifamily Energy Savings Program respondents (Table I-44.).

Table I-44. Multifamily Energy Savings Program Participant Spillover Percentage Estimate

Variable	Total Verified Lifecycle MMBtu Gross Savings Estimate
Spillover Savings	696
Program Savings	146,749
Spillover Estimate	**1%**

Final Net-to-Gross Analysis

The Evaluation Team combined the spillover information with the freeridership results to achieve the NTG ratios, using the following calculation, as shown in Table I-45:

NTG = 1 – Freeridership + Spillover

Table I-45. Multifamily Energy Savings Program NTG Estimates

Analysis Category	n	Freeridership	Spillover	NTG	Percentage of Total Survey Sample Savings
Incentive	59	42%	1%	72%	90%
Contractor	11	12%	1%	94%	10%
Overall	**70**	**27%[a]**	**1%**	**74%[a]**	**100%**

[a] Weighted by verified lifecycle MMBtu gross energy savings.

Renewable Energy Competitive Incentive Program Self-Report NTG Methodology and Findings

Freeridership

Intention Freeridership Survey Questions

The participant survey's *intention* freeridership section included eight questions, addressing the six core *intention* freeridership dimensions. The *intention* freeridership questions included these (asked in the survey format):

- F1. First, would your organization have installed the [INSERT PROJECT] without the incentives offered through the RECIP program?
- F2. I will read four statements and would like you to select the one that best describes where you were in the planning of your project's installation when you first learned of Focus on Energy's RECIP program. [READ ALL AND SELECT ONE]
- F3. Prior to participating in the RECIP, was the [INSERT PROJECT] included in your organization's capital or operating budget?
- F4. [IF YES TO F3] Did your capital or operating budget assume that the [INSERT PROJECT] would receive an incentive through RECIP?
- F5. [Ask if Yes to question F1] Without the RECIP program, would you have installed… [READ LIST AND SELECT ONE]
- F6. [Ask if Yes to question F1] Without the RECIP incentive, would you have installed the renewable energy project… [READ LIST; WHEN RESPONSE SELECTED, SKIP TO SECTION G]

Convert Responses to Matrix Terminology

Table I-46 shows how the initial participant received incentive-focused survey responses were translated into the responses *yes, no*, or *partially*, indicative of *intention* freeridership (in parentheses).

Table I-46. RECIP Raw Survey Response Translation to *Intention* Freeridership Scoring Matrix Terminology

F1. First, would your organization have installed the [INSERT PROJECT] without the incentives offered through the RECIP program?	F2. I will read four statements and would like you to select the one that best describes where you were in the planning of your project's installation when you first learned of Focus on Energy's RECIP program. [READ ALL AND SELECT ONE]	F3. Prior to participating in the RECIP, was the [INSERT PROJECT] included in your organization's capital or operating budget?	F4. [IF YES TO F3] Did your capital or operating budget assume that the [INSERT PROJECT] would receive an incentive through RECIP?	F5. [IF YES TO F1] Without the RECIP program, would you have installed… [READ LIST AND SELECT ONE]	F6. [IF YES TO F1] Without the RECIP incentive, would you have installed the renewable energy project…
Yes (Yes)	We had no formal plans for the project (No)	Yes (Yes)	Yes (Yes)	The same size system (Yes)	Within the same year? (Yes)
No (No)	We had already spoken to installation contractors but had not received any quotes for the project (Partial)	No (No)	No (No)	A smaller system (No)	Within one to two years? (Partial)
Don't Know (Partial)	We had already spoken to installation contractors and had received a quote (Yes)	Don't Know (Partial)	Don't Know (Partial)	No new system at all (No)	Within three to five years? (No)
Refused (Partial)	We had received a quote and decided upon the renewable energy system we wanted to install (Yes)	Refused (Partial)	Refused (Partial)	Don't Know (Partial)	In more than five years? (No)
	Don't Know (Partial)			Refused (Partial)	Don't Know (Partial)
	Refused (Partial)				Refused (Partial)

Participant Intention *Freeridership Scoring*

The *intention* freeridership score started with 100%, which the Evaluation Team decremented based on the participant's responses to the 6 questions, as shown in Table I-47.

Table I-47. RECIP *Intention* Freeridership Scoring Legend

Question #	Decrement
F1	50% decrement for "No," 25% decrement for "Partial"
F2	50% decrement for "No", 25% decrement for "Partial"
F3	50% decrement for "No", 25% decrement for "Partial"
F4	50% decrement for "No", 25% decrement for "Partial"
F5	50% decrement for "No", 25% decrement for "Partial"
F6	100% decrement for "No", 25% decrement for "Partial"

Intention Freeridership Analysis

Table I-48. shows the unique response combinations from participants answering the RECIP *intention* freeridership questions (actual responses mapped to yes, no, or partial, as indicative of freeridership), the *intention* freeridership score assigned to each combination, and the number of responses. The Evaluation Team calculated an *intention* freeridership score for the Program based on the distribution of scores within the matrix.

Table I-48. RECIP Frequency of *Intention* Freeridership Scoring Combinations

F1. First, would your organization have installed the [INSERT PROJECT] without the incentives offered through the RECIP program?	F2. I will read four statements and would like you to select the one that best describes where you were in the planning of your project's installation when you first learned of Focus on Energy's RECIP program. [READ ALL AND SELECT ONE]	F3. Prior to participating in the RECIP, was the [INSERT PROJECT] included in your organization's capital or operating budget?	F4. [IF YES TO F3] Did your capital or operating budget assume that the [INSERT PROJECT] would receive an incentive through RECIP?	F5. [IF YES TO F1] Without the RECIP program, would you have installed… [READ LIST AND SELECT ONE]	F6. [IF YES TO F1] Without the RECIP incentive, would you have installed the renewable energy project…	*Intention* FR Score	Count
Yes	Yes	Yes	Yes	Partial	Yes	75%	1
Yes	Yes	No	x	Partial	Partial	12.5%	1
Yes	Partial	No	x	Yes	No	0%	1
No	Yes	Yes	Yes	Partial	Yes	25%	1
No	Yes	No	x	Yes	Partial	0%	1
No	Yes	No	x	Partial	Partial	0%	1
No	Yes	No	x	No	x	0%	1
No	Yes	Yes	No	No	x	0%	1
No	Partial	No	x	Partial	Yes	0%	1
No	No	No	x	No	x	0%	1

Weighting individual respondent *intention* freeridership scores by verified lifecycle MMBtu gross savings resulted in a 14% *intention* freeridership score for RECIP.

Influence Freeridership Analysis

The Evaluation Team assessed *influence* freeridership by asking participants how important various program elements were in their purchasing decisions. Table I-49 shows the program elements participants rated for importance, along with a count and average rating for each factor.

Table I-49. RECIP *Influence* Freeridership Responses

Influence Rating	*Influence* FR Score	The Focus on Energy program incentive	The recommendation from Focus on Energy Staff	The information provided by Focus on Energy on energy savings opportunities	The recommendation from a contractor or vendor	Previous participation in a Focus on Energy renewable energy or energy efficiency program
1 - Not at all important	100%	0	4	2	1	0
2	75%	0	2	0	0	0
3	25%	2	3	6	2	4
4 - Very important	0%	8	0	2	6	4
Don't know	50%	0	1	0	1	2
Average Rating		**3.8**	**1.7**	**2.8**	**3.1**	**2.8**

The Team determined each respondent's *influence* freeridership rate for each measure category, using the maximum rating provided for any factor included in Table I-49. As shown in Table I-50, 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 one factor *very important*. Counts refer to the number of "maximum influence" responses for each factor, or *influence* freeridership score, response option.

Table I-50. RECIP *Influence* Freeridership Score

Maximum *Influence* Rating	*Influence* FR Score	Count	Total Analysis Sample Verified Lifecycle MMBtu Savings	*Influence* Score MMBtu Savings
1 - Not at all important	100%	0	0	0
2	75%	0	0	0
3	25%	0	0	0
4 - Very important	0%	10	75,469	0
Average Maximum Influence Rating - Simple Average		**4.0**		
Average Influence Score - Weighted by Verified Lifecycle MMBtu Gross Savings		**0%**		

The average *influence* freeridership score of 0% for RECIP is weighted by verified lifecycle MMBtu gross savings.

Participant Spillover Analysis

None of the RECIP survey respondents reported purchasing or installing high-efficiency equipment after participating in the program that was influenced by their participation in the RECIP. This yielded a 0% spillover estimate for the RECIP respondents (Table I-51).

Table I-51. RECIP Participant Spillover Percentage Estimate

Variable	Total Verified Gross Lifecycle MMBtu Savings Estimate
Spillover Savings	0
Program Savings	75,469
Spillover Estimate	**0%**

Final Net-to-Gross Analysis

The Evaluation Team combined the spillover information with the freeridership results to achieve the NTG ratios, using the following calculation, as shown in Table I-52.

NTG = 1 – Freeridership + Spillover

Table I-52. RECIP NTG Estimates

n	Freeridership[a]	Spillover	NTG[a]
10	7%	0%	93%

[a] Weighted by verified lifecycle gross MMBtu savings.

Appendix J. Survey and Interview Instruments by Program

This appendix includes the CY 2019 survey instruments and ongoing participant satisfaction survey questions for several programs in Focus on Energy's residential and nonresidential sectors.

Customer Satisfaction Survey Questions

The Program Administrator fielded online customer satisfaction surveys throughout CY 2019, and the Evaluation Team fielded supplementary mail surveys for all nonresidential and residential programs (except Retail Lighting and Appliance Online Coupon Smart Thermostats and Pop-Up Retail).

Table J-1 shows a matrix of the ratings questions asked in the online and mail satisfaction surveys. All questions were based on a 0 to 10 scale, where 10 indicated the highest satisfaction or likelihood and 0 indicated the lowest satisfaction or likelihood. Five core ratings questions were asked across the surveys.

- **Overall program satisfaction**: "Overall, how satisfied are you with your most recent experience with Focus on Energy?"
- **Staff satisfaction**: "How satisfied are you with the Energy Advisor or Focus on Energy staff member who assisted you with your project?"
- **Trade Ally satisfaction**: "How satisfied are you with the contractor (Trade Ally) that provided the service?"
- **Recommend the program likelihood**: "How likely is it that that you would recommend this program to others?"
- **Future improvement likelihood**: "How likely are you to initiate another energy efficiency improvement in the next 12 months?"

Four additional ratings questions were limited to specific programs:

- **HPwES – Whole Home**: "How satisfied are you with the contractor that completed your Home Assessment?"
- **Retail Lighting and Appliance Online Coupon Smart Thermostats**: "How would you describe your satisfaction in obtaining and redeeming your instant coupon?"
- **Retail Lighting and Appliance Pop-Up Retail:** "How satisfied are you with the event experience for purchasing the energy-efficient products?"
- **Simple Energy Efficiency:** "How satisfied are you with the pack you received?"

Table J-1. CY 2019 Customer Satisfaction Survey Question Matrix: Ratings

Program Survey	Program Overall	Staff	Trade Allies	More Improve-ments	Recommend Program	Other Ratings
Agriculture, Schools, and Government/Agribusiness	✓	✓	✓	✓	✓	-
Business Incentive	✓	✓	✓	✓	✓	-
Large Energy Users	✓	✓	✓	✓	✓	-
Small Business	✓	✓	✓	✓	✓	-
Multifamily Energy Savings	✓	✓	✓	✓	✓	-
Home Performance with ENERGY STAR – HVAC/Renewable Path	✓	✓	✓	✓	✓	-
Home Performance with ENERGY STAR – Whole Home Path	✓	✓	✓	✓	✓	✓
Appliance Recycling	✓	✓	-	✓	✓	-
Simple Energy Efficiency	✓	-	-	✓	✓	✓
Retail Lighting and Appliance – Retail Smart Thermostats	✓	-	-	✓	✓	-
Retail Lighting and Appliance – Online Coupon Smart Thermostats	✓	-	-	✓	✓	✓
Retail Lighting and Appliance – Pop-Up Retail	✓	-	-	✓	✓	✓

Table J-2 shows a matrix of CY 2019 satisfaction survey questions that were not based on a rating. Six core questions were asked across surveys.

- **Comments and suggestions**: "Please tell us more about your experience and any suggestions for improvement."
- **Awareness of utility role:** "The Focus on Energy program you participated in is offered in partnership with your local energy utility. Before taking this survey, was this something you were aware of?"
- **Opinion of utility**: "How have these offerings affected your opinion of your utility, if at all?"
- **Awareness sources**: "How did you learn about this particular opportunity from Focus on Energy?"
- **Focus on Energy assistance (nonresidential only)**: "Aside from providing project incentive dollars, how can Focus on Energy best support your organization going forward?"
- **Purchase decision factors (residential only)**: "What most influences your decision to make a purchase (energy efficiency or otherwise)?"

Several surveys also included program-specific questions, listed in the "Other Questions" column of Table J-2.

Table J-2. CY 2019 Customer Satisfaction Survey Question Matrix: Non-Ratings

Program Survey	Core Questions						Other Questions
	Comments and Suggestions	Awareness of Utility Role	Opinion of Utility	Awareness Source	Focus Assistance (Nonresidential)	Purchase Decision Factors (Residential)	
Agriculture, Schools, and Government/Agribusiness	✓	✓	✓	✓	✓	-	
Business Incentive	✓	✓	✓	✓	✓	-	
Large Energy Users	✓	✓	✓	✓	✓	-	
Small Business	✓	✓	✓	✓	✓	-	
Multifamily Energy Savings	✓	✓	✓	✓	✓	-	
Home Performance with ENERGY STAR – HVAC/Renewable Path	✓	✓	✓	✓	-	✓	
Home Performance with ENERGY STAR – Whole Home Path	✓	✓	✓	✓	-	✓	
Appliance Recycling	✓	✓	✓	✓	-	✓	• Motivation for recycling appliance • Participation without incentive
Simple Energy Efficiency	✓	✓	✓	✓	-	✓	
Retail Lighting and Appliance – Retail Smart Thermostats	✓	✓	✓	✓	-	✓	
Retail Lighting and Appliance – Online Coupon Smart Thermostats	✓	✓	✓	✓	-	✓	
Retail Lighting and Appliance – Pop-Up Retail	✓	✓	✓	-	-	✓	• Improving the event experience

All residential program surveys also included the same four demographic questions: respondent age, annual household income, home ownership, and housing type. Table J-3 shows the results from these questions.

Table J-3. CY 2019 Residential Demographics and Household Characteristics

Survey Question	Simple Energy Efficiency	Appliance Recycling	Retail Lighting and Appliance			Home Performance with ENERGY STAR		
			Retail Smart Thermostats	Online Coupon Smart Thermostats	Pop-Up Retail	HVAC Path	Whole Home Path	Renewable Rewards Path
Respondent age	**n=1,277**	**n=1,458**	**n=785**	**n=24**	**n=167**	**n=1,336**	**n=217**	**n=219**
18-24	1%	0.1%	1%	0%	1%	0.1%	0%	0%
25-34	5%	4%	17%	0%	7%	3%	9%	8%
35-44	10%	8%	15%	33%	9%	6%	10%	16%
45-54	16%	16%	17%	21%	23%	11%	21%	17%
55-64	27%	33%	24%	29%	35%	27%	22%	28%
65-74	29%	27%	22%	17%	22%	35%	30%	18%
75 or older	13%	12%	5%	0%	4%	18%	9%	12%
Annual household income	**n=936**	**n=1,044**	**n=622**	**n=21**	**n=144**	**n=942**	**n=178**	**n=174**
Less than $20,000	9%	5%	1%	0%	1%	4%	5%	1%
$20,000 up to $50,000	31%	22%	12%	24%	17%	24%	21%	13%
$50,000 up to $75,000	23%	27%	17%	14%	26%	28%	24%	21%
$75,000 up to $100,000	19%	20%	25%	24%	21%	17%	24%	22%
$100,000 up to $150,000	13%	17%	28%	14%	26%	16%	17%	24%
$150,000 up to $200,000	3%	5%	11%	19%	6%	6%	4%	10%
$200,000 or more	2%	4%	6%	5%	3%	5%	5%	10%
Home ownership	**n=1,152**	**n=1,456**	**n=796**	**n=24**	**n=170**	**n=985**	**n=218**	**n=215**
Own/buying home	87%	97%	97%	100%	94%	98%	99%	94%
Rent/lease	12%	3%	3%	0%	6%	1%	1%	5%
Occupied without payment of rent	0.3%	0.3%	0.3%	0%	0%	1%	0%	0.5%
Housing type	**n=1,294**	**n=1,504**	**n=777**	**n=24**	**n=167**	**n=1,351**	**n=219**	**n=216**
Single-family home, detached house	79%	91%	89%	79%	90%	90%	89%	92%
Attached house with 1 to 3 units	7%	5%	6%	13%	5%	5%	9%	2%
Multifamily apartment or condo building with 4 or more units	9%	2%	4%	4%	3%	3%	1%	0%
Mobile/manufactured home	3%	2%	1%	4%	2%	1%	0.5%	3%
Retirement Community	1%	0.5%	0%	0%	0%	0.1%	0.5%	3%

Survey Instruments and Interviews

Survey instruments and interview guides will be inserted as PDFs after the appendix is compiled and generated as a PDF.

Residential Programs

- Simple Energy Efficiency Program Multifamily Participant Online Survey
- Connected Devices Kits Program Participant Online Survey
- Retail Lighting and Appliance Program Advanced Power Strip and Smart Thermostat Participant Survey
- Direct-Mail Home Energy Assessment Program Participant Survey

Nonresidential Programs

- Business Incentive Program Participant Survey
- Agriculture, Schools and Government Program Participant Survey

Multifamily Programs

- Strategic Energy Management Program Participant Interview Guide
- Large Energy Users Program Participant Customer Survey

Special text indicates the following throughout all of the survey scripts:

GREEN TEXT: INTERVIEW INSTRUCTIONS

RED TEXT: CATI PROGRAMMING INSTRUCTIONS

Asterisk (*): Survey questions labeled with an asterisk are core question that were asked across all Focus on Energy phone surveys, where appropriate.

Appendix K. Healthcare Focus Groups Findings

Historically and during CY 2019, Focus on Energy has offered incentives to healthcare facilities. Based on their facility size, healthcare customers could apply to either the Large Energy Users Program or the Business Incentive Program for custom and prescriptive incentives.

The Large Energy Users Program is administered by APTIM and implemented by Leidos Engineering. The Business Incentive Program is also administered by APTIM and is implemented by Franklin Energy.

In CY 2019, the Evaluation Team conducted a qualitative analysis of the incentive offerings by hosting four online focus groups and conducting five in-depth interviews with Wisconsin healthcare facilities. These groups and interviews provided insight into facility managers' processes and decisions, participation barriers, level of interest in current Focus on Energy offerings, and reactions to retrocommissioning and strategic energy management (SEM) offerings.

Research Approach and Objectives

The Evaluation Team had three research objectives based upon input from the Program Administrator and Program Implementers:

- Explore internal decision-making processes regarding facility improvements and incorporating energy efficiency into those improvements
- Identify how to overcome barriers to participating in Focus on Energy programs
- Assess the overall appeal of two Focus on Energy offerings (retrocommissioning and strategic energy management) and opportunities for current program refinement

Segmentation

The Evaluation Team conducted focus groups with hospitals and skilled nursing facilities (SNFs). The Team worked with a local recruitment firm to schedule a total of 18 facility managers for the four online focus groups. Because of challenges in recruiting from a small sample of hospitals, the Team also conducted five one-on-one in-depth interviews with hospital facility managers. The groups were segmented by historical participation with Focus on Energy and by facility size, as shown in Table K-1.

Table K-1. Segmentation and Sample Sizes

Segmentation	Groups	Unique Contacts[a]	Respondents
Nonparticipant Hospitals	1	90	2
Participant Hospitals (≥1 projects since 2015)	0		5[b]
Participant Skilled Nursing Facilities (all sizes, ≥1 projects since 2015)	1	103	8
Nonparticipant Large Skilled Nursing Facilities (≥50 residents)	1	190	5
Nonparticipant Small Skilled Nursing Facilities (<50 residents)	1	97	3
Total	**4**	**464**	**23**

[a] Several contacts were facility managers for more than one facility
[b] Individual in-depth interviews

This report analyzes differences in facility manager responses by size (large versus small), facility type (hospitals versus SNFs), and participation (nonparticipant and participant SNFs). Most participant SNF facility managers reported managing large facilities, defined as having at least 50 beds. This report uses the term large facilities to refer to hospitals, participant SNFs, and large nonparticipant SNFs.

Screening and Pre-Group Exercises

To verify that all respondents could speak to the topics covered by the focus groups and interviews, the Evaluation Team screened participants to ensure they managed their facilities' energy use or were involved in decisions for capital improvements. Respondents said they were facility owners, executive leaders, or facility managers. In this report, the Team refers to all respondents as facility managers.

Prior to the start of each focus group and interview, the moderator asked respondents to complete a short online survey about their familiarity with energy efficiency and Focus on Energy. The Evaluation Team used the results of these surveys to supplement findings from the focus group discussions and interviews.

Findings

This section includes the detailed findings from the focus groups and in-depth interviews.

Decision-Making Processes

The Evaluation Team assessed the healthcare facilities' internal decision-making processes regarding facility improvements and incorporating energy efficiency into those improvements. Facility managers were asked about the timing of capital project planning, key decision-makers, priorities for facility upgrades, and whether energy efficiency is considered when making facility plans.

Highlights of Decision-Making Processes

- Most facilities have an annual capital budget process, and most large facilities require approval from executive leaders or a board of directors. Small SNFs have a less formal approval process.
- Though all facilities consider upfront cost and payback period, only some hospitals and SNFs target a specific payback period. Half the hospitals target a payback period of one to five years, and half the SNFs target a payback period of half the measure life (e.g., a 10-year payback for a measure life of 20 years).
- Large facility managers are more concerned about their energy costs than are small SNFs, but concern does not always translate into action or energy-savings goals. Only three hospitals have formal energy savings goals, while no SNFs did.
- Most facility managers upgrade or replace equipment for revenue generation, occupant comfort, or safety reasons rather than cutting energy costs. However, when making these upgrades, most large hospitals and SNFs consider installing energy-efficient equipment models.

Budgeting and Project Approvals

Most facility managers set aside capital budgets for facility improvements, but just two hospitals set aside budgets specifically for energy efficiency projects. Facility managers reported varying budget

timeframes, with most facilities planning their capital budgets one year in advance. Three large facilities (one hospital and two SNFs) reported longer timelines and said they plan their capital budgets three years in advance, forecasting when equipment may fail. One hospital and some SNFs described more reactive capital budget planning processes. Some planned their budgets six months in advance and two planned budgets on a rolling basis as needs arose or equipment failed.

Both models—planning far in advance and reactive spending when needs arise—present their own unique challenges for incorporating energy efficiency into the decision-making process. Facility managers who plan on a rolling basis typically choose the least cost equipment replacement option, even if it is the least energy efficient. Those who plan their projects six months to one year in advance reported it would be difficult to quickly gain approval for non-emergency energy opportunities that arose outside their project plans.

Capital budget approval processes are formal at large facilities but less formal and more streamlined at small facilities. The executive-level and facility managers who participated in this research said they provide input into decision-making, but few had autonomy to proceed with spending decisions alone. Most large facility managers require approval from their chief executive officer, chief operating officer, chief financial officer, or board of directors to make facility or equipment upgrades. Small facilities said the facility owner either makes the decision or does so in conjunction with maintenance staff.

One of the key factors in all cases for project approval was cost. The Evaluation Team observed differences according to facility type for target payback periods. All facilities consider forecasts for payback period and return on investment (ROI) during their decision-making processes, and most hospitals specified that energy was factored into financial estimates. However, only half the hospitals and SNFs target specific payback periods. These hospitals aimed for a one-to-five year payback period, and these SNFs wanted the payback period to be half the measure life (e.g., a 10-year payback if the equipment will last 20 years).

Level of Importance Placed on Reducing Facility Energy Usage

Large facility managers were more concerned about their energy bills than were small nonparticipant SNFs. All participant SNFs, half the large nonparticipant SNFs, and some hospitals thought energy usage was a concern. However, no small nonparticipant SNFs said energy use was a concern. Most hospitals and some large SNFs monitor their energy usage regularly, but small nonparticipant SNFs do not.

Concern about energy usage did not always translate into action. Though energy monitoring caused some facility managers to take energy-saving actions (through energy-efficient equipment replacements or conservation actions such as regulating thermostat levels or turning off lights), others who monitor their bills do not try to reduce energy use since it makes up a small percentage of their facility budgets. Nonparticipant SNFs commonly mentioned that the top ongoing costs were employee wages, food, and transportation.

Only hospitals had energy-savings goals or formal top-down initiatives to save energy across multiple facilities. Three had formal energy-savings goals and one hospital facility manager's corporation was working to establish goals for the hospitals it manages. This corporation creates top-down capital

initiatives that can apply broadly, such as installing LEDs across 40% of its hospitals nationwide. This hospital facility manager did not think its corporate decision-makers knew that its LED upgrades in Wisconsin would have qualified for Focus on Energy incentives. No SNFs had formal energy-savings goals, though one SNF is working to establish goals.

Project Prioritization

When asked what type of building or equipment improvements receive top priority, all segments agreed about making building improvements necessary for patient safety and comfort and immediately fixing failed equipment that affects safety. Most participant SNFs understood the correlation of tenant comfort with HVAC systems, insulation levels, and air sealing, but several facility managers from all SNF segments reported struggling to meet their tenant's heating and cooling comfort needs. Challenges include that residents varied in their desired thermostat setting (though some who live in apartment-style spaces can control their own temperature and lighting usage), and it can be difficult to maintain even heating and cooling across large open facility areas.

All segments prioritize capital improvements that generate revenue by attracting new tenants or patients. Aesthetics were particularly important to SNFs. All SNFs prioritize aesthetics (such as new paint and furniture) to appear welcoming and attractive to new patients, and one said his facilities completely upgrade a room each time a tenant changes. In contrast, only one hospital facility manager mentioned aesthetics. Hospital facility managers explained that medical equipment takes precedent over infrastructure upgrades, since medical equipment generates revenue and infrastructure upgrades do not. Across all segments, early replacement of equipment or infrastructure that is old, yet not failing, was a low priority.

When asked how energy efficiency ranks with other facility improvements priorities, just one participant SNF and one large nonparticipant SNF ranked energy efficiency highly. Though reducing energy costs was not the main goal for most facility managers when upgrading the facility, most large SNFs and hospitals said they would consider installing energy-efficient equipment models. Four facility managers linked energy efficiency to cost savings when making decisions. One participant SNF and two hospitals include energy efficiency in a long-term cost-reduction plan. One large nonparticipant SNF reported choosing energy-efficient clothes dryers despite the upfront incremental cost because they would lead to cost savings. Participant SNFs reported receiving Focus on Energy audits to learn how their buildings can save energy, and one hospital participates in the Focus on Energy SEM program.

Approach to System Upgrades

All facility managers agreed that HVAC systems were a common building improvement concern at their facilities because they involve air quality, resident comfort, and resident safety. However, most replace upon failure rather than proactively plan for HVAC project upgrades. Small facility managers reported that if a furnace failed, they replaced it with the cheapest and fastest option. One large nonparticipant SNF had plans for water heater replacements because they tend to fail every seven years.

Participation Barriers

Facility managers reported several barriers to participating in Focus on Energy programs.

Highlights of Participating in Focus on Energy Programs

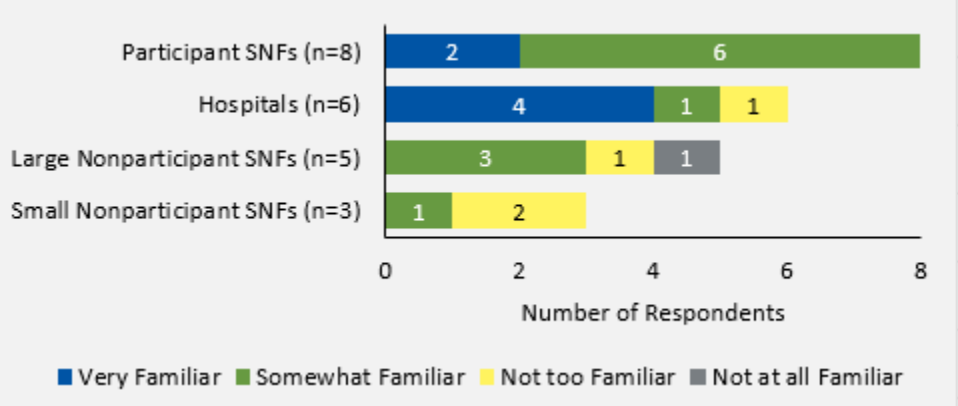
- Hospitals and participant SNFs have the highest awareness of ways to save energy and of Focus on Energy offerings. However, some respondents in all segments lack awareness of either and also lack the time and staff expertise to research these on their own.
- Large and small facilities have critically different needs for obtaining information. Large facility managers desire more interaction with Focus on Energy representatives, but small SNFs lack any time to meet.
- Large facility managers are more interested in participating in Focus on Energy programs than are small facilities.
- Detailed payback period forecasts and information on Focus on Energy incentives can help overcome the barrier of competing budget priorities.
- Small SNFs need more financial help and guidance than large facilities. Small facilities are less able to handle high upfront costs and suggest that grants or loans would help them overcome this barrier.
- All facility managers trust industry-specific healthcare associations as a source of information for Focus on Energy offerings.

Lack of Awareness

Awareness of ways to save energy at healthcare facilities corresponded to historical participation in Focus on Energy and facility size. The Evaluation Team assessed facility manager familiarity with ways to save energy at healthcare facilities through a pre-focus group survey question and during the focus group discussions and interviews.

As shown in Figure K-1, participant SNFs and hospitals reported the most familiarity with ways to save energy in their facilities, followed by large nonparticipant SNFs. Small nonparticipants reported the lowest familiarity with ways to save energy.

Figure K-1. Focus Group Segment Familiarity with Ways to Save Energy at their Healthcare Facilities



Source: Pre-focus group survey question "How familiar are you with ways to save energy at your healthcare facility?"

Similarly, during the focus group discussions, all participant SNFs and most hospitals reported being familiar with energy efficiency options. However, half the large nonparticipant SNFs and all small nonparticipants SNFs reported no familiarity with opportunities beyond LEDs.[55] Participant SNFs reported completing projects that included HVAC systems, insulation, building audits, energy-efficient laundry systems, design assistance, retrocommissioning, and solar. Just two large nonparticipant SNFs had already installed energy-efficient products (LEDs, motion detecting lights, and clothes dryers), but half the nonparticipant SNFs had plans to install LEDs, efficient boilers, and water heaters at the end of the useful life of their existing equipment. The other large nonparticipant SNFs were familiar with LEDs as energy efficiency options but lacked knowledge of deeper retrofit opportunities.

Participant SNFs and some hospitals had high awareness of current Focus on Energy programs; however, only some large nonparticipant SNFs and no small nonparticipants SNFs were aware. No large nonparticipant SNFs knew what Focus on Energy offers beyond lighting. No nonparticipant SNFs and only some hospitals knew who to speak with about opportunities for incentives. One hospital facility manager thought incentives had "dissipated" in the past few years because a Focus on Energy representative who used to visit him quarterly to discuss current and future projects stopped coming a few years ago. Another hospital facility manager said the number of projects approved for participation had decreased due to eligibility requirements.

Lack of Staff Time and Resources

Most nonparticipant SNFs and two hospitals said their facility staff lacked the expertise or time to research and understand their energy savings options without outside help. The large facility managers agreed Focus on Energy could help them understand and prioritize their energy efficiency options and that the opportunities for incentives and cost savings was worth their time to talk with Focus on Energy. The large facility managers wanted a program representative to phone or set up one-on-one meetings,

[55] Though all small nonparticipants reported in the pre-focus group survey that they were *somewhat* or *not too familiar* with ways to save energy at their healthcare facilities, during the focus groups discussions all said they were *not at all familiar* with ways to save energy.

and they wanted to use this representative as their point-of-contact when they have questions. Participant SNFs also said incentives and cost savings made them interested in Focus on Energy.

Small nonparticipants SNFs were less certain that the time barrier could be overcome. Though they now have heard about Focus on Energy, they said they still lacked the time to understand their energy efficiency options, the estimated project cost, program requirements and offerings, and the application process. They already felt inundated with information professionally and could not commit to a one-on-one visit from a Focus on Energy representative. Instead, they would rather learn information from their energy companies or contractors. They thought incentives could help prioritize energy efficiency at their companies; however, they were less likely to state that they would apply for rebates in the future because of so little time to focus on implementing an energy efficiency project.

Facility managers needed an easy application process and clear communication from Focus on Energy. Large nonparticipant SNFs and all but one hospital said they would likely participate in the future, but large nonparticipant SNFs said the application process would need to be easy. Though most participant SNFs said the process of working with Focus on Energy was seamless because contractors did all the paperwork, several hospital facility managers who completed a Focus on Energy project since 2015 said it was difficult to determine which types of projects would qualify for incentives. Before committing to participate, small nonparticipant SNFs are looking for details such as a project schedules, when areas of the facilities would need to be closed, and whether permits are required.

Concerning information from Focus on Energy, large nonparticipant SNFs wanted to know how much money they could expect to save from various energy efficiency options. Hospitals thought written recommendations they could reference over time and case studies from similar projects would be useful.

A few participant SNFs received incentives from Focus on Energy for building audits that identified projects that were easy to implement as well as mid- and long-term energy-savings opportunities. They said these audits were helpful in prioritizing projects and understanding how they could reduce energy costs.

All large facility managers primarily wanted to learn about offerings directly from a Focus on Energy representative. All groups agreed that marketing materials from Focus on Energy and healthcare industry associations could increase their awareness of these offerings. SNFs recommended that Focus on Energy marketing materials and emails use “assisted living” or “healthcare facilities” in the title so they would know the information applied to them.

Participant SNFs learned of Focus on Energy incentive details from their contractors, which shows that contractors are also an important information source for facility managers. All facility managers also agreed that industry-specific healthcare associations could help increase their awareness of Focus on

Energy offerings. They recommended the following Wisconsin industry groups as trusted sources of information in addition to Focus on Energy:

- **Hospitals.** Wisconsin Healthcare Engineering Association and the American Society for Health Care Engineers
- **Skilled nursing facilities.** Wisconsin Assisted Living Association, Wisconsin Health Care Association

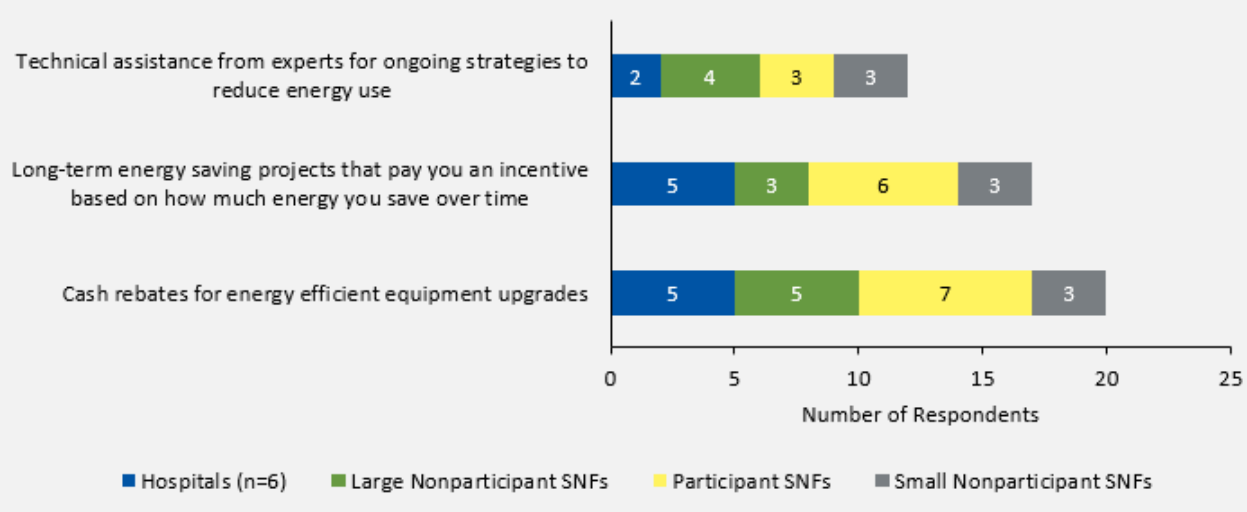
Obtaining Capital for Upfront Costs and Competing Budget Priorities

Competing budget priorities are a barrier to reducing energy costs for all facility managers. Obtaining capital for upfront costs is a barrier for small SNFs. Most facility managers thought Focus on Energy incentives, combined with detailed forecasts for payback period and ROI, could help them resolve competing budget priorities and increase the chance of project approval. Though not all facilities required that projects meet a certain payback period, such estimates can help decision-makers recognize that energy efficiency projects are financially compelling. Some facility managers recommended that Focus on Energy also provide forecasts of lifecycle costs for the energy-efficient measure compared to the baseline measure and a savings calculator for various equipment types. However, two hospitals do not factor incentives into ROI because it was difficult to determine whether their project would be eligible when seeking internal approval.

Nonparticipant SNFs and some hospitals said that the best time to involve Focus on Energy was during the budget or project planning process so Focus on Energy could provide financial details. However, some hospitals said that there was no good time for them to consider incentives, because their leadership would plan and implement the projects they want regardless of incentive availability. These hospitals said it was difficult to fit the incentive application into their capital project approval and implementation processes. Two government-owned hospitals said projects were identified at a regional level and did not typically consider incentives during the design and implementation of improvements.

When asked in a pre-focus group survey which type of program incentive appealed to them, SNFs were most interested in cash rebates and hospitals were interested in cash rebates and projects that paid for performance (Figure K-2). During the focus group discussions, some small nonparticipant SNFs also suggested that Focus on Energy provide grants or a loan to overcome the barrier of upfront costs.

Figure K-2. Incentive Types that Appeal to Market Segments



Source: Pre-focus group survey question "Which type of incentive program is appealing to you? Select all that apply."

Program Concept Testing

The Evaluation Team gave one-page descriptions of Retrocommissioning and SEM programs to all facility managers (as shown in Figure K-3 and Figure K-4). They identified appealing program components and barriers to participation, and their responses are described below.

Figure K-3. Retrocommissioning Program Concept

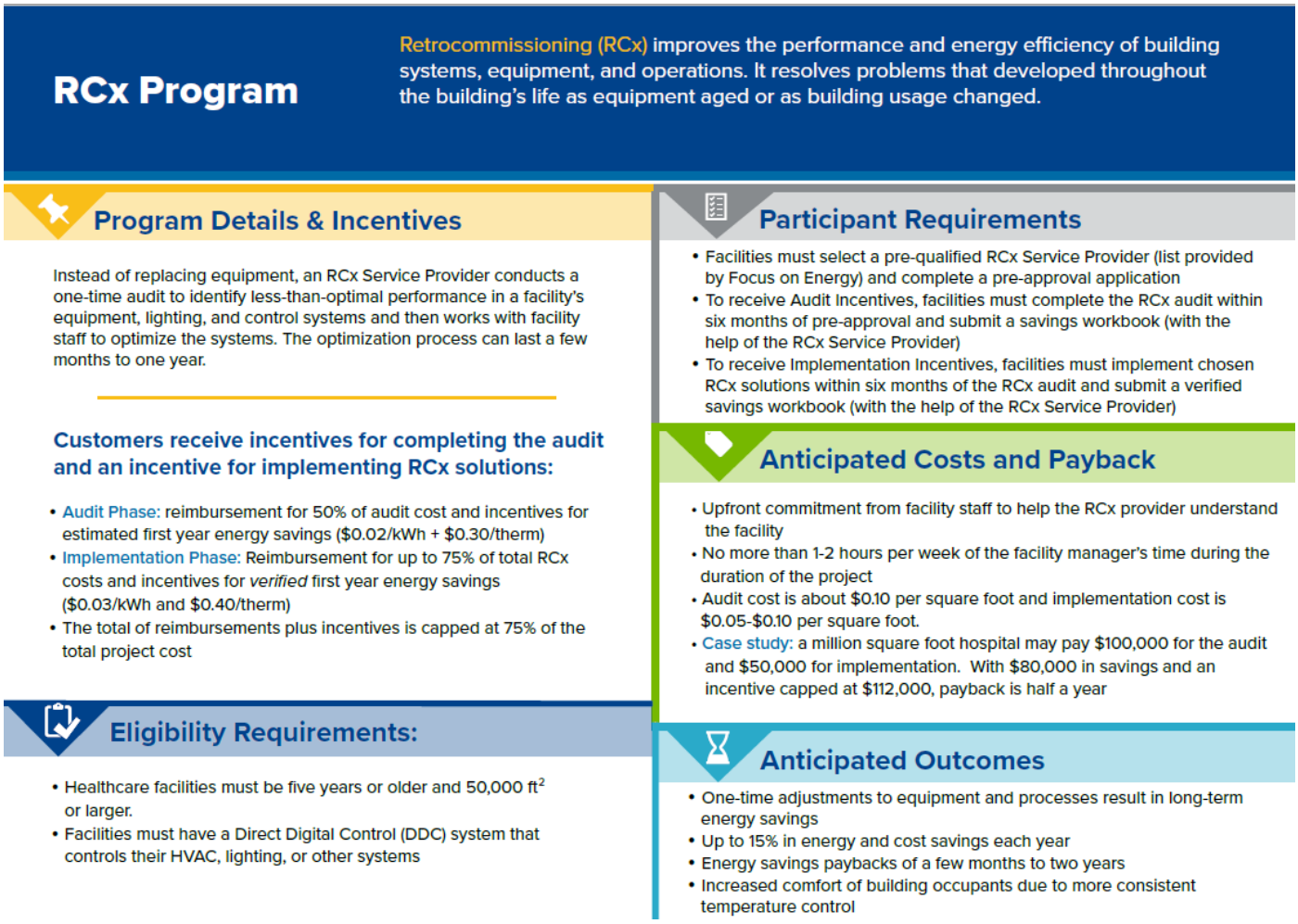
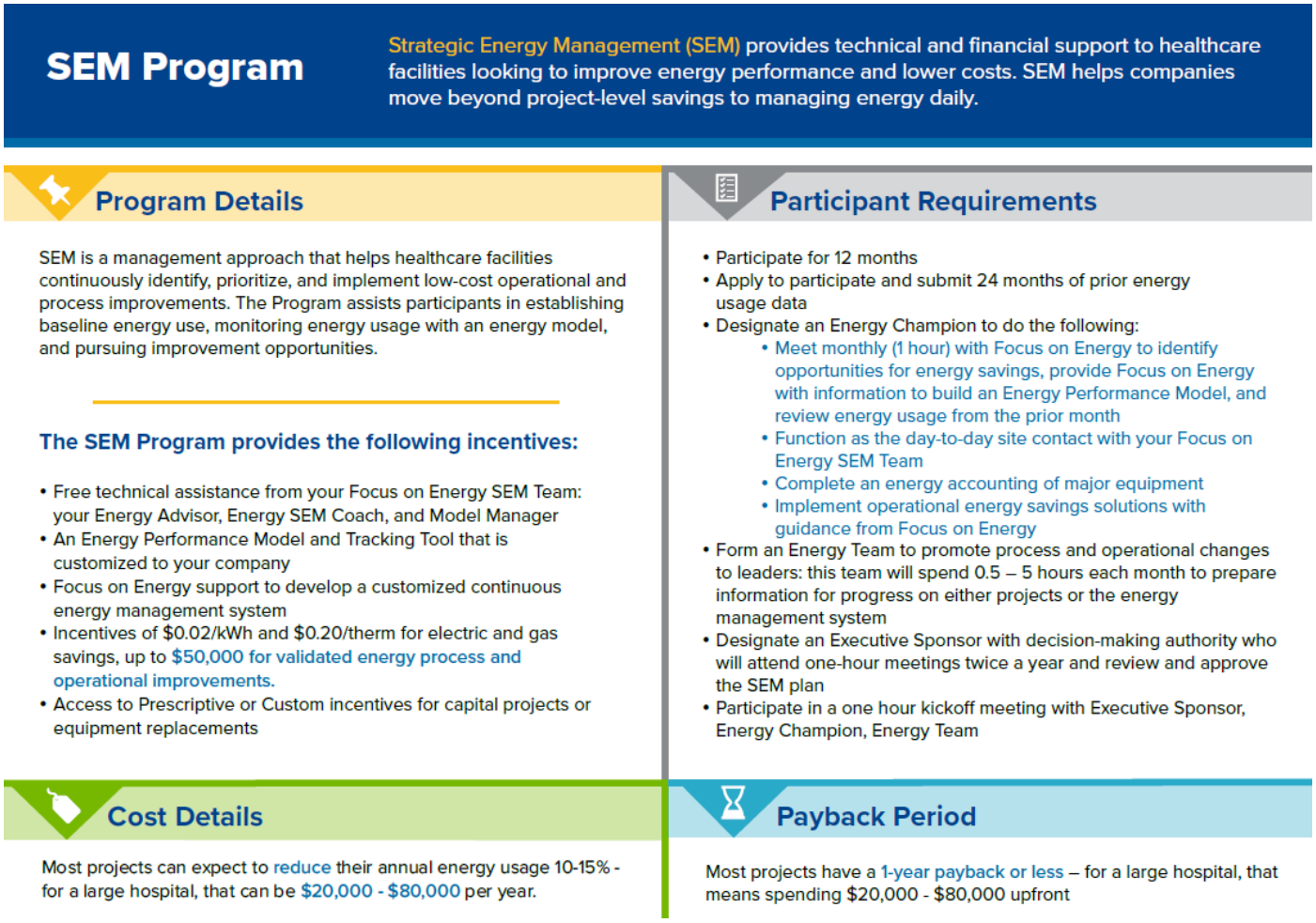


Figure K-4. Strategic Energy Management Program Concept



Retrocommissioning

Highlights of Retrocommissioning Components and Barriers to Participation

- The chance for long-term energy savings, program incentives, and audit recommendations appeal to all facility managers.
- Most facilities are not likely to participate due to challenges in meeting the program requirements for digital direct control (DDCs), building minimum size or age, and weekly staff time commitments.
- All SNF facility managers worry about not achieving enough energy savings to recoup the upfront audit cost. They question the feasibility of the retrocommissioning savings estimates.
- All SNFs want to see case studies of retrocommissioning project costs, savings, and time commitments for healthcare facilities or multifamily buildings similar in size to their facilities.
- Some hospitals and nonparticipant SNFs cannot afford the upfront costs despite the availability of future incentives.

Appealing Aspects of Retrocommissioning

Only hospital facility managers had heard the term "retrocommissioning" in relation to building management or building incentives prior to the focus group discussions and in-depth interviews. All facility managers were interested in the incentive levels for the audit and the implementation, the chance to receive information about their facilities' energy-savings opportunities, and the stated 15% cost savings estimate. The large facilities were also attracted to the estimate of a two-year or less payback. Additionally, one hospital said the retrocommissioning offering was appealing because it would lead to greater comfort for patients, which is their priority when making improvements.

Three hospitals had received retrocommissioning audits in the past, but just one had participated in the Focus on Energy Retrocommissioning Program. All thought retrocommissioning was an effective way to identify improvement opportunities.

One hospital facility manager who had had a retrocommissioning audit outside of the program used the report to immediately implement more than three dozen low- or no-cost improvements in his facilities and to justify his request for 12 large capital improvement projects. In his words, "This was a rude awakening to the issues my hospital had." When he compared the Focus on Energy offering described in the information sheet with his own retrocommissioning experience, he said he would have participated to take advantage of the incentives had he known about it sooner.

Barriers and Concerns with Retrocommissioning

Most facility managers in each group could not meet the current retrocommissioning offering's requirements for at least one of the following reasons:

- Most SNF facilities are smaller than the required minimum 50,000 square feet.
- Some SNF facilities and hospitals said their buildings are less than five years old.
- The requirement to have a DDC for HVAC and lighting was a challenge for three hospitals and all small nonparticipant SNFs. One hospital facility manager explained it is not cost-effective to wire older buildings for DDCs. In contrast, all participant SNFs and most large nonparticipant SNFs already have DDCs or are planning to get them soon.
- Some hospitals and all participant and large nonparticipant SNFs said it would be challenging to implement retrocommissioning solutions within six months of their audit. The delay would stem from the timing of the organizations' approval processes or contractor labor shortages. One hospital facility manager who had prior experience with retrocommissioning said the approval process to implement audit recommendations could take multiple years. Though he had immediately implemented low- to no-cost recommendations using his existing allocated budget and internal staff, he had received budget approval for only one large capital project since the retrocommissioning audit two years ago. He was still in the process of getting approval for the 11 other capital project proposals.
- Some hospitals and all small nonparticipant SNFs said their staff could not commit one to two hours per week of the facility manager's time to focus on the retrocommissioning audit or

implementation. Participant and large nonparticipant SNFs said the time commitment was not a barrier.

- Two hospitals and all small nonparticipant SNFs said they could not afford to pay for the cost of the audit upfront despite the availability of incentives later.

All SNFs also expressed concern about recouping audit costs. Participant and large nonparticipant SNFs worried that the audit might not reveal opportunities for substantial energy savings if their buildings already operate efficiently. One facility manager asked, "What if you already have an efficient building, drop $100,000, and don't get any payback?"

Small nonparticipant SNFs also showed distrust for the audit recommendations and the role of the retrocommissioning service provider. As one said: "They are there to make money, not just to help me save money." One small nonparticipant SNF expressed preference for capital projects over retrocommissioning: "When you invest in energy-efficient equipment, you know you get savings right away." Because of these concerns, nonparticipant SNFs disliked the requirement to pay for the audit up front.

Separate from the issue of recovering their costs, some hospitals, large nonparticipant SNFs, and small nonparticipant SNFs said that receiving approval for upfront audit costs would be a barrier despite the opportunity to receive incentives and cost-savings down the road. Small nonparticipant SNFs also said not knowing the upfront audit costs and subsequent implementation costs would deter them from considering applying to for the retrocommissioning offering in a Focus on Energy program. Participant SNFs did not see upfront costs as a barrier.

As an alternative to a retrocommissioning program and audit recommendations specific to their facilities, participant SNFs wanted the opportunity to attend a series of educational webinars geared to healthcare owners and administrators. They suggested that these webinars describe solutions for the challenge of reducing energy usage in facilities where individual tenants controlled their own usage.

Need for Program Case Studies

All SNFs said reading case studies for retrocommissioning buildings of similar size to theirs could help mitigate their concerns about not recouping their upfront costs and would also raise their interest in Focus on Energy's retrocommissioning offering. Case studies would help them understand what to expect by detailing upfront audit and implementation costs of real projects, estimated commitment of time, monetary savings, and length of project payback. Most large nonparticipant SNFs wanted the case studies to focus on the healthcare industry, but the other groups said case studies need not be for healthcare facilities if building sizes and uses were similar. They agreed that examples of condominiums or apartment buildings would suffice.

Questions and Proposed Changes to the retrocommissioning program

Both large and small nonparticipant SNFs wanted to know more about program requirements for working with a retrocommissioning service provider. Large nonparticipant SNFs wanted to know if the

Focus on Energy program required participants to implement all retrocommissioning recommendations or if they could choose which ones to implement.

When asked what could make them more likely to participate, large nonparticipant SNFs made the following suggestions to mitigate the upfront cost challenge:

- Provide a free or low-cost audit
- Provide a loan instead of rebates for the audit
- Prorate the audit cost if the retrocommissioning report finds that the building already operates efficiently

Strategic Energy Management

Facility managers shared their thoughts on SEM components and barriers to participation.

Highlights of Strategic Energy Management Components and Barriers to Participation

- SEM appeals to all facility managers. Several SNFs prefer it over retrocommissioning since there is no upfront cost.
- Many facility managers from all segments except large nonparticipant SNFs cannot meet the required time commitments, and some small SNFs lack the staff to create energy teams.
- Large SNFs and most hospitals are interested in participating in SEM but need more information about the actual activities required of staff.
- All SNFs question the feasibility of the cost-savings estimates presented to them.
- All SNFs want to see case studies of project costs, savings, and time commitments for healthcare facilities or multifamily buildings of similar size.

Appealing Aspects of SEM

Just two hospitals had heard of SEM prior to the focus group discussions or in-depth interviews (no SNFs had heard of it). One hospital is currently participating in a SEM offering through Focus on Energy. The incentives and estimated cost savings presented during the groups and interviews appealed to all facility managers. All SNFs and some hospitals (including the one currently participating) also valued the SEM offering as a way to understand their cost-savings opportunities and to access a 12-month energy coach. They viewed this energy coach as a consultant with whom they could discuss projects and ask questions. Several SNFs preferred the SEM offering over the retrocommissioning offering since there is no upfront cost.

The large SNFs liked that SEM is an ongoing process and viewed the creation of energy teams and access to the energy coach as an exciting opportunity to motivate staff to investigate their facilities and solve problems. In particular, large nonparticipant SNFs were more favorable to the SEM offering because it provides long-term assistance whereas the retrocommissioning offering provides only a one-time audit with upfront costs.

Though most hospitals already use tools to track energy, some hospital facility managers liked that the SEM offering would provide a tracking tool to monitor energy usage and cost savings tied to SEM. Their interest in such tools is consistent with their reported practice of tracking their energy bills. One hospital facility manager said, "Cost savings are great, but I like the idea that I can track if my equipment adjustments are working out." Hospitals also liked the one-year payback period. One hospital facility manager thought SEM could help him get projects approved, saying that it "gives us incentives and information needed to get approval for energy-efficient upgrades."

Barriers and Concerns with SEM

Some SNF and hospital facility managers could not meet the current SEM requirements for at least one of the following reasons:

- Some small SNFs could not meet the requirements to designate an energy champion and form energy teams because staff is limited. Some also worried that their staff might lack the expertise needed to be a part of an energy team.
- Depending on the actual required time commitment, several participant and small nonparticipant SNFs and some hospitals said they could not meet the requirements for staff to commit half an hour to five hours per month. Small SNFs specified they could handle one to two hours per month and wanted to remove responsibility from their staff by having Focus on Energy representatives take on larger roles.
- Some hospitals thought gathering the data for the required energy accounting and equipment inventory would be a time barrier.

Similar to their concerns about the savings estimates in the retrocommissioning offering, all SNFs were also skeptical about the SEM offering. SNFs did not think the hospital savings example was useful, with one SNF facility manager saying "It would be nice to have a concrete example for a building that is smaller than a larger hospital so that I can know what that the costs and payback period would be. I don't have a way of relating to a large hospital."

Need for Program Case Studies

To make the estimates for required SEM expenditures and cost savings relevant to their facilities, all SNF facility managers wanted case studies for buildings of similar size. They wanted case studies that showed upfront costs and savings for specific equipment upgrades as well as the required time commitments and specific staff activities. The SNFs agreed that the case studies need not focus specifically on healthcare facilities and that similarly sized tenant living spaces such as condos or apartments would suffice. Small nonparticipant SNFs wanted the case studies to specify square footage and number of floors.

Some SNFs also wanted the case studies to show how time commitments vary by facility size. One SNF facility manager explained that he assumes smaller facilities would need less time than hospitals.

Program Interest, Questions, and Proposed Changes to the SEM program

The hospitals, a few large SNFs, and one small SNF were very interested in participating in an SEM offering. However, the SNFs agreed that to prioritize SEM for their facilities, Focus on Energy would need to provide more details about the advantages of participating and what staff and financial resources they must commit.

All segments needed a deeper understanding of the activities expected of the energy champion and energy teams to achieve savings. They said they understood how to join a Focus on Energy program but did not understand what daily or monthly responsibilities would be. Verbatim responses from the groups expressing their confusion include the following:

- "It's not at all clear what we would need to do to achieve energy savings or what my staff would actually be doing,"
- "What would be involved in the five hours a month?"
- "I need more information on what 'progress toward project' means before I can commit."

SNFs and hospitals also wanted a better idea of their commitment in time and staff. Small SNFs asked if they could still participate if only one person could be dedicated to the SEM offering. One asked, "If I can only designate one person total, can I still participate?" Another asked if time commitments scale with facility size.

Suggestions for changes to the SEM offering involved upfront financial support, greater flexibility for staff participation requirements, and more support from Focus on Energy. In terms of financial support, some small SNFs wanted a sign-on bonus, and some large SNFs recommended that Focus on Energy provide low-interest loans to remove any upfront costs instead of promising that participants would recoup their costs through long-term energy savings.

For more flexible participation requirements, some hospitals wanted to limit energy champion participation to attending the kickoff and half-hour monthly meetings, while they delegate day-to-day SEM tasks to their staff and plant operators. Some hospitals also suggested quarterly rather than monthly meetings because they thought there might not be much to report on a monthly basis. Some hospitals also thought that Focus on Energy could work directly with utility partners to gather the data needed for the energy accounting.

Outcomes and Recommendations

Outcome 1: Both large and small nonparticipants lacked resources to understand deep savings potential, but outreach from Focus on Energy and healthcare trade associations can overcome this barrier. All small nonparticipant SNFs, half the large nonparticipant SNFs, and some hospitals lacked awareness of how to save energy beyond LEDs and lacked the time and staff expertise to research opportunities for deeper savings. These nonparticipants also lacked time to research Focus on Energy offerings and did not know who to contact at Focus on Energy.

All facility managers said Focus on Energy could help them understand and prioritize their energy efficiency options. Large facility managers wanted in-person interaction and guidance from Focus on

Energy. However, small nonparticipant SNFs lacked the time to meet with Focus on Energy in person and preferred learning of opportunities through their energy companies or contractors. Participant SNFs learned of Focus on Energy through their contractors, which shows that Trade Allies can also play an important role in facility manager education and Focus on Energy promotion.

All facility managers also trusted industry-specific healthcare associations as a source of information for Focus on Energy offerings. Trusted healthcare associations include the Wisconsin Healthcare Engineering Association, American Society for Health Care Engineers, Wisconsin Assisted Living Association, and Wisconsin Health Care Association. All segments recommended that marketing materials contain key words such as "hospitals," "healthcare facilities, and "assisted living facilities."

Recommendation 1: Consider separate outreach strategies for large and small facilities (see Outcome #4 below for more on this) rather than considering all nursing facilities as the same healthcare segment. Research shows there are key differences in how nursing facilities make decisions and the best way to reach them. For example, because large facilities prefer phone calls and in-person meetings, consider reaching out at least once a year and ensure these facilities know how to contact their energy advisor. Consider how to target smaller facilities in similar way as for other small businesses or multifamily properties because they are not as receptive to in-person outreach.

Recommendation 2: Consider partnering with healthcare industry associations to market Focus on Energy offerings. Use targeted subject language such as "assisted living," "hospitals," and "healthcare facilities" when doing broader marketing efforts.

Outcome 2: Case studies are an effective way to demonstrate the financial value of program participation as well as participation requirements, which will increase the chance of project approval. Facility managers wanted to understand how energy efficiency projects would impact their bottom line and said detailed financial estimates of cost, payback period, and incentives could improve the chances of project approval. Though not all facilities required that projects meet a certain payback period, such estimates could help decision-makers view energy efficiency projects as financially compelling.

Case studies are most likely to resonate when targeted to the types of equipment and/or processes and size of the facility and they may not need to be specific to industry. In particular, SNFs wanted to see case studies for retrocommissioning and SEM improvements in nursing facilities or multifamily buildings. They agreed that case studies did not need to be limited to healthcare if the facility is of similar size and use, such as condominiums or apartments. They did not find the hospital example in the information sheets (Figure K-3 and Figure K-4) relevant.

Recommendation 1: Increase healthcare facilities' trust that the retrocommissioning and SEM offerings will benefit them financially by creating detailed case studies tailored to various building sizes and uses.

- Develop case studies for retrocommissioning, SEM, and various equipment replacements or upgrades.
- Provide details on upfront cost and incentive levels, energy savings, payback period, and non-energy benefits, such as improved comfort levels, as well as facility information like square

footage to ensure relatability to specific target customers. Consider if multifamily case studies are relevant to SNFs and the best methods to provide that information. Facility managers are also seeking more information from their peers about the processes, such as project timing, staff activities and time commitments, and required permits.

- Make case studies easy to find online and include links to case studies in email newsletters.
- Consider showing an enticing summary then requiring the reader to provide an email address to download the full case study. Email capture will allow Focus on Energy to follow up with the reader.
- Provide case studies to Trade Allies to share with customers and consider training Trade Allies how to discuss the benefit of choosing the energy-efficient option when making emergency equipment replacements or when planning future replacements.

Outcome 3: Focus on Energy can increase its appeal to healthcare facilities by promoting non-energy benefits and providing guidance for how to meet occupant safety and comfort needs. Hospitals and SNFs reported facing challenges with HVAC systems in terms of meeting occupants' safety and comfort. Commonly reported challenges included that residents varied in their preferences for thermostat settings, residents in some facilities had control of HVAC and lighting in apartment-style units, and the need to maintain even temperatures across facility areas. SNFs prioritize aesthetics and frequently upgrade facility aesthetics in common areas and resident rooms, which provides an ongoing opportunity to pair facility upgrades with energy-efficient HVAC improvements.

Recommendation 1: Educate healthcare facilities about HVAC solutions to increase resident comfort and encourage them to work these solutions into their plans for facility upgrades.

Recommendation 2: Where applicable based on energy savings opportunities, promote individual heaters and air conditioning units (such as ductless heat pumps) and individual climate controls so tenants can better control their room's temperature.

Recommendation 3: Consider targeting SNFs with smart thermostats that can be centrally programmed for efficiency and cost savings but still allow individual resident climate control.

Recommendation 4: Promote the non-energy benefits of Focus on Energy program participation and tie SEM and retrocommissioning to greater occupant comfort and safety.

Outcome 4: Focus on Energy offerings for small businesses or multifamily buildings would be a good fit for small SNFs, which need simple programs for continuous energy savings. Small SNFs reported operating like small businesses, with small staff size, streamlined approval processes, and limited staff time and resources to dedicate to energy efficiency projects. Small SNFs need more financial support than large facilities and access to technical assistance outside of SEM and retrocommissioning. They said it was difficult to obtain capital to cover upfront costs for energy projects or facility audits. They also cannot meet the requirements for the retrocommissioning or SEM offerings because their facilities and staff sizes are too small. Small SNFs think free facility audits, grants, or loans with favorable terms would help them overcome the barriers of upfront costs.

The structure and use of assisted living facilities are similar to condominiums or apartment buildings, which indicates that energy efficiency measures normally offered to multifamily buildings would also be a good fit for assisted living facilities. Some SNFs wanted the opportunity to attend educational webinars that describe solutions to the challenge of reducing energy usage in facilities where individual tenants control their own usage.

Recommendation 1: Consider extending the online energy assessment tool to small SNFs.

Recommendation 2: Consider offering free energy audits to help educate small SNFs on opportunities.

Outcome 5: Facility managers struggle to participate in programs that do not account for long planning periods. Most facility managers plan improvements on an annual basis and reported that implementation of proposed projects must usually wait until the next budget cycle. This makes it difficult for facilities to quickly implement projects that were not in the approved project plan. Six months after the customers receive their retrocommissioning audit recommendations may not be long enough for facilities to implement retrocommissioning projects (the Focus on Energy website states that customers have 180 days to implement audit recommendations in order to receive incentives).

The incentive application process is a participation deterrent for some hospitals that must make firm plans for facility upgrades and do not want projects to be contingent on the availability of incentives. Two government-owned hospitals specified that their projects are identified at a regional level and do not typically consider incentives during the design and implementation of improvements. These two hospitals would likely be considered free riders if they did apply for incentives, unless Focus on Energy can show that the incentive influenced their project plans.

Recommendation 1: For programs geared toward long-term, ongoing savings, many customers need long implementation periods to accommodate the participant's budget and planning processes. Explore extending the required time to implement retrocommissioning audit recommendations after the completion of the audit to at least one year. If customers allowed to extend their implementation timeline on an as-needed basis, educate customers on the opportunity for flexible implementation timelines.

Recommendation 2: Prioritize targeting private hospitals over federal government hospitals since private hospitals have more flexibility in their capital planning processes.

Recommendation 3: Because of their long planning processes, engage with facility managers frequently so they can incorporate energy efficiency and incentives into their plans.

Outcome 6: Hospital and SNF facility managers are receptive to SEM and retrocommissioning but need education on how savings are achieved to persuade decision-makers to commit staff resources. The retrocommissioning offering design needs an adjustment to increase participation. SEM appealed to all facility managers, with several SNFs preferring this concept over the retrocommissioning concept since there is no upfront cost. Large SNFs and most hospitals were interested in participating in SEM, but, before committing, needed more information about actual activities required of staff and how

continuous energy improvements would lead to savings. Although there are no fees for participation in SEM, staff time is a tangible operations cost and a significant burden to participation.

Facility managers liked the idea of receiving a retrocommissioning audit from an expert so they could understand options to save energy and reference the written recommendation report when seeking project approvals. However, most could not meet the current program requirements for these reasons:

- Most SNF facilities are smaller than the required minimum square footage of 50,000 square feet.
- Some SNF facilities are less than five years old.
- Hospitals do not have DDCs for lighting and said it would not be cost-effective to wire the buildings for DDCs, and no small nonparticipant SNF facility managers have DDCs.
- Facility staff cannot meet the required time commitments, though large facilities may just need to be convinced that these energy-savings offerings are worth their time and resources.

Recommendation 1: In the marketing materials, explain the purpose of the SEM and retrocommissioning offerings and provide more detail of required staff activities and time commitment.

Recommendation 2: Follow up initial marketing with SEM and retrocommissioning case studies.

Recommendation 3: If feasible, consider changing monthly SEM meetings to bimonthly or quarterly.

Recommendation 4: For customers who are interested in retrocommissioning but lack DDC controls, encourage them to explore the potential to use custom incentives for converting pneumatic controls to DDC systems to optimize their systems.

Recommendation 5: Explore the feasibility of tracking the age of SNF facilities so they can be targeted for retrocommissioning participation when they are more than four years old.

Appendix L. Additional Research for the New Homes Program

Following finalization of the CY 2019 evaluation report, Cadmus expanded the New Homes Program billing analysis to address unexpected findings that arose from the original analysis. The original billing analysis primarily compared Program homes to nonparticipant homes that were built in the same zip codes as Program homes.

Results showed that Program homes did not consume less energy than nonparticipant homes built in the same zip codes. Cadmus and stakeholders questioned whether this result was because of the close proximity of the Program and nonparticipant homes. Therefore, Cadmus expanded the CY 2019 billing analysis to include nonparticipant homes located in zip codes that had no Program activity.

This appendix provides the findings of this additional analysis.

Methods

After reporting the CY 2019 billing analysis results for the New Homes Program, Cadmus reviewed the billing data of an additional 5,921 new homes that were constructed in zip codes that did not have CY 2019 Program activity. Of these 5,921 new nonparticipant homes, 2,771 homes were included in an expanded billing analysis. Like the original billing analysis, Cadmus excluded homes from the final analysis if any of the following:

- Home square footage was not available
- It was a commercial building
- It was unoccupied
- It was not a new home (for example, it was an addition to an existing home)

Cadmus added 1,709 nonparticipant homes to the analysis of electric savings and 1,747 nonparticipant homes to the analysis of gas savings.

In this appendix, the new nonparticipant homes located outside of Program home zip codes are referred to as “outside” homes.

Results

Table L-1 shows how the additional “outside” homes impact the overall electric net adjustment for the New Homes Program. The overall net adjustment increases by approximately 19% because the electric energy use intensity (kWh/SQFT) of the additional nonparticipant homes increases by 2%. However, despite this increase in net adjustment, the overall net adjustment remains negative.

Table L-1. Change in Overall Electric Net Adjustment with Additional Nonparticipant Homes

	Nonparticipant Homes		Program Homes		Net Adjustment
	kWh/ SQFT	SQFT	kWh/ SQFT	SQFT	
Original Results (as reported in CY 2019 Evaluation Report)	3.90	2,435	4.12	2,296	-67%
Updated Results (including "outside" homes and nonparticipant homes from the CY 2019 billing analysis)	3.97	2,361			-46%
Percent Difference	2%	-3%			19%

Table L-2 shows how including the "outside" nonparticipant homes affect the electric net adjustment for Program homes at each Program tier. Net adjustments improved for each tier; however, the net adjustments remain negative for the low and intermediate savings tiers. The net adjustment for homes in the high savings tier increases from 14% to 38%. These results maintain the original finding that the overall negative electric net adjustment is primarily driven by Program homes in the two lower tiers. Program homes consume, on average, more electricity per square foot than nonparticipant homes, even with the additional "outside" nonparticipant homes.

Table L-2. Changes in Electric Net Adjustment for Each Program Tier

Program Tier	Nonparticipant Homes	
	Original Results (CY 2019 Report)	New Results (including "outside" homes and nonparticipant homes from the CY 2019 billing analysis)
Low Savings Tier Homes (25%-29.9% Better than Code)	-181%	-162%
Intermediate Savings Tier Homes (30%-34.9% Better than Code)	-48%	-27%
High Savings Tier Homes (35%-99% Better than Code)	14%	38%

Table L-3 shows how including new "outside" nonparticipant homes in zip codes with no Program activity affects the overall gas net adjustment for the New Homes Program. The overall net adjustment increases by approximately 2% because the gas use intensity (therms/SQFT) increases by 1% overall when the additional nonparticipant homes are considered in the analysis.

Table L-3. Change in Overall Gas Net Adjustment with Additional Homes

	Nonparticipant Homes		Program Homes		Net Adjustment
	Therms/ SQFT	SQFT	Therms/ SQFT	SQFT	
Original Results (as reported in CY 2019 Evaluation Report)	0.395	2,364	0.391	2,291	5%
Updated Results (including "outside" homes and nonparticipant homes from the CY 2019 billing analysis)	0.397	2,296			7%
Percent Difference	1%	-3%			2%

Table L-4 shows how including "outside" nonparticipant homes affects the gas net adjustment for Program homes at each tier. The net adjustment increases by approximately 2% to 3% for homes in each

tier. However, the net adjustment for homes in the low savings tier remains negative, indicating that nonparticipant homes continue to consume less gas per square footage than Program homes in this tier, even when the "outside" nonparticipant homes are considered.

Table L-4. Changes in Gas Net Adjustment for Each Program Tier

Program Tier	Nonparticipant Homes	
	Original Results (CY 2019 Report)	New Results (including "outside" homes and nonparticipant homes from the CY 2019 billing analysis)
Low Savings Tier Homes (25%-29.9% Better than Code)	-23%	-21%
Intermediate Savings Tier Homes (30%-34.9% Better than Code)	11%	13%
High Savings Tier Homes (35%-99% Better than Code)	23%	26%

Cadmus also considered how the net adjustment would change if energy use intensity for Program homes was compared with energy use intensity of the nonparticipant homes in zip codes *with* and *without* Program activity. Table L-5 shows that when nonparticipant homes are grouped by zip code, the electric net adjustment increases from -67% to 38%. This change occurs because nonparticipant homes in zip codes with Program homes consume approximately 8% less electricity per square foot than nonparticipant homes in zip codes without Program homes.

Nonparticipant homes in zip codes with Program homes are also approximately 10% larger than nonparticipant homes in zip codes without Program homes.

Table L-5. Electric Consumption Comparison by Zip Code Group

	Nonparticipant Homes		Program Homes		Net Adjustment
	kWh/ SQFT	SQFT	kWh/ SQFT	SQFT	
Program Home Zip Codes	3.90	2,418	4.12	2,294	-67%
Nonparticipant Home Zip Codes	4.25	2,200			38%
Percent Difference	8%	-10%			105%

Cadmus also analyzed gas net adjustment in both zip code groups. As shown in Table L-6, a comparison of nonparticipant homes in zip codes with and without Program homes increases the gas net adjustment from 4% to 22%. This occurs because nonparticipant homes in zip codes with Program homes consume approximately 4% less gas per square foot than nonparticipant homes in zip codes without Program homes.

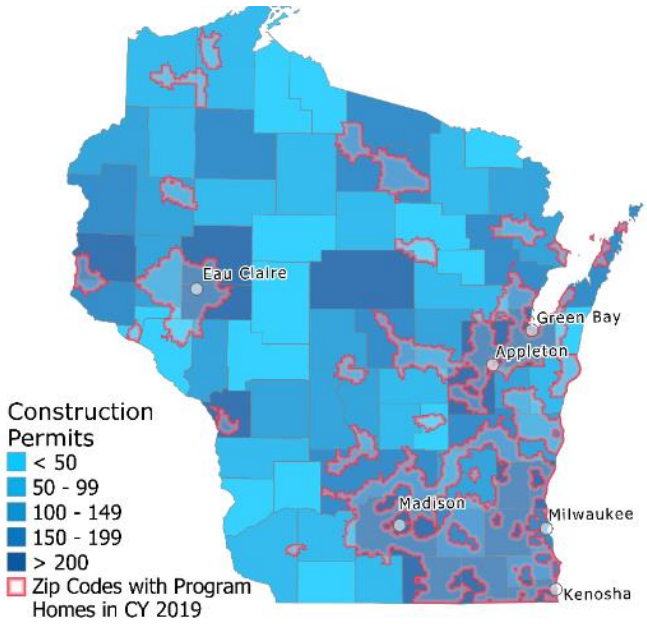
Nonparticipant homes in zip codes with Program homes are also approximately 21% larger than nonparticipant homes in zip codes without Program homes.

Table L-6. Gas Consumption Comparison by Zip Code Group

	Nonparticipant Homes		Program Homes		Net Adjustment
	Therms/ SQFT	SQFT	Therms/ SQFT	SQFT	
Program Home Zip Codes	0.395	2,373	0.391	2,291	4%
Nonparticipant Home Zip Codes	0.411	1,960			22%
Percent Difference	4%	-21%			18%

Figure L-1 shows zip codes with CY 2019 Program homes (outlined in red) and residential construction permits by county, with darker blue shading indicating more permit activity. CY 2019 Program homes are primarily clustered in urban areas with high construction activity.

Figure L-1. CY 2019 Program Home Activity and Significant Construction Activity



Source: U.S. Census Bureau

Summary of Findings: Updated Billing Data Analysis

The inclusion of additional new "outside" nonparticipant homes that are not located in zip codes with Program homes provides support for the following findings:

- The energy consumption and size of nonparticipant homes differs according to market area. Nonparticipant homes located in zip codes without Program homes consume more energy per square foot and are smaller than nonparticipant homes in zip codes with Program homes.
- Program homes are primarily located in urban markets with high construction volume.
- The differentiation of nonparticipant homes by market area appears to support—but does not prove—the market effects theory of change reported in the CY 2019 New Homes Program chapter. This theory of change found that the New Homes Program can influence the construction practices of nonparticipant homes, primarily through contractors bringing building practices learned while constructing Program homes to the nonparticipant homes they work on.

To further investigate the market effects theory of change, Cadmus will continue research to monitor the Wisconsin residential new homes market. Most notably, Cadmus will move forward the Delphi panel that will determine the Program's market effects; the panel will now convene in 2020, instead of 2022. Results from the panel will be included in the CY 2020 evaluation report.