Focus on Energy
Calendar Year 2017 Evaluation Report

Appendices

May 22, 2018

Public Service Commission of Wisconsin
North Tower, 6th Floor
Hill Farms State Office Building
4822 Madison Yards Way
Madison, WI 53705-9100

The Cadmus Group LLC
An Employee-Owned Company • www.cadmusgroup.com

This page left blank.

CADMUS

Prepared by:
Cadmus
Apex Analytics
St. Norbert College Strategic Research Institute

Table of Contents

Figures

Tables

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

A.1. Program Participants

- 2017 Residential: 113,478
  - Upstream lighting participation: 873,660
- 2017 Nonresidential: 5,133
- 2017 Pilots: 155
- 2017 Rural: 3
- 2017 Total Participants: 118,769

A.2. Total Electric and Natural Gas Energy Usage (2016)

- Electric Sales to Wisconsin Retail Customers megawatt hours (MWh): 69,736,338[1]
- Wisconsin Aggregated Electric Utilities Noncoincident Peak Demand megawatts (MW): 16,480
- 2017 Natural Gas Consumption (therms): 3,855,438[2]

A.3. Total Verified Gross Lifecycle Savings

- 2017 Energy Savings (MWh): 11,709,433
- 2017 Demand Reduction (MW): 97
- 2017 Natural Gas Savings (therms): 292,878,320

A.4. Total Verified Net Annual Savings

- 2017 Energy Savings (MWh): 475,245
- 2017 Demand Reduction (MW): 65
- 2017 Natural Gas Savings (therms): 15,112,376

---

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

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

A.5. Population Numbers (2016)

- Statewide Census Population: 5,778,708[3]
- Wisconsin Residential Electric Accounts: 2,662,284[4]
- Wisconsin Residential Gas Accounts: 1,738,858[5]
- Wisconsin Nonresidential Electric Accounts: 354,862
- Wisconsin Nonresidential Gas Accounts: 178,083

Table A-1. CY 2017 Costs, Benefits, and Modified TRC Test Results by Sector

	Residential	Nonresidential	Total
Administrative Costs	$4,505,599	$4,336,290	$8,841,889
Delivery Costs	$10,274,774	$17,706,879	$27,981,653
Incremental Measure Costs	$52,340,833	$97,863,384	$150,204,217
Total Non-Incentive Costs	**$67,121,206**	**$119,906,553**	**$187,027,759**
Electric Benefits	$147,114,241	$360,001,717	$507,115,958
Gas Benefits	$34,874,492	$119,170,577	$154,045,069
Emissions Benefits	$27,784,615	$72,107,782	$99,892,397
Total TRC Benefits	**$209,773,348**	**$551,280,076**	**$761,053,424**
TRC Benefits Minus Costs	**$142,652,142**	**$431,373,523**	**$574,025,665**
TRC Ratio[1]	**3.13**	**4.60**	**4.07**

[1]The TRC 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 and Acronyms

Table B-1. 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 influence of the program, and the savings would not have been achieved in the program's absence.
Avoided Costs	Costs to the utility avoided by the implementation of an energy efficiency measure, program, or practice.
Administrative Cost	Administrative costs are the costs not directly associated with a specific program activity but which are 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 implementation of the subject measure or project. The conditions can be either as found prior to the energy efficiency retrofit, meeting 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 the implementation of energy efficiency measures, programs, practices, or emissions reductions.
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	Indicator of the relative performance or economic attractiveness associated with implementation of energy efficiency measures, programs, practices, or emissions reductions.
Custom Savings	Savings for nonprescriptive measures that do not meet criteria for deemed savings, as calculated by a Program Administrator or Program Implementer at the time of the project's 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 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 and directly offsets the first cost of the equipment and reduces 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 estimates an evaluator reports after a completed energy-impact evaluation.

Term	Definition
Freeriders	Participants who took part in an efficiency program but who 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 and/or demand resulting from program-related actions taken by participants in an efficiency program.
Interactive Effects	The influence in energy use between one technology application and 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.
Lifetime Savings	Energy savings—expressed as verified gross or verified net—produced as a result of measures installed in the current program cycle and in the previous program cycle(s), provided the reporting period falls within the measure's useful life. Savings incorporate 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 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 and/or distributors. Programs are designed to encourage the targeted audience to stock, promote, and sell more energy-efficient products.
Net Savings	Savings "net" of what would have occurred in the program's absence (observed impacts attributable to the program). Net savings is typically calculated by applying the net-to-gross ratio to the gross verified 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 are derived from energy-efficient measures in addition to energy savings.
Nonparticipant Spillover	The effect of general consumers who are eligible but did not participate in an efficiency program but who adopted more energy-saving products or practices because of program influence without program assistance.
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 that 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).

Term	Definition
Resource Acquisition Program	An efficiency program designed to directly achieve energy and/or demand savings and avoided emissions.
Standard Error	A measure of a data sample’s variability (i.e., the distance of a typical data point from the sample’s 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 that provides incentives to manufacturers and is designed to encourage manufacturers to promote and sell more energy-efficient products.
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 of changes in energy consumption and/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. For verified net savings, the Evaluation Team makes adjustments for outside influences, such as freeridership and spillover.

Table B-2. List of Acronyms

Acronym	Term
ACS	American Community Survey
AFUE	Annual fuel utilization efficiency
AIC	Akaike Information Criteria
APS	Advanced power strip
AVERT	AVoided Emissions and geneRation Tool
CALP	Common Area Lighting Package
CDD	Cooling degree day
CF	Coincidence factor
CFL	Compact fluorescent lamp
CREED	Consortium for Retail Energy Efficiency Data
CSA	Conditional savings analysis
CSS	Cross-sector sales
CY	Calendar year
DIO	Days incentive outstanding
DLC	DesignLights Consortium
DNAC	Difference in normalized annual consumption
ECM	Electronically commutated motor
EER	Energy efficiency rating

Acronym	Term
EIA	U.S. Energy Information Administration
EISA	Energy Independence and Security Act of 2007
EM&V	Evaluation, measurement, and verification
EPA	U.S. Environmental Protection Agency
EUL	Effective useful life
EWG	Energy Working Group
HDD	Heating degree day
HOU	Hours of use
HVAC	Heating, ventilation, and air conditioning
IAC	UW-Milwaukee Industrial Assessment Center
ILLC	Integrated Luminaire Level Controls
ISP	Internet service provider
ISR	In-service rate
KAM	Key account manager
KBtu/h	Thousand British thermal units per hour
KPI	Key performance indicator
kW	Kilowatt
kWh	Kilowatt hour
LED	Light-emitting diode
LMP	Locational marginal pricing
lm	Lumen
LPD	Lighting power density
MBps	Megabytes per second
MGE	Madison Gas and Electric
MISO	Midcontinent Independent Transmission System Operator, Inc.
MMBtu	Million British thermal units
MThm	Megatherm
MWh	Megawatt hour
NAC	Normalized annual consumption
NCP	National Consumer Panel
NCTA	The Internet and Television Association
NLC	Networked Lighting Controls
NOAA	National Oceanographic and Atmospheric Administration
NPS	Net promoter score
NRA	National rebate administrator
NTG	Net-to-gross
OLS	Ordinary least squares
POS	Point-of-sale
PPS	Probability Proportional to Size
POSTNAC	Post-installation weather-normalized
PRISM	PRInceton Scorekeeping Method

Acronym	Term
PRENAC	Pre-installation weather-normalized
PSC	Public Service Commission of Wisconsin
PSI	Pounds per square inch
Psig	Pounds per square inch gauge
PV	Photovoltaic
QA/QC	Quality assurance/quality control
RIM	Ratepayer impact measure
RPP	Retail Products Platform
SaaS	Software-as-a-service
SEER	Seasonal energy efficiency rating
SEERA	Statewide Energy Efficiency and Renewable Administration
SEM	Strategic energy management
SMI	State median income
SMP	Standard market practice
SPECTRUM	Statewide Program for Energy Customer Tracking, Resource Utilization, and Data Management
TMY	Typical meteorological year
TRC	Total resource cost (test)
TRM	Technical reference manual
UAT	Utility administrator test
UCT	Utility cost test
UEC	Unit energy consumption
UMP	Uniform Methods Project
VFD	Variable-frequency drive (also known as variable-speed drive, or VSD)
WHF	Waste heat factor
WSTA	Wisconsin State Telecommunications Association

Appendix C. CY 2017 Program Descriptions

This section provides detailed descriptions of Focus on Energy residential and nonresidential programs included in the CY 2017 evaluation.

Descriptions of Residential Programs

During the CY 2017 evaluation, the Evaluation Team assessed the six residential programs and five residential pilot programs described below. Of the residential pilot programs, two operated as a subcomponent of another residential program and two operated independently.

Appliance Recycling Program

Program Dates: The current Appliance Recycling Program was launched with a new Program Implementer in January 2017 after Focus on Energy suspended it in November 2015 following complications with the previous Program Implementer.

Program Purpose: The Appliance Recycling Program expedites the retirement of old, inefficient refrigerators and freezers to reduce peak demand and energy consumption. The Program offers customers free pick-up and incentives for recycling old refrigerators and freezers.

Target Audience: The Program targets customers who have extra refrigerators and freezers. Because customers must own their appliances in order to participate, program participants tend to be single-family homeowners.

Program Implementer: ARCA

Process and Associated Measures: The Program offers customers free pick-up and recycling of old appliances, with a $35 incentive for each refrigerator or freezer recycled (limited to two per address, every three years). To be eligible for pick-up through the Program, customers' refrigerators or freezers must be in working condition and between 10 and 30 cubic feet in size, in addition to other logistical requirements. The Program Implementer arranges for these appliances to be dismantled and recycled in an environmentally responsible manner.

The Program Implementer oversees all aspects of Program delivery including appliance pick-up and recycling, producing and distributing marketing materials, managing the call center and online scheduler, and data reporting. The Program Implementer also purchases media for advertising, though sometimes combines advertising budgets with the Program Administrator to take advantage of lower bulk rates. The Program Administrator maintains the Focus on Energy website and manages outreach through social media, with content provided by the Program Implementer.

Home Performance with ENERGY STAR Program

Program Dates: The Home Performance with ENERGY STAR Program launched January 1, 2006.
In CY 2017, the Program operated as a single program, offering three paths: the whole home path, the heating and cooling path, and the renewable energy path. The whole home and heating and cooling

paths offer two tiers of incentive levels—Tier 1 (the standard track) and Tier 2 (the income-qualified track).

Program Purpose: The Program encourages comprehensive energy efficiency retrofits in utility customers' homes. Focus on Energy designed the Program to address uncertainty about home improvements, their possible costs, and the potential for energy savings by providing information and recommendations specific to each participant's home.

Target Audience: Single-family homes, defined as all homes with three or fewer units (all paths), small businesses (renewables path), and low-income customers (income-qualified tracks)

Program Implementer: CLEAResult

Process and Associated Measures: The Evaluation Team interviewed Program actors, reviewed the tracking database, analyzed ongoing participant satisfaction surveys, fielded and analyzed Trade Ally surveys, conducted engineering reviews, visited sites for verification, calibrated modeling software, and analyzed gas and electric customer billing data. Table C-1 through Table C-3 list the measures offered through the three tracks.

Table C-1. CY 2017 Home Performance with ENERGY STAR Program Eligibility and Incentives: Whole Home Measures

Program Features	Standard Track	Income-Qualified Track
Household Income Qualification	None	80% or less of state median income
Assessment Type	Comprehensive (must include blower door and combustion safety tests)	
Assessment Cost	Market rate (average cost $200-$400)[1]	$50 copay (Trade Allies reimbursed $150 by Program)
Eligible Major Measures	Air sealing, attic insulation, exterior and interior wall insulation, sill box insulation, and HVAC equipment	
Incentives	10% to 19% reduced energy use: $850 20% to 29% reduced energy use: $1,250 30%+ reduced energy use: $2,000	10% to 19% reduced energy use: $1,000 20% to 29% reduced energy use: $1,500 30%+ reduced energy use: $2,250
	$250 bonus for installing both whole home and HVAC measures	No bonus

[1] Standard track participants residing in rural zip codes received coupons for $300 off the cost of an assessment.

Table C-2. CY 2017 Home Performance with ENERGY STAR Program
Eligibility and Incentives: Heating and Cooling Measures

Eligibility	Standard Track	Income-Qualified Track
Household Income Qualification	None[1]	80% or less of State Median Income
Measures	**Incentive**	
Propane Multistage Furnace with ECM, 90%+ AFUE	$100	$300
Natural Gas Furnace, 95%+ AFUE	n/a	$350[2]
Natural Gas Multistage Furnace with ECM, 95%+ AFUE	$125[2]	$525[2]
Natural Gas Multistage Furnace with ECM, 95%+ AFUE installed with a 16+ SEER air conditioner	$250[2]	$750[2]
Air Source Heat Pump 16+ SEER and 8.4+ HSPF (propane, oil or electric furnace only; cannot be a mini-split or ductless system)	$300[2]	
ECM Replacement (must replace existing PSC motor)	$100	
Natural Gas Home Heating Boiler, 95%+ AFUE	$400[2]	$550[2]
Indirect Water Heater (installed at same time as qualified boiler)	$100	$150
Natural Gas Combination Boiler, 95%+ AFUE	$500[2]	$675[2]
Heat Pump Water Heater (ENERGY STAR-qualified)	$300	
Ductless/Mini-Split Heat Pump, 18+ SEER and 9.0+ HSPF (only for homes heated solely with electric resistance heat)	$500	
Smart Thermostat Standalone	$75	

[1] Standard track participants can earn a $250 bonus for installing HVAC and whole home measures.

[2] Natural gas furnaces, natural gas boilers, and air source heat pumps installed with smart thermostats are eligible for bonus $50 incentive in addition to the individual measure incentives.

Table C-3. CY 2017 Home Performance with ENERGY STAR Program
Eligibility and Incentives: Renewable Energy Measures

Measure	Residential	Small Business
Geothermal Heat Pump	$650	$650
Solar Electric (PV) System	12% of total cost ($2,000 maximum)	12% of total cost ($4,000 maximum)

[1] $300 minimum incentive, $2,400 maximum incentive.

Rural Broadband Offering: In CY 2017, the Rural Broadband Offering was added to the whole home path and is intended to encourage participation in hard-to-reach areas by providing rural customers opportunities to pursue building shell improvements. The offering distributes coupons for $300 off home energy assessments to customers living in rural zip codes who completed self-assessments through the Direct Mail Home Energy Assessment Pilot. The offering relies on the Pilot to reduce customer acquisition costs.

Low-e Storm Windows Pilot

Pilot Dates: The Low-e Storm Windows Pilot launched in September 2017.

Pilot Purpose: The Pilot encourages the purchase of energy-saving low-e storm windows by providing instant point-of-sale rebates to customers and spiffs to participating distributors.

Target Audience: The pilot targets residential, small commercial, and multifamily customers.

Pilot Implementer: D+R

Process and Associated Measures: The Low-e Storm Windows Pilot is a retail-based promotion that provides midstream incentives and price markdowns for low-e storm windows. The Pilot pays a spiff to each participating distributor, and customers receive an instant discount at the point of sale. The Pilot runs in the early fall during the prime season for storm window sales.

Multifamily Energy Savings Program, Multifamily New Construction Program, and Multifamily Direct Install Program

Program Dates: These programs launched in 2001 as the Apartment and Condominium Efficiency Services Program. In 2012, the programs were revised and renamed to their current titles and offerings. At the end of CY 2017, Focus on Energy discontinued the Multifamily Direct Install Program, replacing it with tenant-or-condominium-installed offerings available through the Simple Energy Efficiency Program. In CY 2017, Focus on Energy launched a Multifamily New Construction Program, offering prescriptive incentives for projects or measures that do not qualify for the Design Assistance Program.

Program Purpose: The Focus on Energy Multifamily Energy Savings, Multifamily New Construction, and Multifamily Direct Install Programs (collectively called the Multifamily Programs) provide education and energy-saving opportunities to multifamily buildings and condominiums of four or more units. The Programs offer incentives for energy-efficient upgrades and no-cost, direct install measures.

Target Audience: The Multifamily Programs target condominium and apartment associations and multifamily building owners and managers.

Program Implementer: Franklin Energy Services, LLC

Process and Associated Measures: The Multifamily Energy Savings Program offers two types of rewards: prescriptive rebates for eligible measures, including an emphasis on discounts for common area lighting, and custom incentives for performance-based projects. The Multifamily New Construction Program offers prescriptive incentives for multifamily new construction projects or measures that do not qualify for the Design Assistance Program, such as projects or measures that arise after completing the building design phase or after the funds from the Design Assistance Program have been exhausted. The Multifamily Direct Install Program offers free, direct installation of LEDs, specialty CFLs, pipe insulation, pre-rinse sprayers, faucet aerators, and showerheads as well as water heater temperature setback services and also offers no-cost vending misers and LED retrofits for exit signs in common areas.

The Program Implementer markets the Multifamily Programs through regionally based Energy Advisors to building owners and managers and to the Trade Allies working with these customers. The Program Implementer also processes customer applications, manages Program data, and educates Trade Allies to help cost-effectively promote the Multifamily Programs.

New Homes Program

Program Dates: The New Homes Program originated in 2000 and continued until 2011 under the name Wisconsin ENERGY STAR Homes. During CY 2011 and CY 2012, Focus on Energy modified the Program design and launched the current version as the New Homes Program in CY 2012.

In CY 2017, the New Homes Program offered builders incentives for constructing homes that are at least 25% more efficient than Wisconsin's Uniform Dwelling Code. Builders could achieve an incentive of $400 for gas and electric homes and $150 for electric-only homes with no gas heat.

Because a billing analysis of Program homes rebated from 2012-2014, published in May 2016, found that most builders in Wisconsin are now constructing new homes to efficiency levels above the Wisconsin Uniform Dwelling Code, Focus on Energy conducted a Baseline and Market Characterization Study. The study, conducted by Seventhwave, was intended to establish a market baseline in Wisconsin by obtaining data about the efficiency levels of homes built outside of the Program. The study also informed the redesign of the New Homes Program for CY 2018.

Program Purpose: The Program provides information, implementation assistance, and incentives for builders of new, single-family (one- to three-unit) homes in Wisconsin that meet energy efficiency requirements.

Target Audience: The Program targets builders of new, single-family homes.

Program Implementer: Wisconsin Energy Conservation Corporation (WECC)

Process and Associated Measures: The New Homes Program offers builders graduated incentives for constructing homes that are at least 25% more efficient than Wisconsin's Uniform Dwelling Code. In CY 2017, the Program offered one incentive level for homes built by customers who received electric service and one incentive level for homes built by customers who received electric and gas service. Table C-4 shows the incentive levels for each type of home available in CY 2017.

Table C-4. CY 2017 New Homes Program Incentive Levels

Certification Level	Incentive
CY 2017 Electric and Gas Homes	
25% – 100% better than code	$400
25% – 100% better than code (no gas heat)	$150

Retailer Lighting and Appliance Program

Program Dates: The Retailer Lighting and Appliance Program launched January 1, 2006.

Program Purpose: The Program is a retail-based promotion that provides upstream incentives and price markdowns for efficient lighting and customer-directed incentives for qualified appliances purchased through participating retailers.

Target Audience: The Program targets residential customers. The lighting component is delivered as an upstream program and therefore eligible products may be purchased by customers in other sectors and by participants who are not customers of participating Focus on Energy utilities.

The Retail Products Platform (RPP) component targets retailers by delivering incentives that encourage them to stock, promote, and ultimately sell more energy-efficient products than they otherwise would absent the pilot.

Program Implementer: ICF International

Process and Associated Measures: For the lighting component, the Program partners with national, regional, and local retail stores to discount ENERGY STAR®-qualified lighting technologies. Markdowns vary by products and stores and change throughout the year. The Program increases brand awareness through Focus on Energy signage on marked-down products and through events at participating stores. Starting in CY 2017, the program discontinued CFLs and incentivized LEDs exclusively. In CY 2017, the Program also expanded offerings beyond light bulbs by introducing smart thermostat, advanced power strips (CEE Tier 1), and connected lighting measures.

Retail Products Platform: In April of 2016, the Retailer Lighting and Appliance Program launched a market transformation appliance pilot named the Retail Products Platform (RPP). Its purpose is to transform the market such that the purchase of efficient appliances becomes standard practice. The RPP delivers incentives directly to participating retailers for qualified product sales to encourage them to sell more efficient appliances through product placement and promotion.

The RPP partners with ENERGY STAR, the U.S. Environmental Protection Agency (EPA), and national retailers. The Program Administrator and Program Implementer work with these retailers to offer certain products to customers. Table C-5 lists the products offered in CY 2016, all of which were at or above ENERGY STAR specifications

Table C-5. CY 2017 Retail Products Platform Qualified Products and Specifications

Qualifying Product	Tier	Specification
Soundbar	Basic	ENERGY STAR v3 +15%
	Advanced	ENERGY STAR v3 +50%
Air Cleaner	Basic	ENERGY STAR v1.2+30%
	Advanced	ENERGY STAR v1.2+50%
Freezer	Basic	ENERGY STAR v5
	Advanced	ENERGY STAR v5 +5%
Electric Dryer	Basic	ENERGY STAR v1
	Advanced	ENERGY STAR Most Efficient 2017
Room AC	Basic	ENERGY STAR v4
	Advanced	ENERGY STAR V4 + connectivity
Clothes Washer	Basic	ENERGY STAR Most Efficient 2017
	Advanced	ENERGY STAR Most Efficient 2017 +5%

Qualifying Product	Tier	Specification
Refrigerator	Basic	ENERGY STAR v5
	Advanced	ENERGY STAR Most Efficient 2017

Simple Energy Efficiency Program

Program Dates: The Simple Energy Efficiency Program encourages participating customers to install no-cost energy efficiency measures. Originally launched as the Express Energy Efficiency Program in CY 2012, the Program was rebranded as the Simple Energy Efficiency Program on January 1, 2016, and changed to a mail-by-request package delivery structure.

Program Purpose: The Simple Energy Efficiency Program mails no-cost packs containing various combinations and quantities of LEDs, faucet aerators, showerheads, smart strips, and other energy-saving measures directly to residential customers.

Target Audience: The Program targets single-family homes and multifamily homes with one to three units.

Program Implementer: Energy Federation, Inc. (EFI)

Process and Associated Measures: The Program offered different selections of energy-saving measures in the first and second halves of the year. Table C-6 and Table C-7 lists the items in each of the various packs offered to customers who participated in the Program in CY 2017.

Table C-6. CY 2017 Simple Energy Efficiency Program Packs – First Half (January – June)

Measure	Quantity per Pack					
	Focus	Smart Strip	Showerhead	Flood Light	Decorative Light	Globe Light
LED A19	3	2	3			
LED BR30 Reflector				4		
LED G25 Globe						3
LED Candelabra					3	
Showerhead	1		1*		1	1
Kitchen Aerator	1	1	1		1	1
Bathroom Aerator	1	1	1		1	1
Advanced Power Strip		1				

*Hand-wand showerhead

Table C-7. CY 2017 Simple Energy Efficiency Program Packs – Second Half (July – December)

Measure	Quantity per Pack					
	Light Bulb	Fixed Showerhead	Hand-Wand Showerhead	Flood Light	Decorative	Focus
LED A19 (800 lumens)	4	2			2	3
LED A19 (1,100 lumens)	2					
LED BR30 Reflector				6		
LED G25 Globe		3	3			
LED Candelabra					6	
Pipe Wrap (15 ft. roll)	1	1	1			1
Pipe Tape		1	1			
Showerhead		1	1*			
Bathroom Faucet Aerator		2	2			
Hot H_2O Temp Card		1	1			1
Advanced Power Strip						1

*Hand-wand showerhead

Connected Devices Kits Program: At the direction of the Public Service Commission (PSC) of Wisconsin, Focus on Energy added the Connected Devices Kits Program in CY 2017, which operates similar to but independent of the Simple Energy Efficiency Program.[6] This offers five packs (three free and two for $170) with measures such as smart thermostats, smart power strips, and LED light bulbs and is available to customers in designated rural zip codes with access to sufficient internet speed. Table C-8 lists the items in each pack.

Table C-8. CY 2017 Rural Broadband Kits Program Packs

Measure	Pack 1	Pack 2	Pack 3	Pack 4	Pack 5
Co-pay	**$0**	**$0**	**$0**	**$120**	**$120**
Embertec Smart Strip	✓				
Philips Hue LEDs	✓				
Emerson Wi-Fi Thermostat		✓			
Nest E Smart Thermostat			✓		
Nest Smart Thermostat				✓	
Ecobee Smart Thermostat					✓

6 Focus on Energy uses the term "pack" to distinguish the Simple Energy Efficiency Program from other Wisconsin utility programs that offer energy-saving kits. Furthermore, Focus on Energy uses the term "kits" to distinguish the Connected Devices Kits Program from the Simple Energy Efficiency Program.

Seasonal Savings Pilot

Pilot Dates: The Seasonal Savings Pilot operated in CY 2016 and CY 2017.

Pilot Purpose: The Pilot uses an algorithm to make small, energy-saving adjustments to thermostat setpoints during summer and/or winter months in qualifying homes with Nest thermostats.

Target Audience: The Pilot targets residential customers who own Nest thermostats.

Pilot Implementer: Nest Labs

Process and Associated Measures: Nest algorithms use customer temperature setpoints and schedules, along with additional information gathered from Nest thermostats, to determine eligibility for the Seasonal Savings Pilot. Qualifying participants are given the ability to opt in to the Pilot through their Nest thermostat. An algorithm is then applied remotely over a period of three weeks and adjusts temperature settings slightly during the winter and summer seasons.

Direct-Mail Home Energy Assessment Pilot

Program Dates: The Direct-Mail Home Energy Assessment Pilot operated CY 2016 through CY 2017.

Program Purpose: In 2016, the PSC determined that rural customers had historically been underserved by Focus programs and allocated funding to a package of programs to enhance service in 2017 and 2018. Focus launched the Direct-Mail Home Energy Assessment (DHEA) Program as one component of the rural package, designed to educate rural homeowners and increase their participation in Focus on Energy's residential program offerings.

Target Audience: Rural residential customers in Wisconsin (rural is designated by the customer's zip code).

Program Implementer: EnergySavvy

Process and Associated Measures: The DHEA Pilot is designed to reach rural customer by mailing a home Energy Savings Survey, which is designed to assess a home's energy efficiency. In CY 2017, the Program Implementer sent 100,000 surveys (in batches of 50,000) to designated rural customers and, upon receipt of a completed survey, sent the customer a personalized home energy savings report. The report provides information about the home's energy consumption and recommendations to improve the home's efficiency using Focus on Energy residential program offerings.

Descriptions of Nonresidential Programs

The Evaluation Team assessed eight nonresidential programs and one nonresidential pilot program during the CY 2017 evaluation. Of the two nonresidential pilot programs, one operated as a subcomponent of another nonresidential program and one operated independently.

Agriculture, Schools, and Government Program

Program Dates: The Agriculture, Schools and Government Program launched January 1, 2015.

Program Purpose: The Program offers prescriptive and custom incentives to customers installing energy-efficient equipment at agricultural, educational, and institutional facilities.

Target Audience: The Program targets all customers within the following groups, with the exception of individual customers that qualify as large energy users [average monthly demand exceeding 1,000 kW]:

- Agriculture producers (producers of grain, livestock, milk, poultry, fruits, vegetables, bees, honey, fish, and shellfish) and the target audience includes green houses, grain elevators, and feed mills
- Educational entities (K-12 schools, two-year University of Wisconsin colleges, and four-year private colleges)
- Government entities (counties, cities, towns, villages, tribes, and state and federal agencies)
- Municipal wastewater treatment facilities

Program Implementer: CESA 10

Process and Associated Measures: In addition to the measures and incentives offered through other Focus on Energy nonresidential programs, the Program offers specialized incentives targeted to agricultural producers, educational facilities, and public buildings. The Program relies on dedicated Energy Advisors, assigned to different regions of the state, to work with customers and Trade Allies.

Business Incentive Program

Program Dates: The Business Incentive Program launched April 1, 2012. In CY 2017, Focus on Energy discontinued the Chain Stores and Franchises Program, and its projects are now eligible for incentives from the Business Incentive Program.

Program Purpose: The Program encourages energy efficiency by offering incentives for prescriptive and custom measures to nonresidential customers with electricity demand of 1,000 kW or less.

Target Audience: The Program targets nonresidential segments, including commercial spaces (e.g., hotels and independent retailers, food sales, and food service establishments) and small- to medium-sized industrial facilities. It includes customers who are not eligible for the Agriculture, Schools, and Government Program or Large Energy Users Program.

Program Implementer: Franklin Energy Services, LLC

Process and Associated Measures: The Program Implementer and Trade Allies recruit eligible customers, identify energy-saving opportunities, and lead customers through the incentive application process. Many technologies qualify for prescriptive incentives, including lighting, HVAC, commercial refrigeration, and compressed air. Customers may also receive custom incentives for more complex energy efficiency projects.

Design Assistance Program

Program Dates: The Design Assistance Program launched January 1, 2013.

Program Purpose: The Program provides design professionals, builders, developers, and building owners energy-saving options for the design of new buildings. The Program also offers design teams and building owners incentives that can be used to reduce the upfront cost of high-efficiency measures that exceed Wisconsin energy code requirements.

Target Audience: This program works with new construction and major renovation projects for buildings over 5,000 square feet. Possible building types include all commercial and industrial buildings as well as multifamily buildings with four or more units.

Program Implementer: The Weidt Group

Process and Associated Measures: Once accepted into the Program, a project receives a customized energy simulation modeling analysis to assist with making energy efficiency decisions along with information regarding possible owner incentives. Upon completion of the analysis, the Program provides incentives to the design team. After the building has been completed, Focus on Energy verifies the implementation of the energy efficiency measures then gives the building owner financial incentives.

Measures typically considered during the whole-building energy analysis include these:

- Improved wall assembly
- Improved roof assembly
- Improved window/glazing assembly
- HVAC system improvements
- Fan and pump improvements
- Automated daylighting controls
- Other lighting controls
- Lighting design to reduce lighting power densities
- Conditioning of outside air strategies
- Service water heating improvements

Large Energy Users Program

Program Dates: The Large Energy Users Program launched April 1, 2012.

Program Purpose: The Program encourages the installation of energy-efficient technologies by offering incentives and services for large industrial, commercial, and institutional customers. These offerings include financial incentives for prescriptive and custom energy-efficient technologies, no-cost access to energy experts, training and tools to identify and evaluate energy efficiency opportunities, resources to develop and benchmark energy management practices, and engineering reviews of proposed projects. Many technologies, including lighting, HVAC, commercial refrigeration, variable frequency drives, and food service equipment, may qualify for prescriptive incentives.

Target Audience: The Program targets large industrial, commercial, and institutional business customers of participating Wisconsin electric and natural gas utilities; participants must have had a system-wide energy utility bill of at least $60,000 in one month of the preceding year and energy use at one contiguous facility meeting one or the other of the following criteria:

- Over 1,000 kW of electric demand in a single month in the past year
- Over 100,000 therms of natural gas consumption in a single month in the past year

Program Implementer: Leidos Engineering, LLC

Process and Associated Measures: Program Energy Advisors work directly with large industrial, commercial, and institutional business customers to identify and analyze opportunities for improving energy efficiency in customers' facilities and processes. The Energy Advisors provide technical expertise and ongoing education about large-scale, energy efficiency measures, and best practices. They also help customers develop energy teams and energy management plans, establish energy baselines and key performance indicators for facilities and end uses, and design custom incentive projects or hybrid projects with custom and prescriptive incentives.

The Program offers the same measures and incentives offered through other Focus on Energy nonresidential programs. Customers also may propose additional energy efficiency projects through the custom incentive option.

Strategic Energy Management Pilot: The Strategic Energy Management Pilot is a sub-component of the Large Energy Users Program. The Pilot targets large industrial companies, offering a strategic energy management advisor, financial incentives, technical training, and professional development opportunities to customers that demonstrate a commitment to improving energy performance. The Pilot helps customers promote a strategic energy management system in their facilities and develop a workforce of individuals in Wisconsin with experience in leading strategic energy management initiatives.

Midstream Commercial Kitchen Equipment Pilot

Pilot Dates: The Midstream Commercial Kitchen Equipment Pilot operated in CY 2017.

Pilot Purpose: The intent of the Pilot is to accelerate the adoption of energy-efficient commercial kitchen equipment through increased program participation and transform the market through increased awareness of energy-efficient equipment options for the targeted participating distributors and the end-use customers that they serve.

Target Audience: Participating commercial kitchen equipment distributors and their customers.

Pilot Implementer: Franklin Energy

Process and Associated Measures: Provides incentives for distributors to increase sales of energy-efficient commercial kitchen equipment. The Pilot targets increased sales of ENERGY STAR®-qualified and other energy-efficient equipment, including dishwashers, fryers, hot food holding cabinets, steam cookers, griddles, refrigerators, freezers, ice makers, rack ovens, combination ovens, coffee brewers, pre-rinse sprayers, and ventilation controls through increased marketing and customer incentives for qualifying equipment.

Renewable Energy Competitive Incentive Program

Program Dates: The Renewable Energy Competitive Incentive Program (RECIP) launched April 1, 2012.

Program Purpose: The Program provides incentives for cost-effective renewable energy systems installed at eligible Wisconsin organizations through a competitive request for proposals (RFP) process.

Target Audience: The Program targets all businesses within Focus on Energy's utility territory.

Program Implementer: Because RECIP crosses multiple sectors and applies to all nonresidential customers, the Program Administrator (APTIM) issues RFPs and awards funding to customers. A Program Implementer is assigned to a customer according to the program for which the customer is eligible. The Program Implementer is responsible for processing the awarded project.

Process and Associated Measures: Through the Program, Focus on Energy solicits proposals from eligible business customers for six renewable energy technologies: solar photovoltaic, solar thermal, wind, geothermal, biogas, and biomass.

The Program offers incentive amounts up to $0.50 per kWh produced or up to $1.00 per therm, not to exceed 50% of total project costs. Focus on Energy caps the maximum total incentives per customer (including energy efficiency and renewable energy incentives) at $400,000.

Communications Providers Initiative

Program Dates: The Communications Providers Initiative launched during the third quarter 2017.

Program Purpose: The Communications Providers Initiative is designed to drive infrastructure updates for telephone, cable, broadband, and internet service providers in Wisconsin. Outreach activities primarily target providers that are associated with the Wisconsin State Telecommunications Association (WSTA) and The Internet and Television Association (NCTA).

Target Audience: The Program targets telephone, cable, broadband, and internet service providers in Wisconsin.

Program Implementer: Franklin Energy

Process and Associated Measures: The initiative strives to make connections with internet service providers to identify projects that fit the general description of update infrastructure and improve system efficiency. The Program offers elevated prescriptive and custom lighting, heating and cooling measures for qualifying customers, with an emphasis on the installation of soft switches as one potential major opportunity. Custom measures are provided an incentive of $0.06 to $0.09/kWh, and $150 to $200/kW.

Digital Customer Engagement for Business Pilot

Program Dates: The Digital Customer Engagement for Business Pilot was scoped in CY 2017 and will launch in CY 2018.

Program Purpose: The Pilot utilizes a digital customer engagement platform, FirstEngage, to engage small- and medium-business customers and create energy efficiency program opportunities.

Target Audience: Small and medium business customers.

Program Implementer: FirstFuel

Process and Associated Measures: An enterprise-class, software-as-a-service (SaaS) white-label application that helps utilities and energy providers drive adoption of energy efficiency programs, enhance sales effectiveness, improve customer engagement, and reduce and improve renewal rates.

Small Business Program

Program Dates: Launched July 1, 2012.

Program Purpose: The Program encourages commercial and industrial customers to install energy-efficient products at their facilities by helping to offset the cost barriers to participation. The Program offers the highest incentives among Focus on Energy's business programs. In the second half of CY 2017, Focus on Energy also developed and launched the Community Small Business Offering, which provides extensive, community-based outreach activities and additional incentives for rural customers. These incentives are 30% to 70% higher than those offered to nonrural customers.

Target Audience: The Program targets commercial and industrial customers with an average monthly summer consumption of 40,000 kWh or less. The rural offering, Community Small Business, focused its first campaign and outreach on the community of Cross Plains.

Program Implementer: Franklin Energy, LLC

Process and Associated Measures: With consultation from a participating Trade Allies, customers can select any number of the energy-efficient products (not to exceed $10,000 per site) from four categories: lighting, HVAC/plumbing, refrigeration, and compressed air systems. The Program can directly pay the customer for the dollar amount of the products installed, or participating Trade Allies have the option to receive incentive payments on behalf of the customer and pass along the savings through an instant discount at the time of invoicing.

Appendix D. CY 2017 Statewide Total Energy Efficiency Savings and Participation

Table D-1 presents the CY 2017 program savings and participation for Focus on Energy, Northern States Power, and We Energies. Northern States Power and We Energies ran voluntary programs, with authorization from the Public Service Commission of Wisconsin, using additional funds to the funding they contribute to Focus on Energy.

Northern States Power and We Energies complemented Focus on Energy programs in CY 2017 by adding bonus incentives. Therefore, these programs' kW, kWh, 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 2017 Wisconsin Total Energy Efficiency Verified Gross Annual Savings and Participation

Program	Participation	kW	kWh	therms
Focus on Energy	992,439	97,298	11,704,299,638	291,563,218
Northern States Power[1]	2,390	3,412	39,400,860	278,546
We Energies[2]	204	0	0	74,584

[1] 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. See Docket 4220-GF-123 for additional details.

[2]We Energies' Residential Assistance Natural Gas Program. See Docket 6630-GF-136 for additional details.

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.

E.1. Overview of Savings

Table E-1 lists the CY 2017 gross, verified gross, and verified net savings claimed basis prior to verification.

Table E-1. CY 2017 First-Year Annual Savings by Segment[1]

Savings Type	Unit	Residential	Nonresidential	Pilots	Total
Gross	MMBtu	1,275,668	3,090,874	172,044	4,538,586
	kWh	252,356,217	462,766,457	5,913,973	721,036,647
	kW	32,551	64,419	665	97,635
	therms	4,146,287	15,119,151	1,518,651	20,784,089
Verified Gross	MMBtu	1,202,995	3,055,220	168,794	4,427,009
	kWh	234,024,868	474,028,579	5,802,194	713,855,641
	kW	30,868	65,410	1,020	97,298
	therms	4,045,022	14,378,344	1,489,966	19,913,332
Verified Net	MMBtu	677,475	2,287,420	167,880	3,132,774
	kWh	127,346,813	342,364,018	5,534,332	475,245,163
	kW	16,704	47,230	991	64,925
	therms	2,429,672	11,192,738	1,489,966	15,112,376

[1] Totals may not match the sum of nonresidential and residential savings due to rounding.

Table E-2 lists the verified net annual savings achieved in the first three years of the quadrennial period.

Table E-2. CY 2015, CY 2016, and CY 2017 First-Year Annual Verified Net Savings by Segment[1]

Calendar Year	Unit	Residential	Nonresidential	Pilots	Total
2015	MMBtu	927,346	3,869,846	N/A	4,797,192
	kWh	206,530,139	351,708,289	N/A	558,238,428
	kW	24,312	48,869	N/A	73,180
	therms	2,226,649	26,698,171	N/A	28,924,820
2016	MMBtu	808,349	2,658,146	N/A	3,466,495
	kWh	148,369,600	293,179,447	N/A	441,549,046
	kW	21,746	41,663	N/A	63,409
	therms	3,021,116	16,578,176	N/A	19,599,292
2017	MMBtu	677,475	2,287,420	167,880	3,132,774
	kWh	127,346,813	342,364,018	5,534,332	475,245,163
	kW	16,704	47,230	991	64,925
	therms	2,429,672	11,192,738	1,489,966	15,112,376
Total	**MMBtu**	**2,413,169**	**8,815,412**	**167,880**	**11,396,460**
	kWh	**482,246,552**	**987,251,753**	**5,534,332**	**1,475,032,637**
	kW	**62,762**	**137,762**	**991**	**201,515**
	therms	**7,677,437**	**54,469,086**	**1,489,966**	**63,636,488**

[1] Totals may not match the sum of residential and nonresidential savings due to rounding.

Table E-3 lists the lifecycle savings achieved by Focus on Energy in CY 2017. Lifecycle savings represent the savings a program can realize through measures over these measures' effective useful life (EUL).

Table E-3. CY 2017 Lifecycle Savings by Segment[1]

Savings Type	Unit	Residential	Nonresidential	Pilots	Total
Gross	MMBtu	24,712,620	47,042,100	571,212	72,325,932
	kWh	4,812,046,701	7,345,668,045	55,184,499	12,212,899,245
	kW	32,551	64,419	665	97,635
	therms	82,939,166	219,786,810	3,829,226	306,555,202
Verified Gross	MMBtu	23,504,189	45,551,206	185,023	69,240,418
	kWh	4,494,017,462	7,204,857,056	10,558,641	11,709,433,159
	kW	30,868	65,410	1,020	97,298
	therms	81,706,019	209,682,335	1,489,966	292,878,320
Verified Net	MMBtu	12,317,548	33,746,144	167,712	46,231,404
	kWh	2,373,352,657	5,144,023,044	5,485,116	7,522,860,817
	kW	16,704	47,230	991	64,925
	therms	42,196,686	161,947,374	1,489,966	205,634,026

[1] Totals may not match the sum of nonresidential and residential savings due to rounding.

Table E-4 lists the verified gross lifecycle savings achieved by Focus on Energy in CY 2015, CY 2016, and CY 2017.

Table E-4. CY 2015, CY 2016, and CY 2017 Verified Gross Lifecycle Savings by Segment[1]

Calendar Year	Unit	Residential	Nonresidential	Pilots	Total
2015	MMBtu	15,832,924	61,140,436	N/A	76,973,360
	kWh	2,223,095,841	6,583,672,339	N/A	8,806,768,180
	kW	28,896	62,608	N/A	91,504
	therms	82,477,213	386,769,461	N/A	469,246,674
2016	MMBtu	19,728,652	52,365,600	N/A	72,094,252
	kWh	3,199,626,956	6,291,666,334	N/A	9,491,293,290
	kW	29,612	59,101	N/A	88,712
	therms	88,115,245	308,984,348	N/A	397,099,593
2017	MMBtu	23,504,189	45,551,206	185,023	69,240,418
	kWh	4,494,017,462	7,204,857,056	10,558,641	11,709,433,159
	kW	30,868	65,410	1,020	97,298
	therms	81,706,019	209,682,335	1,489,966	292,878,320
Total	**MMBtu**	**59,065,765**	**159,057,242**	**185,023**	**218,308,030**
	kWh	**9,916,740,259**	**20,080,195,729**	**10,558,641**	**30,007,494,629**
	kW	**89,375**	**187,119**	**1,020**	**277,514**
	therms	**252,298,477**	**905,436,144**	**1,489,966**	**1,159,224,587**

[1] Totals may not match the sum of residential and nonresidential savings due to rounding.

E.2. Summary of Savings by Program

Table E-5 summarizes the first-year annual savings by program.

Table E-5. Summary of First-Year Annual Savings by Program, CY 2017

Program Name	Gross			Verified Gross			Verified Net		
	kWh	kW	therms	kWh	kW	therms	kWh	kW	therms
Residential Programs									
Multifamily Direct Install	4,490,222	268	126,190	4,212,647	235	105,175	4,212,647	235	105,175
Multifamily Energy Savings	8,952,599	835	153,060	8,096,642	791	132,601	6,522,913	637	106,828
Multifamily New Construction	2,481,485	360	84,700	1,600,039	364	79,415	1,289,043	293	63,979
Appliance Recycling Program	11,989,897	1,404	0	10,144,693	1,233	0	5,448,059	660	0
Home Performance with ENERGY STAR	17,440,976	5,359	1,528,776	18,556,076	5,581	1,509,969	15,021,183	4,315	1,146,029
New Homes Construction	4,339,960	1,403	986,067	4,339,960	1,403	986,067	0	0	72,740
Retail Lighting and Appliance	185,820,254	21,155	226,235	170,657,789	19,527	226,235	80,560,957	9,126	162,889
Simple Energy Efficiency	12,310,646	1,122	546,130	11,895,726	1,102	508,691	11,895,726	1,102	508,691
Design Assistance - Residential	4,530,178	646	495,128	4,521,295	632	496,869	2,396,286	335	263,341
Residential Total	**252,356,217**	**32,551**	**4,146,287**	**234,024,868**	**30,868**	**4,045,022**	**127,346,813**	**16,704**	**2,429,672**
Nonresidential Programs									
Small Business	21,557,262	2,723	72,944	21,933,322	2,673	55,407	19,882,116	2,423	50,225
Renewable Energy Competitive Incentive	4,919,834	1,541	0	4,919,834	1,803	0	4,624,644	1,695	0
Design Assistance	33,124,797	5,313	744,645	33,059,843	5,200	747,264	17,521,717	2,756	396,050
Business Incentive	170,173,893	22,757	1,737,666	159,236,928	21,397	1,358,252	95,051,087	12,772	810,763
Agriculture, Schools, and Government	87,275,215	12,685	2,182,165	86,058,588	13,253	1,912,567	66,852,000	10,295	1,485,720
Large Energy Users	145,715,455	19,400	10,381,731	168,820,065	21,084	10,304,854	138,432,453	17,289	8,449,980
Nonresidential Total	**462,766,457**	**64,419**	**15,119,151**	**474,028,579**	**65,410**	**14,378,344**	**342,364,018**	**47,230**	**11,192,738**

Program Name	Gross			Verified Gross			Verified Net		
	kWh	kW	therms	kWh	kW	therms	kWh	kW	therms
Pilot Programs									
Strategic Energy Management	4,648,326	499	1,343,787	5,133,522	972	1,315,102	5,133,522	972	1,315,102
Advanced Lighting Controls	914,071	166	0	317,096	47	0	49,235	18	0
Seasonal Savings	351,576	0	174,864	351,576	0	174,864	351,576	0	174,864
Pilot Total	**5,913,973**	**665**	**1,518,651**	**5,802,194**	**1,020**	**1,489,966**	**5,534,332**	**991**	**1,489,966**
Total All Programs	**721,036,646**	**97,635**	**20,784,088**	**713,855,641**	**97,298**	**19,913,333**	**475,245,163**	**64,925**	**15,112,376**

Because evaluation activities and results were not completed within the CY 2017 evaluation year for the Midstream Commercial Kitchen Equipment Pilot, the Low-E Storm Windows Pilot, or the Digital Customer Engagement for Business Pilot, the Evaluation Team did not provide evaluation findings for these pilots. For this reason, the gross savings for these pilots are reported separately and excluded from all portfolio summaries of savings and cost-effectiveness. Table summarizes the first-year annual savings for the Midstream Commercial Kitchen Equipment Pilot and the Low-E Storm Windows Pilot. The Digital Customer Engagement for Business Pilot did not track any savings in CY 2017.

Table E-6. Summary of First-Year Annual Gross Savings by Pilot, CY 2017

Pilot Name	Gross		
	kWh	kW	therms
Midstream Commercial Kitchen Equipment Pilot	291,867	19	6,554
Low-E Storm Windows Pilot	9,125	15	16,692

E.3. Summary of Savings by Measure

Table E-7 summarizes CY 2017 residential savings by measure category.

Table E-7. 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 %		
Agriculture - Variable Speed Drive	175,296	0.07%	15	0.05%	0	0.00%	$8,456.00	0.04%
Boilers & Burners - Boiler	0	0.00%	0	0.00%	149,209	3.69%	$270,321.00	1.27%
Boilers & Burners - Controls	366,228	0.16%	18	0.06%	27,499	0.68%	$23,528.81	0.11%
Boilers & Burners - Insulation	147,613	0.06%	1	0.00%	27,936	0.69%	$25,320.81	0.12%
Building Shell - Air Sealing	0	0.00%	0	0.00%	0	0.00%	$0.00	0.00%
Building Shell - Insulation	0	0.00%	0	0.00%	0	0.00%	$0.00	0.00%
Domestic Hot Water - Aeration	2,443,999	1.04%	148	0.48%	361,400	8.93%	$120,775.03	0.57%
Domestic Hot Water - Insulation	1,095,885	0.47%	163	0.53%	121,410	3.00%	$77,638.50	0.36%
Domestic Hot Water - Other	260,424	0.11%	6	0.02%	51,347	1.27%	$38,224.63	0.18%
Domestic Hot Water - Showerhead	1,291,563	0.55%	57	0.18%	129,155	3.19%	$104,389.89	0.49%
Domestic Hot Water - Water Heater	77,929	0.03%	6	0.02%	9,249	0.23%	$29,500.00	0.14%
HVAC - Chiller	157,585	0.07%	18	0.06%	0	0.00%	$11,443.68	0.05%
HVAC - Controls	2,051,224	0.88%	913	2.96%	766,686	18.95%	$946,863.17	4.45%
HVAC - Furnace	6,584,955	2.81%	1,299	4.21%	577,980	14.29%	$2,379,820.00	11.17%
HVAC - Motor	30,830	0.01%	6	0.02%	0	0.00%	$225.00	0.00%
HVAC - Other	2,291,727	0.98%	791	2.56%	67,641	1.67%	$869,450.00	4.08%
HVAC - Packaged Terminal Unit (PTAC, PTHP)	142,556	0.06%	-1	0.00%	0	0.00%	$11,400.00	0.05%
HVAC - Rooftop Unit / Split System AC	26,038	0.01%	116	0.37%	0	0.00%	$58,112.01	0.27%
HVAC - Smart Thermostat, Existing Air Source Heat Pump2	9,240	0.00%	0	0.00%	0	0.00%	$1,575.00	0.01%
HVAC - Steam Trap	0	0.00%	0	0.00%	44,470	1.10%	$3,560.00	0.02%
Laundry - Clothes Washer	6,354	0.00%	0	0.00%	0	0.00%	$250.00	0.00%
Lighting - Delamping	31,964	0.01%	4	0.01%	0	0.00%	$388.00	0.00%
Lighting - Fluorescent, Compact (CFL)	53,896	0.02%	5	0.02%	0	0.00%	$6,265.00	0.03%
Lighting - Fluorescent, Linear	93,243	0.04%	12	0.04%	0	0.00%	$15,003.50	0.07%

Measure Category	Verified Gross						Incentive Dollars	Incentive Dollars %
	kWh	kWh %	kW	kW %	Therms	Therms %		
Lighting - Light Emitting Diode (LED)	184,469,391	78.82%	21,174	68.60%	0	0.00%	$10,525,702.89	49.42%
Motors & Drives - Motor	55,610	0.02%	11	0.03%	0	0.00%	$13,400.00	0.06%
New Construction - Design	4,521,295	1.93%	632	2.05%	496,869	12.28%	$756,466.40	3.55%
New Construction - Whole Building	4,339,960	1.85%	1,403	4.55%	986,067	24.38%	$696,950.00	3.27%
Other - Bonus	0	0.00%	0	0.00%	0	0.00%	$30,556.00	0.14%
Other - Other	3,250,526	1.39%	-170	-0.55%	228,105	5.64%	$2,359,393.09	11.08%
Refrigeration - Other	10,144,693	4.33%	1,233	3.99%	0	0.00%	$446,845.00	2.10%
Renewable Energy - Geothermal	148,045	0.06%	29	0.09%	0	0.00%	$18,850.00	0.09%
Renewable Energy - Photovoltaics	7,407,850	3.17%	2,745	8.89%	0	0.00%	$1,080,851.82	5.08%
Training & Special - Other	545,686	0.23%	0	0.00%	0	0.00%	$0.00	0.00%
Vending & Plug Loads - Controls	1,803,262	0.77%	237	0.77%	0	0.00%	$365,098.29	1.71%

Table E-8 lists CY 2017 nonresidential savings by measure category.

Table E-8. 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	754,364	0.16%	128	0.20%	0	0.00%	$39,501.79	0.12%
Air Sealing	10,604	0.00%	0	0.00%	154,567	1.07%	$66,035.62	0.20%
Boiler	27,162	0.01%	6	0.01%	1,072,176	7.46%	$1,308,527.85	4.05%
Bonus	0	0.00%	0	0.00%	0	0.00%	$118,512.02	0.37%
Chiller	13,439,357	2.84%	2,757	4.22%	0	0.00%	$1,004,878.10	3.11%
Clothes Washer	0	0.00%	0	0.00%	721	0.01%	$493.80	0.00%
Compressor	6,143,292	1.30%	1,060	1.62%	0	0.00%	$400,140.00	1.24%
Controls	29,441,164	6.21%	2,461	3.76%	805,078	5.60%	$1,718,797.91	5.32%
Delamping	5,643,579	1.19%	1,162	1.78%	0	0.00%	$131,996.44	0.41%
Design	33,059,843	6.97%	5,200	7.95%	747,264	5.20%	$3,183,935.48	9.85%
Dishwasher, Commercial	352,115	0.07%	1	0.00%	4,485	0.03%	$19,330.00	0.06%
Door	-1,114	0.00%	-11	-0.02%	45,038	0.31%	$15,566.10	0.05%
Dryer	578,345	0.12%	105	0.16%	35,291	0.25%	$40,650.50	0.13%

Measure Category	Verified Gross						Incentive Dollars	Incentive Dollars %
	kWh	kWh %	kW	kW %	Therms	Therms %		
Economizer	188,736	0.04%	0	0.00%	0	0.00%	$5,092.33	0.02%
Energy Recovery	-460,663	-0.10%	32	0.05%	1,852,611	12.88%	$859,433.23	2.66%
Fan	2,750,178	0.58%	614	0.94%	4,808	0.03%	$268,455.64	0.83%
Filtration	1,188,572	0.25%	233	0.36%	266,016	1.85%	$181,103.20	0.56%
Fluorescent, Linear	4,449,224	0.94%	824	1.26%	0	0.00%	$200,363.68	0.62%
Fryer	17,696	0.00%	4	0.01%	3,095	0.02%	$4,780.00	0.01%
Furnace	126,589	0.03%	-7	-0.01%	265,000	1.84%	$136,759.70	0.42%
Grain Dryer	0	0.00%	0	0.00%	65,095	0.45%	$49,966.80	0.15%
Greenhouse	0	0.00%	0	0.00%	40,125	0.28%	$11,848.38	0.04%
Griddle	5,482	0.00%	1	0.00%	0	0.00%	$450.00	0.00%
Heat Exchanger	1,065,000	0.22%	0	0.00%	0	0.00%	$52,391.00	0.16%
High Intensity Discharge (HID)	7,565	0.00%	1	0.00%	0	0.00%	$224.00	0.00%
Hot Holding Cabinet	9,221	0.00%	2	0.00%	0	0.00%	$160.00	0.00%
Ice Machine	33,714	0.01%	4	0.01%	0	0.00%	$1,690.00	0.01%
Infrared Heater	0	0.00%	0	0.00%	65,972	0.46%	$23,065.00	0.07%
Insulation	6,954	0.00%	1	0.00%	175,613	1.22%	$87,474.52	0.27%
Irrigation	100,899	0.02%	25	0.04%	0	0.00%	$3,250.00	0.01%
Light Emitting Diode (LED)	217,398,250	45.86%	32,013	48.94%	0	0.00%	$13,183,967.53	40.78%
Livestock Waterer	568,499	0.12%	0	0.00%	0	0.00%	$16,320.00	0.05%
Motor	7,781,944	1.64%	922	1.41%	0	0.00%	$300,981.36	0.93%
Nozzle	498,785	0.11%	177	0.27%	0	0.00%	$736.00	0.00%
Other	47,055,131	9.93%	5,400	8.25%	7,378,248	51.32%	$4,644,582.46	14.37%
Oven	14,378	0.00%	4	0.01%	8,685	0.06%	$10,660.00	0.03%
Packaged Terminal Unit (PTAC, PTHP)	600,969	0.13%	0	0.00%	0	0.00%	$33,150.00	0.10%
Photovoltaics	4,919,834	1.04%	1,803	2.76%	0	0.00%	$1,398,442.41	4.33%
Pre-Rinse Sprayer	0	0.00%	0	0.00%	115	0.00%	$125.00	0.00%
Process Heat	25,025	0.01%	4	0.01%	0	0.00%	$1,008.00	0.00%
Pump	5,930,105	1.25%	651	1.00%	0	0.00%	$213,705.50	0.66%
Reconfigure Equipment	2,696,482	0.57%	424	0.65%	0	0.00%	$114,350.82	0.35%
Refrigerated Case Door	4,318,558	0.91%	345	0.53%	101,410	0.71%	$209,612.00	0.65%

Measure Category	Verified Gross						Incentive Dollars	Incentive Dollars %
	kWh	kWh %	kW	kW %	Therms	Therms %		
Refrigerator / Freezer - Commercial	609,571	0.13%	70	0.11%	0	0.00%	$35,675.00	0.11%
Rooftop Unit / Split System AC	560,879	0.12%	762	1.16%	56,828	0.40%	$204,661.72	0.63%
Scheduling	59,766	0.01%	18	0.03%	4,425	0.03%	$7,524.60	0.02%
Steam Trap	0	0.00%	0	0.00%	778,863	5.42%	$80,114.43	0.25%
Steamer	91,563	0.02%	17	0.03%	0	0.00%	$4,000.00	0.01%
Strip Curtain	23,889	0.01%	3	0.00%	0	0.00%	$656.00	0.00%
Supporting Equipment	114,617	0.02%	10	0.02%	0	0.00%	$4,054.07	0.01%
Tune-up / Repair / Commissioning	14,158,529	2.99%	1,195	1.83%	166,129	1.16%	$212,734.32	0.66%
Unit Heater	0	0.00%	0	0.00%	17,187	0.12%	$6,325.00	0.02%
Variable Air Volume (VAV)	80,942	0.02%	0	0.00%	91,307	0.64%	$38,385.90	0.12%
Variable Speed Drive	67,454,020	14.23%	6,971	10.66%	0	0.00%	$1,512,137.06	4.68%
Water Heater	64,661	0.01%	1	0.00%	167,622	1.17%	$151,837.80	0.47%
Welder	40,058	0.01%	21	0.03%	0	0.00%	$2,886.00	0.01%
Window	24,248	0.01%	0	0.00%	4,570	0.03%	$4,100.79	0.01%

Appendix F. Cost-Effectiveness and Emissions Methodology and Analysis

For the current quadrennial cycle (CY 2015–CY 2018), the Focus on Energy Program Administrator developed a specific calculator for its use and use by Program Implementers in assessing 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 (PSC) and the Evaluation Team.

To maintain consistency between planning and evaluation approaches—critical for an understanding of program performance compared to expectations—the Evaluation Team used the same calculator to evaluate the cost-effectiveness of the Focus on Energy programs in CY 2017. Its findings are presented in this section.

As directed by the PSC, the modified Total Resource Cost (TRC) test is considered the primary test in assessing the cost-effectiveness of individual programs or the entire Focus on Energy portfolio of programs.[7] The PSC also directs that three additional tests be conducted for advisory purposes. These are an expanded TRC test that also includes net economic benefits, the Utility Administrator Test (UAT), and the Ratepayer Impact Measure (RIM) test.

Net-to-gross (NTG) ratios can be a significant driver in the results of the TRC, UAT, and RIM tests. NTG ratios are applied to adjust the impacts of the programs so that 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 (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 (e.g., delivery and administrative costs).

F.1. 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 analysis for energy efficiency programs in the United States.[8] Four tests—the modified TRC test, the expanded TRC test, the UAT, and the RIM test—are described in the next sections.

---

7 The use of the modified TRC test as the primary cost-effectiveness test is directed by the PSC. Public Service Commission of Wisconsin. *Quadrennial Planning Process II – Scope.* Order PSC Docket 5-FE-100, REF#:215245. September 3, 2014. Available online: http://psc.wi.gov/apps35/ERF_view/viewdoc.aspx?docid=215245

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

F.1.1. 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 Cost 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 (e.g., emission reduction benefits).

The modified TRC test used for the CY 2017 evaluation determines if programs are cost-effective from a regulatory perspective (i.e., 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 and 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:

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

F.1.2. 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 2017 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:

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

F.1.3. 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 (i.e., 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 (i.e., not subtracted from denominator).

The benefit/cost equation used for the UAT is:

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

F.1.4. 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 neither accounts 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 (i.e., 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 (i.e., 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 (i.e., efficiency) test in an economic sense but, rather, an analysis of the distributional (i.e., equity) impacts on energy bills.[9] 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.

[9] 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.

F.2. 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 multiperspective 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 quadrennial (CY 2015–CY 2018), the cost-effectiveness results reported here are not directly comparable to results from the previous quadrennial cycle (CY 2011–CY 2014).

F.3. Energy Avoided Costs

The PSC established the methodology to estimate electric energy avoided costs in PSC Order, docket 5-GF-191 (PSC REF#:166932).[10] The source for electric energy avoided costs in this CY 2017 evaluation comes from the annualized forecast avoided cost model developed by Cadmus. This forecast relied on the Midwest Independent Transmission System Operator, Inc. (MISO), forecast of Locational Margin Price (LMP) for the years 2019, 2024, and 2029.[11] The PSC established the natural gas avoided costs in PSC Order, docket 5-FE-100 (PSC REF#:232431).[12] These electric and gas costs are based on Henry Hub price forecasts from the U.S. Energy Information Administration (EIA) 2014 Annual Energy Outlook.[13]

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-1 shows the assumptions for the 2015, 2016, and 2017 evaluation avoided cost used for the cost-effectiveness tests.

---

[10] Public Service Commission of Wisconsin. *Quadrennial Planning Process II – Scope.* Order PSC Docket 5-GF-191, REF#:166932. June 18, 2012. Available online: http://psc.wi.gov/apps35/ERF_view/viewdoc.aspx?docid=166932

[11] Midcontinent Independent Transmission System Operator, Inc. Available online: https://www.misoenergy.org/

[12] Public Service Commission of Wisconsin. *Quadrennial Planning Process II – Scope.* Order PSC Docket 5-FE-100, REF#:232431. February 25, 2015. Available online: http://psc.wi.gov/apps35/ERF_view/viewdoc.aspx?docid=232431

[13] U.S. Energy Information Administration. *Annual Energy Outlook 2014*. May 7, 2014. Available online: https://www.eia.gov/outlooks/archive/aeo14/

Table F-1. Avoided Costs

Avoided Cost	CY 2015	CY 2016	CY 2017
Electric Energy ($/kWh)	$0.02914–$0.06871[1]	$0.03525–$0.06871[1]	$0.04136–$0.06871[1]
Electric Capacity ($/kW year)	130.26	130.26	130.26
Gas ($/therms)	$0.625–$1.278[2]	$0.691–$1.278[2]	$0.735–$1.278[2]
Avoided Cost Inflation	0%	0%	0%
Real Discount Rate	2%	2%	2%
Line Loss	8%	8%	8%

[1] The CY 2015 - 2017 cost-effectiveness analyses used a time series that grows from $0.02914 to $0.06871 over 14 years in the forecast model.

[2] The natural gas avoided costs grow from $0.625 to $1.278 over a 25-year period based on growth rates from the U.S. Energy Information Administration. *Annual Energy Outlook 2014*. May 7, 2014. Available online: https://www.eia.gov/outlooks/archive/aeo14/

F.4. 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 (CO_2), sulfur dioxide (SO_2), and nitrogen oxides (NO_x). Determining the emissions benefits requires three key parameters: lifecycle net energy savings, 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 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:

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

The natural gas emissions factor has remained constant since the 2011 evaluation report and is derived from a best-practice greenhouse gas inventory method developed by the California Energy Commission. For CY 2017, the Evaluation Team revised the electric emissions factors using a tool developed by the U.S. Environmental Protection Agency (EPA) to calculate avoided emissions from renewable energy and energy efficiency programs (the tool is officially called the “AVoided Emissions and geneRation Tool” or “AVERT”). 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. The Evaluation Team used the model 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. It then calculated an emissions factor based on the tons of emissions displaced by each MWh of generation avoided.

Table F-2 lists the emissions factors and allowance prices.

Table F-2. Emissions Factors and Allowance Price

Service Fuel Type	CO_2	NO_X	SO_2
Electric Emissions Factor (Tons/MWh)	0.8855	0.0007	0.0015
Gas Emissions Factor (Tons/MThm)	5.85	N/A	N/A
Allowance Price ($/Ton)	$15	$7.50	$2

The Evaluation Team obtained NO_x and SO_2 emissions allowance prices from near the end of 2016 from the EPA's Cross State Air Pollution Rule (CSAPR).[14] Markets for NO_x and SO_2 allowances continue to be volatile, making it difficult to forecast NO_x and SO_2 allowance prices. However, given the generally lower prices in 2016 and 2017, the Evaluation Team kept the lowered avoided emissions values for SO_2 and NO_x from 2016 to maintain a conservative estimate of the value of avoided emissions. The Evaluation Team used the CO_2 emissions price in the PSC's Order, docket 5-FE-100 Ref#: 279739, which states, "For purposes of evaluating the Focus program during the 2015–2018 quadrennium, the value of avoided carbon emissions shall be $15 per ton."[15]

Table F-3 lists the emissions benefits for all programs by residential and nonresidential segment.

Table F-3. Total Program Emissions Benefits by Segment[1]

Program Year	Residential	Nonresidential	Total
CY 2015 Emissions Benefits	$25,236,521	$85,344,610	$110,581,131
CY 2016 Emissions Benefits	$33,448,073	$70,655,200	$104,103,273
CY 2017 Emissions Benefits	$27,784,615	$72,107,782	$99,892,397

[1]Reported emissions impacts are based upon portfolio level modeling and are not measure- or project-level specific.

F.5. Program Costs

The 2017 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 program costs because they are deemed transfer payments, which is consistent with industry guidelines defining the TRC test.

14 U.S. Environmental Protection Agency. "Cross-State Air Pollution Rule (CSAPR)." December 14, 2017. Accessed May 2018: https://www.epa.gov/csapr

15 Public Service Commission of Wisconsin. *Quadrennial Planning Process II – Scope.* Order PSC Docket 5-FE-100, REF#:279739. September 3, 2014. Available online: http://psc.wi.gov/apps35/ERF_view/viewdoc.aspx?docid=279739

F.6. 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 2017 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, similar to the energy savings values used in the cost-effectiveness tests, required the application of attribution factors to account for freeridership.

Similar to the previous quadrennial's evaluation effort, the Evaluation Team assigned actual project cost values from the program tracking databases to the renewable energy projects.

F.7. Cost-Effectiveness Results by Test

Table F-4 presents the inputs and results from the modified TRC test for the Focus on Energy 2017 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 2017 programs were more than $574,025,665 overall. The benefits from the residential programs were 3.13 times greater than the costs, while the benefits from the nonresidential programs outweighed the costs by a factor of 4.60.

Table F-4. CY 2017 Sector-Level and Overall Results, Modified Total Resource Cost Test

	Residential	Nonresidential	Total
Administrative Costs	$4,505,599	$4,336,290	$8,841,889
Delivery Costs	$10,274,774	$17,706,879	$27,981,653
Incremental Measure Costs	$52,340,833	$97,863,384	$150,204,217
Total TRC Costs	**$67,121,206**	**$119,906,553**	**$187,027,759**
Electric Benefits	$147,114,241	$360,001,717	$507,115,958
Gas Benefits	$34,874,492	$119,170,577	$154,045,069
Emissions Benefits	$27,784,615	$72,107,782	$99,892,397
Total TRC Benefits	**$209,773,348**	**$551,280,076**	**$761,053,424**
TRC Benefits Minus Costs	**$142,652,142**	**$431,373,523**	**$574,025,665**
TRC Benefit/Cost Ratio	**3.13**	**4.60**	**4.07**

Table F-5 presents the inputs and results from the UAT for the 2017 Focus on Energy portfolio. The benefits from the residential programs were 5.06 times greater than the costs, while the benefits from the nonresidential programs outweighed the costs by a factor of 8.61.

Table F-5. CY 2017 Sector-Level and Overall Results, Utility Administrator Test

	Residential	Nonresidential	Total
Incentive Costs	$21,194,958	$33,631,479	$54,826,436
Administrative Costs	$4,505,599	$4,336,290	$8,841,889
Delivery Costs	$10,274,774	$17,706,879	$27,981,653
Total UAT Costs	**$35,975,330**	**$55,674,648**	**$91,649,978**
Electric Benefits	$147,114,241	$360,001,717	$507,115,958
Gas Benefits	$34,874,492	$119,170,577	$154,045,069
Total UAT Benefits	**$181,988,733**	**$479,172,294**	**$661,161,027**
UAT Benefits Minus Costs	**$146,013,403**	**$423,497,646**	**$569,511,049**
UAT Benefit/Cost Ratio	**5.06**	**8.61**	**7.21**

Table F-6 shows the inputs and results from the RIM test for 2017 energy efficiency and renewable resource programs. As expected, estimated benefit/cost value from the RIM test is near 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-6. CY 2017 Sector-Level and Overall Results, Ratepayer Impact Measure Test

	Residential	Nonresidential	Total
Incentive Costs	$21,194,958	$33,631,479	$54,826,436
Electric Lost Revenues	$234,032,093	$339,394,992	$573,427,085
Gas Lost Revenues	$23,731,121	$74,970,187	$98,701,308
Admin Costs	$4,505,599	$4,336,290	$8,841,889
Delivery Costs	$10,274,774	$17,706,879	$27,981,653
Total RIM Costs	**$293,738,544**	**$470,039,827**	**$763,778,371**
Electric Benefits	$147,114,241	$360,001,717	$507,115,958
Gas Benefits	$34,874,492	$119,170,577	$154,045,069
Total RIM Benefits	**$181,988,733**	**$479,172,294**	**$661,161,027**
RIM Benefits Minus Costs	**($111,749,811)**	**$9,132,467**	**($102,617,343)**
RIM Benefit/Cost Ratio[1]	**0.62**	**1.02**	**0.87**

[1] For the CY 2017 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.

F.8. Cost-Effectiveness Results by Program

Table F-7 and Table F-8 provide the sector-level and overall results of the cost-effectiveness analysis shown by core efficiency programs, pilots, and renewables. In CY 2017, cost-effectiveness is presented in more detail due to the presence of new pilot and rural programs. The overall effects of the presence of these new programs is limited in 2017 because evaluated programs had limited effects and because no rural programs were evaluated in 2017, but these programs will have more influence on the portfolio in 2018. 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-7. CY 2017 Overall Cost-Effectiveness Analysis with Portfolio Breakout

Focus on Energy Benefits and Costs		Portfolio Breakout	Core Efficiency	Pilots	Rural	Renewables
Incentives	$54,826,436		$51,250,513.17	$1,047,818.60	$0.00	$2,493,460.23
Modified TRC Benefits	$761,053,424		$731,169,845.79	$4,802,481.14	$0.00	$24,845,374.55
Modified TRC Costs	$187,027,759		$166,534,956.80	$2,118,661.71	$0.00	$18,198,531.23
Portfolio TRC Ratio	**4.07**	Alone	**4.39**	2.27	N/A	1.37
		With Core		**4.36**	N/A	4.09
		With Core & Pilots (All Efficiency)			**N/A**	4.07
		With Core & Pilots & Rural				**4.07**

Table F-8. CY 2017 Overall with Renewables Separate Cost-Effectiveness Analysis

	Residential	Nonresidential	Renewables	Total
Incentive Costs	$20,336,446	$31,996,530	$2,493,460	$54,826,436
Administrative Costs	$4,335,316	$4,278,495	$228,078	$8,841,889
Delivery Costs	$9,886,452	$17,470,877	$624,323	$27,981,653
Incremental Measure Costs	$45,458,527	$87,399,561	$17,346,130	$150,204,217
Total Non-Incentive Costs	**$59,680,295**	**$109,148,933**	**$18,198,531**	**$187,027,759**
Electric Benefits	$140,478,132	$344,375,014	$22,262,812	$507,115,958
Gas Benefits	$34,874,492	$119,170,577	$0	$154,045,069
Emissions Benefits	$27,014,491	$70,295,344	$2,582,563	$99,892,397
Total TRC Benefits	**$202,367,115**	**$533,840,935**	**$24,845,375**	**$761,053,424**
TRC Benefits Minus Costs	**$142,686,820**	**$424,692,002**	**$6,646,843**	**$574,025,665**
TRC Ratio	**3.39**	**4.89**	**1.37**	**4.07**

Table F-9 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.

Table F-9. CY 2017 Residential Programs Cost-Effectiveness Analysis

	Home Performance with ENERGY STAR			Appliance Recycling	Simple Energy Efficiency	Multifamily Programs			New Homes	Retailer Lighting and Appliance
	HVAC and Whole Home	Renewable Rewards Residential	Renewable Rewards Nonresidential			Multifamily Energy Savings	Multifamily Direct Install	Multifamily New Construction		
Incentive Costs	$6,165,794	$858,512	$236,506	$446,565	$1,536,983	$912,839	$329,684	$225,983	$696,950	$9,197,123
Administrative Costs	$1,226,573	$170,283	$25,953	$530,547	$440,222	$256,931	$244,627	$94,163	$200,203	$1,042,219
Delivery Costs	$2,797,134	$388,321	$105,977	$1,209,883	$1,003,902	$585,918	$557,859	$214,734	$456,553	$2,376,723
Incremental Measure Costs	$20,602,521	$6,882,307	$4,360,509	$347,262	$1,477,862	$1,307,220	$646,616	$1,346,016	$1,550,502	$16,425,723
Total Non-Incentive Costs	**$24,626,228**	**$7,440,911**	**$4,492,438**	**$2,087,692**	**$2,921,986**	**$2,150,070**	**$1,449,102**	**$1,654,913**	**$2,207,258**	**$19,844,664**
Electric Benefits	$16,236,636	$6,636,109	$5,208,868	$1,941,575	$10,124,460	$4,973,392	$3,509,816	$1,644,139	$1,147,693	$97,771,265
Gas Benefits	$21,044,655	$0	$0	$0	$4,156,455	$1,135,204	$763,917	$758,185	$1,639,098	$1,171,688
Emissions Benefits	$4,219,194	$770,124	$597,164	$363,509	$2,330,372	$1,043,315	$772,285	$315,646	$286,822	$16,756,088
Total TRC Benefits	**$41,500,485**	**$7,406,233**	**$5,806,032**	**$2,305,084**	**$16,611,288**	**$7,151,912**	**$5,046,018**	**$2,717,970**	**$3,073,613**	**$115,699,041**
TRC Benefits Minus Costs	**$16,874,257**	**($34,678)**	**$1,313,594**	**$217,392**	**$13,689,301**	**$5,001,842**	**$3,596,917**	**$1,063,057**	**$866,355**	**$95,854,377**
TRC Ratio	**1.69**	**1.00**	**1.29**	**1.10**	**5.68**	**3.33**	**3.48**	**1.64**	**1.39**	**5.83**

Table F-10 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.

Table F-10. CY 2017 Nonresidential Programs Cost-Effectiveness Analysis

	Agriculture, Schools, and Government	Business Incentive	Large Energy Users	Small Business	Design Assistance Residential	Design Assistance Nonresidential	Renewable Energy Competitive Incentive
Incentive Costs	$6,836,351	$9,453,441	$9,097,292	$2,344,328	$756,466	$3,183,935	$1,398,442
Admin Costs	$808,476	$1,211,595	$1,164,121	$297,595	$124,929	$419,137	$24,635
Delivery Costs	$3,301,342	$4,947,445	$4,753,592	$1,215,203	$284,894	$1,711,512	$100,595
Incremental Measure Costs	$19,171,821	$25,917,820	$31,310,130	$4,896,648	$1,723,033	$5,206,928	$6,103,314
Total Non-Incentive Costs	**$23,281,639**	**$32,076,860**	**$37,227,843**	**$6,409,446**	**$2,132,855**	**$7,337,577**	**$6,228,544**
Electric Benefits	$69,239,637	$97,087,875	$132,259,787	$20,301,742	$3,083,904	$23,216,281	$10,417,835
Gas Benefits	$15,309,240	$8,173,944	$87,348,431	$678,361	$3,902,293	$5,868,832	$0
Emissions Benefits	$12,844,571	$17,102,397	$31,961,008	$3,553,473	$886,805	$4,245,856	$1,215,274
Total TRC Benefits	**$97,393,447**	**$122,364,216**	**$251,569,225**	**$24,533,576**	**$7,873,002**	**$33,330,969**	**$11,633,109**
TRC Benefits Minus Costs	**$74,111,809**	**$90,287,356**	**$214,341,382**	**$18,124,130**	**$5,740,146**	**$25,993,391**	**$5,404,565**
TRC Ratio	**4.18**	**3.81**	**6.76**	**3.83**	**3.69**	**4.54**	**1.87**

Table F-11 provides pilot 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.

Table F-11. CY 2017 Pilots Cost-Effectiveness Analysis

	Networked Lighting Control Pilot	Seasonal Savings	Strategic Energy Management
Incentive Costs	$172,246	$0	$875,573
Admin Costs	$7,249	$19,932	$220,367
Delivery Costs	$29,599	$45,453	$899,849
Incremental Measure Costs	$352,394	$0	$543,819
Total Non-Incentive Costs	**$389,242**	**$65,385**	**$1,664,035**
Electric Benefits	$263,575	$12,394	$2,006,117
Gas Benefits	$0	$120,831	$1,791,770
Emissions Benefits	$46,540	$19,755	$541,499
Total TRC Benefits	**$310,115**	**$152,980**	**$4,339,387**
TRC Benefits Minus Costs	**($79,127)**	**$87,595**	**$2,675,352**
TRC Ratio	**0.80**	**2.34**	**2.61**

F.9. Cost-Effectiveness Results for Renewables

Table F-12 lists the CY 2015, CY 2016, and CY 2017 cost-effectiveness results, with renewables separate and with renewables included.

Table F-12. Cost-Effectiveness Results for Focus on Energy Portfolio

Calendar Year	Residential	Nonresidential	Renewables	Total
CY 2015: Modified TRC Test Result with Renewables	3.12	3.63	n/a	3.51
CY 2015: Modified TRC Test Result Renewables Separate	3.33	3.93	1.18	3.51
CY 2016: Modified TRC Test Result with Renewables	2.75	3.13	n/a	3.00
CY 2016: Modified TRC Test Result Renewables Separate	2.93	3.36	1.09	3.00
CY 2017: Modified TRC Test Result with Renewables	3.13	4.60	n/a	4.07
CY 2017: Modified TRC Test Result Renewables Separate	3.39	4.89	1.37	4.07

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 2015–2018 quadrennial 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 Wisconsin 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

Below, the Evaluation Team provides details on how it calculated total net savings estimates and their standard errors.

G.1. Introduction to Statistical Uncertainty

The Evaluation Team collected data from surveys, billing histories, meters, and secondary sources including the Focus on Energy Technical Reference 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 accurate and precise results. The strength of an estimate is related to the amount of uncertainty or error around it, 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. It refers to the probability that true value of the metric of interest (e.g., kWh 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, whereas 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 2015–2018 quadrennial. 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.[16]

G.2. 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, one set of data collected from surveys, billing analyses, metering, and/or TRM review are used to estimate gross savings and another set of data collected from a separate survey are 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* saving are represented by x_i, and the standard error of the NTG ratio estimate is represented by SE_{NTG}, in the following formulas:

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

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

[16] U.S. Environmental Protection Agency. "Energy and the Environment. National Action Plan for Energy Efficiency." Accessed April 2017: http://www.epa.gov/cleanenergy/energy-programs/suca/resources.html

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:

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

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

G.3. Nonresidential Programs

The Evaluation Team selected a sample of projects within 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 within 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 Protocol sampling chapter where the weights (w_i) are proportional to the sampling probabilities (i.e., contribution to savings), *ex ante* savings are represented by x_i and *ex post* saving are represented by y_i:[17]

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

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

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

The Team estimated nonresidential NTG ratios using survey data collected from an independent simple random sample of participants and then multiplied these ratios to 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.

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

Table G-1 presents the precision of total net first and cumulative year MMBtu savings estimates at 90% confidence for each nonresidential program.[18] The sources of uncertainty in all nonresidential savings estimates were due to estimating realization rate and NTG values based on samples.

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

Nonresidential Programs	Precision at 90% Confidence			
	CY 2015	CY 2016	CY 2017	Cumulative
Agriculture, Schools and Government	15%	16%	16%	10%
Business Incentive	38%	54%	36%	25%
Chain Stores and Franchises	27%	27%	n/a	27%
Design Assistance	31%	12%	34%	14%
Large Energy Users	14%	21%	26%	11%
Small Business	9%	12%	7%	6%

G.4. 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.[19] 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.

[18] In estimating precision around cumulative savings, the Evaluation Team corrected an error in the precision CY 2015 precision equation and updated CY 2015 precision estimates, provided in Table G-1..

[19] In estimating precision around cumulative savings for the Multifamily Direct Install and Multifamily Energy Savings Programs, the Evaluation Team corrected an error in the precision CY 2015 precision equation and updated CY 2015 precision estimates, provided in Table G-2.

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

Residential Programs	Precision at 90% Confidence				Sources of Uncertainty
	CY 2015	CY 2016	CY 2017	Cumulative	
Multifamily Direct Install	7%	1%	5%	3%	Realization rate and NTG ratio
Multifamily Energy Savings	19%	12%	19%	10%	Realization rate and NTG ratio
Multifamily New Construction	n/a	n/a	32%	32%	Realization rate and NTG ratio
Residential Lighting and Appliances	n/a	17%	48%	22% (1)	ISR and NTG ratio
Home Performance with ENERGY STAR® - Whole Home Standard Track, Electric	15%	42%	16%	13%	PRISM model
Home Performance with ENERGY STAR® - Whole Home Standard Track, Gas	7%	26%	9%	8%	PRISM model
Home Performance with ENERGY STAR® - Whole Home Income Qualified, Electric	38%	38%	28%	25%	PRISM model
Home Performance with ENERGY STAR® - Whole Home Income Qualified, Gas	18%	18%	15%	11%	PRISM model
Home Performance with ENERGY STAR® - HVAC Path	n/a	n/a	6%	6%	D+R survey and Program data
Home Performance with ENERGY STAR® - Renewables	n/a	n/a	9%	9%	Realization Rate and NTR ratio
Simple Energy Efficiency	2%	6%	6%	3%	Survey estimated ISRs

(1) Cumulative precision is based on CY 2016 and CY 2017 results only as precision could not be estimated in CY 2015.

G.4.1. Retailer Lighting and Appliance Program

The following describes the method the Evaluation Team used to calculate standard errors around gross and net-to-gross savings for the Retailer Lighting and Appliance Program.

Gross Savings

The Evaluation Team estimated first-year savings for the Retailer Lighting and Appliance Program according to the method described in the Retailer Lighting and Appliance Program chapter. Precision around gross program savings was entirely driven by LED lighting in-services rates and the lighting cross-sector-sales proportion, as the Evaluation Team applied deemed savings to advanced power strips and smart thermostats.

In-Service Rate

The Evaluation Team estimated first-year ISRs in CY 2017 by applying a four-year trajectory ISR to the surveyed ISR. The Team calculated the standard error for the surveyed ISRs using the formula for a proportion:

$$ISR_1 = \frac{\#\ installed}{\#\ reported}$$

$$SE_1 = \sqrt{\frac{ISR_1 * (1 - ISR_1)}{n}}$$

The Evaluation Team calculated a six-year projected ISRs (net present value ISR) for LEDs and CFLs according to the method recommended in the UMP,[20] which assumes that each year, participants install 24% of their storage bulbs from the previous year, up to six years after participants received their bulbs. The Evaluation Team calculated the standard error of the net present value ISR by first rewriting the formula in the UMP as follows:

$$ISR_{NPV} = f(rate, \%installed) + ISR_1 * (f(rate, \%installed) - 1)$$

Where:

ISR_{NPV}	=	Net Present Value ISR
$rate$	=	Discount rate (2%)
$\%installed$	=	Percentage of storage bulbs installed (24%)

The UMP did not provide standard errors or sample sizes used to estimate the percentage of storage bulbs installed each year. Instead, the Evaluation Team assumed that the function of the discount rate and percentage of installed storage bulbs achieved 10% precision at 90% confidence and calculated the standard error around the estimate as:

$$SE_f = \frac{10\% * f(rate, \%installed)}{z\text{-}statistic}$$

The Evaluation Team calculated the standard error around the net present value ISR as follows:

$$SE_{NPV} = \sqrt{SE_f^2 + SE_{\mathrm{ISR}_1}^2 * (f(rate, \%installed) - 1)^2 + SE_f^2 * \mathrm{ISR}_1^2 + SE_{\mathrm{ISR}_1}^2 * SE_f^2}$$

Cross-Sector Sales Proportion

The Evaluation Team calculated the proportion of lighting cross-sector sales by taking the average of the CY 2014 and CY 2015 cross-sector sales proportions. For each proportion, the Evaluation Team calculated the following standard errors:

$$CSS = \frac{\#\ small\ business\ customers\ with\ CFL\ or\ LED\ purchases\ from\ participating\ retailers}{\#\ CFLs\ and\ LEDs\ purchased\ from\ participating\ \mathrm{retailers}}$$

[20] National Renewable Energy Laboratory. *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.* "Chapter 21: Residential Lighting Evaluation Protocol." Prepared by Apex Analytics, LLC. February 2015. Available online: http://energy.gov/sites/prod/files/2015/02/f19/UMPChapter21-residential-lighting-evaluation-protocol.pdf

$$SE_{CSS_{CY}} = \sqrt{\frac{CSS * (1 - CSS)}{n}}$$

To combine the uncertainties from both CY 2014 and CY 2015 cross-sector sales proportions, the Evaluation Team calculated the square root of the sum of squared standard errors of each respective sales proportion:

$$SE_{CSS} = \frac{1}{2}\sqrt{SE_{CSS_{CY2014}}^2 + SE_{CSS_{CY2015}}^2}$$

Gross Savings Results

The Evaluation Team calculated final gross savings by adding residential and commercial gross savings, weighted by the cross-sector sales proportion. The standard error around final gross savings incorporates uncertainties from the ISR and cross-sector sales proportion as follows.

$$SE_{gross} = \sqrt{SE_{NPV}^2 * \left(kWh_{Res} + CSS * (kWh_{Com} - kWh_{Res})\right)^2 + (kWh_{Com} - kWh_{Res})^2 * SE_{CSS}^2 * ISR_{NPV}^2 + SE_{NPV}^2 * SE_{CSS}^2}$$

Where:

kWh_{Res} = Total lighting savings calculated based on residential inputs for delta watts, hours of use, and waste heat factor.

kWh_{Com} = Total lighting savings calculated based on commercial inputs for delta watts, hours of use, and waste heat factor.

Net-to-Gross Savings

The Evaluation Team estimated NTG ratios for LEDs using four separate methods as described in the Retailer Lighting and Appliance Program chapter. It applied the weighted average of the resulting NTG ratio estimates as its final LED NTG ratio, weighted by the precision around each estimate.

The Evaluation Team calculated the standard errors around the final LED NTG ratio as follows:

$$SE_{NTG} = \sqrt{\left(\frac{1}{\sum_{m=1}^{4} w_m}\right)^2 * \sum_{m=1}^{4} SE_{NTG}^2 * w_m^2}$$

Where:

w_m = $1/(precision\ of\ NTG\ method\ m)$

NTG_m = Net-to-Gross ratio resulting from NTG method m

The Evaluation Team applied the CFL NTG ratio from the CY 2015 evaluation to the CFL gross savings for CY 2016; however, it did not calculate precision around the NTG ratio.

The uncertainty around final NTG savings incorporates both the uncertainty around NTG ratios and uncertainty around gross savings. The Evaluation Team combined these uncertainties and calculated the standard error around NTG savings as follows:

$$SE_{kWh_{net}} = \sqrt{SE^2_{\Delta kWh} * NTG^2 + SE^2_{NTG} * \Delta kWh + SE^2_{\Delta kWh} * SE^2_{NTG}}$$

G.4.2. Home Performance with ENERGY STAR® Program – Whole Home Path

The Evaluation Team used PRInceton Scorekeeping Method (PRISM) models to estimate savings for the Home Performance with ENERGY STAR programs. The PRISM modeling approach has often been used in billing analysis since first introduced in the 1980s—and is the standard approach for billing analysis used by Cadmus, since the method obtains weather normalized usage and savings estimates at the customer level. With these customer-level weather-normalized usages, obtaining savings for various subsets and subgroups is straightforward. The Evaluation Team calculated the precision of each estimate based on the PRISM regression standard errors of the estimated changes in usage, then it pooled standard errors within participants and nonparticipants to calculate precision for the final adjusted gross savings.

G.4.3. Home Performance with ENERGY STAR® Program – HVAC Path

The Evaluation Team used a standard market practice analysis to estimate savings for the Home Performance with ENERGY STAR Program HVAC path. It used D+R data to estimate the proportion of HVAC equipment in each AFUE category. The D+R survey reported proportions based on over 9,000 sampled units. The Evaluation Team calculated the corresponding precision of these estimates, which is close to 0%. It combined the D+R AFUE proportions with those observed in the program tracking database to estimate a Wisconsin-specific distribution of non-program HVAC AFUE in the market place and then multiplied this result with the energy consumption estimates calculated using an engineering algorithm with inputs from the TRM.

The TRM values are not reported with error bounds, thus the Evaluation Team was not able to calculate the uncertainty in the energy consumption estimates. To estimate savings, the Team calculated the difference between the market baseline and the program energy consumption estimates. Because the Team could not account for uncertainty in the engineering algorithm inputs from the TRM, it did not calculate the precision of net savings for this program.

G.4.4. Simple Energy Efficiency Program

The Evaluation Team estimated both measure-level and program total savings from the kits distributed through the Simple Energy Efficiency Program. Uncertainty around these savings came from the measure ISRs, which the Evaluation Team estimated using surveys collected from a sample of customers who received one of the six distributed kit types. Because respondents to the survey answered installation questions about all the measures included in their kits, estimated ISRs within kit type were correlated. To account for this correlation, the Evaluation Team first estimated standard errors around total savings within a kit type as follows:

$$SE_h = \sqrt{\sum_i X_{hi}^2 Var(ISR_{hi}) + 2\sum_{i>j}\sum X_{hi}X_{hj}\rho_{hi,hj}s_{hi}s_{hj}}$$

Where

SE_h = Standard error for total savings in kit type h

X_{hi} = Total savings for measure i from kit type h assuming 100% ISR

X_{hj} = Total savings for measure j from kit type h assuming 100% ISR

$Var(ISR_{hi})$ = The variance of the ISR measure i from kit type h, calculated as $Var(ISR_{hi}) = ISR_{hi}(1 - ISR_{hi})/n_{hi}$, where n_{hi} is the number of survey respondents

$\rho_{hi,hj}$ = The correlation coeffect between responses to measure i and measure j in kit type h

s_{hi} = The standard deviation of the ISR measure i from kit type h, estimated as the square root of its variance

s_{hj} = The standard deviation of the ISR measure j from kit type h, estimated as the square root of its variance

The Evaluation Team combined kit-type uncertainty to estimate standard errors around program total savings as follows:

$$SE(Program\ Total\ Savings) = \sqrt{\sum_h SE_h^2}$$

The Evaluation Team assumed a net-to-gross ratio of one for this program, and so total net savings are equal to total gross savings.

G.4.5. Appliance Recycling Program

The Evaluation Team estimated average annual unit energy consumption (UEC) using a dataset of metered refrigerators and freezers from prior studies conducted by the Evaluation Team. The standard error for the UEC is calculated using this formula for a population mean:

$$SE_{UEC} = \sqrt{\frac{\sum(Mean\ UEC - UEC_i)^2}{n}}$$

Gross savings are a product of the average UEC and the part use factor. The Evaluation Team collected survey responses from participants to estimate the part use factor (PF).

$$SE_{PF} = \sqrt{\frac{PF * (1 - PF)}{n}}$$

Therefore, the standard error for gross savings accounts for the uncertainty around the UEC and PF estimates pooling the standard errors and was calculated as:

$$SE_{kWh_{gross}} = \sqrt{SE_{UEC}^2 * PF^2 + SE_{PF}^2 * UEC}$$

The Evaluation Team used participant survey responses to calculate freeridership and secondary market impacts. The standard error was calculated as:

$$SD_{NTGR} = \sqrt{\frac{\sum(Mean\ FR\ kWh - FR\ kWh_i)^2}{n - 1}}$$

And

$$SE_{NTGR} = \sqrt{\frac{SD_{NTGR}}{n}}$$

Finally, the standard error for net savings combines the standard error of gross savings and NTG ratio:

$$SE_{kWh_{net}} = \sqrt{SE_{gross}^2 * NTGR^2 + SE_{NTGR}^2 * Gross\ kWh}$$

Appendix H. Measure Analysis

This appendix describes the analyses of measures offered in Focus on Energy programs during CY 2017. It includes methodologies that the Evaluation Team followed, and describes the results applied to the CY 2017 program evaluations.

H.1. Retailer Lighting and Appliance Program

H.1.1. Lighting

Unit Energy Savings Input Details

Table H-1 provides the descriptions, values, and sources for the inputs the Program Implementer applied to estimate *ex ante* savings for the lighting component of the Retailer Lighting and Appliance Program. The Evaluation Team used items under the heading Unit Savings Inputs to calculate savings for individual bulbs and applied the items under the heading Total Savings Inputs to aggregated savings.

Table H-1. CY 2017 Lighting SPECTRUM Inputs

Input	Description	Value	Units	Source
Unit Savings Inputs				
HOU[1]	Hours of use: daily average use of CFLs and LEDs	2.73	Hours/day	2017 Wisconsin TRM
ISR	In-service rate: percentage of lights installed	n/a	-	Not applied in SPECTRUM
ΔWatts	Delta watts: difference in wattage between the efficient and baseline bulb	varies	W	2017 Wisconsin TRM
CF[1]	Coincidence factor: summer peak coincidence factor	0.116	-	2017 Wisconsin TRM
365	Days per year: conversion to annualize the daily hours of use	365	Days/year	2017 Wisconsin TRM
Total Savings Inputs				
EUL_{LED}[2]	Effective useful life: average life of a LED bulb	20.0	Years	2017 Wisconsin TRM

[1]HOU and CF include adjustments for cross-sector sales (CSS) of 6.6%.

[2]Effective useful life (EUL) values listed are for the LEDs offered by the Program and are not representative of all existing LEDs.

The Evaluation Team used the values shown in Table H-2 to calculate verified savings.

Table H-2. CY 2017 Lighting Verified Gross Inputs

Input	Description	Residential Value	Nonresidential Value	Units	Source
Unit Savings Inputs					
HOU	Hours of use: daily average use of CFLs and LEDs	2.20	10.20	Hours/day	2017 Wisconsin TRM
ISR_{LED}	In-service rate: percentage of LEDs installed	87%	87%	%	Study administered during the WI 2017 in-home audits of 120 homes. Net present value ISR accounts for bulbs installed from storage.
ΔWatts	Delta watts: difference in wattage between the efficient and baseline bulb	varies	varies	W	WI 2017 lumen equivalence analysis
CF	Coincidence factor: summer peak coincidence factor	0.069	0.770	-	2017 Wisconsin TRM
365	Days per year: conversion to annualize the daily hours of use	365	365	Days/year	2017 Wisconsin TRM
Total Savings Inputs					
CSS	Cross-sector sales: percentage of bulbs sales allocated to the residential and nonresidential sector	93.4%	6.6%	%	WI 2015 cross-sector sale analysis
EUL_{LED}	Effective useful life: average life of a LED bulb	20.0	20.0	Years	2017 Wisconsin TRM, MMID 3553-3556 and 3112

The verified inputs include 6.6% cross-sector sales because verified savings calculate residential and nonresidential savings independently then weight the savings for each residential and nonresidential measure using this percentage. The verified savings in Table H-3 show the residential, nonresidential, and weighted savings.

Table H-3. CY 2017 Verified Gross Unit Savings[1]

Measure	Residential		Nonresidential		Residential/ Nonresidential Weighted[2]	
	kWh	kW	kWh	kW	kWh	kW
LED, Reflector	37	0.003	171	0.035	46	0.005
LED, Omnidirectional, 310-749 lm	20	0.002	93	0.019	25	0.003
LED, Omnidirectional, 750-1,049 lm	24	0.002	109	0.023	29	0.003
LED, Omnidirectional, 1,050-1,489 lm	28	0.002	132	0.027	35	0.004
LED, Omnidirectional, 1,490-2,600 lm	40	0.003	185	0.038	49	0.006

[1]No gas savings are claimed for the Program.

[2]Residential and nonresidential unit savings weighted by evaluated cross-sector sales percentage

Table H-4 provides baseline and efficient wattages and the corresponding delta watts values for the *ex ante* and verified savings.

Table H-4. *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	63	12	10	53	53
LED, Omnidirectional, 310-749 lm	29	34	7	6	22	29
LED, Omnidirectional, 750-1,049 lm	43	43	11	9	32	34
LED, Omnidirectional, 1,050-1,489 lm	53	53	13	12	40	41
LED, Omnidirectional, 1,490-2,600 lm	72	72	17	15	55	57

Delta Watts Lumens Bins

This section provides details related to lumens bins, which were used when calculating verified delta watts inputs. Lumen bins for specialty bulbs are shown in Table H-5, Table H-6, and Table H-7 and are derived from the U.S. Department of Energy Uniform Methods Project (UMP).[21]

Table H-5. Globe Lumen Bins

Bin	Baseline (EISA-Impacted Bulbs)
250-349	25
350-499	29
500-574	43
575-649	53
650-1099	72
1100-1300	72

Table H-6. 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

[21] National Renewable Energy Laboratory. *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.* "Chapter 21: Residential Lighting Evaluation Protocol." Prepared by Apex Analytics, LLC. February 2015. Available online: http://energy.gov/sites/prod/files/2015/02/f19/UMPChapter21-residential-lighting-evaluation-protocol.pdf

Table H-7. EISA-Exempt Lumen Bins (3-way, post lamps, etc.)

Bin	Baseline (Exempt Bulbs)
0-309	25
310-449	25
450-799	40
800-1099	60
1100-1599	75
1600-1999	100
2000-2600	150
2601-3300	150
3301-4815	200

Market Characterization Tables

This section provides details for the pricing comparison from three retailers—DIY-2, Mass-Market-1, and Mass-Market-2. Table H-8 shows the distribution of prices by retailer, bulb category, technology, and the number of unique products observed in each category in July 2017. Observations were included in the report chapter for October and December, but July was not included because retailer DIY-1 did not have data for this period (and therefore the Evaluation Team could not compare prices between a retailer with identified program bulbs and comparison retailers with no Program-supported LEDs). Table H-9 and Table H-10 show the same information in October and December, respectively.

Table H-8. July 2017 Per-bulb Prices by Retailer, Technology, and Category

Category	Retailer	Technology	Unique Model Count	Price Per Bulb			
				Minimum	Mean	Median	Maximum
A-line	DIY - 2	CFL	9	$1.66	$3.85	$2.50	$10.98
		Halogen	23	$0.86	$2.23	$2.00	$3.25
		Incandescent	19	$0.99	$2.50	$1.89	$4.98
		LED	40	$0.89	$6.70	$4.98	$19.98
	Mass-market - 1	CFL	1	$19.99	$19.99	$19.99	$19.99
		Halogen	19	$1.25	$2.35	$2.00	$4.65
		Incandescent	9	$1.65	$4.60	$2.79	$13.49
		LED	53	$2.50	$8.86	$8.10	$19.79
	Mass-market - 2	CFL	3	$0.75	$3.22	$3.94	$4.97
		Halogen	26	$0.99	$2.39	$1.55	$8.23
		Incandescent	6	$1.17	$3.01	$2.56	$5.97
		LED	82	$1.00	$5.18	$3.93	$18.34
Reflector	DIY - 2	CFL	2	$3.66	$4.58	$4.58	$5.49
		Halogen	32	$2.69	$6.84	$7.74	$10.98
		Incandescent	14	$0.29	$5.00	$4.48	$14.49
		LED	74	$3.00	$11.43	$9.98	$33.73
	Mass-market - 1	Halogen	9	$3.83	$7.40	$7.75	$10.19
		Incandescent	10	$3.33	$7.50	$6.53	$16.99
		LED	14	$5.40	$11.95	$11.10	$21.49
	Mass-market - 2	CFL	1	.	.	.	.
		Halogen	13	$1.00	$5.61	$4.94	$15.44

Category	Retailer	Technology	Unique Model Count	Price Per Bulb			
				Minimum	Mean	Median	Maximum
		Incandescent	3	$2.47	$5.22	$5.22	$7.97
		LED	53	$1.25	$6.51	$4.95	$24.84
Specialty	DIY - 2	Halogen	8	$1.89	$2.86	$2.99	$3.98
		Incandescent	77	$0.99	$3.25	$2.41	$12.98
		LED	45	$1.39	$7.40	$7.98	$14.98
	Mass-market - 1	Halogen	5	$1.25	$2.38	$2.66	$2.75
		Incandescent	22	$0.99	$1.70	$1.40	$3.33
		LED	31	$5.59	$9.63	$8.89	$16.99
	Mass-market - 2	CFL	2	.	.	.	.
		Halogen	7	$0.75	$1.14	$1.09	$1.63
		Incandescent	8	$1.29	$3.54	$1.88	$11.60
		LED	58	$1.00	$4.27	$3.74	$9.84

Table H-9. October 2017 Per-Bulb Prices by Retailer, Technology, and Category

Category	Retailer	Technology	Unique Model Count	Price Per Bulb			
				Minimum	Mean	Median	Maximum
A-line	DIY - 2	CFL	9	$1.66	$3.85	$2.50	$10.98
		Halogen	21	$0.28	$2.18	$2.00	$3.25
		Incandescent	19	$0.93	$2.49	$1.89	$4.98
		LED	34	$0.64	$6.21	$4.78	$18.07
	Mass-market - 1	Halogen	17	$1.25	$2.35	$2.00	$4.65
		Incandescent	7	$1.63	$2.36	$2.50	$3.12
		LED	92	$3.00	$9.81	$8.00	$19.99
	Mass-market - 2	CFL	1	.	.	.	.
		Halogen	20	$0.99	$3.03	$1.55	$8.23
		Incandescent	3	$1.17	$1.50	$1.19	$2.13
		LED	75	$1.00	$5.46	$3.92	$19.78
Reflector	DIY - 2	CFL	2	$2.79	$3.49	$3.49	$4.19
		Halogen	30	$2.77	$6.34	$6.98	$9.98
		Incandescent	14	$0.71	$5.01	$4.48	$14.20
		LED	73	$2.47	$10.64	$9.98	$25.98
	Mass-market - 1	Halogen	8	$3.83	$7.55	$7.95	$10.19
		Incandescent	7	$3.33	$6.66	$5.00	$16.99
		LED	10	$6.00	$11.24	$10.49	$18.99
	Mass-market - 2	Halogen	17	$1.00	$4.26	$3.90	$9.88
		Incandescent	1	$2.38	$2.38	$2.38	$2.38
		LED	49	$1.50	$5.54	$4.01	$18.84
Specialty	DIY - 2	Halogen	7	$1.89	$2.98	$3.12	$3.98
		Incandescent	74	$1.00	$3.30	$2.33	$13.55
		LED	39	$1.00	$7.10	$7.29	$14.98
	Mass-market - 1	Halogen	3	$2.66	$2.70	$2.70	$2.75
		Incandescent	19	$1.00	$1.55	$1.25	$3.33
		LED	51	$5.00	$8.95	$9.99	$16.99
	Mass-market - 2	Halogen	5	$1.00	$1.31	$1.31	$1.63
		Incandescent	6	$1.00	$1.49	$1.63	$1.88
		LED	66	$1.00	$4.54	$4.25	$9.44

Table H-10. December 2017 Per-bulb Prices by Retailer, Technology, and Category

Category	Retailer	Technology	Unique Model Count	Price Per Bulb			
				Minimum	Mean	Median	Maximum
A-line	DIY - 2	CFL	9	$1.50	$3.59	$2.50	$10.09
		Halogen	17	$0.36	$1.92	$1.79	$3.25
		Incandescent	14	$0.82	$1.91	$1.54	$3.33
		LED	23	$0.44	$5.82	$4.10	$17.98
	Mass-market - 1	Halogen	16	$1.25	$2.18	$2.00	$4.30
		Incandescent	7	$1.65	$2.37	$2.50	$3.12
		LED	73	$3.00	$8.59	$6.05	$19.99
	Mass-market - 2	CFL	3	$5.00	$8.95	$8.95	$12.89
		Halogen	22	$0.99	$3.60	$1.91	$11.93
		Incandescent	3	$1.56	$4.80	$2.62	$10.21
		LED	81	$0.89	$5.85	$4.75	$19.09
Reflector	DIY - 2	CFL	2	$2.56	$3.20	$3.20	$3.84
		Halogen	27	$2.69	$6.11	$7.09	$9.48
		Incandescent	10	$1.16	$4.58	$3.39	$13.04
		LED	61	$2.25	$10.15	$8.99	$22.90
	Mass-market - 1	Halogen	4	$1.66	$5.72	$5.51	$10.19
		Incandescent	7	$3.33	$6.77	$5.00	$16.99
		LED	11	$6.00	$11.67	$10.50	$19.99
	Mass-market - 2	Halogen	17	$1.91	$8.98	$9.03	$19.15
		Incandescent	1	$3.48	$3.48	$3.48	$3.48
		LED	56	$2.11	$8.06	$5.80	$21.99
Specialty	DIY - 2	Halogen	4	$1.70	$2.37	$1.89	$3.98
		Incandescent	69	$0.90	$3.26	$2.93	$12.98
		LED	39	$1.00	$6.64	$6.73	$13.48
	Mass-market - 1	Halogen	2	$2.66	$2.66	$2.66	$2.66
		Incandescent	17	$1.00	$1.41	$1.25	$2.79
		LED	52	$3.49	$7.06	$6.00	$13.99
	Mass-market - 2	CFL	1	.	.	.	.
		Halogen	3	$1.46	$3.91	$2.96	$7.32
		Incandescent	4	$1.97	$2.27	$2.16	$2.78
		LED	76	$0.95	$6.06	$5.77	$19.00

Table H-11 shows the customer ratings collected in July 2017 within three retailers: DIY 2, Mass-Market-1, and Mass-Market-2. Ratings for products at Mass-Market-2 stores are shown only in December 2017 because ratings were missing for all but one product per category in July and October.

Ratings for products at DIY-1 stores are shown separately since DIY-1 is the only retailer for which ratings and prices could be compared between Program-supported LEDs and other competing LEDs.

Table H-11. Customer Ratings by Month, Retailer, Technology, and Category

Month	Retailer	Technology	Category	Unique Model Count	Customer Rating		
					Minimum	Mean	Maximum
Jul-17	DIY - 2	CFL	A-line	4	3.00	3.83	4.50
		Halogen		7	1.00	3.94	5.00
		Incandescent		7	1.00	3.32	5.00
		LED		7	1.00	3.99	5.00
	Mass-Market-1	Halogen		7	1.00	4.03	5.00
		Incandescent		2	1.00	4.33	5.00
		LED		15	1.00	4.01	5.00
	DIY - 2	CFL	Reflector	2	2.50	3.00	3.50
		Halogen		7	1.00	3.63	5.00
		Incandescent		6	1.00	3.21	4.50
		LED		8	1.50	4.17	5.00
	Mass-Market-1	Halogen		3	1.00	3.50	5.00
		Incandescent		2	1.75	2.50	3.25
		LED		4	3.50	4.39	5.00
	DIY - 2	Halogen	Specialty	4	2.00	3.67	4.50
		Incandescent		8	1.00	3.87	5.00
		LED		7	1.00	3.64	5.00
	Mass-Market-1	Halogen		1	1.00	1.00	1.00
		Incandescent		10	1.00	2.81	5.00
		LED		8	1.00	3.87	5.00
Oct-17	DIY - 2	CFL	A-line	5	2.50	3.67	4.50
		Halogen		7	1.00	3.69	5.00
		Incandescent		7	1.00	3.29	5.00
		LED		7	1.00	3.91	5.00
	Mass-Market-1	Halogen		7	1.00	3.52	5.00
		Incandescent		4	2.33	3.69	5.00
		LED		13	1.00	4.19	5.00
	DIY - 2	CFL	Reflector	2	2.50	3.00	3.50
		Halogen		7	1.00	3.62	5.00
		Incandescent		6	1.00	3.23	4.50
		LED		8	1.50	4.18	5.00
	Mass-Market-1	Halogen		4	1.67	3.50	5.00
		Incandescent		1	2.11	2.11	2.11
		LED		3	3.50	4.40	5.00
	DIY - 2	Halogen	Specialty	3	2.50	3.70	4.50
		Incandescent		8	1.00	3.90	5.00
		LED		10	1.00	3.80	5.00
	Mass-Market-1	Halogen		1	1.00	1.00	1.00
		Incandescent		11	1.00	2.57	4.00
		LED		6	2.00	4.40	5.00
Dec-17	DIY - 2	CFL	A-line	5	3.00	3.83	5.00
		Halogen		7	1.00	3.31	5.00
		Incandescent		7	1.00	3.07	5.00
		LED		7	1.00	3.61	5.00
	Mass-Market-1	Halogen		7	1.00	3.45	5.00
		Incandescent		5	2.33	4.03	5.00
		LED		12	1.00	4.02	5.00
	Mass-Market-2	Halogen		10	1.00	3.46	5.00

Month	Retailer	Technology	Category	Unique Model Count	Customer Rating		
					Minimum	Mean	Maximum
		Incandescent		3	3.50	3.69	4.00
		LED		9	1.00	3.72	5.00
	DIY - 2	CFL	Reflector	2	2.50	3.00	3.50
		Halogen		6	2.00	3.71	5.00
		Incandescent		6	1.00	3.25	4.50
		LED		8	1.50	4.14	5.00
	Mass-Market-1	Halogen		1	4.33	4.33	4.33
		Incandescent		1	2.11	2.11	2.11
		LED		3	3.00	4.61	5.00
	Mass-Market-2	Halogen		7	1.00	3.74	5.00
		Incandescent		1	4.00	4.00	4.00
		LED		8	1.00	3.97	5.00
	DIY - 2	Halogen	Specialty	3	2.50	4.00	5.00
		Incandescent		8	1.00	3.91	5.00
		LED		11	2.50	3.86	5.00
	Mass-Market-1	Halogen		1	1.00	1.00	1.00
		Incandescent		10	1.00	2.57	4.00
		LED		7	1.00	4.24	5.00
	Mass-Market-2	Halogen		2	1.00	2.00	3.00
		Incandescent		2	3.00	3.60	4.20
		LED		8	2.00	4.49	5.00

The following tables present products, by technology and category, at retailer DIY-1 stores and include rated life hours, which was not consistently available for the three retailers in the previous tables in addition to prices and customer ratings. Table H-12 shows prices, Table H-13 shows customer ratings, and Table H-14 shows rated life hours.

Table H-12. Prices by Technology and Category for Retailer DIY – 1

Month	Bulb Category	Technology	Unique Model Count	Price Per Bulb			
				Minimum	Mean	Median	Maximum
Oct-17	A-Line	CFL	20	$1.29	$2.12	$1.74	$3.99
		Halogen	28	$0.81	$1.70	$1.49	$3.99
		Incandescent	37	$1.24	$2.97	$2.74	$7.78
		LED	68	$1.29	$3.66	$2.47	$15.47
		Prog LED	38	$1.11	$3.84	$2.35	$14.97
	Decorative Candle	Halogen	10	$1.99	$5.72	$5.97	$9.97
		Incandescent	24	$0.87	$1.60	$1.24	$3.97
		LED	45	$2.32	$4.26	$2.66	$8.41
		Prog LED	1	$6.97	$6.97	$6.97	$6.97
	Globe	Halogen	2	$2.66	$2.66	$2.66	$2.66
		Incandescent	24	$0.99	$2.19	$2.32	$4.47
		LED	29	$3.31	$5.56	$4.97	$11.67
	Reflector	CFL	2	$2.44	$2.44	$2.44	$2.44
		Halogen	28	$4.44	$6.34	$4.99	$15.97
		LED	81	$1.57	$8.34	$5.86	$19.97
		Prog LED	36	$1.57	$8.18	$7.07	$19.97
Dec-17	A-Line	CFL	11	$1.29	$2.04	$1.74	$3.99

Month	Bulb Category	Technology	Unique Model Count	Price Per Bulb			
				Minimum	Mean	Median	Maximum
		Halogen	20	$0.97	$1.62	$1.49	$2.74
		Incandescent	34	$1.24	$3.03	$2.97	$7.68
		LED	52	$0.24	$3.85	$2.39	$11.22
		Prog LED	37	$1.07	$3.61	$1.52	$14.67
	Decorative Candle	Halogen	9	$1.99	$6.09	$5.99	$9.97
		Incandescent	22	$0.87	$1.58	$1.24	$3.97
		LED	25	$2.32	$2.93	$2.98	$7.78
		Prog LED	1	$6.97	$6.97	$6.97	$6.97
	Globe	Halogen	2	$2.66	$2.66	$2.66	$2.66
		Incandescent	15	$0.99	$2.09	$2.32	$4.47
		LED	23	$3.31	$4.77	$4.66	$11.67
	Reflector	CFL	1	$2.44	$2.44	$2.44	$2.44
		Halogen	26	$4.97	$6.99	$5.99	$15.97
		LED	70	$2.78	$8.66	$7.44	$19.97
		Prog LED	36	$2.71	$6.58	$4.38	$19.97

Table H-13. Customer Ratings by Technology and Category for Retailer DIY - 1

Month	Bulb Category	Technology	Unique Model Count	Customer Rating			
				Minimum	Mean	Median	Maximum
Oct-17	A-Line	CFL	20	3.30	3.89	4.00	4.60
		Halogen	28	1.00	2.54	2.00	4.30
		Incandescent	37	1.00	3.62	3.80	5.00
		LED	68	1.00	3.79	4.40	4.90
		Prog LED	38	3.00	4.23	4.10	5.00
	Decorative Candle	Halogen	10	1.80	3.65	3.70	4.20
		Incandescent	24	1.00	4.02	4.20	5.00
		LED	45	3.20	4.23	4.10	5.00
		Prog LED	1	4.50	4.50	4.50	4.50
	Globe	Halogen	2	4.20	4.20	4.20	4.20
		Incandescent	24	3.00	4.13	4.00	5.00
		LED	29	3.10	4.27	4.40	5.00
		Halogen	28	1.00	3.13	3.80	5.00
		LED	81	2.00	4.30	4.40	5.00
		Prog LED	36	1.00	4.17	4.30	5.00
Dec-17	A-Line	CFL	11	3.40	3.96	4.10	4.50
		Halogen	20	1.00	2.65	2.20	4.30
		Incandescent	34	1.00	3.87	3.90	5.00
		LED	52	2.00	4.25	4.40	5.00
		Prog LED	37	3.80	4.29	4.40	4.70
	Decorative Candle	Halogen	9	1.80	3.75	3.80	5.00
		Incandescent	22	1.00	4.03	4.20	5.00
		LED	25	3.20	4.15	4.10	5.00
		Prog LED	1	4.50	4.50	4.50	4.50
	Globe	Halogen	2	4.20	4.20	4.20	4.20
		Incandescent	15	2.80	4.14	4.00	5.00
		LED	23	2.70	4.17	4.40	5.00
		Halogen	26	2.60	3.55	3.90	5.00

Month	Bulb Category	Technology	Unique Model Count	Customer Rating			
				Minimum	Mean	Median	Maximum
		LED	70	1.50	4.41	4.50	5.00
		Prog LED	36	2.30	4.17	4.20	5.00

Table H-14. Rated Life Hours by Technology and Category for Retailer DIY - 1

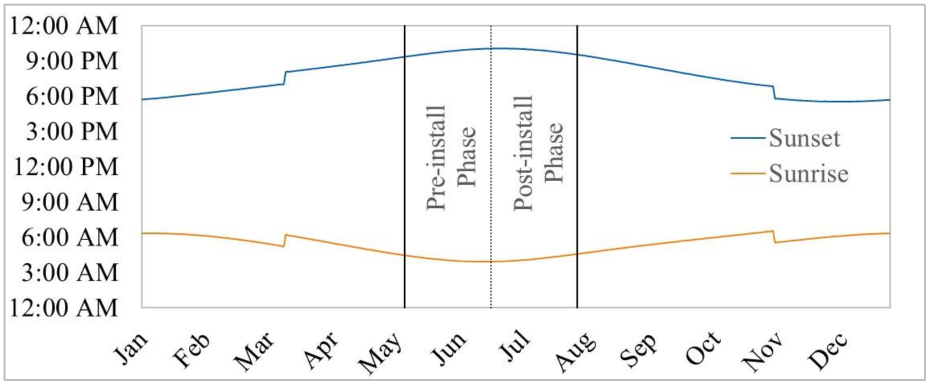
Month	Bulb Category	Technology	Unique Model Count	Life Hours			
				Minimum	Mean	Median	Maximum
Oct-17	A-Line	CFL	20	8,000	10,379	10,000	12,000
		Halogen	28	985	1,408	1,000	2,000
		Incandescent	37	500	2,013	1,750	3,500
		LED	68	1,100	13,474	11,000	25,000
		Prog LED	38	23	18,741	15,000	25,000
	Decorative Candle	Halogen	10	1,000	1,732	2,000	2,500
		Incandescent	24	30	2,219	3,000	3,000
		LED	45	1,500	14,351	15,000	25,000
		Prog LED	1	25,000	25,000	25,000	25,000
	Globe	Halogen	2	2,500	2,500	2,500	2,500
		Incandescent	24	1,500	2,210	1,500	4,000
		LED	29	15,000	20,000	20,000	25,000
	Reflector	Halogen	28	1,100	1,665	1,100	6,000
		LED	81	10,000	25,718	25,000	50,000
		Prog LED	36	25,000	25,000	25,000	25,000
Dec-17	A-Line	CFL	11	8,000	10,379	10,000	12,000
		Halogen	20	985	1,207	1,000	2,000
		Incandescent	34	500	1,996	1,750	3,500
		LED	52	1,100	14,134	11,000	25,000
		Prog LED	37	23	19,618	15,000	25,000
	Decorative Candle	Halogen	9	1,000	1,699	2,000	2,500
		Incandescent	22	30	2,200	3,000	3,000
		LED	25	10,000	14,312	15,000	25,000
		Prog LED	1	25,000	25,000	25,000	25,000
	Globe	Halogen	2	2,500	2,500	2,500	2,500
		Incandescent	15	1,500	2,087	1,500	3,000
		LED	23	15,000	21,000	25,000	25,000
	Reflector	Halogen	26	1,100	1,847	1,100	6,000
		LED	70	10,000	24,154	25,000	35,000
		Prog LED	36	25,000	25,000	25,000	25,000

H.2. Connected Devices Kit

The Connected Devices Kit Program offers customers in rural zip codes a free connected home kit containing an advanced power strip (APS) and a connected lighting system. Because existing research on savings from connected home kit products was limited, Focus on Energy partnered with Madison Gas and Electric (MGE) in early 2017 to develop a study for the Evaluation Team to assess in-home savings from both the APS and the connected lighting system.

A common issue in short-term residential lighting metering studies is normalizing hours of use for daylight variations throughout a calendar year. In other words, people use lights more on days with shorter daylight hours. To normalize this effect in the study, the Evaluation Team designed the logging period to straddle the summer solstice. See Figure H-1 for a graphical depiction of the study timeline.

Figure H-1. Graphical Depiction of Study Timeline Imposed on Annual Sunlight Chart for Madison



The figure depicts the sinusoidal nature of sunrise and sunset hours, with one-hour offsets visible during the daylight savings start and end dates. Pre-installation metering began six weeks prior to the summer solstice (the dotted line in Figure H-1). On the summer solstice (June 21), participants received a home energy kit and installed the connected lighting system and the APS. The Team provided instructions to help participants set up communication of the products with their smart devices and included a phone number to help troubleshoot the installation if required. The post-installation phase lasted six weeks to ensure that the average daylight hours in each phase was equal.

The Team recruited 88 MGE customers for the study and coordinated with them through email, phone, mailings, and site visits to install energy data loggers in their homes for the 12-week data-logging study. The Team installed three 120-volt plug load data loggers in each home: one logger for the entertainment system power strip and two loggers on plug-in lamps.

H.2.1. Connected Lighting System

The connected lighting system offered through the Focus on Energy program includes two medium screw base LED bulbs and a wireless hub. The hub connects to the user's Wi-Fi router via an ethernet cable and syncs with the LEDs via Zigbee communication protocol. Using an app on a smart phone or tablet, the homeowner can interact wirelessly with the installed lightbulbs. The energy-savings potential for the lighting system derives from three sources:

- ***Wattage reduction.*** The simple replacement of a lightbulb with a more efficient LED will result in a power reduction for all hours of use.
- ***Dimming capability.*** The additional controls present in the smart phone/tablet app enable the user to reduce the luminosity of the connected lighting, therefore offering further power reduction based on homeowner preference.

- ***Lighting schedules.*** Another connected lighting control allows homeowners to set automatic on and off times based on their schedules. Homeowners can achieve savings by automatically turning off lights that might otherwise have remained on. The savings potential for lighting schedules in residential applications is highly dependent on homeowner behavior and can also cause an increase in consumption in some cases. For example, a homeowner can set the lights to turn on automatically before arriving at home or keep a light on when not in use.

Because it is clearly established that connected lighting will achieve savings because of the reduction in wattage, this study focused on measuring the savings achieved from dimming capability and lighting schedules.

Analysis

To assess the savings that come from increased connectivity, the Team first calculated and isolated the savings from wattage reduction. Because the study collected actual wattage values for the lamps, this was as simple as identifying the wattage of the existing bulbs from measured data. The measured existing bulb wattage minus the known efficient bulb wattage supplied simple wattage reduction, which could be combined with baseline usage patterns to find energy savings from wattage reduction.

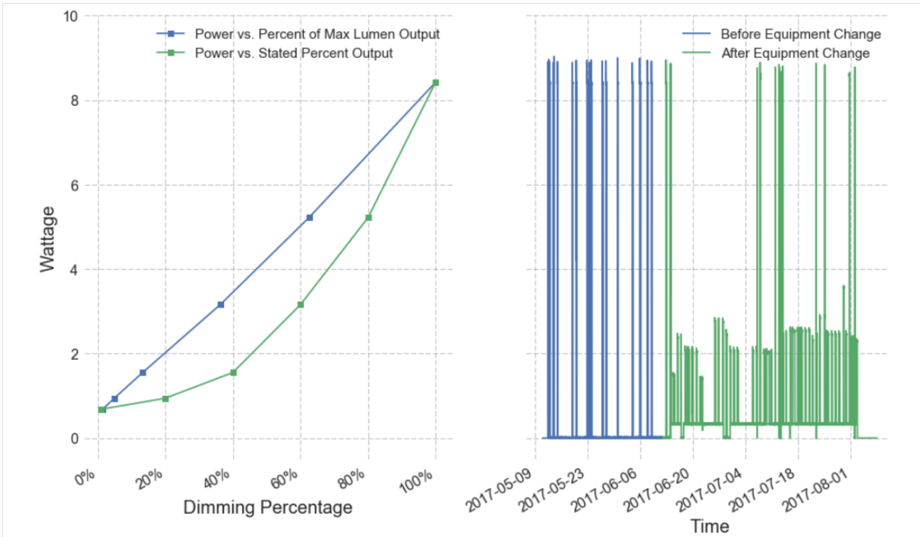
The connected lighting technology introduced the potential for further energy reduction by its dimming capability in previously non-dimmable sockets and by allowing the homeowner to implement lighting schedules. connected lighting also introduces two additional power draws that are not associated with standard lighting: the power draw of the hub and the standby wattage of the connected LEDs when they have been turned off through the app.

To calculate savings from dimming, the average run time wattage was subtracted by the maximum known power draw of the lamp then extrapolated over the run time of the lamp. This assumes that the run time of the lamp would not have changed if the lamp was not dimmable. The plot on the right side in Figure H-2 shows an example of one lamp that was dimmed frequently and to a significantly lower wattage than the full wattage output of the lamp.

The graph on the left in Figure H-2 shows the power input versus the percentage of total lumens, as well as versus the technology's stated "dimming percentage." Although lumen meters (blue line) confirmed linearity between lumen reduction with power reduction, the technology's stated dimming percentage (green line) depicts an exponential relationship to power reduction. When the participant on the right set the dimming level to 50% on the device app, the actual lumen and wattage output reduced to 30% of maximum levels.

Energy savings from the implementation of a lighting schedule posed a more complicated problem, requiring more nuanced assumptions. The two drivers of run time changes from connected lighting were the ability to turn off lights through the application and the ability to set a timer through the application. In contrast to the dimming feature, it was not entirely clear at the outset of the study whether these capabilities would cause run time to increase or decrease. Both were lumped together and analyzed by looking at the duration before and after the change to the efficient lighting was made.

Figure H-2. Power Consumption Versus Dimming Percentage (left) and Example of Frequently Dimmed LED (right)



Derivation of Energy-Savings Equations for Connected Lighting System

Equation 1 summarizes the relationship between the four elements that make up the savings from the connected lighting system:

Equation 1

$$Eq.1: \quad \Delta E_{total} = \Delta E_{wattage} + \Delta E_{dimming} + \Delta E_{schedule} - \Delta E_{stdby}$$

Where:

ΔE_{total} = Total energy reduction per bulb attributed to the connected lighting system

$\Delta E_{wattage}$ = Energy reduction per bulb due to the wattage reduction

$\Delta E_{dimming}$ = Energy reduction per bulb due to increased dimming capability

$\Delta E_{schedule}$ = Energy reduction per bulb due to lighting schedules

ΔE_{stdby} = Energy increase per bulb due to standby consumption

Using standard efficient lighting equations derived from the conservation of energy, the Team further derived equations 2 through 5:

Equation 2

$$Eq.2: \quad \Delta E_{wattage} = \left(P_{pre} - P_{post,100\%}\right) * h_{pre}$$

Where:

P_{pre} = Pre-installation power consumption of baseline bulb

$P_{post,100\%}$ = Wi-Fi LED[22] power consumption at 100% lumen output

h_{pre} = Average annual hours of use of pre-installation lighting

Equation 3

$$Eq.3: \quad \Delta E_{dimming} = P_{post,100\%} * h_{pre} * \%\Delta P_{dim} * (1 - \%\Delta h)$$

Where:

$\%\Delta P_{dim}$ = Average percent power reduction of Wi-Fi LED bulbs due to dimming capability

$= 1 - \left(\frac{P_{post,dimmed}}{P_{post,100\%}}\right)$

$\%\Delta h$ = Average percent hours of use reduction of Wi-Fi LED bulbs due to scheduling capability

$= 1 - \left(\frac{h_{post}}{h_{pre}}\right)$

Equations 4 and 5

$$Eq.4: \quad \Delta E_{schedule} = P_{post,100\%} * h_{pre} * \%\Delta h$$

$$Eq.5: \quad \Delta E_{stdby} = P_{stdby} h_{stdby}$$

Where:

P_{stdby} = Standby power consumption of Wi-Fi LED bulbs

h_{stdby} = Annual standby hours of Wi-Fi LED bulbs

By substituting equations 2 through 5 into Equation 1, and cancelling like terms, the Team minimized the energy balance to Equation 6, which depicts the simplified lighting algorithm we would expect for the lighting system:

Equation 6

$$Eq.6: \quad \Delta E_{total} = P_{pre}(h_{pre}) - P_{post,dimmed}(h_{post}) - P_{stby}(h_{stby})$$

Where:

$P_{post,dimmed}$ = Average dimmed power consumption of Wi-Fi LEDs

h_{post} = Average annual hours of Wi-Fi LED use

[22] Wi-Fi LED refers to the LED bulbs included in the connected lighting system

To ascertain the full energy-savings profile from the connected lighting system, the Team must consider the single hub load connected to all the lamps, which presumably will be present only when the user has installed the mobile app as well. This means the savings beyond the simple wattage reduction of lamps in a home with the connected technology successfully configured can be described in equation 7 by the following:

Equation 7

$$Eq.7 \quad \Delta E_{App} = \left(\Delta E_{dimming} + \Delta E_{schedule} - \Delta E_{stby}\right) * N - (P_{hub} * 8{,}760)$$

Where:

ΔE_{app} = Energy reduction associated with smart phone/table app use

P_{hub} = Power consumption of communications hub

N = Number of installed Wi-Fi LEDs

When rolling up the results to expected savings in a kit program, there would be two in-service rates (ISRs): bulbs and mobile app. As stated previously, savings from watt reduction occurs as long as the lamps are installed in the owner's home, and the savings would depend solely on the bulb ISR. From there, the final expected savings from the kits can be defined in Equation 8 as follows:

Equation 8

$$Eq.8 \quad \Delta E_{Lighting\ System\ Gross} = ISR_{Bulb} * \Delta E_{wattage} + ISR_{App} * \Delta E_{App}$$

Results

For several reasons, it is important to compartmentalize savings into their various components. The main reason is to understand how energy savings will scale depending on the baseline bulb wattage and the number of bulbs installed on a hub. Table H-15 depicts the breakdown of energy savings by two baseline assumptions: the minimum federal baseline based on lumen output (43 watts) and a traditional LED without the capabilities present in the connected lighting app.

Table H-15. Annual Energy Savings from connected lighting technology

Savings source	Unit	Savings Based on Replacing a Single 43W Halogen		Savings Based on Replacing a Single 9.5W Traditional LED	
		Annual kWh	% Savings of Baseline	Annual kWh	% Savings of Baseline
$\Delta E_{wattage}$	Per lamp	27.77	78%	0.00	0%
$\Delta E_{dimming}$	Per lamp	0.83	2%	0.83	11%
$\Delta E_{schedule}$	Per lamp	0.32	1%	0.32	4%
ΔE_{stby}	Per lamp	-0.05	-0.1%	-0.05	-1%
ΔE_{hub}*	Per home	-14.37	-40%	-14.37	-182%
Total		**14.50**	**41%**	**-13.27**	**-168%**

*ΔEhub = (Phub *8,760)

By replacing a single federal minimum baseline bulb with a Wi-Fi LED, average savings are immediate (14.5 kWh), but it is mostly based on the wattage reduction from installing a more efficient lighting technology, not from the connected lighting controls. For a homeowner who replaces a traditional LED with a Wi-Fi LED, the energy consumption of the hub, on average, negates any of the savings from connected lighting controls. However, because the dimming and scheduling savings are on a per-lamp basis, one begins to see positive savings when 14 Wi-Fi lamps are installed on a hub:

$$Annual\ kWh\ savings = 14 * (0.83 + 0.32 - 0.05) - 14.37 = 1.03$$

The energy-savings potential available now from this technology may change drastically in the future as interconnectedness takes over in the modern home, and as telecommunication technologies improve. As LED saturation increases in homes, the baseline wattage will be lower, affecting the savings from wattage reduction. Therefore, a hub-less connected lighting system offers better longevity of energy savings because it would essentially reduce the additional 14.37 annual kWh from the hub to zero, and connected lighting could achieve 1.1 annual kWh savings (0.83+0.32-0.05) per installed lamp when compared to a traditional LED. An Evaluation Team laboratory test further supported this potential by determining that the bulb standby of a hub-less system was essentially the same as the bulb standby power of the product used in this study (0.3 watts).

H.2.2. Tier 2 APS

The Tier 2 APS offered in the kit incorporates Bluetooth-enabled communication with the user's smart phone or tablet. The functionality that provides potential energy savings is specific to entertainment systems and is not appropriate for home office setups. The APS has two types of outlets that, when used properly, can achieve electric savings:

- ***Uncontrolled outlets*** are meant for entertainment system appliances that require constant access to power for the user. Examples include internet modems/routers and DVRs. The cable box is another common appliance that users prefer to leave uncontrolled due to the long reboot time required after power is reconnected.
- ***Controlled outlets*** are meant for appliances that do not need constant access to power and are instantly functional when power is back. The APS will cut power to the appliances in the controlled outlets during idle-use periods to remove standby power. Examples of appliances commonly used in the controlled outlets include televisions, DVD players, A/V equipment, and gaming systems.

To achieve any energy savings, the user must use appliances in the controlled outlets. There are two ways the APS achieves energy savings with the controlled outlets:

- ***Phantom load reduction.*** The APS has load-sensing capabilities that will shut power off to the controlled outlets when it senses a large wattage drop that lasts several seconds (e.g., when a user shuts the television off after viewing).
- ***Idle hours reduction.*** The APS is equipped with an infrared sensor. If the infrared sensor does not detect any use from a remote-control device for a predefined amount of time, it will cut power to the controlled outlets. The user has a choice of timer length, and the user also receives a visual warning when the power is going to be shut down.

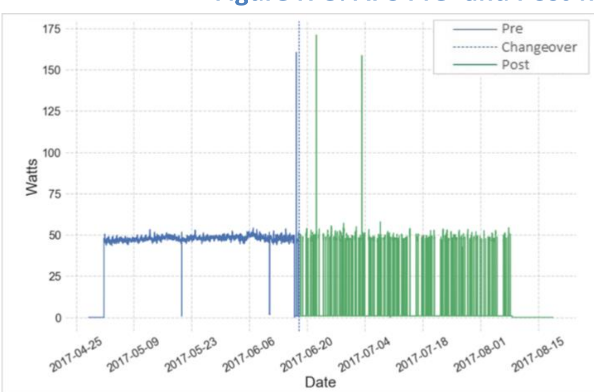
The APS smart phone/tablet app connects to the device via Bluetooth and allows the user to view real-time power consumption of the APS, choose the timer length, and manually control power to the controlled outlets.

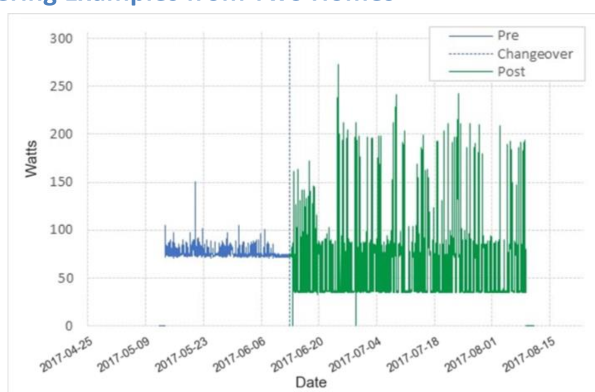
Analysis

Analysis of energy savings for the APS posed its own unique set of challenges, because a variety of factors could affect the energy reduction observed. The analysis of energy savings for APS relied on direct wattage measured and on survey responses from participants. The survey responses guided the analysis, helping to identify if end uses were moved on or off the APS during the metering period.

An advantage of the APS technology is that the equipment is exclusively energy saving, whereas part of the analysis challenge with connected lighting was that usage is vulnerable to increase. In certain situations, like the plot on the *left side* of Figure H-3, it was clear that the APS had driven energy savings during hours of low occupancy. This participant indicated that the loads on the APS remained the same for both pre- and post-installation. The consistent power draw during use periods seems to confirm that this was the case. In this situation, the participant obtained an energy reduction of more than 81% after the installation of the APS.

Figure H-3. APS Pre- and Post-Metering Examples from Two Homes





The challenges with the APS analysis arose from the tendency of participants to relocate loads. A visual inspection of the meter data on the *right side* of Figure H-3 clearly shows that the participant did not keep a consistent device configuration after the APS was installed. In fact, survey data showed that the participant added several devices—including a smart TV media player, a video game system, and audio speakers—during the post-install phase. Even though this case most likely resulted in energy savings for the user (assuming the added devices were not controlled in the baseline period), the savings could not be analyzed. Baseline usage on the power meter was not representative of the post-install setup. Similarly, the tendency of participants to relocate loads (due to the limit of two uncontrolled outlets) caused data attrition. The end uses added by the user on the *right side* of Figure H-3 were also commonly removed from the APS in the beginning of the post-installation phase. Although the APS instructions recommended that these devices be connected to a controlled outlet, many participants preferred them to be uncontrolled.

Survey results and specific analytical methods provided insights into any alterations from the original sample. Of the full sample in the study (88 participants), approximately 35% of APS users were lost to attrition (27% of participants relocated loads, and 8% of participants did not return their loggers in the specified time-window). Another 15% of the users did not install the APS (common reasons being that it did not fit in the desired location or it did not have enough uncontrolled outlets), leading to about 50% of meaningful pre-post data to analyze for savings.

Derivation of Energy-Savings Equations for Tier 2 APS System

The energy equation was simplified significantly for the APS relative to the connected lighting, primarily because of the type of technology. There were no indicators to differentiate between the two energy savings functions (phantom load reduction and idle-hours reduction), and the difficulty in distinguishing between them outweighed the need to disaggregate the savings. Thus, the impacts from the two functions were reported as combined savings in Equation 9 below.

Equation 9

$$Eq. 9 \quad \Delta Wh_{APS\ Gross} = ISR_{APS} * \Delta Wh_{APS}$$

Results

For the APS technology, a larger energy-savings figure was found, driven by some participants who realized major savings. For the half of participants with meaningful pre- and post-installation data, an average 33% energy reduction was realized on home entertainment systems (356 kWh of pre-installation annual consumption). The savings are not gross, because they do not consider the ISR. The Evaluation Team's early findings from program surveys showed that 45% of participants either removed or did not install the APS device, but a true evaluation at a larger scale is recommended to determine a more representative value for a general population ISR. This study's pre-ISR savings are consistent with other studies on Tier 2 APS devices, which found a range of 20% to 51% savings with annual baseline consumption ranging from 432 kWh to 679 kWh per year.

H.2.3. Participant Feedback

Results from the feedback surveys depicted a general trend of greater user satisfaction and engagement with the connected lighting system compared with the APS. Questions regarding both products focused on customer interaction with the devices themselves and the associated smart device apps that control them.

Results regarding products

The APS devices had a lower installation rate compared with the connected lighting system (85% vs. 90%). Additionally, the reasons for not installing the APS had more to do with the characteristics of the technology (e.g., unit would not fit in desired location, user did not want timed control on television), whereas other considerations affected the connected lighting installation (e.g., users waiting for other bulbs to burn out first). Furthermore, after the study, 30% of survey respondents removed the APS, while only 3% chose to remove the connected lighting system. When asked if they would recommend the products to friends or family, 79% of respondents said they would recommend the connected lighting system compared to only 32% of respondents who said they would recommend the APS.

The main reported drawback of the APS was the idle-use sensing function. For this function to properly reduce idle hours, the device requires users to interact with the device and adjust their behavior. Users must turn on the APS every time before powering up the television, and they must engage with the television remote when they receive the shut-down warning. Because users cannot deactivate the idle-use reduction (timer) function, they tend to remove the device if they are unsatisfied with its operation. On the other hand, users interact with the connected lighting system only when they want to do so. They can treat the bulbs as traditional LEDs on a wall or fixture switch unless they decide to dim or apply a timer. The technology does not require any behavior change to interact with the system on a day-to-day basis and, therefore, has better potential for installation persistence.

Respondents cited issues with the idle-use reduction function as the feature they liked the least about the APS. The feature they liked the most about the APS was that it saves energy. For the connected lighting system, respondents most commonly liked the added convenience and control of lighting, while the most commonly reported drawback was a belief that the systems would be too expensive. The fact that these home energy kits are free encourages installation of the connected lighting systems (by making them more affordable), but it can also result in low installation rates of APSs because users will likely be unfamiliar with their operation and more willing to remove them.

Results regarding smart device apps

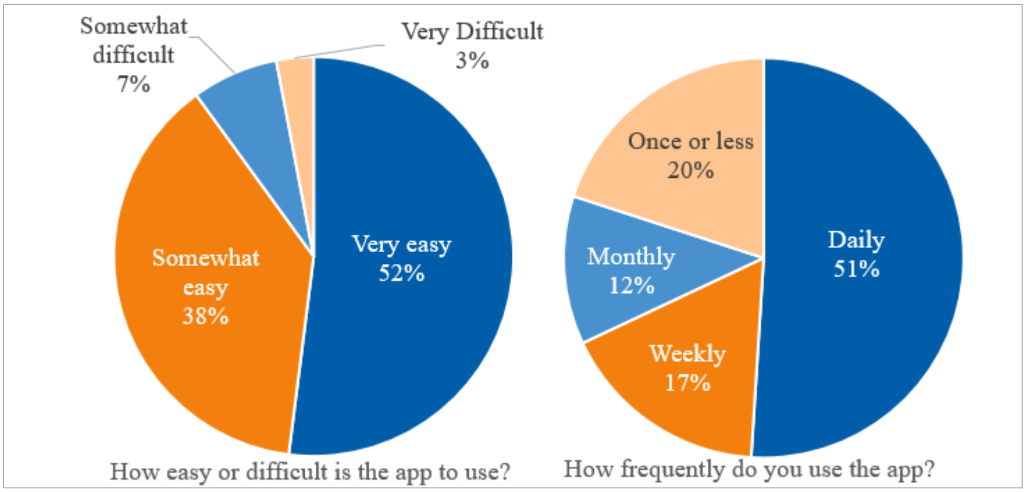
The download rates for the smart phone/tablet apps in this study were 74% for the APS and 84% for the connected lighting systems. Most participants who did not download the apps said they were either not aware of the app or did not think it was necessary to download it. Participants received multiple mailings describing the scope of the study and instructions for using the products, so these responses illustrate the need for better energy and product education for kit recipients.

It is important to note that the APS app is not vital to achieving energy savings. All energy-saving functions in the APS app are present in the user interface on the APS itself. The added benefit of the app is that users can view real-time power consumption and can control timer settings remotely. Conversely, the only way users can achieve dimming and scheduling savings from the connected lighting system is by directly using the app. Therefore, low download rates have more negative effects on savings for the connected lighting than for the APS device.

For participants who downloaded the apps, the study’s follow-up survey asked them about ease and frequency of use. These questions can help illustrate potential for connected lighting savings persistence over time, because users need to continue to interact with the app to achieve savings. Figure H-4 summarizes the results for these two questions regarding the connected lighting app.

Roughly half of respondents claimed that the app was “very easy” to use. Likewise, about half of respondents used the app daily. As expected, there is a correlation between the simplicity of technology and how often users engage with it. This illustrates the point that the usability of the technology needs to be simple and easy to learn to ensure that connected home products succeed in providing energy savings to customers in the long term.

Figure H-4. Connected Lighting App Survey Results Regarding User Engagement



H.3. Appliance Recycling Program

In CY 2017, the Evaluation Team estimated the per-unit savings estimates for recycled refrigerators and freezers analysis using the same meter data and multivariate regression models as in the CY 2013-2015 evaluations.

H.3.1. Regression Models

Table H-16 shows the model specification the Team used to estimate annual energy consumption of refrigerators recycled in CY 2017 along with the model's estimated coefficients.

Table H-16. Refrigerator UEC Regression Model Estimates (Dependent Variable = Average Daily kWh, R-square = 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 (ft.^{3})	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 HDDs	-0.04	0.000
Interaction: Unconditioned Space x CDDs	0.03	0.239

Table H-17 details the final model specifications the Team used to estimate energy consumption of participating freezers recycled, along with the results.

Table H-17. Freezer UEC Regression Model Estimates (Dependent Variable = Average Daily kWh, R-square = 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 (ft.^{3})	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

H.3.2. Extrapolation

After estimating the final regression models, the Evaluation Team analyzed the corresponding characteristics (i.e., the independent variables) for participating appliances as they were captured in the Program Administrator's program database.[23] Table H-18 summarizes program averages or proportions for each independent variable.

Table H-18. CY 2017 Participant Mean Explanatory Variables

Appliance	Independent Variables	Participant Population Mean Value
Refrigerator	Age (years)	22.76
	Dummy: Manufactured Pre-1990	0.25
	Size (sq.ft.)	17.93
	Dummy: Single Door	0.04
	Dummy: Side-by-Side	0.15
	Dummy: Primary	0.38
	Interaction: Unconditioned Space x HDDs[1]	7.1
	Interaction: Unconditioned Space x CDDs[1]	0.5
Freezer	Age (years)	26.76
	Dummy: Manufactured Pre-1990	0.42
	Size (sq.ft.)	16.77
	Dummy: Chest Freezer	0.35
	Interaction: Unconditioned Space x HDDs[1]	8.11
	Interaction: Unconditioned Space x CDDs[1]	0.57

[1] CDDs and HDDs derive from the weighted average from Typical Meteorological Year (TMY3) data for weather stations that the Evaluation Team mapped to participating appliance zip codes. TMY3 uses median daily values for a variety of weather data collected from 1991–2005.

Using the values from Table H-16, Table H-17, and Table H-18, the Evaluation Team estimated the *ex post* annual UEC of the average refrigerator and freezer participating in the Program. Table H-19 shows the estimated *ex post* estimates.

[23] These data were not available in SPECTRUM. The Evaluation Team requested and received these data from ARCA in February 2018.

Table H-19. Average UEC by Appliance Type

Appliance	*Ex Post* Annual UEC (kWh/year)	Relative Precision (90% Confidence)
Refrigerators	962	11%
Freezers	926	22%

H.3.3. 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 it 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 its 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 0.46, or five months. Freezers operating part time had a part use factor of 0.26, or three months.

These three steps resulted in information about how refrigerators and freezers operated prior to recycling, as shown in Table H-20.

Table H-20. Historical Part-Use Factors by Category

Usage Type and Part-Use Category	Percentage of Recycled Units	Part-Use Factor	Per-Unit Energy Savings (kWh/Yr)
Secondary Refrigerators Only			**n = 61**
Not in Use	8%	0	0
Used Part Time	21%	0.46	443
Used Full Time	70%	1.00	962
Weighted Average		**0.80**	**766**
All Refrigerators (Primary and Secondary)			**n = 99**
Not in Use	5%	0	0
Used Part Time	13%	0.46	443
Used Full Time	82%	1.00	962
Weighted Average		**0.88**	**846**
All Freezers			**n = 70**
Not in Use	16%	0	0
Used Part Time	11%	0.26	241
Used Full Time	73%	1.00	926
Weighted Average		**0.76**	**702**

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 (0.88) 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-20 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-21, produced the CY 2017 part-use factor for refrigerators (0.86, down slightly from 0.88 in CY 2015) and freezers (0.76, up from 0.73 in CY 2015). Changes in both refrigerator and freezer part-use were small and not statistically different from CY 2015.

Table H-21. 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)	1.00	3%
	Kept (as secondary unit)	0.80	7%
	Discarded	0.88	28%
Secondary Refrigerators	Kept	0.80	37%
	Discarded	0.88	25%
Overall		**0.86**	**100%**
Freezers	Kept	0.76	52%
	Discarded	0.76	48%
Overall		**0.76**	**100%**

Applying the part-use factors from Table H-21 to the modeled annual consumption from Table H-18 yields the average gross per-unit energy savings. Table H-22 shows that the average gross savings for refrigerators is 825 kWh and the average gross savings for freezers is 702 kWh.

Table H-22. Per-Unit Gross Energy Savings by Measure

Appliance	Average Per-Unit Annual Energy Consumption (kWh/Year)	Part-Use Factor	Adjusted Per-Unit Gross Energy Savings (kWh/Year)	Precision at 90% Confidence
Refrigerators	962	0.86	825	±13%
Freezers	926	0.76	702	±24%

H.4. Methodology for Estimating Strategic Energy Management Program Energy Savings

The Evaluation Team estimated electric and natural gas savings for six facilities that participated in the CY 2017 Strategic Energy Management Program. For each facility, the Team verified the Program Implementer's regression models and savings estimates, evaluated facility energy savings using independent models developed by the Evaluation Team, and calculated realization rates to compare evaluated savings to the Implementer's energy savings estimates. The next sections describe these activities in detail.

H.4.1. Facility-Level Savings Estimation

The Evaluation Team estimated electric and natural gas participant facility savings for each facility using a regression-based approach. It modeled energy consumption as a function of weather and production variables observed during the baseline period (the 12 months prior to Strategic Energy Management Program participation) then used that model to predict the energy consumption expected during the performance period (the 12 months following Program matriculation). The result provided an adjusted baseline, or the energy consumption expected during the performance period in the absence of participating in the Program, given observed weather and production during the performance period.

The Evaluation Team estimated gross facility-level energy savings as the difference between the expected energy consumption, or adjusted baseline, and actual energy consumption during the performance period. The gross savings included the effects of the Strategic Energy Management Program participation and capital projects that received incentives from Focus on Energy's Large Energy Users or Strategic Energy Management programs.

To account for the capital project savings, the Evaluation Team estimated net facility-level energy savings, or strategic energy management (SEM) operational and behavioral (O&B) savings, by subtracting the incented capital project energy savings from the gross facility-level energy savings. These O&B energy savings resulted primarily from operations and maintenance (O&M) and behavior-based measures, although they also included savings from capital projects for which incentives were not offered through any Focus on Energy programs.

The following sections provide additional detail on the methodology used to estimate facility-level gross and net savings for each of the six facilities in this evaluation.

H.4.2. Review Documentation

The Evaluation Team requested and reviewed project documentation for each participating facility. The documentation included details about SEM activities, such as implementation dates, descriptions of O&M and behavior-based measures, claimed savings, and installation dates of capital projects.

In the data review, the Evaluation Team used the project documentation to verify the following:

- ***Baseline period.*** The Evaluation Team verified that the baseline period for each facility included at least one year of data and that it defined the baseline period the same as the Program Implementer. The Team requires a full year of data to account for seasonality in facility energy use.[24]
- ***Facility reporting period definition.*** The Evaluation Team verified that it defined the performance period using the same date range as the Program Implementer.

[24] In select cases for which a year of baseline data was not available, the sites were evaluated but the savings estimated were noted to be less reliable because of the shortened baseline.

H.4.3. Estimate Adjusted Baseline Consumption

The Evaluation Team used the forecast regression method to estimate the adjusted baseline consumption for each facility. The forecast approach is recommended for estimating facility savings in IPMVP Option C and in the Uniform Methods Project (UMP) Strategic Energy Management Program Evaluation Protocols.[25,26]

The Evaluation Team built a separate regression model for each facility's gas and electric meters (i.e., one model for facilities that used either gas or electric and two for those that used both types of fuel). It followed the five steps described below.

Step 1. Identify Candidate Variables

The Evaluation Team identified and calculated candidate variables for the regression model by selecting significant drivers of facility energy consumption for which data were included in the project documentation. The Team considered the following variable types for each facility:

- ***Facility shutdowns or closures.*** The Evaluation Team expected facility shutdowns or closures to reduce energy consumption and accounted for these days by testing federal holidays and any known facility closures as candidate variables in the model selection.
- ***Weather.*** The Evaluation Team expected weather to be a significant driver of energy consumption in industrial facilities and tested heating degree days (HDDs) and cooling degree days (CDDs) as candidate variables in the regression model. The Team calculated each facility's HDDs and CDDs using daily mean temperatures obtained from the National Oceanic and Atmospheric Administration (NOAA), and matched this data with consumption data.[27]
- ***Production variables.*** The Evaluation Team tested all valid production tracked at the facility that was provided by the Implementer.

After identifying and calculating candidate variables, the Team developed the initial baseline regression model by determining which candidate variables had significant effects on energy consumption.

---

25 National Renewable Energy Laboratory. *International Performance Measurement & Verification Protocol.* Available online: https://www.nrel.gov/docs/fy02osti/31505.pdf

26 National Renewable Energy Laboratory. *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures*. "Chapter 24: Strategic Energy Management (SEM) Evaluation Protocol." Available online: https://www.nrel.gov/docs/fy17osti/68316.pdf

27 The Evaluation Team optimized the selection of HDD and CDD base temperatures by testing all pairs of HDD and CDD base temperatures between 0°F and 85°F, which the Team considered reasonable setpoints for manufacturing facilities. The final base temperature pair maximized the model-adjusted R^2.

Step 2. Develop Initial Baseline Regression Model

The Evaluation Team developed an initial regression model using the variables identified and calculated in the previous step. Equation 1 provides the general form of the initial baseline consumption model:

Equation 1

$$e_t = \alpha + f(weather_t, \beta) + g(other_t, \gamma) + \varepsilon_t$$

Model variables are defined as follows:

t	=	The t^{th} time interval, $t = 1, \dots, T$. Weekly intervals were the most common for facilities in this evaluation. In this case, t=1 represents the first week of the baseline period, t=2 represents the second week, and so on up to t= $T = 52$ if weekly energy use was modeled and energy-use data were available for a full year.
e_t	=	Facility energy consumption during the t^{th} time interval.
α	=	Intercept representing facility average base-load energy use per interval.
$weather_t$	=	A vector of outdoor temperature variables (e.g., HDD and CDD) affecting facility energy use during the t^{th} interval.
β	=	A vector of coefficients that represent the relationships between energy use and weather. For example, the coefficient of HDD corresponds to the average change in energy use per heating degree day.
$other_t$	=	A vector of additional explanatory variables and/or indicators related to facility energy consumption during the t^{th} time interval, including one or more production variables.
γ	=	A vector of coefficients that represent the relationships between the additional explanatory variables (e.g., production) and energy consumption.
ε_t	=	The model error term representing unobservable influences on energy consumption during the t^{th} time interval.

The Evaluation Team fit a separate baseline model specification for every linear combination of variables for each facility. It selected the model that best fit the facility's baseline period energy consumption, based on the model R^2 and Akaike Information Criteria (AIC) values, as well as its review of actual vs. predicted energy consumption. The Evaluation Team estimated all models by ordinary least squares (OLS).

The Team selected the initial baseline model based on the following criteria:

- ***Accuracy of within-sample prediction:*** The selected model accurately predicted energy consumption during each time interval in the baseline period.
- ***Expected signs and statistical significance of the coefficients:*** The regression coefficients in the selected model had the expected signs (positive or negative) and were statistically significant, based on standard *t* tests and *F* tests.
- ***Overall explanatory power:*** The R^2 values of the selected models were greater than 0.6, the criteria defined in the UMP.[28]

The result was one initial baseline regression model for each facility that included significant main effects or predictors of energy consumption. Variables included in the initial baseline regression model were included as candidate variables for the final baseline regression model**.** After developing these models, the Evaluation Team tested interactions between variables to determine if they should be included in the regression model in addition to the main effects.

Step 3. Identify Interactions Between Variables

The Evaluation Team expected production and weather to have interactions that were significant drivers of energy consumption in addition to the main effects identified in the previous step[29]. For example, a facility that uses a furnace as part of its manufacturing process might be expected to have lower heating-related energy use in the winter and higher cooling-related energy use in the summer.

The Evaluation Team reviewed the scatterplots and residual plots corresponding to variables selected in the initial baseline model. When these plots suggested that relationships between the variables might exist, the Team tested specific interactions between those variables by including them in the initial baseline model to determine if they were significant, improved the overall explanatory power of the model, and made sense (i.e., had the expected sign). Any interactions that met these criteria were included as candidate variables for the final baseline regression model.

Step 4. Develop Final Baseline Regression Model

The Evaluation Team developed a final baseline regression model using the candidate variables identified in the previous steps. The final baseline regression model follows the same functional form as the initial baseline model in Equation 1, except the $other_t$ vector includes interaction terms in addition

---

28 Higher adjusted R^2 values indicate that the explanatory variables in the model explain most of the variation in consumption.

29 The Team selected initial baseline models and interacted baseline models in separate steps because of the number of production variables at some facilities and to reduce the likelihood of an over-fit model. Because it was not possible to test all possible combinations of variables and interaction terms, the Team limited candidate variables for interactions only to those that were included in the initial baseline model.

to the main effects. Again using OLS, when possible, the Evaluation Team fit a regression model that included every combination of main effects and interaction terms identified in the previous steps.[30]

The Evaluation Team selected the final baseline consumption model for each facility based on the same criteria as described above for the initial baseline model. The result of this step was one final baseline energy consumption model for each facility, which the Team used to estimate the adjusted baseline or expected energy consumption for that facility.

Step 5. Estimate Adjusted Baseline

The Evaluation Team used the final baseline energy consumption models developed in the previous step to estimate an adjusted baseline for each facility. For each interval of a facility's reporting period, the Team used the best final baseline model to calculate the adjusted baseline energy use:

Equation 2

$$\widehat{e_t} = \hat{\alpha} + f\left(outside\ temperature_t, \hat{\beta}\right) + g(other_t, \hat{\gamma})$$

Where:

$\widehat{e_t}$ is the adjusted baseline energy use for interval (e.g., week) t and ˆ denotes an estimate. The outside temperature and other variables are the actual values of these variables during the reporting period. As previously noted, adjusted baseline consumption is an estimate of energy consumption if the SEM Program had not been implemented and the facility operated in the reporting period as it had during the baseline period.

H.4.4. Facility Savings

The Evaluation Team estimated energy savings during interval *t* of the reporting period, s_t, according to Equation 3:

Equation 3

$$\hat{s}_{\mathrm{t}} = \widehat{e_t} - e_t$$

Energy savings during the reporting period, S, equal the sum of savings over the T intervals of the reporting period:

Equation 4

$$S = \sum_{t=1}^{T} \hat{s}_{\mathrm{t}}$$

30 In some cases, because of a high number of selected variables in the initial model, it was not possible to fit a regression model for every combination. In these cases, the Evaluation Team used stepwise selection to create the final model.

The Evaluation Team estimated SEM savings for each i^{th} facility ($\hat{y}_i$) by subtracting any capital projects incentivized through other Focus on Energy programs (S_K) during the reporting period from S :

Equation 5

$$\hat{y}_i = S - S_K$$

The Evaluation Team obtained estimates of the facility's capital project savings from SPECTRUM.

A non-routine adjustment is an out-of-model adjustment to metered energy use that accounts for a change unrelated to the SEM Program in the facility's energy consumption. The Evaluation Team did not make any non-routine adjustments to metered energy use for these facilities.

H.4.5. Example Model Selection and Savings Estimation

The following example illustrates model selection by describing the process for estimating electricity savings at an example facility. The Evaluation Team used baseline period consumption to select HDD and CDD base temperatures by choosing the pair that maximized the adjusted R^2. In the example facility, the data selected base temperatures of 55°F for HDD and 66°F for CDD.

Table H-23 provides the example variables, model specifications, and fit statistics used to select a final model. Other statistics considered include the adjusted R^2 and Akaike Information Criteria (AIC) for each tested model specification.[31] Smaller AIC values suggest better-fitting models. In the example, each candidate variable accounted for 36% or more of the variability in consumption in the baseline period, but including all three resulted in the best-fitting model according to both the adjusted R^2 and the AIC. Therefore, model 7 was selected for this example facility.

Table H-23. Model Fit Statistics for Example Facility

Model	HDD 55	CDD 66	Lbs Raw Material	Adjusted R^2 (1)	AIC (2)
1	✓			**0.79**	**133**
2		✓		0.60	140
3			✓	0.36	146
4	✓	✓		0.87	128
5	✓		✓	0.94	120
6		✓	✓	0.58	142
7	✓	✓	✓	**0.97**	**112**

(1) The model with the highest adjusted R^2 controls for the most variation in the data.

(2) The model with the smallest AIC controls for the most variation in the data but penalizes for the inclusion of unnecessary variables.

31 Like the adjusted R^2, the AIC informs users of the model quality in terms of the amount of variability it accounts for. AIC puts a greater penalty on including additional variables and is more likely than the adjusted R^2 to suggest a simpler model.

Table H-24 displays the estimated coefficients and significance of variables included in the selected model. All three variables in the example have *p*-values less than 0.05, so are significant at the 5% significance level, suggesting that true coefficients are significantly different from zero. The signs of coefficients are not unexpected: as HDD, CDD, and Lbs Raw Material increased, consumption increased (positive coefficients).

Table H-24. Final Model Specification for Example Facility

Term	Coefficient Estimate (kWh/week)	Standard Error (kWh/week)	*Test* Statistic	*p*-value [1]
Intercept	1,425	61	23.44	< 0.0001
HDD 55	99	10	10.30	< 0.0001
CDD 66	84	27	3.13	0.0141
Lbs Raw Material	65	12	5.33	0.0007

[1] There is evidence to suggest the true coefficient value is significantly different from zero at the 5% significance level when the *p*-value is less than 0.05.

By reviewing graphs of actual baseline consumption and predicted baseline energy use over time, the Evaluation Team can identify where the chosen model did not accurately predict consumption in the baseline period. See the light-gray region in Figure H-5 for an example of an actual versus predicted graph of the baseline period.

H.4.6. Strategic Energy Management Facility-Specific Summaries

The following sections describe the final model selected for each facility fuel types.

Participant 1

Electric

The Program Implementer designated the baseline period as January 11, 2015, to January 9, 2016, a full year prior to the facility's SEM kickoff (August 1, 2016). The Evaluation Team found this baseline to be well defined. The facility provided raw production data at the weekly level. The Implementer's final model is presented in Table H-25.

Table H-25. Implementer's Participant 1 Electric Model[1]

Variable	Estimate	Standard Error	*T*-Statistic	*P*-Value
Intercept	427,791.3	22,686.4	18.9	4.17E-24
Total Heads	30.7	2.5	12.3	1.40E-16
CDD45	406.3	20.7	19.6	7.03E-25

[1]Adjusted R^2 of 0.901.

The Implementer's model had an adjusted R^2 over 0.9 and all the variables had low *p*-values. This indicates that the largest drivers of energy are being captured in their model. The performance period for this site was defined as January 10, 2016, to July 16, 2017. This period began directly after the end of the baseline period but prior to the SEM kickoff. The Implementer's final CUSUM (cumulative sum) from this period was 1,118,847 kWh.

Initially, the Team tested production variables that the Implementer did not include in its model, and found that some of these variables were significant in the Team's model. However, these additional variables were not available (or had not been collected) during the performance period, so the Team created a model using only the production variables that were available. The Team's final model is presented in Table H-26. The Evaluation Team's final SEM savings from this period was 1,253,338 kWh.

Table H-26. The Evaluation Team Participant 1 Electric Model[1]

Variable	Estimate	Standard Error	*T*-Statistic	P Value
Intercept	439,610.7	19,639.6	22.4	4.76E-27
Total Heads	31.3	2.1	14.6	2.83E-19
HDD56	-76.6	14.5	-5.3	3.08E-06
CDD58	688.0	45.8	15.0	8.90E-02

[1]Adjusted R^2 of 0.927

The Evaluation Team's model is similar to the Implementer's model. The differences are in the base temperatures used to calculate CDD (45°F verses 58°F) and the fact that the Team's model includes HDD. The Evaluation Team's model adjusted R^2 of 0.927 indicated a slight improvement in explanatory power compared to the Implementer's.

As shown in Table H-27, the Evaluation Team's final model CUSUM was 1,253,338 kWh, resulting in a realization rate of 112%. The final savings had a standard error of 215,940 kWh at 90% confidence with a lower bound of 819,304 kWh and an upper bound of 1,615,372 kWh. The Program Implementer's final savings were within the Evaluation Team's confidence interval, meaning that these values were not statistically different within 90% confidence.

Table H-27. Participant 1 Electric Savings Summary

Reported Savings	Evaluated Savings				Realization Rate
	Savings	Standard Error	Lower Bound	Upper Bound	
1,118,847	1,253,338	215,940	819,304	1,615,372	112%

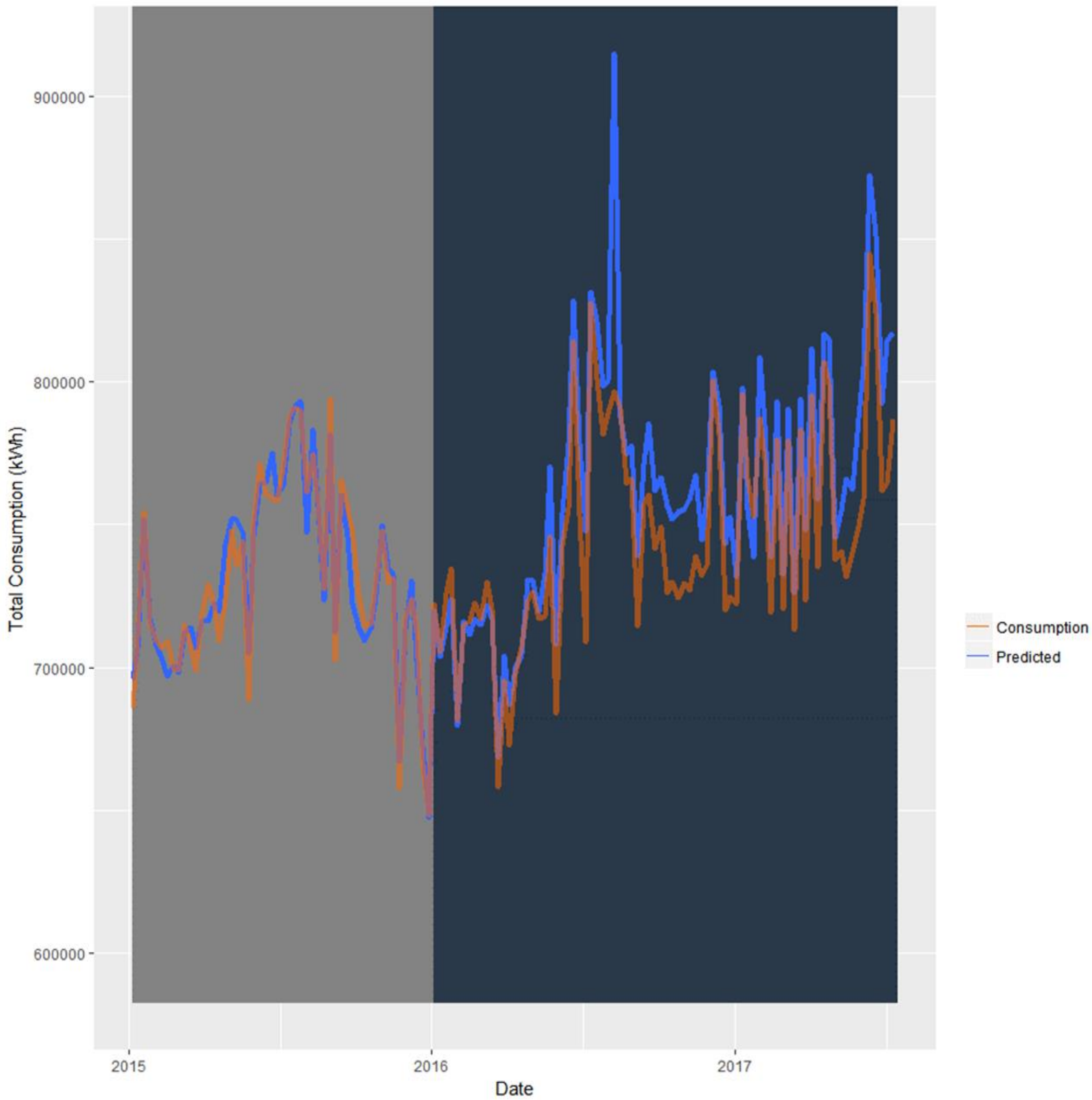
As shown in Table H-28, the facility claimed 312,715 kWh in savings through the SEM Program. The facility tracked 696,341 kWh in savings that were either claimed through the LEU Program or otherwise tracked by the Program Implementer. To isolate the O&M and behavior-based savings, the Evaluation Team subtracted these savings from the total reported savings and the evaluated savings. This resulted in 109,792 kWh of reported savings and 244,283 kWh of evaluated savings.

Table H-28. Participant 1 Electric Capital Projects Summary

SEM Capital Savings	LEU and Other Capital Savings	O&M and Behavior-Based Savings	
		Reported	Evaluated
312,715	696,341	109,792	244,283

Figure H-5 shows the predicted and actual consumption. During the baseline period (light grey background), predicted consumption closely follows actual consumption. During the performance period (dark grey background), savings can be seen when predicted consumption is greater than actual consumption.

Figure H-5. Evaluation Team's Participant 1 Electric Model



Natural Gas

The Program Implementer designated the baseline period for natural gas as January 11, 2015, to January 9, 2016, a full year prior to the facility's SEM kickoff on August 1, 2016. The Evaluation Team found this baseline to be well defined. The facility provided raw production data at the weekly level. The Program Implementer's final model is presented in Table H-29.

Table H-29. Program Implementer's Participant 1 Natural Gas Model[1]

Variable	Estimate	Standard Error	*t*-Statistic	*p*-Value
Intercept	22,069.3	7,446.4	3.0	4.76E-03
Temperature	-395.6	25.1	-15.8	2.13E-20
Total Heads Killed	5.5	0.8	6.7	2.50E-08
Pre–Natural Gas Change	13,429.8	1,298.3	10.3	1.06E-13
Natural Gas Change Phase 1	3,716.5	1,659.8	2.2	2.99E-02

[1] Adjusted R^2 of 0.911.

The Program Implementer's model had an adjusted R^2 above 0.9 and all the variables had low *p*-values. This indicates that the largest drivers of energy are being captured in their model. The performance period for this site was defined as January 10, 2016, to July 16, 2017, which began directly after the baseline period but prior the facility's SEM kickoff. The Program Implementer's final CUSUM from this period was 122,744 therms.

Initially, the Evaluation Team tested production variables that the Program Implementer did not include in its model. The Team did not find any additional significant production variables. The Team's final SEM savings from this period was 229,700 therms. Table H-30 shows the final model.

Table H-30. Evaluation Team's Participant 1 Natural Gas Model[1]

Variable	Estimate	Standard Error	*t*-Statistic	*p*-Value
Intercept	-13,720.1	6,852.9	-2.0	5.16E-02
HDD 53°F	111.3	16.6	6.7	3.48E-08
CDD 73°F	-1,340.9	812.9	-1.6	1.06E-01
Natural Gas Change Phase 1	60,089.1	23,279.3	2.6	1.33E-02
Total Heads Killed	6.7	0.8	8.7	4.82E-11
Pre–Natural Gas Change	13,166.1	1,349.4	9.8	1.81E-12
HDD 53°F * HDD 53°F	-0.1	0.1	-2.4	1.95E-02
CDD 73°F * CDD 73°F	114.5	84.4	1.4	1.82E-01
Natural Gas Change Phase 1 * Total Heads Killed	-6.4	2.7	-2.4	2.16E-02

[1] Adjusted R^2 of 0.932.

The Evaluation Team's model is like the Program Implementer's model in base variables. The Team used HDDs and CDDs as opposed to temperature and included interactions to the variables. The Team model's adjusted R^2 of 0.932 is an improvement over the Program Implementer's adjusted R^2 of 0.911.

As presented in Table H-31, the Evaluation Team's final model CUSUM was 229,700 therms, for a realization rate of 187%. The final savings had a standard error of 215,940 therms at 90% confidence with a lower bound of 35,438 therms and an upper bound of 423,962 therms. The Program Implementer's final savings was within the Evaluation Team's confidence interval.

Table H-31. Participant 1 Natural Gas Savings Summary

Reported Savings	Evaluated Savings				Realization Rate
	Savings	Standard Error	Lower Bound	Upper Bound	
122,744	229,700	115,498	35,438	423,962	187%

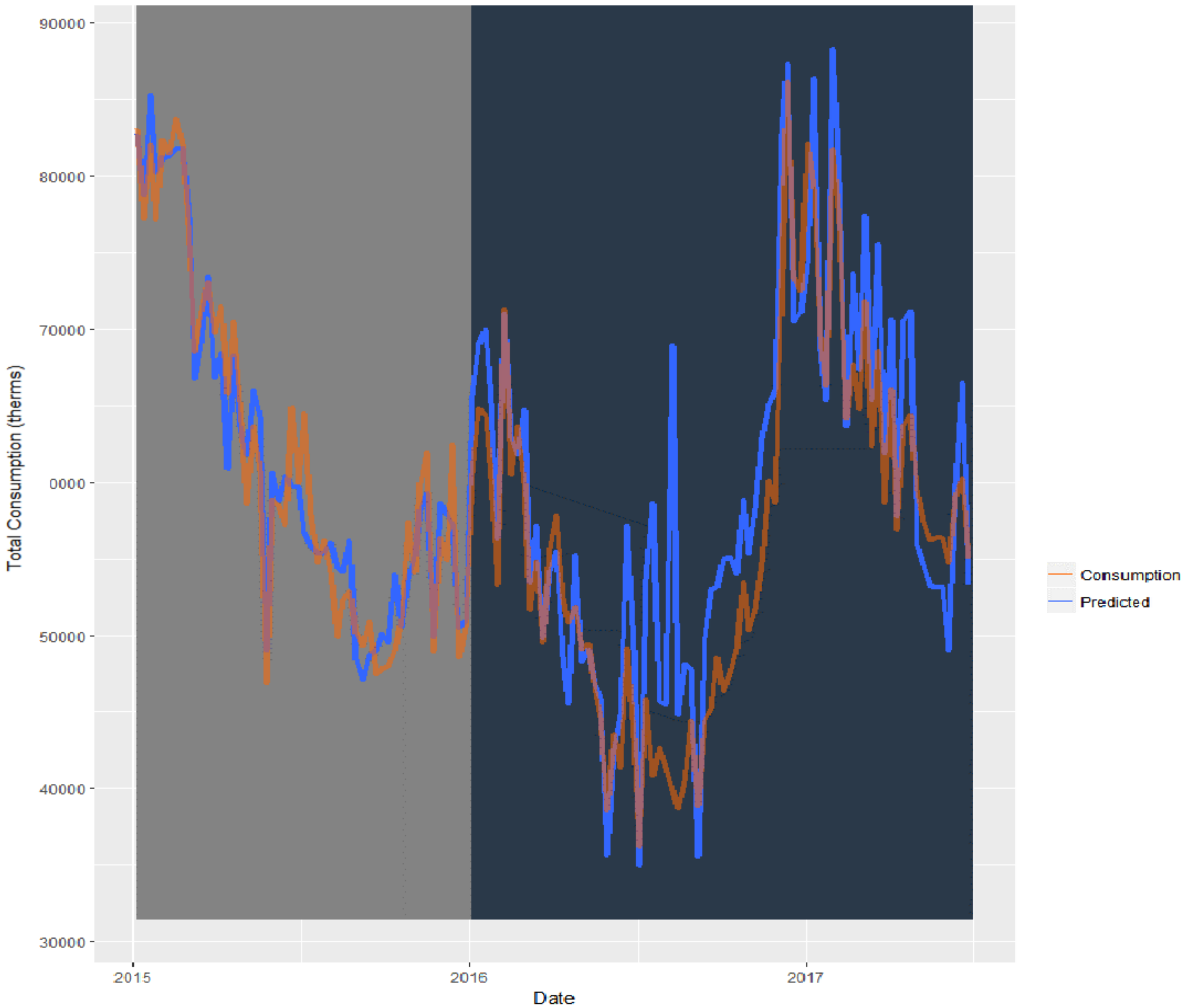
As shown in Table H-32, the facility claimed 33,859 therms in savings through the SEM Program. They tracked 22,012 therms in savings that were either claimed through the LEU Program or otherwise tracked by the Program Implementer. To isolate the O&M and behavior-based savings, the Evaluation Team subtracted these savings from the total reported savings and the evaluated savings. This resulted in 66,872 therms of reported savings and 173,828 therms of evaluated savings.

Table H-32. Participant 1 Natural Gas Capital Projects Summary

SEM Capital Savings	LEU and Other Capital Savings	O&M and Behavior-Based Savings	
		Reported	Evaluated
33,859	22,012	66,872	173,828

Figure H-8 shows predicted and actual consumption. During the baseline period (light grey background), predicted consumption closely follows actual consumption. During the performance period (dark grey background), savings are shown when predicted consumption is greater than actual consumption.

Figure H-6. Evaluation Team's Participant 1 Natural Gas Model



Participant 2

Electric

The Program Implementer assigned the baseline periods for electric as January 1, 2016, to December 31, 2016, a full year of baseline data that overlapped with the SEM kickoff on June 1, 2016. As electric data were not available prior to this period, the Evaluation Team moved forward with this baseline. If a baseline period overlaps with the beginning of the performance period, this can make the evaluated savings lower than the true savings. The facility provided raw production data at the monthly level. The Program Implementer's final model is presented in Table H-33.

Table H-33. Program Implementer's Participant 2 Electric Model[1]

Variable	Estimate	Standard Error	*t*-Statistic	*p*-Value
Intercept	-	-	-	-
Total Virgin Resin for Class PL	1.5	0.5	2.9	1.71E-02
Days in Month	19,699.3	3,348.7	5.9	1.55E-04

[1] This model led to an adjusted R^2 of 0.897.

The Program Implementer's model had an adjusted R^2 close to 0.9 and all the variables had low p-values, which indicates that the largest drivers of energy are being captured in its model. However, the Evaluation Team does not recommend a suppression of the intercept unless either the baseline consumption is normalized or there is an indication that consumption reaches zero when all variables are held constant.

The performance period for this site was defined as January 1, 2017, to August 31, 2017, which began directly after the baseline period but not prior the SEM kickoff. The Program Implementer's final CUSUM from this period was 507,050 kWh.

The Evaluation Team tested production variables that the Program Implementer did not include in its model and found additional production variables that were significant in the Team's baseline model. As these additional variables were not available during the performance period, the Evaluation Team created a model including only production variables that were available. The Team's final SEM savings from this period was 549,032 kWh. The Team's final model is presented in Table H-34.

Table H-34. The Evaluation Team's Participant 2 Electric Model[1]

Variable	Estimate	Standard Error	*t*-Statistic	*p*-Value
Intercept	1,731,630.0	289,290.1	6.0	5.50E-04
Days in Month	-30,870.6	9,444.2	-3.3	1.37E-02
Holidays	-30,769.2	9,644.4	-3.2	1.53E-02
Total Virgin Resin for Class PL * Total Virgin Resin for Class PL	0.000003	0.000001	4.6	2.51E-03
Total Virgin Resin for Class PL * HDD 7°F	0.005865	0.001202	4.9	1.79E-03

[1] This model led to an adjusted R^2 of 0.862.

The Evaluation Team's model is very similar to the Program Implementer's model. It includes an indication of the number of holidays in each month and interactions of the variables. The Team did not suppress the intercept, but the Program Implementer did—this means that, although the Evaluation Team did not improve upon the Program Implementer's adjusted R^2, these adjusted R^2 are difficult to compare.

As shown in Table H-35, the Evaluation Team's final model CUSUM was 549,032 kWh, for a realization rate of 108%. The final savings had a standard error of 78,345 kWh at 90% confidence with a lower bound of 396,793 kWh and an upper bound of 701,271 kWh. The Program Implementer's final savings was within the Evaluation Team's confidence interval.

Table H-35. Participant 2 Electric Savings Summary

Reported Savings	Evaluated Savings				Realization Rate
	Savings	Standard Error	Lower Bound	Upper Bound	
507,050	549,032	78,345	396,793	701,271	108%

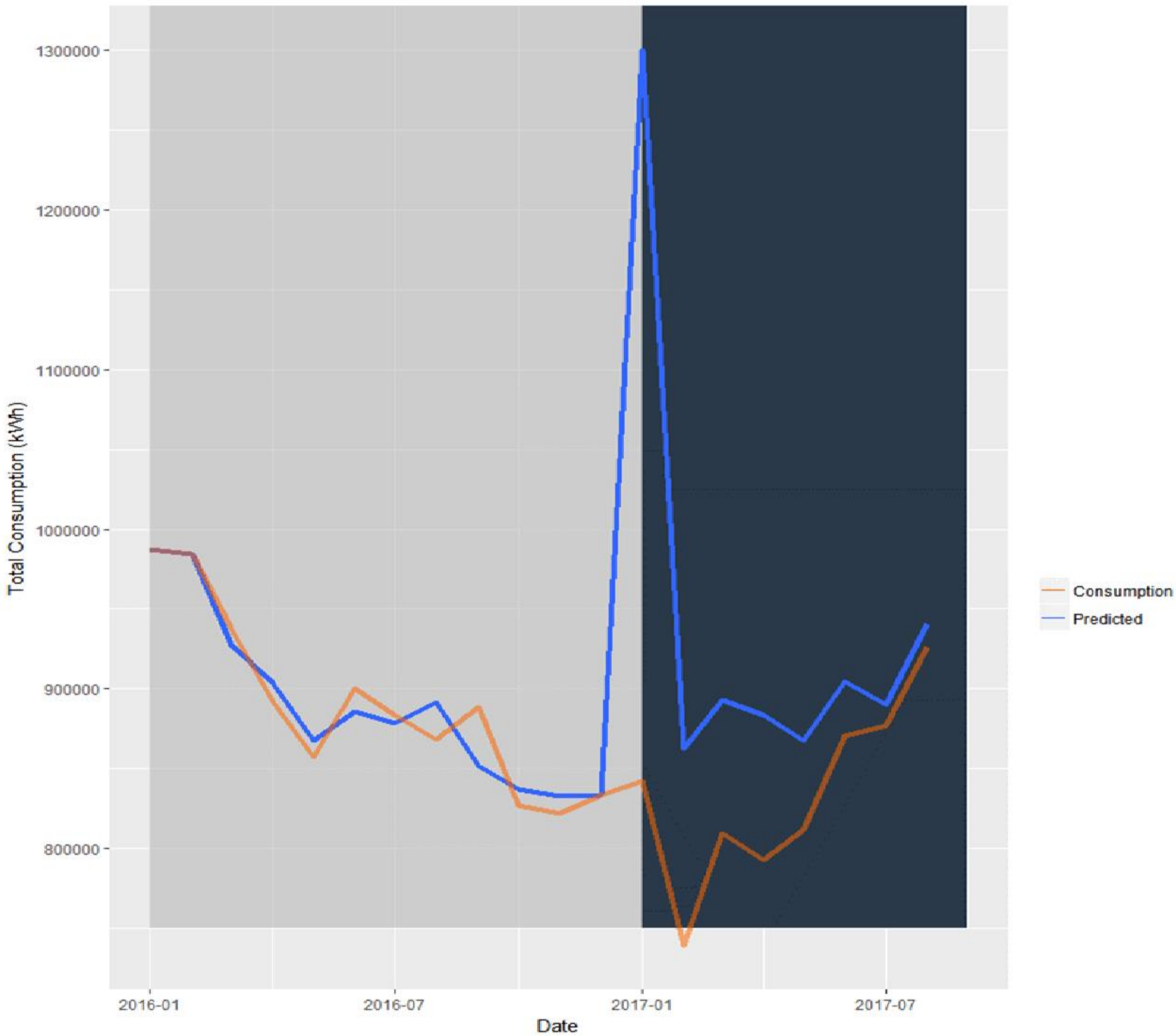
As shown in Table H-36, the facility claimed 381,246 kWh in savings through the SEM Program and tracked 90,750 kWh in savings that were either claimed through the LEU Program or otherwise tracked by the Program Implementer. To isolate the O&M and behavior-based savings, the Evaluation Team subtracted these savings from the total reported savings and the evaluated savings. This resulted in 35,051 kWh of reported savings and 77,033 kWh of evaluated savings.

Table H-36. Participant 2 Electric Capital Projects Summary

SEM Capital Savings	LEU and Other Capital Savings	O&M and Behavior-Based Savings	
		Reported	Evaluated
381,246	90,750	35,051	77,033

Figure H-7 shows the predicted and actual consumption. During the baseline period (light grey background), predicted consumption closely follows actual consumption. Savings are shown during the performance period (dark grey background) when predicted consumption is greater than actual. Because the data were at the monthly level, the model does not fit as well as the weekly models.

Figure H-7. Evaluation Team's Participant 2 Electric Model



Natural Gas

The Implementer assigned the baseline period as July 5, 2014, to October 31, 2015, which was more than a full year prior to the SEM kickoff (January 1, 2016). The Evaluation Team found that this baseline was well defined. The facility provided raw production data at the monthly level. The Implementer's final model is presented in Table H-37.

Table H-37. Program Implementer's Participant 2 Natural Gas Model[1]

Variable	Estimate	Standard Error	T-Statistic	P Value
Intercept	84.9	74.6	1.1	2.82E-01
HDD60	1.2	0.1	11.7	3.83E-07

[1] This model led to an adjusted R^2 of 0.925.

The Implementer's model had an adjusted R^2 above 0.9 and all variables had low p-values, which indicates that the largest drivers of energy are being captured. The performance period for this site, Participant 2, was defined as November 1, 2015, to August 31, 2017, beginning directly after the end of the baseline period but prior to the SEM kickoff. The Implementer's final CUSUM from this period was 5,170 therms.

The Evaluation Team tested production variables that the Implementer did not include in its model and found additional production variables to be significant in the Team's baseline model. However, these variables were not available during the performance. The Evaluation Team created a new model with only the available production variables. The Team's final model is presented in Table H-38, and its final SEM Program savings from this period (November 1, 2015, to August 31, 2017) is -27,189 therms.

Table H-38. Evaluation Team's Participant 2 Natural Gas Model[1]

Variable	Estimate	Standard Error	T-Statistic	P Value
Intercept	432.3	219.0	2.0	7.98E-02
Capital Project Boiler	-402.3	177.6	-2.3	4.97E-02
HDD68	0.8	0.1	6.2	1.66E-04

[1] This model led to an adjusted R^2 of 0.939.

The Evaluation Team's model and the Implementer's models were very similar; the only differences were that the Team selected a different HDD and included a capital project that was implemented during the baseline period. The Evaluation Team model's adjusted R^2 of 0.939 is a slight improvement from the Implementer's adjusted R^2 of 0.925.

As presented in Table H-39, the Evaluation Team's final model CUSUM was -27,189 therms, for a realization rate of 108%. The final savings had a standard error of 1,484 therms at 90% confidence for a lower bound of -29,910 therms and an upper bound of -24,468 therms.

Table H-39. Participant 2 Natural Gas Savings Summary

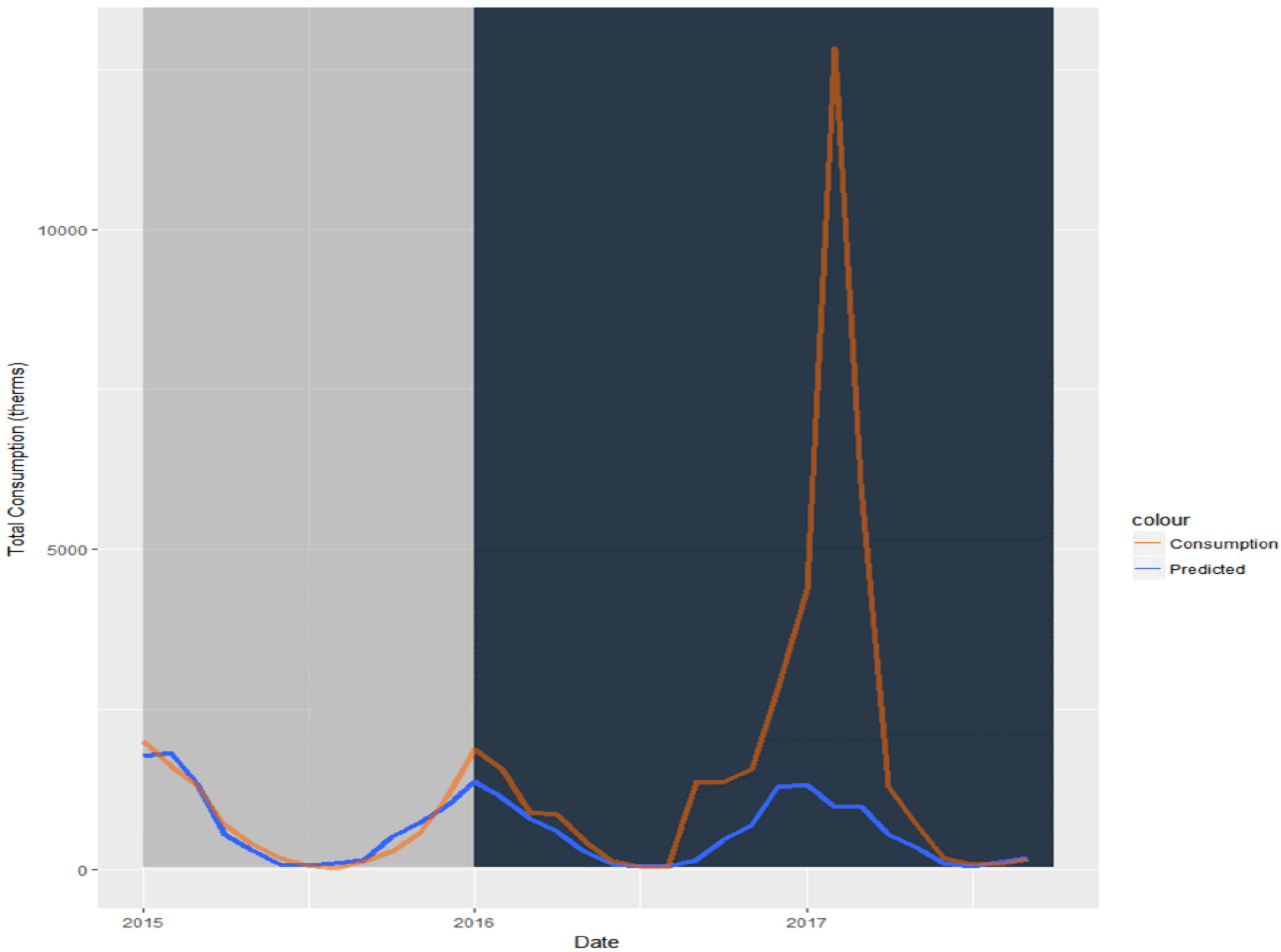
Reported Savings	Evaluated Savings				Realization Rate
	Savings	Standard Error	Lower Bound	Upper Bound	
-25,170	-27,189	1,484	-29,910	-24,468	108%

The Implementer's final savings was within the Evaluation Team's confidence interval. The Team believes that the reason for the negative savings is because of unusually high consumption for one month in the performance period. Without more information, however, the Team cannot isolate the cause of this spike in consumption.

Participant 2 did not install any gas capital projects beyond the O&M and behavior-based savings that were measured through regression analysis.

Figure H-8 presents the predicted and actual consumption. During the baseline period (light grey), the predicted consumption closely follows actual consumption. During the performance period (dark grey), savings can be seen when predicted consumption is greater than actual consumption, while increases in consumptions can be seen when actual consumption is greater than predicted consumption.

Figure H-8. Evaluation Team's Participant 2 Natural Gas Model



Participant 3a and Participant 3b

Electric

Participant 3 has two separate facilities, referred to as Participant 3a and Participant 3b, each with its own facility boundary and set of meters to measure energy consumption. Therefore, a separate electric model was generated for each facility's meters.

Participant 3a

The Implementer defined the baseline period as January 4, 2016, to January 1, 2017, a full year of baseline that overlapped with the SEM kickoff (January 1, 2016) by one month. If a baseline period overlaps with the beginning of performance period, this can cause evaluated savings to be lower than the true savings; however, this overlap was relatively small (one month) and likely would not have a great effect on savings. Because electric data were not available prior to this period, the Evaluation Team moved forward with this baseline. The facility provided raw production data at the weekly level. The Implementer's final model is presented in Table H-40.

Table H-40. Implementer's Participant 3a Electric Model[1]

Variable	Estimate	Standard Error	*t*-Statistic	*p*-Value
Intercept	75,511.1	9,152.2	8.3	1.27E-10
Inline 2	0.1	0.0	5.5	1.87E-06
Inline 4	0.1	0.0	2.6	1.36E-02
Extrusion/Facilities	0.04	0.02	2.1	3.90E-02
Rollfed	0.04	0.01	2.9	5.18E-03
CDD60	225.2	24.6	9.2	5.98E-12

[1] This model led to an adjusted R^2 of 0.723.

The Implementer's model had an adjusted R^2 of 0.723, suggesting the model explains less than three-fourths of the variation in energy use. Given that approximately 27% of the variation in energy use is not captured by the model, the model may be missing other drivers of energy consumption. All variables had low p-values, which indicates that the Program Implementer captured the largest drivers of energy consumption in its model. The performance period for this site was January 2, 2017, to September 24, 2017, which began directly after the end of the baseline period but overlapped with the SEM kickoff by one month. The Implementer's final CUSUM from this period was 127,372 kWh.

Initially, the Evaluation Team tested production variables that the Implementer did not include in its model and found additional production variables significant in the Team's baseline model. However, data for some of these variables were not available for the full duration of the performance period. For example, the Inline 3 variable was not included in the Implementer's model but data were available for the entire performance period. Therefore, the Evaluation Team created a new model that included only the production variables for which all production period data were available. The Evaluation Team's final SEM savings from this period was 142,088 kWh, and its final model is presented in Table H-41.

Table H-41. Evaluation Team's Participant 3a Electric Model[1]

Variable	Estimate	Standard Error	*t*-Statistic	*p*-Value
Intercept	81,984.1	7,855.1	10.4	2.32E-13
Inline 2	0.1	0.0	4.3	9.62E-05
Inline 3	0.1	0.0	2.3	2.50E-02
Inline 4	0.1	0.0	3.1	3.74E-03
Rollfed	0.02	0.01	1.9	5.96E-02
Extrusion Chiller	0.04	0.02	2.6	1.43E-02
Rollfed*CDD 49	0.00023	0.00002	10.2	4.40E-13

[1] This model led to an adjusted R^2 of 0.781.

The Evaluation Team's model is very similar to the Implementer's model. The primary differences are that the Evaluation Team and the Implementer used different CDD and HDD values and that the Team included the Inline 3 production variable, which the Implementer did not. The Evaluation Team model's adjusted R^2 of 0.781 is an improvement from the Implementer's adjusted R^2 of 0.723.

As presented in Table H-42, the Evaluation Team's final model CUSUM was 142,088 kWh, for a realization rate of 112%. The final savings had a standard error of 105,873 kWh at 90% confidence for a lower bound of -35,893 kWh and an upper bound of 320,069 kWh. The Implementer's final savings was within the Evaluation Team's confidence interval. The Evaluation Team's savings were also not statistically different from 0.

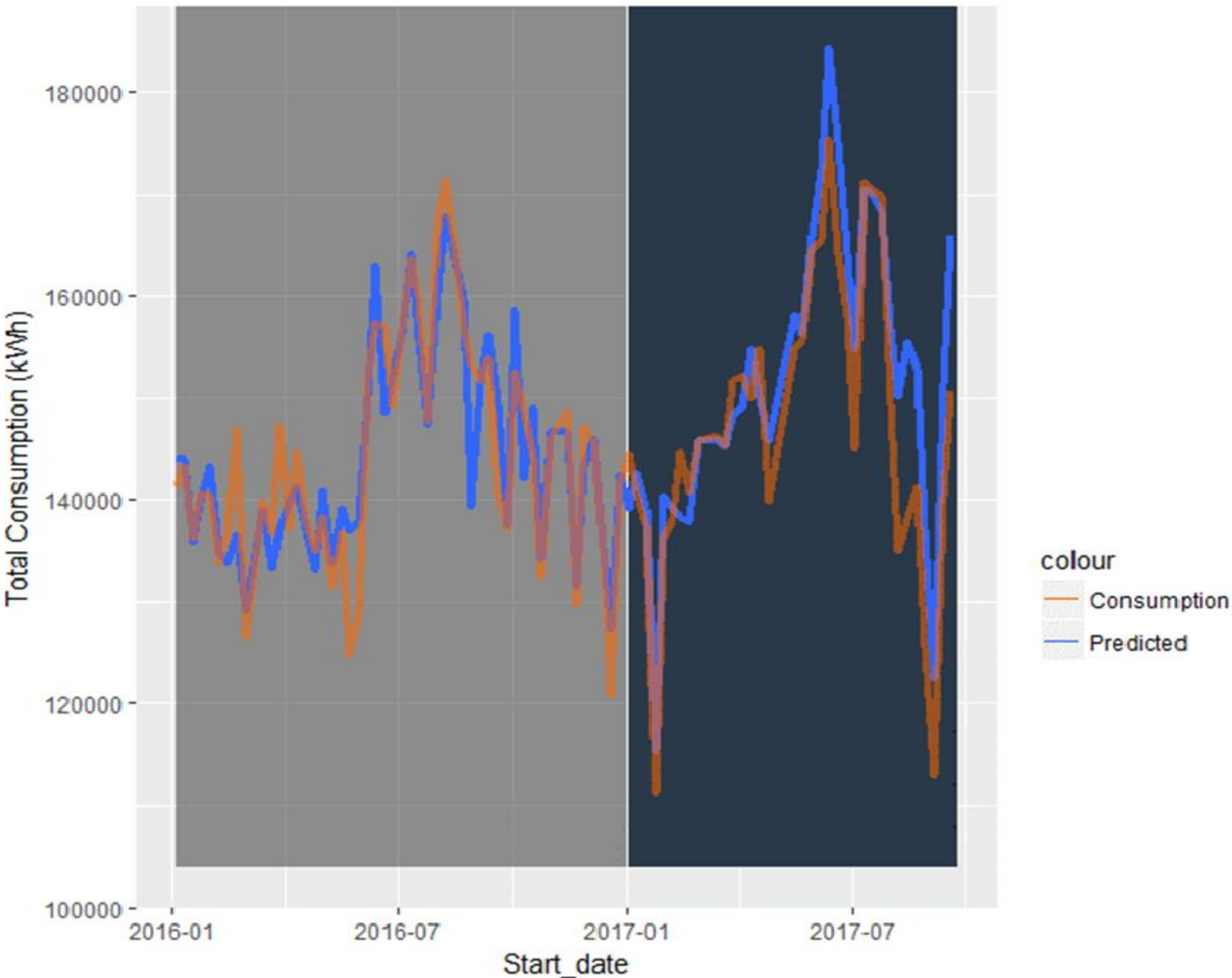
Table H-42. Participant 3a Electric Savings Summary

Reported Savings	Evaluated Savings				Realization Rate
	Savings	Standard Error	Lower Bound	Upper Bound	
127,372	142,088	105,873	-35,893	320,069	112%

Participant 3a installed capital projects that reduced electric consumption; however, there was no way to determine how the savings were distributed across the two meters. Because savings are summed for total program savings, the Evaluation Team simply subtracted the savings from the Participant 3b regression savings.

Figure H-5 shows predicted and actual consumption at the Participant 3a facility. During the baseline period (light grey), predicted consumption closely follows actual consumption. During the performance period (dark grey), savings can be seen when predicted consumption is greater than actual consumption.

Figure H-9. Evaluation Team's Participant 3a Electric Model



Participant 3b

The Implementer defined the baseline period as January 5, 2015, to January 3, 2016, a full year of baseline and, did overlap with the SEM kickoff (January 1, 2016), though only by 3 days. The Evaluation Team found this baseline was well defined. Like Participant 3a, the facility provided production data at the weekly level. The Implementer's final model is presented in Table H-43.

Table H-43. Program Implementer's Participant 3b Electric Model[1]

Variable	Estimate	Standard Error	*t*-Statistic	*p*-Value
Intercept	16,682.4	2,660.9	6.3	9.71E-08
Extrusion	0.03	0.01	6.9	9.50E-09
Bottlewash	0.01	0.00	5.9	3.25E-07
Average Temperature	97.0	26.8	3.6	7.21E-04

[1] This model led to an adjusted R^2 of 0.769.

The Implementer's model had an adjusted R^2 0.769 and all variables had low p-values, suggesting the model explains more than three-fourths of the variation. This indicates that the model is capturing the largest drivers of energy but may be missing some other drivers. The performance period for this site was defined as January 3, 2016, to September 24, 2017, which began directly after the end of the baseline period and overlapping with the SEM kickoff by 3 days which should not have a significant effect on savings. The Implementer's final CUSUM from this period was 563,006 kWh.

The Implementer included all available production variables in its Participant 3b model. The Team's final SEM savings from this period was 559,947 kWh, and its final model is presented in Table H-44.

Table H-44. Evaluation Team's Participant 3b Electric Model[1]

Variable	Estimate	Standard Error	*t*-Statistic	*p*-Value
Intercept	16,909.9	2,823.1	6.0	2.79E-07
Extrusion	0.03	0.00	6.6	3.38E-08
Bottlewash	0.02	0.00	5.4	2.10E-06
CDD31	37.1	10.5	3.5	9.43E-04
Bottlewash*CDD_31	-0.00003	0.00002	-1.9	6.45E-02

[1] This model led to an adjusted R^2 of 0.790.

The Team's final model is similar to the Implementer's, with the exception the Team's model used the HDD and CDD setpoints and included an interaction between the bottlewash production variable and CDD. The Evaluation Team improved upon the Implementer's adjusted R^2.

As shown in Table H-45, the Evaluation Team's final model CUSUM was 559,947 kWh, for a realization rate of 99%. The final savings had a standard error of 57,106 kWh at 90% confidence for a lower bound of 464,127 kWh and an upper bound of 655,766 kWh. The Implementer's final savings was within the Evaluation Team's confidence interval, meaning these values were not statistically different at 90% confidence.

Table H-45. Participant 3b Electric Savings Summary

Reported Savings	Evaluated Savings				Realization Rate
	Savings	Standard Error	Lower Bound	Upper Bound	
563,006	559,947	57,106	464,127	655,766	99%

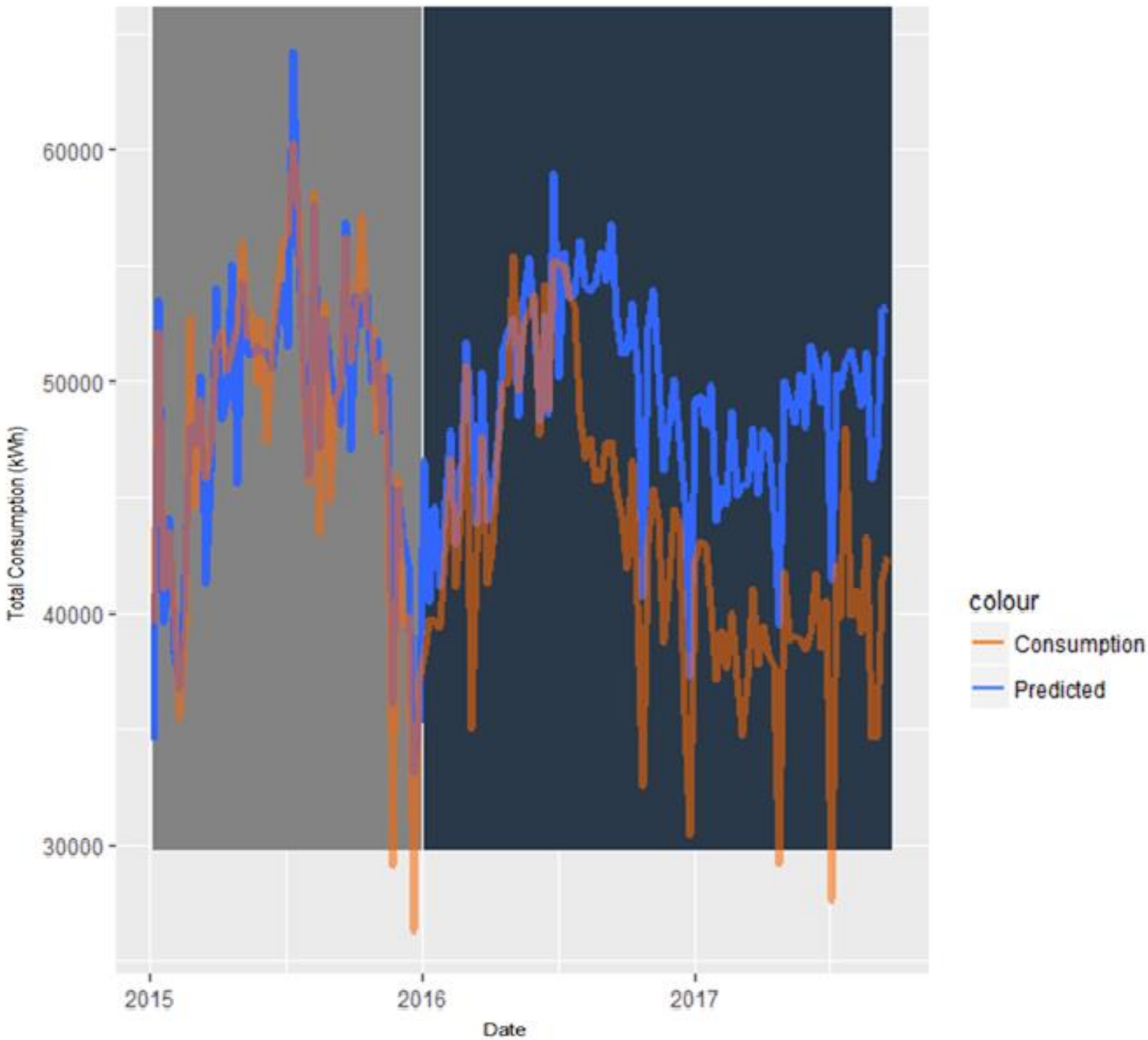
As shown in Table H-46, the facility, Participant 3b, claimed 270,154 kWh in savings through the SEM Program. It tracked 13,778 kWh in savings that were either claimed through the LEU Program or otherwise tracked by the Implementer. To isolate the O&M and behavior-based savings, these savings were subtracted from the total reported savings and the evaluated savings, resulting in 279,075 kWh reported savings and 276,015 kWh evaluated savings.

Table H-46. Participant 3b Electric Capital Projects Summary

SEM Capital Savings	LEU and Other Capital Savings	O&M and Behavior-Based Savings	
		Reported	Evaluated
270,154	13,778	279,075	276,015

Figure H-10 presents the predicted consumption and actual consumption. During the baseline period (light grey), the predicted consumption closely follows actual consumption. Savings can also be seen during the performance period (dark grey) when predicted consumption is greater than actual consumption.

Figure H-10. Evaluation Team's Participant 3b Electric Model



Natural Gas

The Implementer was not able to create a gas model for the Participant 3b meter and therefore claimed only therm savings for the gas meter at the Participant 3a facility.

Participant 3a

The Implementer assigned the baseline period as January 5, 2015, to January 3, 2016, a full year of baseline that did overlap with the SEM kickoff (January 1, 2016), though only by 3 days. The Evaluation Team found this baseline to be well defined. The facility manager provided raw production data at the weekly level. Therefore, the Implementer and the Evaluation Team were restricted to creating a weekly baseline model. The Implementer's final model is presented in Table H-47.

Table H-47. Program Implementer's Participant 3a Natural Gas Model[1]

Variable	Estimate	Standard Error	T-Statistic	P Value
Intercept	73.30	7.31	10.03	1.48E-13
HDD65	3.04	0.0410	74.25	7.84E-53

[1] This model led to an adjusted R^2 of 0.991.

The Implementer's model had an adjusted R^2 of 0.991, which suggests the model explains approximately 99% of the energy use. Additionally, all the variables had low p-values, indicating the model captured the majority of the largest drivers of energy use. The site's performance period was January 4, 2016 to October 23, 2017, beginning directly after the end of the baseline.

Initially, the Team tested production variables that the Implementer did not include in its model, and found that some of these variables were significant in the Team's model Data for these variables were available for the entire performance period because they were also used in the Participant 3a electric model. The Team's final model is presented in Table H-48. The Implementer's final CUSUM from this period was 16,976 therms.

Table H-48. Evaluation Team's Participant 3a Natural Gas Model[1]

Variable	Estimate	Standard Error	T-Statistic	P Value
Intercept	122.3314	36.7245	3.3311	0.0017
Inline 2	0.0003	0.0002	1.9378	0.0589
Inline 3	-0.0004	0.0002	-2.1811	0.0344
Rollfed	-0.0001	0.0001	-1.8409	0.0722
Extrusion Chiller	0.0001	0.0001	1.9198	0.0612
HDD 59	3.2745	0.0402	81.3812	0.0000
Holidays*HDD 59	0.1043	0.0638	1.6349	0.1090

[1] This model led to an adjusted R^2 of 0.9943.

The Evaluation Team's model contains many more variables than the Implementer's model. The Evaluation Team improved slightly upon the Implementer's adjusted R^2.

As presented in Table H-49, the Evaluation Team's final model CUSUM was 16,976 therms, for a realization rate of 61%. The final savings had a standard error of 9,622 therms at 90% confidence for a lower bound of 820 therms and an upper bound of 33,130 therms. The Implementer's final savings was within the Evaluation Team's confidence interval, meaning that these values were not statistically different at 90% confidence.

Table H-49. Participant 3a Natural Gas Savings Summary

Reported Savings	Evaluated Savings				Realization Rate
	Savings	Standard Error	Lower Bound	Upper Bound	
32,120	16,976	9,622	820	33,130	61%

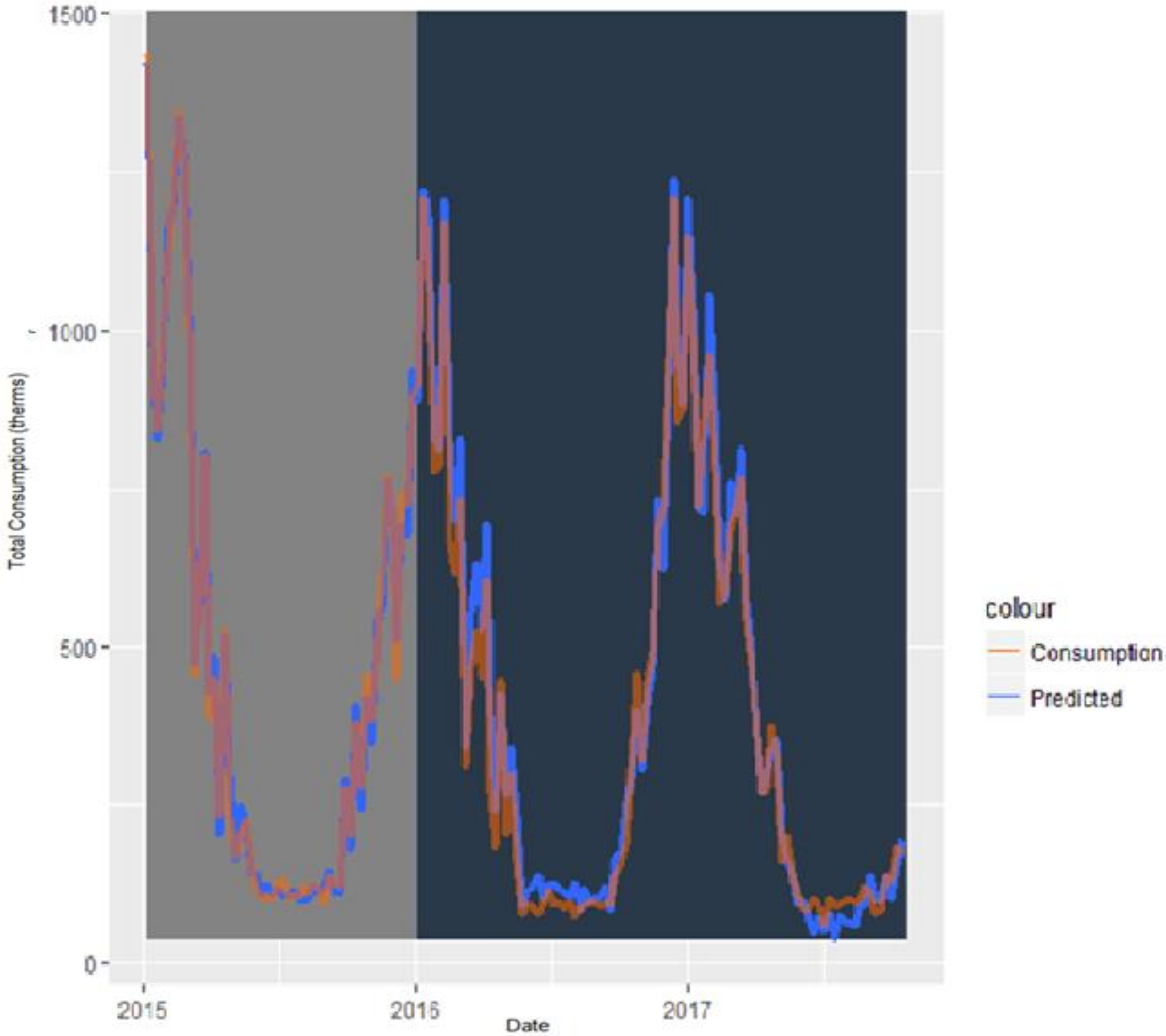
As shown in Table H-50, the Participant 3a facility did not claim any therms in savings through the SEM Program. It tracked savings of 20,516 therms that were either claimed through the LEU Program or otherwise tracked by the Implementer. To isolate the O&M and behavior-based savings, these savings were subtracted from the total reported savings and the evaluated savings, resulting in 7,137 therms reported savings and -3,540 therms evaluated savings.

Table H-50. Participant 3a Natural Gas Capital Projects Summary

SEM Capital Savings	LEU and Other Capital Savings	O&M and Behavior-Based Savings	
		Reported	Evaluated
-	20,516	7,137	-3,540

Figure H-11 shows the predicted consumption and the actual consumption. During the baseline period (light grey), predicted consumption closely follows actual consumption. During the performance period (dark grey), savings can be seen when predicted consumption is greater than actual consumption.

Figure H-11. Evaluation Team's Participant 3a Gas Model



Participant 4

Electric

The Implementer assigned the baseline periods as January 5, 2015, to January 3, 2016, a full year of baseline that was prior to the SEM kickoff (July 1 ,2016). The Evaluation Team found this baseline was well defined. The facility provided raw production data at the weekly level. The Implementer's final model is presented in Table H-51.

Table H-51. Program Implementer's Participant 4 Electric Model[1]

Variable	Estimate	Standard Error	*t*-Statistic	*p*-Value
Intercept	88,907.9	13,266.9	6.7	1.92E-08
Average Temperature	429.0	139.8	3.1	3.50E-03
Heats	1,017.2	61.9	16.4	1.46E-21

[1] This model led to an adjusted R^2 of 0.841.

The Implementer's model had an adjusted R^2 above 0.8, suggesting the model explained most of the variation. All of the variables had low p-values, which indicates the model is probably capturing the largest drivers of energy. The performance period for the Participant 4 facility was defined as January 5, 2016, to January 3, 2017, which began directly after the end of the baseline period but prior to the SEM kickoff. The Implementer's final CUSUM from this period was 2,065,454 kWh.

Initially, the Evaluation Team tested production variables that the Implementer did not include in its model and found no additional production variables significant in the Team's baseline model. The Evaluation Team's final SEM savings from this period was 1,715,372 kWh. Table H-52 presents the Evaluation Team's final model.

Table H-52. Evaluation Team's Participant 4 Electric Model[1]

Variable	Estimate	Standard Error	*t*-Statistic	*p*-Value
Intercept	284,649.3	6,356.2	44.8	8.20E-41
Average Temperature	695.8	190.3	3.7	6.33E-04
Capital Projects Leak	-209,475.4	12,652.4	-16.6	1.78E-21
Capital Projects Leak*Heats	1,001.0	61.8	16.2	4.30E-21

[1] This model led to an adjusted R^2 of 0.858.

The Evaluation Team's and Implementer's models included average temperature and the heats production variable. The Team's model included a capital project that was installed during the baseline period, and this variable was significant because of its interactions with the heats production variable. The Evaluation Team model's adjusted R^2 of 0.858 was an improvement from the Implementer's adjusted R^2 of 0.841.

As shown in Table H-53, the Evaluation Team's final model CUSUM was 1,715,372 kWh, for a realization rate of 83%. The inclusion of the capital project could be a factor in the lower realization rate. The final savings had a standard error of 412,385 kWh at 90% confidence for a lower bound of 1,023,988 kWh and an upper bound of 2,406,756 kWh. The Implementer's final savings was within the Evaluation Team's confidence interval.

Table H-53. Participant 4 Electric Savings Summary

Reported Savings	Evaluated Savings				Realization Rate
	Savings	Standard Error	Lower Bound	Upper Bound	
2,065,454	1,715,372	412,385	1,023,988	2,406,756	83%

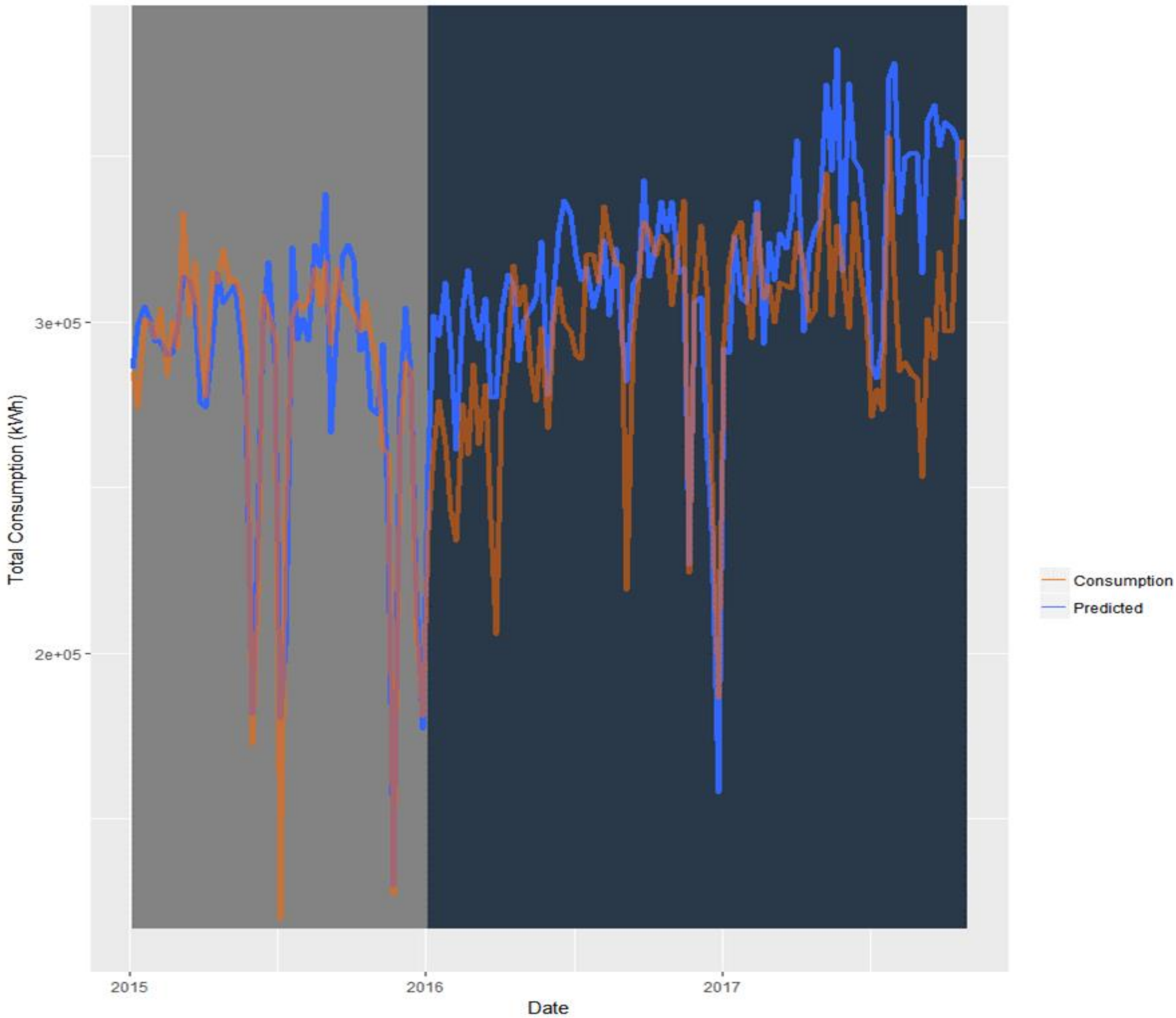
As shown in Table H-54, the Participant 4 facility claimed 437,508 kWh in savings through the SEM Program. It tracked 1,570,391 kWh in savings that were either claimed through the LEU Program or otherwise tracked by the Implementer. To isolate the O&M and behavior-based savings, these savings were subtracted from the total reported savings and the evaluated savings, which resulted in 57,555 kWh reported savings and -292,527 kWh evaluated savings.

Table H-54. Participant 4 Electric Capital Projects Summary

SEM Capital Savings	LEU and Other Capital Savings	O&M and Behavior-Based Savings	
		Reported	Evaluated
437,508	1,570,391	57,555	-292,527

Figure H-12 shows the predicted and actual consumption. During the baseline period (light grey), the predicted consumption follows closely with the actual consumption. Savings can also be seen during the performance period (dark grey) when predicted consumption is greater than actual consumption.

Figure H-12. Evaluation Team's Participant 4 Electric Model



Natural Gas

The Implementer assigned the baseline periods as January 5, 2015, to January 3, 2016, a full year of baseline that was prior to the SEM kickoff (July 1, 2016). The Evaluation Team found this baseline to be well defined, meeting all requirements for a baseline period. The facility provided raw production data at the weekly level. The Implementer's final model is presented in Table H-55

Table H-55. Program Implementer's Participant 4 Natural Gas Model[1]

Variable	Estimate	Standard Error	T-Statistic	P Value
Constant	4,741.9	498.4	9.5	1.02E-12
HDD40	20.5	1.8	11.5	1.50E-15
Heats	38.5	2.8	13.6	3.24E-18

[1] This model led to an adjusted R^2 of 0.872.

The Implementer's model had an adjusted R^2 close to 0.9, and all variables had low p-values, which indicates that the model was capturing the largest drivers of energy. The performance period for this site was January 4, 2016, to October 29, 2017, which began directly after the end of the baseline period but prior the SEM kickoff. The Implementer's final CUSUM from this period was 70,759 therms.

Initially, the Evaluation Team tested production variables that the Implementer did not include in its model and found no additional production variables significant in the Team's baseline model. The Evaluation Team's final CUSUM from this period was 22,858 therms. Table H-56 presents the Evaluation Team's final model.

Table H-56. Evaluation Team's Participant 4 Natural Gas Model[1]

Variable	Estimate	Standard Error	T-Statistic	P Value
Intercept	1,484.3	777.0	1.9	6.25E-02
Heats	93.5	11.3	8.3	1.46E-10
HDD38	58.0	10.0	5.8	5.88E-07
HDD38*HDD38	-0.04	0.02	-1.9	6.48E-02
CDD40*CDD40	-0.02	0.01	-3.5	9.53E-04
Heats*HDD38	-0.2	0.1	-2.9	6.25E-03
Heats*Heats	-0.2	0.0	-4.6	3.28E-05

[1] This model led to an adjusted R^2 of 0.941.

The Evaluation Team's model and the Implementer Team's model both include HDD and the production variable heats. The Evaluation Team also included CDD as well as interactions variables. The Evaluation Team model's adjusted R^2 of 0.941 is an improvement from the Implementer's adjusted R^2 of 0.872.

As presented in Table H-57, the Evaluation Team's final model CUSUM was 22,858 therms, for a realization rate of 32%. The final savings had a standard error of 16,542 therms at 90% confidence for a lower bound of -4,924 therms and an upper bound of 50,939 therms. The Implementer's final savings was not within the Evaluation Team's confidence interval. The Evaluation Team's savings were also not statistically different than 0.

Table H-57. Participant 4 Natural Gas Savings Summary

Reported Savings	Evaluated Savings				Realization Rate
	Savings	Standard Error	Upper Bound	Lower Bound	
70,759	22,858	16,542	-4,924	50,639	32%

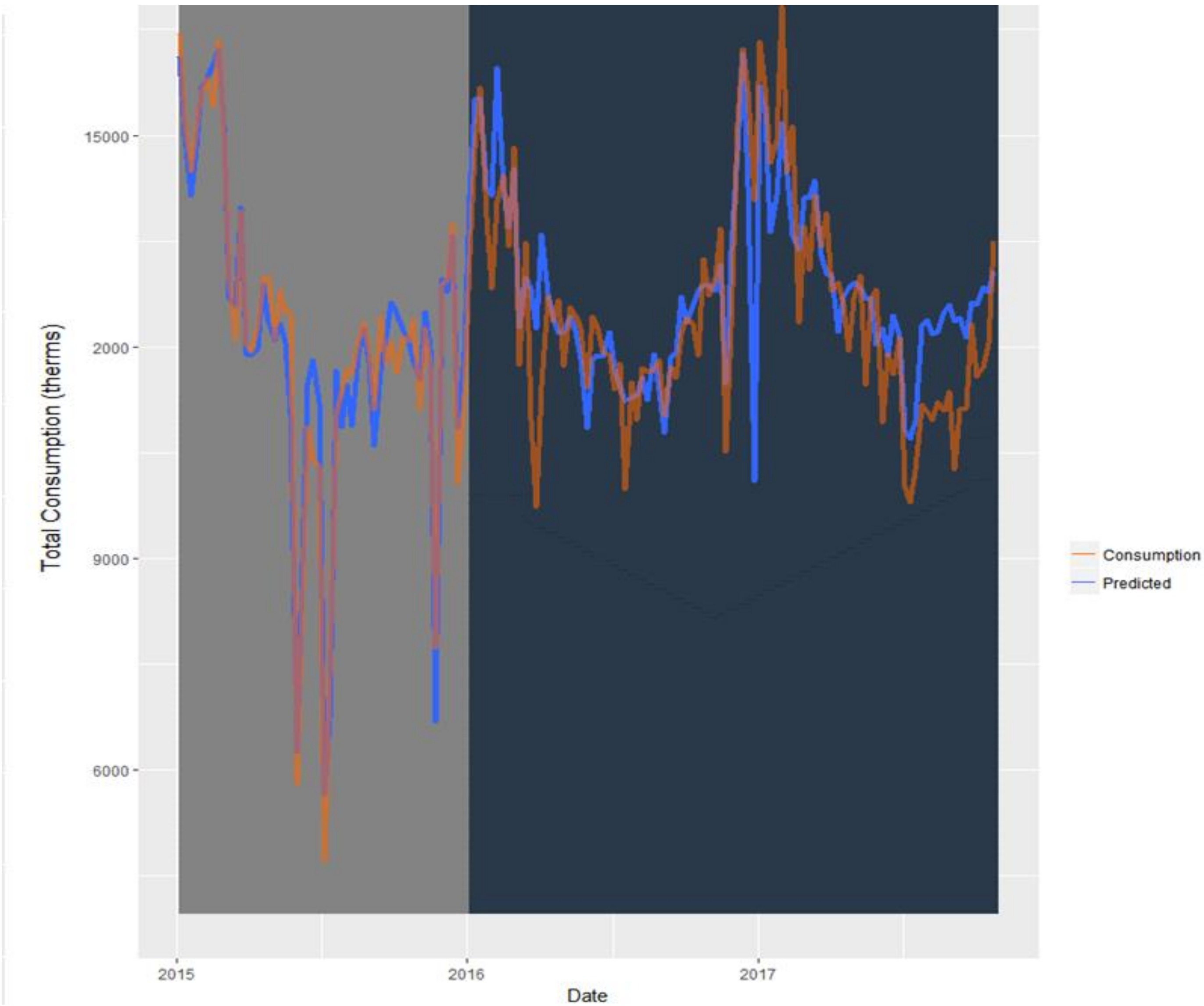
As shown in Table H-58, the Participant 4 facility did not claim any savings in therms through the SEM Program. It tracked 8,812 therms in savings that were either claimed through the LEU Program or otherwise tracked by the Implementer. To isolate the O&M and behavior-based savings, these savings were subtracted from the total reported savings and the evaluated savings, resulting in 61,947 therms reported savings and 14,045 therms evaluated savings.

Table H-58. Participant 4 Natural Gas Capital Projects Summary

SEM Capital Savings	LEU and Other Capital Savings	O&M and Behavior-Based Savings	
		Reported	Evaluated
-	8,812	61,947	14,045

Figure H-13 shows graphs the predicted and actual consumption. During the baseline period (light grey), predicted consumption follows closely with actual consumption. During the performance period (dark grey), savings can be seen when the predicted consumption is greater than the actual consumption.

Figure H-13. Evaluation Team's Participant 4 Gas Model



Participant 5

Electric

The Implementer assigned the baseline periods as March 16, 2015, to January 31, 2016, which was not a full year of baseline and overlapped with SEM kickoff (January 1, 2016). The Evaluation Team discussed the shortened baseline with the Implementer, who explained that prior to March 16, 2015, the facility was making changes that made creating a business-as-usual baseline model difficult. Although at least one year of baseline data is recommended, the Evaluation Team agreed this was not feasible for this facility and fuel type so recommends keeping in mind that the baseline model is incomplete when viewing the final savings. The baseline also overlaps with the SEM kickoff by one month, so the site's evaluated savings could be slightly lower than actual savings; however, this overlap is relatively small (one month) and unlikely to have a great effect on savings. The facility provided raw production data at the weekly level. The Implementer's final model is presented in Table H-59.

Table H-59. Program Implementer's Participant 5 Electric Model[1]

Variable	Estimate	Standard Error	*t*-Statistic	*p*-Value
Intercept	81,761.0	15,668.3	5.2	6.70E-06
MSF Produced	1.2	0.4	2.7	1.07E-02
Average Web Width	720.3	260.0	2.8	8.61E-03
Total Press	3.8	0.7	5.5	2.87E-06
Total Labeler	4.4	1.4	3.1	3.71E-03

[1] This model led to an adjusted R^2 of 0.744.

The Implementer's model had an adjusted R^2 0.744, suggesting the model explains about three-fourths of the variation, and all the variables had low p-values. This indicates that the model is capturing the largest drivers of energy but may be missing some other drivers. The performance period for this site was defined as February 1, 2016, to July 14, 2017, beginning directly after the end of the baseline period but overlapping with kickoff period by one month

Initially, the Evaluation Team tested production variables that the Implementer did not include in their model. The Evaluation Team found additional production variables significant in their baseline model. However, these variables were not available during the performance the Evaluation Team created a new model including only production variables that were available. The Evaluation Team's final SEM savings from this period was 618,257 kWh. Table H-60 presents the Team's final model.

Table H-60. Evaluation Team's Participant 5 Electric Model[1]

Variable	Estimate	Standard Error	*t*-Statistic	*p*-Value
Intercept	-416,376.7	115,929.8	-3.6	1.34E-03
HDD37	-594.9	233.7	-2.5	1.72E-02
CDD37	-129.7	62.8	-2.1	4.88E-02
Total Press	44.1	9.5	4.6	8.59E-05
Average Web Width	7,005.9	1,613.1	4.3	1.90E-04
MSF Produced.	4.2	2.2	1.9	6.85E-02
Total Labeler	87.2	24.7	3.5	1.54E-03
Holidays	-38,234.6	11,719.9	-3.3	3.09E-03
Total Press*holidays	5.2	1.5	3.4	2.32E-03
Total Press* Average Web Width	-0.4	0.1	-3.4	2.39E-03
Average Web Width*Total Labeler	-1.1	0.4	-3.0	6.51E-03
`Total Press*MSF Produced	-0.0005	0.0002	-1.9	6.51E-02
HDD37*MSF Produced	-0.04	0.01	-4.0	4.76E-04
HDD37*Total Labeler	0.3	0.1	4.9	4.87E-05
CDD37*Total Labeler	0.1	0.0	3.0	5.57E-03

[1] This model led to an adjusted R^2 of 0.925.

The Evaluation Team's and Implementer's models included the same production variables. The Evaluation Team also included HDD, CDD, and many interactions. It is possible that the reason so many interactions were significant in the Team's model was that some production variables were omitted from the model. The Evaluation Team model's adjusted R^2 of 0.925 is an improvement from the Implementer's adjusted R^2 of 0.744.

As presented in Table H-61, the Evaluation Team's final model CUSUM was 618,257 kWh, for a realization rate of 132%. The final savings had a standard error of 73,071 kWh at 90% confidence for a lower bound of 494,798 kWh and an upper bound of 741,160 kWh. The Implementer's final savings was not within the Evaluation Team's confidence interval, because the Evaluation Team believes the Implementer did not capture all of the largest energy drivers.

Table H-61. Participant 5 Electric Savings Summary

Reported Savings	Evaluated Savings				Realization Rate
	Savings	Standard Error	Lower Bound	Upper Bound	
468,204	618,257	73,071	494,798	741,160	132%

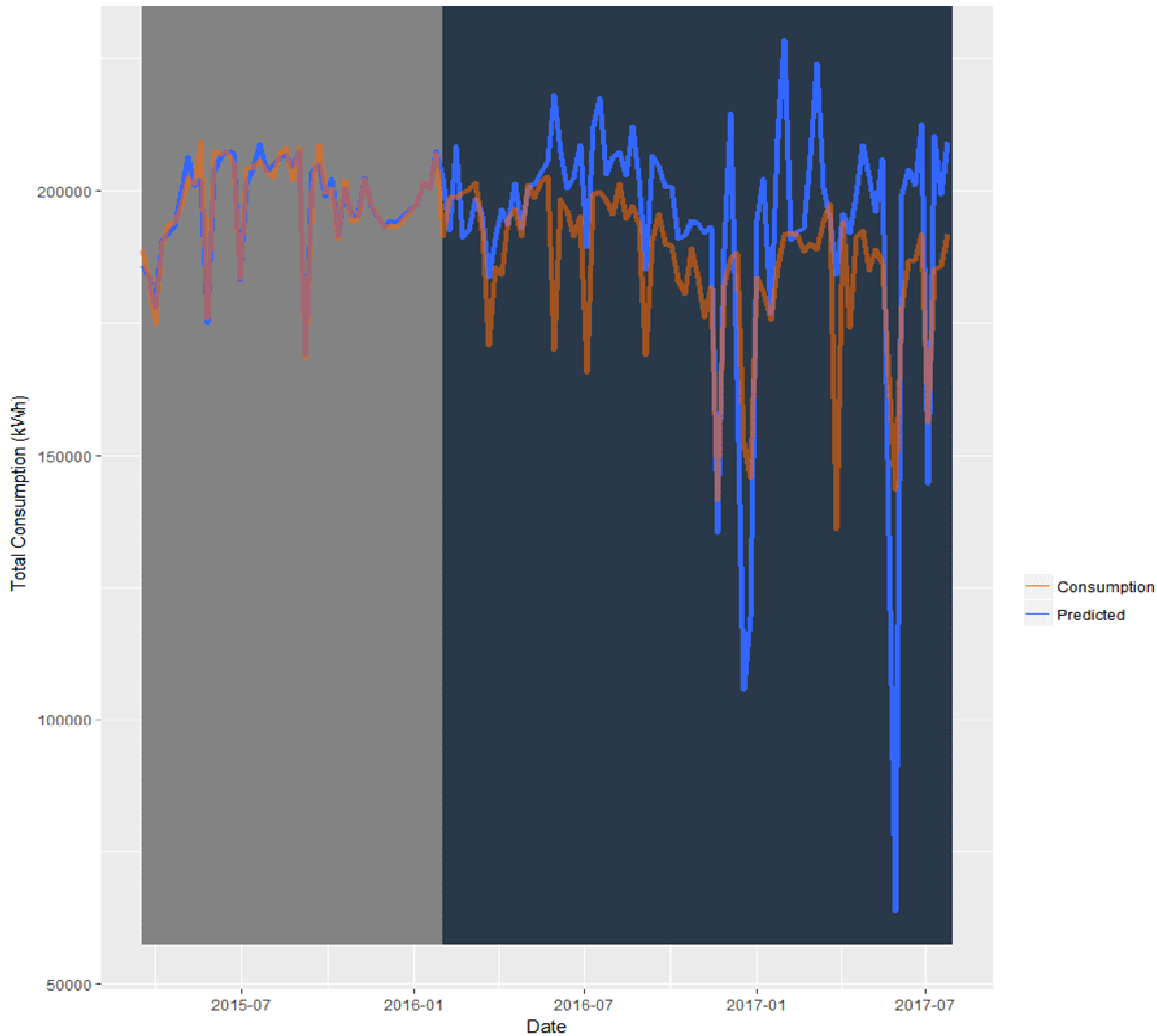
As shown in Table H-62, the Participant 5 facility claimed 249,005 kWh in savings through the SEM Program. It tracked 204,491 kWh in savings that were either claimed through the LEU Program or otherwise tracked by the Implementer. To isolate the O&M and behavior-based savings, these savings were subtracted from the total reported savings and the evaluated savings, which resulted in 14,708 kWh reported savings and 164,761 kWh evaluated savings.

Table H-62. Participant 5 Electric Capital Projects Summary

SEM Capital Savings	LEU and Other Capital Savings	O&M and Behavior-Based Savings	
		Reported	Evaluated
249,005	204,491	14,708	164,761

Figure H-14 shows the predicted and actual consumption. During the baseline period (light grey), the predicted consumption closely follows the actual consumption. During the performance period (dark grey), savings can be seen when the predicted consumption is greater than the actual consumption.

Figure H-14. Evaluation Team's Participant 5 Electric Model



Natural Gas

The Implementer assigned the baseline periods as July 5, 2014, to October 31, 2015, more than a full year of baseline and prior to the SEM kickoff (January 1, 2016). The Evaluation Team found this baseline was well defined. The Participant 5 facility provided raw production data at the monthly level. The Implementer's final model is presented in Table H-63.

Table H-63. Program Implementer's Participant 5 Natural Gas Model[1]

Variable	Estimate	Standard Error	T-Statistic	P Value
Intercept	17873.9	6998.6	2.6	2.40E-02
Tons Consumed	4.5	1.7	2.6	2.18E-02
HDD62	26.3	1.4	18.3	1.19E-10

[1] This model led to an adjusted R^2 of 0.958.

The Implementer's model had an adjusted R^2 above 0.9 and all the variables had low p-values, which indicates that its model was capturing the largest drivers of energy. The performance period for this site was defined as November 1, 2015, to July 31, 2017, which began directly after the end of the baseline period but prior the SEM kickoff. The Implementer's final CUSUM from this period was 158,379 therms.

Initially, the Evaluation Team tested production variables that the Implementer did not include in its model and did not find additional production variables significant. The Evaluation Team's final SEM savings from this period was 136,249 therms. Table H-64 presents the Team's final model.

Table H-64. Evaluation Team's Participant 5 Natural Gas Model[1]

Variable	Estimate	Standard Error	T-Statistic	P Value
Intercept	13,541.2	6,102.5	2.2	4.65E-02
HDD50	53.2	6.2	8.5	1.93E-06
Tons Consumed	6.0	1.5	4.0	1.79E-03
HDD50*HDD50	-0.02	0.01	-2.7	1.79E-02

[1] This model led to an adjusted R^2 of 0.969.

The Evaluation Team's and Implementer's models were very similar; the only differences were in the Evaluation Team's selection of a different HDD and inclusion of HDD squared. The Evaluation Team model's adjusted R^2 of 0.969 is an improvement from the Implementer's adjusted R^2 of 0.958.

As shown in Table H-65, the Evaluation Team's final model CUSUM was 136,249 therms, for a realization rate of 86%. The final savings had a standard error of 14,845 therms at 90% confidence for a lower bound of 110,597 therms and an upper bound of 159,562 therms. The Implementer's final savings was within the Evaluation Team's confidence interval.

Table H-65. Participant 5 Natural Gas Savings Summary

Reported Savings	Evaluated Savings				Realization Rate
	Savings	Standard Error	Lower Bound	Upper Bound	
158,379	136,249	14,845	110,597	159,562	86%

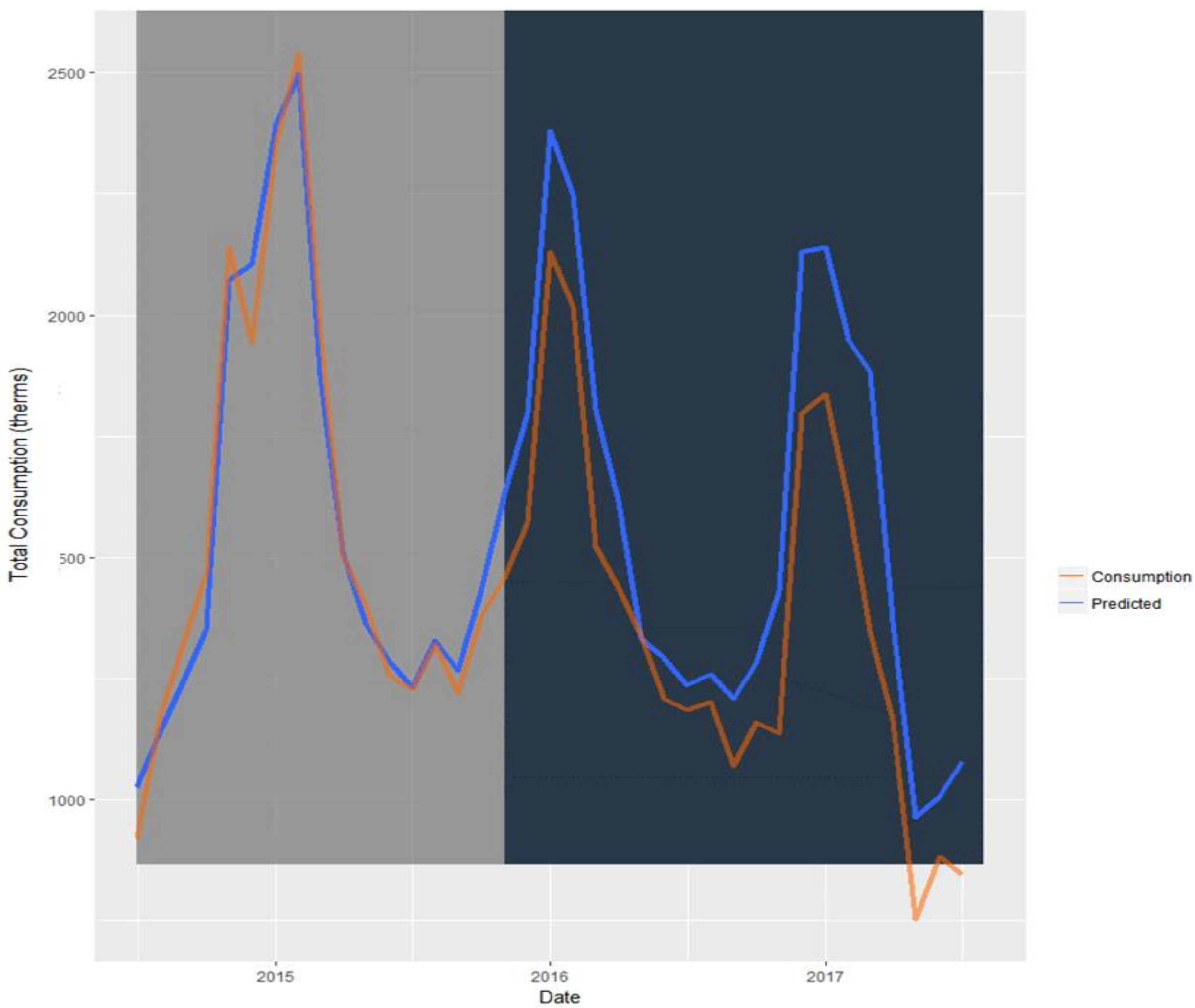
As shown in Table H-66, the Participant 5 facility claimed 7,559 therms in savings through the SEM Program. It tracked 12,366 therms in savings that were either claimed through the LEU Program or otherwise tracked by the Implementer. To isolate the O&M and behavior-based savings, these savings were subtracted from the total reported savings and the evaluated savings, which resulted in 138,454 therms reported savings and 116,325 therms evaluated savings.

Table H-66. Participant 5 Natural Gas Capital Projects Summary

SEM Capital Savings	LEU and Other Capital Savings	O&M and Behavior-Based Savings	
		Reported	Evaluated
7,559	12,366	138,454	116,325

Figure H-15 shows the predicted and actual consumption. During the baseline period (light grey), predicted consumption closely follows actual consumption. Savings can also be seen during periods that During the performance period (dark grey), savings can be seen when predicted consumption is greater than actual consumption.

Figure H-15. Evaluation Team's Participant 5 Natural Gas Model



Participant 6

Electric

The Implementer assigned the baseline periods as January 1, 2015, to December 31, 2015, a full year of baseline that does not overlap with SEM kickoff (August 1, 2016). The Evaluation Team found this baseline was well defined. The facility provided raw production data at the daily level. The Implementer's final model is presented in Table H-67.

Table H-67. Program Implementer's Participant 6 Electric Model[1]

Variable	Estimate	Standard Error	*t*-Statistic	*p*-Value
Intercept	198,382.0	382.3	518.9	0.0E+00
TM Tons Under 150	999.4	31.5	31.7	1.4E-106
Pulper Under 200	255.2	16.9	15.1	2.0E-40

[1] This model led to an adjusted R^2 of 0.867.

The Implementer's model had an adjusted R^2 above 0.85, suggesting that the model explained most of the variation and all of the variables had low p-values. This indicates that the model is mostly likely capturing the largest drivers of energy. The performance period for this site was defined as January 1, 2016, to September 30, 2017, which began directly after the end of the baseline period and prior to the SEM kickoff period. The Implementer's final CUSUM from this period was 1,755,095 kWh.

Initially, the Evaluation Team tested production variables that the Implementer did not include in its model and found additional production variables significant in the Team's baseline model. However, these variables were not available during the performance, so the Team created a new model that included only the available production variables. The Team's final SEM savings from this period was 2,252,191 kWh. The Team's final model is presented in Table H-68.

Table H-68. Evaluation Team's Participant 6 Electric Model[1]

Variable	Estimate	Standard Error	*t*-Statistic	*p*-Value
Intercept	231,933.3	15,255.5	15.2	1.49E-40
HDD65	-52.5	19.1	-2.7	6.28E-03
TM Tons Under 150.	-1,153.1	88.9	-13.0	9.25E-32
Pulper Under 200	-227.1	31.7	-7.2	4.62E-12
TM1 Tons	-248.6	113.6	-2.2	2.93E-02
TM2 Tons	-209.9	121.3	-1.7	8.44E-02
Pulper Tons	-213.6	59.7	-3.6	3.94E-04
TM1 Tons*Pulper Tons	1.5	0.5	3.2	1.39E-03
HDD65*TM Tons Under 150	5.3	1.9	2.8	5.45E-03
`TM2 Tons*Pulper Tons	1.3	0.6	2.3	1.98E-02

[1] This model led to an adjusted R^2 of 0.873.

The Evaluation Team's and the Implementer's models included TM tons under 150 and pulper under 200. However, the Team's model also included HDD, the effects of TM tons and Pulper Tons, and many interactions. The Team model's adjusted R^2 of 0.873 is an improvement from the Implementer's adjusted R^2 of 0.867.

As presented in Table H-69, the Evaluation Team's final model CUSUM was 2,252,191 kWh, for a realization rate of 128%. The final savings had a standard error of 294,987 kWh at 90% confidence for a lower bound of 1,765,711 kWh and an upper bound of 2,738,671 kWh. The Implementer's final savings was not within the Evaluation Team's confidence interval. The Evaluation Team still believes that the Implementer did capture the greatest drivers of energy saving as the Implementer's savings estimate is barely outside the confidence interval and there was a relatively small difference in the adjusted R^2.

Table H-69. Participant 6 Electric Savings Summary

Reported Savings	Evaluated Savings				Realization Rate
	Savings	Standard Error	Lower Bound	Upper Bound	
1,755,095	2,252,191	294,987	1,765,711	2,738,671	128%

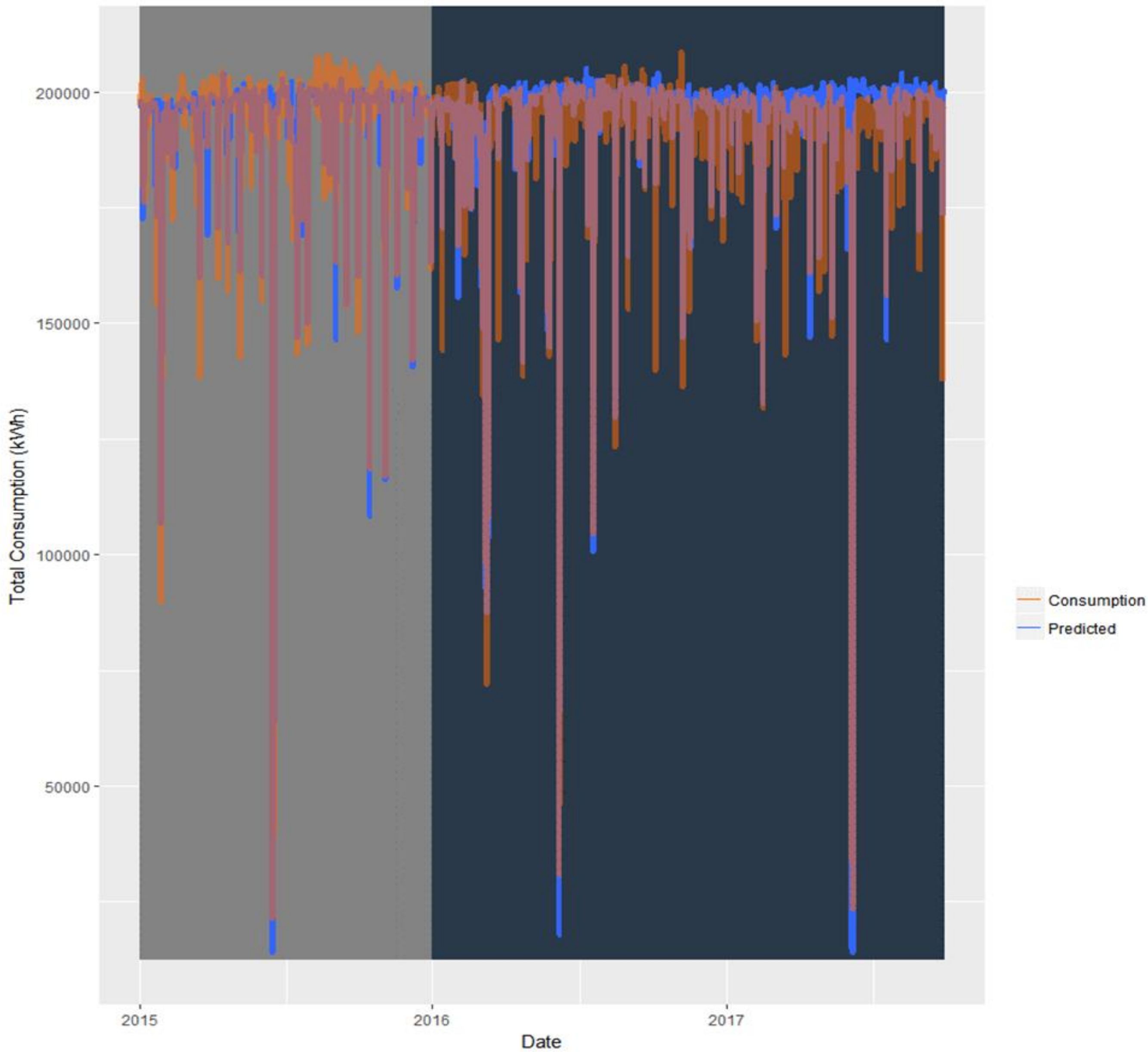
As shown in Table H-70, the facility claimed 249,005 kWh in savings through the SEM Program. It tracked 204,491 kWh in savings that were either claimed through the LEU Program or otherwise tracked by the Implementer. To isolate the O&M and behavior-based savings, these savings were subtracted from the total reported savings and the evaluated savings, which resulted in 14,708 kWh reported savings and 164,761 kWh evaluated savings.

Table H-70. Participant 6 Electric Capital Projects Summary

SEM Capital Savings	LEU and Other Capital Savings	O&M and Behavior-Based Savings	
		Reported	Evaluated
249,005	204,491	14,708	164,761

Figure H-16 graphs the predicted and actual consumption. During the baseline period (light grey), predicted consumption closely follows actual consumption. During the performance period (dark grey), savings can be seen when predicted consumption is greater than actual consumption.

Figure H-16. Evaluation Team's Participant 6 Electric Model



Natural Gas

The Implementer assigned the baseline periods as January 1, 2015, to December 31, 2015, a full year of baseline prior to the SEM kickoff (August 1, 2016). The Evaluation Team found this baseline was well defined. The facility provided raw production data at the daily level. The Implementer's final model is presented in Table H-71.

Table H-71. Program Implementer's Participant 6 Natural Gas Model[1]

Variable	Estimate	Standard Error	*t*-Statistic	*p*-Value
Intercept	11,701.4	580.9	20.1	5.71E-61
TM1 Tons	57.4	4.6	12.3	1.90E-29
TM2 Tons	75.5	6.6	11.5	2.93E-26
Pulper Tons	8.1	1.9	4.2	2.74E-05
Average Temperature	-99.9	3.2	-30.9	3.15E-103

[1] This model led to an adjusted R^2 of 0.811.

The Implementer's model had an adjusted R^2 above 0.8 and all the variables had low p-values, which indicates its model was capturing the largest drivers of energy. Nevertheless, there may be room for improvement. The performance period for this site was defined as January 1, 2015, to September 30, 2017, which period began directly after the end of the baseline period but prior to the SEM kickoff. The Implementer's final CUSUM from this period was 1,079,702 therms.

Initially, the Evaluation Team tested production variables that the Implementer did not include in its model and found additional production variables significant in the Team's baseline model. However, these variables were not available during the performance, so the Evaluation Team created a new model that included only the available production. The Team's final model is presented in Table H-72.

Table H-72. Evaluation Team's Participant 6 Natural Gas Model[1]

Variable	Estimate	Standard Error	*t*-Statistic	*p*-Value
Intercept	2,717.6	1,123.5	2.4	1.61E-02
HDD66	106.6	3.2	33.4	3.57E-112
Pulper Under 200	-9.8	2.8	-3.5	6.06E-04
TM1 Tons	90.9	12.2	7.4	7.27E-13
TM2 Tons	183.2	23.8	7.7	1.26E-13
TM2 Tons*TM2 Tons	-0.6	0.2	-2.7	8.21E-03
`TM1 Tons*TM2 Tons	-0.5	0.2	-2.9	4.17E-03

[1] This model led to an adjusted R^2 of 0.879.

The Evaluation Team's and Implementer's models included TM1 Tons and TM2 Tons. The Evaluation Team's model included Pulper under 200 rather than Pulper Tons and included TM1 and TM2 squared. The Team model's adjusted R^2 of 0.879 is an improvement from the Implementer's adjusted R^2 of 0.811. The Evaluation Team's final SEM savings from this period was 1,026,787 therms.

As presented in Table H-73, the Evaluation Team's final model CUSUM was 1,026,787 therms, for a realization rate of 95%. The final savings had a standard error of 50,508 therms at 90% confidence for a lower bound of 943,491 therms and an upper bound of 1,110,083 therms. The Implementer's final savings was within the Evaluation Team's confidence interval.

Table H-73. Participant 6 Natural Gas Savings Summary

Reported Savings	Evaluated Savings				Realization Rate
	Savings	Standard Error	Lower Bound	Upper Bound	
1,079,702	1,026,787	50,508	943,491	1,110,083	95%

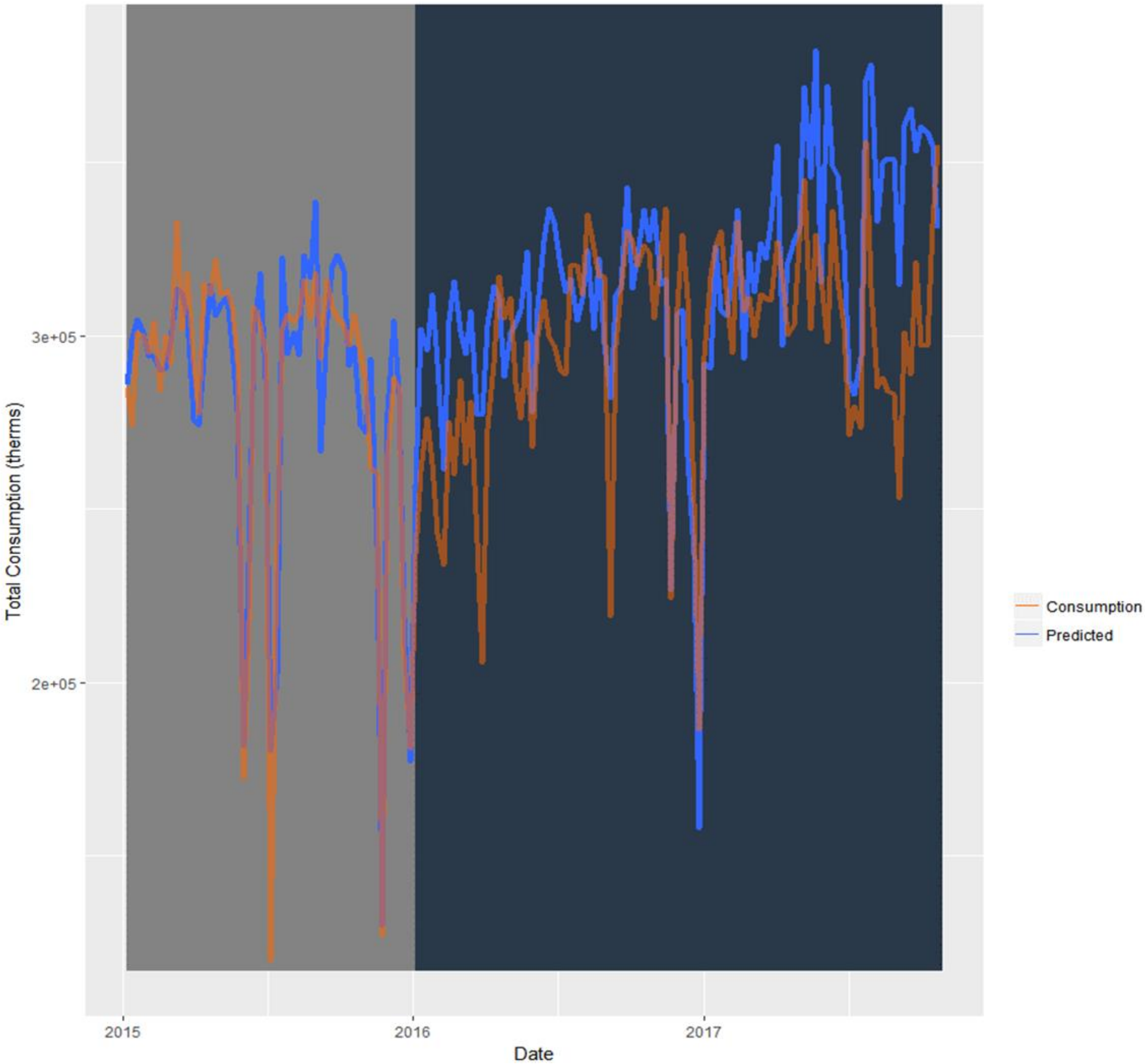
As shown in Table H-74, the Participant 6 facility claimed 162,707 therms in savings through the SEM Program. It tracked 29,924 therms in savings that were either claimed through the LEU Program or otherwise tracked by the Implementer. To isolate the O&M and behavior-based savings, these savings were subtracted from the total reported savings and the evaluated savings, which resulted in 887,071 therms reported savings and 834,156 therms evaluated savings.

Table H-74. Participant 6 Natural Gas Capital Projects Summary

SEM Capital Savings	LEU and Other Capital Savings	O&M and Behavior-Based Savings	
		Reported	Evaluated
162,707	29,924	887,071	834,156

Figure H-17 graphs the predicted and actual consumption. During the baseline period (light grey), predicted consumption closely follows actual consumption. During the performance period (dark grey), savings can be seen when predicted consumption is greater than actual consumption.

Figure H-17. Evaluation Team's Participant 6 Natural Gas Model



H.5. Networked Lighting Controls Pilot

The Networked Lighting Controls Pilot was implemented by Franklin Energy, which installed 12 networked lighting controls systems for five customers. The following information was available to the Evaluation Team:

- Fixture inventories and specifications were available through SPECTRUM documents for all participating projects. This information included the quantity of fixtures controlled by each system, and fixture wattage.

- The Implementer recorded the square footage of controlled lighting in each facility using application documents, building drawing review, and on-site verification.
- The Evaluation Team installed various light loggers at three participating projects. Light state loggers, which record when the light turns on/off, were installed prior to control system installation to measure baseline hours. After the networked lighting controls installation was complete, the Team installed light intensity loggers to measure fixture dimming behavior and a rooftop pyranometer to measure the ambient solar illuminance, used to model daylight harvesting behavior.
- Two sites installed networked lighting controls systems with built-in energy monitoring and reporting capabilities. The Implementer requested data files from these sites to cover the post-installation metering period during which the Evaluation Team's loggers were active. Both systems used the same energy monitoring software, which could export data in one-hour increments that included the actual energy consumption and the savings attributable to task tuning, daylight harvesting, and occupancy sensing.

Table H-75. Calculation Methodologies Used in the Networked Lighting Controls Pilot

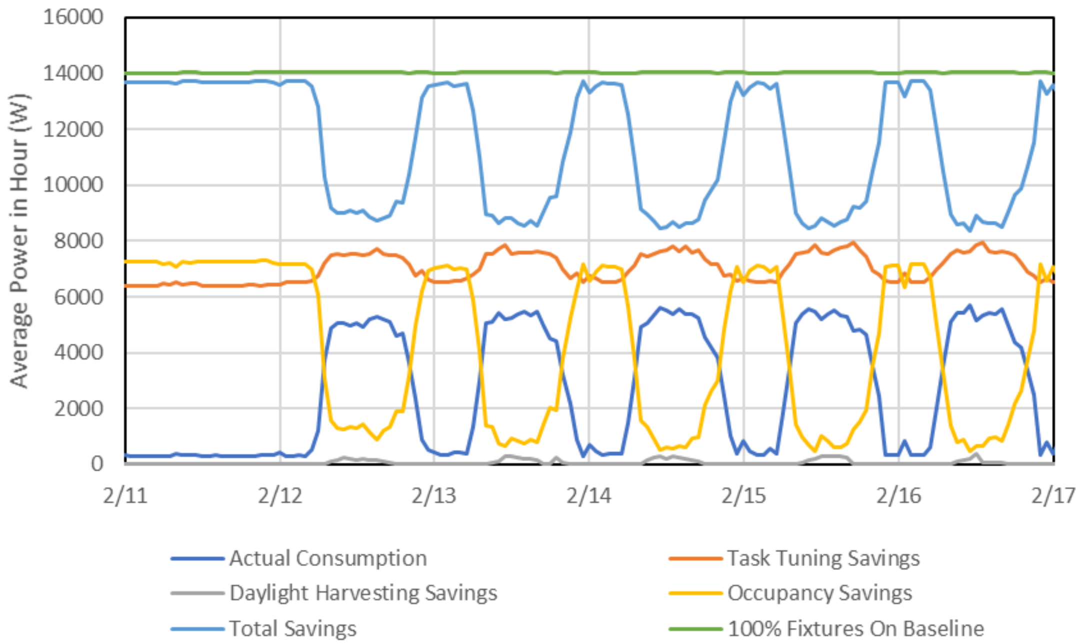
<table>
<tr><th>Project Description</th><th>Number of Projects</th><th>Connected Load Calculation</th><th>Baseline Operation Calculation</th><th>NLC Operation Calculation</th></tr>
<tr><td>Parking Garage</td><td>1</td><td rowspan="2">Energy monitoring data</td><td rowspan="3">Light state (on/off) loggers</td><td rowspan="2">Energy Monitoring Data</td></tr>
<tr><td>Commercial Building with Warehouse and Offices</td><td>1</td></tr>
<tr><td>School District 1 – High School</td><td>1</td><td rowspan="5">Fixture quantity and specification from invoices and SPECTRUM documentation</td><td>Light intensity (brightness) loggers</td></tr>
<tr><td>School District 1 – Other Schools</td><td>4</td><td>Extrapolation from High School loggers</td><td>Extrapolation from High School loggers</td></tr>
<tr><td>School District 1 – Administration Building</td><td>1</td><td>TRM hours of use</td><td rowspan="3">Engineering review</td></tr>
<tr><td>School District 2 Schools</td><td>3</td><td>TRM hours of use</td></tr>
<tr><td>Commercial Manufacturing Building</td><td>1</td><td>TRM hours of use</td></tr>
</table>

H.5.1. System Energy Monitoring Data Modeling

The energy monitoring systems analyzed in this study assumed a baseline of all fixtures connected to the control system 100% on at all times. The actual baseline energy usage depended on how the system was controlled prior to installing the networked lighting controls. Therefore, savings reported by networked lighting controls software were typically higher than actual savings for a given project. The savings attributable to each control strategy as shown in these data were not the final verified savings.

Two projects had system energy monitoring data available. Figure H-18 shows one week of data from one of these exports.

Figure H-18. One Week of Energy Monitoring Data Exported from Networked Lighting Control System



For these two sites, the Evaluation Team analyzed the system behavior during the monitoring period and modeled the system's operation over a full year to estimate the annual energy savings. Daylight harvesting savings were modeled by correlating the actual solar illuminance measured by a rooftop pyranometer with the system-reported daylight harvesting savings.

An example of the rooftop solar data is shown in Figure H-19. The model is extrapolated to a full typical year using NOAA TMY3 solar illuminance data. Occupancy control savings were modeled by correlating the hour of the day and day of the week with the reported occupancy control savings. Task tuning savings were modeled from the correlation between system-reported task tuning savings and the system-reported actual energy consumption; both of these were applied after both daylight harvesting and occupancy savings.

Figure H-19. Solar Radiation Measured by a Rooftop Solar Pyranometer

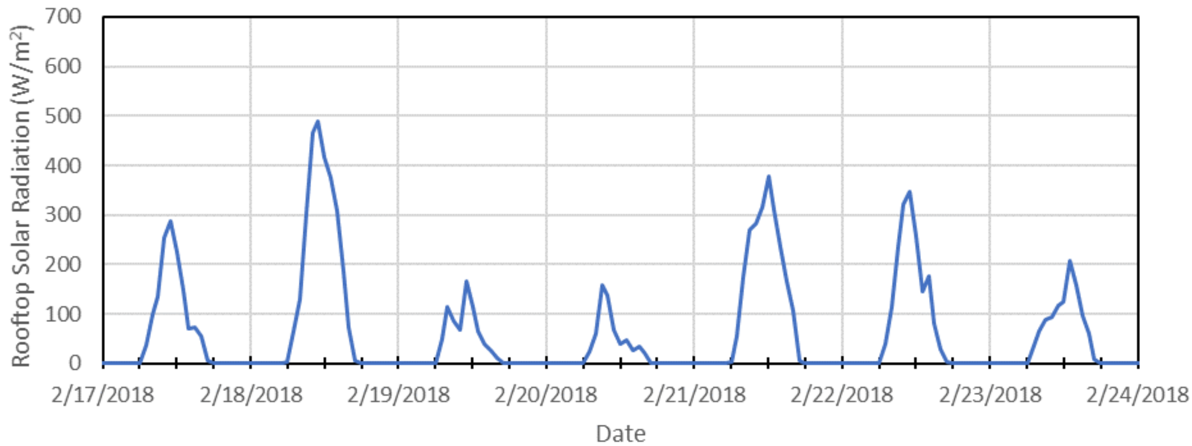
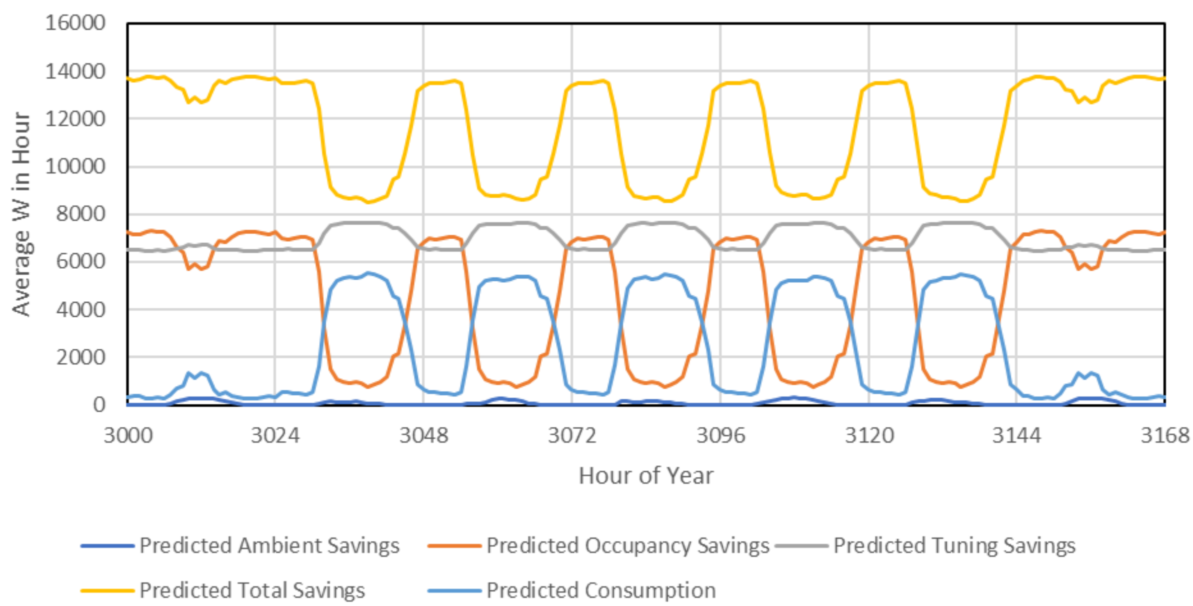


Figure H-20 shows an example of one week of modeled system behavior. The savings are still relative to a baseline that all fixtures were on 100% of the time. Only the modeled energy consumption was used to calculate the verified savings. The verified baseline was calculated using the hours of use from light state loggers installed before the networked lighting controls system was installed. This baseline calculation methodology was the same for sites with energy monitoring data as for sites that only had light logger data and is described in more detail below.

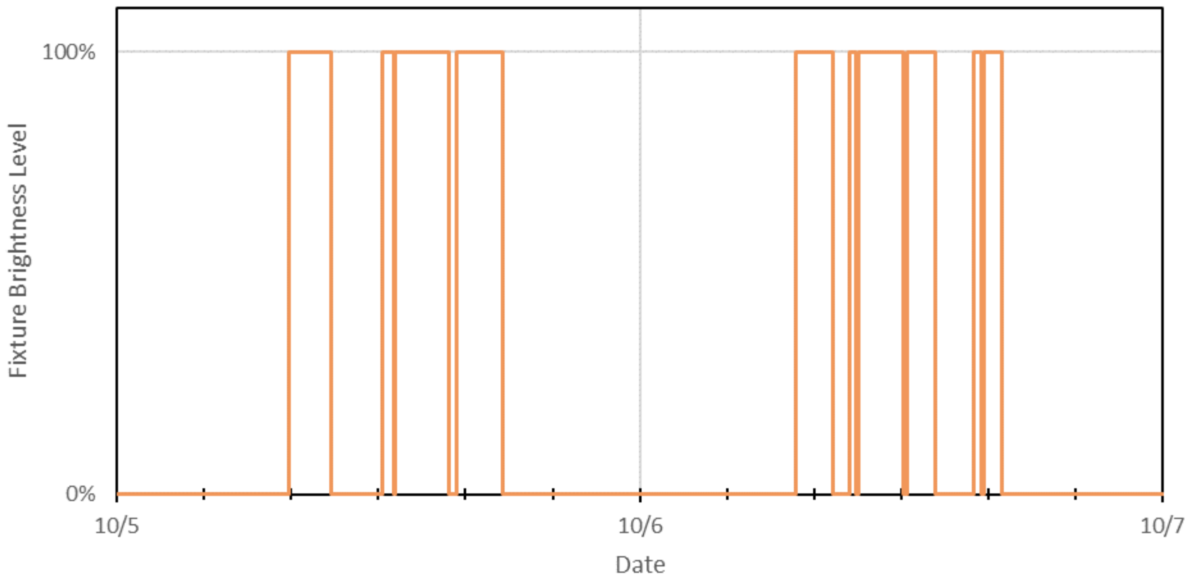
Figure H-20. Modeled Energy Consumption Using Energy Monitoring Data



H.5.2. Logger Data Analysis

The Evaluation Team installed light state (on/off) loggers to estimate the baseline annual hours of use for each site prior to the networked lighting controls installation. Annual hours of use were extrapolated by calculating the percentage of weekday, weekend, and holiday hours the lights were on during the metered period then multiplying by the total number of weekday, weekend, and holiday hours in a year. Figure H-21 is an example of light logger data collected at one site prior to networked lighting controls installation.

Figure H-21. Light Logger On/Off State During Two Days in the Baseline Metering Period in a Commercial Office Area

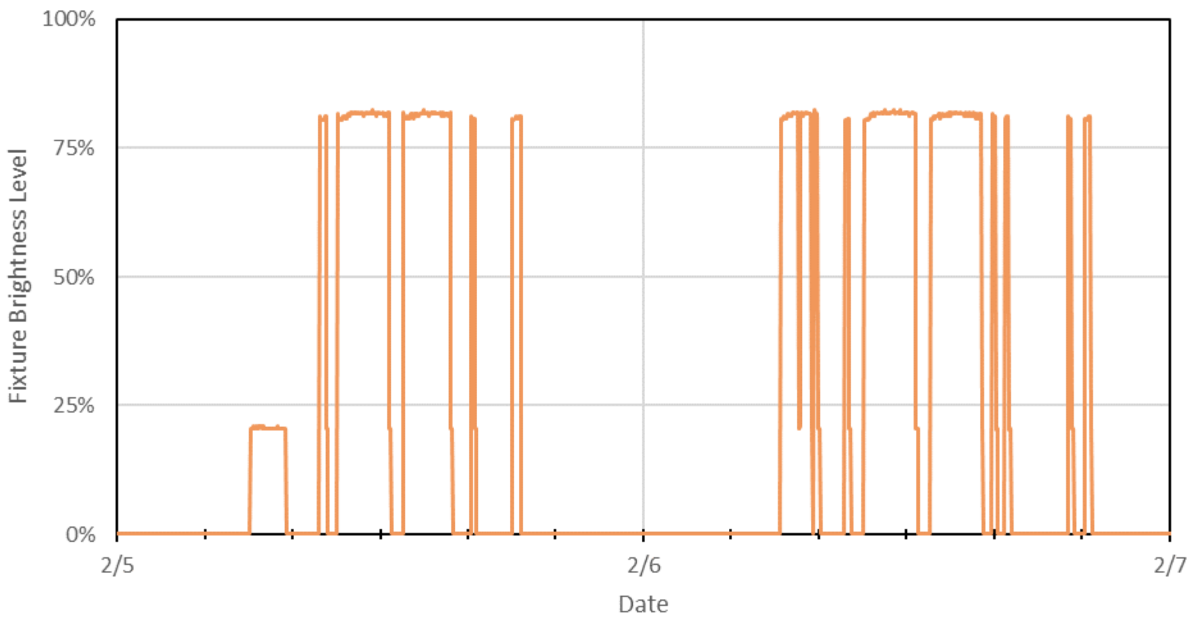


For one site, the Evaluation Team had collected logger data but did not have any energy monitoring data. The Team installed light intensity loggers on various fixtures representing different space types and including interior (windowless) and exterior-facing rooms to account for different behavior from daylight harvesting controls. The Team used light intensity loggers, rather than on/off state loggers, because networked lighting controls systems partially dim lights in some modes.

Figure H-22 shows an example of the light brightness behavior observed in a classroom. The Team used the measured fixture intensity to create a fixture output percentage model for each of the logged spaces then applied this model to the rest of the building based on the percentage of square footage in each space category. However, with no energy system data, the Team could not determine the savings attributable to each specific control strategy, so the Team created a model using the time of day and day of the week to extrapolate energy consumption to a full year. The Team calculated savings by subtracting the modeled energy consumption from the baseline energy consumption described above.

As shown in the figure, the light intensity never goes above 80% because of the task tuning applied. Occupancy sensing behavior can be seen where the lights turn off or dim when the room is not in use. No daylight harvesting behavior is visible because this is an interior room without any daylight aperture.

Figure H-22. Brightness of Networked Lighting Controls-Enabled Light Fixture Metered by Light Intensity Logger in a High School Classroom

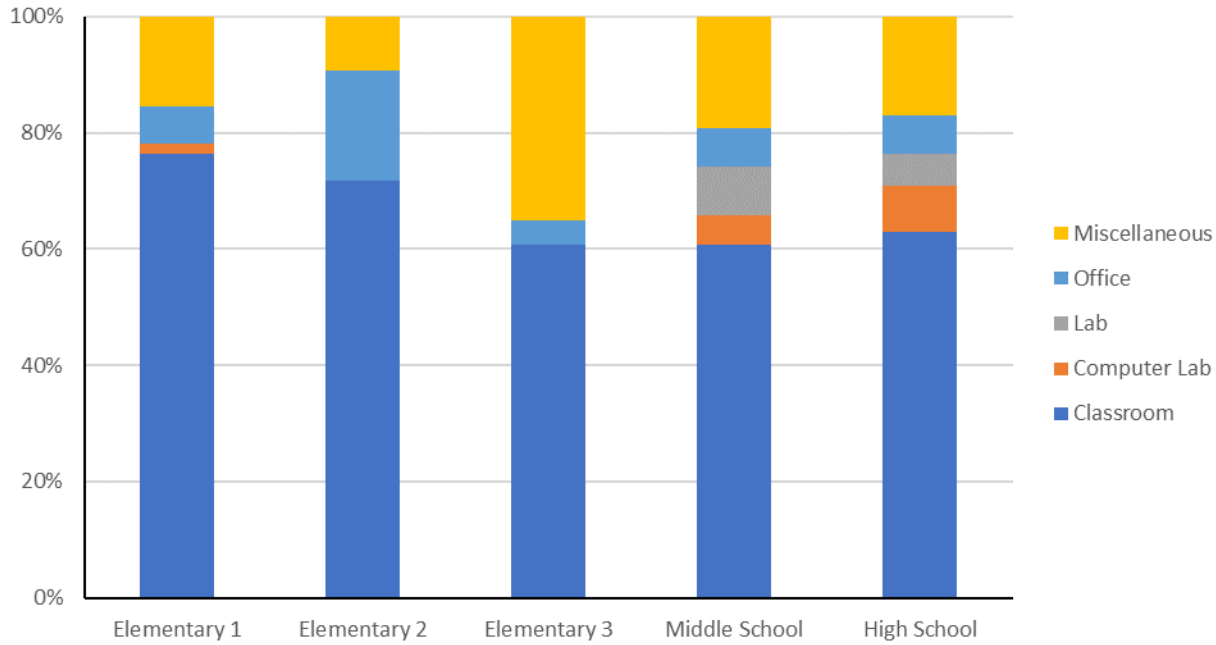


H.5.3. Engineering Review Using Logger Data Analysis from Similar Sites

The school district had four other schools, in addition to the high school described above, but no loggers were installed at these sites. The Evaluation Team applied the same model developed for the high school to the other four schools and made adjustments for the different distribution of space types and site-specific baseline energy consumptions.

Figure H-23 shows the distribution of different space types at each participating school in this district.

Figure H-23. Distribution of Space Types in Schools in a participating School District



H.5.4. Engineering Review Without Logger Data

Three projects had no logger data available and were sufficiently unique that meter data from other projects could not be applied. The second participating school district installed networked lighting controls systems at three schools. The system configuration was different from the first participating school district. The other two sites without data included the district administration office from the first participating school district, and a commercial office building.

The Evaluation Team calculated the connected controlled lighting load for each of these sites from invoices submitted to SPECTRUM. The baseline hours of use for each project was assumed from the 2017 Wisconsin TRM for each project's sector.

The reported system configuration for the second school district did not include daylight harvesting and included a 15-minute occupancy sensor timeout and a 20% task tuning reduction. Classrooms tend to have high occupancy, and when users are diligent about manually turning off lights when not in use prior to the installation of occupancy controls, hours of use can actually increase with the addition of occupancy controls. Some spaces in the metered school showed an increase in hours of use after adding networked lighting controls, and classrooms are rarely unoccupied for more than 15 minutes during occupied hours.

Based on these observations, the Evaluation Team did not find sufficient evidence to support either a reduction or increase in hours of use attributable to occupancy sensors. Without any daylight harvesting active, the Evaluation Team applied 20% task tuning savings to these three projects.

For the school administration building and the commercial manufacturing building, the Evaluation Team used the 47% energy reduction factor that the implementer used in the original estimates. The Design Lights Consortium (DLC) has also released a report which supports a 47% average reduction when all three major networked lighting controls strategies are employed.[32] The Team did not have any additional quantifiable information available about these two projects that would support increasing or decreasing the savings factor; however, for comparison only one of the metered projects in this pilot achieved greater than 47% savings; most achieved under 25% savings.

32 https://www.designlights.org/lighting-controls/reports-tools-resources/nlc-energysavings-report/

Appendix I. Net Savings Analysis

For the CY 2017 evaluation of Focus on Energy's programs, the Evaluation Team applied net-to-gross (NTG) adjustments drawn mostly from primary research. This appendix presents four general approaches used to assess net savings—standard market practice (SMP), demand elasticity modeling, national sales data modeling, and self-report NTG—and how they were applied to each program.

I.1. Net Savings Overview

As described in Volume II, the evaluation of a program involves reviewing the reported gross savings and conducting on-site visits 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 program is directly responsible for the savings, and the savings would not have been achieved in the absence of that program. In deriving this value, evaluators account for, and 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 account for, 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 the progress toward the savings targets established for Focus on Energy by the Public Service Commission of Wisconsin.

This appendix discusses the specific approaches the Evaluation Team used to derive the net savings for the CY 2017 Focus on Energy programs. Of particular note, beginning in CY 2013, the Evaluation Team began the process of moving away from estimating net savings exclusively from survey results to approaches driven by sales data or an experimental design. One example is SMP, an approach that measures the impact of the programs on the average efficiencies of measures sold and installed in Wisconsin. Other examples of data-driven approaches are national sales data modeling and demand elasticity modeling (which measures the lift in retail sales resulting from changes in incentive levels).

Focus on Energy's long-term goal is to use these data-driven approaches as broadly as possible and to limit reliance on self-reporting methods. The Evaluation Work Group (EWG) approved the use of these approaches and supports increasing their use where evaluators can obtain reliable with reasonable cost and effort.

The Evaluation Team conducted SMP, demand elasticity modeling, national sales data modeling, and self-report methods to assess the performance of measures offered throughout the portfolio. In some cases, the Evaluation Team combined the measure-level results from the SMP with the self-report 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 2017 evaluation.

Table I-1. CY 2017 Net Savings Methodology by Program

CY 2017 Programs	Net Savings Methodologies
Residential	
Multifamily Energy Savings	Self-Report
Multifamily Direct Install	Stipulated NTG = 1.0
Home Performance with ENERGY STAR (Whole Home)	CY 2017 Billing Analysis
Home Performance with ENERGY STAR (HVAC Standard Track)	Standard Market Practice and CY 2015 Self-Report
Home Performance with ENERGY STAR (HVAC Income-Qualified Track)	Stipulated NTG = 1.0
New Homes	CY 2015 Billing Analysis
Retailer Lighting and Appliance	National Sales Data Modeling
Simple Energy Efficiency	Stipulated NTG = 1.0
Appliance Recycling	CY 2017 Self-Report
Nonresidential	
Agriculture, Schools and Government	CY 2016 and CY 2015 Self-Report
Business Incentive	CY 2016 and CY 2015 Self-Report
Small Business	CY 2016 and CY 2015 Self-Report
Large Energy Users	CY 2016 and CY 2015 Self-Report
Renewable Energy Competitive Incentive	CY 2017 Self-Report
Design Assistance	CY 2017 Self-Report
Pilots	
Networked Lighting Controls	CY 2017 Self-Report
Seasonal Savings	Stipulated NTG = 1.0
Strategic Energy Management	Stipulated NTG = 1.0

The Evaluation Team launched a new strategy to collect these data for CY 2017 directly from distributors and manufacturers.

I.2. Standard Market Practice Approach

The Evaluation Team applied the SMP approach to the HVAC standard track of the Home Performance with ENERGY STAR Program. The Team calculated net-of-freeridership savings using program data and data collected through the evaluation process to define the average market baseline and average program-installed energy consumption (kWh and therm) of each measure category.

The Evaluation Team first accessed data on a significant share of sales and current installations in Wisconsin, showing efficiency levels of a particular equipment type outside of the Focus on Energy program. Market baselines include a range of varying efficiency levels (both inefficient and efficient levels) and nominally represent the average efficiency installed in Wisconsin during the current program year. In the SMP approach, the Evaluation Team calculated net-of-freeridership savings as the difference between the average market baseline and the average program-installed energy consumption, under the assumption that freeridership is captured in the baseline. Note that since verified gross savings employ deemed values for baseline and installed efficiency for these measures, the Team considered the market baseline adjustment a net adjustment even though it can be understood to have gross savings implications.

However, the SMP approach does not capture participant spillover effects, so the Evaluation Team applied participant spillover (estimated through the self-report surveys) to the net-of-freeridership savings. The Team compared net savings to the verified gross savings to determine the NTG ratio.

I.2.1. SMP Baseline Data Sources

The Evaluation Team determined the baseline for each selected Residential Rewards Program measure category using these two sources of sales and installation data:

- D+R International sales data from 2014, 2015, and 2016
- CY 2012 through CY 2017 Home Performance with ENERGY STAR Program audit data

Table I-2 lists the measures selected for the SMP analysis in CY 2017 and their corresponding baseline data sources.

Table I-2. Measures Assessed with Standard Market Practice Methodology

CY 2017 SMP Measures	Baseline Data Source
Natural Gas Furnace	D+R International (2014 – 2016) and HPwES Audit Data (2012 – 2017)
Air Conditioner	D+R International (2014 – 2016) and HPwES Audit Data (2012 – 2017)
ECM	D+R International (2014 – 2016)

D+R International 2014 and 2015 HVAC Market Reports

D+R International Ltd. has an exclusive license with Heating, Air Conditioning, and Refrigeration Distributors International (HARDI) that authorizes D+R to collect data from HARDI members and to aggregate member data to produce analysis and reports. The Evaluation Team purchased a D+R report of residential HVAC measures sold in Wisconsin during 2014, 2015, and 2016. The report used sales data reported to D+R International by HARDI members participating in the Unitary HVAC Market Report. The report contained summaries of quantities of observed sales by efficiency level and estimations of the size of each measure's total market in 2014, 2015, and 2016. To represent a rolling market baseline, the Evaluation Team used data from all three of these years. The Team then combined these data to produce average annual fuel utilization efficiency (AFUE), seasonal energy efficiency rating (SEER), and electronically commutated motor (ECM) penetration values.

Home Performance with ENERGY STAR Program Audit Data

CLEAResult, the Program Implementer for the Home Performance with ENERGY STAR Program, provided the Evaluation Team with data obtained during all home assessments (i.e., before Program upgrades were made) since the inception of the Program in CY 2012 through CY 2017. The data contained information on efficiency and age of household equipment such as furnaces and air conditioners.

I.2.2. Measure-Specific Analyses

The Evaluation Team used the SMP approach to determine freeridership for furnaces, air conditioners, and ECMs offered under the Home Performance with ENERGY STAR Program. The analysis used sales data from the same two sources (D+R and Home Performance with ENERGY STAR audit data) to estimate a market baseline efficiency.

Table I-3 lists the SMP results for the Home Performance with ENERGY STAR Program, showing per-unit net-of-freeridership savings and the corresponding percentage of freeridership for all measures evaluated.

Table I-3. CY 2017 Summary of Net-of-Freeridership Savings by Measure

Measure	Per-Unit Savings			Freeridership (%)		
	kWh	kW	therms	kWh	kW	therms
ECM, Furnace (New or Replacement)	339	0.06	--	18%	19%	n/a
Furnace and AC, ECM, 95%+ AFUE (Existing)	409	0.14	35.1	21%	51%	-67%
NG Furnace with ECM, 95%+ AFUE (Existing)	339	0.06	22.8	19%	19%	-9%
NG Furnace with ECM, 96%+ AFUE	339	0.06	30.6	19%	19%	-2%
NG Furnace with ECM, 97%+ AFUE	339	0.06	41.8	18%	19%	-7%
NG Furnace with ECM, 98%+ AFUE	339	0.06	56.2	19%	19%	-67%
LP Furnace with ECM, 90%+ AFUE (Existing)	339	0.06	--	18%	19%	n/a

SMP gas savings for furnaces produced varying freeridership results because of three factors:

- The Evaluation Team looked up model numbers on all furnaces sold through the Program in CY 2017 and found that average AFUE values for rebated furnaces were slightly higher than those in the *ex ante* assumptions for most furnace measures and notably higher for the combined furnace and air conditioning measure. This had a disproportionately large negative effect on freeridership.
- Furnaces rebated through the program often had capacities slightly larger or smaller than the TRM assumptions, which had a small effect on freeridership for most measures and a large negative effect for the 98% AFUE measure.
- The market baseline AFUE was just slightly lower than the *ex ante* assumptions for AFUE, which had a small negative effect on freeridership for all measures.

Net-of-freeridership gas savings for all furnace measures produced a negative freeridership percentage, meaning the savings found through this analysis were higher than the reported *ex ante* savings. This was because of a combination of the three factors listed above. For instance, for the “NG Furnace with ECM, 95%+ AFUE (Existing)” measure, the actual Home Performance with ENERGY STAR Program average installed AFUE was 96.5% instead of the deemed value of 95%. This factor alone would have driven gas savings freeridership down to -65.6%. However, because the market baseline AFUE was 92.76% instead of the deemed 92.80%, gas freeridership dropped further to -67.4%. Finally, the capacity adjustment from the deemed 72.0 MBTU/h to 71.9 MBTU/h drove gas freeridership to a final value of -67.2% for this measure.

Ex ante assumptions for energy and demand savings for ECMs and furnaces with ECMs did not incorporate market baselines and, therefore, freeridership is higher for those savings types. For these measures, freeridership is simply the fraction of non-rebated furnaces being sold that have ECMs (18.5%). Actual freeridership values across ECM measures vary based on slight variations in SPECTRUM-derived *ex ante* savings. Resulting calculated freeridership values round to either 19% or 18%, as seen in Table I-13. Covariance Table of Potential Independent Variables.

Part of the energy and demand savings for the combined furnace and air conditioner measure come from the non-cooling mode benefits of the ECM. But another component of this measure comes from cooling system size and efficiencies and is impacted by market baselines. For energy, the non-cooling mode energy savings and freeridership of the ECM drive overall measure freeridership to 12%. The difference in baseline SEER (13.9 market versus 13 *ex ante*) and capacity (28.1 MBh actual versus 29.1 *ex ante*) drives freeridership up further to 24%. Finally, a difference in installed SEER (16.35 actual versus 16.00 *ex ante*) brings freeridership down to 21%. Similar factors contributed to an overall demand freeridership of 51%.

Natural Gas Furnace

To estimate net-of-freeridership savings for natural gas furnaces, the Evaluation Team first calculated weighted average market baseline efficiency (AFUE) using the two baseline data sources. Because of offsetting strengths and weaknesses in these data sources, the Team averaged the market baseline efficiencies for an average AFUE of 92.76% AFUE (Table I-4).

Table I-4. CY 2017 Natural Gas Furnace Market Baseline AFUE by Data Source

Data Source	Market Baseline AFUE
D+R International (2014 and 2015 sales data)	93.23
HPwES Assessment Data (2012 – 2016)	92.28
Average	**92.76**

The Evaluation Team then applied the average AFUE (92.76%) as the baseline efficiency to calculate the average baseline consumption. Similarly, the Evaluation Team used the weighted average efficiency of all units in the Home Performance with ENERGY STAR Program tracking database (program-installed average efficiency) to calculate the average program-installed energy consumption.

The Team used the following equation and inputs shown in Table I-5 to calculate furnace consumption for the market baseline and the average efficient case for each natural gas furnace.

$$Annual\ therms = \frac{MBTU/h \times Hours_{Heating}}{\frac{AFUE}{100}}$$

Table I-5. CY 2017 Natural Gas Furnace SMP Inputs

Variable	Market Baseline Input	Efficient Case Input	Market Baseline Source	Efficient Case Source
95% Furnace with ECM				
MBTU/h	67.2		SPECTRUM CY 2017 Data	
$Hours_{heating}$	1,158		2017 Wisconsin TRM	
AFUE	92.76	95.3	HPwES/D+R	SPECTRUM CY 2017 Data
96% Furnace with ECM				
MBTU/h	70.2		SPECTRUM CY 2017 Data	
$Hours_{heating}$	1,158		2017 Wisconsin TRM	
AFUE	92.76	96.1	HPwES/D+R	SPECTRUM CY 2017 Data
97% Furnace with ECM				
MBTU/h	73.4		SPECTRUM CY 2017 Data	
$Hours_{heating}$	1,158		2017 Wisconsin TRM	
AFUE	92.76	97.2	HPwES/D+R	SPECTRUM CY 2017 Data
98% Furnace with ECM				
MBTU/h	84.4		SPECTRUM CY 2017 Data	
$Hours_{heating}$	1,158		2017 Wisconsin TRM	
AFUE	92.76	98.0	HPwES/D+R	SPECTRUM CY 2017 Data
95% Furnace and Air Conditioner with ECM				
MBTU/h	71.9		SPECTRUM CY 2017 Data	
$Hours_{heating}$	1,158		2017 Wisconsin TRM	
AFUE	92.76	96.5	HPwES/D+R	SPECTRUM CY 2017 Data

Table I-6 lists the average market baseline and efficient case gas consumption for the five natural gas furnace measures offered by the Home Performance with ENERGY STAR Program. The difference between the baseline and efficient consumption yields the net-of-freeridership savings for each measure.

Table I-6. CY 2015 Natural Gas Furnace SMP Savings Results (therms)

Measure	Market Baseline Consumption	Efficient Case Consumption	Net-of-Freeridership Per Unit Savings
95% Furnace with ECM	838.4	815.6	22.8
96% Furnace with ECM	877.0	846.4	30.6
97% Furnace with ECM	916.0	874.2	41.8
98% Furnace with ECM	1053.7	997.5	56.2
95% Furnace and Air Conditioner with ECM	897.8	862.7	35.1

Air Conditioner

Similar to natural gas furnaces, the Evaluation Team calculated a weighted average SEER value from baseline source data to calculate the average consumption of a market baseline air conditioner. Again, to offset strengths and weaknesses from the data sources, the Evaluation Team averaged the market baseline efficiencies, resulting in an average SEER of 13.85 (Table I-7).

Table I-7. CY 2017 Air Conditioner Market Baseline SEER Value by Data Source

Data Source	Market Baseline SEER
D+R International (2014 and 2015 sales data)	13.81
HPwES Assessment Data (2012 – 2016)	13.90
Average	**13.85**

The Evaluation Team applied the 13.85 SEER as the baseline efficiency to calculate the average baseline consumption. The Team used the weighted average efficiency of all units in the Home Performance with ENERGY STAR Program tracking database (program-installed average efficiency) to calculate the average program-installed energy consumption.

The Evaluation Team used the following equation and inputs shown in Table I-8 to calculate the electric consumption of air conditioners for the market baseline and the average efficient case.

$$Annual\ kWh = \frac{Mbtu/h \times Hours_{Cooling}}{SEER}$$

Table I-8. CY 2017 Air Conditioner SMP Inputs

Variable	Market Baseline Input	Efficient Case Input	Market Baseline Source	Efficient Case Source
MBTU/h	28.12		SPECTRUM CY 2017 Data	
$Hours_{cooling}$	410		2017 Wisconsin TRM	
SEER	13.85	16.35	HPwES/D+R	HPwES/D+R

Table I-9 lists the average market baseline and efficient case electric consumption for the joint air conditioner measure offered by the Home Performance with ENERGY STAR Program. The difference between the baseline and efficient consumption yields the net-of-freeridership savings for the air conditioner measure.

Table I-9. CY 2017 Air Conditioner SMP Savings Results (kWh)

Measure	Market Baseline Consumption	Efficient Case Consumption	Net-of-Freeridership Per Unit Savings
Air Conditioner	832.3	705.2	127.1

Electronically Commutated Motors

Measuring net-of-freeridership savings for ECMs differs from the analysis for furnaces and air conditioners, which used an efficiency rating to determine the market baseline, because there are no efficiency ratings for furnace fans. The Evaluation Team used a binary approach—the measure is simply installed or not installed—to estimate freeridership as the percentage of market furnaces (sold outside of the Home Performance with ENERGY STAR Program) that had ECMs, compared to other types of motors such as a permanent split capacitor.

Using market data from D+R International, the Evaluation Team estimated that 18.5% of furnaces sold outside of the Program had ECMs. The Evaluation Team then applied the CY 2017 Wisconsin TRM savings of 416 kWh per motor and 518 kWh per air conditioner with ECM measure and applied the percentage of freeridership to calculate net-of-freeridership savings.

Table I-10 lists the savings in the CY 2017 Wisconsin TRM and the net-of-freeridership savings calculated by the Evaluation Team.

Table I-10. ECMs: CY 2017 Net-of-Freeridership Electric and Demand Savings

Measure	TRM Per-Unit Savings		Freeridership	Net-of-Freeridership Per-Unit Savings	
	kWh	kW		kWh	kW
Furnace with ECM	416.0	0.0792	18.5%	338.9	0.065
Standalone ECM	416.0	0.0792	18.5%	338.9	0.065
Furnace and AC with ECM	345.5	0.1680	18.5%	281.4	0.137

I.3. National Sales Data Modeling

The Evaluation Team estimated the NTG for LEDs for the Retail Lighting and Appliance Program using a national sales data model; this was the same approach the Team used in CY 2016. The underlying theory behind the national lighting sales data NTG model is that states that have 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 relied on sales data from all lighting categories 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. The result of the modelling was a comprehensive NTG estimate that captured freeridership, participant spillover, and nonparticipant spillover.

The primary objective of the model was to quantify the relationship between program intensity (e.g., program spending per household) and LED sales (the percentage of LED purchases), which could then be used to estimate the NTG for efficient lighting measure categories in Focus on Energy's Retailer Lighting and Appliance Program. The model focused on 2016 sales and market shares of LEDs exclusively rather than combined efficient (CFL and LED) lighting, similar to the prior year's analysis.[33] This reflects the increasing dominance of LEDs in the market as the preferred energy-efficient lighting technology, which continues to be driven by rapidly decreasing costs, new ENERGY STAR specifications,[34] and improved performance over CFLs. The CY 2017 model is similar to the CY 2016 model, with comparable household

[33] Apex Analytics. "Wisconsin Focus on Energy Lighting Sales Data Modeling Results." January 2017.

[34] Note that even though the Lighting 2.0 specification did not officially take effect until January 1, 2017, manufacturers were allowed to label ENERGY STAR products that met the new specifications any time after June 2016. The new specification effectively limits the ENERGY STAR rating to LEDs. The ENERGY STAR Lamp 2.0 specification can be found online at: https://www.energystar.gov/products/spec/lamps_specification_version_2_0_pd.

and demographic characteristics, but with one key difference—the inclusion of prior program activity as a predictor variable for current LED market share (discussed in more detail below).

The lighting data also provided helpful insights into what other factors drive purchases of LEDs and opportunities for benchmarking Wisconsin lighting efficiency shares and program spending against other states.

I.3.1. Data Sources

The Evaluation Team leveraged a variety of data sources for the analysis, relying primarily on 2016 sales data prepared by the Consortium for Retail Energy Efficiency Data (CREED),[35] which were mostly generated from two sources. These sources were point-of-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 purchased raw datasets from third-party vendors and through a CREED initiative. The Evaluation Team then cleaned and processed all data for analysis.[36,37] The model inputs also included a combination of program data collected by the Evaluation Team and household and demographic data collected through various publicly available websites.

The primary model input data sources are listed here and discussed in more detail below:

- 2016 national bulb sales
  - POS data (grocery, drug, dollar, discount, mass merchandiser, and selected club stores)
  - Panel data (home improvement, hardware, online, and selected club stores)
- U.S. Census Bureau import data (CFL imports)[38]
- DSM Insights, an E Source database of utility program data

---

35 CREED serves as a collaborative effort of program administrators, retailers, and manufacturers to collect the necessary data to better plan and evaluate energy efficiency programs. LightTracker is 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. As a consortium, CREED speaks as one voice for program administrators nationwide for requesting, collecting, and reporting on the sales data needed by the energy efficiency community. https://www.creedlighttracker.com.

36 The information contained herein is based in part on data reported by IRI 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.

37 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, 2016, for the available state-level markets and Expanded All Outlets Combined (xAOC) and Total Market Channels.

38 Note the census bureau only tracks CFL imports and does not currently have a category to identify LED imports.

- 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 (NEMA) shipment data
- American Community Survey (ACS) data (household characteristics and demographic data)
- Retailer square footage per state (based on the two primary retailer channel data sources)
- 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 home and instructed to scan every purchase they make that has a bar code. For Wisconsin, the NCP collected data from approximately 1,400 households in 2016. 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 required a considerable effort to ensure data integrity and inclusion of all of 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, the Evaluation Team created a proprietary Universal Product Code (UPC) database with approximately 30,000 bulbs from five sources, including manufacturer product databases, retailer “web scraping,” and the ENERGY STAR product catalog.

Key aspects of the lighting dataset included these:

- 2016 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
- Sales volume and pricing by state (with 48 states included in both POS and non-POS) and bulb type
- Inclusion of all bulb styles (e.g., A-lamps, reflectors, globes, and candelabras)

As will be discussed below, the dependent variable of the model used 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 of efficient lamps, and other factors that drive lighting sales.

Program Activity

To research lighting program activity in the 48 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. The Evaluation Team contacted local utilities in areas where reports with relevant information were not available. Additionally, the Evaluation 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.[39]

The Evaluation Team collected these program data:

- Total number of claimed LED upstream program bulbs reported by each program
- 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.[40] The Evaluation Team aggregated data from each utility by state and assigned a modeling flag to that state based on the source of and confidence in the data provided across all major utilities and program administrators:

- "0" was assigned to any state with no program activity
- "1" was assigned to states in which all program activity data points were collected from every program administrator (including municipalities and cooperatives)
- "2" was assigned to states that had some program administrator data and some ENERGY STAR data (usually overall program expenditures)
- "3" was assigned to the remaining states where all data points were derived from ENERGY STAR

The Evaluation Team could iterate through the model using states with the most accurate data (with flags of 0 or 1) then open the model up to include additional states (with flags of 2 or 3). After accounting for the states with incomplete program data, the final model included 38 states (discussed in more detail below).

To determine the Retailer Lighting and Appliance Program activity in Wisconsin, the Evaluation Team used the SPECTRUM database as a key input in developing a 2016 efficient lighting NTG estimate. This

39 E Source. "DSM Insights." April 2017.

40 Note that because the ENERGY STAR report included only expenditure ranges, the Evaluation Team used the midpoints of the ranges to represent the expenditures.

dataset listed the incentives, number and type of program-supported bulbs sold in each utility service area, and the overall Program expenditures.

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. These data were used 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 of these retailers. Note that 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 Evaluation Team then combined these data with other possible explanatory variables, including political index, average cost of living, and average electric retail rates.

I.3.2. Modeling Methods

As previously stated, the primary objective of the model was to quantify the impact of state-level 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. Note that the Evaluation Team considered the comprehensive set of variables listed below; the final model, presented in Table I-11, 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

Program Spending per HH_i = Number of 2016 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' [41]

Program Age = Number of years state 'i' has been running an upstream lighting program

β_3 and β_4 = Array of regression coefficients for the channel variables and demographic variables

Channel Variables = Numeric variables summarizing state-level retailer characteristics (additional detail is provided in Table I-11)

Demographic Variables = Numeric variables that summarize state-level population, housing, and economic attributes in (additional detail is provided in Table I-11)

ϵ_i = Error term

Table I-11. Channel and Demographic Variable Descriptions

Type of Variable	Description
Channel Variables	
Sqft NonPOS per HH_i	The 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 $NonPOS_i$	The 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	The average POS retail square footage per household in state 'i.' Equal to POS square footage divided by the number of households in state 'i.'
Demographic Variables	
Political $Index_i$	A state-level partisan voter index developed by Cook Political Report (used for 2015 index)[1] and Gallup (used for 2016 index)[2]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 $Cost_I$	The state-level average residential retail rate of electricity, sourced directly from the U.S. Energy Information Agency[3]
Cost of $Living_i$	State-level cost of living indices developed by the Missouri Economic Research and Information Center[4]
Percentage of Homes Built Pre-1980_i	All of these state-level demographic and household variables were derived from the most current U.S. Census ACS[5]
Percentage of Renters Paying $Utilities_i$	
Median $Income_i$	
Percentage Owner $Occupied_i$	
Percentage of Population with College $Degree_i$	

[1] http://cookpolitical.com/house/pvi
[2] http://www.gallup.com/poll/125066/state-states.aspx
[3] https://www.eia.gov/electricity/data/state/
[4] https://www.missourieconomy.org/indicators/cost_of_living/
[5] http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t

41 Note that the Evaluation Team attempted to collect LED program spending only, but it was successful at collecting for only a limited number of states (n=24). For the model, the Evaluation Team used total program spending to include more states.

Correlation of the Independent (Explanatory) Variables

Table I-12 shows the correlation between the dependent variable (LED market share) and 12 potential channel and demographic/household variables, along with the two program variables (program age and program spending per household). Eleven of the variables are positively correlated with LED market share and three, in red, are negatively correlated. Correlation coefficients can range from -1.0 to 1.0, and the magnitude of the absolute value indicates the degree of correlation. This means that program age is the most correlated variable with LED market share (i.e., higher LED market shares typically occurring in states with longer-running programs).

Table I-12. Independent Variable Correlation Table

	LED Market Share
Sqft NonPOS per HH	0.34
Sqft POS per HH	-0.39
Percent Sqft NonPOS	0.49
Political Index (2015)	0.51
Political Index (Gallup 2016)	0.32
Median Income	0.50
Average Electricity Cost	0.36
Cost of Living	0.36
Percentage of Homes Built Pre-1980	0.27
Percentage of Renters Paying Utilities	-0.33
Percentage Owner Occupied	-0.10
Percentage of Population with College Degree	0.45
Program Age	0.66
Program Spend per Household	0.60

Table I-13 provides a correlation matrix among the potential independent variables. Although political index and cost of living are both positively correlated with energy efficiency market share, they are also highly correlated with one another (correlation coefficient = 0.7). When multiple independent variables that are correlated with one another are included in a model specification, a regression 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.

Because of the complexity of the relationships and numerous options of these channel, demographic, and household characteristic variables, the Team developed and tested different model options. Ultimately, the Team focused on the final best fit model option explained in the findings section below.

Model Weighting

Another key consideration in the modeling is the weighting of states within the model. One option is to weight each of the 38 states equally. However, since each state is one observation in the model, the Evaluation Team wanted to account for larger states having larger sample sizes in the panel data and bigger impacts on the lighting market as a whole, either by using the number of households or total bulb sales as the weight.

Table I-13. Covariance Table of Potential Independent Variables

	Sqft NonPOS per HH	Sqft POS per HH	Percent Sqft NonPOS	Political Index (2015)	Political Index (Gallup 2016)	Median Income	Average Electricity Cost	Cost of Living	Percentage of Homes Built Pre-1980	Percentage of Renters Paying Utilities	Percentage Owner Occupied	Percentage of Population with College Degree	Program Age	Program Spend per Household
Sqft NonPOS per HH	1.00													
Sqft POS per HH	0.01	1.00												
Percent Sqft NonPOS	0.36	-0.91	1.00											
Political Index (2015)	0.03	-0.78	0.75	1.00										
Political Index (Gallup 2016)	-0.12	-0.76	0.68	0.92	1.00									
Median Income	0.27	-0.66	0.74	0.62	0.58	1.00								
Average Electricity Cost	-0.09	-0.56	0.53	0.62	0.57	0.60	1.00							
Cost of Living	-0.18	-0.75	0.67	0.71	0.69	0.72	0.83	1.00						
Percentage of Homes Built Pre-1980	0.02	-0.39	0.41	0.42	0.35	0.38	0.48	0.45	1.00					
Percentage of Renters Paying Utilities	-0.10	0.25	-0.26	-0.20	-0.06	-0.47	-0.39	-0.45	-0.52	1.00				
Percentage Owner Occupied	0.35	0.43	-0.32	-0.32	-0.36	-0.25	-0.30	-0.50	-0.08	-0.06	1.00			
Percentage of Population with College Degree	0.14	-0.66	0.68	0.70	0.64	0.91	0.60	0.71	0.32	-0.39	-0.34	1.00		
Program Age	-0.02	-0.59	0.56	0.58	0.49	0.52	0.65	0.70	0.40	-0.41	-0.34	0.54	1.00	
Program Spend per Household	-0.11	-0.50	0.44	0.59	0.52	0.46	0.45	0.54	0.27	-0.34	-0.08	0.51	0.68	1.00

The Evaluation Team believed that using analytic weights in the model was appropriate because the dataset consisted of a series of purchase transactions that had been condensed into an observed mean.[42] Estimating the following regression model with analytic weights, where each state's average market share is based on n observations, as in this model:

$$LED\ Market\ Share_i\ =\ \beta_0 +\ \beta_1 * Program\ Spending\ per\ HH_i$$

Would be analogous to estimating using this model:

$$LED\ Market\ Share_i * \sqrt{n_i}\ =\ \beta_0 * \sqrt{n_i} +\ \beta_1 * Program\ Spending\ per\ HH_i * \sqrt{n_i}$$

The square root term means that the weights are proportional to the inverse of the variance.

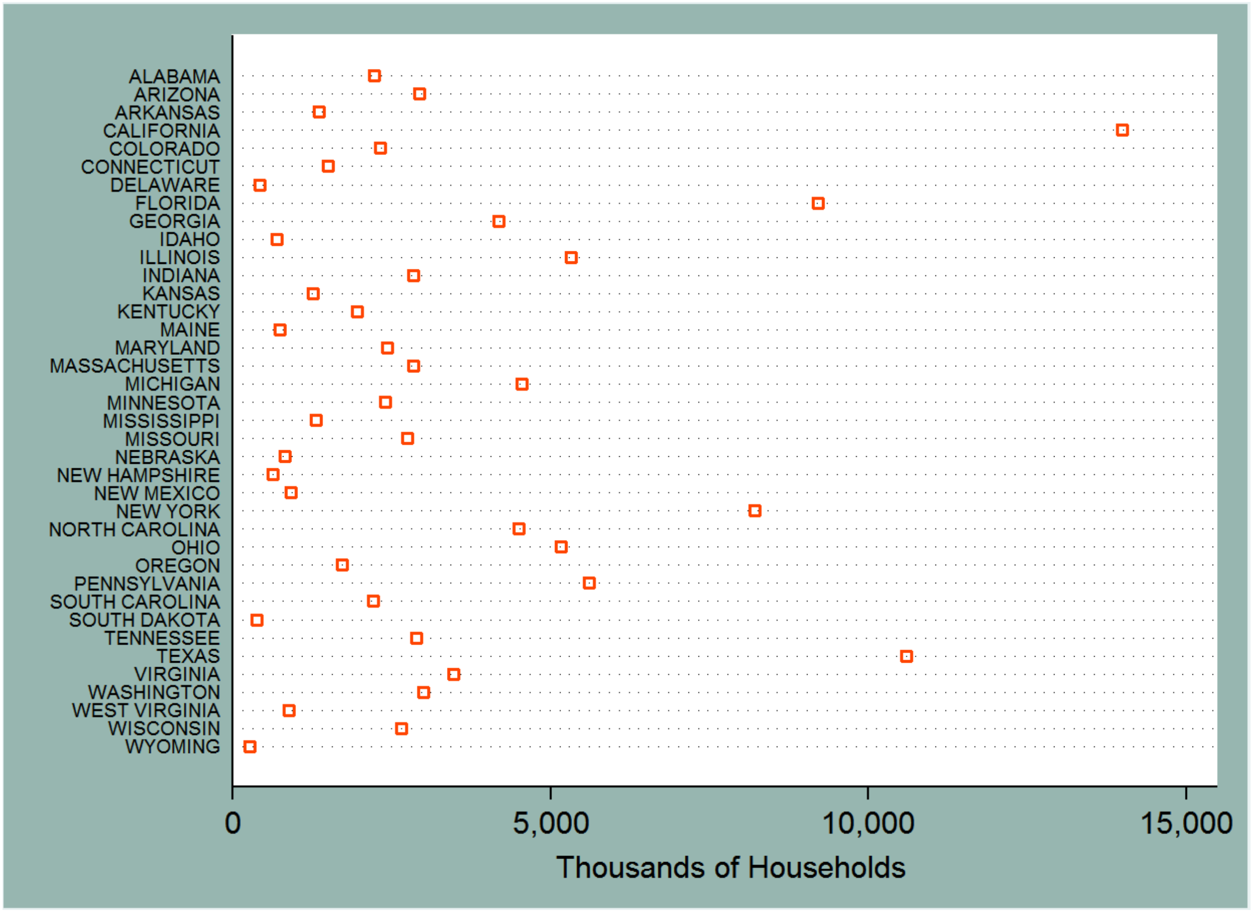
Because the Evaluation Team's analysis dataset consisted of multiple data streams, the definition of an observation was inconsistent so a proxy was needed for the weighting variable. The sample size in the panel data was generally proportional to state population, and large states also represented a larger share of the overall U.S. lighting market than smaller states.

This also meant that the Evaluation Team was generally more confident in the non-POS lamp shares for larger states compared to smaller states because the average lighting share value in large states was based on more measurements than small states, which therefore should make the market share estimate more precise.

Figure I-1. shows the distribution of households for each of the 38 states in the model.

42 Stata. "State 15 help for weight." Available online: http://www.stata.com/help.cgi?weight

Figure I-1. Number of Households by State

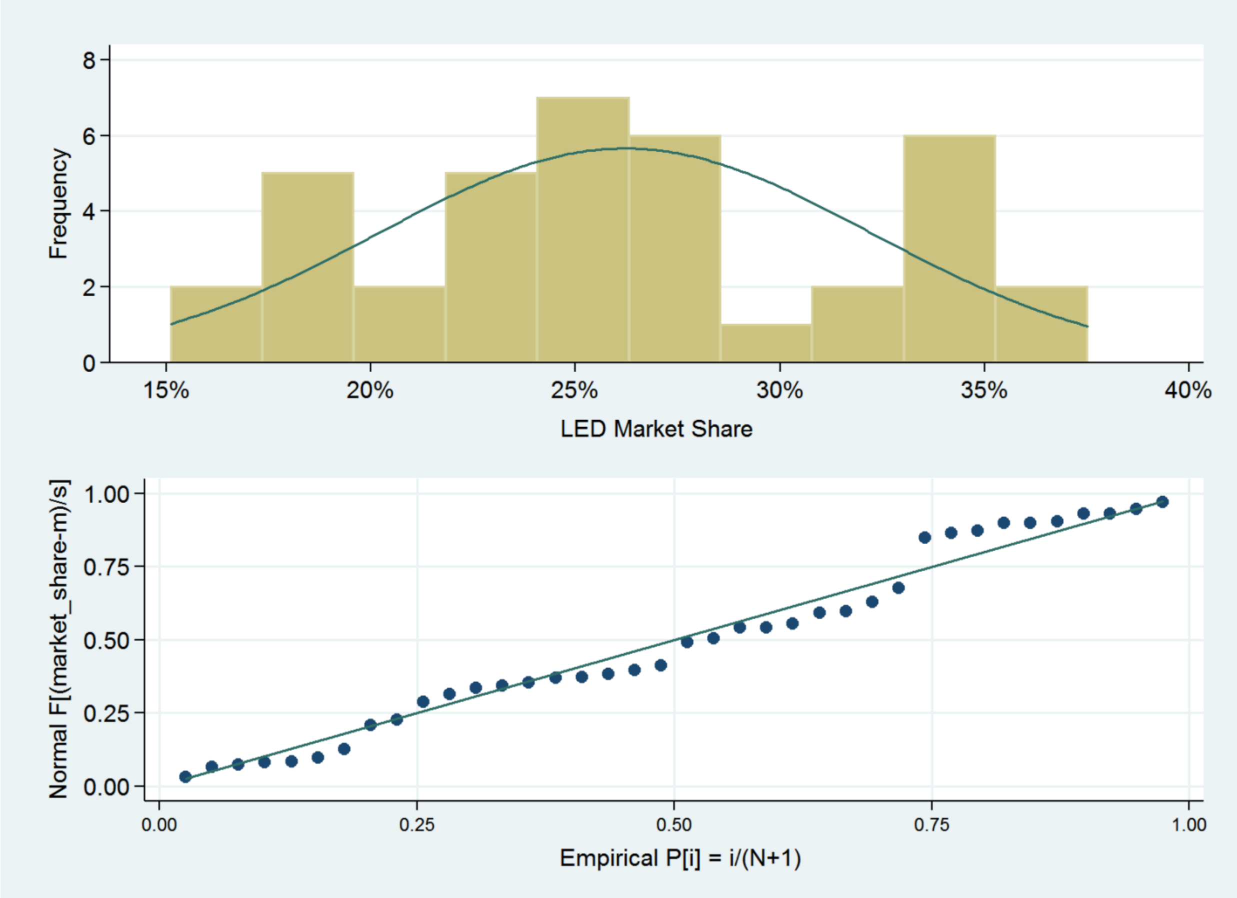


Model Functional Form

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-2 contains a histogram and a standardized normal probability plot for the LED market share of the 38 states in the analysis dataset and indicates that the data are approximately normally distributed.[43]

[43] 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 0.18 at the 95% confidence so there is no reason to reject the hypothesis that LED market share is normally distributed.

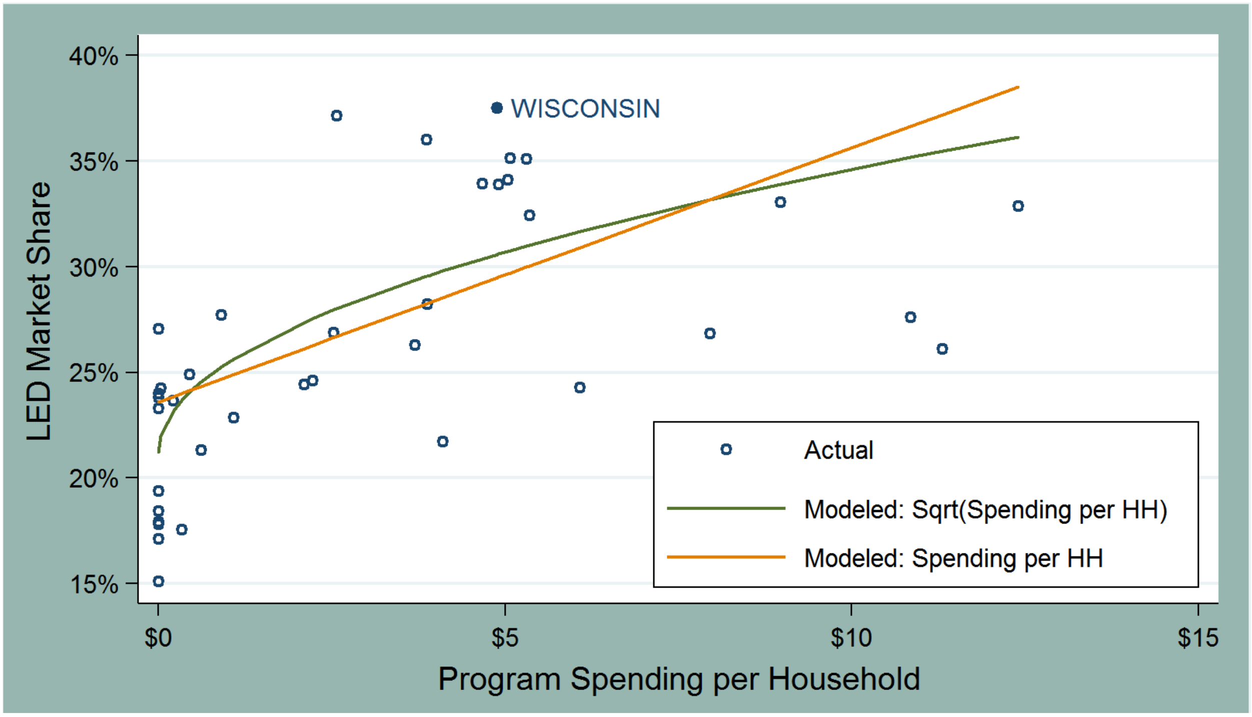
Figure I-2. Histogram and Standardized Normal Probability Plot



LED market share has practical bounds on both ends of the distribution. It cannot be less than 0%, and it cannot be greater than 100%. The Evaluation Team considered beta regression as well as fractional regressions (both probit and logit) to explicitly address this limitation and impose the theoretical limitations on the model. Ultimately, the Evaluation Team elected to estimate the model using ordinary least squares (OLS) regression because the range of the data (e.g., LED market shares) stayed within the constraints of 0 and 1 without use of a functional form that directly imposed these bounds; in addition, the results are easier to interpret (e.g., for every dollar increase in spending per household, there is a constant increase in efficiency share).

The Evaluation Team also explored transformations of independent variables, including the square root of spending as the program intensity variable. Figure I-3 shows that the square root model tapers LED market share as the square root of spending ("sqrt" in the figure) increases. This probably reflects diminishing returns in terms of market share as program spending increases and graphically provides a good fit for the data.

Figure I-3. Linear vs. Non-Linear Modeling



Sqrt = square root of spending, HH = household.

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 2016. The Evaluation 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 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 2016, 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 Evaluation Team then divided by the total number of program bulbs sold (i.e., the gross number of bulbs) to determine NTG:

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

I.3.3. Key Findings

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.

The following sections present the findings from analyzing descriptive data statistics and applying the multivariate regression model.

Analysis of the Combined Dataset (Descriptive Statistics)

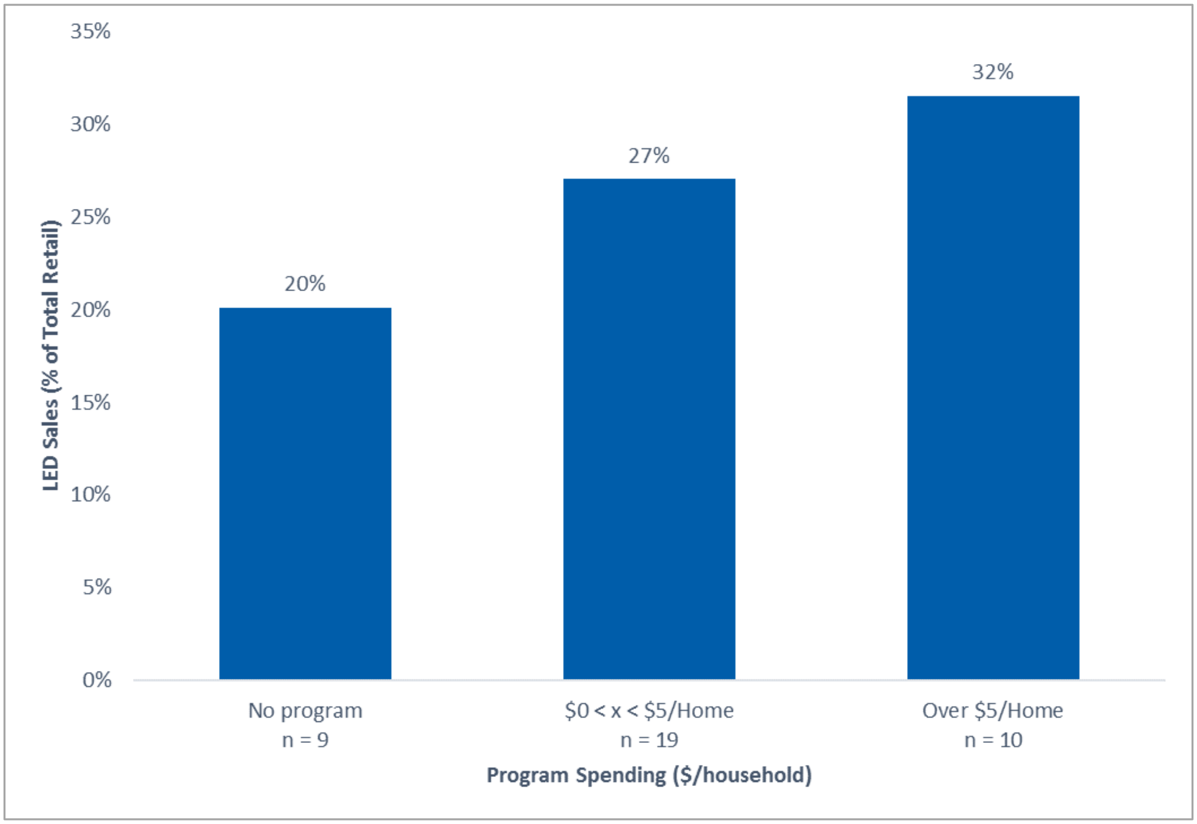
Some of the key attributes the Evaluation Team developed were these:

- **Program intensity.** LED lighting market share relative to overall program expenditures per household (binned by three tiers of magnitude of spending)
- **Market share distribution.** LED market share distribution across each state and across retail channels
- **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-4 shows the state-level LED share as a function of program spending. As clearly demonstrated in this graphic, LED share increases as program spending increases. In the program activity dataset of 38 states, nine states did not run an upstream lighting program and, on average, of total bulb sales in these nine "no program" states, 20% were LEDs.[44] The Wisconsin Focus on Energy Retailer Lighting and Appliance Program fell into the moderate program activity category, spending just under $5 per household in the upstream lighting program ($4.13/home), and of total 2016 bulb sales, 27% were LEDs.

[44] The nine states that do not run an upstream lighting program (and therefore have zero program spending) and that are included in the model are Alabama, Delaware, Kansas, Kentucky, Mississippi, Nebraska, South Dakota, Tennessee, and Virginia.

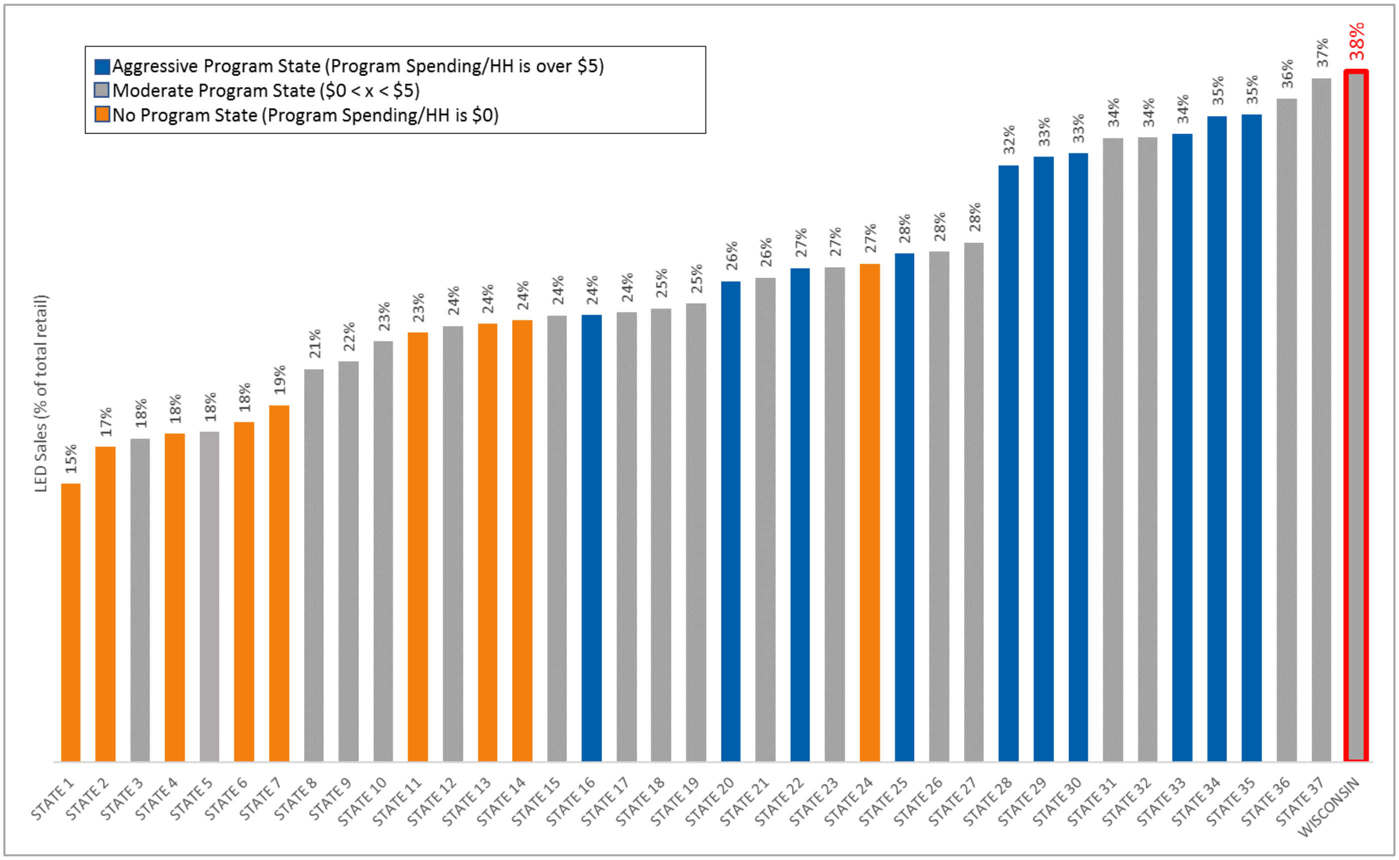
Figure I-4. Relationship between Program Spending and LED Sales (2016)



Similarly, Figure I-5 shows how LED sales in Wisconsin compare to the 38 modeled states. States highlighted in blue represent states with aggressive programs, spending more than $5 per household. States with gray bars spent an average greater than $0 and less than $5 per household.

Wisconsin falls slightly below the average aggressive program state in terms of program spending but with an estimated 38% market share for LEDs was the top state in the model (gray bar outlined in red). Orange bars represent states that did not offer a lighting program.

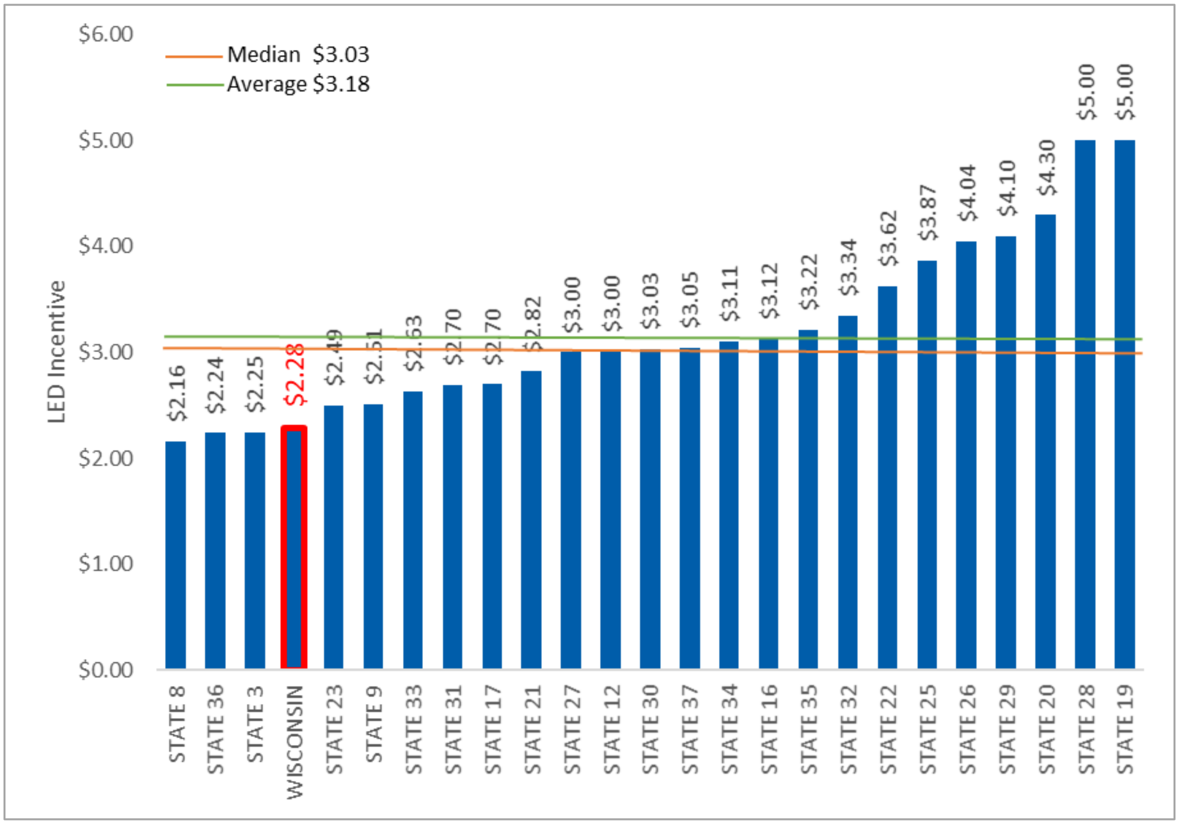
Figure I-5. LED Sales Distribution Across States (2016)



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 25 states that had sufficient data, LED incentives ranged from approximately $2 to $5 per LED bulb, with most of these states offering approximately $3 per LED (the average LED incentive was $3.18).

Wisconsin ranks below the overall averages of incentives per bulb (blue bar outlined in red), offering $2.28 per LED in its upstream lighting program.

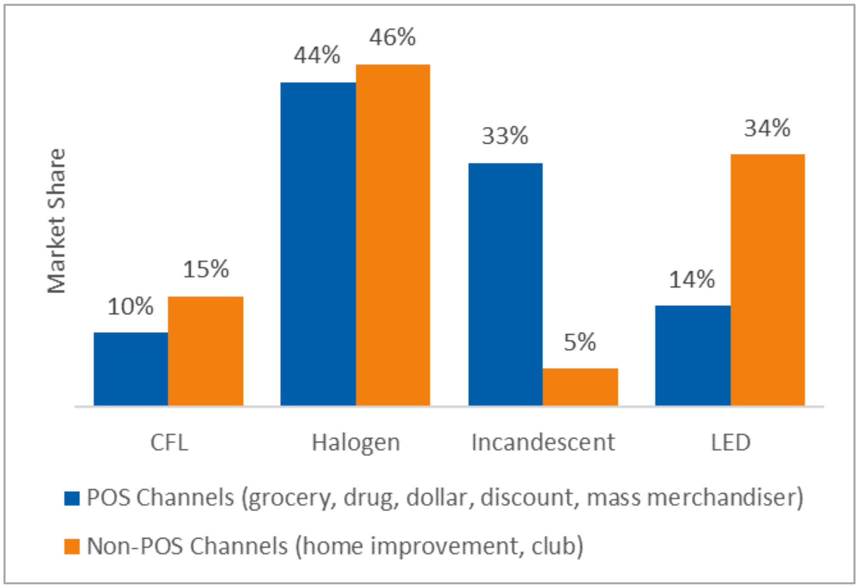
Figure I-6. Average Upstream Lighting Incentive per LED



Analysis of the sales data model showed that sales of efficient bulb types (CFL and LED) had substantially greater market share in the non-POS retail channels than the POS retail channels, as shown in Figure I-7. The figure also shows that the opposite is true for incandescent bulbs, where 33% of bulbs purchased in the POS channels were incandescent bulbs and only 5% of bulbs purchased in the non-POS channel were incandescent bulbs.[45]

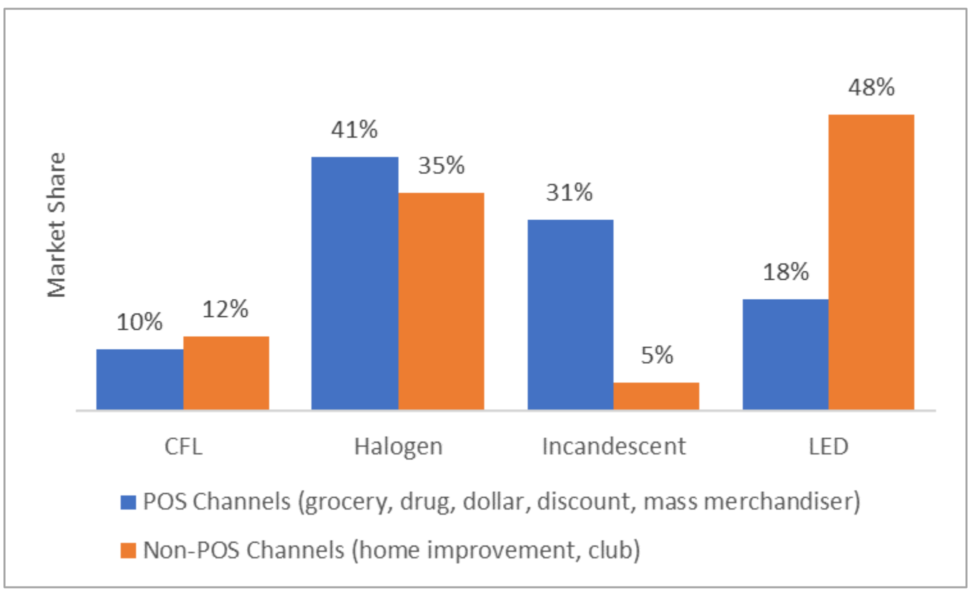
[45] In total, however, 62% of bulbs were purchased in the non-POS channels, whereas only 38% were purchased in the POS channels.

Figure I-7. National Market Share by Retail Channel (2016)



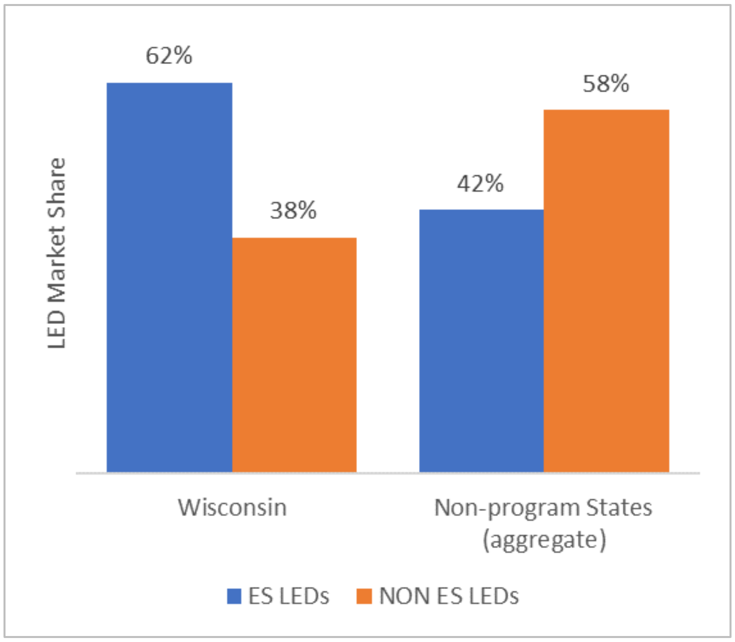
The trends seen in the national dataset are comparable to Wisconsin market share by retail channel, where Figure I-8 shows an increase of efficient lighting product market share in the non-POS channel and the opposite in the POS channel.

Figure I-8. Wisconsin Market Share by Retail Channel (2016)



The Evaluation Team looked at ENERGY STAR LED distribution when there was sufficient resolution.[46] As shown in Figure I-9, the POS retail channel shows that 62% of LED purchases in Wisconsin were ENERGY STAR LEDs, whereas only 42% of LED purchases in states with no programs were ENERGY STAR LEDs.

Figure I-9. ENERGY STAR LED Wisconsin Share (2016 POS Channels)



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.

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. The Evaluation Team explored

---

46 The ENERGY STAR website does not include the UPCs of qualifying lamps, so the Evaluation Team identified ENERGY STAR-qualified lamps by looking up the make and model in other sources. It successfully identified 66% of LED sales with an ENERGY STAR attribute (whether an LED was designated ENERGY STAR or not). The remaining 34% of LEDs could not be identified so were excluded in Figure I-9. In addition, this analysis was conducted based only on the POS data because the size of the panel data was not sufficient to stratify by ENERGY STAR designation. Lastly, states that did not offer a program but had sufficient sales data to be included in the aggregate were Alabama, Florida, Kansas, Mississippi, Tennessee, and Virginia.

both forward and backward stepwise regression procedures to allow different combinations of independent variables to enter and exit the model.

Table I-14 displays the relevant statistics and outcomes from the best fit model specification.[47] The final set of explanatory variables included program spending per household, political index, median income, an interaction term between political index and median income, non-POS square feet per household, and program age.[48]

Table I-14. Model Summary Statistics (n=38 States)

Independent Variables	Model Coefficient	P-Value of Coefficient
Intercept	(0.908)	0.013
Program Spending per Household (Sqrt)	0.029	0.001
Political Index	0.010	0.005
Median Income	0.00002	0.007
Political Index * Median Income	(0.0000002)	0.006
Non-POS Square Feet per Household	0.011	0.187
Program Age	0.002	0.068
Model Adjusted R-squared		**0.677**

For these model details, if an independent variable was included in the model, the regression coefficient and its associated p-value are included in the table. P-values of all variables were below alpha = 0.1, meaning all coefficients were significant at the 90% confidence level (with the exception of the non-POS square feet per household variable).

There are a few potential limitations to the model that are worth noting. Although the R-squared value of 0.677 is considered a "good fit," it is possible that the model still omitted variables that might better explain LED market share. For example, the political index may be picking up other effects that the Team has not explicitly identified. 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 Residential Lighting 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/comparison area sales and mean that the Program spending coefficient was being underestimated (and the resulting NTG would be a conservative estimate).

47 As noted above, the Evaluation Team elected to use an OLS model and weight by the number of homes for each state.

48 As stated above, program spending was not limited to LED program spending. Some upstream programs offered incentives for CFLs, and the program spending per household in states with significant CFL programs, may have understated the impact that program spending per household has on LED market share. In other words, the coefficient of the program spending per household variable could have been less than if LED-only program spending was isolated.

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 a simplistic proxy for market effects, meaning the portion of efficient lighting sales from potentially permanent changes in the market are a result of ongoing program activity.

Table I-15 shows the NTG calculations. The 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.[49,50]

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 2016 (subtract 1 year from the program age).

Table I-15 presents the two options to treating the program age counterfactual and calculates NTG ratios for each option. The NTG ratio, excluding market effects, is 46.7%. Adding in the impacts of past programs (market effects) leads to an additional 24.3% (827,583) lamps.

[49] Note that the modeled market share (and sales) compared quite closely to the actual market share (and sales). Specifically, in Wisconsin, the model predicted a 34% LED market share for 2016, whereas the national dataset reported Wisconsin with 38% LED market share. Putting this into sales, the model predicted 8,512,822 LEDs sold in Wisconsin, and the national dataset reported that 9,542,450 LEDs were sold in Wisconsin in 2016. The ratio of modeled to actual LED market share/sales is 89%.

[50] For the Focus on Energy Retailer Lighting and Appliance Program scenario, the Evaluation Team included both 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."

Table I-15. Wisconsin NTG Calculations

Calculation Term	Current and Past Influence (Including Market Effects)	Current Program Spending and Age Influence (Excluding Market Effects)
Total Wisconsin Bulbs 2016 (A)	25,438,532	25,438,532
Program $ per HH Actual (B)	$4.13	$4.13
Program $ per HH Counterfactual (C)	$0.00	$0.00
Program Age Actual (D)	14	14
Program Age Counterfactual (E)	0	13
LED Market Share Counterfactual (F)	23.5%	26.8%
LED Market Share Modeled (G)	33.0%	33.0%
LED Qty Modeled (H=A*G)	8,394,716	8,394,716
LED Qty Counterfactual (I= A*F)	5,978,055	6,804,807
Net LEDs Modeled (J=H-I)	2,416,661	1,589,909
Program Bulbs 2016 (K)	3,405,692	3,405,692
NTGR (L=J/K)	**71.0%**	**46.7%**
Market Effects (M=Difference of NTGR of columns)	**24.3%**	**N/A**
Market Effects Lamps (N=M*K)	**827,583**	**N/A**

Incorporating of Market Effects

The Evaluation Team recommends that past program influence (market effects) be included in calculating program savings, and added in at the end of the program quadrennial for a number of reasons, including these:

- **The Retail Lighting and Appliance Program seeks to have long-term market effects impacts that are likely being reflected in the program age variable**. The incentives and marketing/outreach of the Program seeks 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 savings realized in 2016**. The change in market share resulting from prior program activities is actually realized in 2016 (i.e., prior program activities are helping “bump” up the current market share). This represents increased sales of LEDs in 2016 that were not counted in prior years (i.e., they are 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 Residential Lighting Program**. The gross savings analysis for the Residential Lighting Program already accounts for the future installation of program lamps in the current program year (i.e., although the first year

ISR is less than 100%, an installation trajectory is used to model and claim discounted savings for lamps that get installed in future years). Rather than accelerating future savings, as is done with the ISR, 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 quadrennial. This is particularly important because the LED market is extremely dynamic, and these parameters can vary from year to year.

As shown in Table I-15 above, the additional lamps due to market effects for 2016 is 827,583, and the final average gross savings and incremental cost should be applied to this total. A similar calculation should be done in the analysis of 2017 and 2018 POS data, using the appropriate inputs in place for those specific calendar years.[51] Summing the totals for each year will determine the total additional market effects savings and costs over the quadrennial that can be applied to quadrennial impact and cost-effectiveness analysis.

I.4. Self-Report Net-To-Gross Methodology

Two components—freeridership and spillover—constitute NTG. True freeriders are customers who would have purchased a measure without a program's influence. Spillover is the amount of additional 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 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 SMP and the self-report methods to determine weighted average program NTG ratios.

51 Note that in 2015, the first year of the current quadrennium, the Retail Lighting and Appliance Program was only beginning to ramp up LED support, incenting only 511,182 LEDs, compared to 3.4 million in 2016 and 4.2 million in 2017. Therefore, this is the first year the Evaluation Team has estimated market effects.

I.4.1. Survey Design

The Evaluation Team conducted participant surveys for the Renewable Energy Competitive Incentive and Design Assistance programs for the CY 2017 evaluation.[52] The survey asked a series of freeridership and spillover questions.

The Evaluation Team designed the freeridership questions to elicit, to the best of the respondent's ability, the impact of the particular program on the respondent's decision to purchase the high-efficiency equipment. Programs can also influence a customer in a number of ways: 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. The survey also asked questions about what decision-makers might have done in the program's 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 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 then checking for consistent responses.

Basing 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, if a respondent would not have installed the measure(s) to the same level of efficiency without the program, they were automatically a 0% freerider. If they would not have installed the measure(s) within two years without the program, they were automatically a 0% freerider.

The Team assigned other questions included in the freeridership analysis partial weights for responses that were indicative of a non-freerider. Again, this method did not allow estimation of a respondent as a 100% freerider based on a single answer to a single question; a respondent had to provide consistent responses across the relevant questions in the freeridership analysis.

The survey questions addressed five core dimensions of freeridership for residential programs and six core freeridership dimensions for nonresidential programs, all 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?

[52] For nonresidential programs that did not have participant surveys conducted in CY 2017, the Evaluation Team calculated the overall program NTG for CY 2017 using an energy savings weighted average of the CY 2015 and CY 2016 NTG estimates.

- 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 freeridership questions used for the programs are presented in their analysis sections in this appendix.

I.4.2. Freeridership Methodology

The Evaluation Team used probability matrix to assign a single score to each participant, using his or her responses to targeted survey questions.[53] The Evaluation Team applied freeridership scores to question response patterns in the probability matrix and calculated confidence and precision estimates to the distribution of these scores.

This matrix approach provides these key benefits:

- Derivation of a partial 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 freeridership. Experience has shown that program participants do not fall neatly into freerider and non-freerider categories. For example, the Team assigned partial freeridership scores to participants who had plans to install a measure; 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 freeridership matrix terminology, combined each participant's converted responses to assign a score from the matrix, and aggregated all participants into an average freeridership score for the entire program category, ultimately assessing freeridership at three different levels.

I.4.3. Convert Responses to Matrix Terminology

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

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

---

53 Khawaja, M. S. *The NAPEE Handbook on DSM Evaluation.* 2007 edition, pp. 5-1.

I.4.4. Participant Freeridership Scoring

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

- Customers were categorized as 0% 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% 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 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 percentage of freeridership percentage.

I.4.5. Measure Category Freeridership Scoring

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

$$\text{SavingsWeightedFreeridership} = \frac{\sum[\text{Respondent FR Score}] * [\text{Measure Energy Savings}]}{\sum[\text{All Respondents Measure Energy Savings}]}$$

I.4.6. Spillover Methodology

Spillover refers to additional savings generated by program participants through 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 participate (or otherwise cannot participate) in the program.

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

I.4.7. Participant Spillover Analysis

The Evaluation Team used a top-down approach to calculate spillover savings. Analysis began with a subset containing 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 that 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:

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

I.4.8. 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-16 summarizes the self-report CY 2017 participant freeridership, spillover, and NTG results by program.

Table I-16. CY 2017 Self-Report Participant Freeridership, Spillover and NTG by Program

Program	n	Freeridership[1]	Spillover	NTG
Renewable Energy Competitive Incentive	6	6%	0%	94%
Design Assistance	14	47%	0%	53%

[1]Weighted by gross evaluated energy savings.

For nonresidential programs that did not have participant surveys conducted in CY 2017, the Evaluation Team calculated the overall program NTG for CY 2017 using the CY 2015 and CY 2016 net savings data (sum of net savings from CY 2015 and CY 2016 divided by the sum of the gross savings from CY 2015 and CY 2016), which was based on participant surveys. Table I-17 summarizes the overall CY 2017 NTG for nonresidential programs that did not have participant surveys conducted in CY 2017.

Table I-17. CY 2017 NTG for Programs Using CY 2015 and CY 2016 Evaluation Results

Program	CY 2015 & CY 2016 Total First-Year Gross Verified Savings (MMBtu)	CY 2015 & CY 2016 Total First-Year Net Verified Savings (MMBtu)	CY 2017 NTG
Business Incentive	679,142[1]	405,391[1]	60%
Multifamily Energy Savings	40,886	32,939	81%
Agriculture, Schools and Government	484,889	376,671	78%
Large Energy Users	1,606,499	1,317,330	82%
Small Business	80,377[2]	72,860[2]	91%

[1] This calculation also includes a large portion (roughly 98%) of the savings from the CY 2015 and CY 2016 Chain Stores ad Franchises Program, which was absorbed into the Business Incentive offering.

[1] This calculation also includes a large portion (roughly 2%) of the savings from the CY 2015 and CY 2016 Chain Stores ad Franchises Program, which was absorbed into the Small Business Program offering.

I.5. Renewable Energy Competitive Incentive Program (RECIP) Self-Report NTG Methodology and Findings

I.5.1. Freeridership Survey Questions

For RECIP, the participant survey's freeridership section included eight questions, addressing five core freeridership dimensions. The 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]
- F6. [Ask if No to question F1] To confirm, when you say you would not have installed the same [INSERT PROJECT], do you mean that without the incentive from RECIP, that you would not have installed [INSERT PROJECT] at all?
- F7. [Ask if No to question F1] Without the RECIP program, would you have installed… [READ LIST AND SELECT ONE]

- F8. [Ask if No to question F1] Any finally, would you have installed the [INSERT PROJECT], ….
[READ LIST AND SELECT ONE]
- F9. [ASK IF NO TO F1] And finally, would you have installed the [INSERT PROJECT]... [READ LIST AND SELECT ONE]

I.5.2. Convert Responses to Matrix Terminology

Table I-18 illustrates how the Evaluation Team translated initial RECIP survey responses into “yes,” “no,” or “partial” values, indicative of freeridership.

Table I-18. RECIP: Raw Survey Response Translation to 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…	F7. [ASK IF NO TO F1] To confirm, when you say you would not have installed the same [INSERT PROJECT], do you mean that without the incentive from RECIP, that you would not have installed [INSERT PROJECT] at all?	F8. [ASK IF NO TO F1] Without the RP program, would you have installed… [READ LIST AND SELECT ONE]	F9. [ASK IF NO TO F1] And finally, would you have installed the [INSERT PROJECT]… [READ LIST AND SELECT ONE]
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)	Yes (No)	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)	No (Yes)	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)	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)	Refused (Partial)	Don't Know (Partial)	In more than five years? (No)
	Don't Know (Partial)			Refused (Partial)	Don't Know (Partial)		Refused (Partial)	Don't Know (Partial)
	Refused (Partial)				Refused (Partial)			Refused (Partial)

I.5.3. RECIP Participant Freeridership Scoring

Each freeridership score started with 100%, which the Evaluation Team decremented based on the participant’s responses to the eight questions shown in Table I-19.

Table I-19. RECIP Freeridership Scoring Legend

Q#	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'
F7	100% decrement for 'No', 25% decrement for 'Partial'
F8	50% decrement for 'No', 25% decrement for 'Partial'
F9	100% decrement for 'No', 25% decrement for 'Partial'

I.5.4. RECIP Freeridership Findings

In Table I-20, the Evaluation Team illustrates the unique response combinations from participants answering the RECIP freeridership battery of questions (with actual responses mapped to “yes,” “no,” or “partial,” as indicative of freeridership), the freeridership score assigned to each combination, and the number of responses. The Team calculated a freeridership score for RECIP based on the distribution of scores within the matrix.

Table I-20. RECIP Frequency of Incentive 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…	F7. [ASK IF NO TO F1] To confirm, when you say you would not have installed the same [INSERT PROJECT], do you mean that without the incentive from RECIP, that you would not have installed [INSERT PROJECT] at all?	F8. [ASK IF NO TO F1] Without the RECIP program, would you have installed… [READ LIST AND SELECT ONE]	F9. [ASK IF NO TO F1] And finally, would you have installed the [INSERT PROJECT]… [READ LIST AND SELECT ONE]	FR Score	Frequency
Yes	Yes	No	✓	Yes	Yes	✓	✓	✓	50%	1
Yes	Yes	No	✓	No	Partial	✓	✓	✓	0%	1
No	Partial	No	✓	✓	✓	No	✓	✓	0%	2
No	No	No	✓	✓	✓	Yes	No	Partial	0%	1
No	No	No	✓	✓	✓	No	✓	✓	0%	2

I.5.5. RECIP Energy Savings Program 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-21).

Table I-21. RECIP Participant Spillover Percentage Estimate

Variable	Total MMBtu Savings Estimate
Spillover Savings	0
Program Savings	961
Spillover Estimate	**0%**

I.5.6. RECIP Net-to-Gross Analysis

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

$$NTG = 1 - Freeridership + Spillover$$

Table I-22. RECIP NTG Estimate

n	Freeridership	Spillover	NTG
7	6%	0%	94%

I.6. Design Assistance Program: Self-Report NTG Methodology and Findings

As in CY 2016, the Evaluation Team considered the modeling assistance and incentives it offers when assessing the Design Assistance Program's net savings. Similarly, in CY 2017, the Evaluation Team estimated two different intention-based freeridership scores: one for modeling assistance and another for the incentives.

In addition, the Evaluated Team included an influence-based freeridership score and combined it with the average of the modeling assistance and incentive intention-based freeridership scores.[54] The intention-based freeridership scoring was based on eight questions: five questions that assessed the

[54] For seven of the 14 sites in the analysis, the Evaluation Team could not schedule interviews with the design team, so the incentive-focused intention-based freeridership score (derived from the interview with the building owner) equaled the final intention-based freeridership score, which was averaged with the influence-based freeridership score to arrive at the site's final freeridership score. For one of the 14 sites, the Evaluation Team could not complete an interview with the building owner, so the modeling assistance-focused intention-based freeridership score (derived from the design team interview) equaled the final intention-based freeridership score, which was averaged with the influence-based freeridership score to arrive at the site's final freeridership score. Except for these sites, the net savings analysis approach used in CY 2017 was the same as the approach used in CY 2015 and CY 2016.

importance of the modeling assistance and three questions that assessed the participant's likelihood to install energy-efficient equipment or features without the incentives and assistance from the program.

I.6.1. Freeridership Survey Questions

For the Design Assistance Program, the participant's survey's freeridership sections included five questions focused on modeling assistance, and four questions focused on intention, all asked in the survey format and shown below:

- E1. Without this assistance, would your team have conducted energy modeling to the same extent during the early stages of the design process?
- E2. And would you have conducted the same energy modeling in the early stages without the modeling tools, consultation and input provided by Focus on Energy Program staff?
- E3. [IF NO TO E1, OR E2] Would you have done modeling in the early stages at all?
- E4. [IF E3= YES] How would the modeling you would have done been different from the modeling performed by program staff? Would it have been…
- E5. How important was the energy modeling analysis in the early stages on your decision to add higher efficiency measures to the project? Were the recommendations…

The incentive focused intention freeridership questions included (asked in the survey format):

- E6. Without the incentive, would you have considered and implemented strategies that were just as efficient
- E7. Without the report, would you have considered and implemented strategies that were just as efficient?
- E8. Had the incentive or energy modeling not been available, when would you have considered and implemented the same energy efficiency strategies…
- E9. [ASK IF E6= 1 OR 2 AND E8=1 OR 2] Before you enrolled in the Design Assistance Program, was the purchase and installation of the specific energy efficient strategies highlighted in the report included in your construction budget?

The influence-focused freeridership question asked participants to rate the level of influence—on a scale of 1 to 5, with 1 being *not at all influential* and 5 being *very influential*—of the following three factors in their decision to participate in the Design Assistance Program:

- Total program incentives
- Assistance provided by Design Assistance Program staff in the bundle selection
- Energy modeling results and report identifying energy saving options

I.6.2. Design Assistance Program Participant Freeridership Scoring

Modeling Assistance Focused (Intention) Freeridership Scoring

Each participant freeridership score started with 50%, which the Evaluation Team decremented based on the participant's responses to the five questions shown in Table I-23. Decrements are shown in parentheses following a response option.

Table I-23. Modeling Assistance Focused (Intention) Freeridership Scoring Legend

E1. Without this assistance, would your team have conducted energy modeling to the same extent during the early stages of the design process?	E2. And would you have conducted the same energy modeling in the early stages without the modeling tools, consultation and input provided by Focus on Energy Program staff?	E3. [IF NO TO E1, OR E2] Would you have done modeling in the early stages at all?	E4. [IF E3= YES] How would the modeling you would have done been different from the modeling performed by program staff? Would it have been…	E5. How important was the energy modeling analysis in the early stages on your decision to add higher efficiency measures to the project? Were the recommendations…
Yes (-0%)	Yes (-0%)	Yes, would have done modeling (-0%)	Just as comprehensive as FOE modeling (-0%)	Very important (-12.5%)
No (-12.5%)	No (-12.5%)	No, would not have done modeling (- 12.5%)	More comprehensive than FOE modeling (-0%)	Somewhat important (-12.5%)
Don't Know (-12.5%)	Don't Know (-12.5%)	Don't Know (-12.5%)	Less comprehensive than FOE modeling (-25%)	Not too important (-0%)
			Don't Know (-12.5%)	Not at all important (0%)
				Don't Know (-12.5%)

Incentive Focused (Intention) Freeridership Scoring

Each freeridership score started with 50%, which the Evaluation Team decremented based on the participant's responses to the four questions as shown in Table I-24. Decrements are shown in parentheses following a response option.

Table I-24. Incentive Focused (Intention) Freeridership Scoring Legend

E6. Without the incentive, would you have considered and implemented strategies that were just as efficient?	E7. Without the report, would you have considered and implemented strategies that were just as efficient?	G8. Had the incentive or energy modeling not been available, would you have installed the same energy efficient equipment…	E9. [ASK IF E6= 1 OR 2 AND E8=1 OR 2] Before you enrolled in the Design Assistance Program, was the purchase and installation of the specific energy efficient strategies highlighted in the report included in your construction budget?
Yes - all (-0)	Yes - all (-0)	This year (-0%)	Yes (-0%)
Yes - some (-25%)	Yes - some (-25%)	Within 1-2 years (- 25%)	No (-25%)
No (-50%)	No (-50%)	Within 3 years (-50%)	Don't Know (-12.5%)
		I would not have done it (-50%)	

Influence Focused Freeridership Scoring

The Evaluation Team used the maximum score given by each participant for any program factor addressed through the influence question to determine their influence freeridership score. Respondents were asked to rate each factor on a scale of 1 to 5, with 1 being *not at all influential* and 5 being *very influential*. The results, including the assigned influence score, are shown in Table I-25.

Table I-25. Influence Focused - Freeridership Scoring Legend

Maximum Influence Score	Influence Score
1 - *Not at all influential*	50%
2	37.5%
3	25%
4	12.5%
5 - *Very influential*	0%

I.6.3. Design Assistance Program Freeridership Findings

The modeling assistance, incentive, and influence-focused freeridership scores had maximum values of 50%. The Evaluation Team took the average of the modeling assistance and incentive focus freeridership score and added it to the influence freeridership score to determine the final freeridership score for a participant. The Team then calculated the overall program-level freeridership estimate of 45% (rounded to the nearest whole percentage) by weighting participant's final freeridership scores by evaluated program savings, as shown in Table I-26.

Table I-26. Design Assistance Program Freeridership Findings Summary

Respondent (n=14)	Modeling Assistance - Freeridership	Incentive - Freeridership	Average of Modeling Assistance & Incentive Freeridership	Influence - Freeridership	Final FR Score	Evaluated MMBtu Program Savings
1	0.0%	NA	0.0%	NA	0.0%	27,583
2	0.0%	50.0%	25.0%	50.0%	75.0%	136,374
3	37.5%	0.0%	18.8%	0.0%	18.8%	39,399
4	0.0%	0.0%	0.0%	12.5%	12.5%	6,215
5	NA	50.0%	50.0%	0.0%	50.0%	28,478
6	0.0%	12.5%	6.3%	0.0%	6.3%	77,167
7	NA	25.0%	25.0%	12.5%	37.5%	53,632
8	0.0%	0.0%	0.0%	12.5%	12.5%	18,942
9	NA	37.5%	37.5%	37.5%	75.0%	168,966
10	NA	50.0%	50.0%	50.0%	100.0%	475
11	12.5%	0.0%	6.3%	0.0%	6.3%	-
12	NA	25.0%	25.0%	0.0%	25.0%	9,134
13	NA	0.0%	0.0%	12.5%	12.5%	7,189
14	NA	0.0%	0.0%	12.5%	12.5%	43,155
Overall Weighted Average	**5%**	**29%**	**23%**	**24%**	**45%**	**616,710**

I.6.4. Design Assistance Program Participant Spillover Analysis

The Evaluation Team determined that there was no spillover for the Design Assistance Program based on self-report survey data. None of the surveyed participants attributed additional energy-efficient equipment purchases or energy modeling (for which they did not receive an incentive) to their participation in the Design Assistance Program. This yielded 0% spillover (Table I-27).

Table I-27. Design Assistance Participant Spillover Percentage Estimate

Variable	Total MMBtu Savings Estimate
Spillover Savings	0
Program Savings	616,710
Spillover Estimate	**0%**

I.6.5. Net-to-Gross Analysis

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

NTG = 1 – Freeridership + Spillover

Table I-28. Design Assistance Program NTG Estimate

n	Freeridership	Spillover	NTG
14	47%[1]	0%	53%[1]

[1] Weighted by gross evaluated savings

I.7. Appliance Recycling Program: Net-To-Gross Methodology

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

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

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-12 and Figure I-13 as the end of the section illustrate the full decision trees.

I.7.1. 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-29).

Table I-29. Final Distribution of Kept and Discarded Appliance

Stated Action Absent Program	Indicative of Freeridership	Refrigerators (n=90)	Freezer (n=58)
Kept	No	39%	59%
Discarded	Varies by Discard Method	61%	41%
Total		**100%**	**100%**

As shown in Table I-29, 61% of respondents would not have kept their refrigerator. Of those, 72% 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 43% reduction in gross savings due to freeridership for refrigerators.[55]

Freeridership for freezer recyclers was lower. Of the 41% of respondents who would not have kept their freezer, 80% 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 33%.

I.7.2. Secondary Market Impacts

If, in the Appliance Recycling Program's absence, a participant would have directly or indirectly (through a market actor) transferred the Program-recycled unit to another customer, the Evaluation 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 UMP recommends that evaluators assume one-half of would-be acquirers would find an alternate unit.[56] Without information to the contrary, the Evaluation Team applied the UMP recommendation to this evaluation.

---

[55] Sixty-one percent of respondents not keeping their appliance multiplied by 72% of respondents who reported one of the three actions leading to freeridership equals 43% freeridership. For freezers, 41% * 80% = 33%.

[56] 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

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).[57]

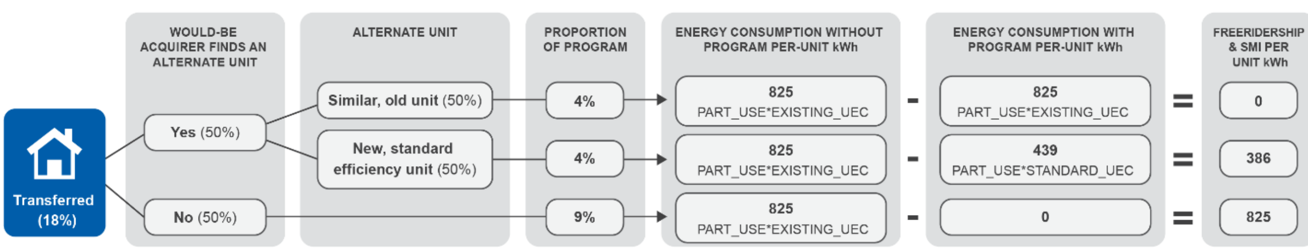
Again, as discussed, definitively estimating this distribution proves difficult. The UMP recommends adopting a midpoint approach when primary research is unavailable: evaluators should assume one-half of the would-be acquirers who would have acquired an alternate unit would find a similar used appliance, 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,[58] then averaged the reported energy consumption of new, standard-efficiency appliances with sizes and configurations comparable to the Program units.

Figure I-10 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-13 provides a freezer-specific diagram). As is evident, accounting for market effects results in three savings scenarios:

- Full per-unit gross savings
- No savings
- Partial savings (i.e., the difference between energy consumption of the program unit and the new, standard-efficiency appliance acquired alternatively)

Figure I-10. Secondary Market Inpacts--Refrigerators



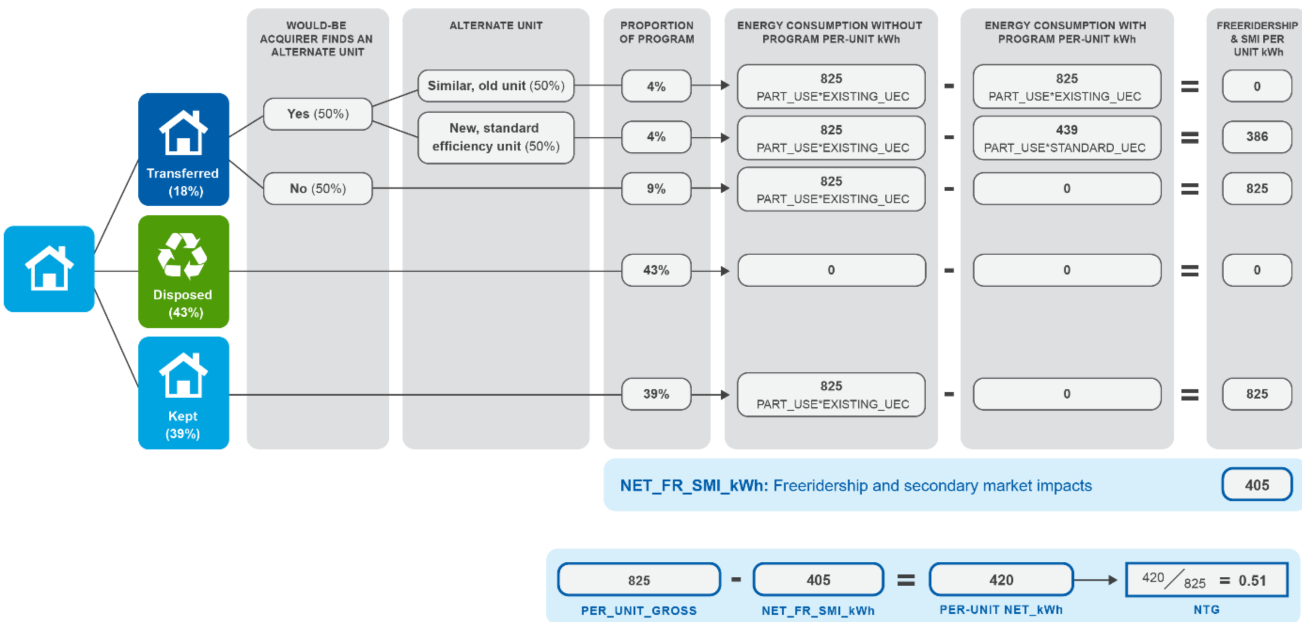
57 It is also possible that the would-be acquirer would select a new ENERGY STAR unit. However, the Evaluation Team assumed most customers who are in the market for a used appliance would upgrade to the next lowest price point (a baseline, standard-efficiency unit).

58 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.

I.7.3. 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. Figure I-11 shows how 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-11. Savings Net of Freeridership and Secondary Market Impacts—Refrigerators



I.7.4. Induced Replacement

The UMP evaluation protocol for refrigerator recycling was updated in 2017 and induced replacement was dropped from the protocol because of "difficulty measuring the adjustment and its small impact on savings." Therefore, the Evaluation Team did not apply this adjustment in the CY 2017 evaluation.

I.7.5. 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 increased likelihood of participants to participate in other available residential programs, though these savings are captured in other program evaluations. Therefore, the Evaluation Team did not include spillover questions in the participant survey for CY 2017.

I.7.6. Final Net-to-Gross

As shown in Table I-30, the Evaluation Team determined final net savings as evaluated gross per-unit savings, less per-unit freeridership and secondary market impacts.

Table I-30. CY 2017 NTG Ratios

Appliance	Gross Per-Unit Savings	Freeridership and Secondary Market Impacts (kWh)	Net Per-Unit kWh	NTG
Refrigerator	825	405	420	51%
Freezer	702	255	447	64%

The decision trees used to calculate NTG are shown in Figure I-12 for refrigerators and Figure I-13 for freezers.

Figure I-12. Refrigerator NTG Combined Decision Tree

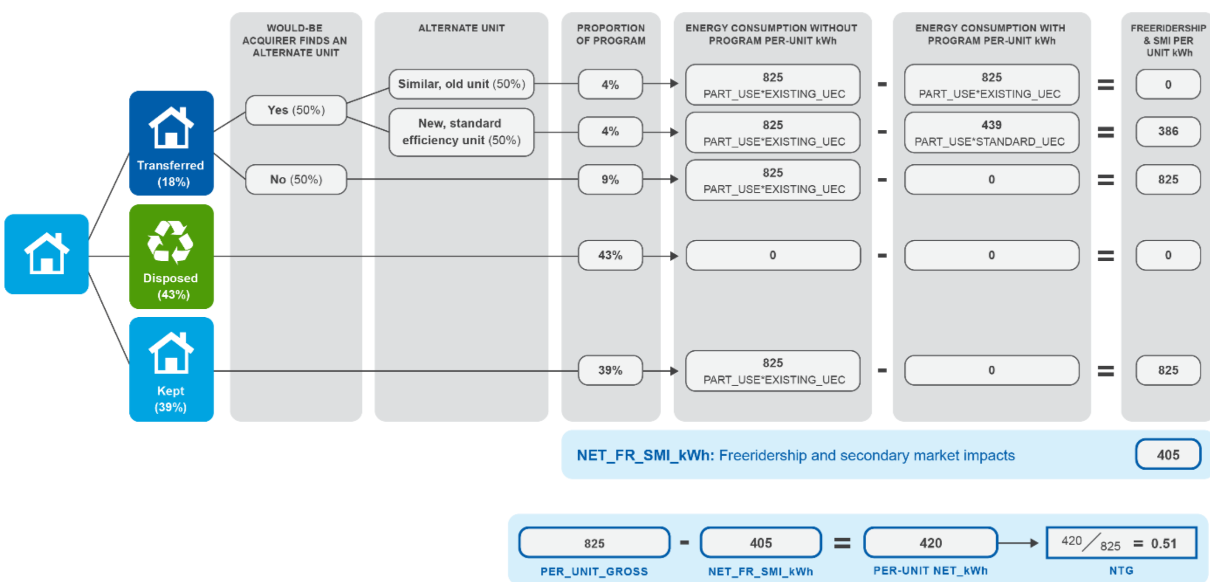
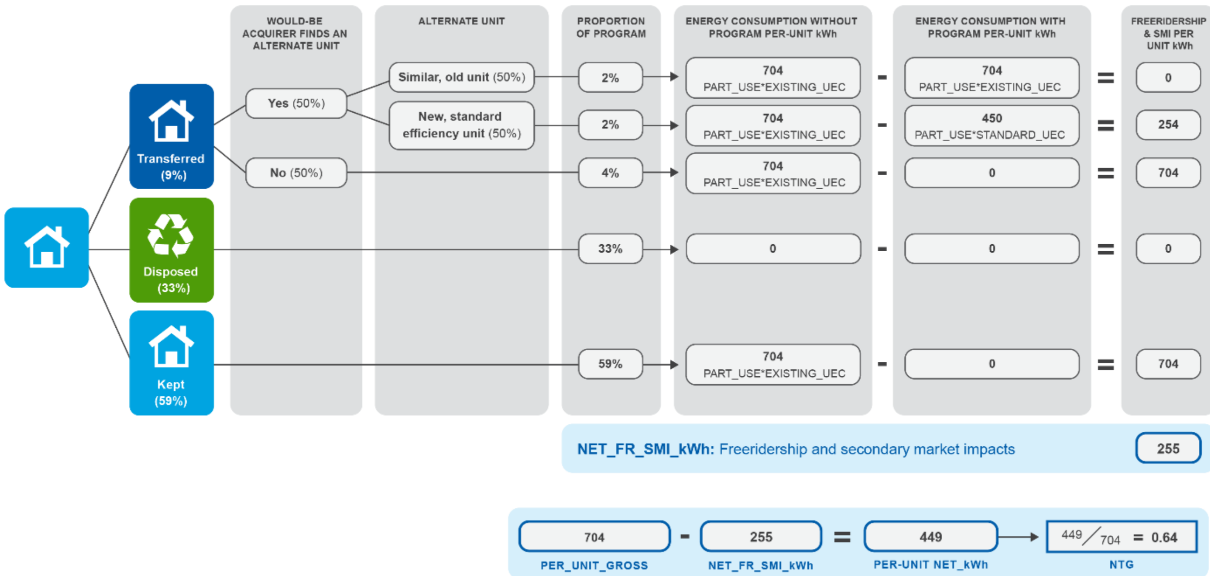


Figure I-13. Freezer NTG Combined Decision Tree



I.8. Billing Analysis – Home Performance with ENERGY STAR

Focus on Energy provided the Evaluation Team with gas and electric billing data for all customers who participated in the Standard Track (Tier 1) and the Income-Qualified Track (Tier 2) of the Home Performance with ENERGY STAR Program during CY 2016 and CY 2017. These data were from most of the utilities in Wisconsin and covered the period from January 2015 through February 2018.[59,60] Focus on Energy also provided detailed tracking data from SPECTRUM for participants in all of its programs from CY 2016 and CY 2017.

59 The Evaluation Team received billing data for the following gas utilities: Alliant (Wisconsin Power & Light), Madison Gas and Electric Company, Northern States Power Company (Xcel Energy-Wis), Superior Water Light and Power Co., Wisconsin Electric Power Company (We Energies), and Wisconsin Public Service Corporation.

60 The Evaluation Team received billing data for the following electric utilities: Adams-Columbia, Alliant (Wisconsin Power & Light), Black River Falls Municipal Electric & Water, Boscobel Municipal Utilities, Brodhead Water & Light, Cedarburg Light & Water, Cumberland Municipal Utility, Eau Claire Energy Coop, Evansville City of Water & Light, Hartford City of Utilities, Hustisford Utilities, Jefferson Utilities, Kaukauna Utilities, Lake Mills Light & Water, Madison Gas and Electric Company, Manitowoc Public Utilities, Marshfield Utilities, Menasha Electric & Water Utilities, Mount Horeb Electric Utility, New Glarus Light and Water Works, New London Electric & Water Utility, New Richmond Municipal Electric Utility, Northern States Power Company (Xcel Energy-Wis), Oconomowoc City of Utilities, Oconto Falls Municipal Utilities, Plymouth Utilities, Prairie du Sac Municipal Electric & Water, River Falls Municipal Utilities, Rock Energy Cooperative, Sauk City Municipal Water & Light Utility, Slinger Utilities, Stoughton Utilities, Sturgeon Bay Utilities, Sun Prairie Water & Light Commission, Superior Water Light and Power Co., Waunakee Water and Light Commission, Wisconsin Electric Power Company (WE Energies), and Wisconsin Public Service Corporation.

The Evaluation Team conducted a billing analysis to determine the net savings from gas and electric customers in the Tier 1 and Tier 2 tracks. To control for exogenous factors during the analysis period, the Team used a nonparticipant group that included future participants. The percentage change in this group's energy use allowed the Team to calculate the programs' net savings. The Team also estimated these programs' overall and pre-participation use quartile energy savings.

For each participant, the Evaluation Team obtained these data:

- SPECTRUM ID and customer ID
- Customer name and address including zip code
- Minimum measure installation date
- Maximum measure installation date
- Total *ex ante* gas therm savings
- Total *ex ante* electric kWh savings
- Minimum installation date of other Focus on Energy program measure(s)
- Maximum installation date for other Focus on Energy program measure(s)
- Total therm *ex ante* savings from participation in other Focus on Energy program(s)
- Total kWh *ex ante* savings from participation in other Focus on Energy program(s)
- Measure-level flags including air sealing, attic insulation, foundation insulation, sill-box insulation, wall insulation, bonus measures, and other low-cost water-heating measures (showerheads, aerators, water heater replacement, pipe wrap), CFLs, LEDs, and a measure completion indicator

The Evaluation Team then combined the customer-level tracking information with the electric and gas billing data by SPECTRUM ID and service address. Next, the Evaluation Team followed these steps to conduct the billing analysis of the Tier 1 and Tier 2 tracks:

4. Checked each participant account against the complete measure tracking data for participation in other programs occurring in the analysis period
5. Used zip code mapping to determine the nearest weather station for each zip code
6. Obtained daily average temperature weather data from January 2015 through February 2018 for 41 National Oceanic and Atmospheric Administration (NOAA) weather stations, representing all zip codes associated with the participants
7. Used daily average temperatures to determine base 45 through base 85 heating degree days (HDDs) and cooling degree days (CDDs) for each station
8. Obtained typical meteorological year 3 (TMY3; 1991 through 2005) annual normal and cooling degree days to weather normalize the billing data
9. Matched billing data periods with the CDDs and HDDs from the associated stations

I.8.1. Comparison Group

An important aspect of the CY 2017 billing analysis quasi-experimental design is to compare the participant, or treatment group, to a group of nonparticipants to account for exogenous factors that may have occurred simultaneous to Program activity. These factors can include macroeconomic effects, increases or decreases in energy rates, or other interactions that may have affected energy consumption outside of Program influence. For the Tier 1 and Tier 2 tracks in the Home Performance with ENERGY STAR Program, nonparticipant groups can be identified by sampling future Program participants—that is, late CY 2017 customers who participated *after* the CY 2016 analysis period.

This approach has several advantages over randomly selecting from the customer population. First, the future participants are more representative of the participant treatment group because they are more likely to be aware of saving energy and to have similar pre-Program building characteristics. Second, this population has received Program measures (though after the analysis period), so the installation period can be isolated to ensure this group had no impact during the analysis period.

Because comparison group pre-period use may not be identical to participant pre-period use, the Evaluation Team used a percentage of pre-period use to obtain the net participant savings. The following formula depicts this specific calculation for adjusted gross participant savings:

$$Net\ Savings = (Pre\ Part\ Usage)\left(\frac{Part\ Change\ In\ Usage}{Pre\ Part\ Usage} - \frac{NonPart\ Change\ In\ Usage}{Pre\ NonPart\ Usage}\right)$$

Instead of taking the difference between the participant savings delta and the nonparticipant savings delta (i.e., a difference-of-differences approach), the calculation can obtain the percentage reduction of both the participant and the nonparticipant groups. The percentage reduction that represents net savings is the participant percentage-change reduction minus the nonparticipant percentage reduction. This net percentage reduction can then be multiplied by the participant pre-period use to obtain the net participant savings, thus effectively accounting for the differences in pre-period use between participants and nonparticipants.

The Evaluation Team defined the future nonparticipant group as participants who installed measures from August 2017 through December 2017. This group did not have sufficient post-period billing data to be used in the participant group but had sufficient pre-participation billing data.

The Evaluation Team defined the participant pre-installation period as the one year before the first measure installation and the post-installation period as the one year after the last measure installation. It assigned the nonparticipant periods using the average participant installation date of July 15, 2016. The nonparticipant pre-period was July 2015 through June 2016, and the post-period was August 2016 through July 2017.

The Evaluation Team relied primarily on the PRInceton Scorekeeping Method (PRISM) to develop savings estimates because its models are easier to summarize across various groups and yield better precision than the more complex Conditional Savings Analysis (CSA) fixed-effects modeling approach. The Evaluation Team used the CSA approach to corroborate PRISM findings at the overall program level only.

I.8.2. Data Screening

The Evaluation Team removed these items from the analysis:

- 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 10 pre- and 10 post-installation months
- Nonparticipant customers with fewer than 10 pre- and 10 post-installation 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 pre- and post-installation billing data. These models provided weather-normalized pre- and post-installation annual use for each account and an alternate check to savings obtained from the fixed-effects model.

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 pre-/post-installation 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 45-65 average daily HDDs for the specific location
$AVGCDD_{it}$	=	Base 65-85 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 participant for the pre- and post-installation periods 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 pre-/post-program 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 pre- and post-installation uses were obtained for each customer, the Evaluation Team applied other PRISM-based screening steps and excluded these items:

- Accounts where the post-installation weather-normalized (POSTNAC) use was 70% higher or lower than the pre-installation weather-normalized (PRENAC) use. Such large changes could indicate property vacancies when adding or removing other electric equipment that are unrelated to the Program.
- Accounts that had missing PRENAC or POSTNAC estimates (because of negative heating/cooling slopes or negative intercepts) because they probably indicated problems with the billing data
- Accounts that received additional measures through other programs in the analysis period
- Accounts where the *ex ante* claimed savings was less than 1% of the PRENAC
- Electric accounts where PRENAC or POSTNAC was less than 1,200 kWh or more than 60,000 kWh
- Gas accounts where PRENAC or POSTNAC was less than 150 therms or more than 5,500 therms

Finally, the Evaluation Team performed a billing data screen that examined the gas and electric monthly billing data for one customer at a time and plotted average monthly use. To avoid confounding the billing analysis, the Evaluation Team removed accounts with outliers, vacancies, seasonal use, and equipment changes in the pre- or post-installation periods.

Table I-31 summarizes the attrition for the Tier 1 track for the Home Performance with ENERGY STAR Program gas account participants from the various screens. The data showed that 1,369 participants received project completion gas measures from January 2016 through July 2017. Attrition removed approximately 49% because billing data did not match and there were insufficient months of billing data.[61] Another 3% were removed from individual billing review problems and 1% from PRISM screening, large percentage changes, or participation in other programs during the analysis period. The final analysis group involved 641 participants.

61 Most of the attrition is from customers that installed measures before October 2015 or after February 2017, where there was insufficient pre- and post- period billing data.

Table I-31. Tier 1 Home Performance with ENERGY STAR Program Gas Participant Account Attrition

Screen	Participants Remaining	Percentage Remaining	Number Dropped	Percentage Dropped
Original Gas Accounts	**1,369**	**100%**	**0**	**0%**
Matched to Billing Data Provided	1,242	91%	127	9%
Less than 10 Months of Pre- or Post-Period Billing Data	698	51%	544	40%
Usage/Percentage Change Screens + PRISM Screening	684	50%	14	1%
Participated in Other Programs During Analysis Period	684	50%	0	0%
Individual Customer Bill Review: Outliers, Vacancies, Seasonal Usage, and Equipment Changes	641	47%	43	3%
Final Analysis Group	**641**	**47%**	**728**	**53%**

Table I-32 lists the attrition of Tier 1 track gas account nonparticipants from the various screens. From August 2017 through December 2017, there were 311 nonparticipant gas accounts that had project completions. Attrition removed approximately 35% because billing data did not match and there were insufficient months of billing data. Another 4% was from individual billing review problems. Another 2% of the attrition was from PRISM screening, large percentage changes, or from participation in other programs during the analysis period. The final analysis group involved 187 nonparticipants.

Table I-32. Tier 1 Home Performance with ENERGY STAR Program Gas Nonparticipant Account Attrition

Screen	Nonparticipants Remaining	Percentage Remaining	Number Dropped	Percentage Dropped
Original Gas Accounts	**311**	**100%**	**0**	**0%**
Matched to Billing Data Provided	290	93%	21	7%
Less than 10 Months of Pre- or Post-Period Billing Data	204	66%	86	28%
Usage/Percentage Change Screens + PRISM Screening	200	64%	4	1%
Participated In Other Programs During Analysis Period	198	64%	2	1%
Individual Customer Bill Review: Outliers, Vacancies, Seasonal Usage, And Equipment Changes	187	60%	11	4%
Final Analysis Group	**187**	**60%**	**124**	**40%**

Table I-33 lists the attrition of Tier 2 track gas account participants from the various screens. From January 2016 through July 2017, 427 participants received project completion gas measures. Attrition removed approximately 46% because billing data did not match and there were insufficient months of billing data.[62] Another 3% were removed because of individual billing review problems and 1% because of PRISM screening, large percentage changes. The final analysis group involved 209 participants.

62 Most of the attrition is from customers that installed measures before October 2015 or after February 2017, where there was insufficient pre- and post- period billing data.

Table I-33. Tier 2 Home Performance with ENERGY STAR Program Gas Participant Account Attrition

Screen	Participants Remaining	Percentage Remaining	Number Dropped	Percentage Dropped
Original Gas Accounts	**427**	**100%**	**0**	**0%**
Matched to Billing Data Provided	387	91%	40	9%
Less than 10 months of Pre- or Post-Period Billing Data	227	53%	160	37%
Usage/Percentage Change Screens + PRISM Screening	223	52%	4	1%
Participated In Other Programs During Analysis Period	223	52%	0	0%
Individual Customer Bill Review: Outliers, Vacancies, Seasonal Usage, And Equipment Changes	209	49%	14	3%
Final Analysis Group	**209**	**49%**	**218**	**51%**

Table I-34 lists the attrition of Tier 2 track gas account nonparticipants from the various screens. From August 2017 through December 2017, there were 60 nonparticipant gas accounts that had project completions. Attrition removed approximately 33% because billing data did not match and from insufficient months of billing data. Another 3% were removed because customers had participated in other programs during the analysis period, 2% were removed because of PRISM screening and large percentage changes, and 2% were removed for individual billing review problems. The final analysis group involved 36 nonparticipants.

Table I-34. Tier 2 Home Performance with ENERGY STAR Program Gas Nonparticipant Account Attrition

Screen	Nonparticipants Remaining	Percentage Remaining	Number Dropped	Percentage Dropped
Original Gas Accounts	**60**	**100%**	**0**	**0%**
Matched to Billing Data Provided	57	95%	3	5%
Less than 10 months of Pre- or Post-Period Billing Data	40	67%	17	28%
Usage/Percentage Change Screens + PRISM Screening	39	65%	1	2%
Participated in Other Programs During Analysis Period	37	62%	2	3%
Individual Customer Bill Review: Outliers, Vacancies, Seasonal Usage, And Equipment Changes	36	60%	1	2%
Final Analysis Group	**36**	**60%**	**24**	**40%**

Table I-35 lists the Tier 1 track electric account participants from the various screens. From January 2016 through July 2017, 1,463 participants received project completion electric measures. Attrition removed approximately 57% because billing data did not match and from insufficient months of billing data.[63] Another 8% were removed from individual billing review problems, and 2% were removed because of PRISM screening, large percent changes, and participation in other programs during the analysis period. The final analysis group involved 497 participants.

Table I-35. Tier 1 Home Performance with ENERGY STAR Program Electric Participant Account Attrition

Screen	Participants Remaining	Percentage Remaining	Number Dropped	Percentage Dropped
Original Electric Accounts	**1,463**	**100%**	**0**	**0%**
Matched to Billing Data Provided	1,260	86%	203	14%
Less than 10 Months of Pre- or Post-Period Billing Data	638	44%	622	43%
Usage/Percentage Change Screens + PRISM Screening	620	42%	18	1%
Participated in Other Programs During Analysis Period	607	41%	13	1%
Individual Customer Bill Review: Outliers, Vacancies, Seasonal Usage, And Equipment Changes	497	34%	110	8%
Final Analysis Group	**497**	**34%**	**966**	**66%**

Table I-36 lists the attrition of Tier 1 track electric account nonparticipants from the various screens. From August 2017 through December 2017, there were 325 nonparticipant electric accounts that had project completions. Attrition removed approximately 37% because billing data did not match and there were insufficient months of billing data. Another 5% were removed because of PRISM screening, large percentage changes, or participation in other programs during the analysis period, and 5% were removed because of individual billing review problems. The final analysis group involved 171 nonparticipants.

[63] Most of the attrition is from customers that installed measures before October 2015 or after February 2017, where there was insufficient pre- and post-installation period billing data.

Table I-36. Tier 1 Home Performance with ENERGY STAR Program Electric Nonparticipant Account Attrition

Screen	Nonparticipants Remaining	Percentage Remaining	Number Dropped	Percentage Dropped
Original Electric Accounts	**325**	**100%**	**0**	**0%**
Matched to Billing Data Provided	284	87%	41	13%
Less Than 10 Months of Pre- or Post-Period Billing Data	205	63%	79	24%
Usage/Percentage Change Screens + Prism Screening	199	61%	6	2%
Participated in Other Programs During Analysis Period	188	58%	11	3%
Individual Customer Bill Review: Outliers, Vacancies, Seasonal Usage, And Equipment Changes	171	53%	17	5%
Final Analysis Group	**171**	**53%**	**154**	**47%**

Table I-37 lists the attrition of Tier 2 track electric account participants from the various screens. From January 2012 through September 2014, 412 participants received project completion electric measures. Attrition removed approximately 50% because billing data did not match and there were insufficient months of billing data. [64] Another 8% were removed because of individual billing review problems, 2% because of participation in other programs during the analysis period, and 2% because of PRISM screening and large percentage changes. The final analysis group included 158 participants.

Table I-37. Tier 2 Home Performance with ENERGY STAR Program Electric Participant Account Attrition

Screen	Participants Remaining	Percentage Remaining	Number Dropped	Percentage Dropped
Original Electric Accounts	**412**	**100%**	**0**	**0%**
Matched to Billing Data Provided	356	86%	56	14%
Less than 10 Months of Pre- or Post-Period Billing Data	208	50%	148	36%
Usage/Percentage Change Screens + PRISM Screening	200	49%	8	2%
Participated In Other Programs During Analysis Period	191	46%	9	2%
Individual Customer Bill Review: Outliers, Vacancies, Seasonal Usage, And Equipment Changes	158	38%	33	8%
Final Analysis Group	**158**	**38%**	**254**	**62%**

Table I-38 lists the attrition of Tier 2 track electric account nonparticipants from the various screens. From August 2017 through December 2017, there were 62 nonparticipant electric accounts that had project completions. Attrition removed approximately 42% because the billing data did not match and

[64] Most of the attrition is from customers that installed measures before October 2015 or after February 2017, where there was insufficient pre- and post- period billing data.

there were insufficient months of billing data. Another 5% were removed because of participation in other programs during the analysis period, from PRISM screening and large percentage changes, and 2% from individual billing review problems. The final analysis group involved 32 nonparticipants.

Table I-38. Tier 2 Home Performance with ENERGY STAR Program Electric Nonparticipant Account Attrition

Screen	Nonparticipants Remaining	Percentage Remaining	Number Dropped	Percentage Dropped
Original Electric Accounts	**62**	**100%**	**0**	**0%**
Matched to Billing Data Provided	56	90%	6	10%
Less than 10 Months of Pre- or Post-Period Billing Data	36	58%	20	32%
Usage/Percentage Change Screens + PRISM Screening	34	55%	2	3%
Participated In Other Programs During Analysis Period	33	53%	1	2%
Individual Customer Bill Review: Outliers, Vacancies, Seasonal Usage, And Equipment Changes	32	52%	1	2%
Final Analysis Group	**32**	**52%**	**30**	**48%**

Following these screens, the final gas analysis groups for Tier 1 track involved 641 participants (47% of the original total) and 187 nonparticipants (60% of the original total), and for Tier 2 track involved 209 participants (49% of the original total) and 36 nonparticipants (60% of the original total).The final electric analysis groups for Tier 1 track involved 497 participants (34% of the original total) and 171 nonparticipants (53% of the original total), and for Tier 2 track involved 158 participants (38% of the original total) and 32 nonparticipants (52% of the original total).

From the screened billing analysis samples, the Evaluation Team summarized the PRISM average Difference in Normalized Annual Consumption (DNAC = PRENAC – POSTNAC) for participants and nonparticipants to yield the average gross savings for the programs. The Evaluation team also used the PRISM method to obtain the weather normalized pre-installation period usage (PRENAC) used to determine the percentage savings. The difference between the participant and nonparticipant percentage change in use yielded the adjusted gross savings.

I.8.3. Tier 1 Billing Analysis Results

Electric Savings Results

Table I-39 presents the Tier 1 track gross and net realized electric savings estimated by the PRISM models, NTG rates, and the standard errors around the savings estimates. The participant group reduced energy use by 737 kWh or 7.5%. The nonparticipant group change in usage was nearly flat showing a reduction in usage of 11 kWh, or 0.1% over the same period. However, this change in usage was not statistically significant from 0 (relative precision was 1,270%). As a result, the participant net savings are the same as the gross savings because the insignificant nonparticipant adjustment was not applied.

Table I-39. Tier 1 Home Performance with ENERGY STAR Program Gross and Net Electric Savings from Billing Analysis

Group	*N*	*Ex Post* Model Savings (kWh)	*Ex Ante* Savings per Participant	NTG Rate	Precision at 90% Level	PRENAC	*Ex Ante* Expected Percent Savings	*Ex Post* Percent Savings
Participant Gross	497	737	704	**105%**	16%	9,858	7.1%	7.5%
Nonparticipant	171	11	n/a	**n/a**	1,270%	9,280	n/a	0.1%
Participant Net[65]	497	737	704	**105%**	16%	9,858	7.1%	7.5%

Table I-40 summarizes the Tier 1 track net electric savings overall and by quartile, based on consumption during the pre-installation period.[66] The average Tier 1 track participant achieved net electric savings of 737 kWh. Compared to the *ex ante* savings estimate of 704 kWh, this represents a 105% NTG rate. With an average pre-installation period use of 9,858 kWh, the savings represent a reduction in use of approximately 7.5%.

The Evaluation Team also separated the electric PRENAC uses into four quartiles. Net savings represented approximately 4% of pre-installation period consumption for the lowest quartile and 10% for the highest use quartiles. The *ex ante* expected consumption savings as a percentage of pre-installation period consumption ranged from 3% to 11%. Thus, the realized savings were low, at 85% of claimed savings for the lowest quartile group and 153% in the third quartile.

Table I-40. Tier 1 Home Performance with ENERGY STAR Program Evaluated Electric Net Energy Savings by Quartile

Group	*N*	*Ex Post* Model Savings (kWh)	*Ex Ante* Savings per Participant	NTG Rate	Precision at 90% Level	PRENAC	*Ex Ante* Expected Percent Savings	*Ex Post* Percent Savings
Quartile 1	125	194	228	**85%**	46%	4,500	5.1%	4.3%
Quartile 2	124	279	231	**121%**	40%	7,240	3.2%	3.9%
Quartile 3	124	678	443	**153%**	24%	10,106	4.4%	6.7%
Quartile 4	124	1,799	1,916	**94%**	21%	17,629	10.9%	10.2%
Overall	**497**	**737**	**704**	**105%**	**16%**	**9,858**	**7.1%**	**7.5%**

Table I-41 summarizes the Tier 1 track net electric savings overall and by project completion tier (project completion 10%, 20%, 30%). The 10% project completion group achieved savings of 629 kWh (6.3%), and the 30% group achieved savings of 865 kWh (8.5%). The NTG ratio is higher at 133% for the 10% group, which suggests that the *ex ante* estimate may be low for the 10% group.

65 Nonparticipant change in usage was not statistically significant from 0. Nonparticipant adjustment not applied.

66 Quartiles are defined as equal groups of participants sorted by pre-installation period consumption (lowest to highest).

Table I-41. Tier 1 Home Performance with ENERGY STAR Program
Evaluated Electric Net Energy Savings by Completion Tier

Group	*N*	*Ex Post* Model Savings (kWh)	*Ex Ante* Savings per Participant	NTG Rate	Precision at 90% Level	PRENAC	*Ex Ante* Expected Percent Savings	*Ex Post* Percent Savings
Completion 10%	170	629	473	**133%**	29%	10,044	4.7%	6.3%
Completion 20%	159	715	725	**99%**	32%	9,301	7.8%	7.7%
Completion 30%	168	865	916	**94%**	23%	10,197	9.0%	8.5%
Overall	**497**	**737**	**704**	**105%**	**16%**	**9,858**	**7.1%**	**7.5%**

Gas Savings Results

Table I-42 presents the Tier 1 track gross and net gas savings estimated by the PRISM models, NTG rates, and the standard errors around the savings estimates. The participant group reduced energy use by 126 therms or 13%. However, the nonparticipant group increased energy use by 22 therms, or 2.4% over the same period. As a result, participants achieved a net reduction in use of 150 therms, or 15% savings.[67]

Table I-42. Tier 1 Home Performance with ENERGY STAR Program
Gross and Net Gas Savings from Billing Analysis

Group	*N*	*Ex Post* Model Savings (therms)	*Ex Ante* Savings per Participant	NTG Rate	Precision at 90% Level	PRENAC	*Ex Ante* Expected Percent Savings	*Ex Post* Percent Savings
Participant Gross	641	126	387	**n/a**	8%	973	39.8%	13.0%
Nonparticipant	187	-22	n/a	**n/a**	42%	897	n/a	-2.4%
Participant Net	641	150	387	**39%**	9%	973	39.8%	15.4%

Table I-43 summarizes the Tier 1 track net gas savings overall and by quartile. The average Tier 1 participant achieved net gas savings of 150 therms. Compared to the *ex ante* savings estimate of 387 therms, this represents a 39% NTG rate. With an average pre-installation period use of 973 therms, the savings represent a reduction in use of approximately 15%.

The Team also separated the gas PRENAC uses into four quartiles. Net savings represented approximately 14% of pre-installation period consumption for the lowest quartile and 17% for the highest quartile. The *ex ante* expected savings as a percentage of pre-installation period consumption were as high as 60% for the first quartile (i.e., the lowest pre-installation period consumption) to 33% for the highest quartile. Thus, the realized savings were very low for the lowest quartile group, at only 23%

67 The Evaluation Team checked the PRISM savings estimate against an alternate monthly fixed effects model specification using the average PRISM reference temperatures. The fixed effects models yielded a very similar net savings estimate of 147 therms, with a similar precision of 9%. As noted, the Evaluation Team used the PRISM approach to obtain the final savings estimates.

of claimed savings, whereas for the highest consumption quartile, realized savings were 51% of claimed savings.

Table I-43. Tier 1 Home Performance with ENERGY STAR Program Evaluated Gas Net Energy Savings by Quartile

Group	*N*	*Ex Post* Model Savings (therms)	*Ex Ante* Savings per Participant	NTG Rate	Precision at 90% Level	PRENAC	*Ex Ante* Expected Percent Savings	*Ex Post* Percent Savings
Quartile 1	161	76	326	**23%**	16%	547	59.6%	13.8%
Quartile 2	159	115	333	**35%**	13%	777	42.9%	14.8%
Quartile 3	160	143	370	**39%**	11%	997	37.1%	14.4%
Quartile 4	161	265	519	**51%**	12%	1,570	33.0%	16.9%
Overall	**641**	**150**	**387**	**39%**	**9%**	**973**	**39.8%**	**15.4%**

Table I-44 summarizes the Tier 1 track net gas savings overall and by project completion tier (project completion 10%, 20%, 30%). The group where 10% savings were expected achieved savings of 110 therms (11.6%), and the group with 30% savings achieved savings of 194 therms (19.1%). The NTG ratio ranged from 52% for the 10% completion group to 33% for the 30% completion group. The *ex ante* percent savings ranged from 22% for the 10% project completion participants to 58% for the 30% project completion participants.

Table I-44. Tier 1 Home Performance with ENERGY STAR Program Evaluated Gas Net Energy Savings by Completion Tier

Group	*N*	*Ex Post* Model Savings (kWh)	*Ex Ante* Savings per Participant	NTG Rate	Precision at 90% Level	PRENAC	*Ex Ante* Expected Percent Savings	*Ex Post* Percent Savings
Completion 10%	229	110	213	**52%**	13%	947	22.5%	11.6%
Completion 20%	210	151	380	**40%**	13%	959	39.7%	15.7%
Completion 30%	202	194	591	**33%**	12%	1,017	58.1%	19.1%
Overall	**641**	**150**	**387**	**39%**	**9%**	**973**	**39.8%**	**15.4%**

I.8.4. Tier 2 Billing Analysis Results

Electric Savings Results

Table I-45 lists the Tier 2 track gross and net realized electric savings estimated by the PRISM models, NTG rates, and the standard errors around the savings estimates. The participant group reduced energy use by 861 kWh or 9.6%. The nonparticipant group change in usage was nearly flat showing an increase in usage of 35 kWh—or 0.4% over the same period. However, this change in usage was not statistically significant from 0 (relative precision was 850%). As a result, the participant net savings are the same as the gross savings because the insignificant nonparticipant adjustment was not applied.

Table I-45. Tier 2 Home Performance with ENERGY STAR Program Gross and Net Electric Savings from Billing Analysis

Group	*N*	*Ex Post* Model Savings (kWh)	*Ex Ante* Savings per Participant	NTG Rate	Precision at 90% Level	PRENAC	*Ex Ante* Expected Percent Savings	*Ex Post* Percent Savings
Participant Gross	158	861	563	**153%**	28%	8,966	6.3%	9.6%
Nonparticipant	32	-35	n/a	**n/a**	850%	8,830	n/a	-0.4%
Participant Net[68]	158	861	563	**153%**	28%	8,966	6.3%	9.6%

Table I-46 lists the Tier 2 track net electric savings overall and by quartile. The average Tier 2 participant achieved net electric savings of 861 kWh. Compared to the *ex ante* savings estimate of 563 kWh, this represents a 153% NTG rate. With an average pre-installation period use of 8,966 kWh, the savings represent a reduction in use of approximately 10%.

The Team also separated the electric PRENAC uses into four quartiles. Net savings represent approximately 4% of pre-installation period consumption for the lowest quartile and 16% for the highest quartile.

The *ex ante* expected consumption savings as a percentage of pre-installation period consumption ranged from 4% to 8%. The realized savings were low for the lowest quartile group, at only 60% of claimed savings, whereas for the two highest consumption quartiles, realized savings were 157% and 199% of claimed savings, respectively.

Table I-46. Tier 2 Home Performance with ENERGY STAR Program Evaluated Electric Net Energy Savings by Quartile

Group	*N*	*Ex Post* Model Savings (kWh)	*Ex Ante* Savings per Participant	NTG Rate	Precision at 90% Level	PRENAC	*Ex Ante* Expected Percent Savings	*Ex Post* Percent Savings
Quartile 1	40	199	332	**60%**	96%	4,603	7.2%	4.3%
Quartile 2	39	370	403	**92%**	67%	7,514	5.4%	4.9%
Quartile 3	39	573	364	**157%**	65%	9,342	3.9%	6.1%
Quartile 4	40	2,280	1,144	**199%**	30%	14,378	8.0%	15.9%
Overall	**158**	**861**	**563**	**153%**	**28%**	**8,966**	**6.3%**	**9.6%**

Table I-47 summarizes the Tier 2 track net savings overall and by project completion tier (project completion 10%, 20%, 30%). The 10% project completion group achieved savings of 368 kWh (4.0%), and the 30% group achieved savings of 809 kWh (9.2%). The NTG ratios are all higher ranging from 133% to 188%, which suggests that the *ex ante* estimates are low.

68 Nonparticipant change in usage was not statistically significant from 0. Nonparticipant adjustment not applied.

Table I-47. Tier 2 Home Performance with ENERGY STAR Program Evaluated Electric Net Energy Savings by Completion Tier

Group	*N*	*Ex Post* Model Savings (kWh)	*Ex Ante* Savings per Participant	NTG Rate	Precision at 90% Level	PRENAC	*Ex Ante* Expected Percent Savings	*Ex Post* Percent Savings
Completion 10%	30	368	247	**149%**	95%	9,125	2.7%	4.0%
Completion 20%	43	1,305	694	**188%**	49%	9,177	7.6%	14.2%
Completion 30%	85	809	609	**133%**	33%	8,802	6.9%	9.2%
Overall	**158**	**861**	**563**	**153%**	**28%**	**8,966**	**6.3%**	**9.6%**

Gas Savings Results

Table I-48 presents the Tier 2 track gross and net realized gas savings estimated by the PRISM models, NTG rates, and the standard errors around the savings estimates. The participant group reduced use by 203 therms or 18.1%. However, the nonparticipant group increased use by 35 therms or 3.1% over the same period. As a result, the participants achieved a 238 therms net reduction in use or 21% savings.[69]

Table I-48. Tier 2 Home Performance with ENERGY STAR Program Gross and Net Gas Savings from Billing Analysis

Group	*N*	*Ex Post* Model Savings (therms)	*Ex Ante* Savings per Participant	NTG Rate	Precision at 90% Level	PRENAC	*Ex Ante* Expected Percent Savings	*Ex Post* Percent Savings
Participant Gross	209	203	552	**n/a**	13%	1,120	49.3%	18.1%
Nonparticipant	36	-35	n/a	**n/a**	76%	1,123	n/a	-3.1%
Participant Net	209	238	552	**43%**	15%	1,120	49.3%	21.2%

Table I-49 summarizes the Tier 2 track net savings overall and by quartile. The average Tier 2 participant achieved net gas savings of 238 therms. Compared to the *ex ante* savings estimate of 552 therms, this represents a 43% NTG rate. With an average pre-installation period use of 1,120 therms, the savings represent a reduction in use of approximately 21%.

The Team also separated the gas PRENAC uses into four quartiles. Net savings represent approximately 15% of pre-installation period consumption for the lowest quartile, increasing to 26% for the highest use quartile. The *ex ante* expected consumption savings as a percentage of pre-installation period consumption were as high as 68% for the first quartile (i.e., lowest pre-installation period consumption) to 41% for the highest quartile. Thus, the realized savings were very low for the lowest quartile, at only

[69] The Evaluation Team checked the PRISM savings estimate against an alternate monthly fixed effects model specification using the average PRISM reference temperatures. The fixed effects models yielded a very similar net savings estimate of 228 therms, with a similar precision of 15%. As noted, the Team only used the PRISM approach to obtain the final savings estimates.

22% of claimed savings, whereas for the highest consumption quartile, realized savings were 63% of claimed savings.

Table I-49. Tier 2 Home Performance with ENERGY STAR Program Evaluated Gas Net Energy Savings by Quartile

Group	*N*	*Ex Post* Model Savings (therms)	*Ex Ante* Savings per Participant	NTG Rate	Precision at 90% Level	PRENAC	*Ex Ante* Expected Percent Savings	*Ex Post* Percent Savings
Quartile 1	53	81	375	22%	46%	554	67.7%	14.6%
Quartile 2	52	154	445	35%	33%	866	51.4%	17.8%
Quartile 3	52	249	644	39%	24%	1,242	51.8%	20.0%
Quartile 4	52	471	749	63%	25%	1,830	40.9%	25.7%
Overall	**209**	**238**	**552**	**43%**	**15%**	**1,120**	**49.3%**	**21.2%**

Table I-50 summarizes the Tier 2 track net savings overall and by project completion tier (project completion 10%, 20%, 30%). The group where 10% savings were expected achieved savings of 135 therms (13.2%), and the group with 30% savings achieved savings of 288 therms (24.8%). The NTG ratio ranged from 52% for the 10% completion group to 40% for the 30% completion group. The *ex ante* percent savings ranged from 25% for the 10% project completion participants to 62% for the 30% project completion participants.

Table I-50. Tier 2 Home Performance with ENERGY STAR Program Evaluated Gas Net Energy Savings from Billing Analysis

Group	*N*	*Ex Post* Model Savings (kWh)	*Ex Ante* Savings per Participant	NTG Rate	Precision at 90% Level	PRENAC	*Ex Ante* Expected Percent Savings	*Ex Post* Percent Savings
Completion 10%	39	135	260	**52%**	41%	1,024	25.4%	13.2%
Completion 20%	61	213	443	**48%**	22%	1,111	39.9%	19.2%
Completion 30%	109	288	718	**40%**	16%	1,160	61.9%	24.8%
Overall	**209**	**238**	**552**	**43%**	**15%**	**1,120**	**49.3%**	**21.2%**

I.8.5. NTG Rates

Table I-51 lists the net overall gas and electric savings per billing analysis participant, NTG rates, and other information for the Home Performance with ENERGY STAR Program tracks.

Table I-51. NTG Rates for Gas and Electric Savings for Tier 1 and Tier 2 Tracks for the Home Performance with ENERGY STAR Program

Program Track + Fuel	*N*	*Ex Post* Model Savings per participant (kWh or therms)	*Ex Ante* Savings per Participant	NTG Rate	Precision at 90% Level	PRENAC	*Ex Ante* Expected Percent Savings	*Ex Post* Percent Savings
Tier 1 Gas	641	150	387	**39%**	9%	973	39.8%	15.4%
Tier 2 Gas	209	238	552	43%	15%	1,120	49.3%	21.2%
Tier 1 Electric	497	737	704	105%	16%	9,858	7.1%	7.5%
Tier 2 Electric	158	861	563	153%	28%	8,966	6.3%	9.6%

Appendix J. Survey Instruments by Program

This appendix includes the CY 2017 survey instruments and interview guides for the following programs in Focus on Energy's residential and nonresidential sectors as well as ongoing participant satisfaction surveys.

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 will be asked across all Focus on Energy phone surveys, where appropriate.

CADMUS

Residential Programs

Appliance Recycling Program Participant Telephone Survey

Objective: The purpose of the survey is to assess program awareness and motivations, inform the replacement rate calculations, the net-to-gross ratio, and to provide inputs for gross savings algorithm.

Researchable Questions	Item
Screening criteria	A1 - A3
Are quantities in tracking database records accurate?	A4 - A7
How did participants become aware of this program, and what is their awareness of other Focus On Energy programs?	B1 - B8
How were appliances used prior to recycling through program and what portion of the year were appliances in use?	C1 - C3
Were appliances that were recycled through the program replaced?	D1 - D2
Were replacement appliances high efficiency appliances?	D3 - D7
Would appliances recycled through the program have remained active on the grid in absence of the program? / Freeridership	E1 - E8
What are participant demographics and household characteristics?	F1

Target Quota = [170 completes, 100 refrigerator and 70 freezer participants. For participants who recycled both, the unit to be surveyed will be noted in the "APPLIANCE" field, see below.]

General Instructions

- Interviewer instructions are in green **[LIKE THIS]**.
- CATI programming instructions are in red **[LIKE THIS]**
- Items that should not be read by the interviewer are in parentheses like this ( ).
- Questions with an asterisk (*) are core questions.

Variables to be Pulled into Survey

[CONTACT NAME] = [PAYEE FIRSTNAME AND LASTNAME]

[PickupDt] = [PICKUPDATE]

[APPLIANCE] = [TYPE]

[CONFIGURATION] = [TYPEDETAIL]

[REF_QTY] = [TYPE] AND [QUANTITY]

[FRZ_QTY] = [TYPE] AND [QUANTITY]

[AGE] = CREATE NEW VARIABLE [PICKUPDATE]-[YEAR]

A. Introduction

Hello, my name is _______________ from ______________. I'm calling on behalf of **Focus on Energy.** May I please speak to **[CONTACT NAME]**?

I am following up on your household's participation in Focus on Energy's program where you recycled your **[APPLIANCE]**.

A1. Are you the person in your household that is most familiar with this pick up?

1. *(Yes)*
2. *(No)*
88. ***(REFUSED)*** ***[THANK AND TERMINATE]***
99. ***(DON'T KNOW)*** *[ASK TO SPEAK WITH SOMEONE WHO KNOWS AND BEGIN AGAIN]*

A2. **[ASK IF A1 = 2, 99]** May I please speak with that person? **[IF NOT AVAILABLE, ATTEMPT TO SCHEDULE A CALL BACK]**

1. *(Yes)*
2. *(No)* ***[THANK AND TERMINATE]***
88. ***(REFUSED)*** ***[THANK AND TERMINATE]***
99. *(DON'T KNOW)*

[TERMINATION SCRIPT: "Those are all the questions we have for you. Thank you very much for your time."]

A3. Great, Focus on Energy would like to make this program as effective as possible. Would you be willing to participate in a short survey to help Focus on Energy evaluate and improve the Appliance Recycling Program? All your answers will be kept confidential.

1. *(Yes)*
2. *(No)* ***[THANK AND TERMINATE]***
88. ***(REFUSED)*** ***[THANK AND TERMINATE]***
99. *(DON'T KNOW)*

[If customer is wary of the survey, reassure them that you are not selling anything. If necessary, offer the following contact: JOE FONTAINE (608-266-0910) as the person to contact with any questions about the validity of the research.]

[NOTE TO INTERVIEWER: If the respondent says that they have already been contacted by the program via an email/online survey or a postcard survey, the following response should be provided: *"Focus on Energy follows up with each participant to ensure that it has met its high customer service standards through a brief online or postcard questionnaire. The survey that I am calling about now explores additional questions to help improve the program's offerings."]*

A4. **[ASK IF REF_QTY > 0]** Our program records indicate you received an incentive for having **[REF_QTY]** refrigerator(s) recycled by Focus on Energy's program on **[PickupDt]**. Is this correct? ***[If needed: specifically a combination refrigerator and freezer, or a standalone refrigerator]***

1. *(Yes, both quantity and date are correct)*
2. *(No, number of refrigerators is not correct)*
3. *(No, pickup date is not correct) [RECORD CORRECT DATE]*
4. *(No, did not recycle any refrigerators) [THANK AND TERMINATE]*

88. *(REFUSED)* ***[THANK AND TERMINATE]***
99. ***(DON'T KNOW)***

A5. **[ASK IF A4=2 or 99]** How many refrigerators did you have recycled through Focus on Energy's program?

1. ***[RECORD QUANTITY] [CREATE VARIABLE V_REFQTY]***

88. *(REFUSED)* ***[THANK AND TERMINATE]***
99. *(DON'T KNOW)*

A6. **[ASK IF FRZ_QTY> 0]** Our program records indicate you received an incentive for having **[FRZ_QTY]** freezer(s) recycled by Focus on Energy's program on **[PickupDt]**. Is this correct? ***[If needed: specifically a standalone freezer]***

1. *(Yes, both quantity and date are correct)*
2. *(No, number of freezers is not correct)*
3. *(No, pickup date is not correct) [RECORD CORRECT DATE]*
4. *(No, we did not recycle any freezers) [THANK AND TERMINATE]*

88. *(REFUSED)* ***[THANK AND TERMINATE]***
99. ***(DON'T KNOW)***

A7. **[ASK IF A6=2 or 99]** How many freezers did you have recycled through Focus on Energy's program?

1. ***[RECORD QUANTITY]*** *[CREATE VARIABLE V_FRZQTY]*

88. *REFUSED* ***[THANK AND TERMINATE]***
99. ***DON'T KNOW***

[TERMINATION SCRIPT: "Those are all the questions we have for you. Thank you very much for your time."]

B. Awareness

B1. *Where did you most recently hear about the Focus on Energy's Appliance Recycling program? **[DO NOT READ LIST, RECORD ONE ANSWER]**

1. (Bill insert)
2. (Direct mail/brochure/postcard)
3. (Family/friends/word-of-mouth)
4. (Focus on Energy or Utility website)
5. (Other website **[SPECIFY: __________])**
6. (Social Media such as Twitter, Facebook, Instagram, etc.)
7. (Television)
8. (Radio)
9. (Print media (magazine, newspaper article or advertisement)
10. (Focus on Energy or Utility representative)
11. (Other, **[SPECIFY:_________________________]**)
98. (Don't know) [skip to B3]
99. (Refused) [skip to B3]

B2. *Are there any other ways you heard about the program? **[DO NOT READ. RECORD ALL THAT APPLY. EXCLUDE RESPONSE FROM B1 UNLESS OTHER SPECIFY.]**

1. (No other way)
2. (Bill insert)
3. (Direct mail/brochure/postcard)
4. (Family/friends/word-of-mouth)
5. (Focus on Energy or Utility website)
6. (Other website **[SPECIFY: __________])**
7. (Social Media such as Twitter, Facebook, Instagram, etc.)
8. (Television)
9. (Radio)
10. (Print media (magazine, newspaper article or advertisement)
11. (Focus on Energy or Utility representative)
12. (Other, **[SPECIFY:_________________________]**)
98. (Don't know)
99. (Refused)

B3. *Other than Focus on Energy's Appliance Recycling program, are you aware of any other Focus on Energy programs or rebates?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

B4. [ASK IF B3=1] *Which programs or rebates are you aware of? [DO NOT READ LIST; RECORD ALL THAT APPLY]

1. (Simple Energy Efficiency) [Other key words: energy-saving packs or kits, light bulb packs or kits]
2. (Home Performance with ENERGY STAR) [Other key words: energy assessments, home audits, weatherization, insulation, HVAC equipment, heating equipment]
3. (New Homes) [Other key words: new construction, building a new home, new build]
4. (Residential Lighting) [Other key words: lighting discounts, CFL bulbs, LED bulbs, rebates on light bulbs]
5. (Multifamily) [Other key words: multifamily direct install, multifamily energy savings, landlord installed efficient products, free products for renters]
6. (Renewables) [Other key words: solar, PV (photovoltaic), ground-source heat pumps, geothermal]
7. (Other [SPECIFY:__________])

98. (Don't know)
99. (Refused)

B5. *Have you participated in any other Focus on Energy programs? [[DO NOT READ, BUT PROMPT IF NECESSARY; RECORD ALL THAT APPLY; IF NEEDED: SUCH AS REBATES ON LED BULBS, ENERGY STAR APPLIANCES, ENERGY-EFFICIENT UPGRADES OR HOME ENERGY AUDITS*]*

1. (Yes)
2. (No)

98. (Don't know)
99. (Refused)

B6. [ASK IF B5=1]* Which programs, rebates, or projects**?** [DO NOT READ, BUT PROMPT IF NECESSARY; RECORD ALL THAT APPLY]

1. (Simple Energy Efficiency) [Other key words: energy-saving packs or kits, light bulb packs or kits]
2. (Home Performance with ENERGY STAR) [Other key words: energy assessments, home audits, weatherization, insulation, HVAC equipment, heating equipment]
3. (New Homes) [Other key words: new construction, building a new home, new build]
4. (Appliance Recycling in a previous year) [Other key words: refrigerator recycling, freezer recycling, refrigerator pick up]
5. (Residential Lighting) [Other key words: lighting discounts, CFL bulbs, LED bulbs, rebates on light bulbs]
6. (Multifamily) [Other key words: multifamily direct install, multifamily energy savings, landlord installed efficient products, free products for renters]
7. (Renewables) [Other key words: solar, PV (photovoltaic), ground-source heat pumps, geothermal]
8. (Other [SPECIFY:_____________])

98. (Don't know)

99. (Refused)

B7. ***What do you think is the best way for Focus on Energy to inform the public about energy-efficiency programs?** **[DO NOT READ LIST; RECORD ALL THAT APPLY]**
1. (Television)
2. (Radio)
3. (Print media, such as magazine, newspaper article or advertisement)
4. (Billboard/outdoor ad)
5. (Bill insert)
6. (Direct mail/brochure/postcard)
7. (Family/friends/word-of-mouth)
8. (Focus on Energy or Utility website)
9. (Social Media such as Twitter, Facebook, or Instagram)
10. (Other **[SPECIFY:________________________]**)
11. (Do not want to receive information)
98. (Don't know)
99. (Refused)

B8. *What motivated you to participate in Focus on Energy's Appliance Recycling program? **[DO NOT READ; RECORD ALL THAT APPLY]**
1. (Save energy)
2. (Reduce energy costs/lower bill)
3. (Convenience of free pick-up and removal)
4. (Good for the environment / environmentally safe disposal / recycled)
5. (Recommended by a friend/relative)
6. (Recommended by a retailer/dealer)
7. (Recommended by a contractor)
8. (Cash / rebate / incentive payment)
9. (Advertisement [newspaper, radio, online, etc.])
10. (Utility sponsorship of the program)
11. (Other **[SPECIFY: __________])**
98. (Don't know)
99. (Refused)

C. Appliance Usage

[IF (REF_QTY OR V_REFQTY=2) OR (FRZ_QTY OR V_FRZQTY=2) OR (REF_QTY OR V_REFQTY=1 and FRZ_QTY OR V_FRZQTY=1) READ] Although you recycled more than one appliance through the program, please answer the rest of the questions only about **[If REF_QTY OR V_REFQTY=1 and FRZ_QTY OR V_FRZQTY=1 read:** the **[APPLIANCE], IF REF_QTY OR V_REFQTY =2 OR FRZ_QTY OR V_FRZQTY =2 read:** the **[CONFIGURATION] [TYPE]**

C1. **Before you made the decision to remove the [APPLIANCE], in what room was it used/located?** **[RECORD ONE RESPONSE; READ LIST IF NEEDED]**

1. *Kitchen*
2. *Garage*
3. *Porch/Patio*
4. *Basement*
5. ***[Do not read]*** *(Other)* ***[Specify]***
88. *(REFUSED)*
99. ***(DON'T KNOW)***

C2. **[ASK ALL]** In the year before you removed the **[APPLIANCE],** how much of the time was it plugged in and running? Was it…? **[READ LIST]**

1. *All the time* ***[Skip to D1]***
2. *Part of the time* **[If needed, clarify as "certain months of the year" or "special occasions"]**
3. *Never* ***[Skip to D1]***
4. ***[Do not read]*** *(Other)* ***[Specify]***
88. *(REFUSED)* ***[Skip to D1]***
99. *(DON'T KNOW)* ***[Skip to D1]***

C3. **[Ask if C2=2 OR 4]** During the year, how many total months do you think it was plugged in and running?

1. ***[Record months; range: 1-12]***
88. ***(REFUSED)***
99. *(DON'T KNOW)*

D. Replacement

D1. Did you replace the **[APPLIANCE]** you recycled through Focus on Energy's program?

1. *(Yes)*
2. *(No)* ***[SKIP TO E1]***
88. *(REFUSED)* ***[SKIP TO E1]***
99. *(DON'T KNOW)* ***[SKIP TO E1]***

D2. Why did you decide to replace your old **[APPLIANCE]**? **[DO NOT READ LIST, CHECK ALL THAT APPLY]**

1. *(Save energy / wanted a more efficient appliance)*
2. *(Save money on utility bills)*
3. *(Good for the environment)*
4. *(Recommended by a friend/relative)*
5. *(Recommended by a retailer/dealer)*
6. *(Recommended by a contractor)*
7. *(Cash/rebate/incentive payment)*
8. *(Utility sponsorship of the program)*
9. *(Wanted to upgrade: more space, new features, appearance, etc.)*
10. *(Old appliance was not working well or at all)*
11. *(Was planning to give previous **[APPLIANCE]** away)*
12. *(Other)* ***[SPECIFY: __________]***
88. *(REFUSED)*
99. *(DON'T KNOW)*

D3. Was the new replacement **[APPLIANCE]** new or used?

1. *(New)*
2. *(Used)*
88. *(REFUSED)* ***[SKIP TO E1]***
99. *(DON'T KNOW)* ***[SKIP TO E1]***

D4. Was the new replacement **[APPLIANCE]** an ENERGY STAR or high-efficiency model?

1. *(Yes)*
2. *(No)* ***[SKIP TO D6]***
88. *(REFUSED)* ***[SKIP TO D6]***
99. *(DON'T KNOW)* ***[SKIP TO D6]***

D5. How important was the program in your decision to replace your old **[APPLIANCE]** with an ENERGY STAR or high-efficiency model? Was it … **[READ LIST]**

1. *Very important*
2. *Somewhat important*
3. *Not too important*
4. *Not at all important*
88. *(REFUSED)*
89. *(DON'T KNOW)*

D6. Were you already planning to replace your **[APPLIANCE]** before you decided to recycle your existing unit through the Appliance Recycling Program?

1. *(Yes)* ***[SKIP TO E1]***
2. *(No)*
88. *(REFUSED)*
99. *(DON'T KNOW)*

D7. Let me make sure I understand: you would <u>*not*</u> have replaced your **[APPLIANCE]** with a different [**APPLIANCE**] without the program? Is that correct?

1. *(Correct, I would not have replaced it without the program)*
2. *(Incorrect, I would have replaced it anyway)*
88. *(REFUSED)*
99. *(DON'T KNOW)*

E. Freeridership

E1. Had you considered getting rid of the **[APPLIANCE]** before you heard about Focus on Energy's Appliance Recycling Program?

i. **[IF NECESSARY, BY "GET RID OF," I MEAN REMOVING THE APPLIANCE FROM YOUR HOME BY ANY MEANS, INCLUDING: SELLING IT, GIVING IT AWAY, HAVING SOMEONE PICK IT UP, OR TAKING IT TO THE DUMP OR A RECYCLING CENTER YOURSELF.]**

1. *(Yes)*
2. *(No)* ***[SKIP TO E3]***
88. *(REFUSED)*
99. *(DON'T KNOW)*

E2. Would you have kept your **[APPLIANCE]** if the program had not been available?

1. *(Yes)*
2. *(No)*
88. *(REFUSED)*
99. *(DON'T KNOW)*

E3. **[ASK IF E1=2 OR E2=1 AND C1 = 1]** If you had kept the **[APPLIANCE]**, would you have kept it in the same location you mentioned earlier? That is would it have remained in the kitchen?

1. *(Yes)* ***[SKIP TO E7]***
2. *(No)* ***[SKIP TO E7]***
88. *(REFUSED)* ***[SKIP TO E7]***
99. *(DON'T KNOW)* ***[SKIP TO E7]***

E4. **[ASK IF E1<>2 OR E2<>1]** How would you have disposed of the unit if the program had not been available? Would you have...**[ALLOW ONLY ONE ANSWER ; PROMPT IF NEEDED, READ LIST IN RANDOM ORDER]**

1. *Sold it to a private party either by an ad or to someone you know*
2. *Sold it to a used appliance dealer*
3. *Given it away to a private party, such as a friend or neighbor*
4. *Given it away to a charity organization*
5. *Left it on the curb with free sign*
6. ***[DISPLAY THIS RESPONSE ONLY IF D1=1]** Had it removed by the dealer you got your new or replacement **[APPLIANCE]** from*
7. *Hauled it to the dump yourself [or friend or family member]*
8. *Hauled to a recycling center yourself [or friend or family member]*
9. *Hired someone to take it to a dump or recycling center*
10. *Have it picked up by local waste management company*
11. *Some other way **[SPECIFY: _______]***

88. *(REFUSED)*
99. *(DON'T KNOW)*

[If (E4 = 2 and AGE > 15) or E4 = 4 or E4 = 7 or E4 = 8] then read follow up question E5 along with the corresponding:

[Read only if E4 = 2 and AGE > 15]
Used appliance dealers typically only buy units that are less than 15 years old and are in very good condition.

[Read only if E4 = 4]
Market research suggests many local charities (Goodwill or Vietnam Veterans of America) only accept appliances that are in good working condition.

[Read only if E4 = 7 or 8]
Appliances are heavy and often require a truck, trailer, or large vehicle to relocate. Also, dumps and landfills often require payment to dispose of appliances.

E5. **[ASK IF (E4 = 2 and AGE > 15) or E4 = 4 or E4 = 7 or E4 = 8]** Given this information, would you have **[READ IN ANSWER FROM E4]**, or would you have done something else?

1. (Same thing as E4) **[SKIP TO E7]**
2. (Something else)

88. (REFUSED) **[SKIP TO E7]**
99. (DON'T KNOW)

E6. **[ASK IF E5=2]** How else would you have disposed of it?

i. [DO NOT READ; ALLOW ONLY ONE ANSWER BUT DO NOT ALLOW PREVIOUS ANSWER]

1. *(Sold it to a private party either by an ad or to someone you know)*
2. *(Sold it to a used appliance dealer)*
3. *(Given it away to a private party, such as a friend or neighbor)*
4. *(Given it away to a charity organization)*
5. *(Left it on the curb with free sign)*
6. ***[DISPLAY ONLY IF D1=1]*** *(Had it removed by the dealer you got your new or replacement* ***[APPLIANCE]*** *from)*
7. *(Hauled it to the dump yourself [or friend or family member])*
8. *(Hauled to a recycling center yourself [or friend or family member])*
9. *(Hired someone to take it to a dump or recycling center)*
10. *(Have it picked up by local waste management company)*
11. *(Kept it)*
12. *(Some other way)* ***[SPECIFY: _______]***

88. *(REFUSED)*
99. *(DON'T KNOW)*

E7. Would you have participated in the program if the amount of the rebate had been less?

1. *(Yes)*
1. *(No)* ***[SKIP TO E9]***

88. *(REFUSED)*
99. *(DON'T KNOW)*

E8. Would you have participated in the program with no rebate check at all?

1. *(Yes)*
2. *(No)*

88. *(REFUSED)*
99. *(DON'T KNOW)*

E9. **Did the contactor who picked up your appliance leave you with any informational materials**?

1. (Yes)
2. (No)

88. (REFUSED)
99. (DON'T KNOW)

E10. **[READ IF E9 = 1] What type of materials were left when your appliance was picked up**? (Check all mentions)

1. (Receipt for the recycled units)
2. (Pamphlet/brochure about energy efficiency kits sent by mail / the Focus on Energy Simple Energy Efficiency program)
3. (Other, specify) ***[RECORD RESPONSE]***

88. (REFUSED)
99. (DON'T KNOW)

E11. What suggestions, if any, do you have for improving the Focus on Energy Appliance Recycling Program? (What do you suggest?)

1. (Suggestions given) **[RECORD RESPONSE]**
2. (No suggestions)

88. *(REFUSED)*
99. ***(DON'T KNOW)***

F. Demographics

Now I have just a few final questions.

F1. *What type of fuel do you use to heat your home?

1. (Natural gas)
2. (Electricity)
3. (Propane/Bottled gas)
4. (Wood)
5. (Other **[SPECIFY:____________________]**)

88. (Don't know)
99. (Refused)

F2. * What type of fuel does your water heater use?

1. (Natural gas)
2. (Electricity)
3. (Propane/Bottled gas)
4. (Wood)
5. (Other **[SPECIFY:____________________]**)

88. (Don't know)
99. (Refused)

F3. *What type of home do you live in? Is it a: **[READ LIST]**

1. Mobile/manufactured home
2. Single-family home, detached house
3. Attached house (townhouse, row house, or duplex)
4. Multifamily apartment or condo building with 4 or more units
5. Co-op/retirement community
6. Other **[SPECIFY:_____________]**

88. (Don't know)
99. (Refused)

F4. Do you or members of your household own this home or do you rent?
1. (Own/buying)
2. (Rent/lease)
3. (Occupied without payment of rent)
4. (Other **[SPECIFY:________________]**)
88. (Don't know)
99. (Refused)

F5. *Is your home occupied ... [READ LIST]*
1. *Year round? or*
2. *On a seasonal basis or as a vacation home?*
88. *(Don't know)*
99. (Refused)

F6. **[ASK IF F5=2]** During the year, how many total months is your home occupied?
1. ***[Record months; range: 1-12; Half a month = 0.5]***
88. *(Don't know)*
99. (Refused)

F7. * Approximately how many square feet of living space does your home have? Don't include the basement unless it is a space that you consider lived in? **[READ CATEGORIES IF NEEDED]**
1. (Less than 1,000)
2. (1,000 to less than 1,500)
3. (1,500 to less than 2,000)
4. (2,000 to less than 2,500)
5. (2,500 to less than 3,000)
6. (3,000 to less than 4,000)
7. (4,000 or more)
88. (Don't know)
99. (Refused)

F8. *About when was your home first built? **[READ CATEGORIES IF NEEDED]**
1. (Before 1970s)
2. (1970s)
3. (1980s)
4. (1990 – 1994)
5. (1995 – 1999)
6. (2000s)
7. (2010 or more recently)
8. (Other **[SPECIFY:__________]**)
88. (DON'T KNOW)
99. (REFUSED)

F9. *Including yourself, how many people currently live in this household on a full time basis? **[IF NEEDED: Please include everyone who lives in your home whether or not they are related to you and exclude anyone who is just visiting or in the military or children who may be away at college.]**

1. **[RECORD ANSWER]**
88. (Don't know)
99. (Refused)

F10. **[ASK IF F9>1]** *How many people under the age of 18 live in your home year-round?

1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7 OR MORE
8. None
88. (DON'T KNOW)
99. (REFUSED)

F11. * What is the highest level of school that you have completed? **[READ CATEGORIES, IF NECESSARY]**

1. (Less than ninth grade)
2. (Ninth to twelfth grade; no diploma)
3. (High school graduate; includes GED)
4. (Some college, no degree)
5. (Associates degree)
6. (Bachelor's degree)
7. (Graduate or professional degree)
88. (Don't know)
99. (Refused)

F12. * Which of the following categories best represents your age? Please stop me when I get to the appropriate category. **[READ LIST]**

1. 18-24
2. 25-34
3. 35-44
4. 45-54
5. 55-64
6. 65-74
7. 75 or older
88. (Don't know)
99. (Refused)

F13. *Which category best describes your total household income in 2016 before taxes? Please stop me when I get to the appropriate category. **[READ LIST]**

1. Less than $20,000
2. $20,000, up to $50,000
3. $50,000, up to $75,000
4. $75,000, up to $100,000
5. $100,000, up to $150,000
6. $150,000 up to $200,000
7. $200,000 or more

88. (DON'T KNOW)
99. (REFUSED)

CLOSING SCRIPT: Those are all the questions we have. **Focus on Energy** appreciates your input. Thank you for your time.

Direct-Mail Home Energy Assessment (DHEA) Pilot

A. Introduction and Screener

Thank you for providing feedback about Focus on Energy's Energy Savings Survey. This survey will take less than 5 minutes to complete, and your responses will be kept strictly confidential.

Open drop-down menus by clicking on this icon within the survey.

Click on the "Next" and "Back" buttons at the bottom of each page to navigate through the survey.

Do not forget to opt-in at the end of the survey for a chance to win a $100 gift card!

A1. Our records show that you participated in Focus on Energy's Energy Savings Survey in 2017. In this survey, you completed a home energy profile that asked questions about various features of your home, such as type of air conditioner and insulation. After mailing this profile to Focus on Energy, you received a customized Home Energy Savings report. Is this correct? [FORCE RESPONSE]

1. Yes
2. No [THANK AND TERMINATE]
3. Don't remember [THANK AND TERMINATE]
4. (Prefer not to answer) [THANK AND TERMINATE]

[END OF SURVEY MESSAGE]

Since this survey is regarding the Energy Savings Survey, we only need feedback from people who remember participating. Thank you for your time.

B. Program Satisfaction

The first set of questions ask for your opinion about completing and submitting the Energy Savings Survey, and the report you received from Focus on Energy.

B1. How easy was it to complete the Energy Savings Survey?

Not at all easy										Very easy	Don't know
0	1	2	3	4	5	6	7	8	9	10	

B2. Could the process to complete and submit the Energy Savings Survey be improved?

1. Yes
2. No

B3. [Ask if B2 = 1] What about the Energy Savings Survey could be improved?

1. [OPEN-ENDED]

B4. Were you satisfied with the length of time it took to receive your customized Home Energy Savings report after submitting the survey?

Not at all satisfied										Very satisfied	Don't know
0	1	2	3	4	5	6	7	8	9	10	

B5. How helpful was the information provided in your customized Home Energy Savings report about how you can save energy and money?

Not at all helpful										Very helpful	Don't know
0	1	2	3	4	5	6	7	8	9	10	

B6. How would you rate your satisfaction with the <u>level of detail provided</u> in your customized Home Energy Savings report?

Not at all satisfied										Very satisfied	Don't know
0	1	2	3	4	5	6	7	8	9	10	

B7. How would you rate your <u>overall satisfaction</u> with the Energy Savings Survey program?

Not at all satisfied										Very satisfied	Don't know
0	1	2	3	4	5	6	7	8	9	10	

B8. [Ask if B7**G4** < 8] What changes could have improved your satisfaction with the Home Energy Savings program?

1. [OPEN-ENDED]

C. Energy-Saving Actions

The next few questions are about the energy-saving actions you have taken (or might take) since participating in Home Energy Savings program.

C1. Due to the information you received in the customized Home Energy Savings report, have you purchased or installed any energy-efficient products since you received your report?
1. Yes
2. No

C2. Do you plan to purchase or install any energy-efficient products in the next 6 months?
1. Yes
2. No

C3. [Ask if C1 = 1] Which energy-efficient products have you purchased/installed? (Select all that apply) [MULTIPLE RESPONSES ALLOWED]
1. Received an energy-efficiency kit
2. Had an in-home assessment
3. Upgraded insulation
4. Replaced old light bulbs with LED bulbs
5. Replaced old refrigerator or freezer
6. Recycled old refrigerator or freezer
7. Replaced older appliances with efficient models (please specify) [ALLOW TEXT ENTRY – FORCE TEXT ENTRY]
8. Replaced old thermostat with a smart thermostat (can be controlled via Wi-Fi)
9. Replaced inefficient heating and/or cooling equipment
10. Installed a ductless mini-split heat pump
11. Installed a renewable energy system
12. Replaced standard electric water heater with a heat pump water heater
13. Other (please specify) [ALLOW TEXT ENTRY – FORCE TEXT ENTRY]

C4. [Ask if C2= 1] Which energy-efficient products do you plan to purchase/install in the next 6 months? (Select all that apply) [MULTIPLE RESPONSES ALLOWED]
1. Order an energy-efficiency kit (simple energy efficiency packs)
2. Have an in-home assessment
3. Upgrade insulation
4. Replace old light bulbs with LED bulbs
5. Replace old refrigerator or freezer
6. Replace older appliances with efficient models (please specify) [ALLOW TEXT ENTRY – FORCE TEXT ENTRY]
7. Replace old thermostat with a smart thermostat

8. Replace inefficient heating and/or cooling equipment
9. Install a ductless mini-split heat pump
10. Install a renewable energy system
11. Replace standard electric water heater with a heat pump water heater
12. Other (please specify) [ALLOW TEXT ENTRY – FORCE TEXT ENTRY]

C5. [Ask if C1 ≠ 1 and C2 = 2] Why do you not plan to purchase/install energy-efficient products in the next 6 months? (Select all that apply) [MULTIPLE RESPONSES ALLOWED]

1. Cost/too expensive
2. Don't have time to make efficiency upgrades
3. Unsure about potential energy savings
4. Unsure about potential monetary savings
5. Don't know where to find additional information about energy-efficient products
6. Don't know where to purchase energy-efficient products
7. Don't know where to find contractor to install energy-efficient products
8. The report said my home does not need upgrades
9. Other (please specify) [ALLOW TEXT ENTRY – MEDIUM-SIZED TEXT BOX – FORCE TEXT ENTRY]
98. Don't Know [MAKE RESPONSE EXCLUSIVE]

C6. [Ask if C1C1 = 1 and C3 ≠ 4 or blank] Did you receive a rebate from Focus on Energy for purchasing/installing this/these energy-efficient products? [PIPE IN RESPONSES SELECTED IN C3] [USE DROP-DOWN LISTS]

1. Yes
2. No
98. Don't know

C7. [Ask if C1C1 = 1 or C2 = 1] How important was the Home Energy Savings program in your decision to purchase/install additional energy-efficient products?

Not at all important										Very important	Don't know
0	1	2	3	4	5	6	7	8	9	10	

D. Educational Effectiveness

D1. Were you aware of Focus on Energy programs before you participated in the Energy Savings Survey?

1. Yes
2. No
98.

D2. [Ask if D1 = 1] Which programs are you aware of now that you have participated? (Select all that apply) [MULTIPLE RESPONSES ALLOWED] [RANDOMIZE RESPONSES 1-5]

1. Simple Energy Efficiency (energy kits/energy packs)
2. Home Performance with ENERGY STAR
3. Heating and Cooling
4. Appliance Recycling
5. Retail Lighting
6. Other (please specify) [ALLOW TEXT ENTRY – FORCE TEXT ENTRY]
98. None [MAKE RESPONSE EXCLUSIVE]

D3. Your Home Energy Savings report recommended ways that Focus on Energy can help save energy in your home. Did you connect with Focus on Energy to learn more about those energy-saving opportunities? (Select all that apply) [MULTIPLE RESPONSES ALLOWED]

1. Yes – researched online
2. Yes – inquired by phone
3. No [MAKE RESPONSE EXCLUSIVE]
98. Don't know [MAKE RESPONSE EXCLUSIVE]

D4. [Ask if D3 = 1 or 2] Which energy-saving opportunities did you investigate? (Select all that apply) [MULTIPLE RESPONSES ALLOWED]

1. Ordering an energy-efficiency kit (simple energy efficiency packs)
2. Having an in-home assessment
3. Upgrading insulation to modern standards
4. Replacing old light bulbs with LED bulbs
5. Replacing old thermostat with a smart thermostat
6. Replacing old refrigerator or freezer
7. Replacing inefficient heating and/or cooling equipment
8. Replacing appliances with efficient models
9. Installing a ductless mini-split heat pump
10. Installing a renewable energy system
11. Replacing standard electric water heater with a heat pump water heater
98. Don't know [MAKE RESPONSE EXCLUSIVE]

E. Demographics

These last few questions are for statistical purposes only.

E1. What type of home do you live in? Is it a:
1. Single-family home, detached house
2. Attached house (townhouse, row house, or duplex)
3. Multifamily apartment or condo building with 4 or more units
4. Mobile/manufactured home
5. Co-op/retirement community
6. Other (please specify) [ALLOW TEXT ENTRY – FORCE TEXT ENTRY]

Prefer not to respond

E2. Do you or members of your household own this home or do you rent?
1. Own
2. Rent/lease
3. Other (please specify) [ALLOW TEXT ENTRY – FORCE TEXT ENTRY]

Prefer not to respond

E3. What is the highest level of school that you have completed?
1. Less than ninth grade
2. Ninth to twelfth grade; no diploma
3. High school graduate (includes GED)
4. Some college, no degree
5. Associates degree
6. Bachelor's degree
7. Graduate or professional degree

98. Prefer not to respond

E4. Please enter your age:
1. [OPEN-ENDED]

E5. Which category best describes your total household income in 2016 before taxes?
1. Less than $30,000
2. Between $30,000 and $49,999
3. Between $50,000 and $69,999
4. Between $70,000 and $89,999
5. Between $90,000 and $109,999
6. Between $110,000 and $129,999
7. Between $130,000 and $149,999
8. $150,000 or more

98. Prefer not to respond

F. Closing

F1. Those are all the questions we have. Thank you for your time! Before you go, please tell us if you would like to be entered into the drawing to win a $100 gift card.

1. Yes – I want to enter the contest
2. No – I **do not** want to enter the contest

F2. [Ask if F1 = 1] To be entered into the drawing for the gift card, please verify your name and address. Your information will only be used to mail you the prize if you win the contest. Focus on Energy will not use it for marketing purposes, and they will not update any of your billing or mailing preferences with this information. *Please note, if you do not complete your mailing address, or only fill some of the fields below, you will not be entered into the drawing*.

1. First and Last Name:
2. Street Address:
3. City:
4. State:
5. ZIP code:

[END OF SURVEY MESSAGE]

The survey is now complete. Focus on Energy appreciates your input. Thank you very much for your time!

CADMUS

Home Performance with ENERGY STAR Trade Ally Online Survey

Variables:

[EMAIL ADDRESS] = Trade ally's email address
[COMPANY] = Name of trade ally's company
[FIRST NAME] = Trade ally's first name
[LAST NAME] = Trade ally's last name

Survey Invitation E-mail Message

To: **[EMAIL ADDRESS]**
From: Focus on Energy
Subject: Focus on Energy wants your feedback!

Dear **[FIRST NAME]**:

Focus on Energy is interested in hearing from trade professionals involved with residential energy-efficient equipment or services. We'd like to know more about your experiences so we can improve our programs. Your responses will remain anonymous and be kept confidential. **This survey should only take three minutes.** Please complete the survey by **_____day, October X, 2017**.

Follow this link to the survey: [SURVEY HYPERLINK]
Or copy and paste this URL into your internet browser: [SURVEY URL]

Focus on Energy greatly appreciates your participation. If you have any questions about the survey, please feel free to contact me. Thank you in advance!

Sincerely,
Joe Fontaine
Focus on Energy Performance Manager
Public Service Commission of Wisconsin
(608) 266-0910
Joe.Fontaine@wisconsin.gov

Follow the link to opt out of future emails: ${l://OptOutLink?d=Click here to unsubscribe}

Survey Start Screen

[DISPLAY FOCUS ON ENERGY LOGO]

Welcome! Our records show that your customers have participated in the Home Performance with ENERGY STAR Program. Although we know you or your customers may be involved in other programs that Focus on Energy offers, *for the purposes of this survey, please think about your experiences with the Home Performance Program when answering the questions.*

This survey should take about three minutes.

[DISPLAY "BEGIN SURVEY" BUTTON]

A. Firmographics

A1. How many employees work at your office(s) in Wisconsin? **[TEXT ENTRY BOX; NUMERIC VALIDATION 0-999]**

A2. What does your company specialize in? Select all that apply. **[MULTIPLE RESPONSE]**

1. Commissioning services
2. Electrical/lighting
3. Energy assessments, diagnostics, or ratings
4. HVAC equipment
5. Other mechanical systems
6. Insulation/building envelope
7. New building construction
8. Refrigeration
9. Renewable energy
10. Renovations
11. Training/consulting
12. Other: **[FORCED TEXT ENTRY RESPONSE]**

88. Don't know **[EXCLUSIVE RESPONSE]**

B. Engagement

B1. How often do you promote Focus on Energy programs to customers?

1. All the time **[SKIP TO C1]**
2. Frequently **[SKIP TO C1]**
3. Sometimes
4. Seldom
5. Never

B2. Why don't you promote the programs to the customers more often? Select all that apply. **[MULTIPLE RESPONSE]**

1. I'm not confident about the details of the programs or who is eligible
2. It's confusing to the customer
3. Too much paperwork
4. For the jobs I do, the incentives are not worth the hassle
5. I don't like the equipment or products that Focus on Energy promotes
6. I perceive a financial risk to myself or my customer
7. I don't like having my work inspected
8. Many of my customers are not qualified for Focus on Energy incentives because they use an ineligible fuel type or are served by a nonparticipating utility
9. Other: **[FORCED TEXT ENTRY RESPONSE]**

88. Don't know **[EXCLUSIVE RESPONSE]**

C. Satisfaction

C1. How is Focus on Energy doing when it comes to the following: **[MATRIX WITH RESPONSE CHOICES: EXCELLENT, GOOD, FAIR, POOR, DON'T KNOW, NOT APPLICABLE] [RANDOMIZE ORDER]**

A. Reaching out to you and keeping you informed about programs and offerings
B. Paying you in a timely manner, if you receive the incentive on behalf of your customer
C. Making the paperwork easy to submit
D. Providing you with tools and resources to effectively market programs to your customers
E. Providing educational opportunities or training resources
F. Providing the right amount of support so you can confidently sell and install energy efficiency equipment

C2. How frequently do you run into challenges with the incentive application process?

1. Very often (e.g., almost every time)
2. Somewhat often (e.g., about half the time)
3. Not very often (e.g., once or twice) **[SKIP TO C4]**
4. Never **[SKIP TO C4]**

88. Don't know

C3. What are your most frequent challenges with the incentive application process? Select all that apply. **[MULTIPLE RESPONSE]**

1. Too much information required
2. Too many supporting documents required (e.g., contractor invoices)
3. Takes too much time
4. Too many requirements for eligible equipment
5. Difficult to get a hold of program staff when I had questions
6. Took too long for approval
7. Other: **[FORCED TEXT ENTRY RESPONSE]**

88. Don't know **[EXCLUSIVE RESPONSE]**

C4. On a 10-point scale, where 0 means "not all satisfied" and 10 means "extremely satisfied," how satisfied are you with Focus on Energy's Home Performance with ENERGY STAR Program? **[RESPONSE CHOICES RANGING FROM 0-10, PLUS "DON'T KNOW"]**

C5. **[ASK IF C4 ≤ 6]** Besides incentive amounts, what is one important thing Focus on Energy can improve to increase your satisfaction with the Home Performance with ENERGY STAR program? **[TEXT ENTRY BOX; NO FORCED RESPONSE]**

C6. On a 10-point scale, where 0 means "not all satisfied" and 10 means "extremely satisfied," how satisfied are you with Focus on Energy overall? **[RESPONSE CHOICES RANGING FROM 0-10, PLUS "DON'T KNOW"]**

D. End of Survey Message

Success! Your responses have been submitted. Thank you for taking the time to complete our survey. Have a nice day!

CADMUS

Simple Energy Efficiency Program Participant Online Survey – First Half

Target Quota = Census, or 70 completes per pack type

General Instructions

- Interviewer instructions are in green **[LIKE THIS]** (the style is "Survey: Interviewer Instructions").
- CATI programming instructions are in red **[LIKE THIS]** (the style is "Survey: Programming").
- Response items that should not be read by the interviewer are in parentheses like this: ( ).
- Questions from core question list are indicated with an asterisk (*).
- **All questions are single-response unless specified otherwise.**

Measure	Pack Name					
	Focus	Smart Strip	Showerhead	Flood Light	Decorative Light	Globe Light
LED A19	3	2	3			
LED BR30 Reflector				4		
LED G25 Globe						3
LED Candelabra					3	
Showerhead	1		1*		1	1
Kitchen Aerator	1	1	1		1	1
Bathroom Aerator	1	1	1		1	1
Advanced Power Strip		1				

*Hand-wand showerhead

Introduction and Screening

E-MAIL

Subject: "Take a survey to win $150!"

Hello ${e://Field/Name},

The success of Focus on Energy programs depends on customers like you. On behalf of Focus on Energy and the Public Service Commission of Wisconsin, Cadmus is conducting a survey to better understand your experience with the Simple Energy Efficiency Program. Through this program, you received a pack of energy-efficient products that you could install in your home.

We invite you to complete the following brief survey for a chance to win a $150 Visa gift card. Your participation is voluntary, but your input plays an important role in guiding future program enhancements. All of your survey responses will be kept confidential.

The survey should take about 15 minutes to complete and will be open until **5 p.m. [DATE].**

[SURVEY LINK]

If you have problems with the survey link, please contact the survey coordinator, Alex Chamberlain, at (714) 955-1904 or via email at Alex.Chamberlain@cadmusgroup.com . If you would like to confirm the research effort, please call Joe Fontaine at the Public Service Commission at (608) 266-0910.

We hope you will take this opportunity to have your voice heard. Thank you in advance for your time and for sharing your experiences.

SURVEY INTRODUCTION

Records from Focus on Energy show that you received a pack of energy efficient products in 2017 through Focus on Energy's Simple Energy Efficiency Program. The following survey will ask about your participation in that program. At the end, you will be given the opportunity to enter to win a $150 Visa gift card as a token of our appreciation for your time.

A1. **DO YOU RECALL RECEIVING A FREE PACK OF ENERGY-SAVING PRODUCTS FROM FOCUS ON ENERGY? YOU LIKELY SIGNED UP TO RECEIVE THE PACK ONLINE OR BY PHONE.**

1. Yes
2. No **[THANK AND TERMINATE]**
98. Don't know **[THANK AND TERMINATE]**

TERMINATE MESSAGE: WE ARE ONLY SURVEYING CUSTOMERS WHO RECALL PARTICIPATING IN THE PROGRAM. THANK YOU FOR YOUR TIME.

B. Program Awareness

B1. *Where did you most recently hear about Focus on Energy's Simple Energy Efficiency program?

1. Bill insert
2. Direct mail/brochure/postcard
3. Family/friends/word-of-mouth
4. Focus on Energy or Utility website
5. Other website: **SPECIFY:**________________________
6. Social Media such as Twitter, Facebook, Instagram, etc.
7. Television
8. Radio
9. Print media magazine, newspaper article or advertisement
10. Focus on Energy or Utility representative
11. Other: **SPECIFY:**________________________
98. Don't know **[SKIP TO B3]**

B2. *Are there any other ways you heard about the program? Select all that apply.

1. No other ways
2. Bill insert
3. Direct mail/brochure/postcard
4. Family/friends/word-of-mouth
5. Focus on Energy or Utility website
6. Other website: **SPECIFY:________________________**
7. Social Media such as Twitter, Facebook, Instagram, etc.
8. Television
9. Radio
10. Print media magazine, newspaper article or advertisement
11. Focus on Energy or Utility representative
12. Other: **SPECIFY:________________________**
98. Don't know

B3. *What do you think is the best way for Focus on Energy to inform the public about energy efficiency programs? Select all that apply.

1. Television
2. Radio
3. Print media, such as magazine, newspaper article or advertisement
4. Billboard/outdoor ad
5. Bill insert
6. Direct mail/brochure/postcard
7. Family/friends/word-of-mouth
8. Focus on Energy or Utility website
9. Social Media such as Twitter, Facebook, or Instagram
10. Other: **SPECIFY:________________________**
11. Do not want to receive information
98. Don't know

B4. *What motivated you to participate in the program?

1. **[RECORD RESPONSE]**

C. LEDs

Now I would like to ask you about the energy-saving items you received through the program.

A19 LEDs (3)

[ASK SECTION IF PACK NAME = FOCUS, SHOWERHEAD]

Our records show you received three LED light bulbs in your energy-efficiency pack. These look like your standard light bulbs.

C1. How many of the LEDs are currently installed in your home?

1. 0
2. 1
3. 2
4. 3 **[SKIP TO C4]**

98. Don't know **[SKIP TO C5]**

C2. Of the **[3 MINUS C1]** bulbs *not currently* installed, how many did you install but later remove?

1. **[IF C1<=3]** 0
2. **[IF C1<=2]** 1
3. **[IF C1<=1]** 2
4. **[IF C1=0]** 3

98. Don't know **[SKIP TO C4]**

C3. What did you do with the bulb(s) that are *not currently* installed? Select all that apply.

1. Stored for future use
2. Discarded/recycled
3. Gave to someone else
4. Other: **SPECIFY:**________________________

98. Don't know

C4. Did you have any difficulty installing the LEDs you received?

1. Yes **C5_1. WHAT WAS DIFFICULT ABOUT INSTALLING THEM?**
    1. **WRONG SIZE/DID NOT FIT**
    2. Other: **SPECIFY:**________________________
    3. **DON'T KNOW**
2. No

98. Don't know

C5. How satisfied are you with the LEDs you received?
1. Very satisfied **[SKIP TO D1]**
2. Somewhat satisfied
3. Not too satisfied
4. Not satisfied at all
98. Don't know **[SKIP TO D1]**

C6. Why are you **[C5]**? Select all that apply.
1. Burned out/broke/stopped working
2. Didn't fit properly in fixture
3. Difficult/unable to install
4. Not bright enough
5. Didn't like the color
6. Delay in light coming on
7. Didn't work with dimmer/three-way switch
8. Flickered when turned on
9. Other: **SPECIFY:**______________________
98. Don't know

A19 LEDs (2)

[ASK SECTION IF PACK NAME = SMART STRIP]

Our records show you received two LED light bulbs. These look like your standard lightbulbs.

C7. How many of the LEDs are currently installed in your home?
1. 0
2. 1
3. 2 **[SKIP TO C10]**
98. Don't know **[SKIP TO C11]**

C8. Of the **[2 MINUS C7]** bulbs *not currently* installed, how many did you install but later remove?
1. **[IF C7<=2]** 0
2. **[IF C7<=1]** 1
3. **[IF C7=0]** 2
98. Don't know **[SKIP TO C10]**

C9. What did you do with the bulbs that are *not currently* installed? **SELECT ALL THAT APPLY.**
1. Stored for future use
2. Discarded/recycled
3. Gave to someone else
4. Other: **SPECIFY:**______________________
98. Don't know

C10. Did you have any difficulty installing the LEDs you received?
1. Yes **C10_1. WHAT WAS DIFFICULT ABOUT INSTALLING THEM?**
    1. **WRONG SIZE/DID NOT FIT**
    2. Other: **SPECIFY:**________________________
    3. **DON'T KNOW**
2. No
98. Don't know

C11. How satisfied are you with the LEDs you received?
1. Very satisfied **[SKIP TO D1]**
2. Somewhat satisfied
3. Not too satisfied
4. Not satisfied at all
98. Don't know **[SKIP TO D1]**

C12. Why are you **[C11]**? **SELECT ALL THAT APPLY.**
1. Burned out/broke/stopped working
2. Didn't fit properly in fixture
3. Difficult/unable to install
4. Not bright enough
5. Didn't like the color
6. Delay in light coming on
7. Didn't work with dimmer/three-way switch
8. Flickered when turned on
9. Other: **SPECIFY:**________________________
98. Don't know

Flood Light LEDs

[ASK SECTION IF PACK NAME = FLOOD LIGHT]

Our records show you received four flood light ("reflector") LED light bulbs. Reflectors typically are triangle-shaped and emit light through one large flat lens on top of the bulb, as opposed to all the way around like a standard bulb.

C13. How many of the reflector LEDs are currently installed in your home?
1. 0
2. 1
3. 2
4. 3
5. 4 **[SKIP TO C16]**

98. Don't know **[SKIP TO C17]**

C14. Of the **[4 MINUS C13]** bulbs *not currently* installed, how many did you install but later remove?

1. **[IF C13<=4]** 0
2. **[IF C13<=3]** 1
3. **[IF C13<=2]** 2
4. **[IF C13<=1]** 3
5. **[IF C13=0]** 4

98. Don't know **[SKIP TO C16]**

C15. What did you do with the bulb(s) that are *not currently* installed? **SELECT ALL THAT APPLY.**

1. Stored for future use
2. Discarded/recycled
3. Gave to someone else
4. Other: **SPECIFY:**_______________________

98. Don't know

C16. Did you have any difficulty installing the reflector LEDs you received?

1. Yes **C16_1. WHAT WAS DIFFICULT ABOUT INSTALLING THEM?**
   1. **WRONG SIZE/DID NOT FIT**
   2. Other: **SPECIFY:**_______________________
   3. **DON'T KNOW**
2. No

98. Don't know

C17. How satisfied are you with the reflector LEDs you received?

1. Very satisfied **[SKIP TO D1]**
2. Somewhat satisfied
3. Not too satisfied
4. Not satisfied at all

98. Don't know **[SKIP TO D1]**

C18. Why are you [C17]? **SELECT ALL THAT APPLY.**

1. Burned out/broke/stopped working
2. Didn't fit properly in fixture
3. Difficult/unable to install
4. Not bright enough
5. Didn't like the color
6. Delay in light coming on
7. Didn't work with dimmer/three-way switch
8. Flickered when turned on
9. Other: **SPECIFY:**________________________

98. Don't know

Candelabra LEDs

[ASK SECTION IF PACK NAME = DECORATIVE LIGHT]

Our records show you received three candelabra LED light bulbs. Candelabra bulbs are smaller decorative lamps with a bulb shape like a candle flame.

C19. How many of the candelabra LEDs are currently installed in your home?

1. 0
2. 1
3. 2
4. 3 **[SKIP TO C22]**

98. Don't know **[SKIP TO C23]**

C20. Of the **[3 MINUS C19]** bulbs *not currently* installed, how many did you install but later remove?

1. **[IF C19<=3]** 0
2. **[IF C19<=2]** 1
3. **[IF C19<=1]** 2
4. **[IF C19=0]** 3

98. Don't know **[SKIP TO C22]**

C21. What did you do with the bulb(s) that are *not currently* installed? **SELECT ALL THAT APPLY.**

1. Stored for future use
2. Discarded/recycled
3. Gave to someone else
4. Other: **SPECIFY:**________________________

98. Don't know

C22. Did you have any difficulty installing the candelabra LEDs you received?

1. Yes **C22_1. WHAT WAS DIFFICULT ABOUT INSTALLING THEM?**
    1. **WRONG SIZE/DID NOT FIT**
    2. Other: **SPECIFY:**________________________
    3. **DON'T KNOW**
2. No

98. Don't know

C23. How satisfied are you with the candelabra LEDs you received?

1. Very satisfied **[SKIP TO D1]**
2. Somewhat satisfied
3. Not too satisfied
4. Not satisfied at all

98. Don't know **[SKIP TO D1]**

C24. Why are you **[C23]**? **SELECT ALL THAT APPLY.**

1. Burned out/broke/stopped working
2. Didn't fit properly in fixture
3. Difficult/unable to install
4. Not bright enough
5. Didn't like the color
6. Delay in light coming on
7. Didn't work with dimmer/three-way switch
8. Flickered when turned on
9. Other: **SPECIFY:**________________________

98. Don't know

Globe LEDs

[ASK SECTION IF PACK NAME = GLOBE LIGHT]

Our records show you received three globe LED light bulbs. Globes look like standard lightbulbs except larger and rounder.

C25. How many of the globe LEDs are currently installed in your home?

1. 0
2. 1
3. 2
4. 3 **[SKIP TO C28]**

98. Don't know **[SKIP TO C29]**

C26. Of the [3 MINUS C25] bulbs *not currently* installed, how many did you install but later remove?

1. [IF C25<=3] 0
2. [IF C25<=2] 1
3. [IF C25<=1] 2
4. [IF C25=0] 3

98. Don't know [SKIP TO C28]

C27. What did you do with the bulb(s) that are *not currently* installed? **SELECT ALL THAT APPLY.**

1. Stored for future use
2. Discarded/recycled
3. Gave to someone else
4. Other: **SPECIFY:**_______________________

98. Don't know

C28. Did you have any difficulty installing the globe LEDs you received?

1. Yes **C28_1. WHAT WAS DIFFICULT ABOUT INSTALLING THEM?**
    1. **WRONG SIZE/DID NOT FIT**
    2. Other: **SPECIFY:**_______________________
    3. **DON'T KNOW**
2. No

98. Don't know

C29. How satisfied are you with the globe LEDs you received?

1. Very satisfied [SKIP TO D1]
2. Somewhat satisfied
3. Not too satisfied
4. Not satisfied at all

98. Don't know [SKIP TO D1]

C30. Why are you [C29]? SELECT ALL THAT APPLY.

1. Burned out/broke/stopped working
2. Didn't fit properly in fixture
3. Difficult/unable to install
4. Not bright enough
5. Didn't like the color
6. Delay in light coming on
7. Didn't work with dimmer/three-way switch
8. Flickered when turned on
9. Other: SPECIFY:________________________
98. Don't know

D. Smart Strip

[ASK SECTION IF PACK NAME = SMART STRIP]

Our records show you also received a smart power strip.

D1. Is the smart power strip you received currently installed in your home?

1. **YES [SKIP TO D4]**
2. No
98. Don't know **[SKIP TO D6]**

D2. Was the smart power strip ever installed in your home and later removed?

1. Yes
2. No
98. Don't know **[SKIP TO D4]**

D3. What did you do with the smart power strip?

1. Stored for future use
2. Threw away
3. Gave to someone else
4. Other: SPECIFY:________________________
98. Don't know

D4. [IF D1 = YES] What do you have plugged into your power strip? Select all that apply.

1. Home entertainment center [TVs, cable boxes, streaming devices Apple TV or Roku, DVD players]
2. Home office [laptops, desktop computers, computer monitors, scanners, printers, fax machines]
3. Other equipment **SPECIFY:**________________________

98. Don't know

D5. IF D1 OR D2 = YES] Did you have any difficulty using the smart strip to operate your electronics?

1. Yes **D5_1. WHAT WAS DIFFICULT ABOUT USING IT?**
    1. **[RECORD RESPONSE]**
2. No

98. Don't know

D6. How satisfied are you with the smart power strip you received?

1. Very satisfied **[SKIP TO E1]**
2. Somewhat satisfied
3. Not too satisfied
4. Not satisfied at all

98. Don't know **[SKIP TO E1]**

D7. Why are you **[D6]**? **SELECT ALL THAT APPLY.**

1. Broken/didn't work

89. Difficult/unable to set up

2. Didn't like how it looked
3. Didn't like how the attached equipment worked when hooked up to it
4. Not enough regular outlets
5. Other: **SPECIFY:**________________________

98. Don't know

E. Showerhead

[ASK SECTION IF PACK NAME = FOCUS, SHOWERHEAD, DECORATIVE LIGHT, GLOBE LIGHT]

Our records show you also received a showerhead.

E1. Is the showerhead you received currently installed in your home?

1. **YES [SKIP TO E4]**
2. No

98. Don't know **[SKIP TO E5]**

E2. Was the showerhead ever installed in your home and later removed?

1. Yes
2. No

98. Don't know **[SKIP TO E4]**

E3. What did you do with the showerhead?

1. Stored for future use
2. Threw away
3. Gave to someone else
4. Other: **SPECIFY:**_______________________

98. Don't know

E4. Did you have any difficulty installing the water-saving showerhead you received?

1. Yes **E4_1. WHAT WAS DIFFICULT ABOUT INSTALLING IT?**
   1. **WRONG SIZE/DID NOT FIT**
   2. Other: **SPECIFY:**_______________________
   3. **DON'T KNOW**
2. No

98. Don't know

E5. How satisfied are you with the showerhead you received?

1. Very satisfied **[SKIP TO F1]**
2. Somewhat satisfied
3. Not too satisfied
4. Not satisfied at all

98. Don't know **[SKIP TO F1]**

E6. Why are you **[E5]**? **SELECT ALL THAT APPLY.**
1. Broken/didn't work
2. Difficult/unable to install
3. Didn't fit properly
4. Didn't like the water pressure
5. Didn't like how it looked
6. Other: **SPECIFY:**________________________
98. Don't know

F. Faucet Aerators

[ASK SECTION IF PACK NAME = FOCUS, SMART STRIP, SHOWERHEAD, DECORATIVE LIGHT, GLOBE LIGHT]

Our records show you also received two faucet aerators: one for your kitchen sink, and one for your bathroom sink.

Kitchen Faucet Aerator

F1. Is the kitchen faucet aerator you received currently installed in your home? This one is rated at 1.5 gallons per minute (GPM).
1. **YES [SKIP TO 0]**
2. No
98. Don't know **[SKIP TO F5]**

F2. Was the kitchen faucet aerator ever installed in your home and later removed?
1. Yes
2. No
98. Don't know **[SKIP TO 0]**

F3. What did you do with the kitchen faucet aerator?
1. Stored for future use
2. Threw away
3. Gave to someone else
4. Other: **SPECIFY:**________________________
98. Don't know

F4. Did you have any difficulty installing the kitchen faucet aerator you received?

1. Yes **F4_1. WHAT WAS DIFFICULT ABOUT INSTALLING IT?**
    1. **WRONG SIZE/DID NOT FIT**
    2. Other: **SPECIFY:**________________________
    3. **DON'T KNOW**
2. No

98. Don't know

F5. How satisfied are you with the kitchen faucet aerator you received?

1. Very satisfied **[SKIP TO F7]**
2. Somewhat satisfied
3. Not too satisfied
4. Not satisfied at all

98. Don't know **[SKIP TO F7]**

F6. Why are you **[F5]**? **SELECT ALL THAT APPLY.**

1. Broken/didn't work
2. Difficult/unable to install
3. Didn't fit properly
4. Didn't like the water pressure
5. Didn't like how it looked
6. Other: **SPECIFY:**________________________

98. Don't know

Bathroom Faucet Aerator

F7. Is the bathroom faucet aerator you received currently installed in your home? This one is rated at 1 gallon per minute (GPM).

1. **YES [SKIP TO F10]**
2. No

98. Don't know **[SKIP TO F11]**

F8. Was the bathroom faucet aerator ever installed in your home and later removed?

1. Yes
2. No

98. Don't know **[SKIP TO F10]**

F9. What did you do with the bathroom faucet aerator?

1. Stored for future use
2. Threw away
3. Gave to someone else
4. Other: **SPECIFY:**________________________
98. Don't know

F10. Did you have any difficulty installing the bathroom faucet aerator you received?

1. Yes **F10_1. WHAT WAS DIFFICULT ABOUT INSTALLING IT?**
    1. **WRONG SIZE/DID NOT FIT**
    2. Other: **SPECIFY:**________________________
    3. **DON'T KNOW**
2. No
98. Don't know

F11. How satisfied are you with the bathroom faucet aerator you received?

1. Very satisfied **[SKIP TO G1]**
2. Somewhat satisfied
3. Not too satisfied
4. Not satisfied at all
98. Don't know **[SKIP TO G1]**

F12. Why are you **[F11]**? **SELECT ALL THAT APPLY.**

1. Broken/didn't work
2. Difficult/unable to install
3. Didn't fit properly
4. Didn't like the water pressure
5. Didn't like how it looked
6. Other: **SPECIFY:**________________________
98. Don't know

G. Program Satisfaction

Now I am going to ask you some questions about your experience with the program.

G1. Did you request your pack using the Focus on Energy website, or did you call the 1-800 number?

1. Website
2. 1-800 number **[SKIP TO G4]**
3. Other: **SPECIFY:**_________________________ **[SKIP TO G4]**

98. Don't know **[SKIP TO G4]**

G2. How easy was it to fill out the online request for your energy efficiency pack?

1. Very easy **[SKIP TO G4]**
2. Somewhat easy
3. Somewhat difficult
4. Very difficult

98. Don't know **[SKIP TO G4]**

G3. Why was it **[B4]**?

1. **[RECORD RESPONSE]**

G4. **AFTER YOU SUBMITTED THE REQUEST FOR YOUR ENERGY EFFICIENCY** pack**, HOW LONG DID IT TAKE TO RECEIVE THE KIT IN THE MAIL?**

1. Less than 4 weeks
2. Between 4 and 6 weeks
3. More than 6 weeks

98. Don't know

G5. How satisfied were you with how long it took to receive the pack?

1. Very satisfied **[SKIP TO 0]**
2. Somewhat satisfied
3. Not too satisfied
4. Not at all satisfied

98. Don't know **[SKIP TO 0]**

G6. Why were you **[G5]** with how long it took to receive the pack?

1. **[RECORD RESPONSE]**

H. Energy-Saving Actions

H1. Your pack should have included a pamphlet with information on actions you can take to save energy. Which of these actions have you taken? Select all that apply.

1. Use dimmers on indoor lighting to lower light levels
2. Change my furnace filter
3. Leave shades open during the day to heat my home
4. Keep the freezer full
5. Wash laundry in cold water
6. Reduce my water heater temperature to 120 degrees
7. Did not take any of these actions
8. Did not receive pamphlet

98. Don't know

H2. Since participating in Focus on Energy's program, have you taken any other actions to reduce energy consumption that you have not already mentioned? An energy efficiency action could be turning down the temperature on your thermostat or you water heater, or powering down appliances or computers.

1. Yes
2. No **[SKIP TO H4]**

98. Don't know **[SKIP TO H4]**

H3. Specifically, what other actions have you taken? Select all that apply.

1. Turn down the temperature on my furnace
2. Turn up the temperature on my air conditioner
3. Take shorter or fewer showers
4. Not leave water running
5. Turn off appliances
6. Turn off computers
7. Turn off lights
8. Other: **SPECIFY:**________________________

98. Don't know

H4. How important was the Focus on Energy pack program in your decision to **[INSERT EACH ONE SELECTED IN 0 AND H3]**?

1. Very important
2. Somewhat important
3. Not too important
4. Not at all important
98. Don't know

H5. And, over time, have you continued to **[INSERT EACH ONE SELECTED IN 0 AND H3]** to save energy?

1. Yes
2. No
98. Don't know

I. Cross-Program Marketing

I1. *Are you aware of any other Focus on Energy programs or rebates such as those for **LED BULBS, ENERGY STAR® APPLIANCES, ENERGY-EFFICIENT UPGRADES, OR HOME ENERGY AUDITS?**

1. Yes
2. No **[SKIP TO J1]**
98. Don't know **[SKIP TO J1]**

I2. *Which programs or rebates are you aware of? **SELECT ALL THAT APPLY.**

1. Home Performance with ENERGY STAR **[ENERGY ASSESSMENTS, HOME AUDITS, WEATHERIZATION, INSULATION, HVAC EQUIPMENT, HEATING EQUIPMENT]**
2. New Homes **[NEW CONSTRUCTION]**
3. Appliance Recycling **[REFRIGERATOR/FREEZER RECYCLING/PICKUP]**
4. residential Lighting **[LED/CFL DISCOUNTS REBATES]**
5. Multifamily **[DIRECT INSTALL, FREE PRODUCTS FOR RENTERS]**
6. Renewables **[SOLAR, PV, GROUND-SOURCE HEAT PUMPS, GEOTHERMAL]**
7. Other: SPECIFY:________________________
98. Don't know

I3. *Have you participated in any other Focus on Energy programs **SUCH AS REBATES ON LED BULBS, ENERGY STAR APPLIANCES, ENERGY-EFFICIENT UPGRADES OR HOME ENERGY AUDITS?**

1. Yes
2. No **[SKIP TO I5]**
98. Don't know **[SKIP TO I5]**

I4. *Which programs, rebates, or projects have you participated in? **SELECT ALL THAT APPLY.**

1. Home Performance with ENERGY STAR
2. New Homes
3. Appliance Recycling
4. Residential Lighting
5. Multifamily
6. Renewables
7. Other: **[SPECIFY:______________________]**
98. Don't know

I5. Do you plan to participate in any Focus on Energy programs, rebates, or projects in the next year?

1. Yes **I5_1. WHICH PROGRAMS DO YOU PLAN TO PARTICIPATE IN? SELECT ALL THAT APPLY.**
    1. Home Performance with ENERGY STAR
    2. New Homes
    3. Appliance Recycling
    4. Residential Lighting
    5. Multifamily
    6. Other: **SPECIFY:_______________________**
    7. Don't know
2. No
98. Don't know

J. Customer Demographics

The last few questions are for statistical purposes only.

J1. What type of fuel does your water heater use?

90. Natural gas
1. Electricity
2. Propane/Bottled gas
3. Wood
4. Other: **SPECIFY:_______________________**
98. Don't know

J2. What type of home do you live in?

1. Mobile/manufactured home
2. Single-family home, detached house
3. Attached house townhouse, row house, or duplex
4. Multifamily apartment or condo building with 4 or more units
5. Co-op/retirement community
6. Other: **SPECIFY:**________________________

98. Don't know

J3. Do you or members of your household own or rent this home?

1. Own
2. Rent
3. Other: **SPECIFY:**________________________

98. Don't know

J4. What is the highest level of school that you have completed?

1. Less than 9th grade
2. 9th to 12th grade; no diploma
3. High school graduate (includes GED)
4. Some college, no degree
5. Associate's degree
6. Bachelor's degree
7. Graduate or professional degree

99. (Refused)

J5. Which of the following categories best represents your age?

1. 18-24
2. 25-34
3. 35-44
4. 45-54
5. 55-64
6. 65-74
7. 75 or older

99. (Refused)

J6. Which category best describes your total household income in 2015 before taxes?

1. Less than $20,000
2. $20,000 to $49,999
3. $50,000 to $74,999
4. $75,000 to $99,999
5. $100,000 to $149,999
6. $150,000 to $199,999
7. $200,000 or more
99. (Refused)

[CLOSING SCRIPT]

Those are all the questions we have. Focus on Energy appreciates your input. If you would like to enter for a chance to win a **$150 Visa gift card**, click “Next” below. If you do not want to enter the gift card drawing, please select "Opt Out" before clicking “Next."

Thank you very much for your time.

To learn about additional opportunities to save energy and money in your home, please visit focusonenergy.com.

CADMUS

Simple Energy Efficiency Program Participant Online Survey – Second Half

Target Quota = Census, or 70 completes per pack type

General Instructions

- CATI programming instructions are in red **[LIKE THIS]** (the style is "Survey: Programming").
- Questions from core question list are indicated with an asterisk (*).
- **All questions are single-response unless specified otherwise.**

Measure	Pack Name					
	Light Bulb	Fixed Showerhead	Hand-Wand Showerhead	Flood Light	Decorative	Focus
LED A19 (800 lumens)	4	2			2	3
LED A19 (1,100 lumens)	2					
LED BR30 Reflector				6		
LED G25 Globe		3	3			
LED Candelabra					6	
Pipe Wrap (15 ft. roll)	1	1	1			1
Pipe Tape		1	1			
Fixed Showerhead		1				
Hand-Wand Showerhead			1			
Faucet Aerator		2	2			
Hot H_2O Temp Card		1	1			1
Advanced Power Strip						1

A. Introduction and Screening

E-MAIL

Subject: "Take a survey to win $150!"

Hello ${e://Field/Name},

The success of Focus on Energy programs depends on customers like you. On behalf of Focus on Energy and the Public Service Commission of Wisconsin, Cadmus is conducting a survey to better understand your experience with the Simple Energy Efficiency Program. Through this program, you received a pack of energy-efficient products that you could install in your home.

We invite you to complete the following brief survey for a chance to win a $150 Visa gift card. Your participation is voluntary, but your input plays an important role in guiding future program enhancements. All of your survey responses will be kept confidential.

The survey should take about 15 minutes to complete and will be open until **5 p.m. [DATE].**

[SURVEY LINK]

If you have problems with the survey link, please contact the survey coordinator, Alex Chamberlain, at (714) 955-1904 or via email at Alex.Chamberlain@cadmusgroup.com. If you would like to confirm the research effort, please call Joe Fontaine at the Public Service Commission at (608) 266-0910.

We hope you will take this opportunity to have your voice heard. Thank you in advance for your time and for sharing your experiences.

SURVEY INTRODUCTION

Records from Focus on Energy show that you received a pack of energy efficient products in 2017 through Focus on Energy's Simple Energy Efficiency Program. The following survey will ask about your participation in that program. At the end, you will be given the opportunity to enter to win a $150 Visa gift card as a token of our appreciation for your time.

A1. **DO YOU RECALL RECEIVING A FREE PACK OF ENERGY-SAVING PRODUCTS FROM FOCUS ON ENERGY? YOU LIKELY SIGNED UP TO RECEIVE THE PACK ONLINE OR BY PHONE.**

1. Yes
2. No **[THANK AND TERMINATE]**
98. Don't know **[THANK AND TERMINATE]**

TERMINATE MESSAGE: WE ARE ONLY SURVEYING CUSTOMERS WHO RECALL PARTICIPATING IN THE PROGRAM. THANK YOU FOR YOUR TIME.

B. Program Awareness

B1. *Where did you most recently hear about Focus on Energy's Simple Energy Efficiency program?

1. Bill insert
2. Direct mail/brochure/postcard
3. Family/friends/word-of-mouth
4. Focus on Energy or Utility website
5. Other website: **SPECIFY:**________________________
6. Social Media such as Twitter, Facebook, Instagram, etc.
7. Television
8. Radio
9. Print media magazine, newspaper article or advertisement
10. Focus on Energy or Utility representative
11. Other: **SPECIFY:**________________________
98. Don't know **[SKIP TO B3]**

B2. *Are there any other ways you heard about the program? Select all that apply.

1. No other ways
2. Bill insert
3. Direct mail/brochure/postcard
4. Family/friends/word-of-mouth
5. Focus on Energy or Utility website
6. Other website: **SPECIFY:________________________**
7. Social Media such as Twitter, Facebook, Instagram, etc.
8. Television
9. Radio
10. Print media magazine, newspaper article or advertisement
11. Focus on Energy or Utility representative
12. Other: **SPECIFY:________________________**
98. Don't know

B3. *What do you think is the best way for Focus on Energy to inform the public about energy efficiency programs? Select all that apply.

1. Television
2. Radio
3. Print media, such as magazine, newspaper article or advertisement
4. Billboard/outdoor ad
5. Bill insert
6. Direct mail/brochure/postcard
7. Family/friends/word-of-mouth
8. Focus on Energy or Utility website
9. Social Media such as Twitter, Facebook, or Instagram
10. Other: **SPECIFY:________________________**
11. Do not want to receive information
98. Don't know

B4. * What motivated you to participate in the program?

1. **[RECORD RESPONSE]**

C. LEDs

The next questions are about the energy-saving items you received in your program pack.

A19 LED Mix (6 total)

[ASK SECTION IF PACK NAME = LIGHT BULB]

Our records show you received six LED light bulbs – four rated at 800 lumens and two rated at 1,100 lumens. These look like your standard light bulbs; the bulbs with higher lumen ratings are brighter.

C1. How many of 1,100-lumen LEDs are currently installed in your home? These are the brighter bulbs than the others you received.

1. 0
2. 1
3. 2 **[SKIP TO C4]**

98. Don't know **[SKIP TO C5]**

C2. Of the **[2 MINUS C1]** bulbs *not currently* installed, how many did you install but later remove?

1. **[IF C1<=2]** 0
2. **[IF C1<=1]** 1
3. **[IF C1=0]** 2

98. Don't know **[SKIP TO C4]**

C3. What did you do with the bulb(s) that are *not currently* installed? Select all that apply.

1. Stored for future use
2. Discarded/recycled
3. Gave to someone else
4. Other: **SPECIFY:**________________________

98. Don't know

C4. Did you have any difficulty installing the LEDs you received?

1. Yes **C4_1. WHAT WAS DIFFICULT ABOUT INSTALLING THEM?**
   1. **WRONG SIZE/DID NOT FIT**
   2. Other: **SPECIFY:**________________________
   3. **DON'T KNOW**
2. No

98. Don't know

C5. How satisfied are you with the LEDs you received?

1. Very satisfied **[SKIP TO D1]**
2. Somewhat satisfied
3. Not too satisfied
4. Not at all satisfied
98. Don't know **[SKIP TO D1]**

C6. Why are you **[C5]**? Select all that apply.

1. Burned out/broke/stopped working
2. Didn't fit properly in fixture
3. Difficult/unable to install
4. Not bright enough
5. Didn't like the color
6. Delay in light coming on
7. Didn't work with dimmer/three-way switch
8. Flickered when turned on
9. Other: **SPECIFY:**______________________
98. Don't know

C7. How many of the 800-lumen LEDs are currently installed in your home? These bulbs are less bright than the others you received.

1. 0
2. 1
3. 2
4. 3
5. 4 **[SKIP TO C10]**
98. Don't know **[SKIP TO C11]**

C8. Of the **[4 MINUS C7]** bulbs *not currently* installed, how many did you install but later remove?

1. **[IF C7<=4]** 0
2. **[IF C7<=3]** 1
3. **[IF C7<=2]** 2
4. **[IF C7<=1]** 3
5. **[IF C7=0]** 4
98. Don't know **[SKIP TO C10]**

C9. What did you do with the bulbs that are *not currently* installed? **SELECT ALL THAT APPLY.**

1. Stored for future use
2. Discarded/recycled
3. Gave to someone else
4. Other: **SPECIFY:________________________**

98. Don't know

C10. Did you have any difficulty installing the LEDs you received?

1. Yes **C10_1. WHAT WAS DIFFICULT ABOUT INSTALLING THEM?**
    1. **WRONG SIZE/DID NOT FIT**
    2. Other: **SPECIFY:________________________**
    3. **DON'T KNOW**
2. No

98. Don't know

C11. How satisfied are you with the LEDs you received?

1. Very satisfied **[SKIP TO D1]**
2. Somewhat satisfied
3. Not too satisfied
4. Not at all satisfied

98. Don't know **[SKIP TO D1]**

C12. Why are you **[C11]**? **SELECT ALL THAT APPLY.**

1. Burned out/broke/stopped working
2. Didn't fit properly in fixture
3. Difficult/unable to install
4. Not bright enough
5. Didn't like the color
6. Delay in light coming on
7. Didn't work with dimmer/three-way switch
8. Flickered when turned on
9. Other: **SPECIFY:________________________**

98. Don't know

A19 LEDs (2)

[ASK SECTION IF PACK NAME = FIXED SHOWERHEAD, DECORATIVE LIGHT]

Our records show you received two A-lamp LEDs in your energy-saving kit. A-lamps are your typical light bulbs.

C13. How many of A-lamp LEDs are currently installed in your home?

1. 0
2. 1
3. 2 **[SKIP TO C16]**

98. Don't know **[SKIP TO C17]**

C14. Of the **[2 MINUS C13]** bulbs *not currently* installed, how many did you install but later remove?

1. **[IF C13<=2]** 0
2. **[IF C13<=1]** 1
3. **[IF C13=0]** 2

98. Don't know **[SKIP TO C16]**

C15. What did you do with the bulb(s) that are *not currently* installed? **SELECT ALL THAT APPLY.**

1. Stored for future use
2. Discarded/recycled
3. Gave to someone else
4. Other: **SPECIFY:**________________________

98. Don't know

C16. Did you have any difficulty installing the reflector LEDs you received?

1. Yes **C16_1. WHAT WAS DIFFICULT ABOUT INSTALLING THEM?**
    1. **WRONG SIZE/DID NOT FIT**
    2. Other: **SPECIFY:**________________________
    3. **DON'T KNOW**
2. No

98. Don't know

C17. How satisfied are you with the A-lamp LEDs you received?

1. Very satisfied **[SKIP TO D1]**
2. Somewhat satisfied
3. Not too satisfied
4. Not at all satisfied

98. Don't know **[SKIP TO D1]**

C18. Why are you **[C17]**? **SELECT ALL THAT APPLY.**

1. Burned out/broke/stopped working
2. Didn't fit properly in fixture
3. Difficult/unable to install
4. Not bright enough
5. Didn't like the color
6. Delay in light coming on
7. Didn't work with dimmer/three-way switch
8. Flickered when turned on
9. Other: **SPECIFY:________________________**

98. Don't know

A19 LEDs (3)

[ASK SECTION IF PACK NAME = FOCUS]

Our records show you received three LEDs in your energy-saving kit. These look like your standard light bulbs.

C19. How many of the LEDs are currently installed in your home?

1. 0
2. 1
3. 2
4. 3 **[SKIP TO C22]**

98. Don't know **[SKIP TO C23]**

C20. Of the **[3 MINUS C19]** bulbs *not currently* installed, how many did you install but later remove?

1. **[IF C19<=3]** 0
2. **[IF C19<=2]** 1
3. **[IF C19<=1]** 2
4. **[IF C19=0]** 3

98. Don't know **[SKIP TO C22]**

C21. What did you do with the bulb(s) that are *not currently* installed? **SELECT ALL THAT APPLY.**

1. Stored for future use
2. Discarded/recycled
3. Gave to someone else
4. Other: **SPECIFY:________________________**

98. Don't know

C22. Did you have any difficulty installing the LEDs you received?

1. Yes C22_1. WHAT WAS DIFFICULT ABOUT INSTALLING THEM?
    1. WRONG SIZE/DID NOT FIT
    2. Other: SPECIFY:________________________
    3. DON'T KNOW
2. No

98. Don't know

C23. How satisfied are you with the LEDs you received?

1. Very satisfied [SKIP TO D1]
2. Somewhat satisfied
3. Not too satisfied
4. Not at all satisfied

98. Don't know [SKIP TO D1]

C24. Why are you [C23]? SELECT ALL THAT APPLY.

1. Burned out/broke/stopped working
2. Didn't fit properly in fixture
3. Difficult/unable to install
4. Not bright enough
5. Didn't like the color
6. Delay in light coming on
7. Didn't work with dimmer/three-way switch
8. Flickered when turned on
9. Other: SPECIFY:________________________

98. Don't know

Globe LEDs

[ASK SECTION IF PACK NAME = FIXED SHOWERHEAD, HAND-HELD SHOWERHEAD]

Our records show you received three globe LED light bulbs. Globes look like standard light bulbs except larger and rounder.

C25. How many of the globe LEDs are currently installed in your home?

1. 0
2. 1
3. 2
4. 3 [SKIP TO C28]

98. Don't know [SKIP TO C29]

C26. Of the **[3 MINUS C25]** bulbs *not currently* installed, how many did you install but later remove?

1. **[IF C25<=3]** 0
2. **[IF C25<=2]** 1
3. **[IF C25<=1]** 2
4. **[IF C25=0]** 3

98. Don't know **[SKIP TO C28]**

C27. What did you do with the bulb(s) that are *not currently* installed? **SELECT ALL THAT APPLY.**

1. Stored for future use
2. Discarded/recycled
3. Gave to someone else
4. Other: **SPECIFY:**________________________

98. Don't know

C28. Did you have any difficulty installing the globe LEDs you received?

1. Yes **C28_1. WHAT WAS DIFFICULT ABOUT INSTALLING THEM?**
    1. **WRONG SIZE/DID NOT FIT**
    2. Other: **SPECIFY:**________________________
    3. **DON'T KNOW**
2. No

98. Don't know

C29. How satisfied are you with the globe LEDs you received?

1. Very satisfied **[SKIP TO C31]**
2. Somewhat satisfied
3. Not too satisfied
4. Not at all satisfied

98. Don't know **[SKIP TO C31]**

C30. Why are you **[C29]**? **SELECT ALL THAT APPLY.**

1. Burned out/broke/stopped working
2. Didn't fit properly in fixture
3. Difficult/unable to install
4. Not bright enough
5. Didn't like the color
6. Delay in light coming on
7. Didn't work with dimmer/three-way switch
8. Flickered when turned on
9. Other: **SPECIFY:**______________________

98. Don't know

Reflector LEDs

[ASK SECTION IF PACK NAME = FLOOD LIGHT]

Our records show you received six flood ("reflector") LED light bulbs. Reflectors typically are triangle-shaped and emit light through one large flat lens on top of the bulb, as opposed to all the way around like a standard bulb.

C31. How many of the reflector LEDs are currently installed in your home?

1. 0
2. 1
3. 2
4. 3
5. 4
6. 5
7. 6 **[SKIP TO C34]**

98. Don't know **[SKIP TO C35]**

C32. Of the **[6 MINUS C25]** bulbs *not currently* installed, how many did you install but later remove?

1. **[IF C25<=6]** 0
2. **[IF C25<=5]** 1
3. **[IF C25<=4]** 2
4. **[IF C25<=3]** 3
5. **[IF C25<=2]** 4
6. **[IF C25<=1]** 5
7. **[IF C25=0]** 6

98. Don't know **[SKIP TO C34]**

C33. What did you do with the bulb(s) that are *not currently* installed? **SELECT ALL THAT APPLY.**

1. Stored for future use
2. Discarded/recycled
3. Gave to someone else
4. Other: **SPECIFY:**________________________
98. Don't know

C34. Did you have any difficulty installing the reflector LEDs you received?

1. Yes **C34_1. WHAT WAS DIFFICULT ABOUT INSTALLING THEM?**
   1. **WRONG SIZE/DID NOT FIT**
   2. Other: **SPECIFY:**________________________
   3. **DON'T KNOW**
2. No
98. Don't know

C35. How satisfied are you with the reflector LEDs you received?

1. Very satisfied **[SKIP TO C37]**
2. Somewhat satisfied
3. Not too satisfied
4. Not at all satisfied
98. Don't know **[SKIP TO C37]**

C36. Why are you **[C35]**? **SELECT ALL THAT APPLY.**

1. Burned out/broke/stopped working
2. Didn't fit properly in fixture
3. Difficult/unable to install
4. Not bright enough
5. Didn't like the color
6. Delay in light coming on
7. Didn't work with dimmer/three-way switch
8. Flickered when turned on
9. Other: **SPECIFY:**________________________
98. Don't know

Candelabra LEDs

[ASK SECTION IF PACK NAME = DECORATIVE LIGHT]

Our records show you also received six candelabra LED bulbs in your energy-saving pack. Candelabra bulbs are smaller decorative lamps with a bulb shaped like a candle flame.

C37. How many of the candelabra LEDs are currently installed in your home?

1. 0
2. 1
3. 2
4. 3
5. 4
6. 5
7. 6 **[SKIP TO C40]**

98. Don't know **[SKIP TO C41]**

C38. Of the **[6 MINUS C25]** bulbs *not currently* installed, how many did you install but later remove?

1. **[IF C25<=6]** 0
2. **[IF C25<=5]** 1
3. **[IF C25<=4]** 2
4. **[IF C25<=3]** 3
5. **[IF C25<=2]** 4
6. **[IF C25<=1]** 5
7. **[IF C25=0]** 6

98. Don't know **[SKIP TO C40]**

C39. What did you do with the bulb(s) that are *not currently* installed? **SELECT ALL THAT APPLY.**

1. Stored for future use
2. Discarded/recycled
3. Gave to someone else
4. Other: **SPECIFY:**________________________

98. Don't know

C40. Did you have any difficulty installing the candelabra LEDs you received?

1. Yes **C40_1. WHAT WAS DIFFICULT ABOUT INSTALLING THEM?**
   1. **WRONG SIZE/DID NOT FIT**
   2. Other: **SPECIFY:**________________________
   3. **DON'T KNOW**
2. No

98. Don't know

C41. How satisfied are you with the candelabra LEDs you received?

1. Very satisfied **[SKIP TO D1]**
2. Somewhat satisfied
3. Not too satisfied
4. Not at all satisfied
98. Don't know **[SKIP TO D1]**

C42. Why are you **[C41]**? **SELECT ALL THAT APPLY.**

1. Burned out/broke/stopped working
2. Didn't fit properly in fixture
3. Difficult/unable to install
4. Not bright enough
5. Didn't like the color
6. Delay in light coming on
7. Didn't work with dimmer/three-way switch
8. Flickered when turned on
9. Other: **SPECIFY:**________________________
98. Don't know

D. Smart Strip

[ASK SECTION IF PACK NAME = FOCUS]

Our records show you also received a smart power strip.

D1. Is the smart power strip you received currently installed in your home?

1. **YES [SKIP TO D4]**
2. No
98. Don't know **[SKIP TO D6]**

D2. Was the smart power strip ever installed in your home and later removed?

1. Yes
2. No
98. Don't know **[SKIP TO D4]**

D3. What did you do with the smart power strip?

1. Stored for future use
2. Threw away
3. Gave to someone else
4. Other: **SPECIFY:**________________________
98. Don't know

D4. **[IF D1 = YES]** For what purpose(s) are you using your smart strip? Select all that apply.

1. Home entertainment center [TVs, cable boxes, streaming devices Apple TV or Roku, DVD players]
2. Home office [laptops, desktop computers, computer monitors, scanners, printers, fax machines]
3. Other equipment **SPECIFY:________________________**

98. Don't know

D5. **[IF D1 OR D2 = YES]** Did you have any difficulty using the smart strip to operate your electronics?

1. Yes **D5_1. WHAT WAS DIFFICULT ABOUT USING IT?**
    1. **[RECORD RESPONSE]**
    2. **DON'T KNOW**
2. No

98. Don't know

D6. How satisfied are you with the smart power strip you received?

1. Very satisfied **[SKIP TO E1]**
2. Somewhat satisfied
3. Not too satisfied
4. Not at all satisfied

98. Don't know **[SKIP TO E1]**

D7. Why are you **[D6]**? **SELECT ALL THAT APPLY.**

1. Broken/didn't work

91. Difficult/unable to set up

2. Didn't like how it looked
3. Didn't like how the attached equipment worked when hooked up to it
4. Not enough regular outlets
5. Other: **SPECIFY:________________________**

98. Don't know

E. Showerhead

[ASK SECTION IF PACK NAME = FIXED SHOWERHEAD, HAND-HELD SHOWERHEAD]

Our records show you also received a showerhead.

E1. Is the showerhead you received currently installed in your home?

1. **YES** **[SKIP TO E4]**
2. No
98. Don't know **[SKIP TO E5]**

E2. Was the showerhead ever installed in your home and later removed?

1. Yes
2. No
98. Don't know **[SKIP TO E4]**

E3. What did you do with the showerhead?

1. Stored for future use
2. Threw away
3. Gave to someone else
4. Other: **SPECIFY:**________________________
98. Don't know

E4. Did you have any difficulty installing the water-saving showerhead you received?

1. Yes **E4_1.** **WHAT WAS DIFFICULT ABOUT INSTALLING IT?**
    1. **WRONG SIZE/DID NOT FIT**
    2. Other: **SPECIFY:**________________________
    3. **DON'T KNOW**
2. No
98. Don't know

E5. How satisfied are you with the showerhead you received?

1. Very satisfied **[SKIP TO F1]**
2. Somewhat satisfied
3. Not too satisfied
4. Not at all satisfied
98. Don't know **[SKIP TO F1]**

E6. Why are you **[E5]**? **SELECT ALL THAT APPLY.**

1. Broken/didn't work
2. Difficult/unable to install
3. Didn't fit properly
4. Didn't like the water pressure
5. Didn't like how it looked
6. Other: **SPECIFY:**______________________

98. Don't know

F. Faucet Aerators

[ASK SECTION IF PACK NAME = FIXED SHOWERHEAD, HAND-HELD SHOWERHEAD]

Our records show you also received two faucet aerators: one for your kitchen sink, and one for your bathroom sink.

Kitchen Faucet Aerator

F1. Is the kitchen faucet aerator you received currently installed in your home? This one is rated at 1.5 gallons per minute (GPM).

1. **YES [SKIP TO F4]**
2. No

98. Don't know **[SKIP TO F5]**

F2. Was the kitchen faucet aerator ever installed in your home and later removed?

1. Yes
2. No

98. Don't know **[SKIP TO F4]**

F3. What did you do with the kitchen faucet aerator?

1. Stored for future use
2. Threw away
3. Gave to someone else
4. Other: **SPECIFY:**______________________

98. Don't know

F4. Did you have any difficulty installing the kitchen faucet aerator you received?

1. Yes **F4_1. WHAT WAS DIFFICULT ABOUT INSTALLING IT?**
   1. **WRONG SIZE/DID NOT FIT**
   2. Other: **SPECIFY:**________________________
   3. **DON'T KNOW**
2. No

98. Don't know

F5. How satisfied are you with the kitchen faucet aerator you received?

1. Very satisfied **[SKIP TO F7]**
2. Somewhat satisfied
3. Not too satisfied
4. Not at all satisfied

98. Don't know **[SKIP TO F7]**

F6. Why are you **[F5]**? **SELECT ALL THAT APPLY.**

1. Broken/didn't work
2. Difficult/unable to install
3. Didn't fit properly
4. Didn't like the water pressure
5. Didn't like how it looked
6. Other: **SPECIFY:**________________________

98. Don't know

Bathroom Faucet Aerator

F7. Is the bathroom faucet aerator you received currently installed in your home? This one is rated at 1 gallon per minute (GPM).

1. **YES [SKIP TO F10]**
2. No

98. Don't know **[SKIP TO F11]**

F8. Was the bathroom faucet aerator ever installed in your home and later removed?

1. Yes
2. No

98. Don't know **[SKIP TO F10]**

F9. What did you do with the bathroom faucet aerator?

1. Stored for future use
2. Threw away
3. Gave to someone else
4. Other: **SPECIFY:**________________________
98. Don't know

F10. Did you have any difficulty installing the bathroom faucet aerator you received?

1. Yes **F10_1. WHAT WAS DIFFICULT ABOUT INSTALLING IT?**
    1. **WRONG SIZE/DID NOT FIT**
    2. Other: **SPECIFY:**________________________
    3. **DON'T KNOW**
2. No
98. Don't know

F11. How satisfied are you with the bathroom faucet aerator you received?

1. Very satisfied **[SKIP TO G1]**
2. Somewhat satisfied
3. Not too satisfied
4. Not at all satisfied
98. Don't know **[SKIP TO G1]**

F12. Why are you **[F11]**? **SELECT ALL THAT APPLY.**

1. Broken/didn't work
2. Difficult/unable to install
3. Didn't fit properly
4. Didn't like the water pressure
5. Didn't like how it looked
6. Other: **SPECIFY:**________________________
98. Don't know

G. Pipe Wrap Insulation

[ASK SECTION IF PACK NAME = LIGHT BULB, FIXED SHOWERHEAD, HAND-HELD SHOWERHEAD, FOCUS]

Our records also show you received pipe wrap insulation. This typically looks like foam padding that fits around your water heater's pipes.

G1. Is the pipe wrap insulation you received currently installed in your home?

1. YES [SKIP TO G4]
2. No

98. Don't know [SKIP TO G5]

G2. Was the pipe wrap insulation ever installed in your home and later removed?

1. Yes
2. No

98. Don't know [SKIP TO G4]

G3. What did you do with the pipe wrap insulation?

1. Stored for future use
2. Threw away
3. Gave to someone else
4. Other: SPECIFY:________________________

98. Don't know

G4. Did you have any difficulty installing the pipe wrap insulation you received?

1. Yes G4_1. WHAT WAS DIFFICULT ABOUT INSTALLING IT?
    1. [RECORD RESPONSE]
    2. DON'T KNOW
2. No

98. Don't know

G5. How satisfied are you with the pipe wrap insulation you received?

1. Very satisfied [SKIP TO H1]
2. Somewhat satisfied
3. Not too satisfied
4. Not at all satisfied

98. Don't know [SKIP TO H1]

G6. Why are you [G5]? SELECT ALL THAT APPLY.

1. Difficult to install
2. Wrong size
3. Didn't like how it looked
4. No interest in installing it
5. Other: SPECIFY:________________________

98. Don't know

H. Hot Water Temperature Card

[ASK SECTION IF PACK NAME = FIXED SHOWERHEAD, HAND-HELD SHOWERHEAD, FOCUS]

YOUR PACK SHOULD HAVE INCLUDED A HOT WATER TEMPERATURE CARD THAT SUGGESTED TURNING DOWN YOUR WATER HEATER TO SAVE MORE ENERGY.

H1. Did you use the card to test your water temperature?

1. Yes
2. No **[SKIP TO G1]**

98. Don't know **[SKIP TO G1]**

H2. Did you reduce the temperature of your water heater as a result of using the card?

1. Yes
2. No

98. Don't know

I. Program Satisfaction

Now I am going to ask you some questions about your experience with the program.

I1. Did you request your pack using the Focus on Energy website, or did you call the 1-800 number?

1. Website
2. 1-800 number **[SKIP TO I4]**
3. Other: **SPECIFY:**______________________ **[SKIP TO I4]**

98. Don't know **[SKIP TO I4]**

I2. How easy was it to fill out the online request for your energy efficiency pack?

1. Very easy **[SKIP TO I4]**
2. Somewhat easy
3. Somewhat difficult
4. Very difficult

98. Don't know **[SKIP TO I4]**

I3. Why was it **[B4]**?

1. **[RECORD RESPONSE]**

I4. **AFTER YOU SUBMITTED THE REQUEST FOR YOUR ENERGY EFFICIENCY** pack**, HOW LONG DID IT TAKE TO RECEIVE THE KIT IN THE MAIL?**

1. Less than 4 weeks
2. Between 4 and 6 weeks
3. More than 6 weeks
98. Don't know

I5. How satisfied were you with how long it took to receive the pack?

1. Very satisfied **[SKIP TO 0]**
2. Somewhat satisfied
3. Not too satisfied
4. Not at all satisfied
98. Don't know **[SKIP TO 0]**

I6. Why were you **[G5]** with how long it took to receive the pack?

1. **[RECORD RESPONSE]**

J. Energy-Saving Actions

J1. You should have received in your pack a pamphlet with information on actions you can take to save energy. Which of these actions have you taken? Select all that apply.

1. Use dimmers on indoor lighting to lower light levels
2. Change my furnace filter
3. Leave shades open during the day to heat my home
4. Keep the freezer full
5. Wash laundry in cold water
6. Reduce my water heater temperature to 120 degrees
7. Did not take any of these actions
8. Did not receive pamphlet
98. Don't know

J2. Since participating in Focus on Energy's program, have you taken any other actions to reduce energy consumption that you have not already mentioned? An energy efficiency action could be turning down the temperature on your thermostat or you water heater, or powering down appliances or computers.

1. Yes
2. No **[SKIP TO H4]**
98. Don't know **[SKIP TO H4]**

J3. Specifically, what other actions have you taken? Select all that apply.

1. Turn down the temperature on my furnace
2. Turn up the temperature on my air conditioner
3. Take shorter or fewer showers
4. Not leave water running
5. Turn off appliances
6. Turn off computers
7. Turn off lights
8. Other: **SPECIFY:_______________________**

98. Don't know

J4. How important was the Focus on Energy pack program in your decision to **[INSERT EACH ONE SELECTED IN 0 AND H3]**?

1. Very important
2. Somewhat important
3. Not too important
4. Not at all important

98. Don't know

J5. And, over time, have you continued to **[INSERT EACH ONE SELECTED IN 0 AND J3]** to save energy?

1. Yes
2. No

98. Don't know

K. Cross-Program Marketing

K1. *Are you aware of any other Focus on Energy programs or rebates such as those for **LED BULBS, ENERGY STAR® APPLIANCES, ENERGY-EFFICIENT UPGRADES, OR HOME ENERGY AUDITS?**

1. Yes
2. No **[SKIP TO J1]**

98. Don't know **[SKIP TO J1]**

K2. *Which programs or rebates are you aware of? **SELECT ALL THAT APPLY.**

1. Home Performance with ENERGY STAR **[ENERGY ASSESSMENTS, HOME AUDITS, WEATHERIZATION, INSULATION, HVAC EQUIPMENT, HEATING EQUIPMENT]**
2. New Homes **[NEW CONSTRUCTION]**
3. Appliance Recycling **[REFRIGERATOR/FREEZER RECYCLING/PICKUP]**
4. residential Lighting **[LED/CFL DISCOUNTS REBATES]**
5. Multifamily **[DIRECT INSTALL, FREE PRODUCTS FOR RENTERS]**
6. Renewables **[SOLAR, PV, GROUND-SOURCE HEAT PUMPS, GEOTHERMAL]**
7. Other: SPECIFY:_______________________

98. Don't know

K3. *Have you participated in any other Focus on Energy programs **SUCH AS REBATES ON LED BULBS, ENERGY STAR APPLIANCES, ENERGY-EFFICIENT UPGRADES OR HOME ENERGY AUDITS**?

1. Yes
2. No **[SKIP TO I5]**

98. Don't know **[SKIP TO I5]**

K4. *Which programs, rebates, or projects have you participated in? **SELECT ALL THAT APPLY.**

1. Home Performance with ENERGY STAR
2. New Homes
3. Appliance Recycling
4. Residential Lighting
5. Multifamily
6. Renewables
7. Other: **[SPECIFY:_______________________]**

98. Don't know

K5. Do you plan to participate in any Focus on Energy programs, rebates, or projects in the next year?

1. Yes **I5_1. WHICH PROGRAMS DO YOU PLAN TO PARTICIPATE IN? SELECT ALL THAT APPLY.**
    1. Home Performance with ENERGY STAR
    2. New Homes
    3. Appliance Recycling
    4. Residential Lighting
    5. Multifamily
    6. Other: **SPECIFY:_______________________**
    7. Don't know
2. No

98. Don't know

L. Customer Demographics

The last few questions are for statistical purposes only.

L1. What type of fuel does your water heater use?

92. Natural gas
1. Electricity
2. Propane/Bottled gas
3. Wood
4. Other: **SPECIFY:**________________________
98. Don't know

L2. What type of home do you live in?

1. Mobile/manufactured home
2. Single-family home, detached house
3. Attached house townhouse, row house, or duplex
4. Multifamily apartment or condo building with 4 or more units
5. Co-op/retirement community
6. Other: **SPECIFY:**________________________
98. Don't know

L3. Do you or members of your household own or rent this home?

1. Own
2. Rent
3. Other: **SPECIFY:**________________________
98. Don't know

L4. What is the highest level of school that you have completed?

1. Less than 9th grade
2. 9th to 12th grade; no diploma
3. High school graduate (includes GED)
4. Some college, no degree
5. Associate's degree
6. Bachelor's degree
7. Graduate or professional degree
99. (Refused)

L5. Which of the following categories best represents your age?

1. 18-24
2. 25-34
3. 35-44
4. 45-54
5. 55-64
6. 65-74
7. 75 or older
99. (Refused)

L6. Which category best describes your total household income in 2015 before taxes?

1. Less than $20,000
2. $20,000 to $49,999
3. $50,000 to $74,999
4. $75,000 to $99,999
5. $100,000 to $149,999
6. $150,000 to $199,999
7. $200,000 or more
99. (Refused)

[CLOSING SCRIPT]

Those are all the questions we have. Focus on Energy appreciates your input. If you would like to enter for a chance to win a **$150 Visa gift card**, click “Next” below. If you do not want to enter the gift card drawing, please select "Opt Out" before clicking “Next."

Thank you very much for your time.

To learn about additional opportunities to save energy and money in your home, please visit focusonenergy.com.

Direct-Mail Home Energy Assessment Program

Cadmus will survey Direct-Mail Home Energy Assessment (DHEA) participants at three intervals—three, six, and nine months—after Focus on Energy delivers Home Energy Savings reports. This three-stage survey process will allow Cadmus to track participant satisfaction and energy-saving behaviors as participants have more time to digest their savings reports and act on the energy-efficiency recommendations. Cadmus will offer the survey online. For each wave, Cadmus will send postcard invitations with a survey URL to a random sample of 250 DHEA participants. The target completion is 30 respondents per wave, for a total of 90 respondents.

EnergySavvy distributed two waves of DHEA reports. Due to an error in Phase I reports, only Phase II participants will be eligible to participate in the surveys.

Topics	Researchable Questions	Section
Program satisfaction	Is the customer satisfied with the program?	Section B
Energy-saving actions	Has the customer taken any energy-saving actions since participating in the program?	Section C
Educational effectiveness	How effective is the program in educating hard-to-reach customers about energy-efficiency and other Focus on Energy offerings?	Section D
Demographics	What are the respondent's general household characteristics?	Section C
Closing	Record customer information for incentives	Section F

A. Postcard Message

focus on energy℠
Partnering with Wisconsin utilities

Thank you for participating in Focus on Energy's Energy Savings Survey!

Focus on Energy would like to get your feedback about the Energy Savings Survey. Your feedback will help us continue to improve the program and make Wisconsin a more energy efficient place to live. This brief survey will take less than 5 minutes to complete and your responses will be kept strictly confidential. You will be entered in a drawing to win a $100 Visa gift card for completing the survey.

Visit the following link to complete the survey: https://tinyurl.com/y92jmphh

If you have any questions about this research or any difficulties taking the survey, please contact Ryan Walker at Cadmus, the national research firm conducting this survey on our behalf. You can reach Ryan Walker at (503) 467-7126 or ryan.walker@cadmusgroup.com.

B. Introduction and Screener

focus on energy℠
Partnering with Wisconsin utilities

Thank you for providing feedback about Focus on Energy's Energy Savings Survey. This survey will take less than 5 minutes to complete, and your responses will be kept strictly confidential.

Open drop-down menus by clicking on this icon ▾ within the survey.

Click on the "Next" and "Back" buttons at the bottom of each page to navigate through the survey.

Do not forget to opt-in at the end of the survey for a chance to win a $100 gift card!

B1. Our records show that you participated in Focus on Energy's Energy Savings Survey in 2017. In this survey, you completed a home energy profile that asked questions about various features of your home, such as type of air conditioner and insulation. After mailing this profile to Focus on Energy, you received a customized Home Energy Savings report. Is this correct? **[FORCE RESPONSE]**

1. Yes
2. No [THANK AND TERMINATE]
3. Don't remember [THANK AND TERMINATE]
4. (Prefer not to answer) [THANK AND TERMINATE]

[END OF SURVEY MESSAGE]

Since this survey is regarding the Energy Savings Survey, we only need feedback from people who remember participating. Thank you for your time.

C. Program Satisfaction

The first set of questions ask for your opinion about completing and submitting the Energy Savings Survey, and the report you received from Focus on Energy.

C1. How easy was it to complete the Energy Savings Survey?

Not at all easy										Very easy	Don't know
0	1	2	3	4	5	6	7	8	9	10	

C2. Could the process to complete and submit the Energy Savings Survey be improved?
1. Yes
2. No

C3. [Ask if C2= 1] What about the Energy Savings Survey could be improved?
1. [OPEN-ENDED]

C4. Were you satisfied with the length of time it took to receive your customized Home Energy Savings report after submitting the survey?

Not at all satisfied										Very satisfied	Don't know
0	1	2	3	4	5	6	7	8	9	10	

C5. How helpful was the information provided in your customized Home Energy Savings report about how you can save energy and money?

Not at all helpful										Very helpful	Don't know
0	1	2	3	4	5	6	7	8	9	10	

C6. How would you rate your satisfaction with the <u>level of detail provided</u> in your customized Home Energy Savings report?

Not at all satisfied										Very satisfied	Don't know
0	1	2	3	4	5	6	7	8	9	10	

C7. How would you rate your <u>overall satisfaction</u> with the Energy Savings Survey program?

Not at all satisfied										Very satisfied	Don't know
0	1	2	3	4	5	6	7	8	9	10	

C8. [Ask if B7G4 < 8] What changes could have improved your satisfaction with the Home Energy Savings program?
1. [OPEN-ENDED]

D. Energy-Saving Actions

The next few questions are about the energy-saving actions you have taken (or might take) since participating in Home Energy Savings program.

D1. Due to the information you received in the customized Home Energy Savings report, have you purchased or installed any energy-efficient products since you received your report?
1. Yes
2. No

D2. Do you plan to purchase or install any energy-efficient products in the next 6 months?
1. Yes
2. No

D3. **[Ask if C1 = 1]** Which energy-efficient products have you purchased/installed? (Select all that apply) **[MULTIPLE RESPONSES ALLOWED]**
1. Received an energy-efficiency kit
2. Had an in-home assessment
3. Upgraded insulation
4. Replaced old light bulbs with LED bulbs
5. Replaced old refrigerator or freezer
6. Recycled old refrigerator or freezer
7. Replaced older appliances with efficient models (please specify) [ALLOW TEXT ENTRY – FORCE TEXT ENTRY]
8. Replaced old thermostat with a smart thermostat (can be controlled via Wi-Fi)
9. Replaced inefficient heating and/or cooling equipment
10. Installed a ductless mini-split heat pump
11. Installed a renewable energy system
12. Replaced standard electric water heater with a heat pump water heater
13. Other (please specify) [ALLOW TEXT ENTRY – FORCE TEXT ENTRY]

D4. **[Ask if C2= 1]** Which energy-efficient products do you plan to purchase/install in the next 6 months? (Select all that apply) **[MULTIPLE RESPONSES ALLOWED]**
1. Order an energy-efficiency kit (simple energy efficiency packs)
2. Have an in-home assessment
3. Upgrade insulation
4. Replace old light bulbs with LED bulbs
5. Replace old refrigerator or freezer
6. Replace older appliances with efficient models (please specify) [ALLOW TEXT ENTRY – FORCE TEXT ENTRY]
7. Replace old thermostat with a smart thermostat

8. Replace inefficient heating and/or cooling equipment
9. Install a ductless mini-split heat pump
10. Install a renewable energy system
11. Replace standard electric water heater with a heat pump water heater
12. Other (please specify) [ALLOW TEXT ENTRY – FORCE TEXT ENTRY]

D5. **[Ask if C1 ≠ 1 and C2= 2]** Why do you not plan to purchase/install energy-efficient products in the next 6 months? (Select all that apply) **[MULTIPLE RESPONSES ALLOWED]**

1. Cost/too expensive
2. Don't have time to make efficiency upgrades
3. Unsure about potential energy savings
4. Unsure about potential monetary savings
5. Don't know where to find additional information about energy-efficient products
6. Don't know where to purchase energy-efficient products
7. Don't know where to find contractor to install energy-efficient products
8. The report said my home does not need upgrades
9. Other (please specify) [ALLOW TEXT ENTRY – MEDIUM-SIZED TEXT BOX – FORCE TEXT ENTRY]

98. Don't Know [MAKE RESPONSE EXCLUSIVE]

D6. **[Ask if C1 = 1 and C3 ≠ 4 or blank]** Did you receive a rebate from Focus on Energy for purchasing/installing this/these energy-efficient products? **[PIPE IN RESPONSES SELECTED IN C3] [USE DROP-DOWN LISTS]**

1. Yes
2. No

98. Don't know

D7. **[Ask if C1 = 1 or C2 = 1]** How important was the Home Energy Savings program in your decision to purchase/install additional energy-efficient products?

Not at all important										Very important	Don't know
0	1	2	3	4	5	6	7	8	9	10	

E. Educational Effectiveness

E1. Were you aware of Focus on Energy programs before you participated in the Energy Savings Survey?

1. Yes
2. No

98.

E2. **[Ask if D1= 1]** Which programs are you aware of now that you have participated? (Select all that apply) **[MULTIPLE RESPONSES ALLOWED] [RANDOMIZE RESPONSES 1-5]**

1. Simple Energy Efficiency (energy kits/energy packs)
2. Home Performance with ENERGY STAR
3. Heating and Cooling
4. Appliance Recycling
5. Retail Lighting
6. Other (please specify) [ALLOW TEXT ENTRY – FORCE TEXT ENTRY]

98. None [MAKE RESPONSE EXCLUSIVE]

E3. Your Home Energy Savings report recommended ways that Focus on Energy can help save energy in your home. Did you connect with Focus on Energy to learn more about those energy-saving opportunities? (Select all that apply) **[MULTIPLE RESPONSES ALLOWED]**

1. Yes – researched online
2. Yes – inquired by phone
3. No [MAKE RESPONSE EXCLUSIVE]

98. Don't know [MAKE RESPONSE EXCLUSIVE]

E4. **[Ask if D3 = 1 or 2]** Which energy-saving opportunities did you investigate? (Select all that apply) **[MULTIPLE RESPONSES ALLOWED]**

1. Ordering an energy-efficiency kit (simple energy efficiency packs)
2. Having an in-home assessment
3. Upgrading insulation to modern standards
4. Replacing old light bulbs with LED bulbs
5. Replacing old thermostat with a smart thermostat
6. Replacing old refrigerator or freezer
7. Replacing inefficient heating and/or cooling equipment
8. Replacing appliances with efficient models
9. Installing a ductless mini-split heat pump
10. Installing a renewable energy system
11. Replacing standard electric water heater with a heat pump water heater

98. Don't know [MAKE RESPONSE EXCLUSIVE]

F. Demographics

These last few questions are for statistical purposes only.

F1. What type of home do you live in? Is it a:

1. Single-family home, detached house
2. Attached house (townhouse, row house, or duplex)
3. Multifamily apartment or condo building with 4 or more units
4. Mobile/manufactured home
5. Co-op/retirement community
6. Other (please specify) [ALLOW TEXT ENTRY – FORCE TEXT ENTRY]

Prefer not to respond

F2. Do you or members of your household own this home or do you rent?

1. Own
2. Rent/lease
3. Other (please specify) [ALLOW TEXT ENTRY – FORCE TEXT ENTRY]

Prefer not to respond

F3. What is the highest level of school that you have completed?

1. Less than ninth grade
2. Ninth to twelfth grade; no diploma
3. High school graduate (includes GED)
4. Some college, no degree
5. Associates degree
6. Bachelor's degree
7. Graduate or professional degree

98. Prefer not to respond

F4. Please enter your age:

1. [OPEN-ENDED]

F5. Which category best describes your total household income in 2016 before taxes?

1. Less than $30,000
2. Between $30,000 and $49,999
3. Between $50,000 and $69,999
4. Between $70,000 and $89,999
5. Between $90,000 and $109,999
6. Between $110,000 and $129,999
7. Between $130,000 and $149,999
8. $150,000 or more

98. Prefer not to respond

G. Closing

G1. Those are all the questions we have. Thank you for your time! Before you go, please tell us if you would like to be entered into the drawing to win a $100 gift card.

1. Yes – I want to enter the contest
2. No – I **do not** want to enter the contest

G2. **[Ask if F1 = 1]** To be entered into the drawing for the gift card, please verify your name and address. Your information will only be used to mail you the prize if you win the contest. Focus on Energy will not use it for marketing purposes, and they will not update any of your billing or mailing preferences with this information. *<u>Please note, if you do not complete your mailing address, or only fill some of the fields below, you will not be entered into the drawing</u>.*

1. First and Last Name:
2. Street Address:
3. City:
4. State:
5. ZIP code:

[END OF SURVEY MESSAGE]

The survey is now complete. Focus on Energy appreciates your input. Thank you very much for your time!

CADMUS

Nonresidential Programs

Multifamily Programs

Focus on Energy CY 2017 Interview Guide:
Multifamily Energy Savings Program Participants
September 2017

Respondent name:______________________________

Respondent phone: ______________________________

Interview date: ____________________ Interviewer initials: __________

Researchable Questions		
Key Research Topics	**Areas of Investigation**	**Related Questions**
Awareness and Familiarity	How have participants recently heard about MESP? What has been participants' involvement with Focus on Energy over time?	B1, B6, B7
	To what extent are participants involved and satisfied with the application process?	B2 - B5
Decision-Making	What parties are involved with the decision-making process?	C1-C3
	What are participants' project research and approval processes?	C4, C5
Barriers	What are the barriers to participation? • Biggest challenges to implementing future projects • Likelihood of pursuing a project in the future Priority and timing of future project(s)	D1,D2
Multifamily Direct Install Program Process and Delivery Changes	Are MESP participants aware of the MFDI program? Would changes to the program impact the likelihood that they would promote or participate in the program as a kit offering?	E1 – E5
Benefits and Improvement Recommendations	What are the benefits of participating in MESP?	F1
	What changes could improve the MESP participant experience?	F2

What are MF customers' preferred engagement tactics?

How can the program better reach and serve past participants?

Interviewer instructions are in green.

[BACKGROUND INFORMATION NOT TO BE READ TO RESPONDENT:

SAMPLE FRAME: The Evaluation Team will target CY 2017 Multifamily Energy Savings Program (MESP) program participants who have not participated in the Multifamily Direct Install Program (MFDI) from CY2013 to September, 2017. Sampling only based on participating property; participants may have other properties that have received direct install services.

QUOTA: 10-12 interviews

PURPOSE: The goal of these interviews is to understand how MESP participants engage with Focus on Energy Programs and whether additional support could lead to deeper energy savings. The Evaluation Team will also explore possible barriers with and opportunities for their tenants participating in the Simple Energy Efficiency Kit Program, rather than the landlord's participation in a direct install program. Participant interviews will be structured, but open-ended, to allow respondents to highlight successes and challenges from their perspective. Conversations will be 15-20 minutes long.]

A. Introduction

A1. Hello, my name is [NAME] and I am calling on behalf of Wisconsin's Focus on Energy Programs. Focus on Energy wants to learn about your participation in the Multifamily Program for the property at [SITE ADDRESS(ES)] [SOME CONTACTS MAY HAVE RECEIVED SERVICES FOR MORE THAN ONE PROPERTY/SITE ADDRESS]

[IF NO CONTACT NAME]: May I please speak with the person at [SITE ADDRESS] who was most involved with the property's 2017 participation in Focus on Energy's Multifamily Program? [IF CONTACT NAME PROVIDED]: May I please speak with [CONTACT NAME]?

1. (Yes)
2. (Yes, call transferred) [START OVER WITH NEW RESPONDENT]
3. (No, not available) [SCHEDULE CALLBACK]
98. (DON'T KNOW) [ASK TO SPEAK WITH SOMEONE WHO WOULD KNOW AND START AGAIN]
99. (REFUSED) [THANK AND TERMINATE]

A2. I'd like to ask you about your role in relation to the property. What is the best way to describe your role at *[SITE ADDRESS]*? Are you the. . .? *[READ LIST]*

1. Property owner
2. Property manager
3. Both property owner and manager
4. Maintenance or facilities supervisor
5. Onsite contact
6. Other *[Specify:________________________]*
98. (Don't know)
99. (Refused)

A3. Is the property an apartment complex or condo association?
1. (Apartment complex)
2. (Condominiums/ condo association)
98. (DON'T KNOW) [ASK TO SPEAK WITH SOMEONE WHO WOULD KNOW AND START AGAIN]
99. (REFUSED) [THANK AND TERMINATE]

A4. Does your company own or manage other 4+ unit multifamily properties in Wisconsin?
1. Yes *[Specify number of properties:________________________]*
2. No
98. (Don't know)
99. (Refused)

B. Awareness and Familiarity

B1. How did your organization learn about the Focus on Energy incentives available for this project? [DO NOT READ LIST; MULTIPLE RESPONSES POSSIBLE] [IF RESPONDENT MENTIONS WEBSITE CLARIFY IF UTILITY OR FOCUS ON ENERGY WEBSITE SO YOU KNOW HOW TO CODE ANSWER ON LIST.]
1. (Contact with Focus on Energy representative through phone, email, or in person)
2. (Focus on Energy quarterly newsletter)
3. (Focus on Energy website)
4. (Focus on Energy sponsored workshop or event)
5. (Focus on Energy printed program materials)
6. (Contact with utility representative)
7. (Utility mailing, bill insert, or utility Website)
8. (Word of mouth (family, friend, or business colleague)
9. (I contacted my contractor/ vendor to ask)
10. (My contractor or vendor let me know about them)
11. (Previously participated in program/received an incentive)
12. (Through a trade association or professional organization [SPECIFY:________________________])
13. (Other [SPECIFY:________________________])
99. (Don't know)
88. (Refused)

B2. Who took the lead role in completing the application for the financial incentive? Was it… [READ OPTIONS, ONLY ONE RESPONSE]
1. You (i.e., respondent)
2. Someone at your organization
3. The contractor and/or vendor
4. A Focus on Energy, Energy Advisor
5. Someone else [SPECIFY:_________]
99. (Don't know)
88. (Refused)

B3. Who else contributed to completing the application for the financial incentive? [READ LIST IF NEEDED, PROBE FOR ALL PARTIES INVOLVED, MULTIPLE RESPONSES ALLOWED]

1. (No one else was involved)
2. (Me [i.e., respondent])
3. (Someone else at my organization)
4. (The contractor and/or vendor)
5. (A Focus on Energy Energy Advisor)
6. (Other) [SPECIFY:_________]

99. (Don't know)
88. (Refused)

B4. **[ASK IF B2=1 OR B3=2]** Thinking about the application you submitted, how easy would you say this paperwork was to complete? Would you say: [READ LIST]

1. Very easy,
2. Easy,
3. Somewhat challenging, or
4. Very challenging?

99. (Don't know)
88. (Refused)

B5. ***[IF B4= 3 OR 4]*** Why do you say that? [OPEN END]

B6. Have you worked with Focus on Energy on other projects in the past?

1. Yes *[Specify number of properties:_________________________]*
2. No

99. (Don't know)
88. (Refused)

B7. ***[IF 0=YES]*** How long has your company been working with Focus on Energy to save energy on your property or properties?

C. Decision Making

Now I'd like to understand more about how your property made decisions about this energy

efficiency project.

C1. Please tell me who, if anyone, was involved in helping you initiate your energy efficiency project. [READ LIST AND MARK 1=YES, 2=NO, 99=DON'T KNOW; 88 REFUSED FOR EACH]

1. Your contractor or vendor
2. A Focus on Energy "Energy Advisor"
3. Your utility account manager

C2. [IF C1=2] Overall, how satisfied were you with the quality of communication between you and your Focus on Energy Energy Advisor? Would you say: [READ LIST]

1. Very satisfied,
2. Somewhat satisfied,
3. Not too satisfied, or
4. Not satisfied at all?
99. (Don't know)
88. (Refused)

C3. Who at your organization is involved in making decisions about energy efficiency when making capital upgrades or improvements? [RECORD VERBATIM AND BIN LATER; DO NOT READ OPTIONS, MULTIPLE RESPONSES ALLOWED]

1. VERBATIM RESPONSE: ___________________________
2. (Me)
3. (President/CEO/Executive Director/Property Owner)
4. (Facility maintenance department/property manager)
5. (Corporate headquarters)
6. (Board of directors, condo association board)
7. (Condo owners)
8. (Other [SPECIFY_________])
99. (Don't know)
88. (Refused)

C4. *[IF C3>1 DECISION-MAKER]* Describe your approval process for common area upgrades, from identifying a need or opportunity, to deciding to move forward with an energy efficiency upgrade?

1. VERBATIM RESPONSE: ___________________________
99. (Don't know)
88. (Refused)

C5. What sources do you use to research your options for making efficiency upgrades for your business? [RECORD VERBATIM AND BIN LATER; PROBE USING LIST IF NEEDED]

1. VERBATIM RESPONSE: ___________________________
2. My Focus on Energy Energy Advisor
3. [UTILITY] representatives
4. My installation contractor/vendor
5. Other business owners/managers
6. Web resources [SPECIFY SITES]
7. Internal maintenance staff
8. Apartment/trade associations (presentations and newsletters)
9. I don't purchase energy-efficient products for my property
10. (Other) [SPECIFY]
99. (Don't know)
88. (Refused)

D. Barriers

These next few questions are about your organization's next steps with the property and the barriers you may be encountering.

D1. What do so see as the biggest challenges to making future energy-efficient improvements at your property or properties? [COLLECT VERBATIM AND BIN LATER; DO NOT READ LIST; RECORD ALL THAT APPLY; PROBE FOR MULTIPLE RESPONSES]

1. VERBATIM RESPONSE: ______________________________
2. (High initial costs)
3. (Budget limitations)
4. (Long payback period)
5. (Funding competition for other investments/improvements)
6. (Replacing equipment without affecting operations)
7. (Understanding potential areas for improvement)
8. (Lack of awareness about available incentives for energy efficient equipment)
9. (Understanding equipment eligibility)
10. (Issues with program application process)
11. (Finding a trade ally with which to work)
12. (Inadequate incentive)
13. (Other [SPECIFY:__________])
98. (Don't know)
99. (Refused)

D2. How likely is your organization to pursue an energy efficiency project for the property in the next few years? *[very likely, somewhat likely, not too likely, not at all likely]*

1. What type of project is the highest priority for the property?
2. When do you think this type of upgrade would occur?
3. How could Focus on Energy help with this future project?

E. Multifamily Direct Install Program Process and Delivery Changes

E1. Next, I'd like to discuss the Focus on Energy's Simple Energy Efficiency Program. This program encourages homeowners to order a kit containing energy saving measures, such as light bulbs, showerheads and faucet aerators, to install themselves. Kits include installation instructions, and the program website provides videos showing proper installation of water-saving measures. Focus on Energy is changing to the design this program, to allow tenants of apartment buildings and condos to order and install these kits. Walking through the list of kit contents, please tell me if your company would allow tenants to install the measures themselves.

1. Light bulbs (Yes/No) *[Identify concerns]*
2. Shower head (Yes/No) *[Identify concerns] [If needed: thread tape is included in the kit in order to install the high efficiency shower head]*
3. Bath faucet aerator (Yes/No) *[Identify concerns] [If needed: screw-in aerators reduce water use on standard bath faucet fixtures.*
4. Pipe insulation (Yes/No) *[Identify whether tenant has access to water pipes, and any concerns] [If needed: Pipe insulation is used on domestic cold and hot water pipes.]*

5. Water heater temperature card (Yes/No) *[Identify whether tenant has access to water heater thermostat, and any concerns] [If needed: the card measures hot water temperatures to determine whether to adjust the water heater thermostat]*
6. Advanced power strip (Yes/No) *[Identify concerns] [If needed: Advanced Power Strips are designed primarily for home entertainment centers and home office areas. They work by preventing electronics from drawing power when they are off or not being used.]*
98. (Don’t know)
99. (Refused)

E2. *[If respondent is comfortable with tenant installing at least one measure in E1 list]* Would your company promote these kits to your tenants?
1. Yes *[Identify whether willing to promote through email, common area poster, and/or offering installation assistance]*
2. No
98. (Don’t know)
99. (Refused)

E3. Does the building owner pay for the electricity bill or do your tenants pay their own bill for in-unit electric use directly to the utility?
1. Building owner pays
2. Tenant pays
3. Some combination of both *[Describe]*
98. (Don’t know)
99. (Refused)

E4. Does that also apply to the gas bill?
1. Building owner pays
2. Tenant pays
3. Some combination of both *[Describe]*
98. (Don’t know)
99. (Refused)

E5. And the water bill?
1. Building owner pays
2. Tenant pays
3. Some combination of both *[Describe]*
98. (Don’t know)
99. (Refused)

E6. On a scale of 1 to 10 where 1 is not at all likely and 10 is extremely likely, how likely would you be to order kits for your facility staff to install, if this was an option through the program?
1. *[Record numerical response, and ask for reasons for providing that rating]*
98. (Don’t know)
99. (Refused)

E7. Using the same scale, where 1 is not at all likely and 10 is extremely likely, how likely would you be to schedule an installation conducted by a Focus on Energy professional, if a program representative had contacted you about this offer?

1. Record numerical response, and ask for reasons for providing that rating *[Identify whether this type of approach would be easier, more difficult, or require about the same level of effort as installing the measures themselves]*
98. (Don't know)
99. (Refused)

F. Benefits and Recommendations for Improvement

These last questions are about your overall experience.

F1. What would you say are the main benefits your company has experienced as a result of the working with Focus on Energy on your energy efficiency upgrades? [RECORD VERBATIM AND BIN LATER; PROBE FOR MULTIPLE RESPONSES]

1. VERBATIM RESPONSE: ____________________________
2. (The incentive payment)
3. (Using less energy, reducing energy consumption or energy demand)
4. (Saving money on our utility bills; lower energy bills)
5. (Increased occupant comfort)
6. (Better aesthetics/better or brighter lighting)
7. (Saving money on maintenance costs)
8. (Other [SPECIFY:________])
9. (NO BENEFITS)
99. (Don't know)
88. (Refused)

F2. Is there anything that Focus on Energy could have done to improve your overall experience with the Multifamily Energy Savings Program? [DO NOT READ THE LIST, RECORD ALL THAT APPLY]

1. (Better/more communication [SPECIFY: Who would you like more communication from?_________])
2. (Quicker response time [SPECIFY: Who would you like a quicker response time from?__])
3. (Larger selection of eligible equipment [ASK: What energy-efficient equipment should Focus on Energy offer incentives for?________________])
4. (Increasing the incentive amount)
5. (Simplify the application process)[ASK: In what way should it be simplified?_____________?]
6. (Allow me to fill out the applications online)
7. (Simplify the website)[ASK: In what way?___________________________]
8. (Provide quicker approval on applications)
9. (Send incentive check out faster)
10. (Provide more face-time with my Energy Advisor (this may include more frequent visits))

11. (Other [SPECIFY:______________________])
12. (No, nothing)
99. (Don't know)
88. (Refused)

G. Closing

Thank you for your participation.

G1. Do you have any final comments about the program or your experience?

CADMUS

New Homes – Participating Builder Interviews

Focus on Energy CY 2017 Interview Guide
Participating Home Builder Interview Guide
New Homes Program
November-December 2017

Respondent name/Company:____

Respondent phone: ____

Interview date: ________________________ Interviewer initials: ____________

Research Questions	Interview Guide Questions
How does the program effect building practices for homes that are not certified?	A4
What are indicators that the program is influencing the building practices in the Wisconsin market?	B1-B4
Are builders already building zero net energy homes?	C4
How close are builders to zero net energy homes?	C1, C2, C3, C5
How does market demand influence efficient building practices?	D1-D6

Thank you for taking the time to speak with me. My company, Cadmus, was hired by the Public Service Commission of Wisconsin to evaluate the Focus on Energy New Homes Program. Before the program transitions to new guidelines in 2018, we want to understand participating builders' experiences with the program and to gather their input on the Wisconsin housing market. Your feedback is a key part of our evaluation. Another important part of this evaluation is to understand your building practices and how the New Homes Program may have affected the building practices of builders that have not participated in the program in recent years.

Do you have 30 minutes to talk about the program and how you build homes? We're offering you a $100 Visa gift card for your time. All your responses will be kept strictly confidential and will not be attributed to you or your company in our reporting.

[IF NOW IS NOT A GOOD TIME, ARRANGE A BETTER TIME TO TALK]

A. Introduction

A1. First, I'd like to ask you about the homes that you build in Wisconsin. How many homes will you have built in Wisconsin by the end of 2017?

1. How does this compare to last year?

2. Of these homes, how many do you expect will be certified through the Focus on Energy New Homes Program?

3. How does the number and percentage of your Focus on Energy certified homes compare to last year?

4. **[ASK IF BUILDER BUILDS BOTH CERTIFIED AND NON-CERTIFIED HOMES]** Why do you build both certified and non-certified homes?

A2. Are you aware of the program changes that Focus on Energy plans to introduce next year?

1. If so, what do you see as the most significant changes to you as a builder?

A3. How do you think the program changes that will be introduced in 2018 will affect your participation in the program?

A4. **[ASK IF BUILDER BUILDS BOTH CERTIFIED AND NON-CERTIFIED HOMES]** How do your certified homes and non-certified homes differ?

1. Do you use building consultants in non-certified homes?
2. Do building practices or equipment differ?
3. Do you conduct blower-door testing in non-certified homes?

B. Market Effects Metrics

B1. Over the past three years, what changes have you seen in the Wisconsin new homes market? How have those changes affected how you build homes? [Probe if necessary: consumer knowledge, preferences, income, codes]

1. What trends, if any, have you observed in building structure and building shells? Why do you think these trends have emerged?

B2. What other changes in building practices have you made in the last three years?

1. Why did you make these changes?

B3. Have you had to work with your architects or subcontractors (such as framers, HVAC contractors, electricians) to ensure that they were able to help you build program-standard homes?

1. Is so, what steps did you take to ensure that they had the skills to build to program standards?
2. Have you experienced any challenges identifying subcontractors that are able to build efficient homes? If so what were the challenges and how did you overcome them?

B4. What effect has the Focus on Energy New Homes Program had on how your company builds homes in Wisconsin? Please focus on specific equipment or building practices and why the program affects them.

1. **[IF BUILDER CONSTRUCTS NON-CERTIFIED HOMES]** On non-certified homes built by you? [Probe for specific building practices or equipment]
2. **[IF NEEDED]** How does the program affect the new homes market? [Probe: use of HERS raters/building consultants, contractors gaining knowledge of efficient construction practices, greater home-buyer demand for efficient homes]

C. Net Zero Homes Freeridership Baseline

C1. I would like to ask you about a few specific building practices. Can you please tell me if you have heard of these practices, if you utilize these practices, and if so, in what percent of your homes you do so?

Building Practice	Heard of? (Y/N)	Utilize? (Y/N)	% of Homes utilized in?
Insulated concrete forms			
Structural Insulated Panels			
Foamed sill boxes			
Closed-cell spray foam insulation			
Continuous exterior wall insulation (ex: Advantech ZIP wall system)			
Net-and-blow in insulation /dense packed walls			
Heat recovery ventilation			
Triple-glazed windows or windows below U-0.25			
Tankless water heaters			
Heat-pump water heaters			
Advanced framing techniques (such as single top plates or 24-inch centers, insulated top plates, three stud corners)			
Advanced ducting (probe for specific practices that keep ducts within conditioned spaces)			

C2. Are you familiar with net zero energy or net zero energy-ready homes?

C3. **[ASK IF C2 = YES]** Have you built any net zero energy-ready homes in Wisconsin in the last three years? If so, how many and what years?

C4. Do plan to (or continue to) build net zero energy-ready homes in Wisconsin in the next three years?

D. Marketing

D1. Do you market your homes as energy-efficient? If so, how?

D2. How does competition influence how you build homes? If so, how?
1. How has that changed in the past five years?

D3. How does market demand influence the way you build homes?
1. How has that changed in the past five years?
2. What do you think is driving those changes?

D4. How valuable is the New Homes Program is in generating new leads for your company?
1. Very important
2. Somewhat important
3. Not too important
4. Not at all important

D5. How valuable is the Focus on Energy marketing to you in terms of making a sale on a certified home?
1. Very important
2. Somewhat important
3. Not too important
4. Not at all important

D6. Do customers ever ask you about making energy-efficient upgrades to your usual building practices? If so, what types of upgrades do they request?

1. How often are these requests integrated into the home?

2. What are common reasons the requested upgrades aren't integrated into the home?

E. Closing

E1. What would need to happen for you to build even more efficient homes in the next few years?

1. What could Focus on Energy do to help you build more efficient homes that it is not doing now?

Is there anything else you think would be valuable for us to know to understand energy efficient building practices in Wisconsin?

CADMUS

New Homes – Nonparticipating Builder Interviews

Focus on Energy CY 2017 Interview Guide
Non-Participating Home Builder Interview Guide
New Homes Program
November-December 2017

Respondent name/Company:____

Respondent phone: ____

Interview date: ______________________________ Interviewer initials: _____________

Research Questions	Interview Guide Questions
What are indicators that the program is influencing the building practices in the Wisconsin market?	B1-B5
Are builders already building zero net energy homes?	C4
How close are builders to zero net energy homes?	C1, C2, C3, C5
How does market demand influence efficient building practices?	D1-D4

Thank you for taking the time to speak with me. My company, Cadmus, was hired by the Public Service Commission of Wisconsin to evaluate the Focus on Energy New Homes Program. Before the program transitions to new guidelines in 2018, we want to understand builders' experiences with the program and to gather their input on the Wisconsin housing market. Your feedback is a key part of our evaluation. Another important part of this evaluation is to understand your building practices and how the New Homes Program may have affected the building practices of builders that have not participated in the program in recent years.

Do you have 30 minutes to answer talk about the program and how you build homes? We're offering you a $100 Visa gift card for your time. All your responses will be kept strictly confidential and will not be attributed to you or your company in our reporting.

[IF NOW IS NOT A GOOD TIME, ARRANGE A BETTER TIME TO TALK AND CALL BACK LATER]

A. Introduction

A1. First, I'd like to ask you about the homes that you build in Wisconsin. How many homes will you have built in Wisconsin by the end of 2017?

1. How does this compare to last year?

A2. ***FOR YOUR WISCONSIN HOMES, DO YOU:***

1. Use building consultants or HERS raters? If so, what do you think the value of testing and commissioning a home is?
2. Conduct blower-door testing? If so, why do you conduct the tests?

A3. Have you heard of the Focus on Energy New Homes Program?

1. If so, have you ever participated in the program? If you have, when was the last year that you participated in the program? (Prod, if necessary: 5 years or less? More than 5 years?)
2. If so, why are you not participating in the program this year?

B. Market Effects Metrics

B1. Over the past three years, what changes have you seen in the Wisconsin new homes market that have affected how you build homes? [probes if necessary: consumer knowledge, preferences, income, codes]

1. What trends, if any, have you observed in building structure and building shells? Why do you think these trends have emerged?

B2. What changes in building practices have you made in the last three years?

1. Why did you make those changes?

B3. **[ASK IF A3 = YES]** ***HAVE ANY OF YOUR SUB-CONTRACTORS WORKED ON HOMES THAT WERE CERTIFIED BY THE FOCUS ON ENERGY NEW HOMES PROGRAM?***

1. ***IF SO, WHAT EFFECT, IF ANY, DID THEIR PARTICIPATION IN THE PROGRAM HAVE ON HOW YOU BUILD YOUR HOMES?***

B4. **[ASK IF A3 = YES]** What effect has the Focus on Energy New Homes Program had on how your company builds homes in Wisconsin? Please focus on specific equipment or building practices and why the program affects them.

1. **[IF NEEDED]** How does the program affect the new homes market? [Probe: use of HERS raters/building consultants, contractors gaining knowledge of efficient construction practices, greater home-buyer demand for efficient homes]

B5. What makes a home energy efficient? [Probe for specifics]
1. How do you stay up-to-date with energy efficient building practices?
2. Do you require especially skilled sub-contractors to build energy-efficient homes? [Probe of specific types of contractors and required skills]

C. Net Zero Homes Freeridership Baseline

C1. I would like to ask you about a few specific building practices. Can you please tell me if you have heard of these practices, if you utilize these practices, and if so, in what percent of your homes you do so?

Building Practice	Heard of? (Y/N)	Utilize? (Y/N)	% of Homes utilized in?
Insulated concrete forms			
Structural Insulated Panels			
Foamed sill boxes			
Closed-cell spray foam insulation			
Continuous exterior wall insulation (ex: Advantech ZIP wall system)			
Net-and-blow in insulation /dense packed walls			
Heat recovery ventilation			
Triple-glazed windows or windows below U-0.25			
Tankless water heaters			
Heat-pump water heaters			
Advanced framing techniques (such as single top plates or 24-inch centers, insulated top plates, three stud corners)			
Advanced ducting (probe for specific practices that keep ducts within conditioned spaces)			

C2. Are you familiar with net zero energy or net zero energy-ready homes?

C3. **[ASK IF C2 = YES]** Have you built any net zero energy-ready homes in Wisconsin in the last five years? If so, how many and what years?

C4. Do plan to (or continue to) build net zero energy-ready homes in Wisconsin in the next three years?

C5. **[ASK IF A2.1= YES]** What is the lowest HERS rating that you have achieved on any home that you have built in Wisconsin in the last five years?

D. Marketing

D1. Do you market your homes as energy-efficient? If so, how?

D2. How does competition influence the decisions you make in building homes? How has that changed in the past five years?

D3. How does market demand influence the way you build homes? How has that changed in the past five years? What do you think is driving those changes?

D4. Do customers ever ask you about making energy-efficient upgrades to your usual building practices? If so, what types of upgrades do they request?

1. How often are these requests integrated into the home?
2. What are common reasons the requested upgrades aren't integrated into the home?

E. Closing

E1. Is there anything that Focus on Energy could change about the program to encourage you to participate?

E2. Is there anything else you think would be valuable for us to know to understand energy efficient building practices in Wisconsin?

Appendix K. Rural Zip Code Eligibility

This appendix includes a table of Wisconsin rural zip codes designated to be eligible for Focus on Energy rural programs.

Zip Code	Zip Code	Zip Code	Zip Code	Zip Code
49801	53054	53148	53507	53557
51016	53056	53152	53508	53559
52114	53057	53156	53510	53560
53001	53059	53157	53512	53561
53002	53060	53159	53515	53565
53003	53061	53168	53516	53566
53004	53063	53170	53517	53569
53006	53064	53171	53518	53570
53008	53065	53176	53520	53571
53009	53070	53178	53521	53572
53010	53073	53179	53522	53573
53011	53075	53180	53523	53574
53013	53078	53181	53525	53575
53014	53079	53187	53526	53576
53015	53082	53190	53528	53577
53016	53088	53192	53529	53578
53019	53091	53193	53530	53579
53020	53093	53194	53531	53580
53021	53096	53195	53533	53581
53023	53098	53199	53534	53582
53026	53099	53201	53535	53583
53030	53101	53237	53536	53584
53031	53102	53267	53537	53585
53032	53107	53290	53540	53586
53034	53109	53298	53541	53587
53035	53114	53317	53542	53588
53038	53115	53401	53543	53594
53039	53120	53407	53544	53596
53040	53127	53425	53547	53599
53042	53128	53501	53550	53707
53047	53137	53502	53551	53783
53048	53138	53503	53553	53801
53049	53141	53504	53554	53802
53050	53145	53505	53555	53803
53052	53147	53506	53556	53804

Zip Code	Zip Code	Zip Code	Zip Code	Zip Code
53805	53937	54015	54137	54212
53806	53939	54016	54138	54213
53807	53940	54017	54139	54214
53808	53941	54018	54148	54215
53809	53942	54020	54149	54216
53810	53943	54021	54150	54217
53811	53944	54022	54151	54221
53812	53945	54023	54152	54226
53813	53946	54024	54153	54227
53816	53947	54025	54154	54228
53817	53948	54026	54156	54229
53818	53949	54027	54157	54230
53820	53950	54028	54158	54231
53821	53951	54082	54159	54232
53824	53952	54091	54160	54234
53825	53953	54101	54161	54235
53826	53954	54102	54162	54240
53827	53955	54103	54164	54245
53901	53956	54104	54165	54246
53910	53957	54105	54166	54247
53911	53959	54106	54170	54305
53913	53960	54107	54171	54306
53916	53961	54108	54174	54308
53919	53962	54110	54175	54310
53920	53963	54111	54177	54344
53922	53964	54112	54180	54354
53923	53965	54114	54182	54402
53924	53968	54119	54194	54405
53925	53969	54120	54195	54406
53926	54001	54121	54201	54407
53927	54002	54123	54202	54408
53928	54003	54124	54203	54409
53929	54004	54125	54204	54410
53930	54005	54126	54205	54411
53931	54006	54127	54206	54412
53932	54007	54128	54207	54413
53933	54009	54129	54208	54414
53934	54011	54131	54209	54415
53935	54013	54132	54210	54416
53936	54014	54135	54211	54417

Zip Code	Zip Code	Zip Code	Zip Code	Zip Code
54418	54463	54530	54590	54652
54420	54464	54531	54602	54653
54421	54465	54532	54610	54654
54422	54466	54533	54611	54655
54423	54470	54534	54612	54656
54424	54471	54535	54613	54657
54425	54473	54536	54614	54658
54426	54475	54537	54615	54659
54427	54479	54538	54616	54660
54428	54480	54539	54618	54661
54429	54484	54540	54619	54662
54430	54485	54541	54620	54664
54431	54486	54542	54621	54665
54432	54487	54543	54622	54666
54433	54488	54545	54623	54667
54434	54489	54546	54624	54670
54435	54490	54547	54625	54702
54436	54491	54548	54626	54716
54437	54493	54549	54627	54721
54440	54495	54550	54628	54722
54442	54498	54551	54629	54723
54443	54499	54552	54630	54724
54444	54501	54553	54631	54725
54445	54510	54554	54632	54726
54446	54511	54555	54634	54727
54447	54512	54556	54635	54728
54448	54513	54557	54637	54730
54449	54514	54558	54638	54731
54450	54515	54559	54639	54732
54451	54516	54560	54640	54733
54452	54517	54561	54641	54734
54453	54519	54562	54642	54735
54454	54520	54563	54643	54736
54455	54521	54564	54644	54737
54456	54524	54565	54645	54738
54457	54525	54566	54646	54739
54458	54526	54567	54647	54740
54459	54527	54568	54648	54741
54460	54528	54570	54649	54742
54462	54529	54572	54651	54743

CADMUS

Zip Code	Zip Code	Zip Code	Zip Code	Zip Code
54744	54821	54870	54947	55317
54745	54822	54871	54948	55450
54746	54824	54872	54949	55749
54747	54826	54873	54950	55808
54748	54827	54874	54951	56026
54749	54828	54875	54954	57534
54750	54829	54876	54957	61761
54751	54830	54880	54958	
54754	54832	54881	54959	
54755	54835	54888	54960	
54756	54836	54889	54961	
54757	54837	54890	54962	
54758	54838	54891	54963	
54759	54839	54892	54964	
54760	54840	54893	54965	
54761	54841	54895	54966	
54762	54842	54896	54967	
54763	54843	54903	54968	
54764	54844	54909	54969	
54765	54845	54912	54970	
54766	54846	54916	54971	
54767	54847	54919	54974	
54768	54848	54921	54975	
54769	54849	54922	54976	
54770	54850	54923	54977	
54771	54852	54924	54978	
54772	54853	54926	54980	
54773	54854	54928	54981	
54801	54855	54929	54982	
54805	54856	54930	54983	
54806	54857	54931	54984	
54810	54858	54932	54986	
54811	54859	54933	55007	
54812	54861	54934	55011	
54813	54862	54935	55047	
54814	54864	54936	55056	
54815	54865	54940	55066	
54817	54866	54941	55072	
54819	54867	54943	55073	
54820	54868	54945	55074	