OHIO ADVANCED ENERGY ECONOMY

A COALITION FOR INNOVATIVE, SECURE, AND AFFORDABLE ENERGY

Ohio House of Representatives
Public Utilities Committee
HB 114, Renewable Energy and Energy Efficiency

Testimony of Ohio Advanced Energy Economy
Terrence O'Donnell, Dickinson Wright PLLC

March 21, 2017

Chairman Seitz, Vice Chair Carfagna, and Ranking Member Ashford,

Thank you for the opportunity to testify today. My name is Terrence O'Donnell and I am legislative counsel for Ohio Advanced Energy Economy (Ohio AEE), the Ohio chapter of a national coalition of businesses in the energy sector seeking to make energy more safe, secure, and affordable.

We testify today regarding the impact of Ohio's renewable energy and energy efficiency policies. Some argue that since 2008, consumers' electric generation bills increased by 9 percent due to the renewable and energy efficiency mandates in Ohio law. (See the attached electricity bill). **However, as we will explain today, the actual impact on monthly bills of the RPS and EERS is far less, and indeed the utilities themselves report these policies are saving Ohioans billions of dollars and creating jobs**.

1. Cost Calculation: The bill shows that the monthly cost of the RPS / EERS to be $4.98. This includes $0.68 for renewables, $3.06 for efficiency, and $1.24 for Peak Demand Reduction. Compared to the total bill ($123.56), the $4.98 charge amounts to only **4%**. A comparison of the RPS / EERS cost to the generation portion of the bill only ($53.55) produces the 9% figure.

Table 1: Cost of RPS/EERS/PDR as Compared to Total Bill

Portion of Electric Bill	Dollar Amount	Percentage of Bill
RPS / EERS / PDR	$4.98	***4%***
Generation Service	$53.55	43%
Other Charges	$65.03	53%
Total	123.56	100%

Table 2: Cost of RPS/EERS/PDR as Compared to Generation Portion of Bill

Portion of Generation Charge	Dollar Amount	Percentage of Generation Charge
RPS/EERS/PDR	$4.98	***9%***
Other Generation Charges	$48.57	91%
Total	53.55	100%

2. Average RPS cost of 29 cents: The PUCO recently produced a table showing the average monthly customer bill impact of various charges. As shown below, the impact varies across territories of the six different utilities, **but the average total monthly customer bill impact of the RPS is only $0.29.** In addition, note that AER riders are bypassable—customers may switch to a CRES provider who may

charge less.[1] Note too that in 2015 the state eliminated the requirement that at least one-half of the RPS be met through facilities located in Ohio, further reducing costs associated with the standards.

Table 3: Average Monthly Consumer Bill Impact by Territory (1st Quarter, 2017)[2]

EDU	AER Rate ($/KWH)	Avg. Monthly Bill Impact
Cleveland Electric illuminating	$0.0002010	$0.15
Dayton Power and Light	$0.0002475	$0.19
Duke Energy—Ohio	$0.0004440	$0.33
Ohio Edison Company	$.0001790	$0.13
Ohio Power Company	$0.0010060	$0.75
Toledo Edison Company	$0.0003130	$0.23

3. Renewable Portfolio Standard: Charges associated with the RPS only amount to roughly **0.5%** of the entire customer bill. A monthly charge of $0.68 does not rise to the level of "high cost," and this cost also ignores the benefits to Ohio of billions of dollars spent on new, clean energy generation and the associated jobs and economic development.

4. Energy Efficiency Savings: An accurate analysis of the state's EERS must also take into account the savings resulting from the standards; not merely the charges. Ohio's utility-run energy efficiency programs have saved ratepayers more than **$2 billion** to date on energy costs. This $2 billion savings figure represents a *conservative* estimate based on 2009-2014 energy efficiency program data from the utility's own status reports, which are publicly filed every year with the PUCO.[3] In fact, AEP Ohio's 2015-2019 EE/PDR Action Plan alone projects EE/PDR savings of approximately $1.5 billion.[4] These savings are a result of the state's EERS and the statutory requirement that utilities achieve annual energy efficiency benchmarks through 2027. Note none of these savings are itemized on the utility bill. Not a penny. **So even a 4% "cost" to consumers is vastly overstated**. The bill shows costs but not benefits.

In addition, in order to receive PUCO approval, utility EE/PDR programs must be cost-effective (i.e. saving more than cost).[5] According to the Lawrence Berkeley National Lab (DOE), Ohio has one of the lowest-cost energy efficiency programs in the country.[6] And, PUCO rules require evaluation, measurement, and verification (EM&V) by utilities of energy savings resulting from EE programs, ensuring these savings are actually realized—not theoretical.

In sum, any fair-minded analysis of customer rate impacts of EE/PDR programs must take into account the significant savings achieved from the programs—not merely tout the charges required to finance the savings achieved.

5. Cost Cap: Not noted in the op-ed is that Ohio law protects consumers from excessive costs associated with the RPS through a **statutory 3% cost cap**. Utilities need not comply with a renewable benchmark to the extent "its reasonably expected cost of that compliance exceeds its reasonably expected

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1 A Competitive Retail Electric Service (CRES) provider is an entity that provides electricity generation service to retail customers on a competitive basis.

2 Source: http://www.puco.ohio.gov/puco/index.cfm/industry-information/industry-topics/ohioe28099s-renewable-and-advanced-energy-portfolio-standard/aer-rates-1q-2017/

3 http://dis.puc.state.oh.us

4 *AEP Ohio, Inc.,* Vol. 1: 2015-2019 EE/PDR Action Plan (Mar. 26 2014) at 6.

5 OAC 4901:1-39-03.

6 See Lawrence Berkeley National Laboratory, The Program Administrator Cost of Saved Energy for Utility Customer-Funded Energy Efficiency Programs, March 2014, available at https://emp.lbl.gov/sites/all/files/lbnl-6595e_0.pdf.

cost of otherwise producing or acquiring the requisite electricity by three per cent or more."[7] Ohio's cost cap has never been invoked because costs have been beneath its threshold.

Thank you again for the opportunity to share my perspective. I am happy to answer any questions.

[7] See RC § 4928.64.

Service Address:

Rate Tariff: Residential Service-013

Account Number	Total Amount Due	Due Date
	$123.56	Aug 16, 2016
Meter Number	**Cycle-Route**	**Bill Date**
	01-17	Jul 29, 2016

Previous Charges:

Total Amount Due At Last Billing	$	95.76
Payment 07/07/16 - Thank You		-95.76
Previous Balance Due	$	.00*

Current AEP Ohio Charges:

Tariff 013 -Residential Service 07/28/16

Service Delivery Identifier: 00040621050590195

Generation Service	$	$\boxed{53.55}$
Transmission Service		12.12
Distribution Service		42.51
Customer Charge		8.40
Retail Stability Rider		5.01
Deferred Asset Phase-In Rider		1.97
Current Electric Charges Due	$	123.56*

Total Amount Due **$123.56**

*Charges make up the "Total Amount Due"

Due Date Aug 16

Price-to-Compare: For tariff 013, in order for you to save money off of your utility's supply charges, a supplier must offer you a price lower than AEP Ohio's price of 5.7 cents per kWh for the same usage that appears on this bill. To review available competitive supplier offers, visit the Public Utilities Commission of Ohio's "Energy Choice Ohio" web site at www.energychoice.ohio.gov.

For Informational Purposes only: The below costs are NOT NEW CHARGES and are approximate values. AEP participates in programs required by the state of Ohio to support energy conservation and to secure renewable energy resources. For more information on energy efficiency programs, please visit aepohio.com/ItsYourPower.

Renewable Programs: $0.68
Energy Efficiency Programs: $3.06
Peak Demand Reduction Programs: $1.24

} = $4.98 ÷ $53.55 = 9%

Meter Number	Service Period From	Service Period To	Meter Reading Detail Previous	Code	Current	Code
	06/28	07/28	37323	Actual	38265	Actual
Multiplier 1.0000			Metered Usage 942 KWH			
Next scheduled read date should be between Aug 26 and Aug 31						

For Billing, Outage or Service Inquiries, Call: 1-800-672-2231
Pay By Phone: 1-800-611-0964

AEP OHIO Messages

In the Company's most recent distribution case, the PUCO granted approval of the Pilot Throughput Balancing Adjustment Rider (PTBAR). The PTBAR ensures that the actual kWh base distribution revenue collected from Residential and small Commercial customers equals the amount authorized and does not vary as a result of usage. Effective with this bill a residential customer using 1,000 kWh of electricity will see a decrease of $0.06 per month.

Make this the last bill sent in the mail. Gain more security and trust and Go Paperless to get an email notification when your bill is ready. Today is the Day! AEPPaperless.com.

Worried that changes in the postal service may delay your bill or your payment? Go paperless! You'll receive an email notification when your new bill is available for viewing. You'll also be able to pay online for free. Go to www.AEPPaperless.com to enroll today!

Visit us at www.AEPOhio.com
Due date does Not Apply to the previous balance due
See other side for Important Information.

AEP OHIO
A unit of American Electric Power

Definitions

Actual reading: A reading we take from your meter.

Estimated reading: When we are unable to read your meter, we calculate your bill based on prior usage. If necessary, we may adjust your bill at the time of the next actual reading. You may read your own meter and provide us with a reading by calling 1-888-237-8811. We also have meter reading cards available upon request.

Kilowatt-hour (kWh): The unit measure for the electricity you use. For example, you use one kWh of electricity to light a 100-watt light bulb for 10 hours.

Customer charge: The fixed monthly basic distribution charge to partially cover costs for billing, meter reading, service line maintenance and equipment.

Generation charge: Charge associated with the production of electricity.

Distribution charge: Charge for use of local wires, transformers, substations and other equipment used to deliver electricity to your home/business from the high-voltage transmission lines.

Transmission services charge: Charge for moving high-voltage electricity from a generation facility to the distribution lines of the local electric utility.

Late payment charge: (if applicable) A 5 percent late charge added to the overdue amount if you do not pay your bill by the due date.

Retail Stability Rider (RSR): The RSR is necessary to provide AEP Ohio with stability while transitioning to 100% auction-based Standard Service Offering (Generation service) pricing.

Phase-In Recovery Rider (PIRR): The PIRR will allow AEP Ohio to recover the cost of fuel deferred from 2009-2011, as previously authorized by the PUCO.

Deferred Asset Phase-In Rider (DAPIR): Recovers previously incurred deferrals for distribution assets. This rider will replace the Deferred Asser Recovery Rider. AEP Ohio will collect this charge from all customers on behalf of its Special Purpose Entity which owns the right to impose and collect such charges.

☐ AEP Ohio offers several ways for you to pay your bill. In addition to paying in person or by mail, you may receive and pay your bill electronically (e-bill) or have your payments deducted automatically from your checking or savings account. Please visit our website at www.AEPOhio.com or call the phone number listed on the front of this bill for more information.

☐ AEP Ohio offers budget billing plans to qualifying customers. A monthly amount is calculated based on previous bills. This monthly amount is reviewed and adjusted based on the type of plan. For more information, please call the phone number shown on the front of the bill.

AEP Ohio can be reached by calling 1-800-672-2231

We welcome the opportunity to assist you. Our customer service center is open 24 hours a day, 7 days a week. If you have a question or want to report a power outage, please call us toll free at 1-800-672-2231, or 1-800-617-1234 (TDD/TTY).

If your complaint is not resolved after you have called AEP Ohio, or for general utility information, residential and business customers may contact the public utilities commission of Ohio (PUCO) for assistance at 1-800-686-7826 (toll free) from eight a.m. to five p.m. weekdays, or at http://www.puco.ohio.gov. Hearing or speech impaired customers may contact the PUCO via 7-1-1 (Ohio relay service).

The Ohio consumers' counsel (OCC) represents residential utility customers in matters before the PUCO. The OCC can be contacted at 1-877-742-5622 (toll free) from eight a.m. to five p.m. weekdays, or at http://www.pickocc.org.

Rates Available on Request

R-OH-OP
REV. 08/13

Renewable Portfolio Standard / Rate Impacts

*** While every effort is made to assure accuracy, the information presented here does not supersede filed tariffs ***

Ohio's electric distribution utilities (EDUs) recover the costs of complying with the state's renewable portfolio standard (RPS) requirement through a rider frequently referred to as an alternative energy rider (AER).

The AERs are currently updated quarterly and they are bypassable, meaning that a customer who switches to a competitive retail electric service (CRES) provider would not pay the EDU's AER. Because the PUCO does not regulate the generation charges of CRES providers, this sheet does not attempt to estimate any RPS compliance costs charged to customers of CRES providers.

The EDU's AERs are designed to be a volumetric charge, so the actual bill impact depends on the volume of electricity for which a customer is charged.[1]

The table below shows the AER rates, by EDU, for the first quarter of 2017[2]. The average monthly bill impact in the table is for residential customers, and assumes monthly usage of 750 KWHs. By clicking on the hyperlink in the source column, you can view the EDU's filing pertaining to its AER rate(s).

1st Quarter 2017

EDU	Source	AER Rate ($/KWH)	Avg. Monthly Bill Impact
Cleveland Electric Illuminating	AER Filing	$0.0002010	$0.15
Dayton Power & Light	AER Filing	$0.0002475	$0.19
Duke Energy – Ohio	AER Filing	$0.0004440	$0.33
Ohio Edison Company	AER Filing	$0.0001790	$0.13
Ohio Power Company	AER Filing	$0.0010060	$0.75
Toledo Edison Company	AER Filing	$0.0003130	$0.23

[1] A customer that consumes a larger volume of electricity (i.e., an industrial customer) would experience a larger average bill impact than would a residential customer with a relatively small electricity usage.

[2] Dayton Power & Light (DP&L) revises its AER on a slightly different schedule, so the AER rate shown for DP&L is in effect for December (2016), January (2017), and February (2017).

VOLUME 1:

2015 TO 2019

ENERGY EFFICIENCY/ PEAK DEMAND REDUCTION (EE/PDR) ACTION PLAN

March 26, 2014

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E EXECUTIVE SUMMARY

E.1 AEP Ohio's Commitment and Strategic Plan Goals

AEP Ohio is committed to helping customers use energy more efficiently and productively by delivering cost-effective programs that provide value to all stakeholders.

The strategic goals of this 2015-2019 Energy Efficiency and Peak Demand Reduction (EE/PDR) Action Plan (Plan) are to:

- Deliver a comprehensive and cost-effective Plan providing the opportunity for participation by all customer rate classes and every major customer segment in every region of AEP Ohio's service territory.
- Reduce inefficient uses of electricity while improving customer productivity, comfort and safety, and increasing satisfaction.
- Provide additional customer financial resources through energy savings for other important needs and to offset rising costs.
- Help delay the need for new electricity generation and future related rate impacts.
- Continue to provide the lowest cost alternative to new generation.
- Reduce the environmental impacts of fossil fuel generation facilities and the cost of compliance with environmental regulations.
- Help provide sustainable jobs for Ohio.
- Increase economic development in Ohio.
- Meet or exceed Ohio Senate Bill (SB) 221 energy efficiency and peak demand reduction requirements.[1]
- Comply with Ohio Revised Code 4901:1-39 for Plan content.[2]

E.2 Summary of 2015-2019 EE/PDR Plan

This Plan is the third plan developed and submitted for approval to the Public Utilities Commission of Ohio (PUCO) by AEP Ohio, following the current approved 2012-2014 EE/PDR Action Plan.[3] The Plan is modeled based on the current market potential study, baseline analyses and actual results from programs delivered through the current Plan.

[1] http://www.legislature.state.oh.us/bills.cfm?ID=127_SB_221

[2] See http://codes.ohio.gov/oac/4901%3A1-39

[3] See PUCO dockets 11-5568-EL-POR and 11-5569-EL-POR for the 2012-2014 EE/PDR Action Plan

This Plan has been lengthened from three years to five years for several reasons:

- A market potential study has been completed for this Plan and AEP Ohio agrees with PUCO staff's recommendation in the revised green rules to increase the length of time from three to five years for market potential study updates[4]. The current rules do not require Plans to be completed on a three year basis; however, Plans have been filed every three years to coincide with the three year market potential study update time frame. AEP Ohio intends to file for an exception to the three year potential study update requirement in this Plan filing.
- A five year Plan reduces administrative burden on the part of AEP Ohio, stakeholders and the PUCO, while maintaining adequate oversight and review through ongoing annual filings of Plan status reports and EE/PDR rider true ups, as well as regular reporting and stakeholder input through the AEP Ohio Collaborative of stakeholders.
- The increase in Plan length will reduce costs for all customers. Plan and market potential study development is a significant cost and increasing the Plan length by two years is expected to save customers nearly $250,000 in Plan development without reducing planning quality or alignment with market conditions.
- Moving to a five year Plan at this time also reflects an experienced AEP Ohio EE/PDR staff with the capability to manage the longer-term Plan effectively based on their proven track record of cost effective goal achievement.
- AEP Ohio has a history of working collaboratively with stakeholders through its Collaborative and with other interested parties and plans to continue that effort in an open, transparent and flexible manner throughout this Plan period.
- The period from 2015 through 2018 represents a stable period of 1 percent incremental energy benchmarks and the conclusion of the cumulative peak demand reduction requirements in 2018. Costs are more predictable as well.
- For 2019, AEP Ohio has sufficient banked savings available prior to the implementation of the 2015-2019 Plan to pledge a minimum of 1 percent in 2019 so that this Plan can be designed to meet or exceed 1 percent in that year, reducing costs for all customers.
- AEP Ohio's position at this time is that 2020 represents a critical year of review to determine if then implemented federal codes and standards will diminish the ability of utilities in Ohio to reach the mandated 2 percent goals past 2019 in a cost effective manner, without significantly increasing costs for all customers.
- AEP Ohio and interested stakeholders need more time leading up to 2020 to develop the future planning necessary to address this challenge and a five year

[4] See PUCO Docket 13-0651-EL-ORD

plan implementation and approval provides that opportunity. Lower statutory goals and/or Plan cost caps may need to be considered in order to continue cost effective programs at reasonable costs for all customers.

- Whether the legislative mandates for energy efficiency and peak demand reduction remain the same, change or are eliminated, this Plan is provided for approval to the Commission for the full term of the Plan. The Plan benefits for all customers and the state of Ohio are significantly higher than the cost.

The Plan reflects the continuance of successful existing programs and modifications to improve program success. In addition, new programs have been added to the Plan to encourage greater participation by customers. Collaborative stakeholder input has been instrumental in identifying and adding new programs and modifications to existing ones. Segmentation continues to be enhanced, enabling targeted marketing to continue increasing customer participation. Ongoing Plan viability, customer acceptance, customer satisfaction and cost effectiveness are critically important; therefore, the Plan continues a rigorous research and development function, to ensure ongoing effective energy efficiency programs that deliver strong performance. The research and development function will also allow new program opportunities identified over the Plan life to be tested, measured and integrated into the program offerings after passing AEP Ohio's screening process.

Significant effort was made to design the Plan at a lower cost on an annual basis than the 2012-2014 approved EE/PDR Action Plan, even though the benchmark requirements are higher. The Plan is designed to meet or exceed the benchmark energy efficiency and peak demand reduction requirements in Ohio law, while capping Plan costs at the 2013 approved levels on average for the 2015-2019 Plan.

This Plan allows the flexibility to adjust and shift incentives between programs to maximize cost effectiveness and increase customer participation as conditions change over the five year period. Any shifting of incentives between residential and commercial/industrial customer classes would require separate PUCO approval and is not expected at this time. AEP Ohio proposes to develop separate residential and business pools of incentive dollars, allocating those incentive dollars to the programs that are the most cost effective and have the highest customer participation each year. Further, AEP Ohio intends to utilize competitive bidding for business incentive dollars through its Bid to Win program in the fall of each year to provide competitive intelligence that can be used to set business program incentives in the following year.

Cost management and overall improvement strategies for the 2015-2019 Plan include:

- Provide program opportunities to improve cost effectiveness while also increasing customer participation and satisfaction.

- Continue and enhance the successful programs currently being delivered; however, focus on adjusting incentives for all programs based on market conditions through competitive bidding and ongoing market analyses.
- Pool some incentive dollars into residential and business buckets to be delivered to customers through approved programs based on cost effectiveness and program participation. Identify methods of reducing the cost of managing and delivering incentives.
- Increase multifamily opportunities for new construction and home retrofit programs.
- Investigate building code compliance educational opportunities and attribute appropriate savings.
- Focus on total electric residential customer opportunities to increase savings per home, including manufactured housing.
- Improve target marketing in all sectors.
- Increase customer awareness of AEP Ohio programs with research and segmentation, to increase opportunities for all customers to participate.
- Add Combined Heat and Power and Waste Energy Recovery (CHP/WER) program and deliver performance based and highly cost effective customer projects to help offset cost effectiveness losses by other programs to codes and standards changes.
- Enhance Continuous Energy Improvement (CEI) program to increase customer productivity and reduce energy density for large scale energy savings at lower cost.
- Provide AEP Ohio side of the meter customer energy efficiency programs such as Volt Var and investigate light-emitting diode (LED) street lighting and LED outdoor lighting programs.
- Continue to investigate upstream and midstream approaches as well as direct opportunities to deliver cost effective energy efficiency measures.

EE/PDR is an important resource for the state of Ohio, AEP Ohio and its customers, continuing to be important as future fuel and commodity prices remain volatile and environmental regulation becomes more stringent. EE/PDR may become an effective resource to help state compliance with potential future federal greenhouse gas regulations. Estimates of EE/PDR potential are a key input to the integrated resource planning process, which considers the load forecast and both supply-side and demand-side resources. The market potential study that informs this Plan is the result of a current analysis of the EE/PDR market potential in AEP Ohio's service territory by Navigant Consulting, Inc. (Navigant), an experienced EE/PDR consultant, under the direct supervision and guidance of AEP Ohio. The market potential study included the results of a recent baseline study completed in AEP Ohio's service territory and the direct experience of AEP Ohio in its current program Plan performance, as well as benchmarking and best practices program analyses from other utility programs.

Ohio law in SB 221 requires investor-owned electric utilities to achieve incremental energy savings each year through EE/PDR programs, with a cumulative 22.2 percent by the end of 2025. Utilities also must implement programs designed to reduce peak energy demand one percent beginning in 2009, and an additional 0.75 percent per year, for a total 7.75 percent through 2018.

Table 1 presents SB 221 EE/PDR percentage requirements and associated energy and summer peak demand requirements for 2015 through 2019, which is the focus of this EE/PDR Action Plan.

Table 1. SB 221 Savings Requirements (at Meter) – 2015 to 2019

SB 221 Requirements				
At Meter	**Energy Savings (GWh)**			
Year	**Incremental**		**Cumulative** (2009 Through)	
2015	1.0%	420.8	5.2%	2,295.7
2016	1.0%	424.9	6.2%	2,720.6
2017	1.0%	425.6	7.2%	3,146.2
2018	1.0%	426.3	8.2%	3,572.5
2019	2.0%	854.5	10.2%	4,427.0
At Meter	**Peak Demand Savings (MW)**			
Year	**Incremental**		**Cumulative (2009 through)**	
2015	0.75%	49	5.50%	479.0
2016	0.75%	55	6.25%	533.9
2017	0.75%	54	7.00%	587.8
2018	0.75%	63	7.75%	650.5
2019	NA	NA	NA	NA

AEP Ohio plans to meet or exceed the SB 221 savings requirements for 2015 to 2019, ensuring that all customer classes have energy saving opportunities. The Plan presents detailed information on the approach, energy efficiency and demand response measures and proposed incentive levels. AEP Ohio anticipates that portions of the Plan will need to be adjusted during implementation in response to better information or changing market conditions. AEP Ohio will update the PUCO in accordance with the rules, and advise the AEP Ohio Collaborative regarding the need for any substantive revisions to this Plan.

E.3 Summary of EE/PDR Program Results

Table 2 presents the actual savings results submitted to the PUCO for 2011 and 2012 programs.

Table 2. EE/PDR Plan Savings Results (at Meter) – 2011 to 2012

EE/PDR Plan Savings Results 2011 to 2012						
At Meter	**Energy Savings (GWh)**					
Year	**Incremental**			**Cumulative (2009 through)**		
	SB 221 Requirement	GWh Achieved	Achievement as Percent of Sales	SB 221 Requirement	GWh Achieved	Achievement as Percent of Sales
2011	0.7%	502	1.04%	1.5%	1,117	0.79%
2012	0.8%	571	1.22%	2.3%	1,688	0.90%
At Meter	**Peak Demand Savings (MW)**					
Year	**Incremental**			**Cumulative (2009 through)**		
	SB 221 Requirement	MW Achieved	Achievement as Percent of Sales	SB 221 Requirement	MW Achieved	Achievement as Percent of Sales
2011	0.75%	128	1.26%	2.50%	270	0.94%
2012	0.75%	82	0.86%	3.25%	352	0.92%

E.4 EE/PDR Plan Summary

AEP Ohio proposes to invest up to $441.4 million over five years on energy efficiency and demand response programs and projects full year savings of 2,705 GWh and 433 MW cumulative annual savings at the meter over a five-year period during calendar years 2015 through 2019. The total customer bill savings from this investment estimated over the life of the installed EE/PDR measures are projected at approximately $1.5 billion, using Participant Cost Test (PCT) net benefit results less program administrative costs. Further, the total net benefits based on the Total Resource Cost (TRC) test are projected to be about $615 million, including reparticipation over the 20-year planning horizon, excluding Combined Heat and Power/Waste Energy Recovery (CHP/WER). With every dollar of program investment yielding over 1.6 dollars in benefits, using the TRC test net benefit results.

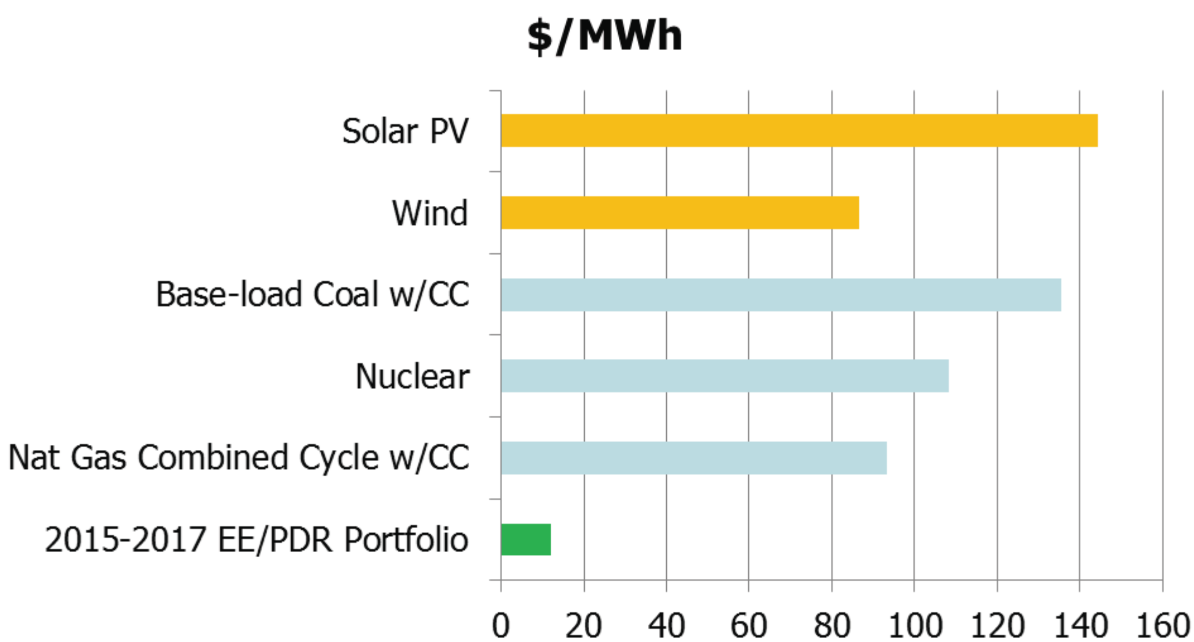
1.5 billion in savings

The overall Plan projected first year annual cost per kWh saved is $0.16/kWh (note that this cost is not comparable to a supply-side investment and is only used to compare programs and Plans at a high level for reasonableness of cost.) This Plan continues the previous Plan's anticipation that the lower cost lighting opportunities are going to be significantly less available over time; however, growing commercial and industrial measures are expected to make up for some of those losses. Large institutional or industrial combined heat and power projects can be highly cost effective in the right applications and may provide significant opportunities to help offset the loss of low cost lighting applications. Another opportunity reflected in this Plan is the shift to LED lighting. While incremental annual savings will be lower, LED lighting measure life will help improve cost effectiveness.

This Plan reflects an ongoing reduction in lighting savings resulting from changes in baselines due to federal lighting standards and projected deeper savings from higher cost, but still cost effective, measures and measure combinations. AEP Ohio's actual program experience with costs has been factored into the 2015-2019 Plan cost projections.

The lifetime cost of saved energy is estimated to be $0.013/kWh for the 2015 to 2019 EE/PDR Plan. The lifetime cost of saved energy is more comparable to a supply-side generation investment alternative. At current supply-side generation investment alternatives including non-dispatchable technologies such as wind and solar, the EE/PDR Plan cost compares favorably and is the lowest cost alternative, as shown in Figure 1.

Figure 1. EE/PDR vs. Supply-Side Investments



Supply-side investments source: Energy Information Administration, Annual Energy Outlook 2013, January 2013, DOE/EIA-0383 (2012).

The division of EE/PDR program investment between residential and business customers is commensurate with each sector's relative cost-effectiveness and contribution to the Plan. Table 3 provides the projected savings, associated funding for

AEP Ohio's 2015 through 2019 program Plan, and projected net present value net benefits.

Table 3. Savings Goals and Efficiency Plan Investment – 2015 to 2019

Consumer Sector (Incremental Annual Savings at Meter)	2015	2016	2017	2018	2019	2015-2019 Total (Cumulative)	NPV Net Benefits (Million $ 2015$)
Energy Savings (GWh)	130	128	133	138	141	591	$136
% Savings of Sector Sales	0.95%	0.95%	0.99%	1.02%	1.05%	4.41%	-
Note: Behavior Change program savings are not cumulative. Combined Heat and Power / Waste Energy Recovery savings are presented in 2015-2019 Total (Cumulative) only; and are not presented in 2015 to 2019 Incremental Annual Savings.							
Demand Savings (MW)	21	20	20	20	21	90	-
% Savings of Sector Sales	0.61%	0.59%	0.60%	0.60%	0.62%		-
Note: Demand savings goals are not cumulative. Behavior Change program savings are not cumulative. Combined Heat and Power / Waste Energy Recovery savings are not presented in 2015 to 2019 Incremental Annual Savings.							
Total Cost (million $)	**$30.2**	**$30.6**	**$34.0**	**$36.5**	**$37.1**	**$168.4**	**-**
Business Sector (Incremental Annual Savings at Meter)	**2015**	**2016**	**2017**	**2018**	**2019**	**2015-2019 Total (Cumulative)**	**NPV Net Benefits (Million$ 2015$)**
Energy Savings (GWh)	299	309	317	321	326	2,114	$511
% Savings of Sector Sales	1.09%	1.12%	1.15%	1.16%	1.18%	7.70%	-
Note: Combined Heat and Power / Waste Energy Recovery savings are presented in 2015-2019 Total (Cumulative) only, and are not presented in 2015 to 2019 Incremental Annual Savings.							
Demand Savings (MW)	53	54	54	54	55	343	-
% Savings of Sector Sales	1.12%	1.13%	1.14%	1.14%	1.15%		-
Demand savings goals are not cumulative. Behavior Change program savings are not cumulative. Combined Heat and Power / Waste Energy Recovery savings are not presented in 2015 to 2019 Incremental Annual Savings.							
Total Cost (million $)	**$44.2**	**$46.2**	**$47.0**	**$47.5**	**$48.0**	**$233.0**	**-**

Total All Sectors (Incremental Annual Savings at Meter)	2015	2016	2017	2018	2019	2015-2019 Total (Cumulative)	NPV Net Benefits (Million $ 2015$)
Energy Savings (GWh)	429	438	450	459	468	2,705	$615
% Savings of Sector Sales	1.04%	1.06%	1.10%	1.12%	1.14%	6.60%	-
Note: Behavior Change program savings are not cumulative. Combined Heat and Power / Waste Energy Recovery savings are presented in 2015-2019 Total (Cumulative) only; and are not presented in 2015 to 2019 Incremental Annual Savings.							
Demand Savings (MW)	74	74	75	74	75	433	-
% Savings of Sector Sales	0.91%	0.91%	0.92%	0.92%	0.93%		-
Note: Demand savings goals are not cumulative. Behavior Change program savings are not cumulative. Combined Heat and Power / Waste Energy Recovery savings are not presented in 2015 to 2019 Incremental Annual Savings.							
Total Cost (million $)	$74.4	$76.8	$81.0	$84.0	$85.1	$401.4	-
Other Costs (million $)	$8.0	$8.0	$8.0	$8.0	$8.0	$40.0	
Portfolio Total Investment (million $)	**$82.4**	**$84.8**	**$89.0**	**$92.0**	**$93.1**	**$441.4**	**-**

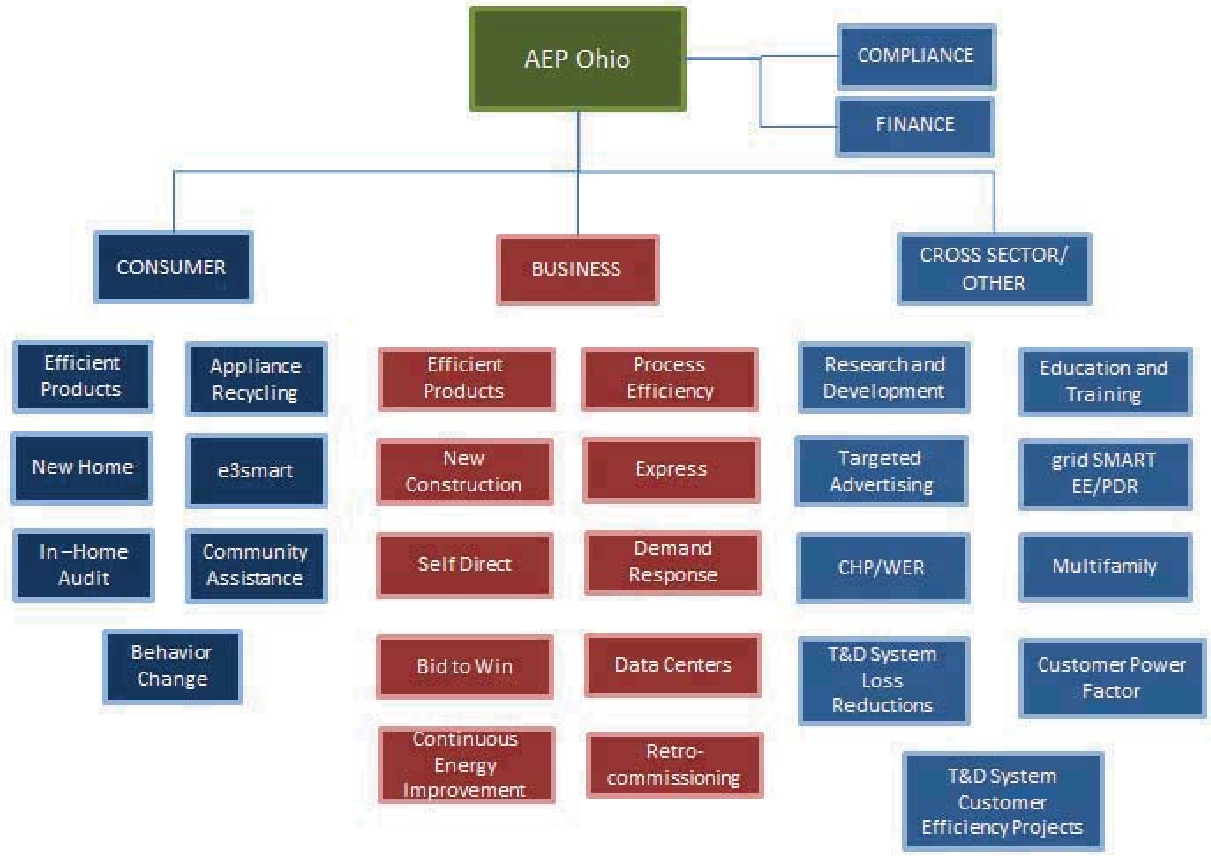
(1) Savings are not projected for Research and Development, Transmission and Distribution (T&D) System Efficiency Improvements, Customer Power System Efficiency or Demand Response. AEP Ohio also will conduct program evaluation and other essential program support functions, such as compliance and reporting, database management, contracting and payables, and Plan cost-benefit analysis.
(2) Other Costs include support and other services, including Research and Development, General Education and Training, Targeted Advertising, and Demand Response, etc.

Incentive levels and other program elements will be reviewed and adjusted to reflect changes in market conditions or implementation processes in order to maximize cost-effective savings.

Plan Structure

Figure 2 presents the proposed Plan structure, including seven consumer sector and ten business sector programs, as well as nine cross-sector programs and other activities. AEP Ohio also will conduct program evaluation and other essential program support functions, such as compliance and reporting, financials, database management, contracting and payables and Plan benefit-cost analysis. The new programs are Multifamily, Combined Heat and Power / Waste Energy Recovery (CHP/WER), Customer Power Factor and transmission and distribution (T&D) Customer Efficiency Projects.

Figure 2. EE/PDR Action Plan Structure – 2015 to 2019



E.5 Energy, Demand and Emissions Savings

Table 4 presents the projected incremental annual GWh energy savings for each year as well as 2015 to 2019 cumulative total, TRC test results, net present value net benefits in 2015 million dollars, lifetime energy saved in thousand MWh, and lifetime cost of saved energy in 2015 dollars per kWh over the five-year period from 2015 to 2019.

Table 4. Incremental Annual Energy (GWh) Savings at Meter – 2015 to 2019

Consumer Sector	`15	`16	`17	`18	`19	`15-`19 Total (cumu-lative)	% of Plan Total	Total Resource Cost Test (TRC)	NPV Net Benefits (million 2015$)	Lifetime Energy Saved (thousand MWh)	Lifetime Cost of Saved Energy (2015$ / kWh)
Appliance Recycling	17	15	15	15	15	**76**	2.8%	2.3	$14.9	609	$0.019
Behavior Change	9	9	9	9	9	**9**	0.3%	1.2	$0.4	9	$0.207
Community Assistance	8	9	9	10	9	**43**	1.6%	0.8	-$5.5	560	$0.060
e3smart	5	5	5	5	5	**24**	0.9%	3.0	$9.8	216	$0.011
Efficient Products	74	74	78	81	84	**353**	13.1%	1.7	$100.9	3,605	$0.018
In-Home Energy	10	10	10	11	12	**51**	1.9%	1.2	$4.4	577	$0.032
New Home	6	7	7	7	7	**34**	1.3%	1.4	$10.7	671	$0.015
Consumer Sector Total	**130**	**128**	**133**	**138**	**141**	**591**	**21.8%**	**1.6**	**$135.7**	**6,246**	**$0.023**
% Total of Consumer Sector Sales	0.95%	0.95%	0.99%	1.02%	1.05%	Note: Behavior Change savings are not cumulative.					

Business Sector	`15	`16	`17	`18	`19	`15-`19 Total (cumu-lative)	% of Plan Total	Total Resource Cost Test (TRC)	NPV Net Benefits (million 2015$)	Lifetime Energy Saved (thousand MWh)	Lifetime Cost of Saved Energy (2015$ / kWh)
New Construction and Major Renovation	32	36	36	36	36	**173**	6.4%	2.6	$63.5	1,757	$0.010
Continuous Energy Improvement	14	16	17	15	14	**74**	2.7%	1.2	$8.3	369	$0.037
Process Efficiency	65	63	67	65	65	**325**	12.0%	2.8	$155.7	4,685	$0.007
Data Center	8	7	7	6	6	**34**	1.3%	1.2	$3.7	169	$0.041
Bid to Win	43	45	45	44	45	**222**	8.2%	1.2	$26.2	2,216	$0.006
Express	20	22	21	21	21	**104**	3.8%	1.5	$23.4	790	$0.025
Efficient Products for Business	99	100	105	111	118	**515**	19.1%	1.7	$150.2	4,732	$0.014
Retro-Commissioning	3	4	4	4	5	**20**	0.7%	1.2	$2.2	99	$0.028
Self-Direct	11	11	12	13	13	**26**	1.0%	3.3	$25.4	258	$0.021
Multifamily	4	5	5	4	4	**22**	0.8%	1.2	$2.4	187	$0.049
Combined Heat and Power/Waste Energy Recovery	-	-	-	-	-	**600**	22.2%	1.2	$50.0	9,600	$0.002
Business Sector Total	**299**	**309**	**317**	**321**	**326**	**2,114**	**78.2%**	**1.6**	**$510.9**	**24,863**	**$0.008**
% Total of Business Sector Sales	1.09%	1.12%	1.15%	1.16%	1.18%	Note: CHP/WER annual savings are not presented.					
PLAN TOTAL (includes Other Costs)	**429**	**437**	**450**	**459**	**467**	**2,705**	**100%**	**1.6**	**$615.2**	**31,109**	**$0.013**
% Total of Total Sales	1.04%	1.08%	1.10%	1.12%	1.14%	Note: CHP/WER annual savings are not presented.					

Table 5 presents the projected incremental annual summer peak demand MW savings levels as well as the cumulative total over the five-year period from 2015 to 2019.

Table 5. Incremental Annual Summer Peak Demand (MW) Savings at Meter – 2015 to 2019

Consumer Sector	2015	2016	2017	2018	2019	2015-2019 Total (cumulative)	Percent of Plan Total
Appliance Recycling	2.3	2.1	2.1	2.1	2.1	**10.8**	2.5%
Behavior Change	1.2	1.2	1.2	1.2	1.2	**1.2**	0.3%
Community Assistance	1.1	1.2	1.2	1.3	1.2	**5.6**	1.3%
e3smart	0.5	0.6	0.5	0.5	0.5	**2.6**	0.6%
Efficient Products	11.1	10.0	9.7	9.3	9.8	**44.7**	10.3%
In-Home Energy	1.9	1.9	2.1	2.3	2.5	**10.0**	2.3%
New Home	2.8	2.8	3.4	3.3	3.2	**15.4**	3.6%
Consumer Sector Total	**21.0**	**19.8**	**20.2**	**20.1**	**20.6**	**90.4**	20.9%
Percent Total of Sector Sales	0.61%	0.59%	0.60%	0.60%	0.62%	**-**	**-**
Business Sector	**2015**	**2016**	**2017**	**2018**	**2019**	**2015-2019 Total (cumulative)**	**Percent of Plan Total**
New Construction and Major Renovation	2.9	3.2	3.2	3.2	3.3	**15.7**	3.6%
Continuous Energy Improvement	2.9	3.5	3.5	3.2	2.9	**15.7**	3.6%
Process Efficiency	14.3	13.6	13.9	13.1	12.8	**66.8**	15.4%
Data Center	0.8	0.7	0.6	0.6	0.6	**3.1**	0.7%
Bid to Win	7.2	7.5	7.4	7.4	7.5	**36.9**	8.5%
Express	4.0	4.2	3.9	3.7	3.6	**18.9**	4.4%
Efficient Products for Business	18.4	18.3	18.7	19.5	20.4	**92.9**	21.4%
Retro-Commissioning	0.5	0.6	0.7	0.7	0.8	**3.3**	0.8%
Self-Direct	1.3	1.2	1.3	1.4	1.4	**2.7**	0.6%
Multifamily	1.0	1.2	1.1	1.0	0.9	**5.1**	1.2%
CHP/WER	-	-	-	-	-	**81.9**	18.9%
Business Sector Total	**53.3**	**55.0**	**54.0**	**53.8**	**54.2**	**343.0**	79.1%
Percent Total of Sector Sales	1.12%	1.13%	1.14%	1.14%	1.15%	**-**	-
Plan Total	**74.3**	**74.8**	**74.2**	**73.9**	**74.8**	**433.3**	**-**
Percent of Total Sales	0.91%	0.91%	0.92%	0.92%	0.93%	**-**	-

Table 6 presents the estimated total emissions reductions based on the projected cumulative annual energy savings at meter over the five-year period from 2015 to 2019.[5]

Table 6. Total Emissions Reductions – 2015 to 2019

Consumer Sector	NOx (metric tons)	SO_2 (metric tons)	CO_2 (metric tons)	H_g (lbs.)
Appliance Recycling	50	151	40,435	2.5
Behavior Change	6	19	4,976	0.3
Community Assistance	29	88	23,694	1.5
e[3]smart[SM]	16	49	13,146	0.8
Efficient Products	255	775	207,747	12.8
In-Home Energy	34	104	28,028	1.7
New Home	22	68	18,123	1.1
Consumer Sector Total	**413**	**1,253**	**336,148**	**20.6**
Business Sector	**NOx** (metric tons)	**SO_2** (metric tons)	**CO_2** (metric tons)	**H_g** (lbs.)
New Construction & Major Renovation	114	346	92,768	5.7
Continuous Energy Improvement	49	149	39,993	2.5
Process Efficiency	213	645	172,987	10.6
Data Center	23	70	18,768	1.2
Bid to Win	145	439	117,714	7.2
Express	69	210	56,230	3.5
Efficient Products for Business	348	1,056	283,339	17.4
Retro-Commissioning	13	40	10,795	0.7
Self-Direct	39	117	31,476	1.9
Multifamily	15	45	11,941	0.7
CHP/WER	1,176	3,564	956,081	58.7
Business Sector Total	2,204	6,681	1,792,092	110.0
PLAN TOTAL	**2,617**	**7,934**	**2,128,241**	**130.6**

E.6 EE/PDRs Investment and Potential Job Creation

The estimated investment for these programs is approximately $88.3 million in each year from 2015-2019, for a total $441.4 million, as shown in Table 7.

[5] Emissions factors from PJM.

Table 7. Estimated Annual Total Investments by Program (million $)

Consumer Sector	2015	2016	2017	2018	2019	2015-2019 Total (cumulative)	Percent of Plan Total
Efficient Products	$13.2	$13.0	$15.4	$17.6	$18.0	**$77.3**	17.5%
Community Assistance	$7.4	$8.0	$8.1	$7.9	$7.9	**$39.4**	8.9%
In-Home Energy	$3.9	$3.8	$4.3	$4.7	$5.1	**$21.9**	5.0%
Appliance Recycling	$2.9	$2.6	$2.6	$2.6	$2.6	**$13.2**	3.0%
New Home	$1.9	$2.0	$2.5	$2.6	$2.6	**$11.7**	2.7%
Behavior Change	$0.4	$0.4	$0.4	$0.4	$0.4	**$2.2**	0.5%
e3smart^{SM}	$0.6	$0.6	$0.6	$0.6	$0.6	**$2.8**	0.6%
Consumer Sector Total	**$30.2**	**$30.6**	**$34.0**	**$36.5**	**$37.1**	**$168.4**	**38.2%**
Business Sector	**2015**	**2016**	**2017**	**2018**	**2019**	**2015-2019 Total (cumulative)**	**Percent of Plan Total**
Efficient Products for Business	$14.5	$14.6	$15.2	$16.1	$16.9	**$77.3**	17.5%
Process Efficiency	$7.9	$7.5	$7.5	$7.1	$6.8	**$36.8**	8.3%
Express	$4.5	$4.9	$4.7	$4.6	$4.6	**$23.3**	5.3%
New Construction and Major Renovation	$3.8	$4.3	$4.3	$4.3	$4.3	**$21.0**	4.8%
Continuous Energy Improvement	$2.9	$3.5	$3.5	$3.2	$2.9	**$16.0**	3.6%
Bid to Win	$3.2	$3.4	$3.3	$3.3	$3.3	**$16.5**	3.7%
CHP/WER	$1.7	$2.1	$2.6	$3.1	$3.5	**$13.0**	2.9%
Multifamily	$1.9	$2.5	$2.3	$2.1	$2.0	**$10.7**	2.4%
Self-Direct	$1.1	$1.1	$1.3	$1.5	$1.4	**$6.5**	1.5%
Data Center	$1.9	$1.7	$1.5	$1.5	$1.4	**$8.0**	1.8%
Retro-Commissioning	$0.5	$0.6	$0.6	$0.7	$0.8	**$3.3**	0.7%
Demand Response	$0.1	$0.1	$0.1	$0.1	$0.1	**$0.5**	0.1%
Business Sector Total	**$44.2**	**$46.2**	**$47.0**	**$47.5**	**$48.0**	**$233.0**	**52.8%**
Other Costs	**2015**	**2016**	**2017**	**2018**	**2019**	**Total**	**Percent of Plan Total**
Targeted Advertising & Outreach	$5.3	$5.3	$5.3	$5.3	$5.3	**$26.5**	6.0%
Research and Development	$2.0	$2.0	$2.0	$2.0	$2.0	**$10.0**	2.3%
Education and Training	$0.7	$0.7	$0.7	$0.7	$0.7	**$3.5**	0.8%
Other Costs Total	**$8.0**	**$8.0**	**$8.0**	**$8.0**	**$8.0**	**$40.0**	**9.1%**
PLAN TOTAL	**$82.4**	**$84.8**	**$89.0**	**$92.0**	**$93.1**	**$441.4**	**-**

(1) Savings are not projected for Research and Development, Education and Training, Targeted Advertising or Demand Response. AEP Ohio also will conduct program evaluation and other essential program support functions, such as compliance and reporting, database management, contracting and payables, and Plan cost-benefit analysis.
(2) Other Costs include support and other services, including Research and Development, General Education and Training, Targeted Advertising, and Demand Response, etc.

To firm up cost estimates and make any necessary budget and schedule changes, AEP Ohio may re-negotiate existing contracts for ongoing programs or issue Requests for Proposals (RFPs) for implementation contractors to bid on the work, and require them to submit detailed budgets along with estimated savings and implementation schedules. All new programs will be competitively bid through an RFP process. The cost for incremental internal management and third party evaluation, measurement and verification activities, and future plan development is included in the cost of the Plan. It is anticipated that these costs will not exceed ten percent of the total costs for the Plan.

Potential Job Creation

To capture the full economic impacts of the investments in energy efficiency, three separate effects (direct, indirect, and induced) must be examined for each change in expenditure. The sum of these three effects yields the total effect resulting from a single expenditure.

- The **direct effect** refers to the on-site or immediate effects produced by expenditures. In the case of installing energy efficiency upgrades in a home or business, the direct effect is the on-site expenditures and jobs of the construction or trade contractors hired to carry out the work.
- The **indirect effect** refers to the increase in economic activity that occurs when a contractor or vendor receives payment for goods or services delivered and is able to pay others who support their businesses. This includes the equipment manufacturer or wholesaler who provided the new technology. It also includes the bank that provides financing to the contractor, the vendor's accountant, and the building owner where the contractor maintains its local offices.
- The **induced effect** derives from the change in spending that energy efficiency investments enable. Businesses and households are able to meet their energy, heating, cooling, and lighting needs at a lower total cost, due to efficiency investments. This lower cost of doing business and operating households makes greater wealth available for businesses and families to spend or invest in other goods and services such as food, clothing, entertainment, or marketing (in the case of businesses).

Table 8 shows the total number of potential jobs—direct, indirect, and induced—that are estimated would be created from investing $441.4 million in electric energy efficiency and peak demand reduction in AEP Ohio customer homes and businesses in 2015 through 2019. AEP Ohio estimates the number of jobs in Table 8.[6] On average, based on this analysis, one job potentially will be created for approximately $100,000 in spending.

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[6] Job creation estimates based on data from Green Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy, pages 9 and 27, Political Economy Research Institute, University of Massachusetts at Amherst, http://www.americanprogress.org/issues/2008/09/pdf/green_recovery.pdf

Table 8. Number of Jobs Created (2015 through 2019)

2015 to 2019	Direct	Indirect	Induced	Total
Jobs Created	1,950	1,450	975	**4,375**

E.7 Benefit-Cost Analysis, Net Benefits and Bill Impacts

Energy efficiency measures were evaluated with respect to each of the four standard benefit-cost tests:[7]

- **Participant Test (PCT)**: Measures are cost effective from this perspective if the reduced electric costs to the participating customer from the measure exceed the after-incentive cost of the measure to the customer.
- **Utility (or program administrator) (UCT) Cost Test**: Measures are cost effective from this perspective if the costs avoided by the measures' energy and demand savings are greater than the utility's EE/PDR program costs to promote the measure, including customer incentives.
- **Ratepayer Impact Measure (RIM) Test:** Measures are cost effective from this perspective if their avoided costs are greater than the sum of the EE/PDR program costs and the "lost revenues" caused by the measure.
- **Total Resource Cost (TRC) Test:** Measures are cost effective from this perspective if their avoided costs are greater than the sum of the measure costs and the EE/PDR program administrative costs.

In line with standard industry practice and PUCO rule, AEP Ohio used the TRC test to guide which EE/PDR programs to include in the Plan. Most measures passed the TRC test. The Plan of EE/PDR programs in the Plan are cost effective by industry standards.

[7] California Public Utilities Commission. California Standard Practice Manual Economic Analysis of Demand-Side Programs and Projects, October 2001, http://drrc.lbl.gov/pubs/CA-SPManual-7-02.pdf.

Table 9 presents the overall benefit cost ratios for the consumer sector, the business sector, and the overall Plan including all costs from cross-sector and other activities.

Table 9. Cost-effectiveness Ratios – 2015 to 2019

Consumer Sector	Total Resource Cost Test (TRC)	Utility Cost Test (UCT)	Participant Cost Test (PCT)	Rate Impact Measure Test (RIM)
Appliance Recycling	2.3	2.3	7.7	0.4
Behavior Change	1.2	1.2	0.0	0.3
Community Assistance	0.8	0.6	3.0	0.3
e3smart	3.0	6.1	8.0	0.5
Efficient Products	1.7	3.8	4.0	0.5
In-Home Energy	1.2	1.5	3.4	0.4
New Home	1.4	3.6	3.0	0.5
Consumer Sector Total	**1.6**	**2.6**	**4.0**	**0.4**
Business Sector	**Total Resource Cost Test (TRC)**	**Utility Cost Test (UCT)**	**Participant Cost Test (PCT)**	**Rate Impact Measure Test (RIM)**
New Construction and Major Renovation	2.6	5.8	4.4	0.7
Continuous Energy Improvement	1.2	3.7	2.3	0.5
Process Efficiency	2.8	7.6	3.6	0.9
Data Center	1.2	2.8	2.8	0.5
Bid to Win	1.2	10.6	1.5	0.8
Express	1.5	3.5	3.3	0.5
Efficient Products for Business	1.7	5.4	2.6	0.7
Retro-Commissioning	1.2	4.5	1.7	0.7
Self-Direct	3.3	6.7	5.1	0.8
Multifamily	1.2	1.7	4.4	0.4
CHP/WER	1.2	18.1	1.2	1.0
Business Sector Total	**1.6**	**6.6**	**2.2**	**0.8**
Plan Total (includes Other Costs)	**Total Resource Cost Test (TRC)**	**Utility Cost Test (UCT)**	**Participant Cost Test (PCT)**	**Rate Impact Measure Test (RIM)**
	1.6	**4.6**	**2.6**	**0.7**

Projected Net Benefits

The formulas used to determine the net benefits for each benefit-cost test are provided in Table 10. After all tests are evaluated by calculating the net present values over the lifetimes of the measures covered by the 20-year planning horizon. The total net benefits for each benefit-cost test for the 2015-2019 EE/PDR Plan are calculated by subtracting the value(s) in the denominator of each formula from the value(s) in the numerator. For example, subtracting both Administrative Costs (B) and Incentive Costs (C) from the Avoided Costs (A) results in the the UCT net benefits.

Table 11 presents the present value costs for the 2015-2019 EE/PDR Plan. The Avoided Costs (A) and Bill Reductions (E) result from energy savings and are valued as benefits. The Administrative Costs (B), Incentive Costs (C), and Technology Costs (D) are valued as costs.

Table 10. Benefit-Cost Test Formulas

Cost Test	Formula	Key of Terms	
Utility Cost Test (UCT)	UCT = A / (B + C)	A = PV Avoided Costs	D = PV Technology Costs
Participant Cost Test (PCT)	PCT = (C + E) / D	B = PV Administrative Costs	E = PV Bill Reductions
Rate Impact Measure Cost Test (RIM)	RIM = A / (B + C + E)	C = PV Incentive Costs	PV = Present Value
Total Resource Cost Test (TRC)	TRC = A / (B + D)		

Table 11. Present Value Costs – 2015 to 2019 (2015$)

PV Avoided Costs (A)	PV Administrative Costs (B)	PV Incentive Costs (C)	PV Technology Costs (D)	PV Bill Reductions (E)
$1,711,817,207	$137,105,377	$240,154,491	$959,552,030	$2,245,373,773

Utilty Cost Test (UCT) indicates how much utilty costs will decrease due to the projected EE/PDR programs. The UCT examines the EE/PDR costs and benefits from the AEP Ohio's perspective. The UCT allows AEP Ohio to evaluate EE/PDR benefits and costs on a comparable basis with supply-side investments. A positive UCT indicates the total EE/PDR costs to save energy are less than the AEP Ohio's costs to deliver the same amount of power though new supply side resources. The net benefits from the UCT is the reduction in supply costs to AEP Ohio due to reduced energy consumption.

Participant Cost Test (PCT) examines the costs and benefits from the perspective of the customer installing the EE/PDR measures. The PCT shows how much the EE/PDR program participants are projected to save over the life of the meaures installed.

Rate Impact Measure Test (RIM) indicates how much AEP Ohio's rates are projected to increase or decrease over the long term as a result of the EE/PDR measures installed. Unlike typical supply-side investments, EE/PDR programs reduce enegy sales. It is also important to consider whether rates overall will increase more or less by installing EE/PDR measures than new supply side resources over the long term.

Total Resource Cost Test (TRC) shows how much more or less energy efficiency resources cost compared to new supply-side electricity resources in the AEP Ohio service area. Unlike other cost tests, the TRC does not take the view of a class of stakeholders. The TRC test is essentially the "all ratepayer" test. The TRC is similar to the UCT except that the TRC considers the full cost of the measure itself rather than only the portion covered by the incentive paid by AEP Ohio.

Table 12 presents the cost test results in terms of net present value (NPV) net benefits based on the projected 2015 to 2019 EE/PDR programs. A positive value indicates cost savings, while a negative value indicates increased costs.

Table 12. Costs Tests – Net Present Value Net Benefits – 2015-2019 (2015 $million)

Consumer Sector	Total Resource Cost Test (TRC)	Utility Cost Test (UCT)	Participant Cost Test (PCT)	Rate Impact Measure Test (RIM)
Efficient Products	$100.9	$179.3	$384.4	($283.5)
In-Home Energy	$4.4	$9.3	$39.9	($35.4)
Appliance Recycling	$14.9	$14.9	$53.4	($38.5)
Behavior Change	$0.4	$0.4	$5.2	($4.8)
New Home	$10.7	$25.7	$41.7	($31.0)
E3smart™	$9.8	$12.4	$26.2	($16.4)
Community Assistance	($5.5)	($12.9)	$43.9	($49.4)
Consumer Sector Total	**$135.7**	**$229.1**	**$594.7**	**($459.0)**
Business Sector	**Total Resource Cost Test (TRC)**	**Utility Cost Test (UCT)**	**Participant Cost Test (PCT)**	**Rate Impact Measure Test (RIM)**
Efficient Products for Business	$150.2	$288.3	$295.1	($144.9)
Process Efficiency	$155.7	$208.5	$179.5	($23.8)
New Construction and Major Renovation	$63.5	$85.0	$116.5	($53.0)
Express	$23.4	$49.3	$89.4	($66.0)
Self Direct	$25.4	$30.8	$35.8	($10.4)

Retro-Commissioning	$2.2	$9.6	$7.2	($5.0)
Continuous Energy Improvement	$8.3	$36.4	$54.1	($45.7)
Bid to Win	$26.2	$134.9	$65.2	($39.1)
Data Center	$3.7	$12.7	$26.1	($22.5)
Combined Heat and Power and Waste Energy Recovery	$50.0	$275.2	$40.5	$9.5
Multifamily	$2.4	$6.6	$21.5	($19.1)
Business Sector Total	**$510.9**	**$1,137.3**	**$930.9**	**($420.0)**
Plan Total (includes Other Costs)	**TRC**	**UCT**	**PCT**	**RIM**
	$615.2	**$1,334.6**	**$1,525.2**	**($910.8)**

Table 13 shows the projected UCT results by program by year for 2015 to 2019.

Table 13. Utility Cost Test (UCT) – Net Present Value Net Benefits (2015 $million)

Consumer Sector	2015	2016	2017	2018	2019	2015-2019 Total
Efficient Products	$39.7	$37.7	$35.7	$33.7	$32.5	$179.3
In-Home Energy	$1.9	$1.8	$1.9	$1.9	$1.9	$9.3
Appliance Recycling	$3.3	$3.0	$2.9	$2.9	$2.8	$14.9
Behavior Change	$0.0	$0.1	$0.1	$0.1	$0.1	$0.4
New Home	$5.3	$5.2	$5.8	$5.3	$4.2	$25.7
e3smart[SM]	$2.7	$2.6	$2.4	$2.4	$2.3	$12.4
Community Assistance	($3.1)	($2.9)	($2.9)	($1.9)	($2.1)	($12.9)
Consumer Sector Total	**$49.8**	**$47.4**	**$45.9**	**$44.3**	**$41.7**	**$229.1**

Business Sector	2015	2016	2017	2018	2019	2015-2019 Total
Efficient Products for Business	$60.3	$58.2	$57.3	$57.5	$55.0	$288.3
Process Efficiency	$46.2	$42.9	$42.9	$39.7	$36.8	$208.5
New Construction and Major Renovation	$17.2	$18.5	$17.6	$16.6	$15.0	$85.0
Express	$10.5	$11.0	$10.1	$9.3	$8.4	$49.3
Self-Direct	$6.7	$6.0	$6.4	$6.4	$5.2	$30.8
Retro-Commissioning	$1.8	$1.9	$2.0	$2.1	$1.9	$9.6
Continuous Energy Improvement	$7.2	$8.4	$8.2	$7.2	$5.4	$36.4
Bid to Win	$29.8	$29.5	$27.8	$26.2	$21.5	$134.9
Data Center	$3.3	$2.8	$2.5	$2.3	$1.8	$12.7
Combined Heat and Power and Waste Energy Recovery	Not presented.					$275.2
Multifamily	$1.2	$1.6	$1.4	$1.3	$1.1	$6.6
Business Sector Total	**$184.3**	**$180.9**	**$176.1**	**$168.5**	**$152.3**	**$1,137.3**
Plan Total (includes Other Costs)	**2015**	**2016**	**2017**	**2018**	**2019**	**2015-2019 Total**
	$226.0	**$220.2**	**$213.9**	**$204.8**	**$185.9**	**$1,334.6**

Projected Electric Bill Reductions

The projected reductions in electric bills for participants in each consumer and business sector program over the life of the measures installed during 2015 to 2019 is approximately $1.5 billion. This amount includes the Plan cost of the programs.

The next section discusses the approach to estimating EE/PDR potential, along with an overview of EE/PDR Potential results for 2015 to 2034, and then program plans are presented, followed by conclusions and recommendations.

E.8 2015 to 2034 EE/PDR Savings Potential Analysis

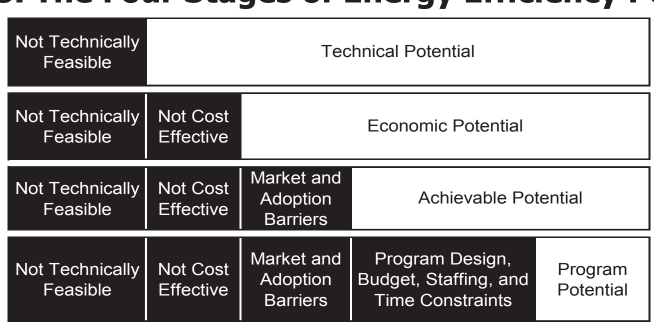
AEP Ohio's program Plan was developed by incorporating elements of the most successful energy efficiency and peak demand reduction programs across North America many of which are already being delivered by AEP Ohio, into program plans designed for the Ohio market and AEP Ohio customers in particular. AEP Ohio used a benchmarking process to review the selected programs, with a focus on successful AEP Ohio and other programs in the Midwest to help shape this Plan.

As detailed in Figure 3 there are four major types of EE/PDR potential:

1. *Technical* potential for all technologies.
2. *Economic* potential, the amount of EE/PDR available that is cost effective.
3. *Achievable* potential, the amount of EE/PDR available under current market conditions and available investments.
4. *Program* potential, the amount of EE/PDR available given limited resources, available time and duration of the efficiency program planning period.

AEP Ohio's EE/PDR Action Plan is focused on capturing cost-effective *program potential* in its service territory while achieving SB 221 requirements for 2015 to 2019. Most energy efficiency measures that were known not to be cost-effective were pre-screened and eliminated from all potential scenarios. Some measures not cost-effective were included as part of an overall program delivery strategy for high customer satisfaction and participation.

Figure 3. The Four Stages of Energy Efficiency Potential



Source: Reproduced from "Guide to Resource Planning with Energy Efficiency November 2007", US EPA. Figure 2-1.

AEP Ohio undertook the EE/PDR potential study with the following key tasks:

- Conduct a baseline market profile study, which included conducting telephone surveys and on-site surveys with random samples of AEP Ohio's residential and non-residential customers. The telephone surveys collected information on customers' awareness of AEP Ohio programs and energy efficiency measures, as well as customers' energy efficient equipment decision making criteria. The on-site surveys conducted detailed inventories of customers' energy using equipment, as well as building shell characteristics.
- Develop baseline consumption profiles, and develop initial building simulation model specifications.
- Characterize the EE/PDR measures.
- Conduct an EE/PDR benchmarking and best practices analysis.
- Conduct benefit-cost analysis (discussed in Section E.7).
- Estimate EE/PDR potentials.
- Develop EE/PDR program plans.

A summary of each of these tasks follows.

Baseline Market Assessments

AEP Ohio conducted a baseline study of the residential market segments in 2013 to characterize AEP Ohio's service territory in terms of customer numbers, age and size of household and housing stock, key building characteristics, saturation of efficient technologies, and customer awareness of and decision making about efficient options. Appendix A in Plan Volume 2 includes detailed baseline survey results.

Baseline Consumption Profiles and Simulation Model Specifications

Segment-level commercial and industrial sales data delivered by AEP Ohio provide a good starting point to determine customer energy use in broad end-use categories, such as lighting, heating, and cooling. These profiles were the calibration points in developing hourly computer models of energy consumption. With building characteristics from the baseline study, the models were used to estimate savings from EE/PDR measures.

The derivation of the residential electricity market profile relied on monthly consumption data and benchmark monthly profiles of end uses to derive annual electricity consumption for seasonal and non-seasonal uses. The starting point in this exercise was the AEP Ohio system-level residential electricity consumption by month for 2012-2013. The household total electricity consumption by month was calculated from this data. There are four seasonal end uses that were tabulated (heating, cooling, hot water, and lighting) in addition to the non-seasonal end uses (includes appliances, plug loads, and other). Results of the baseline study were used for technology saturation data.

Characterizing EE/PDR Measures

Characterization of EE/PDR measures requires:

- Estimating the baseline energy consumption for each end-use (heating, cooling, cooking, hot water, etc.) or unit energy consumption (UEC).
- Estimating the incremental savings from each measure – improving from the baseline to the new technology.
- Determining the incremental costs and lifetimes for each of the new technologies.

In addition, the baselines must consider that different classes of buildings have different penetrations of technologies, such as existing homes compared to new construction. A combination of approaches to characterize the EE/PDR measures was used for this study. For EE/PDR measures having impacts that do not vary with climate, data was used from several different sources, including: ongoing AEP Ohio programs, the 2013 residential and baseline study, the Ohio Statewide TRM for climate-dependent measures, and engineering estimates, as well as publicly available and well-respected sources, such as the California Database on Energy-Efficiency Resources (DEER) database. The approach adjusted the DEER energy and demand impacts for AEP Ohio's customer operating parameters as necessary based on the local weather. In addition to using data from ongoing AEP Ohio programs, or the draft Ohio Statewide TRM for climate-dependent measures, the analysis used a combination of building simulation modeling and engineering estimates specifically developed for AEP Ohio to estimate EE/PDR measure per unit savings.

For EE/PDR measure costs, in addition to using data from ongoing AEP Ohio programs or the draft Ohio Statewide TRM for climate dependent data, AEP Ohio primarily used the California DEER database, adjusted by geographic multiplier factors from industry sources, such as the RS Means Mechanical Cost Data.[8] A variety of sources were used to establish measure lifetimes, including, ongoing AEP Ohio programs, the draft Ohio Statewide TRM, manufacturer data, typical economic depreciation assumptions, and the California DEER database. Appendix C in Plan Volume 2 provides detailed measure descriptions and characterizations.

[8] http://rsmeans.reedconstructiondata.com/

EE/PDR Benchmarking and Best Practices Assessment

To ensure that the demand side management (DSM) potential estimates developed are reasonable and appropriate, and to identify the best practices of DSM programs, AEP Ohio conducted a benchmarking assessment on other utilities' DSM programs, in Ohio and in neighboring states, that have similar DSM requirements and Plans and available data about them. To identify common best practices of top performers, the analysis compared detailed program results by customer sector of those utilities identified as achieving high levels of DSM savings for below-median costs.

Table 14 shows the 2012 and 2013 median EE/PDR benchmarking data for AEP Ohio and eleven other Midwest utilities, including overall spending, savings, costs, and energy costs. Appendix B in Plan Volume 2 provides more benchmarking results.

Table 14. 2012 EE/PDR Benchmarking Data

	Spending as Percent of Revenue	Energy Savings as Percent of Sales	Peak Demand Savings as Percent of Peak Demand	Retail Cost of Energy $/kWh	Cost of First Year Savings (1)	
					$/kWh	$/kW
All Region Median 2012	1.2%	1.2%	0.8%	$0.11	$0.10	$671
AEP Ohio 2012	1.2%	1.1%	0.7%	$0.09	$0.10	$688
AEP Ohio 2013 (2)	1.7%	1.3%	1.0%	$0.08	$0.10	$642

(1) Note: Cost of First Year Savings is not comparable to a supply-side investment and is only used to compare programs and Plans at a high level for reasonableness of cost.
(2) AEP Ohio 2013 results have not been evaluated.

For 2012, the utilities with the largest relative energy savings and below-median costs achieved energy savings at about 1.4 percent of annual sales. The utilities with the largest relative peak demand savings and below-median costs saved about 1.1 percent of peak demand. AEP Ohio saved more than the median amount of savings from the utilities' benchmarked in 2012 and 2013, and AEP Ohio's program costs were lower than the median program costs.

EE/PDR Program Potentials

AEP Ohio developed estimates of EE/PDR measure potentials in terms of technical, economic, and "achievable" potential (the program results that are realistic for AEP Ohio to achieve through cost-effective EE/PDR programs). Economic potential was estimated using the TRC test as described above as the economic "screen" to apply to technical potential estimates in order to determine whether the measures are "cost-effective" or not, and inform which measures were to be included or excluded.

Achievable EE/PDR market potential estimates the amount of EE/PDR potential that could be captured by realistic EE/PDR programs that include cost effective EE/PDR measures over the forecast period covered by this EE/PDR potential analysis. Achievable EE/PDR potential can vary with EE/PDR program parameters, such as the magnitude of rebates or incentives offered to customers for installing EE/PDR measures and, thus, many different scenarios can be modeled.

To estimate achievable potential, a computer model was used to estimate conversion rates from inefficient products to more efficient products for retrofit and replacement measures, as well as installation rates in new buildings for new construction markets. These conversion, replacement, and new construction penetration rates are based on AEP Ohio's and other utilities' actual experiences with these types of programs. AEP Ohio developed two achievable potential estimates:

1. A base case or expected EE/PDR potential estimates. These estimates assume that adequate funding is available to achieve the EE/PDR potentials and that AEP Ohio is able to achieve "best practice" EE/PDR program performance over the short term, from 2015 to 2019.
2. A high case estimate based on the experience of the best of the best utilities' EE/PDR program results, to meet the SB 221 requirements over the long term, through 2034.

The Plan's Business Sector will achieve greater energy and demand savings than the base case scenario. As a result, the overall Plan is projected to achieve energy and demand savings above the Base Case.

EE/PDR Potential Results

The cumulative annual EE/PDR potential savings (Base Case Scenario Market Potential) in 2034 is estimated to be approximately 10.3 thousand GWh at meter, about 24 percent of forecast baseline sales, and approximately 1,670 MW at meter, about 19 percent of baseline peak summer demand, as shown in Table 15. Table 15 also presents the projected savings in 2034 for the technical, economic, and high market potential scenarios.

These results assume a net-to-gross impact ratio of 1.0 whereby free ridership is assumed for this analysis to be offset by spillover impacts. The Base Case market potential meets the SB 221 savings targets over the short term, from 2015 to 2019. Note that in 2019, AEP Ohio is utilizing its banked savings to reach the 2 percent benchmark requirement, so the potential study assumes a 1 percent requirement. The high case market potential meets the SB 221 cumulative savings targets over the long term, through 2034. Unless already specified for a particular measure, the Base Case market potential includes incentives at 50 percent of incremental measure costs. The High Case market potential includes incentives at 75 percent of incremental measure costs in most instances for each measure, unless the existing incentive was greater than 75 percent. Appendix A in Plan Volume 2 provides detailed EE/PDR potential study results.

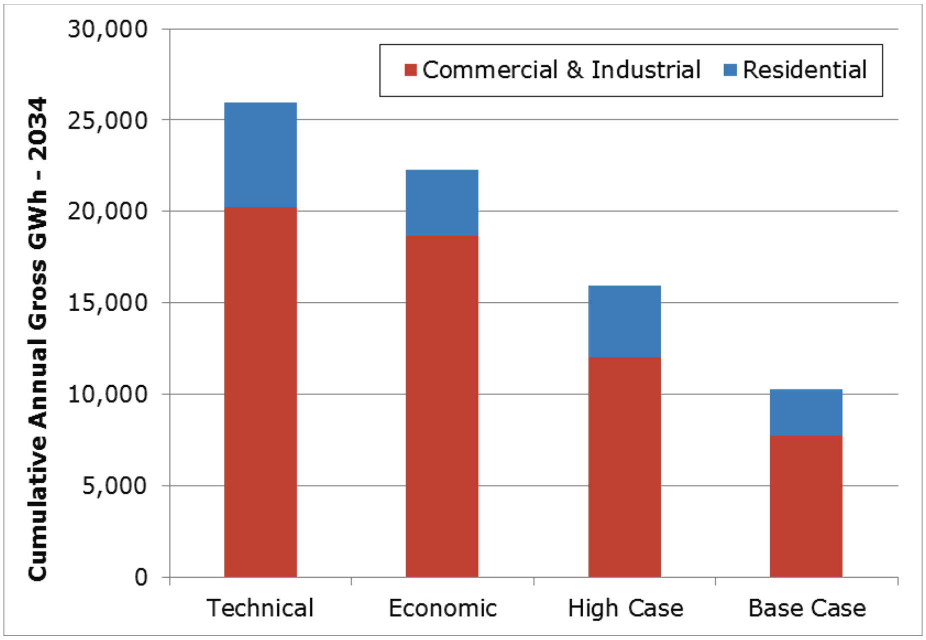
Table 15. Projected Cumulative Annual Savings at Meter and Costs – 2034

Potential Scenario	Cumulative Annual Gross Energy Savings at Meter (2034) (1)		Cumulative Annual Gross Summer Peak Demand Savings at Meter (2034) (1)		Total Cost (Energy Efficiency Only) (2)
Sector	**GWh**	**Percent of 2034 Forecast Sales**	**MW**	**Percent of 2034 Forecast Sales**	**20 Year Cost (2015 to 2034) (million 2015$)**
Residential					
Technical	5,750	41.1%	1,409	38.5%	-
Economic	3,626	25.9%	914	25.0%	-
High Case	4,090	37.7%	723	22.4%	$1,203
Base Case	2,549	18.2%	459	12.6%	$694
Commercial and Industrial (does not include Agricultural or CHP/WER)					
Technical	20,232	70.3%	2,982	60.1%	-
Economic	18,656	64.8%	2,942	59.3%	-
High Case	11,825	45.6%	1,822	40.5%	$1,847
Base Case	7,727	26.8%	1,211	24.4%	$994
Total					
Technical (3)	28,107	65.7%	4,820	55.9%	-
Economic	22,283	52.1%	3,856	44.7%	-
High Case	15,915	37.2%	2,545	29.5%	$3,094
Base Case	10,276	24.3%	1,670	19.4%	$1,688

(1) Savings are not projected for Research and Development, Education and Training, Targeted Advertising, Demand Response. For comparative purposes, savings are not included for Agricultural or Combined Heat and Power / Waste Energy Recovery. AEP Ohio also will conduct program evaluation and other essential program support functions, such as compliance and reporting, database management, contracting and payables, and Plan cost-benefit analysis.
(2) Other Costs include support and other services, including Research and Development, General Education and Training, Targeted Advertising, and Demand Response, etc.
(3) Total technical potential includes codes and standards.

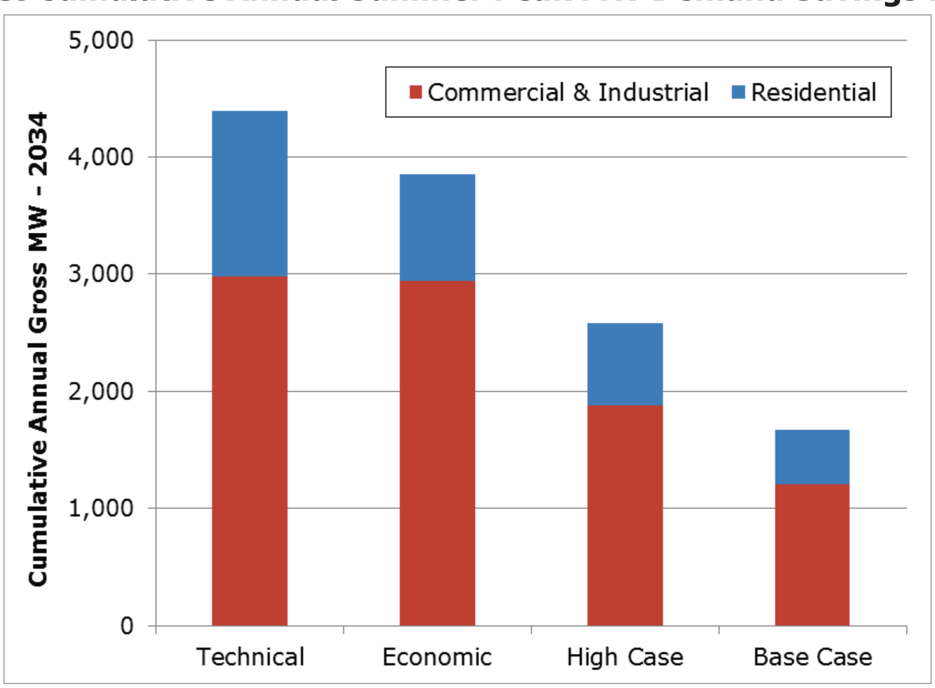
Figure 4 and Figure 5 show the cumulative annual energy and summer peak demand savings in 2034 for each of the four potential analysis scenarios.

Figure 4. Cumulative Annual GWh Energy Savings in 2034



Note: Savings are not projected for Research and Development, Education and Training, Targeted Advertising, Demand Response. For comparative purposes, savings are not included for Agricultural or Combined Heat and Power / Waste Energy Recovery. AEP Ohio also will conduct program evaluation and other essential program support functions, such as compliance and reporting, database management, contracting and payables, and Plan cost-benefit analysis. Total technical potential includes codes and standards.

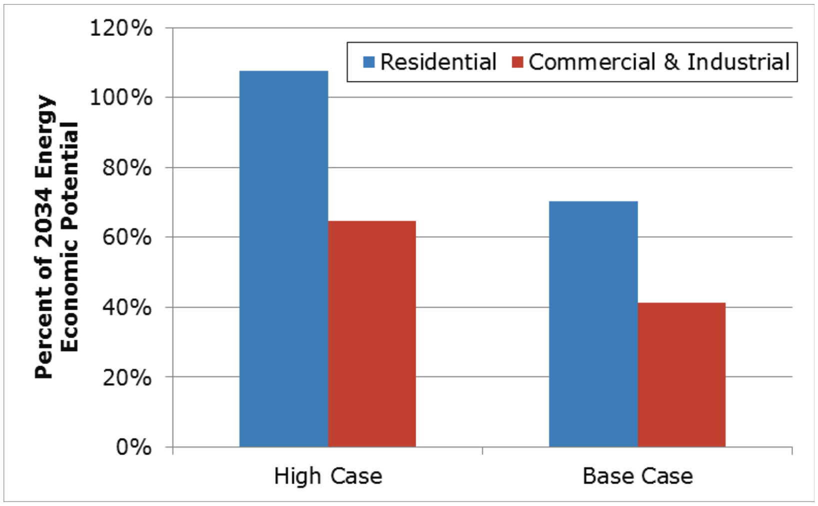
Figure 5. Cumulative Annual Summer Peak MW Demand Savings in 2034



Note: Savings are not projected for Research and Development, Education and Training, Targeted Advertising, Demand Response. For comparative purposes, savings are not included for Agricultural or Combined Heat and Power / Waste Energy Recovery. AEP Ohio also will conduct program evaluation and other essential program support functions, such as compliance and reporting, database management, contracting and payables, and Plan cost-benefit analysis. Total technical potential includes codes and standards.

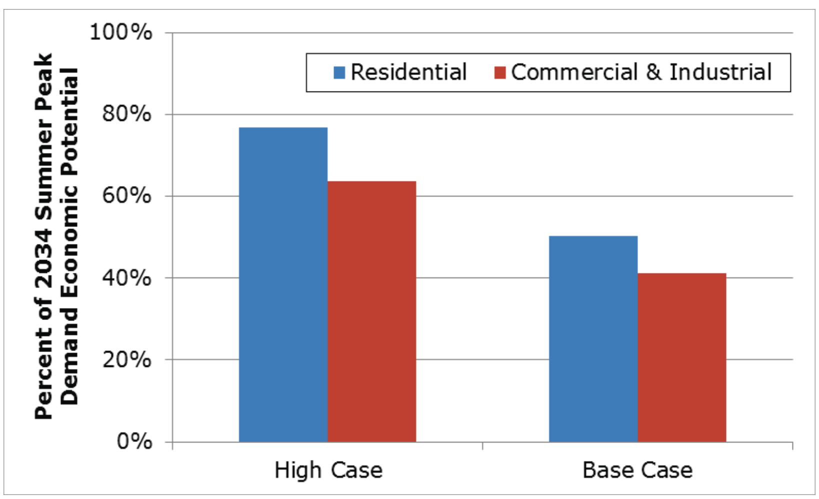
Figure 6 and Figure 7 show the cumulative Market Potential[9] as a percent of the Economic Potential for EE/PDR.

Figure 6. Market Potential Annual Energy Savings at Meter as Percent of Economic Potential in 2034



Note: Savings are not projected for Research and Development, Education and Training, Targeted Advertising, Demand Response. For comparative purposes, savings are not included for Agricultural or Combined Heat and Power / Waste Energy Recovery. AEP Ohio also will conduct program evaluation and other essential program support functions, such as compliance and reporting, database management, contracting and payables, and Plan cost-benefit analysis. Total technical potential includes codes and standards.

Figure 7. Peak Demand Savings at Meter as Percent of Economic Potential in 2034



Note: Savings are not projected for Research and Development, Education and Training, Targeted Advertising, Demand Response. For comparative purposes, savings are not included for Agricultural or Combined Heat and Power / Waste Energy Recovery. AEP Ohio also will conduct program evaluation and other essential program support

[9] Defined here as the potential achievable in real-world market risk situations.

functions, such as compliance and reporting, database management, contracting and payables, and Plan cost-benefit analysis. Total technical potential includes codes and standards.

E.9 Overview of Program Plans

The overview of the Plan presented here is to provide a sense of scope and scale and to convey the general schedule and resources needed to increase participation in the various markets in which AEP Ohio will operate the programs. The plans for newly-proposed programs developed are based on best-practice programs and the experience gained by AEP Ohio through its 2012-2014 Plan, with the strategic concepts outlined. These program plans are proposed as guidelines for more detailed program planning. An update is presented for ongoing programs, along with proposed program modifications that were approved in the 2012-2014 EE/PDR Action Plan.

Overall, the Plan covers a broad range of demographic, business, facility and end-use markets. AEP Ohio's Plan can be divided into consumer, business and cross-sector, with utility administrative functions providing support across all program areas. AEP Ohio will maintain as part of its functions the education and training, advertising, and research and development budgets.

Consumer Sector

AEP Ohio currently offers seven consumer (residential) sector programs:

- **Efficient Products** – This program produces long-term electric savings by increasing the market share of efficient lighting and appliances through price markdowns, coupons and rebates.
- **Appliance Recycling** – This program permanently removes operable second refrigerators and freezers and primary refrigerators and freezers that have been replaced by recycling them in an environmentally safe manner.
- **In-Home Audit** – This program provides custom, prioritized recommendations on appropriate weatherization measures and the installation of high-efficiency lighting, appliances, HVAC and other equipment based on an in-home audit (all electric only), in-home assessment or online energy survey of a customer's single family or multifamily home. Free energy saving items such as CFL light bulbs and electric water heater measures (e.g., low-flow shower head, faucet aerators, pipe wrap), are installed or provided to participating customers. Joint program delivery with other local gas utilities is under consideration.
- **Behavior Change** – This program provides tips that are relevant to a customer's home and provides an estimate on how much electricity and money they may save by implementing suggested energy efficiency measures and changing energy usage behaviors.

- **New Home** – This program produces long-term electric energy savings by affecting the construction of single family homes, duplexes and multifamily housing to meet select ENERGY STAR® efficiency standards on insulation, HVAC, water heating, appliances, lighting, windows, doors and other quality construction measures.
- **e^{3}smart^{SM} school** program – This energy efficiency education program is for students of schools served by AEP Ohio and the curriculum is designed to meet national and state science standards for grades 5-12. Students take home energy efficiency measures and install them as part of the learning experience.
- **Community Assistance Program or CAP** – This program generates energy savings for residential low-income customers through the installation of a wide range of weatherization upgrades and base load electric measures. Qualified customers must be at or below 200 percent of the federal poverty level. Typically these customers are eligible for an energy assistance program such as Home Energy Assistance Program (HEAP), Percentage of Income Payment Plan (PIPP) or Home Weatherization Assistance Program (HWAP).

Business Sector

AEP Ohio currently offers ten business (nonresidential) sector programs:

- **Efficient Products for Business** (previously Prescriptive) – This program is based on a menu of standardized incentives for high efficiency lighting, heating, ventilation, and air conditioning (HVAC), motors, drives and refrigeration.
- **Process Efficiency** (previously Custom) – This program provides incentives for qualifying efficiency improvements not included in the Efficient Products for Business Program or other AEP Ohio Programs.
- **New Construction** – This program provides incentives for new construction and major renovation to exceed current building energy code requirements.
- **Self-Direct** – This program is available to capture retrospective energy savings from large mercantile customers with the capability to administer internal energy management efforts of their own. It allows submittal of energy saving projects from the last three years.
- **Demand Response** – This program is used to supplement the peak demand reductions achieved from energy efficiency programs in order to ensure the peak demand reduction benchmark requirements of SB 221 are met.
- **Express** – This program provides a streamlined, one-stop, turn-key service for small business customers and is delivered through a program implementer.
- **Retro-commissioning** – This program for medium and large customers provides assessments to identify and implement low-cost, operational

adjustments that improve the efficiency of existing buildings' operating systems by optimizing the systems to meet the building's requirements, with a focus on building controls and HVAC systems.

- **Continuous Energy Improvement** (previously Continuous Improvement) – This program is for large customers that consume significant amounts of energy. It is designed to engage corporate management to create a sustainable culture and planned actions to reduce energy use long term.
- **Bid to Win** (previously Energy Efficiency Auction) – This program is for business customers in the capital planning process considering large potential energy efficiency projects, or for aggregators of customer energy efficiency projects. The program will also be an input into annual incentive level pricing for other business programs based on auction results.
- **Data Center** – This program provides for energy savings opportunities for new and existing data centers of all sizes from data closets to enterprise class centers.

Cross-Sector Activities and Other Programs

AEP Ohio currently offers five cross-sector activities/programs and proposes to continue these efforts during the Plan period:

- **Education and Training** – This program will coordinate AEP Ohio's efforts to create customer, marketer, contractor and supplier awareness for the programs and the proper installation of measures, enhance demand and educate customers on energy efficiency.
- **Targeted Advertising** – This program is designed to build customer awareness of energy efficiency in support of AEP Ohio EE/PDR programs and also to encourage market transformation in support of AEP Ohio's commitment and key goals in this Plan.
- **gridSMART Enabled EE/PDR Savings** – This activity provides energy savings achieved from this project.
- **T&D Loss Reduction Projects** (formerly T&D and Internal System Efficiency Improvements) – This activity provides energy savings from AEP Ohio T&D projects that reduce losses on its system, thereby saving energy and demand.
- **Research and Development** – The program objective is to identify and develop new energy efficient technologies, programs and marketing approaches to capture cost effective energy and demand savings.

AEP Ohio proposes four new cross-sector programs:

- **Multi-Family** – This pilot program provides both consumer (tenant) and business (common areas) customers with energy savings opportunities and implementation of cost effective measures to existing and new construction buildings.

- **Combined Heat and Power and Waste Energy Recovery or CHP/WER** – This program is primarily for large high efficiency CHP/WER projects, now allowable through the passage of SB 315. The program provides performance based funding or supports EE/PDR rider exemptions for CHP/WER projects that meet all PUCO and AEP Ohio requirements.

- **T&D Customer Efficiency Projects –** These projects provide direct energy savings through the implementation of high efficiency technologies that reduce customer energy costs. Two projects included in this Plan are Volt Var and LED Street and Outdoor Lighting.

- **Customer Power Factor –** This program provides customers with specific technology measures that can be implemented to improve power quality and to produce energy measure and demand savings within the customers' facilities.

E.10 Plan Implementation

AEP Ohio plans to continue implementing the proposed Plan through a combination of in-house utility staff and competitively selected third-party implementation contractors. For newly-proposed programs, AEP Ohio may issue request for proposals (RFP) to qualified firms for the program delivery. Implementation contractors are eligible to respond to any or all of the RFPs. From start to finish, AEP Ohio anticipates the process of issuing RFPs, evaluating responses and negotiating contracts along with associated program start-up time will result in 2015 launch dates for most newly-proposed programs. Remaining programs needing longer preparation times will begin on an extended schedule. For existing programs, AEP Ohio may issue RFPs or re-negotiate contracts with existing implementation contractors. AEP Ohio plans to issue RFPs for all contractors that have been in place for two previous approved Plan periods.

E.11 Evaluation, Measurement and Verification

Program evaluation, measurement, and verification (EM&V) activities are central to the success of AEP Ohio's Plan and will be used to verify program savings impacts and monitor program performance. These activities serve as a way to determine the actual program level savings being delivered and to maximize energy efficiency and peak demand reduction investments.

Effective EM&V ensures that expected results are measurable, achieved results are robust and defensible, program delivery is effective in maximizing participation, and the overall Plan is cost-effective.

Framework for Evaluation

Appropriate EM&V requires that a framework be established that encompasses both planned EM&V efforts and data collected as part of program implementation. This section provides an overview of the monitoring, verification, and evaluation efforts recommended. The basic requirements and approaches for planning program-specific evaluations, including the allocation of funds across evaluation efforts, also are discussed in this section. Importantly, EM&V efforts evolve over time and change as programs move from initial roll-out with few participants to full-scale implementation.

All significant evaluation activities will be conducted by third-party evaluation consultants. Impact evaluations are most often performed by organizations independent of those responsible for designing and implementing programs to ensure objectivity. Process evaluations and market effects studies typically also are prepared by independent evaluators, but process evaluations in particular are used less to verify performance than to help improve performance and, as such, require active participation by the program administrator/implementer.

Approach to Evaluation

The overall evaluation approach is based on an integrated cross-disciplinary model that includes evaluators as members of "project teams" involved in the various stages of program planning, design, monitoring and evaluation. This is a very cost-effective method that has been very successful for AEP Ohio over the last six years.

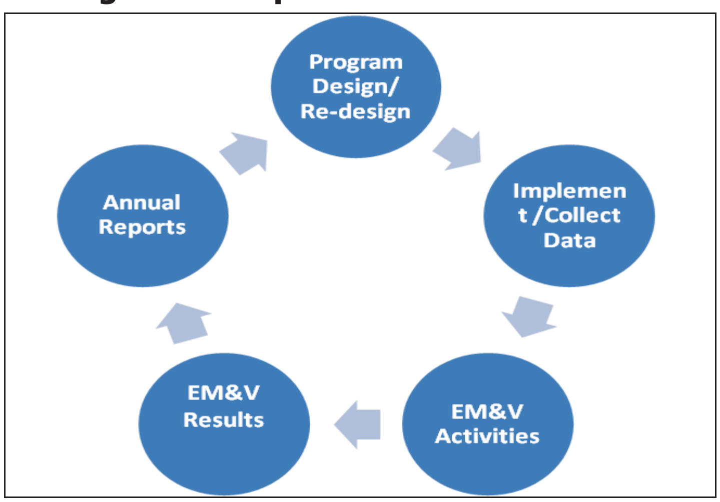
The timing of EM&V activities and reporting can have a significant effect on the accuracy and usefulness of findings. Data collection done months or years after a program intervention can be weakened by fading memories, lost data, and confounding events that have happened in the intervening time. EM&V reports that come well after program intervention can arrive too late to provide input at key program implementation stages.

EM&V plans are designed to mitigate these problems. The process by which this is done is to integrate select data collection within the program implementation process and to provide near real-time feedback on key indicators of program progress. EM&V processes that take an "integrated data collection" (IDC) approach to planning seek out opportunities in the program implementation process where evaluation data can be collected efficiently, cost-effectively, accurately, and produce timely results. One example is program application forms, where programs can collect comparable data in standard formats across programs. Of course, this approach will be highly dependent of the program design and the points where the program interacts with the customer or trade ally.

The IDC approach requires the EM&V and implementation staff to work closely together to develop a protocol for collecting data as part of the standard program implementation practices and customer correspondence associated with the program. It also is important for the program implementation staff to see successful M&V as part of their responsibility; i.e., the program will get credit for the savings that can be verified and program implementers can have a dramatic influence on how accurately this in-field verification can be accomplished.

The IDC protocol garners participant feedback in near real-time to support process, market, and impact analyses. Examples include exit surveys with training participants designed by evaluation staff, but administered by program implementation staff: evaluation inputs on program application forms so key baseline data is collected before existing equipment is replaced, and regular transfer of program data to evaluators, so follow-up surveys can be implemented soon after program participation Figure 8 shows the program evaluation cycle.

Figure 8. Steps of the EM&V Process



Approximately three percent of overall Plan program costs will be allocated to the following activities, further described in the following sections:

- EM&V-related activities.
- Project savings verification and due diligence.
- Independent program evaluations.
- Independent assessment of annual program impacts.
- Internal quality assurance and control.

- Coordination of evaluation activities with other players, such as the PUCO statewide evaluator.

Independent Program Evaluations

Descriptions of proposed evaluations for each program are included in the program plans. The key components of the process and impact evaluations include:

- Evaluations conducted by an independent, EE/PDR evaluation consultant.
- Verification, by an appropriate sample, that efficiency measures are installed as expected.
- In-field measure performance measurement and data collection.
- Energy and demand savings analysis to compute the results that are being achieved.
- Cost-effectiveness analysis by program and overall EE/PDR Plan.
- Process evaluation to indicate how well programs are working to achieve objectives.
- Identification of important opportunities for improvement.

Assessment of Annual Impacts

AEP Ohio's EM&V contractor will prepare an annual report of EE/PDR program results, which will incorporate findings from evaluation activities completed that year, changes to programs, and new programs implemented, as well as energy savings, costs and cost-effectiveness results by program and Plan. It is anticipated that the EM&V contractor's work, as well as participation in the process by the implementation contractor, will identify numerous areas where improvements and refinements to the AEP Ohio deemed measure database would be useful. As required, AEP Ohio will submit program evaluations to the PUCO statewide evaluator for its review.

In addition to the procedures outlined above for verifying savings from AEP Ohio's proposed Plan, AEP Ohio will implement appropriate internal controls to assure the quality of program design and implementation and establish a consistent and integrated tracking and reporting system for all programs in the Plan. AEP Ohio tracks customer interactions, including customers recruited, incentive applications, incentives processed, and installations verified, and will establish procedures for ongoing verification.

AEP Ohio will require implementation contractors or staff to routinely contact or visit a sample of participating customers to assess the quality of program delivery and the installation of measures for which incentives were claimed. AEP Ohio intends to also track on an on-going basis incentive fulfillment time, technical services delivery times (how long between customer request and audit completion for example), incentive documentation, and customer complaints among other metrics of program performance.

PJM Evaluation Requirements

AEP Ohio's EM&V plans will be developed to ensure that the evaluations to be conducted are done in a manner that enables AEP Ohio the ability to nominate achieved and verified energy efficiency and peak demand reduction values with a level of statistical confidence and precision that complies with PJM's Manual 18B Energy Efficiency Measurement & Verification.[10]

E.12Plan Risk

In the current economic environment, AEP Ohio's ability to convince business customers to voluntarily take on additional debt for the installation of cost-effective measures, even with very short pay-back periods, may continue to be challenging. AEP Ohio recognizes this challenge and has striven to develop a balanced Plan that provides opportunities for participation at multiple levels. By proposing a multi-faceted and broad Plan of programs, AEP Ohio will be able to capitalize on those sectors of the market willing to invest in energy efficiency, regardless of the challenging economic landscape. This Plan is designed to allow AEP Ohio to meet overall legislative efficiency goals.

AEP Ohio plans to use the following strategies to minimize the risks associated with its portfolio of EE/PDR programs in this Plan:

- Utilize AEP Ohio's growing experience in successful program implementation and maintain Plan flexibility to adjust programs to meet changing market conditions and other externalities.
- Implementing primarily "tried and true" programs that have been successfully implemented by many utilities in the Midwest and across the country.
- Hiring program implementation contractors with significant experience in implementing EE/PDR programs in the Midwest and other regions.
- Initiating program evaluation activities at the start of program implementation to get real-time feedback on program progress, and to allow any needed fine-tuning to occur as soon as possible.
- Setting up post installation inspection procedures and data to collect before inspections begin.

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[10] See http://pjm.com/~/media/documents/manuals/m18b.ashx. PJM Interconnection is a regional transmission organization (RTO) that coordinates the movement of wholesale electricity in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia.

- Anticipating and preparing for stronger than expected market response.
- Conducting adequate market checks on standard practices and energy efficient product availability.
- Developing incentive structures that are simple to understand.
- Creating simple participation rules.
- Monitoring and responding to rapidly dropping equipment prices quickly.
- Setting appropriate qualifying efficiency levels.
- Setting appropriate incentive levels.
- Rolling out targeted marketing to contractors focusing on what is in it for them and how they participate.
- Training account managers on program rules.
- Establishing documentation, analysis methods and reporting requirements for technical studies.
- Managing the pipeline of projects and establishing decision deadlines so the response time to those waiting for decisions is reasonable.
- Expanding research and development to assist in mid-stream adjustments to current programs as needed and developing new programs for future implementation.

The performance targets of the program plans are based on normal economic conditions and the ability to overcome a variety of market barriers and perceived risks customers have regarding EE/PDR improvements and load management. Problems commonly encountered that affect delivery may occur and dampen program performance include a variety of real and perceived risks in undertaking efficiency improvements or participating in load management programs:

- Reliability of the efficiency improvement, whether real or perceived.
- Fit with existing facilities and processes.
- Return on investment and cash flow effects compared to other financial and operating priorities.
- Unfamiliarity with the technology leading to non-participation.
- Availability of funds or credit to purchase the improvement.
- Concern about occupant comfort and other aesthetics.

E.13 Conclusions and Recommendations

The EE/PDR potential (Base Case Scenario Market Potential) identified in this study represents energy reductions of approximately 28 percent for AEP Ohio residential customers and 31 percent for commercial and industrial customers below forecasted levels and known enacted energy codes and standards by 2034, or approximately 1.5 percent per year. This magnitude of savings has been achieved by best practice program portfolios in the Midwest, Northeast and Western U.S. Summer peak demand and annual energy reductions of the magnitudes found for the Base Market Potentials case are being achieved by a variety of utilities. Meeting the SB 221 targets over the long term, through 2034, will require energy reductions on the order projected in the High Case Scenario Market Potential, which have been achieved by few jurisdictions to date. Accordingly, the proposed 2015 to 2019 EE/PDR Plan includes energy savings goals above the base case scenario for the business sector.

Over time, AEP Ohio will need to increase EE/PDR activities beyond the Base Case Scenario Market Potential for 2015 to 2019 to achieve the projected long-term savings in the High Case Scenario Market Potential. Based on the results from the three-year 2012-2014 period, and considering additional program and measure offerings, in 2019, AEP Ohio will propose EE/PDR efforts beyond the five-year 2015 to 2019 period, to meet the SB 221 savings goals for 2020 to 2024.

The EE/PDR benchmarking analysis results presented in this report give AEP Ohio management confidence that a variety of utilities in the region and throughout the country are achieving large-scale results from their EE/PDR programs.

Utilities that choose to invest significantly in EE/PDR programs often make significant periodic investments to develop and update secondary best-practice and primary market research data to aid their EE/PDR program planning. AEP Ohio conducted a market assessment baseline study of the residential customer sector in 2013 that included significant on-site customer data collection. Both AEP Ohio's 2015 to 2019 EE/PDR Action Plan and the 2015 to 2034 potential study included significant customer data from the residential baseline study. In addition, AEP Ohio's significant direct experience with all customer classes in the implementation of its current Plan has aided the development of the 2015-2019 Plan.

Recommendations to consider include the following:

- Move results into operational planning with a focus on integrating newly proposed programs seamlessly and making ongoing adjustments.
- Consider both insourcing and outsourcing strategies to selectively jump-start key additions to the ongoing Plan and more cost effectively manage existing programs.

1 INTRODUCTION

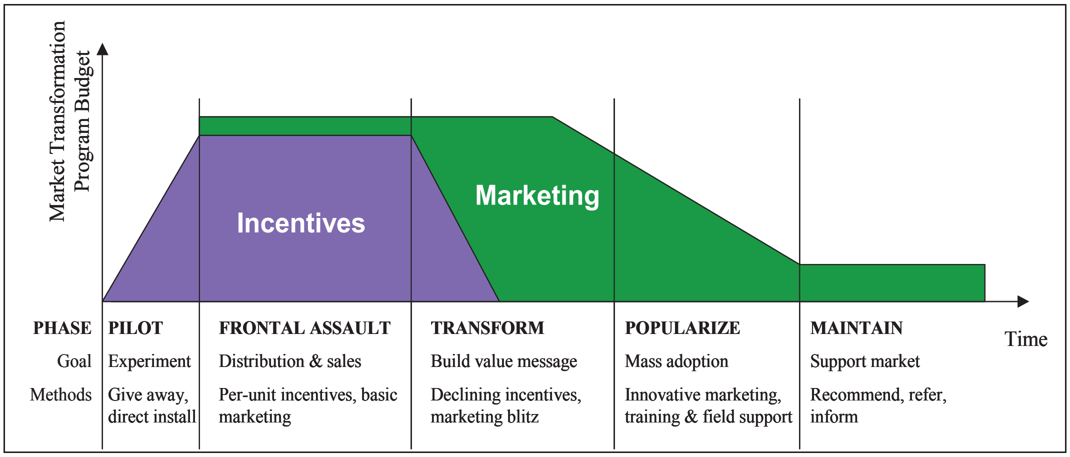
AEP Ohio or Ohio Power Company, is based in Gahanna, and is Ohio's second largest provider of electric service with a mix of 1.5 million residential, commercial and industrial customers. Pursuant to the requirements in 2008 Senate Bill (SB) 221 and Ohio Revised Code 4901:1-39, AEP Ohio submits this Plan for calendar years 2015 to 2019 for approval by the Public Utility Commission of Ohio (PUCO).

The following Plan presents a detailed overview of the proposed electric efficiency programs targeted at the consumer and business sectors, and associated implementation costs, savings, and benefit-cost results. This plan presents detailed information on the approach, EE/PDR measures, and initial proposed incentive levels, though AEP Ohio anticipates that, upon implementation, portions of this plan will need to be adjusted to reflect better information or changing market conditions. AEP Ohio will update the PUCO and AEP Ohio Collaborative accordingly regarding any substantive revisions to the Plan.

Together with stakeholders and the assistance of industry expert Navigant Consulting, Inc. (Navigant), AEP Ohio has designed a comprehensive EE/PDR Plan to deliver significant cost-effective electric efficiency savings. These programs include incentive and buy down approaches for energy efficient products and services, educational, marketing, and outreach approaches to raise awareness and enhance demand, and partnerships with trade allies to apply as much leverage as possible to augment the ratepayer dollars invested. Proper coordination between the programs is essential to maximizing this leverage.

As detailed in Figure 9, AEP Ohio anticipates that over time investment in energy efficiency measures will follow a predictable path of market transformation that has been experienced in other jurisdictions. With sustained levels of investment, promotion of efficient measures will in the early years focus on immediate up-front incentives to stimulate the marketplace. Over time, funds will be transitioned to marketing, training, education, and awareness to sustain program participation. Furthermore, as certain markets become transformed, and the baseline conditions become the efficient options, program resources will be transferred to new program areas and new technologies, and the process will repeat. Each series of the market transformation process will result in greater and more efficient opportunities for residential and business customers.

Figure 9. Phases of Energy Efficiency Promotion



Source: ENERGY STAR® YEAR 3 AND BEYOND, Presentation by Anne Wilkins, NRCAN, 2005

Demand Side Management (DSM) is the planning and implementation of programs and services that help and encourage customers to use electricity as efficiently as possible. DSM represents an important resource for AEP Ohio, growing increasingly important as fuel and commodity prices become more volatile and greenhouse gas regulation becomes more likely. Estimates of DSM or (EE/PDR) potential are a key input to the integrated resource planning process, which considers the load forecast and both supply and demand-side resources. This study presents the results of an analysis of the EE/PDR potential in AEP Ohio's service territory from 2015 to 2034.

1.1 AEP Ohio Overview

As described on AEP Ohio's web site, the Company is a significant distribution utility in the Midwest. With approximately 1.5 million customers, AEP Ohio has a strong market presence. Figure 10 presents AEP Ohio's service territory, which spans a large geographic area in Ohio. AEP Ohio provides power to more than 1,126 communities located in 61 of Ohio's 88 counties.

Figure 10. AEP Ohio's Service Territories

Table 16 outlines key statistics for AEP Ohio.

Table 16. AEP Ohio Key Statistics[11]

AEP Ohio's Business Profile 2012 Statistics	
Operating Information	
Total Customers	1,460,393
Residential	1,273,361
Commercial	173,948
Industrial	10,274
Other	2,810
2012 electrical sales in megawatt-hours	30,897,005
Size of service area (asset)	10,374 square miles
Communities served	1,126
Net plant in service	$9.5 billion
Size of distribution system	45,583 miles
Size of transmission system	9,032 circuit miles
Total number of AEP Ohio employees	2,739
Financial Information	
2012 Operating Revenue	$4.9 billion
2012 Net Income	$343.5 million
2012 Ohio Taxes Paid	$155.0 million
2012 Local Taxes Paid	$210.7 million
Top 5 Customers (by revenue)	
Ormet Primary Aluminum Corporation	Republic Engineered Products Inc.
The Timken Company	The Ohio State University
Globe Metalurgical Inc.	

1.2 EE/PDR Study Goals and Approach

The overall goals of the EE/PDR potential study are to:

- Assess the technical, economic, and achievable potential for the residential, commercial and industrial sectors.
- Develop high-level EE/PDR program plans.

[11] https://aepohio.com/global/utilities/lib/docs/factsheets/aepohio_factsheet_1-14.pdf

AEP Ohio undertook the EE/PDR potential study with the following key tasks:

- Conduct a customer market baseline study using telephone and on-site customer surveys to profile AEP Ohio's residential and non-residential customers.
- Develop baseline consumption profiles, and develop initial building simulation model specifications.
- Characterize the EE/PDR measures.
- Conduct an EE/PDR benchmarking and best practices analysis.
- Conduct benefit-cost analysis.
- Estimate EE/PDR potentials.
- Develop program plans.

These steps are discussed in more detail in Volumes 1 and 2 of the Plan.

1.3 2015 to 2019 EE/PDR Action Plan Report Organization

The remainder of AEP Ohio's EE/PDR Action Plan is divided into the following sections:

Section 2: Plan Development provides an overview of the process used and considerations in developing this Plan.

Section 3: EE/PDR Plan Summary Results details the summary results of Plan electric savings, investment allocations and benefit-cost results.

Section 4: EE/PDR Program Plans presents detailed program plans for AEP Ohio's proposed programs, with full descriptions for new programs.

Section 5: Glossary defines key terms used in the report.

Volume 2 Appendices include: EE/PDR Potential Study results (Appendix A); overall EE/PDR Benchmarking results (Appendix B); EE/PDR Measure Descriptions and Characterizations Results (Appendix C); and EE/PDR Methodology (Appendix D).

2 PLAN DEVELOPMENT

Based on a national review of leading EE/PDR programs, AEP Ohio is proposing a balanced Plan including EE/PDR programs that will achieve significant energy savings, while establishing trade ally and retailer partnerships resulting in lasting market transformation. AEP Ohio's programs will target all major sectors and customer classes, including low-income and small business customers.

AEP Ohio plans to continue offering a diverse Plan of "tried and true" major programs (some of which include sub-program components) across the residential, commercial and industrial sectors. Additionally, in this plan, AEP Ohio also proposes new programs, research and development activities targeting experimental opportunities, as well as broad-based education and training and targeted advertising.

2.1 Plan Tactical Objectives

In addition to AEP Ohio's strategic goals provided in the Plan Executive Summary, AEP Ohio has the following tactical objectives for the 2015-2019 Plan:

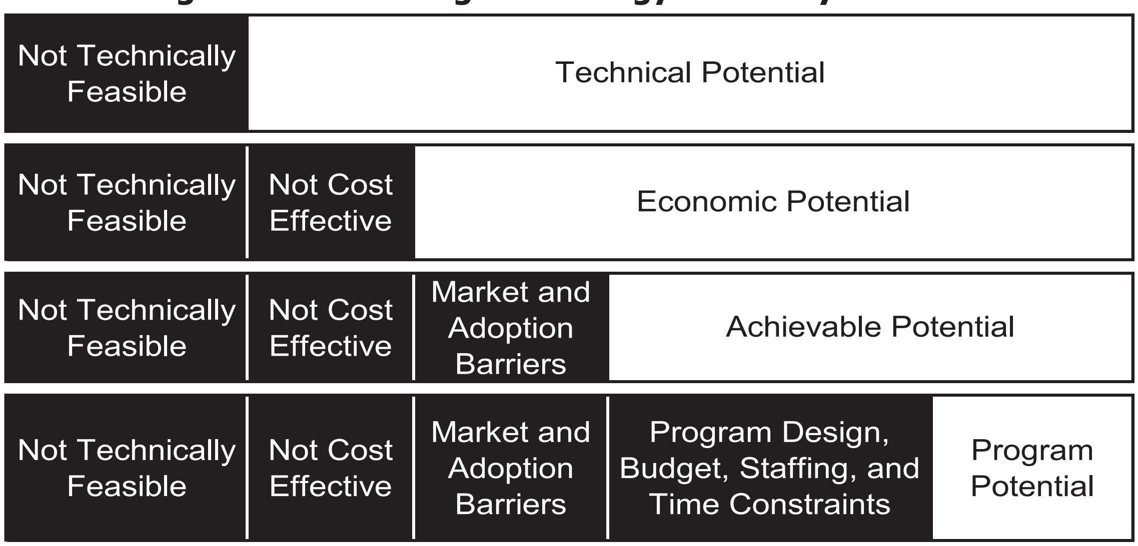
- Meet or exceed SB 221 resource acquisition goals for 2015-2019, while laying the groundwork for long-term market transformation.
- Design and implement a diverse group of programs that provide opportunities for participation by all customers.
- When feasible, maximize opportunities for program coordination with other efficiency programs to yield maximum benefits.
- Maximize program savings at a minimum cost by striving to achieve comprehensive cost-effective savings opportunities.
- Provide AEP Ohio customers with a single web site to access information on all efficiency programs (residential and business) for electricity savings opportunities.
- Expand the energy efficiency infrastructure in the state - for example, increasing the number of available qualified contractors.
- Transform the market for efficient technologies and highly qualified efficiency-oriented trade allies (such as electricians, air sealing and insulation contractors, HVAC contractors, home energy raters, builders, architects and engineers).
- Inform and educate customers and students to enable them to use energy more efficiently.

2.2 Planning Process

AEP Ohio's Plan of programs continues its successful programs while incorporating additional elements of the most successful EE/PDR programs across North America into program plans designed for the Ohio market and AEP Ohio customers in particular. A substantial amount of information including current program performance and evaluation studies were used to develop specific programs for AEP Ohio. AEP Ohio also used a benchmarking process to review the most successful EE/PDR programs from across the country, with a focus on successful Midwest programs to help shape the Plan.

As detailed in Figure 11, there are four major types of energy efficiency potential: (1) *technical* potential for all technologies, (2) *economic* potential, the amount of energy efficiency available that is cost effective, (3) *achievable* potential, the amount of energy efficiency available under current market conditions and available investments, and (4) *program* potential, the amount of energy efficiency available given limited resources, available time and duration of the efficiency program planning period. AEP Ohio's EE/PDR Action Plan is focused on capturing cost-effective *program potential* in its service territory while achieving SB 221 requirements for 2015 to 2019.

Figure 11. Four Stages of Energy Efficiency Potential



Reproduced from "Guide to Resource Planning with Energy Efficiency November 2007", U.S. EPA, Figure 2-1.

2.3 Market Segmentation

Segmentation of the market in AEP Ohio is needed to have ongoing and effective outreach and participation across segments and classes of customers. In addition, AEP Ohio plans to continue measuring geographical participation for geo-targeting opportunities going forward.

Consumer Segmentation

Table 17 presents 2013 data for single-family and multifamily residential customers, including low income. Overall, 69.2 percent of the total residential sector customers are in the base residential segment that excludes all single-family and multifamily low income customer segments. Most, 89.2 percent base residential customers live in single-family homes while the remainder lives in multifamily housing.

Overall, 30.8 percent of total residential sector customers are in the low income segment. Most of these customers (90.8%) live in single-family homes, while the remainder lives in multifamily housing.

Table 17. Residential Customer Data – 2013

Customer Segment - 2013	Number of Accounts	Percent of Accounts	Percent of Consumption
Single Family	737,145	90.7%	94%
Multifamily	75,701	9.3%	5.9%
Residential (Excluding Low Income)	**812,846**	**68.2%**	**69.2%**
Single Family	326,500	86.1%	90.8%
Multifamily	52,570	13.9%	9.2%
Residential (Low Income Only)	**379,070**	**31.8%**	**30.8%**
Single Family	1,063,645	89.2%	93.1%
Multifamily	128,271	10.8%	6.9%
Total - All Residential	**1,191,916**	**100%**	**100%**

(1) Excludes 69,282 accounts (5.5% of total) that do not have income or dwelling type data available.
(2) Low income residential customers are defined as those having incomes less than 200% of the federal income poverty guidelines.

Table 18 presents 2013 participant data for single-family and multifamily residential customers. Results from the Efficient Products Program are not included since customer-specific data is not available for that program.

There is not a significant difference in the EE/PDR program 2013 participant savings as a percent of customer segment consumption (8.9% for low income segment vs. 8.6% for the base residential segment). Average 2013 participant savings vs. participant consumption was higher for multifamily than single-family homes, with low income customers savings more on average than for single-family homes.

Table 18. Consumer Programs Participation - 2013

Customer Segment - 2013	Program Participant Average Consumption (kWh)	Participants vs Segment Consumption (percent)	Participant Savings vs. Customer Segment Consumption (percent)	Participant Savings vs. Participant Consumption (percent)	2009-2013 Participant Savings vs All 2013 Consumption
Single Family	15,069	24.8%	2.1%	8.6%	14.5%
Multifamily	12,034	17.8%	1.7%	9.7%	8.5%
Residential (Excluding Low Income)	**14,907**	**24.8%**	**2.1%**	**8.6%**	**14.1%**
Single Family	15,917	25.3%	2.2%	8.8%	13.5%
Multifamily	12,208	16.3%	1.7%	10.3%	9.0%
Residential (Low Income Only)	**15,627**	**24.5%**	**0.2%**	**8.9%**	**13.0%**
Single Family	13,011	24.9%	2.2%	8.7%	14.2%
Multifamily	8,136	17.2%	1.7%	9.9%	8.4%
Total - All Residential	**12,639**	**24.4%**	**2.1%**	**8.7%**	**13.8%**

(1)Efficient Lighting calculated at a fully saturated 46 lamps per household. 50% of these household's assumed to be new participants

(2) 46 lamps per household source: http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2010-lmc-final-jan-2012.pdf Page 26

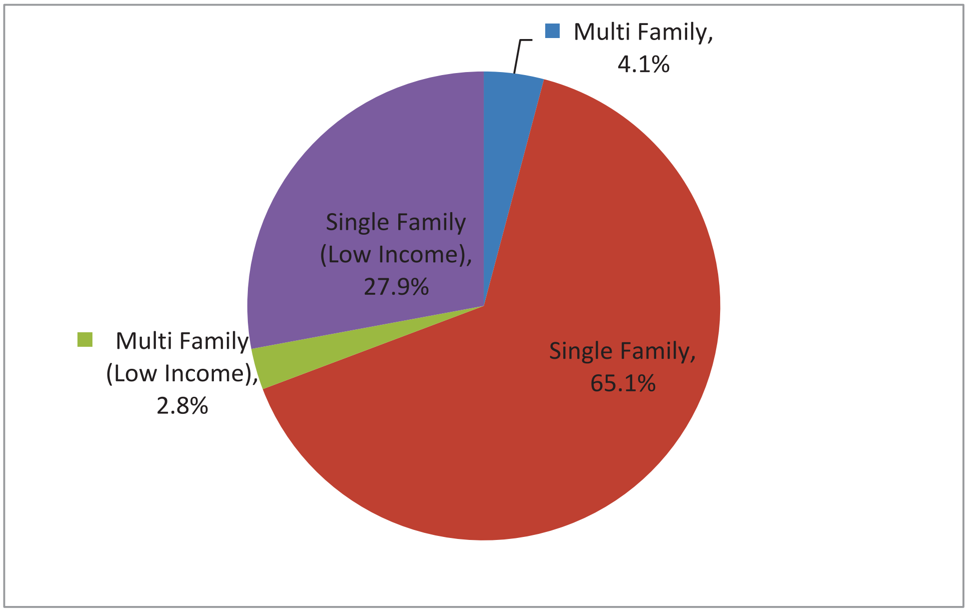
(3) Excludes 69,282 accounts (5.5% of total) that do not have income or dwelling type data available.

(4) Low income residential customers are defined as those having incomes less than 200% of the federal income poverty guidelines.

(5) Penetration Consumption adjusted for Past Energy Savings

Figure 12 shows 2013 single-family and multifamily residential energy consumption by segment. Single-family homes comprised the large majority of residential sector energy usage.

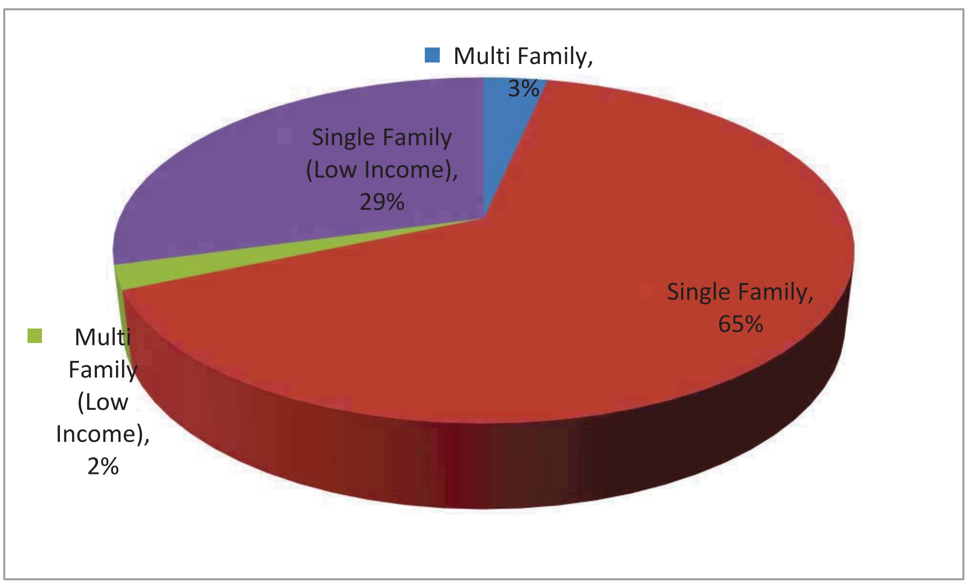
Figure 12. Residential Sector Energy Consumption – 2013



(1) Excludes accounts that do not have income or dwelling type data available.
(2) Low income residential customers are defined as those having incomes less than 200% of the federal income poverty level.

Figure 13 presents 2013 participant savings by segment. Single-family homes comprised the large majority of participants.

Figure 13. Consumer Programs Participant Savings – 2013



(1) Includes Efficient Products program participation or savings.
(2) Excludes accounts that do not have income or dwelling type data available.
(3) Low income residential customers are defined as those having incomes less than 200 percent of the federal income poverty level.

Business Segmentation

Current programs as well as proposed programs are designed to target all segments of the business sector. There are specific target segments that recognize key activities with significant available EE/PDR opportunities.

Table 19 presents 2013 nonresidential customer data by customer type, including the number of EE/PDR participants. Small Office, Manufacturing, Small Retail, and Schools comprised over half the participants.

Table 19. Nonresidential Customer Data – 2013

Type of Customer - 2013	Number of Accounts	Percent of Accounts	Number of Participants	Penetration 2009-2013
Ag,Mine,Const.	14,345	6.69	131	2%
Assembly	17,559	8.19	233	4%
Flat Load Comm	11,820	5.51	43	1%
Grocery	2,599	1.21	200	19%
Health Srv	5,858	2.73	84	5%
Hospitals	432	0.2	21	13%
Light Industrial	196	0.09	10	15%
Manufacturing	6,436	3	377	17%
OfficeLarge	1,912	0.89	181	28%
OfficeSmall	74,824	34.91	825	3%
Other	550	0.26	7	3%
RestaurantLarge	464	0.22	24	14%
RestaurantSmall	7,546	3.52	168	5%
RetailLarge	1,388	0.65	148	31%
RetailSmall	56,893	26.54	788	3%
Schools	5,578	2.6	266	17%
Warehouse	5,931	2.77	170	7%
Total	**214,331**	**100**	**3,676**	**5%**

Table 20 presents 2013 nonresidential participant data. The average Small Office and Other building type participant saved over 28 percent of annual electricity usage. All other participants saved less than 23 percent.

Table 20. Business Programs Participant Savings – 2013

Type of Customer -	Total Participants Consumption (kWh)	Participants vs. Segment Consumption (percent)	Participants Savings vs. Segment Consumption (percent)	Participant Savings as Percent of Participant Consumption	2009-2013 Savings vs All 2013 Consumption
Ag,Mine,Const.	64,150,900	10.5%	0.6%	5%	2%
Assembly	81,341,544	8.4%	8.9%	9%	3%
Flat Load Comm	60,832,743	15.2%	3.5%	4%	1%
Grocery	231,340,000	35.8%	2.7%	3%	5%
Health Srv	20,427,762	3.6%	9.3%	9%	3%
Hospitals	247,360,000	32.9%	1.2%	1%	3%
Light Industrial	7,061,059	14.0%	10.9%	11%	9%
Manufacturing	6,336,000,000	41.3%	1.9%	2%	3%
OfficeLarge	636,860,000	21.3%	4.7%	5%	5%
OfficeSmall	52,640,484	3.6%	47.0%	47%	5%
Other	1,658,820	7.5%	2.2%	29%	7%
RestaurantLarge	22,100,160	8.3%	3.0%	3%	1%
RestaurantSmall	18,518,748	2.9%	11.9%	12%	1%
RetailLarge	228,090,000	14.2%	8.4%	8%	7%
RetailSmall	69,824,477	5.4%	22.3%	22%	4%
Schools	854,450,000	42.5%	4.2%	4%	7%
Warehouse	157,550,000	24.3%	7.0%	7%	11%
Total	**9,090,206,697**	-	-	-	

Figure 14 shows 2013 nonresidential energy consumption by segment. Manufacturing facilities consume two-thirds of nonresidential customer usage.

Figure 14. Nonresidential Energy Consumption – 2013

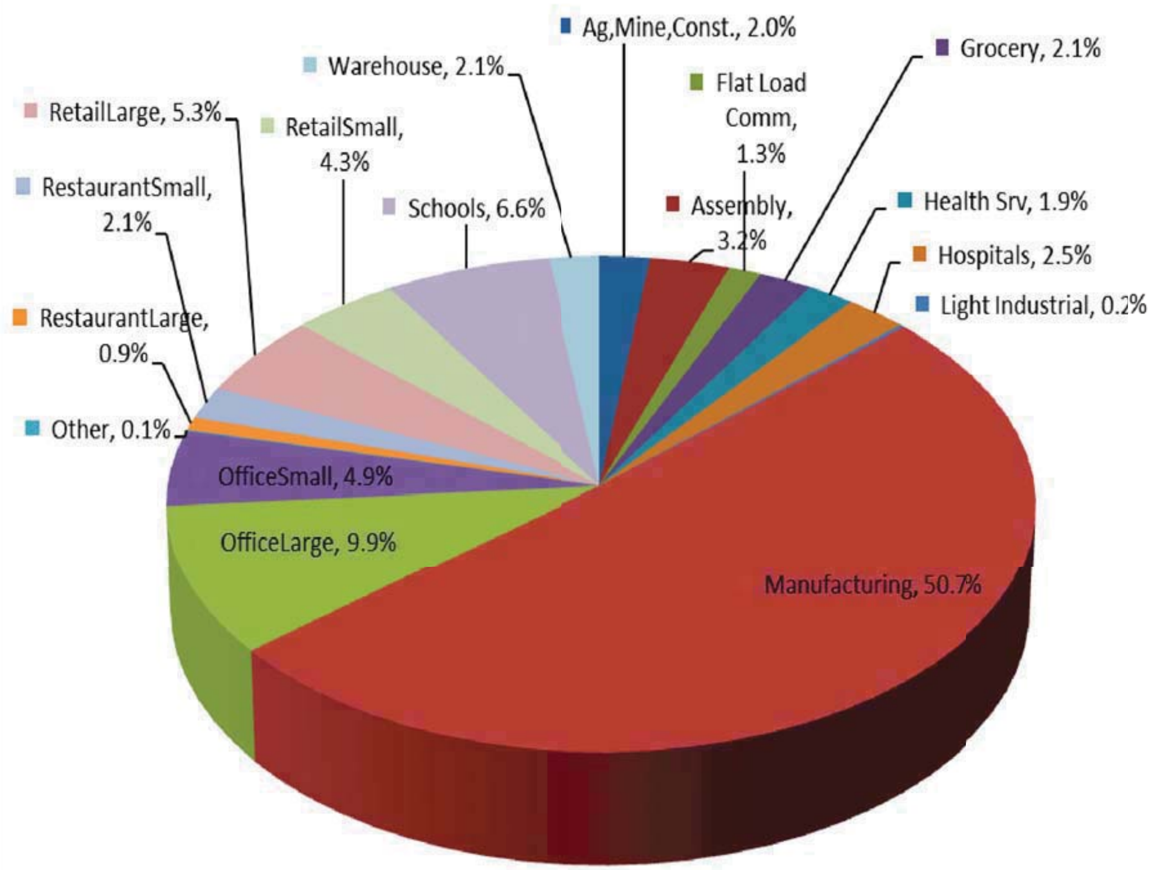
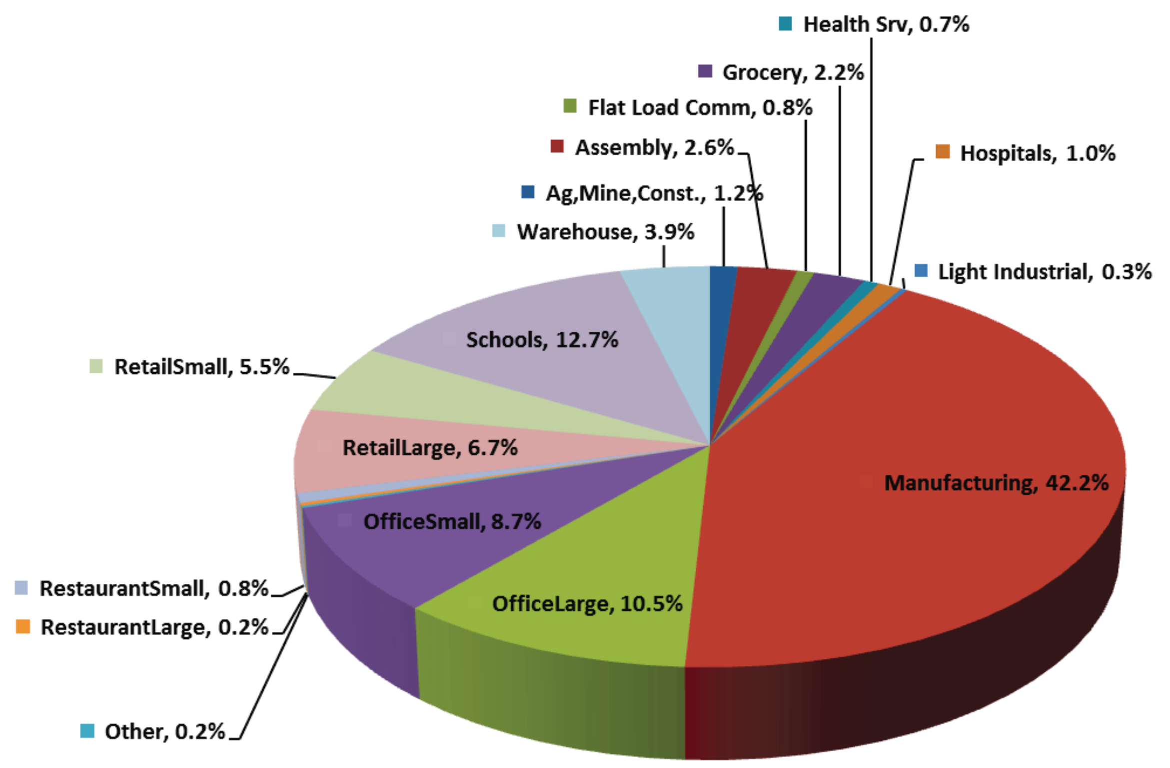


Figure 15 shows 2013 participant savings by segment. Large offices, large retail stores, and schools participated in greater numbers than their share of the AEP Ohio customer base.

Figure 15. Business Programs Participant Savings – 2013



2.4 Stakeholder Participation in the Planning Process

AEP Ohio established the AEP Ohio Collaborative in October 2008, and has met regularly since that time to gain input from its twenty-five members representing all classes of customers on program planning and to provide feedback on the current plan and its performance.

For this Plan's development, the AEP Ohio Collaborative met twelve times in 2013 and 2014 to review AEP Ohio's proposed approaches and Collaborative members had the opportunity as a group and individually to provide feedback throughout the entire process. Included in the count were individual meetings held with interested Collaborative members to provide additional time for input. In some cases, Collaborative members brought in third party EE/PDR consultants to assist AEP Ohio.

The Collaborative members include: PUCO Staff, Ohio Consumers' Counsel, Sierra Club, Natural Resources Defense Council, Ohio Environmental Council, Industrial Energy Users, Ohio Manufacturing Association, Ohio Energy Group, Ohio Hospital Association, Ohio Partners for Affordable Energy, Ohio Air Quality Development Authority, Ohio Development Services Agency (includes the Office of Energy and Office of Community Assistance), Ohio Chamber of Commerce, Ohio Board of Regents, Ohio Farm Bureau, Mid-Ohio Regional Planning Commission, Ohio Poverty Law Center, Corporation for Ohio Appalachian Development, Building Industry Association of Central Ohio, , Association of Independent Colleges and Universities of Ohio, , IMPACT Community Action, Ohio Energy Project, Environmental Law and Policy Center, Environmental Defense Fund, Ohio Legal Services and Ormet.

2.5 Attempts to Align and Coordinate with Other Public Utility Programs

AEP Ohio has regular communication with other utilities in the state regarding EE/PDR activities and is open to opportunities to work together and share information. AEP Ohio has met periodically with all the other utilities, electric and gas, over the last three years to share knowledge on program design and implementation. For example, AEP Ohio and Columbia Gas are currently working together to deliver New Homes, In-Home Audit, e3smart and Energy Code Support Pilot.

2.6 AEP Ohio Plan Management

AEP Ohio serves as the overall program administrator for delivery of the Plan. AEP Ohio plans to engage third-party implementation contractors when it is more cost effective than running the programs in house. Utilization of third party contractors will continue to be subject to cost effectiveness throughout the Plan period. Competitive bidding for third party work is planned for most programs that require third party contractors since many contractors have been working for AEP Ohio through two previous Plan cycles. The competitive bidding process can be lengthy and is one of the key reasons behind completing this Plan early in 2014 for filing and Commission approval.

AEP Ohio is responsible for high-level administrative, contract and program management, program design and marketing oversight of the selected implementation contractors. A Plan of this proposed size and scope requires careful management oversight. The experience gained from implementation of the 2009-2011 and 2012-

2014 Plans provides the best guidance as to the structure and size required to administer these programs. AEP Ohio will continue to have a small and dedicated group of EE/PDR program staff overseeing both AEP Ohio and third-party implemented programs including compliance and financial management activities, as well as research, development, education, training, planning and promotion of programs to increase customer awareness and participation.

AEP Ohio's Manager EE/PDR is responsible for the overall Plan and reports to the Director of Customer Services and Marketing, who reports to the President of AEP Ohio. Six functional areas report to the Manager EE/PDR and include Research & Development, Education & Training, Compliance, Finance, Consumer Programs and Business Programs. A staff of twenty two currently manages these activities, and it is projected that an additional four full-time employees (FTEs) will be needed to manage this Plan due to new programs and expansions, as well as significantly more outreach, and compliance activities. While this staffing level contemplates a continuing reliance on external third-party contractors, it is possible that in house staff may be more cost effective after third-party bidding is analyzed for the various programs. In any case, any increase in the level of in house staffing beyond the FTEs indicated above would be constrained within the overall budget proposed in this Plan, and only if it were determined that in house staffing additions were more cost effective than third party implementation.

AEP Ohio has developed a comprehensive tracking database to ensure accurate and comprehensive reporting of all program participation that will be fully launched by the end of 2014. Additionally, the database will allow AEP Ohio to research and track participation by customer class, segment and geographic area, to identify trends and untapped opportunities to advance program goals and increase first time program participation. Also, AEP Ohio staff has primary responsibility for general energy efficiency education and awareness strategies and activities, including the content of the EE/PDR web site[12], online energy audit software, mass-market media, general education, and efficiency awareness promotions. Research and Development will support in Plan adjustments and future planning intelligence for the achievement of goals.

[12] See http://www.aepohio.com/save

In summary, AEP Ohio will provide comprehensive program contract oversight, including management, financial planning and budgeting, regulatory and legal support, as well as:

- High-level guidance and direction to any implementation contractors, including review and revision of proposed annual implementation plans and proposed milestones, and additionally, daily engagement with the contractor team when working through strategy and policy issues.
- Review and approval of implementation contractor invoices and ensuring program activities are within budget and on schedule.
- Assurance that implementation contractor operational databases are accurate, and data is incorporated into AEP Ohio's comprehensive Plan tracking database to be used for overall tracking, management and regulatory reporting.
- Review of measure saving estimates maintained by AEP Ohio and the implementation contractors.
- Oversight and coordination of evaluation, measurement, and verification contractors.
- Public education and outreach to customers, community groups, trade allies and trade associations.
- Guidance and direction on new initiatives or strategies.
- Communication and direction to implementation contractors regarding other AEP Ohio initiatives that may provide opportunities for cross-program promotion.
- Development, review and approval of printed materials and advertising plans.
- Evaluation of Plan and program cost effectiveness and recommendations for modifications to programs and approach as needed.
- Periodic review of program metrics, conduct investment analyses, and review evolving program designs.
- Research and development, both internal and oversight of third party providers.

3 EE/PDR Plan Summary Results

3.1 Plan Framework and Summary

For this Plan, AEP Ohio is proposing to cap annual Plan spending at less than the 2013 approved level of $91.5 million in the current 2012-2014 EE/PDR Action Plan, which was supported by a broad coalition of stakeholders and approved by the PUCO. Over the five years of the Plan, total spending is proposed at $436.1 million (2015$) on EE/PDR programs during calendar years 2015 to 2019. The division of EE/PDR program investment between residential and business customers is commensurate with each sector's relative contribution to the Plan overall and to the Plan's cost effectiveness.

The plan maximizes the amount of program funds that go directly to customers through rebates and incentives, training and technical assistance, and customer and trade ally education. This Plan also takes into account the realities of program start-up costs for newly proposed programs, and the funds needed to adequately plan, develop, deliver, and evaluate quality programs. The balance of the expenditures will be applied to program administration, including staffing.

Incentive levels and other program elements will be reviewed and modified to reflect changes in market conditions or implementation processes in order to maximize cost-effective savings. Modifications will be reported in the annual reports submitted to the PUCO.

As previously detailed in Table 2, AEP Ohio has developed this plan with the intent to meet or exceed statutory energy savings goals as percent of sales and demand savings as a percent of peak load.

3.2 Benefit-Cost Analysis Background

AEP Ohio has estimated the energy savings, costs and benefits associated with each of the programs included in the proposed Plan. The following section presents the benefit-cost results.

Types of Benefit-Cost Tests

As detailed in Table 21 there are four major benefit-cost tests commonly utilized in the energy efficiency industry, each of which addresses different perspectives. The PUCO established that the Total Resource Cost (TRC) Test be the key test to determine if EE/PDR programs should be offered to customers. Regardless of which perspective is used, benefit-cost ratios greater than or equal to 1.0 are considered beneficial. While various perspectives are often referred to as tests, the following list of criteria demonstrates that decisions on program development go beyond a pass/fail test.

Table 21. Comparative Benefit-Cost Tests

	PARTICIPANT TEST (PCT)	RATE IMPACT MEASURE TEST (RIM)	TOTAL RESOURCE COST TEST (TRC)	UTILITY COST TEST (UCT)
Reduction in Customer's Utility Bill	X			
Incentive Paid by Utility/Program Administrator	X			
Any Tax Credit Received	X		X	
Avoided Supply Costs		X	X	X
Avoided Participant Costs			X	
Participant Payment to Utility (if any)		X		X
Utility Admin Costs		X	X	X
Participant Costs	X		X	
Incentive Costs		X		X
Lost Revenues		X		

AEP Ohio evaluated the cost-effectiveness of the measures, programs and overall Plan based on the following standard tests:

The Participant Cost Test (PCT) illustrates the relative magnitude of net benefits that go to participants compared to net benefits achieved from other perspectives. While called a "participant" perspective, it is not necessarily a perspective indicating whether customers participate. The implied discount rate can vary substantially between customers. More importantly, many customers neither understand nor make decisions based on present-value benefit-cost analysis. Consequently, a simple payback (years) net of incentive has been shown to provide further guidance on customer participation. The benefits derived from this test reflect reductions in a customer's bill and energy costs plus any incentives received from the utility or third parties, and any tax credit. Savings are based on gross revenues. Costs are based on out-of-pocket expenses from participating in a program, plus any increases in the customer's utility bill(s).

The Rate Impact Measure (RIM) Test measures the change in utility energy rates resulting from changes in revenues and operating costs. The higher the RIM test, the less impact is on increasing energy rates. While the RIM results provide a guide as to which technology has more impact on rates, generally it is not considered a pass/fail test. Instead, the amount of rate impact usually is considered at a policy level. The policy level decision is whether the entire Plan's impact on rates is so detrimental that some net benefits have to be forgone.

The Total Resource Cost Test (TRC) is a test that measures the total net resource expenditures of an EE/PDR program from the point of view of the utility and its ratepayers. Resource costs include changes in supply and participant costs. An EE/PDR program, which passes the TRC test (i.e., a ratio greater than 1.0) is viewed as beneficial to the utility and its customers because the savings in electric costs outweigh the EE/PDR costs incurred by the utility and its customers.

The Utility Cost Test (UCT, also referred to as the Program Administrator Test) measures the net benefits of a EE/PDR program as a resource option based on the costs and benefits incurred by the utility (including incentive costs) and excluding any net costs incurred by the customer participating in the efficiency program. The benefits are the avoided supply costs of energy and demand, the reduction in transmission, distribution, generation and capacity valued at marginal costs for the periods when there is a load reduction. The costs are the program costs incurred by the utility, the incentives paid to the customers, and the increased supply costs for the periods in which load is increased.

3.3 Benefit-Cost Methodology

The DSM Resource Assessment Model (DSM-RAM) is a model based on the integration of EE/PDR measure impacts and costs, utility customer characteristics, utility load forecasts, and utility avoided costs and rate schedules. The model utilizes a "bottom-up" approach in that the starting points are the study area building stocks and equipment saturation estimates, forecasts of building stock decay and new construction, EE/PDR technology data, past EE/PDR program accomplishments, and decision maker variables that help drive the market potential scenarios.

The baseline estimates of building stocks and equipment saturations came from the results of the on-site assessments conducted by AEP Ohio for the 2013 residential and nonresidential baseline studies. DSM-RAM also used the electricity forecast, avoided cost forecast, and electricity prices as described below.

DSM-RAM estimates technical, economic, and achievable EE/PDR resource potential as defined below:

- **Technical EE/PDR potential** describes the amount of EE/PDR savings that could be achieved, not considering economic and market barriers, by customers installing EE/PDR measures. Technical potential is calculated as the product of the EE/PDR measures' savings per unit, the quantity of applicable equipment in each facility, the number of facilities in a utility's service area, and 100 percent current market saturation of the measure. Technical potential estimates include EE/PDR measures that may not be cost effective, and technical potential does not consider market barriers, such as customer's lack of awareness of EE/PDR measures. Therefore, technical EE/PDR potential estimates do not provide a realistic basis for setting EE/PDR program goals.
- **Economic EE/PDR potential** describes the amount of technical EE/PDR potential that is "cost-effective," as defined by the results of the TRC test (or other preferred cost effectiveness test). The program benefits for the TRC test include the avoided costs of generation, transmission, and distribution investments and avoided fuel costs due to the energy conserved by the EE/PDR programs. The costs for the TRC test are the EE/PDR measure costs, plus the EE/PDR program administration costs. The TRC test does not consider economic or market barriers to customers installing EE/PDR measures.
- **Achievable EE/PDR market potential** estimates the amount of EE/PDR potential that could be captured by realistic EE/PDR programs that include cost effective EE/PDR measures over the forecast period covered by this EE/PDR potential analysis. Achievable EE/PDR potential can vary with EE/PDR program parameters, such as the magnitude of rebates or incentives offered to customers for installing EE/PDR measures and, thus, many different scenarios can be modeled.

Within the achievable EE/PDR potential assessment, the individual measures are modeled by expected type of EE/PDR program design. Three different program design options are included in DSM-RAM.

- **Replace on Burnout (ROB)** means that an EE/PDR measure is not implemented until the existing technology it is replacing fails. An example would be an energy efficient clothes washer being purchased after the failure of the existing clothes washer.

- **Retrofit (RET)** means that the EE/PDR measure could be implemented immediately. For instance, installing a low flow shower head is usually implemented before an existing shower head fails. Replacing incandescent lamps may be a ROB, but can be treated as a RET, because of the relatively short lifetime for incandescent bulbs.
- **New Construction (New)** means measures that are installed at the time of new construction. Baseline technologies may be different in the new construction

market, and implementation costs are often different due to the different technologies, either the energy efficient or base technology.

Cost Effectiveness Tests

DSM-RAM employs several financial tests, including the cost effectiveness tests described above: the TRC, UCT, PCT, and RIM tests.

Simple Customer Payback

The decision model of DSM-RAM includes simple customer payback as part of its analysis. The calculation takes measure cost less the incentive received and divides it by first year energy bill savings.

EE/PDR Measure Levelized Cost/kWh

EE/PDR supply curves are based on the EE/PDR measure cost per kWh, levelized over the lifetime of the measure. It is calculated by multiplying EE/PDR measure costs by the Capital Recovery Factor (CRF), then dividing by the first year kWh savings.

Discount Rate

There is a time value of money because money spent in the future does not have the same value as money spent today. This time value is represented by a discount rate (analogous to an interest rate). Economic equations use the discount rate to convert all costs and benefits to a "present value" for comparing alternative costs and benefits. AEP Ohio used a uniform discount rate of 8.6 percent for planning purposes only.

Avoided Costs and Energy Costs

EE/PDR avoided cost benefits fall into two categories, avoided capacity benefits, and avoided energy costs. Avoided capacity benefits are the benefits derived from deferring the need to build new generating plants in the future. Avoided capacity values were based on AEP Ohio projections of future power plant costs considering expected level of capacity available over future years, and the costs of that capacity.

Administration, Implementation and Direct Costs

Each program's administration, implementation, and direct costs were allocated to the technologies delivered by the program based on the annual kWh savings per measure. The result is that individual technology benefit/cost ratios can appear low simply because administration or implementation costs have been allocated to the technology beyond the specific technology costs. On the one hand, this allocation helps ensure the overall cost-effectiveness of a program by guiding selection of technologies with sufficient benefits to support program delivery costs. This still allows technologies with a benefit-cost ratio less than 1.0 to be included as needed to meet other goals in addition to Plan cost-effectiveness requirements. AEP Ohio support services that are not specific to individual programs are added as costs at the Plan level for all programs.

3.4 Program Development

Program development involves the selection of technologies to include in a program, estimates of participation levels and estimates of program costs. It is obviously necessary for a Plan to be cost-effective. However, there are multiple and often contradictory perspectives on cost effectiveness. Alternative perspectives are described below. The primary cost-effectiveness perspective in AEP Ohio is the total resource cost test. Fortunately, it is possible to achieve required cost-effectiveness at a Plan level while also considering other important criteria. The following list of criteria was considered in developing programs:

- Achieving more benefits net of cost is a higher priority than a high benefit-cost ratio.
- The Plan must provide opportunities for all customer sectors to participate.
- Long-term contribution of a technology is important to program success and to future cost reductions.
- Consideration of different benefit-cost perspectives is necessary.

While almost all customer sectors will pay a contribution in their utility bill towards the cost of efficiency programs, some customer sectors will not be able to participate unless a program is specifically targeted to overcome their barriers. The Residential Community Assistance Program is an example of a program where improving the ability of a specific sector to participate was a primary program design goal. Similarly the Business Express program is targeted to small businesses and without a focused effort those customers would not participate at a reasonable level.

The next section provides details on the adjustments and enhancements, projected participation, savings, budgets and benefit-cost test results for ongoing programs. Further details are provided for new programs, including:

- Objectives
- Target Markets
- Duration
- Description
- Incentive Strategy
- Eligible Measures

- Implementation Strategy
- Marketing Strategy
- Milestones
- EM&V Strategy
- AEP Ohio Administrative Requirements
- Budget
- Savings Targets
- Benefit-Cost Test Results

4 EE/PDR Program Plans

The programs developed to achieve EE/PDR goals in this Plan are based on lessons learned from the implementation of the 2009-2011 and the 2012-2014 EE/PDR Action Plans as well as other best-practice programs from around the country, with the concepts outlined in a strategic manner. Existing program plans are not repeated from the 2012-2014 EE/PDR Action Plan; however, modifications are included. The plans are proposed as guidelines for more detailed program planning; they are not intended to be operational per se. The intent of the Plan presented here is to provide a sense of scope and scale, and convey the general schedule and resources needed to increase customer participation from previous program efforts in the various markets in which the programs will operate.

Overall, a Plan is presented that covers a broad range of demographic, business, facility, and end-use markets. AEP Ohio's Plan can be divided into consumer, business and cross-sectors with utility administrative functions providing support across all program areas. AEP Ohio will maintain as part of its functionality the advertising, education, training and research and development budgets. The following section presents a summary of the services offered in each program.

4.1 Consumer Programs

For the complete program plan for each ongoing consumer EE/PDR program, please reference the Consumer Program Plans section (pages 57-80) of *Volume 1: AEP Ohio 2012 to 2014 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan*, dated November 29, 2011 (PUCO Docket 11-5568-EL-POR and 11-5569-EL-POR.) Included in each program description below are material program changes shown as adjustments and enhancements, participation levels, budget, savings targets and benefit-cost test results. For the new programs, complete program descriptions are included.

4.1.1 **Efficient Products** (On-Going Program)

This program provides incentives and marketing support through retailers to build market share and usage of efficient lighting and efficient appliances primarily through mark down and rebate approaches. Customer incentives at the point of sale encourage increased purchases of high-efficiency products while in-store signage, sales associate training, and support make provider participation easier.

For appliances, the program uses a retail channel-based strategy to influence the purchase of high-efficiency appliances and electronics. Since appliance standards, as well as the market share of high-efficiency appliances, are gradually increasing, the program will be specific in its list of qualifying models, as well as marketing emphasis.

Lighting: AEP Ohio relies on CFL and LED sales through the over 600 retailers in place throughout its service territory.

Appliances: Funding allows incentives for a variety of cost effective appliances, including refrigerators, freezers, clothes washers, clothes dryers, dishwashers, televisions and pool pumps. AEP Ohio plans for retailer based appliance programs with mid and downstream incentive strategies, depending on the overall cost effectiveness and savings potential for each appliance.

HVAC and Domestic Hot Water: The program affects the purchase and installation of air source heat pumps and electric hot water heaters when replacing less efficient electric space heating or water heating through a combination of market push and pull strategies that stimulate demand while simultaneously increasing market provider investment in stocking and promoting high efficiency products.

The program will work through two distinct market channels – plumbing contractors and the retail Do-It-Yourself stores.

Adjustments and Enhancements
The Efficient Products program will be enhanced to allow agricultural customers on residential tariff(s) to participate in agriculture measures identified in the Efficient Products for Business Program and the savings from those measures to be counted. Other AEP Ohio modifications to the Efficient Products Program as shown below will: • Aggressively promote and discount LED's • Add ENERGY STAR® dryers, smart strips, programmable thermostats to the appliance rebate program offering • Discontinue mid-stream TV incentives and switch to customer rebate • Offer revised electric water heater rebate through trained plumbing contractors and distributors rather than through typical DIY retailer • Incentives not included in the measure mix from previous plan(s) have been deemed either not cost effective or had low participation. • Customer incentives may be adjusted to increase cost effectiveness and/or program participation. • Cost effective measures developed during Plan implementation may be added and measures currently on the list may be changed or removed depending on both cost effectiveness and customer participation.

Participation
The following participation levels have been used for planning purposes. However, AEP Ohio may adjust qualifying energy efficiency measures and anticipated participation levels as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

Incremental Annual Participants (units installed)							
Measure Name	Units	2015	2016	2017	2018	2019	Total 2015 - 2019
5W Chandelier LED bulb	Lamp	2,328	2,812	2,989	3,110	3,378	**14,617**
Air Source Heat Pump SEER 14.5, COP 2.49	Ton	1,390	1,096	1,143	1,442	2,635	**7,706**
Air Source Heat Pump SEER 14.5, COP 2.49	Ton	60	48	51	67	124	**350**
CFL >25W Screw-In Indoor	Lamp	17,669	19,514	19,817	19,681	20,381	**97,063**
CFL >25W Screw-In Outdoor	Lamp	254	278	282	279	288	**1,381**
CFL 13W Screw-In Indoor	Lamp	632,200	666,475	633,066	611,279	615,685	**3,158,706**
CFL 13W Screw-In Outdoor	Lamp	58,170	62,022	59,514	57,992	58,919	**296,616**
CFL 18W Screw-In Indoor	Lamp	37,794	37,200	36,607	35,198	35,258	**182,058**
CFL 18W Screw-In Outdoor	Lamp	4,126	3,990	3,894	3,711	3,684	**19,404**
CFL 23W Screw-In Indoor	Lamp	36,857	38,601	38,708	37,936	38,729	**190,831**
CFL 23W Screw-In Outdoor	Lamp	6,978	7,317	7,341	7,196	7,347	**36,179**
CFL 7W Screw-In Indoor	Lamp	289,581	315,359	305,415	300,019	307,110	**1,517,483**
CFL 7W Screw-In Outdoor	Lamp	12,324	13,522	13,157	12,981	13,342	**65,327**
Clothes Washer Retirement (Early Replacement)	Unit	9,125	10,125	10,272	10,190	10,524	**50,235**
Ductless Mini Split HP SEER 13	Ton	156	173	173	173	186	**861**
Ductless Mini Split HP SEER 15	Ton	156	173	173	173	186	**861**
ECM Fan Motor - Central A/C - EL Heat	Home	203	236	247	254	274	**1,214**
ECM Fan Motor - Central A/C - Non-EL Heat	Home	8,891	10,065	10,384	10,534	11,203	**51,077**
ECM Fan Motor - Heat Pump	Home	1,337	1,485	1,518	1,527	1,611	**7,479**
Efficient Refrigerator (ENERGY STAR® or Better)	Refrigerator	4,212	0	0	0	0	**4,212**
ENERGY STAR® 50 CFM Bathroom Ventilating Fan	Fan	6,267	7,541	7,966	8,235	8,870	**38,878**
ENERGY STAR® 50 CFM Bathroom Ventilating Fan	Fan	419	507	538	559	606	**2,629**
ENERGY STAR® Dehumidifier	Dehumidifier	3,476	4,078	4,252	4,335	4,604	**20,745**
ENERGY STAR® Most Efficient Television	TV	31,500	29,745	29,011	27,928	28,138	**146,322**
ENERGY STAR® Torchiere	Lamp	2,736	2,913	2,954	2,934	3,039	**14,576**
ENERGY STAR® v. 5.3 Television	TV	31,500	29,745	29,011	27,928	28,138	**146,322**
Hardwired Dimmer Switch	Dimmer	89,091	0	0	0	0	**89,091**
Heat Pump Water Heater - 2.0 EF	Unit	1,517	1,811	1,718	1,126	1,242	**7,414**
Heavy Duty Outdoor Timer for Pool Pump	Pump	901	1,085	1,155	1,209	1,330	**5,680**
Indoor Wall-mounted Motion Sensor	Sensor	73,797	0	0	0	0	**73,797**
LED Lighting 12W - Indoor	Lamp	24,003	24,222	24,339	23,915	24,526	**121,005**
LED Lighting 12W - Outdoor	Lamp	3,608	3,715	3,767	3,734	3,863	**18,687**
LED Lighting 8W - Outdoor	Lamp	17,066	16,582	15,229	14,223	13,847	**76,947**
LED Lighting 8W - Indoor	Lamp	191,558	182,887	164,575	150,649	143,593	**833,262**
Outdoor Motion Sensor	Sensor	0	97,643	201,051	303,816	303,227	**905,737**
Premium Efficiency Pool Pumps	Pump	563	681	727	762	839	**3,572**
Programmable Electronic Baseboard Thermostat	Thermostat	295	352	385	419	474	**1,924**
SEER 15 CAC - EL Heat	Ton	0	0	0	0	250	**250**
SEER 15 CAC - Non-EL Heat	Ton	0	0	0	0	5	**5**
Tier 3 GSHP, Open Loop, water to air	Ton	292	301	304	303	313	**1,512**
VSD Pool Pump	Pump	447	535	568	593	649	**2,791**
Waterbed Insulating Pad	Pad	539	623	657	685	748	**3,253**

The following budget has been used for planning purposes. However, AEP Ohio may adjust program budgets as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

	Incremental Annual Budget					
	2015	**2016**	**2017**	**2018**	**2019**	**Total 2015 – 2019**
Administrative	$3,504,219	$3,488,077	$3,656,896	$3,832,695	$3,942,879	**$18,424,765**
Incentive	$9,699,717	$9,544,695	$11,764,377	$13,794,339	$14,105,431	**$58,908,559**
Total	**$13,203,935**	**$13,032,772**	**$15,421,274**	**$17,627,033**	**$18,048,309**	**$77,333,324**

	Incremental Annual					
	2015	**2016**	**2017**	**2018**	**2019**	**Total 2015 – 2019**
Participant Costs	$18,508,119	$15,483,318	$17,897,517	$20,325,161	$20,303,941	**$92,518,056**

Savings Targets

	Incremental Annual Savings – at Meter					
	2015	**2016**	**2017**	**2018**	**2019**	**Cumulative Total 2015 – 2019**
Energy (MWh)	74,272	74,092	77,673	81,245	83,840	**353,460**
Summer Peak Demand (kW)	11,094	10,007	9,678	9,307	9,809	**44,743**

Benefit-Cost Test Results

Benefit-Cost Test	2015-2019 Benefit-Cost Test Ratio
Total Resource Cost (TRC)	1.7
Utility System Resource Cost (UCT)	3.8
Participant Cost (PCT)	4.0
Rate Impact Measure (RIM)	0.5

4.1.2 **Appliance Recycling** (On-Going Program)

Many of the refrigerators and freezers being replaced by AEP Ohio customers are still functioning, and, often end up as energy guzzling secondary appliances in basements and garages. The secondary used refrigerator/freezer market may be an additional source of energy and demand savings. This opportunity continues to be explored. The Appliance Recycling Program targets these "second" refrigerators and freezers, cutting energy consumption. It also intervenes to keep the older, less efficient appliances out of the used appliance market. The program provides incentives to remove working units from service and fully recycle their materials. The program offers an environmentally responsible turnkey pick-up and recycling service.

Adjustments and Enhancements

AEP Ohio modifications to the Appliance Recycling Program as shown below:

- Open business customer pick-up and recycling of refrigerators/freezers to broaden participation.
- Pilot secondary market intervention with potential to add to program.
- Customer incentives may be adjusted to increase cost effectiveness and/or program participation.
- Cost effective measures developed during Plan implementation may be added and measures currently on the list may be changed or removed depending on both cost effectiveness and customer participation.

Participation

The following participation levels have been used for planning purposes. However, AEP Ohio may adjust qualifying energy efficiency measures and anticipated participation levels as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

Incremental Annual Participants (units installed)							
Measure Name	**Units**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total 2015 - 2019**
Refrigerator Retirement	Refrigerator	13,110	11,659	11,479	11,429	11,395	**59,073**
Freezer Retirement	Freezer	3,414	3,074	3,059	3,086	3,129	**15,762**

Budget

The following budget has been used for planning purposes. However, AEP Ohio may adjust program budgets as necessary in accordance with current market conditions, EM&V results, and program implementation experience. Electricity and measure cost savings resulting from removing secondary appliances result in negative participant costs (savings.)

	Incremental Annual Budget					
	2015	**2016**	**2017**	**2018**	**2019**	**Total 2015 – 2019**
Administrative	$827,999	$743,956	$739,791	$744,216	$750,315	**$3,806,276**
Incentive	$2,065,475	$1,841,580	$1,817,289	$1,814,368	$1,815,612	**$9,354,325**
Total	**$2,893,474**	**$2,585,536**	**$2,557,080**	**$2,558,585**	**$2,565,927**	**$13,160,601**

	Incremental Annual					
	2015	2016	2017	2018	2019	Total 2015 – 2019
Participant Costs	$0	$0	$0	$0	$0	**$0**

Savings Targets

	Incremental Annual Savings – at Meter					
	2015	2016	2017	2018	2019	Cumulative Total 2015 – 2019
Energy (MWh)	16,560	14,879	14,796	14,884	15,006	**76,126**
Summer Peak Demand (kW)	2,342	2,106	2,095	2,110	2,129	**10,782**

Benefit-Cost Test Results

Benefit-Cost Test	2015-2019 Benefit-Cost Test Ratio
Total Resource Cost (TRC)	2.3
Utility System Resource Cost (UCT)	2.3
Participant Cost (PCT)	7.7
Rate Impact Measure (RIM)	0.4

4.1.3 **In-Home Audit** (On-Going Program)

This program produces long-term electric energy savings in the consumer sector by helping customers analyze and reduce their energy use from a whole house perspective through the installation of whole house cost effective measures. The customer will have three options to choose from:

Option 1: On-Line Energy Analysis – This program is free to all AEP Ohio customers. Customers who complete the online analysis will receive a kit of energy efficiency measures by mail. Savings could include customer changes in behavior informed from the completion of the energy analysis.

Option 2: In-Home Energy Assessment – This program provides a walk-through audit by pre-certified contractors and a list of recommendations. Customers will also receive direct installed energy efficiency measures and a prioritized list of recommendations. This option is available to customers that are not eligible for Option 3.

Option 3: In-Home Energy Audit (all electric only) – This program provides the customer a comprehensive energy efficiency audit. The audit is performed by a pre-qualified and certified energy auditor, either directly contracted or sub-contracted to AEP Ohio to deliver the services required. The auditors perform blower-door, infrared camera, and combustion air tests, and utilize approved software to provide customers a detailed report of energy usage and potential savings associated with improvements. Customers will also receive the direct installed energy efficiency measures and a prioritized list of recommendations.

For any option selected, customers will be eligible for incentives and can choose from a list of pre-qualified contractors to have energy-saving improvements installed.

Adjustments and Enhancements
Retrofit Manufactured Housing: AEP Ohio will expand the In-Home Audit Program to obtain energy savings through the identification and implementation of cost-effective measures that improve the efficiency and comfort of existing occupied manufactured housing and to serve hard-to-reach customer segments. The Retrofit Manufactured Housing measures are targeted to residential customers with all-electric mobile homes on permanent foundations in urban and rural communities. • AEP Ohio will offer assessment services to identify retrofit opportunities and will offer financial incentives to residents and/or to contractors to assist with installation of measures: o A/C inspection and tune-up o High efficiency heat pump replacements of resistance heating o Ductless mini-splits o Duct sealing and repair o Mobile home belly patch o Mobile home roof coat o Mobile home roof patch o Attic radiant barrier o Mobile home insulation o Mobile home underneath vapor retarder o Mobile home rigid window • The implementation strategy is designed to lower the cost of delivery and increase participation by: o Combining multiple measures in one treatment package per home. o Identifying and engaging other program administrators and collaborators to share costs. o Encouraging third party financing for energy efficiency loans.

- The marketing strategies will vary from community outreach and direct mail to reach the majority of manufactured housing that is sited in rural settings of low population density to door-to-door canvassing of more densely clustered mobile home parks and communities.

- The Manufactured Housing Retrofit implementation contractor will:
    - Market the retrofit program to customers.
    - Implement a screening process to qualify cost-effective candidates for retrofit.
    - Administer, provide quality control, and verify retrofit installations.
    - Identify and collaborate with other manufactured housing efficiency program administrators.

Other AEP Ohio modifications to the In-Home Audit Program as shown below:

- Continue to look for opportunities to partner with other utilities to lower program administration costs and increase participation.
- Targeting only all-electric customers in the 2015-2019 plan for audits.
- Revised measure mix and rebate schedules to improve cost effectiveness.
- Incentives not included in the measure mix from previous plan(s) have been deemed either not cost effective or had low participation.
- Customer incentives may be adjusted to increase cost effectiveness and/or program participation.
- Cost effective measures developed during Plan implementation may be added and measures currently on the list may be changed or removed depending on both cost effectiveness and customer participation.

Participation

The following participation levels have been used for planning purposes. However, AEP Ohio may adjust qualifying energy efficiency measures and anticipated participation levels as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

Incremental Annual Participants (units installed)							
Measure Name	**Units**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total 2015 - 2019**
1W LED Night Light	Lamp	371	381	436	476	515	**2,180**
1W LED Night Light	Lamp	59	61	70	78	85	**353**
5-plug Smart Strip Power Bar	Power Strip	7,383	7,736	9,023	10,110	11,271	**45,523**
7-plug Smart Strip Power Bar	Power Strip	7,383	7,736	9,023	10,110	11,271	**45,523**
CFL >25W Screw-In Indoor	Lamp	2,681	2,524	2,759	2,877	2,961	**13,803**
CFL >25W Screw-In Outdoor	Lamp	38	36	39	41	42	**196**
CFL 13W Screw-In Indoor	Lamp	95,337	85,615	87,240	88,201	87,984	**444,377**
CFL 13W Screw-In Outdoor	Lamp	8,791	7,985	8,232	8,413	8,481	**41,901**
CFL 18W Screw-In Indoor	Lamp	5,608	4,769	5,038	5,072	5,032	**25,519**
CFL 18W Screw-In Outdoor	Lamp	610	510	533	531	521	**2,705**
CFL 23W Screw-In Indoor	Lamp	5,543	4,993	5,391	5,552	5,637	**27,116**
CFL 23W Screw-In Outdoor	Lamp	1,050	947	1,023	1,053	1,070	**5,142**
CFL 7W Screw-In Indoor	Lamp	43,993	40,777	42,493	43,843	44,612	**215,718**
CFL Pin-Based (<25W) Indoor	Fixture	2,806	2,823	3,235	3,550	3,862	**16,275**
CFL Pin-Based (<25W) Outdoor	Fixture	259	266	307	340	373	**1,546**
CFL Pin-Based (>=25W) Indoor	Fixture	72	73	84	92	101	**422**
CFL Pin-Based (>=25W) Outdoor	Fixture	1	1	1	1	2	**6**
DHW Pipe Insulation R-4 10 feet	10 Linear Feet	1,610	1,665	1,914	2,103	2,284	**9,576**
DHW Pipe Insulation R-4 10 feet	10 Linear Feet	142	147	169	186	202	**847**
Duct Sealing and Insulation - CAC - EL Heat	Home	2	2	3	3	3	**14**
Duct Sealing and Insulation - Heat Pump	Home	10	10	12	13	14	**58**
Efficient Refrigerator (ENERGY STAR® or Better) (DUB)	Refrigerator	1,767	1,792	2,063	2,272	2,474	**10,369**
ENERGY STAR® Central A/C (Early Replacement)	Ton	4,327	4,512	5,232	5,813	6,403	**26,288**
ENERGY STAR® Door - EL Heat	Door	88	91	105	115	126	**524**
Freezer Retirement	Freezer	74	78	91	103	115	**460**
Heat Pump Water Heater - 2.0 EF	Unit	16	0	0	0	0	**16**
LED Holiday Lights (300 bulb string)	300 bulb string	9,583	9,916	11,414	12,562	13,675	**57,149**
Low Flow (1.25 GPM) showerhead	Shower	2,956	3,012	3,409	3,688	3,946	**17,012**
Low Flow (1.25 GPM) showerhead	Shower	264	273	315	346	377	**1,575**
Low Flow Faucet Aerator, 1.5 GPM - EDHW	Faucet	3,441	3,501	3,959	4,276	4,566	**19,743**
Low Flow Faucet Aerator, 1.5 GPM - EDHW	Faucet	307	318	365	402	436	**1,828**
Reduced ACHnat 0.3 - Central A/C - EL Heat	Home	3	3	4	4	5	**20**
Reduced ACHnat 0.3 - Heat Pump	Home	19	19	22	24	26	**111**
Shower Start/Stop	Unit	1,194	1,261	1,478	1,665	1,865	**7,464**
Wall Insul. R-11 - Central A/C - EL Heat	1000 sqft wall area	7	7	9	10	10	**43**
Wall Insul. R-11 - Heat Pump	1000 sqft wall area	41	43	50	55	60	**249**

Budget

The following budget has been used for planning purposes. However, AEP Ohio may adjust program budgets as necessary in accordance with current market conditions, EM&V results, and program implementation experience. Electricity and measure cost savings resulting from installing CFLs in lieu of incandescent bulbs result in negative participant costs (savings.)

	Incremental Annual Budget					
	2015	2016	2017	2018	2019	Total 2015 – 2019
Administrative	$1,497,765	$1,449,694	$1,599,370	$1,710,118	$1,800,199	$8,057,146
Incentive	$2,381,652	$2,396,752	$2,738,093	$3,010,486	$3,278,724	$13,805,708
Total	$3,879,416	$3,846,446	$4,337,464	$4,720,605	$5,078,923	$21,862,854

	Incremental Annual					
	2015	2016	2017	2018	2019	Total 2015 – 2019
Participant Costs	$1,088,455	$1,042,131	$1,140,942	$1,215,860	$1,200,503	$5,687,892

Savings Targets

	Incremental Annual Savings – at Meter					
	2015	2016	2017	2018	2019	Cumulative Total 2015 – 2019
Energy (MWh)	9,815	9,506	10,463	11,162	11,821	50,563
Summer Peak Demand (kW)	1,902	1,899	2,138	2,322	2,503	9,963

Benefit-Cost Test Results

Benefit-Cost Test	2015-2019 Benefit-Cost Test Ratio
Total Resource Cost (TRC)	1.2
Utility System Resource Cost (UCT)	1.5
Participant Cost (PCT)	3.4
Rate Impact Measure (RIM)	0.4

4.1.4 **NEW HOME** (On-Going Program)

The New Home Program increases energy efficiency in residential new construction. The program is designed to recruit and educate builders and their trades on the benefits associated with energy efficient homes. Homes become certified at different efficiency levels through a home energy rating system (HERS) rating process and incentivized base on HERS scores. Going forward, the program will provide builder incentives but also focus on helping customers select more efficient new home construction by offering more education on building at higher energy efficiency levels and creating a market demand for energy efficient crafted homes.

Adjustments and Enhancements

New Energy Efficient Manufactured Housing

AEP Ohio will expand the program to obtain energy savings by increasing the share that energy efficient manufactured housing represents of total new manufactured housing sales to AEP Ohio customers.

- AEP Ohio will offer incentives to manufacturers to outfit new manufactured homes at the plant with high efficiency equipment, appliances, lighting and electronics for homes to be sited in AEP Ohio service territory. Measures include:
    - Heat pump water heaters
    - Ductless mini-splits
    - Whole-house sealing
    - Duct sealing
- Manufacturers of housing for sale and shipment to Ohio will be recruited for New Energy Efficient Manufactured Housing participation.
- The Energy Efficient Manufactured Housing implementation contractor will:
    - Market the value of energy efficient manufactured housing to homebuyers.
    - Engage manufacturers to install high-efficiency equipment and lighting to be sited for customers served by AEP Ohio.
    - Identify and collaborate with other manufactured housing efficiency program administrators.

Additional AEP Ohio modifications to the New Homes Program as shown below:

- Include code and standards education and awareness.
- Explore energy savings opportunities that may exist from energy code support activities designed to transform the market. AEP Ohio will attribute any quantifiable energy savings based on the difference between building to the

energy code and actual market practices to the New Homes program.

- Incentives not included in the measure mix from previous plan(s) have been deemed either not cost effective or had low participation.
- Customer/builder incentives may be adjusted to increase cost effectiveness and/or program participation.
- Cost effective measures developed during Plan implementation may be added and measures currently on the list may be changed or removed depending on both cost effectiveness and customer participation.

Participation

The following participation levels have been used for planning purposes. However, AEP Ohio may adjust qualifying energy efficiency measures and anticipated participation levels as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

Incremental Annual Participants (units installed)							
Measure Name	**Units**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total 2015 - 2019**
ENERGY STAR® Double Pane Windows - Central A/C - EL Heat	100 sqft window area	69	69	84	83	77	**383**
ENERGY STAR® Double Pane Windows - Central A/C - Non-EL Heat	100 sqft window area	2,240	2,223	2,703	2,682	2,490	**12,338**
ENERGY STAR® Double Pane Windows - Heat Pump	100 sqft window area	290	288	350	347	322	**1,596**
ENERGY STAR® 2.0/2.5 Qualified Home - Central A/C - Non-EL Heat	Home	465	462	565	566	531	**2,588**
ENERGY STAR® 2.0/2.5 Qualified Home - Heat Pump	Home	61	61	75	75	70	**342**
ENERGY STAR® 3.0 Qualified Home - Central A/C - Non-EL Heat	Home	324	323	397	401	381	**1,827**
ENERGY STAR® 3.0 Qualified Home - Heat Pump	Home	41	41	50	51	48	**231**
ENERGY STAR® 50 CFM Bathroom Ventilating Fan	Fan	3,072	3,047	3,699	3,662	3,387	**16,868**
ENERGY STAR® Manufactured Homes - EL Heat	Home	21	21	25	25	23	**115**
ENERGY STAR® Manufactured Homes - Non-EL Heat	Home	0	62	128	193	179	**563**
Heat Pump Water Heater - 2.0 EF	Unit	612	608	673	475	409	**2,777**
Reduced ACHnat 0.3 - Central A/C - EL Heat	Home	4	4	6	6	7	**27**
Reduced ACHnat 0.3 - Heat Pump	Home	23	23	29	30	29	**134**
Triple Pane Windows - Central A/C - EL Heat	100 sqft window area	50	50	61	61	57	**280**
Triple Pane Windows - Central A/C - Non-EL Heat	100 sqft window area	1,627	1,616	1,973	1,969	1,841	**9,027**
Triple Pane Windows - Heat Pump	100 sqft window area	211	209	255	255	238	**1,168**

Budget

The following budget has been used for planning purposes. However, AEP Ohio may adjust program budgets as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

	Incremental Annual Budget					
	2015	2016	2017	2018	2019	Total 2015 – 2019
Administrative	$741,154	$781,121	$874,224	$816,455	$881,345	**$4,094,299**
Incentive	$1,118,046	$1,266,055	$1,672,688	$1,811,542	$1,693,317	**$7,561,648**
Total	**$1,859,200**	**$2,047,176**	**$2,546,912**	**$2,627,997**	**$2,574,662**	**$11,655,947**

	Incremental Annual					
	2015	2016	2017	2018	2019	Total 2015 – 2019
Participant Costs	$2,977,579	$3,114,070	$3,922,115	$4,024,826	$3,770,031	**$17,808,622**

Savings Targets

	Incremental Annual Savings – at Meter					
	2015	2016	2017	2018	2019	Cumulative Total 2015 – 2019
Energy (MWh)	6,176	6,509	7,285	6,804	7,325	**34,119**
Summer Peak Demand (kW)	2,772	2,788	3,353	3,316	3,212	**15,442**

Benefit-Cost Test Results

Benefit-Cost Test	2015-2019 Benefit-Cost Test Ratio
Total Resource Cost (TRC)	1.4
Utility System Resource Cost (UCT)	3.6
Participant Cost (PCT)	3.0
Rate Impact Measure (RIM)	0.5

4.1.5 BEHAVIOR CHANGE (On-Going Program)

The Behavior Change Program focuses on measuring energy savings persistence as AEP Ohio switches to a digital based home energy savings and education report on an ongoing basis. This program helps pre-selected and new customers on an opt-in basis to reduce energy use by encouraging them to alter their habits of electricity usage by providing positive reinforcement. The report is shared with the customer via email or other electronic media to provide participants with their home's respective usage and other relevant information in a manner to motivate the customer to take action to save energy and maintain those savings through positive reinforcement. For example, the participant is provided a list of simple actions to follow to reduce electricity usage and promote other energy efficiency programs in which they can participate.

Adjustments and Enhancements

AEP Ohio will model savings from current participants to determine the persistence of savings over time and will count associated savings as long as persistence can be validated.

AEP Ohio modifications to the Home Energy Report Program as shown below:

- AEP Ohio will make reports available via email, online or other digital media.
- AEP Ohio customers may opt in to participate in the digital based communications whether they have received printed reports in the past or are new to the Behavior Change program.
- AEP Ohio may consider providing reports with internal resources if it is more cost effective.

Participation

The following participation levels have been used for planning purposes. However, AEP Ohio may adjust qualifying energy efficiency measures and anticipated participation levels as necessary in accordance with current market conditions, EM&V results, and program implementation experience. Participation levels are not assumed to have a one year measure life; however, to be conservative the program design continued that assumption for plan purposes. Therefore, the total participation over the five year period from 2015 to 2019 are based on the number of participants in the fifth year, 2019.

Incremental Annual Participants (units installed)							
Measure Name	**Units**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total 2015 - 2019**
Home Energy Report	Home	24,852	24,852	24,852	24,852	24,852	**124,259**

Budget

The following budget has been used for planning purposes. However, AEP Ohio may adjust program budgets as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

Incremental Annual Budget						
	2015	**2016**	**2017**	**2018**	**2019**	**Total 2015 – 2019**
Administrative	$437,070	$437,070	$437,070	$437,070	$437,070	**$2,185,351**
Incentive	$0	$0	$0	$0	$0	**$0**

Total	$437,070	$437,070	$437,070	$437,070	$437,070	$2,185,351

Incremental Annual						
	2015	2016	2017	2018	2019	Total 2015 – 2019
Participant Costs	$0	$0	$0	$0	$0	**$0**

Savings Targets

Savings for this program are not cumulative due to a one year measure life.

	2015	2016	2017	2018	2019	Cumulative Total 2015 – 2019
Energy (MWh)	9,369	9,369	9,369	9,369	9,369	**9,369**
Summer Peak Demand (kW)	1,218	1,218	1,218	1,218	1,218	**1,218**

Benefit-Cost Test Results

Benefit-Cost Test	2015-2019 Benefit-Cost Test Ratio
Total Resource Cost (TRC)	1.2
Utility System Resource Cost (UCT)	1.2
Participant Cost (PCT)	NA
Rate Impact Measure (RIM)	0.3

4.1.6 **e^{3}smart^{SM}** (On-Going Program)

This energy efficiency education program provides curriculum, teacher training, and supplies for in-class instruction about energy sources, transformation, and uses. Students learn how to use energy efficiently at home. With the permission of their parents or caregiver(s), students take home energy efficiency measures and install them as part of the learning experience. The curriculum is designed to meet national and state science standards for grades 5-12.

Adjustments and Enhancements

AEP Ohio modifications to the e3SMART Program as shown below:

- Adjust the number of student participants to approximately 24,000 per year.
- Remove the outlet gasket measure as a preventative student safety action.
- Expand curriculum from grades 5-9 to grades 5-12.
- Increase the proportion of LED measures in the student and teacher kits.

Participation

The following participation levels have been used for planning purposes. However, AEP Ohio may adjust qualifying energy efficiency measures and anticipated participation levels as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

Incremental Annual Participants (units installed)							
Measure Name	**Units**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total 2015 - 2019**
1W LED Night Light	Lamp	532	585	611	673	720	**3,122**
CFL 13W Screw-In Indoor	Lamp	117,126	116,789	108,706	110,704	109,400	**562,726**
CFL 23W Screw-In Indoor	Lamp	685	395	179	48	0	**1,308**
Hot Water Temp Gauge (Tank Temperature Turn Down)	Unit	3,462	3,806	3,971	4,372	4,686	**20,296**
Low Flow (1.25 GPM) showerhead	Shower	6,780	7,396	7,647	8,333	8,832	**38,988**
Low Flow Faucet Aerator, 1.5 GPM - EDHW	Faucet	7,888	8,597	8,879	9,661	10,217	**45,243**
Reduced ACHnat 0.3 - Central A/C - EL Heat	Home	8	9	9	10	12	**47**
Reduced ACHnat 0.3 - Heat Pump	Home	44	48	50	55	59	**255**

Budget

The following budget has been used for planning purposes. However, AEP Ohio may adjust program budgets as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

Incremental Annual Budget						
	2015	**2016**	**2017**	**2018**	**2019**	**Total 2015 – 2019**
Administrative	$296,180	$300,728	$288,620	$298,574	$299,843	**$1,483,945**
Incentive	$257,969	$268,718	$261,999	$277,269	$285,719	**$1,351,674**
Total	**$554,149**	**$569,445**	**$550,619**	**$575,843**	**$585,562**	**$2,835,619**

Incremental Annual						
	2015	**2016**	**2017**	**2018**	**2019**	**Total 2015 – 2019**
Participant Costs	$606,056	$613,886	$586,475	$607,068	$601,578	**$3,015,062**

Savings Targets

Incremental Annual Savings – at Meter						
	2015	**2016**	**2017**	**2018**	**2019**	**Cumulative Total 2015 – 2019**
Energy (MWh)	4,949	5,018	4,809	4,969	5,004	**24,169**
Summer Peak Demand (kW)	549	553	526	541	541	**2,643**

Benefit-Cost Test Results	
Benefit-Cost Test -	**2015-2019 Benefit-Cost Test Ratio**
Total Resource Cost (TRC)	3.0
Utility System Resource Cost (UCT)	6.1
Participant Cost (PCT)	8.0
Rate Impact Measure (RIM)	0.5

4.1.7 **Community Assistance** (On-Going Program)

The program provides energy efficiency services to AEP Ohio customers with limited income to assist them in reducing their electric energy use and managing their utility costs. AEP Ohio low income residential customers eligible to participate are any customers that have an income of 200 percent of the federal poverty income level or less. These customers are also typically approved for an energy assistance program such as PIPP (percentage of income payment plan) HEAP (home energy assistance program) or HWAP (home weatherization assistance program.) The program generates energy savings for residential low-income customers through an in-home energy audit and the installation of a wide range of base load measures such as efficient lighting, more efficient refrigerators and weatherization upgrades. The program can be delivered through community based action agencies or private contractors. While the program is not cost-effective based on standard tests, it has significant non-energy benefits, including assisting customers with limited incomes to reduce their energy costs, improving their standard of living and maintaining their service.

Adjustments and Enhancements

Retrofit Manufactured Housing:

AEP Ohio will expand the Community Assistance Program to obtain energy savings through the identification and implementation of cost-effective measures that improve the efficiency and comfort of existing occupied manufactured housing and to serve a hard-to-reach customer segment. The Retrofit Manufactured Housing measures are targeted to income-eligible residential customers with all-electric mobile homes on permanent foundations in urban and rural communities.

Other changes to the Community Assistance Program as shown below:

- Incentives not included in the measure mix from previous plan(s) have been deemed either not cost effective or had low participation.
- Customer incentives may be adjusted to increase cost effectiveness and/or program participation.
- Cost effective measures developed during Plan implementation may be added

and measures currently on the list may be changed or removed depending on both cost effectiveness and customer participation.

Participation

The following participation levels have been used for planning purposes. However, AEP Ohio may adjust qualifying energy efficiency measures and anticipated participation levels as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

Incremental Annual Participants (units installed)							
Measure Name	Units	2015	2016	2017	2018	2019	Total 2015 - 2019
1W LED Night Light	Lamp	273	298	305	371	291	**1,537**
Air Source Heat Pump SEER 14.5, COP 2.49	Ton	95	102	104	125	98	**525**
Ceiling Ins. R-30 - Central A/C - EL Heat	1000 sqft footprint	33	36	37	45	35	**187**
Ceiling Ins. R-30 - Central A/C - Non-EL Heat	1000 sqft footprint	147	158	160	194	151	**810**
Ceiling Ins. R-30 - Heat Pump	1000 sqft footprint	190	205	208	251	195	**1,048**
Ceiling Insul R-45 - Central A/C - EL Heat	1000 sqft footprint	33	36	37	45	35	**187**
Ceiling Insul R-45 - Central A/C - Non-EL Heat	1000 sqft footprint	147	158	160	194	151	**810**
Ceiling Insul R-45 - Heat Pump	1000 sqft footprint	190	205	208	251	195	**1,048**
CFL >25W Screw-In Indoor	Lamp	1,376	1,523	1,561	1,905	1,499	**7,863**
CFL >25W Screw-In Outdoor	Lamp	20	22	23	28	22	**114**
CFL 18W Screw-In Indoor	Lamp	3,131	3,440	3,526	4,303	3,385	**17,786**
CFL 18W Screw-In Outdoor	Lamp	345	379	388	474	373	**1,958**
CFL 23W Screw-In Indoor	Lamp	2,970	3,286	3,368	4,109	3,233	**16,966**
CFL 23W Screw-In Outdoor	Lamp	562	622	637	778	612	**3,210**
DHW Pipe Insulation R-4 10 feet	10 Linear Feet	1,397	1,503	1,525	1,841	1,433	**7,700**
DHW Tank Wrap (R-10 Water Heater Blanket)	Unit	966	1,044	1,064	1,294	1,015	**5,383**
Efficient Refrigerator (ENERGY STAR® or Better) (DUB)	Refrigerator	1,883	2,026	2,055	2,481	1,931	**10,375**
ENERGY STAR® Window / Room AC (Early Replacement)	Unit	234	255	261	318	249	**1,317**
Freezer Retirement	Freezer	701	791	826	1,027	823	**4,168**
Heat Pump Water Heater - 2.0 EF	Unit	585	644	663	813	642	**3,347**
High Eff. Elec. Water Heat - Tank - .95 EF	Unit	867	966	1,002	1,241	988	**5,064**
Instantaneous Electric Water Heater - .99 EF	Unit	332	368	380	469	371	**1,919**
Low Flow (1.25 GPM) showerhead	Shower	2,897	3,117	3,163	3,823	2,980	**15,980**
Low Flow Faucet Aerator, 1.5 GPM - EDHW	Faucet	3,025	3,255	3,302	3,987	3,102	**16,671**
Reduced ACHnat 0.3 - Central A/C - EL Heat	Home	5	6	6	7	5	**29**
Reduced ACHnat 0.3 - Central A/C - Non-EL Heat	Home	46	49	50	60	47	**251**
Reduced ACHnat 0.3 - Heat Pump	Home	29	32	32	39	30	**162**
Refrigerator Retirement	Refrigerator	1,475	1,663	1,737	2,160	1,732	**8,769**
Underbelly Insulation R-19 - Central A/C - EL Heat	100 sqft floor area	533	569	574	689	534	**2,899**
Underbelly Insulation R-19 - Heat Pump	100 sqft floor area	1,901	2,046	2,075	2,505	1,950	**10,477**
Wall Insul. R-11 - Central A/C - EL Heat	1000 sqft wall area	9	10	10	12	10	**51**
Wall Insul. R-11 - Central A/C - Non-EL Heat	1000 sqft wall area	40	43	44	53	41	**223**
Wall Insul. R-11 - Heat Pump	1000 sqft wall area	52	56	57	69	54	**288**

Budget

The following budget has been used for planning purposes. However, AEP Ohio may adjust program budgets as necessary in accordance with current market conditions, EM&V results, and program implementation experience. Participant electricity cost savings result in negative participant costs.

Incremental Annual Budget						
	2015	2016	2017	2018	2019	Total 2015 – 2019
Administrative	$899,572	$976,970	$914,815	$1,009,631	$956,232	**$4,757,221**
Incentive	$6,510,515	$7,065,550	$7,218,647	$6,912,691	$6,895,147	**$34,602,550**
Total	**$7,410,086**	**$8,042,520**	**$8,133,462**	**$7,922,322**	**$7,851,379**	**$39,359,770**

Incremental Annual						
	2015	2016	2017	2018	2019	Total 2015 – 2019
Participant Costs	-$1,579,983	-$1,687,211	-$1,719,238	-$1,850,152	-$1,915,230	**-$8,751,815**

Savings Targets

Incremental Annual Savings – at Meter						
	2015	2016	2017	2018	2019	Cumulative Total 2015 – 2019
Energy (MWh)	8,377	9,103	8,579	9,543	9,006	**42,800**
Summer Peak Demand (kW)	1,087	1,191	1,154	1,325	1,181	**5,559**

Benefit-Cost Test Results

Benefit-Cost Test -	2015-2019 Benefit-Cost Test Ratio
Total Resource Cost (TRC)	0.8
Utility System Resource Cost (UCT)	0.6
Participant Cost (PCT)	3.0
Rate Impact Measure (RIM)	0.3

4.2 Business Programs

For the complete program plan for each ongoing business program, please reference the Business Program Plans section (pages 81-126) of *Volume 1: AEP Ohio 2012 to 2014 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan*, dated November 29, 2011 (PUCO Docket 11-5568-EL-POR and 11-5569-EL-POR.) Included in each program description below are material program changes as well as participation levels, budget, savings targets and benefit-cost test results. For the new programs, complete program descriptions are included.

4.2.1 **Efficient Products for Business** (Previously Prescriptive) (On-Going Program)

All business (non-residential) customers in AEP Ohio's service territory are eligible to participate in this program. The program provides a simple and easy way to help fund common energy efficiency projects in existing facilities and new construction projects. A standard menu of incentives, updated annually based on customer participation levels, competitive incentive pricing and market conditions, includes lighting, heating, ventilation, and air conditioning (HVAC), motor drives, refrigeration, and food preparation and storage equipment. Three primary objectives will focus on increasing: market share, installation rates, and operating efficiency. Incentives typically ranging from 20 percent to 50 percent of the incremental cost to purchase energy efficient products will be offered to customers.

Adjustments and Enhancements
AEP Ohio modifications to the Efficient Products for Business Program as shown below: • Add a midstream component for specific lighting and equipment measures to make efficiency available for small projects where an application is a barrier to participation and also to encourage energy efficiency choices at the point of sale with lighting and equipment distributors. • Deliver a motor rewind component through an Implementation Contractor that enlists motor rewind shops to be trained and certified in efficient motor rewind and enrolled in the AEP Ohio EMotor Rewind approach. • Incentives not included in the measure mix from previous plan(s) have been deemed either not cost effective or had low participation. • Customer incentives may be adjusted to increase cost effectiveness and/or program participation. • Cost effective measures developed during Plan implementation may be added and measures currently on the list may be changed or removed depending on

both cost effectiveness and customer participation.

Participation

The following participation levels have been used for planning purposes. However, AEP Ohio may adjust qualifying energy efficiency measures and anticipated participation levels as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

Incremental Annual Participants (units installed)

Measure Name	Units	2015	2016	2017	2018	2019	Total 2015 - 2019
1L4'T5 NLO	Lamp	9,201	6,848	3,615	0	0	**19,664**
1L4'T8 HP	Lamp	9,201	9,928	6,998	3,713	0	**29,842**
1L4'T8 HP	Lamp	23,817	20,720	17,220	14,790	13,299	**89,846**
6L4'T5 HLO	Fixture	17,018	16,772	16,984	17,227	17,382	**85,382**
6L4'T8HP	Fixture	2,925	2,564	2,220	1,867	1,504	**11,080**
Advanced Pre-Rinse Spray Nozzle, <=1.6 GPM	Per Sprayer	3	3	4	4	4	**18**
Agriculture Heat Pads	Unit/swine and hatchery farm	2	3	3	3	3	**14**
Anti-Sweat Heat (ASH) Controls - freezer and cooler glass reach in or freezer door only are eligible	Linear foot door width	75	79	86	96	107	**442**
CFL: Pin-Based (13W) Indoor	Fixture	587	499	419	349	279	**2,133**
CFL: Pin-Based (26W) Indoor	Fixture	14	11	9	6	3	**44**
CFL: Pin-Based (42W) Outdoor Wall Pack	Fixture	74	78	84	91	98	**424**
CFL: Pin-Based (84W) Outdoor Wall Pack	Fixture	335	350	377	408	440	**1,909**
CFL: Screw-In (>26W) Indoor	Lamp	514	510	526	545	563	**2,657**
CFL: Screw-In (10-15W) Indoor	Lamp	3,126	3,065	3,080	3,138	3,204	**15,612**
CFL: Screw-In (16-21W) Indoor	Lamp	1,132	1,141	1,186	1,238	1,289	**5,985**
CFL: Screw-In (22-26W) Indoor	Lamp	138	136	141	145	150	**710**
Cogged (V) belts on fans 5 HP to 100 HP	Fan	7,920	8,185	8,768	9,404	10,039	**44,317**
Cogged (V) belts on fans 5 HP to 100 HP	Fan	1,934	1,995	2,134	2,288	2,443	**10,794**
Cogged (V) belts on fans 5 HP to 100 HP	Fan	968	965	1,013	1,078	1,137	**5,160**
Cogged (V) belts on fans 5 HP to 100 HP	Fan	1,299	1,293	1,332	1,375	1,411	**6,710**
Compressed Air - Air Entraining Air Nozzle, 100 psi, 0.25 kW/scfm	Nozzle	2,753	2,601	2,533	2,461	2,375	**12,723**
Compressed Air - Air Entraining Air Nozzle, 100 psi, 0.25 kW/scfm	Nozzle	522	506	510	519	525	**2,582**

Compressed Air - Air Receiver for Load/No-Load Compressors (>=5 gal/CFM storage), <=300 HP	Gallon Increased Storage	12,546	12,956	13,846	14,837	15,854	**70,040**
Compressed Air - Air Receiver for Load/No-Load Compressors (>=5 gal/CFM storage), <=300 HP	Gallon Increased Storage	5,570	5,883	6,532	7,364	8,259	**33,608**
Compressed Air - Cycling Air Dryer, <=600scfm, thermal mass	sCFM	2,214	2,286	2,443	2,618	2,797	**12,359**
Compressed Air - Cycling Air Dryer, <=600scfm, thermal mass	sCFM	725	732	762	796	830	**3,846**
Compressed Air - Cycling Air Dryer, <=600scfm, thermal mass	sCFM	368	386	427	481	538	**2,200**
Compressed Air - Cycling Air Dryer, <=600scfm, thermal mass	sCFM	121	123	130	138	145	**658**
Compressed Air - Low Pressure Drop Filter for Compressed Air Systems, 25HP to 300HP, <500CFM, mist eliminator, <1 psi new	sCFM	2,150	2,153	2,247	2,351	2,453	**11,354**
Compressed Air - Low Pressure Drop Filter for Compressed Air Systems, 25HP to 300HP, <500CFM, mist eliminator, <1 psi new	sCFM	2,147	2,147	2,236	2,338	2,439	**11,307**
Compressed Air - Low Pressure Drop Filter for Compressed Air Systems, 25HP to 300HP, <500CFM, mist eliminator, <1 psi new	sCFM	356	357	373	390	407	**1,883**
Compressed Air - Low Pressure Drop Filter for Compressed Air Systems, 25HP to 300HP, <500CFM, mist eliminator, <1 psi new	sCFM	356	356	371	388	404	**1,875**
Compressed air - no-loss condensate drains	per drain	2,960	3,072	3,305	3,562	3,826	**16,725**
Compressed air - no-loss condensate drains	per drain	552	573	616	665	714	**3,120**
Compressed Air - Variable Speed Drive Air Compressor, new, less than 150 HP	Compressor HP	1,314	1,341	1,419	1,505	1,592	**7,171**
Compressed Air - Variable Speed Drive Air Compressor, new, less than 150 HP	Compressor HP	438	447	473	502	531	**2,390**
Compressed Air - Variable Speed Drive Air Compressor, new, less than 150 HP	Compressor HP	258	247	244	242	239	**1,229**
Compressed Air - Variable Speed Drive Air Compressor, new, less than 150 HP	Compressor HP	86	82	81	81	80	**410**

Dairy Scroll Compressors (Agriculture)	Unit/1000 dairy cows	1	1	1	1	1	**3**
Daylighting Controls	Watts Controlled, 1 DC	2,433	1,431	632	159	0	**4,656**
EC Motor for HVAC - Cooling Only	Motor	127	135	148	163	180	**752**
EC Motor for HVAC - Heating and Cooling	Motor	506	539	591	652	719	**3,007**
EC Motor for HVAC - Heating Only	Motor	25	27	30	33	36	**150**
EC Motor: Reach-In Enclosure; blended average of coolers and freezers; no controls	Motor	329	338	360	384	411	**1,822**
EC Motor: Walk-In Enclosure; blended average of coolers and freezers; no controls	Motor	207	213	226	241	258	**1,145**
ENERGY STAR Combination Oven	Unit	63	67	74	81	89	**374**
ENERGY STAR Hot Food Holding Cabinet, Half Size, 8 cuft average	Unit	9	10	11	12	13	**54**
Energy Star Ice Making Head (501-1000lbs/day)	100lbs ice	189	200	218	240	263	**1,110**
ENERGY STAR Refrigerated Beverage Vending Machine with Control Software, average	Average Standard Vending	14	15	17	18	20	**84**
ENERGY STAR Refrigerated Beverage Vending Machine without Control Software, average	Average Standard Vending	14	15	17	18	20	**84**
Energy Star Remote Condensing Unit, Without Remote Compressor (1001-1500lbs/day)	100lbs ice	38	40	44	48	53	**222**
ENERGY STAR Solid Door Commercial Freezer	Conventional Non-Energy Star Freezer	0	0	0	24	51	**75**
ENERGY STAR Steam Cooker - 4 Pan - 100lbs/day	Unit	3	3	4	4	4	**19**
ENERGY STAR, CEE Tier 2 or CEE Tier 3 Commercial Clothes Washer	Unit	4,285	4,459	4,790	5,143	5,482	**24,159**
Evap Fan Controller for Cooler and Freezer Walk-ins with glass reach in - ECM	Fan	34	35	37	40	42	**188**
Evap Fan Controller for Cooler and Freezer Walk-ins with glass reach in - Shaded Pole	Fan	34	35	37	40	42	**188**
Evap Fan Controller for Cooler and Freezer Walk-ins, no glass - ECM	Fan	90	93	99	105	113	**500**
Evap Fan Controller for Cooler and Freezer Walk-ins, no glass - Shaded Pole	Fan	90	93	99	105	131	**519**
Floating Head Pressure Controls; 70F or lower, 1 HP or greater	Refrigeration HP	128	134	144	156	169	**731**
Heat Reclaimer Units (Agriculture)	Unit/1000 dairy cows	1	1	1	1	1	**5**
High Volume Low Speed Fans (Agriculture)	Unit/livestock farm	82	87	94	103	113	**478**
Hotel Guest Room Energy Management System (GREM), Electric Cooling, Electric Heating	Hotel Room Controller	1,392	1,448	1,559	1,687	1,825	**7,912**
Hotel Guest Room Energy Management System (GREM), Electric Cooling, NON-Electric Heating	Hotel Room Controller	535	557	600	649	702	**3,043**
LED Exit Sign	Sign	228	229	237	245	252	**1,191**
LED Lighting <10W - Indoor	Lamp	260	400	352	344	336	**1,691**
LED Lighting <10W - Indoor	Lamp	239	239	242	255	267	**1,243**
LED Lighting >=10W - Indoor	Lamp	31	35	0	0	0	**67**
LED Lighting >=10W - Indoor	Lamp	1,473	1,354	1,251	1,213	1,182	**6,472**

Livestock Waterers (Agriculture)	Unit/livestock farm	79	85	94	104	115	**477**
Milk Pre-cooler (Agriculture)	Unit/1000 dairy cows	1	1	1	1	1	**5**
Occupancy Sensor	Watts Controlled, 1 OC	8,882	8,415	8,313	8,462	8,805	**42,878**
Outdoor LED Lighting (130W), TC Control, Pole/Area Mount	Fixture	0	233	500	806	842	**2,381**
Outdoor LED Lighting (130W), TC Control, Pole/Area Mount	Fixture	41	90	146	156	165	**597**
Outdoor LED Lighting (80W), TC Control, Pole/Area Mount	Fixture	940	945	972	1,002	1,032	**4,891**
Outside Air Economizer for Coolers	Cooler	214	223	240	260	281	**1,217**
Packaged terminal air-conditioner (< 7kbtuh, minimum 12.7 EER)	Rated Tons Cooling	44	46	50	54	58	**251**
Photocell (Outdoor Lighting)	Watts Controlled, 1 PC	1,259	1,276	1,328	1,394	1,466	**6,724**
Photocell + Timeclock (Outdoor Lighting)	Watts Controlled, 1 TC, 1 PC	3,945	3,982	4,127	4,310	4,511	**20,874**
Refrigerated Display LED Lighting Strips	Linear foot case door	1,286	1,318	1,397	1,487	1,576	**7,064**
Screw-in 5W CCFL	Lamp	86	84	85	88	92	**435**
Specialty CFL - 16W PAR30	Lamp	4	4	4	4	4	**20**
Specialty CFL - 23W Dimmable R40	Lamp	4	4	4	4	4	**20**
Split/Package system A/C (< 5.4 tons, 14 SEER) - Direct Exp /All Heating Types	Rated Tons Cooling	949	991	1,065	1,146	1,225	**5,376**
Split/Packaged Air Conditioner (120 - 240 kBtu/h) 12 EER, 13 IEER - Direct Exp /All Heating Types	Rated Tons Cooling	118	123	133	143	153	**670**
Split/Packaged Air Conditioner (240 - 760 kBtu/h) 10.6 EER; 12.1 IEER - Direct Exp /All Heating Types	Rated Tons Cooling	304	317	341	367	392	**1,721**
Split/Packaged Air Conditioner (65 - 120 kBtu/h) 12 EER, 13 IEER - Direct Exp /All Heating Types	Rated Tons Cooling	671	701	754	811	867	**3,804**
Split/Packaged Heat Pump (<65 kBtu/h) SEER 14 - Heat Pump	Rated Tons Cooling	127	132	142	153	164	**717**
Split/Packaged Heat Pump (135 - 240 kBtu/h) EER 11.5 - Heat Pump	Rated Tons Cooling	273	285	306	329	352	**1,545**
Split/Packaged Heat Pump (240 - 760 kBtu/h) EER 10.8 - Heat Pump	Rated Tons Cooling	273	285	306	329	352	**1,546**
Split/Packaged Heat Pump (65 - 135 kBtu/h) EER 12 - Heat Pump	Rated Tons Cooling	698	728	783	842	900	**3,952**
T8 Delamping	Lamp	36,950	31,367	25,061	20,025	15,921	**129,324**
Time clock (Outdoor Lighting)	Watts Controlled, 1 TC	0	0	0	0	592	**592**
Tractor Engine Block Heater Timer (Agriculture)	Unit/farm	504	532	579	633	692	**2,941**
Variable Speed Drive for Milk Vacuum Pump	HP/1000 dairy cows	1	1	1	1	1	**3**
Vending Machine PIR Occupancy Sensor - Cold Drink	Per Machine	357	369	395	425	457	**2,004**
Vending Machine PIR Occupancy Sensor - Snacks	Per Machine	357	369	394	424	455	**1,999**
VFD on centrif load - Process or HVAC fans or pumps up to 200 HP	HP	24,059	25,040	26,966	29,190	31,583	**136,838**
VFD on centrif load - Process or HVAC fans or pumps up to 200 HP	HP	3,287	3,421	3,684	3,987	4,314	**18,693**
Water Source Heat Pump (<17 kBtu/h) EER 17 - Heat Pump	Rated Tons Cooling	139	147	161	176	193	**817**
Water Source Heat Pump (>17 kBtu/h and < 135 kBtu/h) EER 17 - Heat Pump	Rated Tons Cooling	139	147	161	176	193	**817**
Window Films on Double Pane - Non-North Facing Windows	100 sqft glazed	0	0	0	2,058	4,035	**6,093**
Zero Energy Door	Case Door	0	151	307	471	442	**1,372**

Budget

The following budget has been used for planning purposes. However, AEP Ohio may adjust program budgets as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

Incremental Annual Budget						
	2015	2016	2017	2018	2019	Total 2015 – 2019
Administrative	$4,563,376	$4,616,148	$4,820,158	$5,105,582	$5,291,578	**$24,396,842**
Incentive	$9,946,207	$9,940,784	$10,372,676	$11,001,108	$11,603,318	**$52,864,094**
Total	$14,509,583	$14,556,932	$15,192,834	$16,106,690	$16,894,896	**$77,260,935**

Incremental Annual						
	2015	2016	2017	2018	2019	Total 2015 – 2019
Participant Costs	$30,333,361	$30,806,907	$32,040,640	$34,628,611	$35,064,900	**$162,874,419**

Savings Targets

Incremental Annual Savings – at Meter						
	2015	2016	2017	2018	2019	Cumulative Total 2015 – 2019
Energy (MWh)	99,158	100,349	104,975	111,265	117,691	**515,534**
Summer Peak Demand (kW)	18,422	18,263	18,740	19,755	20,833	**92,945**

Benefit-Cost Test Results

Benefit-Cost Test	2015-2019 Benefit-Cost Test Ratio
Total Resource Cost (TRC)	1.7
Utility System Resource Cost (UCT)	5.4
Participant Cost (PCT)	2.6
Rate Impact Measure (RIM)	0.7

4.2.2 **Process Efficiency** (Previously Custom) (On-Going Program)

All business (non-residential) customers in AEP Ohio's service territory are eligible to participate. The Process Efficiency program is for cost-effective energy efficiency improvements that reduce energy consumption and peak demand not already covered by other AEP Ohio programs. All technologies are subject to eligibility and verification of savings. Customers receive an incentive customized to the specific results of the energy savings technologies implemented. The program assists larger commercial and industrial customers with the analysis and selection of high-efficiency equipment or processes not covered under the Efficient Products program or other program offerings. This program approach identifies more complex energy savings projects, provides economic analysis and aids in the completion of the incentive application. Incentives are based on energy savings on a per kWh basis for installed measures.

Adjustments and Enhancements
AEP Ohio modifications to the Process Efficiency Program as shown below: • Eliminate the $100/kW demand savings incentive as ancillary to the energy incentive and not seen as a market driver for participation. • Adjust incentive levels annually as appropriate with consideration of Bid to Win auction results. • Incentives not included in the measure mix from previous plan(s) have been deemed either not cost effective or had low participation. • Customer incentives may be adjusted to increase cost effectiveness and/or program participation. • Cost effective measures developed during Plan implementation may be added and measures currently on the list may be changed or removed depending on both cost effectiveness and customer participation.
Participation
The following participation levels have been used for planning purposes. However, AEP Ohio may adjust qualifying energy efficiency measures and anticipated participation levels as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

Incremental Annual Participants (units installed)							
Measure Name	Units	2015	2016	2017	2018	2019	Total 2015 - 2019
Air Cooled Chiller <150 Tons, 90% of code kW/Ton (IPLV)	Rated Tons Cooling	3,054	3,304	3,903	4,259	4,701	**19,222**
Code minimum R-20ci or R-38 batt - Chiller / Elec Resist	1000 sqft roof	1,147	1,106	1,148	1,095	1,051	**5,547**
Compressed Air - Air Entraining Air Nozzle, 100 psi, 0.25 kW/scfm	Nozzle	8,128	8,492	9,682	10,185	10,827	**47,314**
Compressed Air - Air Entraining Air Nozzle, 100 psi, 0.25 kW/scfm	Nozzle	1,295	1,348	1,530	1,602	1,695	**7,469**
Compressed Air - Controls	Compressor HP	7,814	7,605	7,992	7,755	7,622	**38,788**
Compressed Air - Controls	Compressor HP	1,215	1,182	1,242	1,206	1,185	**6,030**
Compressed Air - Cycling Air Dryer, >600scfm, all types	sCFM	9,768	9,506	9,990	9,694	9,527	**48,485**
Compressed Air - Cycling Air Dryer, >600scfm, all types	sCFM	3,512	3,695	4,237	4,478	4,777	**20,700**
Compressed Air - Cycling Air Dryer, >600scfm, all types	sCFM	1,620	1,576	1,657	1,607	1,580	**8,040**
Compressed Air - Cycling Air Dryer, >600scfm, all types	sCFM	589	627	726	776	836	**3,553**
Compressed Air - Variable Speed Drive Air Compressor, new, greater than 150 HP	Compressor HP	12,692	12,051	12,370	11,793	11,466	**60,372**
Compressed Air - Variable Speed Drive Air Compressor, new, greater than 150 HP	Compressor HP	2,252	1,823	1,463	960	485	**6,983**
Compressed Air - Variable Speed Drive Air Compressor, new, greater than 150 HP	Compressor HP	2,429	2,364	2,485	2,411	2,370	**12,059**
Compressed Air - Variable Speed Drive Air Compressor, new, greater than 150 HP	Compressor HP	569	586	659	684	718	**3,215**
Daylighting Controls	Watts Controlled, 1 DC	14,981	11,283	7,771	3,806	1,228	**39,068**
Energy Management System	sf Conditioned Space	12,681	12,335	12,955	12,566	12,347	**62,884**
Energy Management System	1000sf Conditioned Space	32,381	31,498	33,080	32,088	31,528	**160,575**
Intra-company behavioral change re plugloads	Building	1,831	1,785	1,886	1,842	1,823	**9,166**
Multiplex system with oversized condenser	Tons of Refrigeration	91	78	66	52	43	**330**
Network PC Management Software	Per Networked Workstation	890	883	953	957	986	**4,669**
Screw Chillers, Water-Cooled, 150 tons to below 300 tons, 90% of code kW/Ton (IPLV)	Rated Tons Cooling	720	1,113	1,274	1,348	1,445	**5,900**
Screw Chillers, Water-Cooled, 75 tons to below 150 tons, 90% of code kW/Ton (IPLV)	Rated Tons Cooling	538	582	687	750	828	**3,384**
Screw Chillers, Water-Cooled, below 75 tons, 90% of code kW/Ton (IPLV)	Rated Tons Cooling	538	582	687	750	828	**3,384**

Budget

The following budget has been used for planning purposes. However, AEP Ohio may adjust program budgets as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

Incremental Annual Budget						
	2015	2016	2017	2018	2019	Total 2015 – 2019
Administrative	$3,560,626	$3,463,556	$3,649,464	$3,566,800	$3,545,691	**$17,786,136**
Incentive	$4,384,980	$4,012,505	$3,891,486	$3,506,678	$3,259,249	**$19,054,898**
Total	**$7,945,606**	**$7,476,061**	**$7,540,950**	**$7,073,478**	**$6,804,940**	**$36,841,034**

Incremental Annual						
	2015	2016	2017	2018	2019	Total 2015 – 2019
Participant Costs	$13,512,091	$12,604,641	$12,614,240	$11,660,318	$10,925,630	**$61,316,921**

Savings Targets

Incremental Annual Savings – at Meter						
	2015	2016	2017	2018	2019	Cumulative Total 2015 – 2019
Energy (MWh)	65,016	63,308	66,787	65,351	65,218	**324,711**
Summer Peak Demand (kW)	14,280	13,554	13,859	13,144	12,809	**66,784**

Benefit-Cost Test Results

Benefit-Cost Test -	2015-2019 Benefit-Cost Test Ratio
Total Resource Cost (TRC)	2.8
Utility System Resource Cost (UCT)	7.6
Participant Cost (PCT)	3.6
Rate Impact Measure (RIM)	0.9

4.2.3 **New Construction** (On-Going Program)

All business (non-residential) customers in AEP Ohio's service territory are eligible to participate in this program. This program is for new construction and major renovation projects to encourage building owners, designers, and architects to exceed standard building practices to achieve efficiency above current building energy code requirements. The program provides interactive design assistance to the architects and engineers that are designing new buildings. The key design assistance tool is building simulation modeling of more efficient building designs. The program provides incentives to new facility owners for the installation of high-efficiency lighting, HVAC, building envelope, refrigeration and other equipment and controls. The program provides a marketing mechanism for architects and engineers to promote energy efficient new buildings and equipment to end users. This whole building approach requires fully-executable energy models for evaluation and therefore has incentives for the design team as well as the owner. Efficient Business Products and Process Efficiency incentives are available for individual energy efficiency measures that exceed then current code requirements.

Adjustments and Enhancements
AEP Ohio modifications to the New Construction Program as shown: • Master metered apartment buildings are metered for non-residential tariffs. As such, these facilities are eligible for this program. • Incentives not included in the measure mix from previous plan(s) have been deemed either not cost effective or had low participation. • Incentives may be adjusted to increase cost effectiveness and/or program participation. • Cost effective measures developed during Plan implementation may be added and measures currently on the list may be changed or removed depending on both cost effectiveness and customer participation.

Participation
The following participation levels have been used for planning purposes. However, AEP Ohio may adjust qualifying energy efficiency measures and anticipated participation levels as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

Incremental Annual Participants (units installed)							
Measure Name	Units	2015	2016	2017	2018	2019	Total 2015 - 2019
Air Cooled Chiller <150 Tons, 90% of code kW/Ton (IPLV)	Rated Tons Cooling	2,588	2,933	2,963	3,007	3,071	**14,563**
Airside Economizer - below 33,000 Btu/h	Rated Tons Cooling	115	130	132	134	136	**647**
Cogged (V) belts on fans 5 HP to 100 HP	Fan	5,600	6,315	6,309	6,318	6,345	**30,887**
Cogged (V) belts on fans 5 HP to 100 HP	Fan	556	627	627	628	630	**3,068**
Compressed Air - Controls	Compressor HP	944	1,066	1,070	1,076	1,087	**5,243**
Compressed Air - Controls	Compressor HP	283	320	321	323	326	**1,573**
Daylighting Controls	Watts Controlled, 1 DC	1,207	1,361	1,357	1,357	1,360	**6,643**
DCV - Office	1000sf	9,956	11,227	11,217	11,232	11,280	**54,911**
Evap Fan Controller for Cooler and Freezer Walk-ins with glass reach in - ECM	Fan	71	80	81	82	84	**397**
Evap Fan Controller for Cooler and Freezer Walk-ins, no glass - ECM	Fan	112	127	128	130	132	**628**
Hotel Guest Room Energy Management System (GREM), Electric Cooling, Electric Heating	Hotel Room Controller	1,437	1,628	1,644	1,668	1,703	**8,080**
Hotel Guest Room Energy Management System (GREM), Electric Cooling, NON-Electric Heating	Hotel Room Controller	553	626	632	642	655	**3,108**
Improved Ceiling Insulation R45 batt - Direct Exp / Elec Resist	1000 sqft roof	1,846	2,077	2,066	2,057	2,052	**10,097**
Network PC Management Software	Per Networked Workstation	205	233	235	239	244	**1,157**
Package system A/C (>=63.3 tons, minimum 10.2 EER, 11.4 IEER) - Direct Exp / All Heating Types	Rated Tons Cooling	164	185	184	184	183	**900**
Packaged terminal air-conditioner (< 7kbtuh, minimum 12.7 EER)	Rated Tons Cooling	132	148	147	147	146	**720**
Screw Chillers, Water-Cooled, 150 tons to below 300 tons, 90% of code kW/Ton (IPLV)	Rated Tons Cooling	456	516	522	529	541	**2,564**
Screw Chillers, Water-Cooled, 75 tons to below 150 tons, 90% of code kW/Ton (IPLV)	Rated Tons Cooling	456	516	522	529	541	**2,564**
Screw Chillers, Water-Cooled, below 75 tons, 90% of code kW/Ton (IPLV)	Rated Tons Cooling	456	516	522	529	541	**2,564**
Split/Package system A/C (< 5.4 tons, 14 SEER) - Direct Exp /All Heating Types	Rated Tons Cooling	2,858	3,217	3,201	3,189	3,181	**15,646**
Split/Packaged Air Conditioner (120 - 240 kBtu/h) 12 EER, 13 IEER - Direct Exp /All Heating Types	Rated Tons Cooling	356	401	399	398	397	**1,950**
Split/Packaged Air Conditioner (240 - 760 kBtu/h) 10.6 EER; 12.1 IEER - Direct Exp /All Heating Types	Rated Tons Cooling	915	1,030	1,025	1,021	1,018	**5,008**
Split/Packaged Air Conditioner (65 - 120 kBtu/h) 12 EER, 13 IEER - Direct Exp /All Heating Types	Rated Tons Cooling	2,022	2,276	2,265	2,256	2,251	**11,070**
Split/Packaged Heat Pump (<65 kBtu/h) SEER 14 - Heat Pump	Rated Tons Cooling	381	429	427	426	425	**2,088**
Split/Packaged Heat Pump (135 - 240 kBtu/h) EER 11.5 - Heat Pump	Rated Tons Cooling	822	925	920	916	914	**4,498**
Split/Packaged Heat Pump (240 - 760 kBtu/h) EER 10.8 - Heat Pump	Rated Tons Cooling	822	925	920	917	914	**4,498**
Split/Packaged Heat Pump (65 - 135 kBtu/h) EER 12 - Heat Pump	Rated Tons Cooling	2,102	2,365	2,353	2,343	2,337	**11,500**
Water Source Heat Pump (<17 kBtu/h) EER 17 - Heat Pump	Rated Tons Cooling	421	478	483	490	500	**2,372**
Water Source Heat Pump (>17 kBtu/h and < 135 kBtu/h) EER 17 - Heat Pump	Rated Tons Cooling	421	478	483	490	500	**2,372**

Budget

The following budget has been used for planning purposes. However, AEP Ohio may adjust program budgets as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

Incremental Annual Budget						
	2015	2016	2017	2018	2019	Total 2015 – 2019
Administrative	$1,137,156	$1,283,678	$1,284,144	$1,287,567	$1,294,944	**$6,287,488**
Incentive	$2,665,879	$3,006,654	$3,005,011	$3,010,206	$3,024,577	**$14,712,326**
Total	$3,803,035	$4,290,332	$4,289,155	$4,297,772	$4,319,520	**$20,999,814**

Incremental Annual						
	2015	2016	2017	2018	2019	Total 2015 – 2019
Participant Costs	$4,570,611	$5,157,106	$5,159,204	$5,174,363	$5,206,929	**$25,268,213**

Savings Targets

Incremental Annual Savings – at Meter						
	2015	2016	2017	2018	2019	Cumulative Total 2015 – 2019
Energy (MWh)	31,588	35,658	35,671	35,766	35,971	**173,106**
Summer Peak Demand (kW)	2,854	3,224	3,231	3,246	3,273	**15,704**

Benefit-Cost Test Results

Benefit-Cost Test -	2015-2019 Benefit-Cost Test Ratio
Total Resource Cost (TRC)	2.6
Utility System Resource Cost (UCT)	5.8
Participant Cost (PCT)	4.4
Rate Impact Measure (RIM)	0.7

4.2.4 **Express** (On-Going Program)

Program	Express Program

Objective

The Express Program provides a streamlined, one-stop, turn-key energy efficiency service delivered through a program implementer. The program generates energy savings through program services and incentives to help qualifying customers reduce energy usage and lower energy costs. Incentives for energy efficiency retrofit projects are generally higher than the Efficient Products and Process Efficiency Programs, with an initial cap of 70 percent of the project costs.

The Express Program targets small business customers, generally indicated as customers with demands of less than 100 kW or with annual energy consumption of 200,000 kWh or less, based on the last 12 months of billing history. Either the demand or energy consumption limits could be lowered during implementation to focus more on smaller customers during the Plan period. Corporate-owned national accounts are excluded from participation. Funding for large franchisee-owned national accounts customers are eligible but may be limited to ensure local small business participation. As with residential low income customers, small non-profit customers may need additional incentives to afford energy efficiency improvements, and these opportunities will be considered to remove barriers to this group's participation.

Adjustments and Enhancements

AEP Ohio modifications to the Express Program as shown below:

- The Express Program is designed to operate with marketing and installations provided by a single Implementation Contractor, but may operate with multiple trade allies providing marketing and installation services or, a hybrid of the two models as AEP Ohio deems best to increase participation and improve customer satisfaction.
- Implementation contractors or other partners may offer financing to reduce barriers to small business installation of measures.
- In the 2015-2019 Plan customers with an initial demand limit of 100 kW will also be eligible to participate. A study of customers with demands of 100 kW or less, even when energy usage is greater than 200,000 kWh showed that most shared characteristics of other small business Express participants and would benefit by participation in the program.
- Incentives not included in the measure mix from previous plan(s) have been deemed either not cost effective or had low participation.
- Incentives may be adjusted to increase cost effectiveness and/or program participation.
- Cost effective measures developed during Plan implementation may be added and measures currently on the list may be changed or removed depending on both cost effectiveness and customer participation.

Participation

The following participation levels have been used for planning purposes. However, AEP Ohio may adjust qualifying energy efficiency measures and anticipated participation levels as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

Incremental Annual Participants (units installed)							
Measure Name	**Units**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total 2015 - 2019**
1L4'T5 NLO	Lamp	3,347	2,476	1,019	0	0	**6,842**
1L4'T8 HP	Lamp	3,868	3,924	2,345	990	0	**11,128**
1L4'T8 HP	Lamp	10,168	9,825	7,554	6,040	5,154	**38,741**
6L4'T5 HLO	Fixture	10,969	11,999	11,496	11,127	10,962	**56,553**
6L4'T8HP	Fixture	1,249	1,224	983	773	597	**4,826**
Advanced Pre-Rinse Spray Nozzle, <=1.6 GPM	Per Sprayer	1	2	2	2	2	**8**
Anti-Sweat Heat (ASH) Controls - freezer and cooler glass reach in or freezer door only are eligible	Linear foot door width	33	36	36	35	36	**176**
CFL: Pin-Based (13W) Indoor	Fixture	244	230	172	132	99	**876**
CFL: Pin-Based (26W) Indoor	Fixture	6	5	4	2	1	**19**
CFL: Pin-Based (42W) Outdoor Wall Pack	Fixture	33	37	37	37	38	**182**
CFL: Pin-Based (84W) Outdoor Wall Pack	Fixture	147	166	165	167	172	**818**
CFL: Screw-In (>26W) Indoor	Lamp	223	242	230	222	219	**1,136**
CFL: Screw-In (10-15W) Indoor	Lamp	1,337	1,419	1,305	1,230	1,188	**6,480**
CFL: Screw-In (16-21W) Indoor	Lamp	487	529	506	490	484	**2,496**
CFL: Screw-In (22-26W) Indoor	Lamp	60	65	62	60	59	**305**
EC Motor: Reach-In Enclosure; blended average of coolers and freezers; no controls	Motor	144	160	158	157	160	**780**
EC Motor: Walk-In Enclosure; blended average of coolers and freezers; no controls	Motor	91	101	99	99	101	**490**
Evap Fan Controller for Cooler and Freezer Walk-ins with glass reach in - ECM	Fan	15	17	16	16	17	**81**
Evap Fan Controller for Cooler and Freezer Walk-ins with glass reach in - Shaded Pole	Fan	15	17	16	16	17	**80**
Evap Fan Controller for Cooler and Freezer Walk-ins, no glass - ECM	Fan	40	44	43	43	44	**214**
Evap Fan Controller for Cooler and Freezer Walk-ins, no glass - Shaded Pole	Fan	40	44	43	43	44	**214**
LED Exit Sign	Sign	100	109	104	101	99	**512**
LED Lighting <10W - Indoor	Lamp	105	113	106	104	104	**533**
LED Lighting >=10W - Indoor	Lamp	631	642	549	496	459	**2,777**
Occupancy Sensor	Watts Controlled, 1 OC	5,116	5,488	5,183	5,045	5,094	**25,927**
Outdoor LED Flood Light (30W), TC Control	Fixture	2,182	2,492	2,528	2,593	2,713	**12,507**
Outdoor LED Lighting (130W), TC Control, Pole/Area Mount	Fixture	2,109	2,408	2,442	2,505	2,620	**12,084**
Outdoor LED Lighting (80W), TC Control, Pole/Area Mount	Fixture	2,097	2,385	2,407	2,458	2,561	**11,907**
Photocell (Outdoor Lighting)	Watts Controlled, 1 PC	551	605	582	568	567	**2,874**
Photocell + Timeclock (Outdoor Lighting)	Watts Controlled, 1 TC, 1 PC	2,291	2,540	2,477	2,448	2,475	**12,230**
Screw-in 5W CCFL	Lamp	37	40	37	36	35	**185**
Specialty CFL - 16W PAR30	Lamp	2	2	2	2	2	**8**
Specialty CFL - 23W Dimmable R40	Lamp	2	2	2	2	2	**8**
T8 Delamping	Lamp	17,995	17,414	13,439	10,579	8,583	**68,011**
Vending Machine PIR Occupancy Sensor - Cold Drink	Per Machine	156	174	171	171	174	**846**
Vending Machine PIR Occupancy Sensor - Snacks	Per Machine	161	179	176	176	180	**872**

Budget

The following budget has been used for planning purposes. However, AEP Ohio may adjust program budgets as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

Incremental Annual Budget						
	2015	2016	2017	2018	2019	Total 2015 – 2019
Administrative	$1,466,072	$1,602,879	$1,535,021	$1,500,296	$1,493,335	**$7,597,604**
Incentive	$3,082,840	$3,344,094	$3,143,774	$3,069,750	$3,078,098	**$15,718,556**
Total	$4,548,913	$4,946,973	$4,678,795	$4,570,046	$4,571,434	**$23,316,160**

Incremental Annual						
	2015	2016	2017	2018	2019	Total 2015 – 2019
Participant Costs	$5,889,876	$6,444,986	$6,191,587	$6,019,720	$5,801,178	**$30,347,347**

Savings Targets

Incremental Annual Savings – at Meter						
	2015	2016	2017	2018	2019	Cumulative Total 2015 – 2019
Energy (MWh)	20,315	22,248	21,371	20,923	21,008	**103,680**
Summer Peak Demand (kW)	3,982	4,244	3,944	3,747	3,647	**18,917**

Benefit-Cost Test Results

Benefit-Cost Test	2015-2019 Benefit-Cost Test Ratio
Total Resource Cost (TRC)	1.5
Utility System Resource Cost (UCT)	3.5
Participant Cost (PCT)	3.3
Rate Impact Measure (RIM)	0.5

4.2.5 **Self-Direct** (On-Going Program)

AEP Ohio commercial and industrial "mercantile" customers that consume more than 700,000 kWh/year or customers that are part of a national account can participate. Projects must be cost effective. The program is designed to capture energy savings and demand reduction from large customers with the capability to administer internal energy management efforts of their own. To participate, customers submit an application, calculation spreadsheets and supporting documentation. The application is reviewed and if approved by AEP Ohio and by the PUCO, a one-time payment is made or an EE/PDR rider exemption is applied. Customers accepting an exemption from the rider for a specified number of months are not allowed to participate in any other AEP Ohio EE/PDR programs during the period of exemption. The program allows customers to submit energy efficiency projects that are up to three years old. The standard percentage of 75 percent of the calculated incentive under the Efficient Products for Business, Process Efficiency Program, or Data Center Program for customers applies.

Adjustments and Enhancements

AEP Ohio modifications to the Self- Direct Program as shown below:

- Incentives may be adjusted to increase cost effectiveness and/or program participation.

Participation

The following participation levels have been used for planning purposes. However, AEP Ohio may adjust qualifying energy efficiency measures and anticipated participation levels as necessary in accordance with current market conditions, EM&V results, and program implementation experience. These measures are a proxy for the broad variety of measures that will generate the savings expected.

Incremental Annual Participants (units installed)

Measure Name	Units	2015	2016	2017	2018	2019	Total 2015 - 2019
LED Lighting <10W - Indoor	Lamp	154	257	229	217	192	**1,049**
LED Lighting >=10W - Indoor	Lamp	19	23	0	0	0	**41**
Outdoor LED Lighting (130W), TC Control, Pole/Area Mount	Fixture	0	290	629	981	930	**2,831**
Self Direct Program	Project	46	42	47	49	49	**233**
Self Direct Program	Project	28	26	28	30	30	**141**

Budget

The following budget has been used for planning purposes. However, AEP Ohio may adjust program budgets as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

Incremental Annual Budget

	2015	2016	2017	2018	2019	Total 2015 – 2019
Administrative	$466,288	$447,773	$505,691	$548,386	$525,148	**$2,493,286**
Incentive	$638,934	$670,320	$809,253	$932,305	$918,944	**$3,969,755**
Total	$1,105,222	$1,118,093	$1,314,944	$1,480,691	$1,444,092	**$6,463,041**

Incremental Annual

	2015	2016	2017	2018	2019	Total 2015 – 2019
Participant	$1,051,785	$1,107,375	$1,352,736	$1,566,643	$1,349,411	**$6,427,950**

Costs						

Savings Targets

Program impact assessment is performed beginning with the first year of EE/PDR program implementation, in 2009. The reason to do so is to ensure that the effects of consumer actions at the end of measure life are accounted for. The analysis assumes that a certain percentage of program first life participants do not maintain the higher efficiency level but rather return to the baseline condition. This return to the baseline condition causes a loss to cumulative potential, but does not affect incremental potential. Normally these effects are not large. However, in some cases, when a measure has high participation in an early year, relative to later years, the effect can be noticeable. This is the case with the Self Direct Program. In its first year, 2009, savings were 142,101 MWh. This compares to the average annual incremental impacts between 2015 and 2019 of about 12,500 MWh. The original savings in 2009 is over a factor of 10 larger. The average measure life for the program is about 10 years. This means that in about 2019, a certain percentage of this large 142,101 MWh savings will be reverting back to the base technology and thus this savings is effectively lost on a cumulative basis. This loss of savings is not taken from incremental new savings but rather from cumulative potential.

Incremental Annual Savings – at Meter

	2015	2016	2017	2018	2019	Cumulative Total 2015 – 2019
Energy (MWh)	11,006	10,559	11,915	12,911	12,868	**26,081**
Summer Peak Demand (kW)	1,264	1,180	1,297	1,371	1,372	**2,678**

Benefit-Cost Test Results

Benefit-Cost Test -	20152-2019 Benefit-Cost Test Ratio
Total Resource Cost (TRC)	3.3
Utility System Resource Cost (UCT)	6.7
Participant Cost (PCT)	5.1
Rate Impact Measure (RIM)	0.8

4.2.6 **Retro-Commissioning** (On-Going Program)

The Retro-Commissioning program obtains energy savings through the identification and implementation of low-cost, operational adjustments that improve the efficiency of existing buildings' operating systems by optimizing the systems to meet the building's requirements, with a focus on building controls and HVAC systems.

The Retro-commissioning (RCx) Program targets 125 KW or greater, medium to large business customers.

Eligible measures will vary depending on the business sector served, but should include at least:

- **HVAC systems and controls**: Economizers, demand control ventilation, heat/energy recovery ventilators, fan and pump controls, head-pressure controls, setback controls, night venting controls.

- **Lighting controls**: Occupancy/vacancy controls, photo-sensors, timer controls.
- **Motor controls**: Variable frequency/speed drives, timer controls.
- **Process controls**: Where applicable.
- **Distribution transformers**: Harmonic filtering and harmonic mitigating.

Adjustments and Enhancements

AEP Ohio modifications to the Retro-commissioning Program as shown below:

- The program changes from a requirement for customers with a peak demand of 500 kW to a peak demand of 125 kW to avoid eliminating schools which are excellent candidates.
- Incentives not included in the measure mix from previous plan(s) have been deemed either not cost effective or had low participation.
- Customer incentives may be adjusted to increase cost effectiveness and/or program participation.
- Cost effective measures developed during Plan implementation may be added and measures currently on the list may be changed or removed depending on both cost effectiveness and customer participation.

Participation

The following participation levels have been used for planning purposes. However, AEP Ohio may adjust qualifying energy efficiency measures and anticipated participation levels as necessary in accordance with current market conditions, EM&V results and program implementation experience.

Incremental Annual Participants (units installed)							
Measure Name	**Units**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total 2015 - 2019**
RCx Program - IND	Program	1	1	1	1	1	**5**
RCx Program - COM	Program	1	1	1	1	1	**5**

Budget

The following budget has been used for planning purposes. However, AEP Ohio may adjust program budgets as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

	Incremental Annual Budget					
	2015	**2016**	**2017**	**2018**	**2019**	**Total 2015 – 2019**

Administrative	$69,433	$76,864	$84,314	$93,698	$99,957	**$424,266**
Incentive	$472,819	$511,200	$560,296	$622,164	$687,169	**$2,853,649**
Total	**$542,252**	**$588,065**	**$644,610**	**$715,862**	**$787,126**	**$3,277,916**

	Incremental Annual					
	2015	**2016**	**2017**	**2018**	**2019**	**Total 2015 – 2019**
Participant Costs	$1,457,600	$1,624,129	$1,780,111	$1,976,671	$1,983,389	**$8,821,901**

Savings Targets

	Incremental Annual Savings – at Meter					
	2015	**2016**	**2017**	**2018**	**2019**	**Cumulative Total 2015 – 2019**
Energy (MWh)	3,298	3,651	4,005	4,451	4,920	**19,736**
Summer Peak Demand (kW)	550	609	667	742	820	**3,289**

Benefit-Cost Test Results

Benefit-Cost Test	**2015-2019 Benefit-Cost Test Ratio**
Total Resource Cost (TRC)	1.2
Utility System Resource Cost (UCT)	4.5
Participant Cost (PCT)	1.7
Rate Impact Measure (RIM)	0.7

4.2.7 **Continuous Energy Improvement** (On-Going Program)

This program facilitates a comprehensive and ongoing strategic approach to energy reduction at key customer facilities. The Continuous Energy Improvement Program (CEI) realizes widespread, substantial energy savings for participants willing to participate in and partner with the program. The CEI program utilizes low cost/no cost measures to deliver productivity improvements that reduce the energy intensity of those customers. The program targets low cost and no cost operational savings opportunities.

The target participants are:

- Transmission, sub-transmission and self-assessor customers.

- Large, account managed business customers with site electric energy expenditures exceeding $500,000 per annum or with annual consumption greater than 10 GWh.
- Mid-range industrial accounts with energy expenditures ranging from $100,000 to $500,000 per annum.
- Institutional facilities.

Adjustments and Enhancements

AEP Ohio modifications to the Continuous Energy Improvement Program as shown:

- A streamlined option to baseline and model productivity improvements and energy density reductions through the program for transmission, sub-transmission and self-assessor customers.
- Measurement of facility productivity, energy density per product/service reductions and streamlined processes focused efforts are enhanced for this program to increase economic development, retain and enhance manufacturing and increase customer competitiveness.
- Incentives not included in the measure mix from previous plan(s) have been deemed either not cost effective or had low participation.
- Customer incentives may be adjusted to increase cost effectiveness and/or program participation.
- Cost effective measures developed during Plan implementation may be added and measures currently included may be changed or removed depending on both cost effectiveness and customer participation.

Participation

The following participation levels have been used for planning purposes. However, AEP Ohio may adjust qualifying energy efficiency measures and anticipated participation levels as necessary in accordance with current market conditions, EM&V results and program implementation experience. These measures are a proxy for the types of low cost, no cost activities that will generate the savings expected.

Incremental Annual Participants (units installed)

Measure Name	Units	2015	2016	2017	2018	2019	Total 2015 - 2019
Multiplex system with oversized condenser	Tons of Refrigeration	87	104	102	94	87	**475**
T8 Delamping	Lamp	172,685	208,162	211,073	193,798	171,810	**957,528**

Budget

The following budget has been used for planning purposes. However, AEP Ohio may adjust program budgets as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

	Incremental Annual Budget					
	2015	2016	2017	2018	2019	Total 2015 – 2019
Administrative	$304,636	$367,367	$372,645	$342,284	$292,992	**$1,679,924**
Incentive	$2,635,535	$3,105,281	$3,148,662	$2,890,969	$2,563,007	**$14,343,454**
Total	$2,940,171	$3,472,648	$3,521,307	$3,233,252	$2,855,999	**$16,023,379**

	Incremental Annual					
	2015	2016	2017	2018	2019	Total 2015 – 2019
Participant Costs	$5,974,516	$7,273,597	$7,375,141	$6,771,545	$5,407,466	**$32,802,265**

Savings Targets

	Incremental Annual Savings – at Meter					
	2015	2016	2017	2018	2019	Cumulative Total 2015 – 2019
Energy (MWh)	13,568	16,362	16,597	15,245	13,521	**73,638**
Summer Peak Demand (kW)	2,885	3,479	3,529	3,242	2,875	**15,660**

Benefit-Cost Test Results

Benefit-Cost Test	2015-2019 Benefit-Cost Test Ratio
Total Resource Cost (TRC)	1.2
Utility System Resource Cost (UCT)	3.7
Participant Cost (PCT)	2.3
Rate Impact Measure (RIM)	0.5

4.2.8 **Bid to Win** (On-Going Program)

The program produces long-term electric energy savings in the business sector by introducing a competitive bidding approach to EE/PDR. In addition, typical EE/PDR programs don't match up effectively with customers' capital planning schedules. This program provides an opportunity to competitively bid for EE/PDR projects and reserve funds won in a timeframe that fits the individual customer's capital planning needs. The target market consists primarily of larger customers and customer groups that may include industrial and manufacturing facilities, healthcare, government and education. Auction timeframes are planned for fall of each year for future year(s) projects. The auction will also inform AEP Ohio in the process of setting incentives for most of its other major Business programs in the following year.

The Bid to Win Program concept involves the following steps:

1) Customers or project sponsors develop projects with significant savings potential and prepare their projects for pre-qualification.
2) Bidders submit their projects for pre-qualification and qualified bidders are approved to bid their projected energy savings in cost per annual energy saved ($/kWh).
3) Once bidding process is complete, AEP Ohio selects winning applicants based on specified criteria set prior to the scheduled Bid-to-Win auction event.

Adjustments and Enhancements

AEP Ohio modifications to the Bid-to-Win Program as shown below:

- Requires a useful life of 10 years or greater.
- Expansion of the program to provide input to business incentives across multiple programs. Anticipate an annual auction event, ideally in the fall, to gain large projects for the following year at cost competitive incentive rates and where results will provide information to AEP Ohio for setting incentive levels on all major programs in the following year, where appropriate.
- Projects to receive payment based on verified energy savings following project completion and final project application approval.
- Projects and measures eligible for incentive bidding may be added or removed to increase cost effectiveness and/or program participation.
- The number of available auctions may be increased, decreased or eliminated based on customer participation levels.

Participation

The following participation levels have been used for planning purposes. However, AEP Ohio may adjust qualifying energy efficiency measures and anticipated participation levels as necessary in accordance with current market conditions, EM&V results and program implementation experience.

Incremental Annual Participants (units installed)							
Measure Name	**Units**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total 2015 - 2019**
Bid to Win Program - IND	Project	8	8	8	8	8	**39**
Bid to Win Program - COM	Project	5	5	5	5	5	**27**

Budget

The following participation levels have been used for planning purposes. However, AEP Ohio may adjust qualifying energy efficiency measures and anticipated participation levels as necessary in accordance with current market conditions, EM&V results and program implementation experience.

	Incremental Annual Budget					
	2015	2016	2017	2018	2019	Total 2015 – 2019
Administrative	$750,117	$779,498	$775,029	$774,576	$746,461	**$3,825,680**
Incentive	$2,477,647	$2,571,614	$2,553,816	$2,549,278	$2,561,908	**$12,714,263**
Total	$3,227,765	$3,351,112	$3,328,845	$3,323,854	$3,308,368	**$16,539,944**

	Incremental Annual					
	2015	2016	2017	2018	2019	Total 2015 – 2019
Participant Costs	$25,340,419	$26,301,470	$26,119,446	$26,073,033	$23,144,764	**$126,979,133**

Savings Targets

	Incremental Annual Savings – at Meter					
	2015	2016	2017	2018	2019	Cumulative Total 2015 – 2019
Energy (MWh)	43,083	44,771	44,514	44,488	44,762	**221,619**
Summer Peak Demand (kW)	7,181	7,462	7,419	7,415	7,460	**36,936**

Benefit-Cost Test Results

Benefit-Cost Test	2015-2019 Benefit-Cost Test Ratio
Total Resource Cost (TRC)	1.2
Utility System Resource Cost (UCT)	10.6
Participant Cost (PCT)	1.5
Rate Impact Measure (RIM)	0.8

4.2.9 Data Center (On-Going Program)

The program provides energy efficiency opportunities for both new and existing data centers that lead to energy savings. Incentives are provided to qualifying measures, as well as to offset the cost of a preliminary study. The study will be utilized in identifying current and new energy efficiency opportunities.

The Data Center Program is designed for data centers seeking to improve the efficiency of new and existing facilities. Special attention is given to meet the specific needs of each of the three sizes of data centers as defined by the Environmental Protection

Agency, which include: Localized Data Centers (500-1,000 sq. ft.), Mid-tier Data Centers (1,000-5,000 sq. ft.), and Enterprise-class Data Centers (5,000+ sq. ft.).

The following energy efficient opportunities are eligible for the Data Center Program:

- Server Virtualization
- ENERGY STAR® Servers
- High Efficiency UPS –Power Distribution Optimization
- Distribution Power Transformer Optimization
- Storage Optimization –Row-Oriented Cooling Systems
- Efficient Floor Layout Properly Located Vented Floor Tiles
- Optimize Temperature and Humidity Set Points –Economizers PC Power Management –Desktop Virtualization VoIP
- Airflow Optimization
- Variable Flow Devices
- Integrated Controls
- Energy Recovery Devices and Strategies
- Emerging Technologies (Power Management)
- Optimize Data Center Cooling Technology

Adjustments and Enhancements
AEP Ohio modifications to the Data Center program as shown below: • Incentives not included in the measure mix from previous plan(s) have been deemed either not cost effective or had low participation. • Customer incentives may be adjusted to increase cost effectiveness and/or program participation. • Cost effective measures developed during Plan implementation may be added and measures currently on the list may be changed or removed depending on both cost effectiveness and customer participation.

Participation
The following participation levels have been used for planning purposes. However, AEP Ohio may adjust qualifying energy efficiency measures and anticipated participation levels as necessary in accordance with current market conditions, EM&V results and program implementation experience.

Incremental Annual Participants (units installed)							
Measure Name	**Units**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total 2015 - 2019**
2013 OH Data Center	Sqft (DC Floor Area)	1,316	1,442	1,594	1,784	1,985	**8,122**
2013 OH Data Center Post Retrofit	Sqft (DC Floor Area)	215,908	192,122	175,917	167,532	163,111	**914,590**

Budget

The following budget has been used for planning purposes. However, AEP Ohio may adjust program budgets as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

	Incremental Annual Budget					
	2015	2016	2017	2018	2019	Total 2015 – 2019
Administrative	$349,910	$311,761	$285,848	$272,592	$256,517	$1,476,627
Incentive	$1,552,725	$1,351,578	$1,238,602	$1,180,565	$1,150,340	$6,473,810
Total	$1,902,635	$1,663,340	$1,524,450	$1,453,156	$1,406,856	$7,950,437

	Incremental Annual					
	2015	2016	2017	2018	2019	Total 2015 – 2019
Participant Costs	$2,485,933	$2,244,289	$2,056,143	$1,959,265	$1,696,771	$10,442,402

Savings Targets

	Incremental Annual Savings – at Meter					
	2015	2016	2017	2018	2019	Cumulative Total 2015 – 2019
Energy (MWh)	8,318	7,412	6,798	6,484	6,322	33,868
Summer Peak Demand (kW)	750	668	613	585	570	3,054

Benefit-Cost Test Results

Benefit-Cost Test	2015-2019 Benefit-Cost Test Ratio
Total Resource Cost (TRC)	1.2
Utility System Resource Cost (UCT)	2.8
Participant Cost (PCT)	2.8
Rate Impact Measure (RIM)	0.5

4.2.10 Demand Response (On-Going Program)

The Demand Response Program is available to non-residential customers only and may be used to supplement the peak demand reductions achieved from EE/PDR programs in order to ensure the peak demand reduction benchmark requirements of SB 221 are met. The program includes monitoring, participation and compliance with any then in effect Commercial and Industrial Interruptible Rates offered in the AEP Ohio service territory. In addition, PJM Demand Response Program participation may be utilized, provided mercantile customers commit that resource to AEP Ohio. Program funding is primarily limited to gaining customer commitments for the supplemental peak demand reduction needed by AEP Ohio that could include interruptible tariffs, special arrangements, a standard offer or a bid process. No savings for the program are estimated since the program may not be needed during the five-year period.

Adjustments and Enhancements

AEP Ohio modifications to the Demand Response program as shown below:

- Incentives may be adjusted to increase cost effectiveness and/or program participation.

Budget

Incremental Annual Budget						
	2015	**2016**	**2017**	**2018**	**2019**	**Total 2015 – 2019**
Administrative	$0	$0	$0	$0	$0	**$0**
Incentive	$100,000	$100,000	$100,000	$100,000	$100,000	**$500,000**
Total	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$500,000**

4.3 Cross-Sector Programs and Other Activities

AEP Ohio new cross-sector programs and activities that provide measurable savings:

- Multifamily
- Combined Heat and Power (CHP)/Waste Energy Resources (WER)
- Customer Power Factor
- T&D Customer Efficiency

Cross-sector programs for which energy savings are counted from other AEP Ohio activities:

- gridSMART Enabled EE/PDR Savings
- T&D Loss Reduction (formerly T&D and Internal System Efficiency Improvements)

AEP Ohio continuing cross-sector activities for 2015 to 2019:

- Education and Training
- Targeted Advertising
- Research and Development

4.3.1 **Multifamily Program** (New Program)

Program	Multifamily Program
Objective	
To produce long-term electric energy savings in both Consumer and Business sectors for multifamily buildings. The Consumer and Business components are difficult to service separately and maximize savings from a multifamily location. The program may include new construction, retrofit complexes, walk-through audits, direct install measures and recommendations for next level energy efficiency measures.	
Target Market	
The target market consists of multifamily structures, typically up to three floors, containing three or more dwelling units. Investigation of Multifamily structures such as mid (4-6 floors) rise units may also be considered during the Plan.	
Program Duration	
The Multifamily Program will be an ongoing component of the AEP Ohio EE/PDR Plan.	
Program Description	
Working with property owners and managers may allow for an all-in-one program to conduct audits of both individual units and common areas. Consumers may receive direct install measures, recommendations for additional measures and opportunity to apply for additional incentives through other programs such as the Efficient Products and Efficient Products for Business Programs. The savings and cost associated with the Consumer measures will be allocated to the Consumer program and budget. Business sector measures will explore common areas such as hallway lighting, exterior lighting and exit sign lighting. Common area measures will be funded and energy savings attributed to the C&I sector.	
Incentive Strategy	
Customers may be eligible for direct install measures, incentives for next level implementation measures and may choose from a list of pre-qualified contractors to have energy-saving improvements installed. Incentives may be adjusted to increase cost effectiveness and/or program participation.	
Eligible Measures	
Eligible measures will vary depending on whether retrofit or new housing and the opportunities presented: • Cost effective measures developed during Plan implementation may be added and measures currently on the list may be changed or removed depending on both cost effectiveness and customer participation.	

Implementation Strategy

An implementation contractor will oversee the development and delivery of the Multifamily program. The main focus of the implementation strategy is designed to lower the cost of delivery with combining both consumer and business portions of the multi-family facility into one visit. Property Managers and Owners will be engaged prior to the on-site visit and possibly incentivized to participate for common areas and engage the majority of tenants if not all. Additionally, recommendations for home and common areas will promote the use of the Efficient Products program rebates for consumer and business sectors.

Marketing Strategy

Engage property managers and owners at the onset and encourage and secure full capacity participation from tenants.

Milestones

Tasks	Timeframe
Program Implementation Contractor selected	3 months
Program materials developed	5 months
Program launch – marketing begins	6 months

EM&V Strategy

All evaluation activities will be conducted by AEP Ohio's evaluation contractor. An integrated evaluation approach will be taken that includes the following components:

- Addressing evaluation needs at the onset of program design and collecting evaluation data as part of program administration.
- Assessing and documenting baseline conditions.
- Establishing tracking metrics.
- Conducting primary and secondary research as part of the impact and process evaluations.

The overall goal of the impact evaluation will be to validate/calibrate savings values and determine program cost-effectiveness. The participant and nonparticipant surveys will also address program awareness, barriers to participation, participant satisfaction, and process efficiency. These surveys will be enhanced by collecting market data and assessing trends as well as interviews with program staff, the implementation contractor, collaborating program administrators, and participating manufacturers.

The process evaluation will be conducted during the first program year and then coordinated with follow-up impact evaluation work to be performed once program-approved measures have been installed and operating for a sufficient time to enable a robust impact evaluation.

AEP Ohio Administrative Requirements

Initial program administration will be conducted by AEP Ohio EE/PDR personnel. To develop and manage the third-party implementation, it is estimated that 0.25 FTE equivalent will be required for program oversight. Key oversight functions include:

- Recruitment, selection, and management of the implementation contractor(s)
- Customer, Property Owner/Managers recruitment
- Coordination of marketing strategy/public relations among programs and market sectors
- Coordination of all education and training
- Data warehousing
- Management of the evaluation contractor
- Goal achievement within budget

AEP Ohio and its implementation contractor will follow industry best practices during final program design and start-up to ensure success, including:

- Following an integrated evaluation approach as described above
- Account manager and customer service training
- Establishing requirements for supporting documentation, analysis methods, and reporting requirements on technical studies
- Completing all program procedures from marketing through verification and payment and conducting a dry-run prior to launch
- Preparing for stronger or weaker than expected participant response

Participation

The following participation levels have been used for planning purposes. However, AEP Ohio may adjust qualifying energy efficiency measures and anticipated participation levels as necessary in accordance with current market conditions, EM&V results and program implementation experience.

Incremental Annual Participants (units installed)							
Measure Name	Units	2015	2016	2017	2018	2019	Total 2015 - 2019
1L4'T8 HP	Lamp	3,449	4,170	3,156	2,464	2,024	**15,263**
6L4'T5 HLO	Fixture	2,554	3,357	3,076	2,820	2,589	**14,396**
6L4'T8HP	Fixture	418	516	407	312	231	**1,884**
CFL: Pin-Based (13W) Indoor	Fixture	81	97	72	54	39	**343**
CFL: Pin-Based (26W) Indoor	Fixture	2	2	2	1	1	**7**
CFL: Pin-Based (42W) Outdoor Wall Pack	Fixture	12	16	15	15	15	**73**
CFL: Pin-Based (84W) Outdoor Wall Pack	Fixture	52	71	69	68	67	**327**
CFL: Screw-In (>26W) Indoor	Lamp	77	102	96	90	85	**451**
CFL: Screw-In (10-15W) Indoor	Lamp	461	601	543	499	464	**2,569**
CFL: Screw-In (16-21W) Indoor	Lamp	169	224	211	199	189	**992**
CFL: Screw-In (22-26W) Indoor	Lamp	21	28	26	24	23	**121**
Daylighting Controls	Watts Controlled, 1 DC	286	288	116	27	0	**716**
LED Exit Sign	Sign	35	46	43	41	39	**204**
LED Lighting <10W - Indoor	Lamp	0	0	7	14	20	**40**
Occupancy Sensor	Watts Controlled, 1 OC	1,304	1,694	1,523	1,407	1,335	**7,262**
Outdoor LED Lighting (80W), TC Control, Pole/Area Mount	Fixture	119	157	144	133	123	**676**
Photocell (Outdoor Lighting)	Watts Controlled, 1 PC	192	257	243	232	223	**1,147**
Photocell + Timeclock (Outdoor Lighting)	Watts Controlled, 1 TC, 1 PC	602	801	756	717	685	**3,561**
Specialty CFL - 16W PAR30	Lamp	1	1	1	1	1	**3**
Specialty CFL - 23W Dimmable R40	Lamp	1	1	1	1	1	**3**
Split/Package system A/C (< 5.4 tons, 14 SEER) - Direct Exp /All Heating Types	Rated Tons Cooling	147	199	195	191	188	**921**
Split/Packaged Air Conditioner (120 - 240 kBtu/h) 12 EER, 13 IEER - Direct Exp /All Heating Types	Rated Tons Cooling	18	25	24	24	23	**115**
Split/Packaged Air Conditioner (240 - 760 kBtu/h) 10.6 EER; 12.1 IEER - Direct Exp /All Heating Types	Rated Tons Cooling	47	64	62	61	60	**295**
Split/Packaged Air Conditioner (65 - 120 kBtu/h) 12 EER, 13 IEER - Direct Exp /All Heating Types	Rated Tons Cooling	104	141	138	135	133	**651**
Split/Packaged Heat Pump (<65 kBtu/h) SEER 14 - Heat Pump	Rated Tons Cooling	20	27	26	26	25	**123**
Split/Packaged Heat Pump (135 - 240 kBtu/h) EER 11.5 - Heat Pump	Rated Tons Cooling	42	57	56	55	54	**265**
Split/Packaged Heat Pump (240 - 760 kBtu/h) EER 10.8 - Heat Pump	Rated Tons Cooling	42	57	56	55	54	**265**
Split/Packaged Heat Pump (65 - 135 kBtu/h) EER 12 - Heat Pump	Rated Tons Cooling	108	147	143	141	138	**677**
Water Source Heat Pump (<17 kBtu/h) EER 17 - Heat Pump	Rated Tons Cooling	22	30	29	29	30	**140**
Water Source Heat Pump (>17 kBtu/h and < 135 kBtu/h) EER 17 - Heat Pump	Rated Tons Cooling	22	30	29	29	30	**140**

Budget

The following budget has been used for planning purposes. However, AEP Ohio may adjust program budgets as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

	Incremental Annual Budget					
	2015	2016	2017	2018	2019	Total 2015 – 2019
Administrative	$1,437,239	$1,893,286	$1,744,086	$1,623,662	$1,518,455	**$8,216,729**
Incentive	$463,445	$598,212	$531,100	$486,765	$453,448	**$2,532,970**
Total	$1,900,684	$2,491,499	$2,275,186	$2,110,427	$1,971,903	**$10,749,699**

	Incremental Annual					
	2015	2016	2017	2018	2019	Total 2015 – 2019
Participant Costs	$882,059	$1,154,793	$1,048,345	$961,168	$855,187	**$4,901,552**

Savings Targets

	Incremental Annual Savings – at Meter					
	2015	2016	2017	2018	2019	Cumulative Total 2015 – 2019

Energy (MWh)	3,920	5,165	4,769	4,444	4,184	**22,338**
Summer Peak Demand (kW)	958	1,240	1,104	995	910	**5,077**

Benefit-Cost Test Results

Benefit-Cost Test	**2015-2019 Benefit-Cost Test Ratio**
Total Resource Cost (TRC)	1.2
Utility System Resource Cost (UCT)	1.7
Participant Cost (PCT)	4.4
Rate Impact Measure (RIM)	0.5

4.3.2 Combined Heat and Power and Waste Energy Recovery – CHP/WER (New Program)

Program Objective	Combined Heat and Power and Waste Energy Recovery (CHP/WER)

The objective of this program is to support the installation of high efficiency, sustainable and cost effective CHP/WER projects in AEP Ohio's service territory as allowed by SB 315 and supported by the PUCO and state of Ohio.

Target Market

The primary targets for CHP/WER will be large users of steam for ongoing processes and could include industrial, institutional and healthcare facilities. Other types of CHP/WER projects can be considered if they meet minimum efficiency requirements.

Program Duration

The program will operate while funds are available through the Plan period. Filed and approved reasonable arrangements will have their own individual terms.

Program Description

CHP/WER projects can be treated similarly to other energy efficiency projects, but this requires looking at efficiency for this type of application in a different way than the typical upfront incentive. CHP/WER projects, as distributed generation, should be subject to the same cost effectiveness analyses and performance based incentives as any other supply-side generation resource must face. A distributed generation project is not comparable to any other energy efficiency (EE) project due to the surety and permanence of the EE measures installed. It is highly likely that the normal EE measures installed will remain permanent and be a true offset to supply-side options. It is highly unlikely that a customer will install less efficient lighting, air conditioning or production equipment after the end of their ten or twenty year life. On the other hand, it is a complete unknown whether the CHP/WER system will operate two, three, five, ten or twenty years of its expected life. CHP/WER operational longevity will all depend on the price of electricity, price of natural gas and/or availability of waste heat recovery source. Natural gas pricing has always been highly volatile. CHP/WER longevity will further depend on the operation, maintenance and ongoing efficiency of the system. For those reasons, CHP/WER should be directly comparable to supply-side generation in its viability, where the ongoing efficiency and fuel price of the generation unit is critical to whether the generator can run profitably or not and the generator receives payment for energy only when it is delivered. A reasonable proxy for cost effectiveness based on TRC is a seven year simple payback without incentives. It is important that CHP/WER projects have some reasonable expectation of longevity in order to be cost effective.

The efficiency with CHP/WER projects is commonly referred to as total system efficiency, conversion efficiency or Lower Heating Value (LHV). AEP Ohio will utilize LHV until such time as the Commission determines a uniform calculation methodology for measuring total system efficiency for CHP/WER systems. Simply, LHV is the sum of the electrical efficiency plus the thermal efficiency of the system. A higher LHV means greater value and cost effectiveness of the system for the customer and the utility. The minimum total system efficiency required is 60% with a minimum 20% useful thermal energy. AEP Ohio will pay incentives on utility grade metering for the production kWhs generated and will tier the payments based on CHP/WER total system efficiency to encourage the highest efficiency systems that have the greatest chance of long term viability. This method reduces financial risk for all customers by requiring both certainty in production kWhs generated and total system efficiency obtained.

CHP/WER projects can be very large and funding requests can be significant. Exemption from the EE/PDR rider isn't an effective option in some cases. Approved utility program portfolio plan budgets provide programs for all customers, so a balance is provided in this program design to encourage customer participation in CHP/WER while also preserving funds for all other customers to participate in programs. Further, AEP Ohio supports flexibility due to the wide variety and complexity of projects. AEP Ohio recommends joint filing of reasonable arrangements for CHP/WER of significant size. The PUCO standard mercantile commitment form should provide opportunities for smaller customer projects that need funding, either filed jointly and individually. AEP Ohio encourages joint filing to ensure that funding is available from the Plan. The PUCO standard mercantile commitment form should cover every customer that prefers an exemption from the EE/PDR rider.

Incentive Strategy

All incentive payments are subject to AEP Ohio approval and are based on measured production kWhs generated by the CHP/WER project, subject to the following conditions:

For projects up to 2.5 MW:

- Incentive payments on production kWhs cannot exceed $0.01/kWh for five years.
- Total incentive payments are limited to the lower of 25% of the cost of the project or $250,000.

- Incentive payments will be made annually, beginning twelve months following full commissioning date of the project.

For projects greater than 1 MW:

- Project requests will be reviewed by AEP Ohio
- If agreement on project terms can be reached, a joint arrangement between AEP Ohio and the customer will be filed for approval with the PUCO.
- Subject to budget limitations for CHP/WER.
- Incentive payments will be made annually, beginning twelve months following full commissioning date of the project.

For all CHP/WER projects:

- LHV = 80% or more: 100% of the calculated payment.
- LHV = 70% up to 80%: 75% of the calculated payment.
- LHV = 60% up to 70%: 50% of the calculated payment.

Any projects that have payments that extend past December 31, 2019 are required to be jointly filed with the PUCO for approval. In addition to AEP Ohio incentives, ensure that customers are aware of Ohio and Federal incentives and educational opportunities.

Eligible Measures

The minimum total CHP/WER system efficiency required is 60% with a minimum 20% useful thermal energy.

Implementation Strategy

AEP Ohio has received significant requests and is working with a number of customers to develop joint applications for projects. Upon filing and approval of this Plan, it is expected that project activity will increase significantly with a likely backlog of projects available for limited funding. AEP Ohio intends to reach out to large customer groups for potential opportunities as well as work with CHP/WER developers who may be interested, if customer interest is insufficient.

Marketing Strategy

Develop promotional material, utilizing readily available information from the state of Ohio, Department of Energy, the Environmental Protection Agency and the Midwest CHP Application Center, among others.

Milestones

Tasks	Timeframe
Develop promotional material	1st qtr. 2015
Conduct outreach to large customers and segments	Ongoing
Hold periodic education/training on CHP/WER in conjunction with state, regional and federal efforts	Min. 1 per year

EM&V Strategy

- Measure and validate production kWh and total system efficiency measurements for LHV prior to payments on an annual basis.

- Develop effective measurement strategy for average total system efficiencies over the annual period to determine payment eligibility.
- Reach out to CHP/WER experts to develop appropriate LHV, or other methodology to calculate ongoing total system efficiencies.

Participation

The following participation levels have been used for planning purposes. However, AEP Ohio may adjust qualifying energy efficiency measures and anticipated participation levels as necessary in accordance with current market conditions, EM&V results and program implementation experience.

Incremental Annual Participants						
Measure	**2015**	**2016**	**2017**	**2018**	**2019**	**Total 2015 – 2019**
Project	not presented					**65**

Budget

The following budget has been used for planning purposes. However, AEP Ohio may adjust program budgets as necessary in accordance with current market conditions, EM&V results, and program implementation experience.

Incremental Annual Budget						
	2015	**2016**	**2017**	**2018**	**2019**	**Total 2015 – 2019**
Administrative	not presented					
Incentive	not presented					
Total	not presented					**$13,034,128**

Incremental Annual						
	2015	**2016**	**2017**	**2018**	**2019**	**Total 2015 – 2019**
Participant Costs	not presented					**$189,985,148**

Savings Targets

Incremental Annual Savings – at Meter						
	2015	**2016**	**2017**	**2018**	**2019**	**Cumulative Total 2015 – 2019**
Energy (MWh)	not presented					**600,000**
Summer Peak Demand (kW)	not presented					**81,930**

Benefit-Cost Test Results	
Benefit-Cost Test	**2015-2019 Benefit-Cost Test Ratio**
Total Resource Cost (TRC)	1.2
Utility System Resource Cost (UCT)	18.1
Participant Cost (PCT)	1.2
Rate Impact Measure (RIM)	1.0

4.3.3 Customer Power Factor Correction

Program	Customer Power Factor Correction
Objective	
Power Factor Correction provides customers with specific technology measures that can be implemented to improve power quality and to produce energy and demand savings within the customers' facilities or the AEP Ohio Distribution System.	
Target Market	
Power Factor Correction – large industrial customers (>700,000 kWh/12 month average) with process equipment.	
Program Duration	
5 years	
Program Description	
Power Factor Correction. Certain production intensive Manufacturing Industries have production equipment and facilities that contribute to low power factors that affect their equipment and reflect losses back to the Distribution system limiting the ability to use this energy for useful purposes. The power factor correction at the customer delivery point reduces losses to provide small levels of energy savings to the customer. It also reduces KVA, which is equivalent to KW at unity power factor. This is a program under development and any required funding will come from the Process Efficiency program.	
Incentive Strategy	
Power Factor Correction – Power factor correction at the customer delivery point does not provide energy savings to the customer, but does reduce losses on the distribution and transmission system, which can be converted to energy savings. It does provide KVA savings. Incentives will be paid for energy and KVA reduced.	
Eligible Measures	
Power Factor Correction Capacitors	
Implementation Strategy	
AEP Ohio Program Management	
Marketing Strategy	
Power Factor Correction Capacitors. The marketing of this measure is by direct communication by the account managers to the customer and through their industry associations.	

EM&V Strategy
Power Factor Correction Capacitors. Pre and post metering to determine power factor values for evaluation with deemed values. The Commission has indicated that a simplified methodology (deemed value) for capacitors has some merit and that setting a standard ratio of energy savings per kVAR of capacitance does not appear feasible, since energy savings depends on the line loading in kVA (which depends on kW and kVAR loads). It also is required that the methodology be consistent with the Protocol formulas in the Ohio TRM. For Power factor capacitors added at distribution voltages: kW = kV x I x pf, so the initial current (I_i) before power factor correction is I_i = kW/ (kV x pf_i), after capacitors are added kW does not change and the final current (I_f) is I_f = kW/ (kV x pf_f). The reduced current (I_r) is $I_r = I_i - I_f$. The base kW saved is I^2 R. Following the Commission's recommendation, the deemed value for R is the resistance of typical conductor used to connect large industrial facilities with the high kW usage multiplied by the typical distance from the substation to customer connection point. The final system loss reduction = base kW loss x average loss factor (used in T&D loss studies) x 8760 (for fixed power factor correction capacitors), or base kW loss x average loss factor (used in T&D studies) x hours of operation (for switched power factor correction capacitors).

4.3.4 Transmission and Distribution (T&D) Customer Efficiency Projects (New Program)

Program	T&D Customer Efficiency Projects
Objective	
AEP Ohio has opportunities to improve efficiency for customers on its distribution facilities through the installation of EE/PDR measures that can provide long term savings. Utility distribution side energy efficiency programs are elective programs not loss reductions as covered in the T&D Loss Reduction Projects. Capital and O&M cost recovery for T&D Customer Efficiency Projects can be managed in the EE/PDR rider just as other EE/PDR programs. The objective of this program is to describe those opportunities for implementation in a similar manner as other customer efficiency programs and/or complete further investigation. One difference from other programs due to the capital investment required could be to treat any earnings from T&D Customer Efficiency Projects using an enhanced return on investment instead of shared savings. Two of these programs are Volt Var Optimization (VVO) and LED Street/Outdoor Lighting.	
Program Description	
Volt Var Optimization (VVO). End-of-line monitoring allows the utility to determine where AEP can maintain the voltage on the circuit through automating regulators and capacitors to reduce energy consumption and peak demand. In addition, it helps	

maintain unity power factor.

The VVO system that AEP Ohio piloted in its gridSMART phase 1 allows a reduction in voltage while remaining within acceptable ranges. This reduction in voltage yields a reduction in energy and demand that is measurable and consistent as long as the system is operational. In the initial pilot, the average savings in demand and energy was 3%. While this level of savings will vary by circuit, a key advantage of this program is that every customer on the circuits implemented will receive the savings. The non-participants in AEP Ohio's other EE/PDR programs that reside or have businesses on these circuits will become participants in AEP Ohio's EE/PDR programs.

An 80 circuit VVO proposal was filed in the gridSMART Phase 2 expansion that will be removed from that rate mechanism and added to the EE/PDR rider. The build out will be spread over the five year Plan period. Capital and O&M costs for this program will be requested in the EE/PDR rider for this customer efficiency program.

LED Street/Outdoor Lighting. AEP Ohio has been considering LED Street/Outdoor lighting for a period of time; however, pricing and utility grade LED technology concerns have not been conducive to moving forward. Even with the light and O&M savings, the capital costs offset those savings requiring a significant increase in the SL and OL rates. As pricing comes down and quality improves, it is expected that during this Plan period, LED Street/Outdoor lighting conversions may be justified. This program would investigate the opportunity further, and if successful, would develop an implementation plan to move forward. Ideally, the energy and O&M savings would offset the capital costs. At that point, AEP Ohio would file for Commission approval, start the conversion process and complete it over several years.

Capital and O&M costs for this program may be requested in the EE/PDR rider for this customer program, or through another rate mechanism.

4.3.5 gridSMART® Enabled EE/PDR Savings

Program	gridSMART Enabled EE/PDR Savings
Objective	
The gridSMART project is funded under a separate rider and no cost recovery is proposed under the EE/PDR rider. The project is listed here to note that any peak demand reduction and energy efficiency savings results from this effort will be reported toward AEP Ohio's EE/PDR achievements during the respective year in which those results occur.	
Program Description	
The current programs that could produce reportable savings include programs designed to reduce the growing demand for electricity, especially at times when demand is high: • **Energy Portal.** Programs designed to produce energy and demand savings through greater access to energy information • **Home Energy Report.** An option was filed for Phase 2 AMI-Smart Meter	

Deployment.
Enhancements/Adjustments

AEP Ohio has filed a plan to broaden the company's gridSMART program with Advanced Metering Infrastructure (AMI) and Distribution Automation Circuit Reconfiguration (DACR) expansion. Upon approval of the plan by the Public Utilities Commission of Ohio, gridSMART Phase 2 installations are planned to begin in 2015.
 	
• AMI deployment in more than 31 communities.
• DACR on approximately 250 distribution circuits serving more than 300,000 customers.
• Home Energy Reports
    o Savings from gridSMART Phase 1 web portal and reports
    o Savings from gridSMART Phase 2 web portal

4.3.6 Transmission and Distribution (T&D) Loss Reduction Projects (formerly T&D and Internal Efficiency Improvements)

Program	T&D Loss Reduction Projects
Objective	
AEP Ohio T&D are funded through FERC and PUCO approved rates and no cost recovery is proposed under the EE/PDR rider in this Plan. This program captures loss reductions from projects AEP Ohio undertakes to improve the efficiency of its transmission and distribution facilities. These loss reductions will be reported in the annual Plan Status Report.	
Program Description	
The operation of a T&D power system includes a loss of the portion of the power being transmitted due to the electrical resistance of the power system elements (conductors, transformers and regulators). The transmission of power at different voltage levels throughout the power system yields different losses during the delivery of Power. The farther the delivery through the system from the generation point, the greater the loss component associated with the transfer through the voltage transformations. There are various system improvements that, if made, will reduce the T&D losses, including: • Re-conductoring of lines, substation improvements and the replacement of regulators. • Re-conductoring projects involve the replacement of existing wires with larger wires and wires designed for lower losses at transmission and distribution voltages. Re-conductoring projects reduce line losses by lowering the resistance of the system through which energy is provided, such that the power lost during	

transmission is lowered.

- Substation projects typically include connecting previously unconnected T&D lines, and/or the addition or upgrade of transformers and circuits in new or existing locations. These projects can improve efficiency and reduce line losses by providing additional transformation points closer to customers' loads. As a result, a greater portion of the energy is transmitted in the lower resistance transmission lines instead of the higher resistance distribution lines.

4.3.7 Education and Training

Program	Education and Training

Objective

To raise awareness about the benefits of energy efficiency, to promote adoption of energy efficient behaviors and technologies, and to continue to build demand for AEP Ohio EE/PDR programs.

Target Market

The Education and Training Program is targeted to customers, customer groups, contractors, trade associations, civic associations and employees.

Program Description

This program will continue to coordinate AEP Ohio's efforts to provide education, training and direct outreach for customers, customer groups, contractors, trade associations, civic associations and employees. Activities and materials will be tailored to specific audiences: facilities managers, building operators, financial decision makers, builders, contractors, trade associations, civic organizations, workforce development practitioners and students, and AEP Ohio employees whose work brings them in contact with customers.

Education and training participants will be surveyed for feedback on relevance, quality and satisfaction with activities. Pre- and post-learning will be evaluated. Customer Services employees will be surveyed annually in order to help direct training and development focus. Third-party implementers may be selected via competitive bids to assist with education and training activities. Audiences for training and education activities include:

- **Commercial & Industrial (C&I) Customers:** Customer education events will continue to be offered via webinar and face-to-face seminars at multiple sites throughout the service area as needed to permit customers to participate while minimizing travel. Seminars will continue to feature subject-matter experts, trade allies, and hands-on demonstrations of high efficiency technologies eligible for C&I programs.

  Content and outreach will be designed to increase participation by key decision makers, plant managers, finance managers, treasurers, energy managers and sustainability coordinators. Technical, in-depth training will be offered for building operators, facilities managers, designers, engineers and others whose day-to-day practices influence energy use. Ongoing customer education programs will be marketed to appropriate customer segments across the 61 counties served by AEP Ohio. Marketing may include contact by customer service account representatives, direct mail, E-mail, and/or telephone. Overall objectives will be to develop knowledgeable and informed customers and EE/PDR providers to identify energy saving opportunities and take action to achieve long-term efficiency gains.

- **Customer Service Employees:** AEP Ohio C&I customers have account representatives who assist them with new service, changes, power quality, billing inquiries and more. Whether power engineers or representatives with more business than engineering training, all customer service employees are expected to assist customers with EE/PDR. Accordingly, they have participated in training on every one of AEP Ohio's programs as they have launched. Customer service employee training will continue through webinars, face-to-face meetings, and E-mail to continue to build staff knowledge about EE/PDR programs, to help them identify customers' energy efficiency opportunities, and to assist customers in applying for, monitoring and re-investing incentives in ongoing energy efficiency practices and equipment. Training will cover programs, technologies, decision-making support, financing and the benefits of energy efficiency to customers, their communities and AEP Ohio. The 2015-2019 Plan will focus on more efficient delivery through the development of more on-line, on-demand education and training resources. Objectives for training will be to raise awareness of the benefits of energy efficiency and to increase customer participation in AEP Ohio programs.

- **Customer-Facing Employees:** Meter readers, line crews, field technicians, and community affairs representatives are among the many AEP Ohio employees who interact with customers daily - though they are not identified strictly as "customer service" employees. To date, many of these customer-facing employees, or their supervisors, have participated in briefings about AEP Ohio's EE/PDR programs. All have received printed materials for them to share with customers when opportunity and safety permit. Education activities will continue to help customer-facing employees understand the benefits energy efficiency can bring to communities, customers and AEP Ohio, to increase their awareness and understanding of programs to help business and residential customers save energy and money, and to encourage them to share information about these programs with the customers they encounter and with others in their communities.

- **Trade Associations, Civic and Other External organizations:** AEP Ohio will expand outreach activities tailored for trade associations, civic and other external

organizations whose members may be customers, and/or may provide services to customers. These activities will be coordinated with, and marketed through customer service employees, third-party implementers, direct mail, E-mail, and/or telephone. This outreach effort will develop targeted presentations, recruit and train presenters, and deliver presentations to help trade associations' members understand the benefits energy efficiency brings to customers and to their members, to raise awareness of AEP Ohio programs, to help them participate in these programs as contractors and/or as customers, and to help them provide feedback to AEP Ohio.
Implementation Strategy
Education and training participants will be surveyed for feedback on relevance, quality and satisfaction with activities. Pre and post-learning will be evaluated. Customer Services employees will be surveyed annually with results compared to survey baseline. Third-party implementers may be selected via competitive bids to assist with education and training activities.

4.3.8 Targeted Advertising

4.3.2 Program	Targeted Advertising
Objective	
The Targeted Advertising program builds customer awareness and program participation of energy efficiency in support of AEP Ohio EE/PDR programs and also encourages market transformation in support of AEP Ohio’s commitment and key goals of this Plan.	
Target Market	
This program will target the mass market, as well as business customers.	
Program Duration	
This program is expected to be ongoing.	
Program Description	
Media outreach and advertising primarily is for the mass market, but outreach also will target small commercial and industrial customer participation. The program is designed to increase customer adoption of EE/PDR programs as well as bringing AEP Ohio’s commitment to energy efficiency to its customers. There are several barriers to the adoption of energy efficiency. In some cases, it is simple lack of customer awareness or customers’ misperception. In other cases, it is a lack of contractor awareness or support to make efficiency a realistic decision choice for customers. For other cases, many technology choices are made spur of the moment or in a fail and replace scenario, where the person or contractor contacted are aware of the Plan programs and make the efficient decision. In all cases, these programs should further AEP Ohio’s commitment to efficiency and bridge the Plan program goals and the consumer lack of adoption. The Targeted Advertising program will focus on improving customer awareness and	

adoption of EE/PDR programs specifically, as well as encourage market transformation and adoption of energy efficiency in general through the following activities:

- Market research and market segmentation for target marketing
- Emphasis on customer satisfaction
- Advertising development
- Advertising campaigns
- Program promotional materials and displays
- Event marketing and outreach campaigns
- Increased social and mobile device media efforts
- Customer testimonials
- More emphasis on customer touch points and cross selling and promotion
- Customer surveys to identify market transformation opportunities and impacts

Adjustments and Enhancements
AEP Ohio modifications to Targeted Advertising will increase customer awareness and participation in AEP Ohio programs and gain cost effective energy savings. Outreach will be customized to strengthen relevance and increase program participation in some hard to reach customer groups. Other customer groups may be identified and added to the following:

Customized Customer Outreach:

Agriculture. AEP Ohio will bring energy savings and demand reduction to the specialized needs of the agricultural sector by continuing to offer facility audits, assistance identifying additional funding sources, and installation support services of energy efficient measures incentivized through AEP Ohio's energy efficiency programs. Agriculture farms that produce poultry, livestock, dairy and/or edible crops in AEP Ohio's service territory will be eligible, whether their electric service tariff is classified as residential or non-residential. All measures demonstrating energy savings and capable of measurement and verification are eligible for the Agriculture initiative. Typically, measures are those in existing programs such as Efficient Residential Products, Efficient Business Products, and Process Efficiency. AEP Ohio will cover some or all of the cost of agriculture audits for those customers that install a significant portion of the recommended measures identified in the audit. AEP Ohio will continue to work closely with the extended agricultural community including the Ohio Farm Bureau, Extension Service, United States Department of Agriculture's (USDA) Natural Resources Conservation Services, (NRCS), and other market actors. Outreach will help demonstrate how energy efficiency contributes to increased competitiveness and/or profitability while promoting compliance with environmental requirements through successful implementation of the program measures.

- **Chain Stores (National Accounts).** AEP Ohio will develop a comprehensive and ongoing outreach strategy to achieve energy reduction at National Accounts and Chain Stores. These accounts typically act on a regional or national basis with decision makers that are outside the AEP Ohio footprint and hard to engage. The differing designs, incentives, and terms and conditions of efficiency programs offered by individual utilities across regions or the nation present a barrier to participation by National Accounts. The outreach program will overcome this barrier with a successfully demonstrated outreach and engagement strategy to enlist participation and facilitate program adoption. Incentives will generally be offered to customers by way of existing programs such as Efficient Business Products, Process Efficiency, Retro-commissioning, Data Centers, and New Construction (and major renovation). However, unique incentive mechanisms which match National Accounts business strategies will be considered. All measures demonstrating energy savings and capable of measurement and verification are eligible for the National Accounts initiative.

- **Commercial Real Estate.** AEP Ohio will develop a comprehensive and ongoing outreach strategy to achieve energy reduction at key managed real estate facilities. The commercial real estate market is hard to reach since real estate management seldom is responsible for energy cost and it does not always fully comprehend the importance of building asset improvement as a business driver. The outreach program will address these obstacles with a successfully demonstrated program design to enlist participation of commercial real estate customers. Incentives will generally be offered to customers by way of existing programs such as Efficient Business Products, Process Efficiency, Retro-commissioning, Data Centers, and New Construction (and major renovation). However, unique program designs with incentives designed to attract both owners and tenants could be offered through this effort without going through existing programs. All measures demonstrating energy savings and capable of measurement and verification are eligible.

- **Community Energy Savers.** AEP Ohio will establish partnerships with communities to engage their communication channels and relationships towards mutually shared goals of increasing the percentage of their residents and businesses that participate in and benefit from energy efficiency programs. AEP Ohio will provide supporting resources and communities will earn awards for projects they choose to encourage local support for meeting those goals. AEP Ohio believes that these partnerships will lower the costs of acquiring participation in energy efficiency programs, will link energy efficiency programs to community-based sustainability efforts, will recruit hard-to-reach populations and will deepen the understanding of the value of energy efficiency within Ohio's communities.

4.3.9 Research and Development

Objective	Research and Development

Key objectives of Research and Development include:

- Provide support to the implementation team for testing and making mid-stream adjustments to the current Plan as needed.
- Prepare for the new and modified cost effective programs needed to achieve EE/PDR targets in future plans.
- Support market transformation.

Description	

AEP Ohio believes that a systematic research and development (R&D) process to test new and innovative technologies, program concepts, implementation methods and marketing techniques is critical to finding opportunities to drive down EE/PDR Plan costs, increase customer opportunities for participation and satisfaction with the programs. AEP Ohio will manage that R&D capacity and function with the flexibility and analytical rigor to assess changes in the market and alternative approaches to energy efficiency delivery for inclusion in the Plan.

AEP Ohio proposes that any kWh savings realized from R&D pilot activities count towards the annual kWh goal. AEP Ohio also intends to work with the AEP Ohio Collaborative on the new concepts for consideration.

Given the ongoing rapid pace of change, AEP Ohio does not attempt to identify every project that could potentially be funded over the course of the Plan. Instead, AEP Ohio intends to continually monitor the energy efficiency space and identify opportunities when they arrive in partnership with the AEP Ohio Collaborative.

Implementation Strategy

For this Plan, AEP Ohio intends to continue the screening process that identifies opportunities, ranks them, pilots the most promising, evaluates them for kWh savings and cost-effectiveness, and recommends appropriateness for Plan inclusion and application to the annual kWh goal.

- **Scan & Screen Options:** This initial screen involves reviewing other utility programs, contacting various associations and communicating with key stakeholders to determine suitability, and expected savings. Next, the remaining technologies/programs are assessed for market opportunity, estimated costs, risks and barriers, proposed pilot strategies, targeted customers, and non-energy benefits (e.g., improved performance, water efficiency) to identify the most promising options for further development.
- **Define Pilots:** In this step, AEP Ohio completes a work plan including target market, measurement and verification, budget and timeline and then launches a pilot implementation strategy.
- **Evaluate Results:** AEP Ohio evaluates the pilot results to determine the kWh savings, the cost-effectiveness and whether the emerging technology or program strategy tested is suitable for inclusion in AEP Ohio's Plan.
- **Transfer to Programs:** AEP Ohio determines whether or not the technology or strategy should be incorporated into the Plan, whether as a new measure within an existing program or as an entirely new program, the determination of incentive levels and articulation of the value proposition.

Planned R&D Programs

AEP Ohio is considering R&D and pilot programs for the following technologies and/or programs:

Energy ABCs-Auditing, Benchmarking, and Capturing Savings. AEP Ohio's Energy ABCs Pilot expands beyond the offers of financial assistance for energy efficiency audits under the AEP Ohio Business Incentives program. In addition to incentives for energy audits to non-residential (commercial and industrial) customers, AEP Ohio will provide the technical platform and the customer services support to help customers establish a monthly automatic upload of their electricity usage data to ENERGY STAR® Portfolio Manager to help them make informed electrical energy decisions and implement strategies to capture energy savings. Portfolio Manager is an interactive, online energy management tool developed by the U.S. Environmental Protection Agency that allows building owners and managers to track and assess energy and water consumption within individual buildings as well as across an entire portfolio of buildings in a secure online environment. Portfolio Manager can help set investment priorities, identify under-performing buildings, verify efficiency improvements and receive EPA recognition for superior energy performance. Benchmarking will help non-residential customers set priorities for the facilities where energy audits will further identify economically viable improvements to yield annual energy savings by participating in the AEP Ohio Business incentives program. AEP Ohio began implementing the C/I Audit Pilot Program in early 2011 and plans to test this expanded program offering through this planning cycle.

Energy Efficiency Advisor. This pilot will explore offering a service to business customers, and possibly consumers, that may require a more one on one in depth approach in understanding energy efficiency and savings opportunities. The goal is to make it easier and less time intensive for customers to participate in energy efficiency programs. The Energy Efficiency Advisor could provide an opportunity for customers to make informed decisions, optimize their energy consumption and efficiency. The Advisor may provide a variety of services, including audits, energy efficiency recommendations, program management, completing applications and measurement and verification. The Advisor aims also to provide guidance on other energy efficiency programs, processes and incentive opportunities that are available. In addition, the relationship with consumer and business customers may improve with the assistance of the Energy Efficiency Advisor. Incentives may be available for engineering and design costs, in depth facility audits and per kwh saved for retrofits and financing options.

Energy Efficiency Financing and Funding. AEP Ohio has had initial discussions with lending institutions to encourage financing, a streamlined process, and alternative financing mechanisms to support capital investment in EE/PDR, with the goal of reducing incentives in favor of financing or funding alternatives. In addition, AEP Ohio hopes to work collaboratively with customers to tie their sustainability activities and emission reduction activities to energy efficiency and increase the total available funding for investment. Also, AEP Ohio will continue to actively seek out state and federal funding opportunities for EE/PDR projects that will enable customers to save energy.

Business Behavior/Intelligent Prospecting. Business Behavior programs will continue to be investigated as pilot programs. Analytics, also known as Intelligent Prospecting, may be used to identify potential participants in more effective ways. Additional Intelligent Prospecting pilots targeting small to medium business customers and possibly large business customers are planned. In addition, AEP Ohio may conduct auditing of facilities and provide business behavioral recommendations. Candidates may also be funneled directly to our other Business programs where appropriate.

The following planned programs require additional R&D prior to full scale launch:

- **Advanced Lighting.** The pilot will investigate opportunities to incentivize advanced lighting techniques for business sector customers. This lighting and intelligent controls initiative will encourage early adoption of innovative, commercially available technologies that drive deeper energy savings. Customers may receive enhanced administrative, technical and financial offerings and services. AEP Ohio may offer this program to its business sector customers. This is an opportunity to introduce enhanced energy savings to customers as they advance in their energy efficiency knowledge and as new technologies continue to enter the marketplace.

- **Commercial New Construction Code Support.** AEP Ohio will research approaches to overcome the barriers to the effective implementation of improved commercial building energy codes to capture all the energy savings available. AEP Ohio will consider approaches including but not limited to measuring commercial energy code compliance, providing training and technical support to improve compliance and capture the energy savings available from the code, providing funding and/or other resources to better equip local code agencies to enforce and improve energy code compliance over time, and promoting market awareness of the value of compliant construction. A calculation methodology to apportion energy savings attribution from energy codes will be developed and approved by the PUCO.

- **Programmable Communicating Thermostat.** AEP Ohio will research various thermostats; if proven, AEP Ohio will add respective measures and incentives to Efficient Products.

- **Remodeling.** Energy codes for residential and non-residential construction apply when certain thresholds such as change in use, percentage of affected area are exceeded. Code compliance practitioners generally agree that substantial energy savings may be gained by improving remodelers' understanding of energy code, when it applies, and how to comply. This pilot will assess the potential for savings, identify the activities with greatest likelihood for improving compliance, and test those with the estimated greatest cost-effectiveness. Benefits will include increased awareness by remodelers and the opportunity to promote installation of energy efficient lighting, appliances, and HVAC equipment and controls at the time that residential and commercial property owners are making investment decisions.

- **Water/Energy Nexus.** AEP Ohio will research water/energy pilot programs for business customers. By focusing in a few target sectors, AEP Ohio will develop relationships with customers and become a trusted advisor for customers' industry challenges. The program may include detailed energy audits, recommendations, project management assistance and financial incentives for implementations. Successful case studies could be developed to demonstrate the energy savings and market achievements.

Additional Research Under Consideration
New technologies enter the market every year. As a result, energy efficiency options are likely to be different from those being promoted today. AEP Ohio believes continuing to screen and research new technologies and program concepts will aid in developing future program plans.

5 GLOSSARY OF TERMS

Achievable Potential: the amount of energy use that efficiency can realistically be expected to displace assuming the most aggressive program scenario possible (such as providing end-users with payments for the entire incremental cost of more efficient equipment). This is often referred to as maximum achievable potential. Achievable potential takes into account real-world barriers to convincing end-users to adopt efficiency measures, the non-measure costs of delivering programs (for administration, marketing, tracking systems, monitoring and evaluation, etc.), and the capability of programs and administrators to ramp up program activity over time.

Applicability Factor: the fraction of the applicable dwelling units that are technically feasible for conversion to the efficient technology from an **engineering** perspective (e.g., it may not be possible to install CFL bulbs in all light sockets in a home because the CFL bulbs may not fit in every socket in a home).

Base Case Equipment End Use Intensity: the electricity used per customer per year by each base-case technology in each market segment. This is the consumption of the electric energy using equipment that the efficient technology replaces or affects. For example purposes only, if the efficient measure were a high efficiency lamp (CFL), the base end use intensity would be the annual kWh use per bulb per household associated with an incandescent light bulb that provides equivalent lumens to the CFL.

Base Case Factor: the fraction of the end use electric energy that is applicable for the efficient technology in a given market segment. For example, for residential lighting, this would be the fraction of all residential electric customers that have electric lighting in their household.

Coincidence Factor: the fraction of connected load expected to be "on" and using electricity coincident with the system peak period.

Cost-Effectiveness: a measure of the relevant economic effects resulting from the implementation of an energy efficiency measure. If the benefits outweigh the cost, the measure is said to be cost-effective.

Cumulative Annual: refers to the overall savings occurring in a given year from both new participants and savings continuing to result from past participation with measures that are still in place. Cumulative annual does not always equal the sum of all prior year incremental values as some measures have relatively short measure lives and, as a result, their savings drop off over time.

Demand Response: the ability to provide peak load capacity through demand management (load control) programs. This methodology focuses on curtailment of loads during peak demand times thus avoiding the requirement to find new sources of generation capacity.

Dispatchable: refers to generation technologies such as coal, natural gas, nuclear, geothermal and biomass whose output can be varied to follow demand. For non-dispatchable technologies such as wind, solar and hydro, operation is tied to the availability of an intermittent resource.

Early Replacement: refers to an efficiency measure or efficiency program that seeks to encourage the replacement of functional equipment before the end of its operating life with higher-efficiency units

Economic Potential: the subset of the technical potential screen that is economically cost-effective as compared to conventional supply-side energy resources. Both technical and economic potential screens are theoretical numbers that assume immediate implementation of efficiency measures, with no regard for the gradual "ramping up" process of real-life programs. In addition, they ignore market barriers to ensuring actual implementation of efficiency. Finally, they only consider the costs of efficiency measures themselves, ignoring any programmatic costs (such as marketing, analysis, administration) that would be necessary to capture them.

Effective Useful Life (EUL): the number of years (or hours) that the new energy efficient equipment is expected to function. Useful life is also commonly referred to as "measure life."

End-Use: a category of equipment or service that consumes energy (e.g., lighting, refrigeration, cooling, mechanical ventilation, heating, process heat, pumping, conveyance, compressed air).

Energy Efficiency: the practice of using less energy to provide the same or an improved level of output or service to the energy user . Sometimes "conservation" is used as a synonym, but that term is usually taken to mean using less of a resource even if this results in a lower service level (e.g., setting a thermostat lower or reducing lighting levels). This definition recognizes that energy efficiency includes using less energy at any time, including at times of peak demand through demand response and peak shaving efforts.

Ex-Ante: refers to the "claimed" savings values reported by an implementer or administrator *and often referred to in "deemed savings" or engineering calculations to estimate savings*.

Ex-Post: refers to the "evaluated" or "verified" savings values reported by an independent, third-party evaluator after the subject energy efficiency activities have been implemented and an impact evaluation has been completed.

Free Drivers: the individuals or businesses that adopt an energy efficient product or service because of an EE/PDR program, but are difficult to identify either because they do not receive an incentive or are not aware of exposure to the program.

Free Riders: the participants in an EE/PDR program who would have adopted an EE/PDR technology or improvement in the absence of a program or financial incentive.

Incremental: refers to savings or costs in a given year associated only with new installations happening in that year.

Impact Evaluation: the estimation of effects from the implementation of one or more EE/PDR programs. Most program impact projections contain ex-ante estimates of energy savings and demand reductions expected from program implementation efforts often used for program planning and contracting purposes and for setting program funding priorities. In contrast, the impact evaluation focuses on identifying and estimating the amount of energy and demand the program actually provides.

Integrated Data Collection (IDC): an approach in which surveys of key market actors and end-use customers (EUCs) are conducted in "real time" as close to the key intervention points as possible; usually integrated as part of the standard program implementation or other program paperwork process.

Lost-opportunity: refers to an efficiency measure or efficiency program that seeks to encourage the selection of higher-efficiency equipment or building practices than would typically be chosen at the time of a purchase or design decision.

Market Characterization: refers to evaluations focused on the evaluation of program-induced market effects when the program being evaluated has a goal of making longer-term lasting changes in the way a market operates. These evaluations examine changes within a market that are caused, at least in part, by the EE/PDR programs attempting to change that market.

Market Transformation: an approach in which a program attempts to influence "upstream" service and equipment provider market channels and what they offer end customers, along with educating and informing end customers directly. The emphasis is on influencing market channels and key market actors other than end customers.

Measure: any action taken to increase efficiency, whether through changes in construction, equipment, control strategies, or behavior. Examples are above-code buildings, higher-efficiency central air conditioners, occupancy sensor control of lighting, and retro-commissioning. In some cases, bundles of technologies or practices may be modeled as single measures. For example, an ENERGY STAR™ home package may be treated as a single measure.

MegaWatt (MW): a unit of electrical output, equal to one million watts or one thousand kilowatts. It is typically used to refer to the output of a power plant.

MegaWatt-hour (MWh): one thousand kilowatt-hours, or one million watt-hours. One MWh is equal to the use of 1,000,000 watts of power in one hour.

Net-to-Gross (NTG) Ratio: a factor representing net program savings divided by gross program savings that is applied to gross program impacts to convert them into net program load impacts

Plan: either a collection of similar programs addressing the same market, technology, or mechanisms; or the set of all programs conducted by one organization.

Process Evaluation: a systematic assessment of an EE/PDR program for the purposes of documenting program operations at the time of the examination and identifying improvements that can be made to increase the program's efficiency or effectiveness for acquiring energy resources.

Program: a mechanism for encouraging EE/PDR. May be funded by a variety of sources and pursued by a wide range of approaches. Typically includes multiple measures.

Program Potential: the efficiency potential possible given specific program funding levels and designs. Often, program potential studies are referred to as "achievable" in contrast to "maximum achievable."

Remaining Factor: the fraction of applicable units that have not yet been converted to the electric EE/PDR measure; that is, one minus the fraction of units that already have the EE/PDR measure installed.

Replace on Burnout (ROB): an EE/PDR measure that is not implemented until the existing technology it is replacing fails. An example would be an energy efficient water heater being purchased after the failure of the existing water heater.

Resource Acquisition: an approach in which end customers are the primary target of program offerings (e.g., using rebates to influence customers' purchases of end use equipment).

Retrofit: refers to an efficiency measure or efficiency program that seeks to encourage the replacement of functional equipment before the end of its operating life with higher-efficiency units (also called “early retirement”) or the installation of additional controls, equipment, or materials in existing facilities for purposes of reducing energy consumption (e.g., increased insulation, low flow devices, lighting occupancy controls, economizer ventilation systems).

Savings Factor: the percentage reduction in electricity consumption resulting from application of the efficient technology used in the formulas for technical potential screens.

Technical Potential: the theoretical maximum amount of energy use that could be displaced by efficiency, disregarding all non-engineering constraints such as cost-effectiveness and the willingness of end-users to adopt the efficiency measures. It is often estimated as a “snapshot” in time assuming immediate implementation of all technologically feasible energy saving measures, with additional efficiency opportunities assumed as they arise from activities such as new construction.

4901:1-39-03 Program planning requirements.

(A) Assessment of potential. Prior to proposing its comprehensive energy efficiency and peak-demand reduction program portfolio plan, an electric utility shall conduct an assessment of potential energy savings and peak-demand reduction from adoption of energy efficiency and demand-response measures within its certified territory, which will be included in the electric utility's program portfolio filing pursuant to rule 4901:1-39-04 of the Administrative Code. An electric utility may collaborate with other electric utilities to co-fund or conduct such an assessment on a broader geographic basis than its certified territory. However, such an assessment must also disaggregate results on the basis of each electric utility's certified territory. Such assessment shall include, but not be limited to, the following:

(1) Analysis of technical potential. Each electric utility shall survey and characterize the energy-using capital stock located within its certified territory and quantify its actual and projected energy use and peak demand. Based upon the survey and characterization, the electric utility shall conduct an analysis of the technical potential for energy efficiency and peak-demand reduction obtainable from applying alternate measures.

(2) Analysis of economic potential. For each alternate measure identified in its assessment of technical potential, the electric utility shall conduct an assessment of cost-effectiveness using the total resource cost test.

(3) Analysis of achievable potential. For each alternate measure identified in its analysis of economic potential as cost-effective, the electric utility shall conduct an analysis of achievable potential. Such analysis shall consider the ability of the program design to overcome barriers to customer adoption, including, but not limited to, appropriate bundling of measures.

(4) For each measure considered, the electric utility shall describe all attributes relevant to assessing its value, including, but not limited to potential energy savings or peak-demand reduction, cost, and nonenergy benefits.

(B) Program design criteria. When developing programs for inclusion in its program portfolio plan, an electric utility shall consider the following criteria:

(1) Relative cost-effectiveness.

(2) Benefit to all members of a customer class, including nonparticipants.

(3) Potential for broad participation within the targeted customer class.

(4) Likely magnitude of aggregate energy savings or peak-demand reduction.

(5) Nonenergy benefits.

(6) Equity among customer classes.

(7) Relative advantages or disadvantages of energy efficiency and peak-demand reduction programs for the construction of new facilities, replacement of retiring capital stock, or retrofitting existing capital stock.

(8) Potential to integrate the proposed program with similar programs offered by other utilities, if such integration produces the most cost-effective result and is in the public interest.

(9) The degree to which a program bundles measures so as to avoid lost opportunities to attain energy savings or peak reductions that would not be cost-effective or would be less cost-effective if installed individually.

(10) The degree to which the program design engages the energy efficiency supply chain and leverages partners in program delivery.

(11) The degree to which the program successfully addresses market barriers or market failures.

(12) The degree to which the program leverages knowledge gained from existing program successes and failures.

(13) The degree to which the program promotes market transformation.

(C) Promising measures not selected. Each electric utility shall identify measures considered but not found to be cost-effective or achievable but show promise for future deployment. The electric utility shall identify potential actions that it could undertake to improve the measure's technical potential, economic potential, and achievable potential to enhance the likelihood that the measure would become cost-effective and reasonably achievable.

(D) The electric utility may seek to collaborate or consult with other utilities, regional and municipal governmental organizations, nonprofit organizations, businesses, and other stakeholders to develop programs meeting the requirements of this chapter.

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The Program Administrator Cost of Saved Energy for Utility Customer-Funded Energy Efficiency Programs

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Environmental Energy Technologies Division

March 2014

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Acronyms and Abbreviations

ACEEE	American Council for and Energy-efficient Economy
C&I	commercial and industrial (private sector)
CCE	Cost of conserved energy
CEE	Consortium for Energy Efficiency
CSE	Cost of saved energy
DOE	U.S. Department of Energy
DSM	Demand-Side Management
EIA	Energy Information Administration
EERS	Energy Efficiency Resource Standards
HVAC	heating, ventilation, air conditioning
LCOE	Levelized cost of energy
MUSH	Municipal and state governments, universities and colleges, K-12 schools, and healthcare markets
WACC	Weighted average cost of capital

Executive Summary

End-use energy efficiency is increasingly being relied upon as a resource for meeting electricity and natural gas utility system needs within the United States. There is a direct connection between the maturation of energy efficiency as a resource and the need for consistent, high-quality data and reporting of efficiency program costs and impacts. To support this effort, LBNL initiated the Cost of Saved Energy Project (CSE Project) and created a Demand-Side Management (DSM) Program Impacts Database to provide a resource for policy makers, regulators, and the efficiency industry as a whole.

> **Cost of Saved Energy (CSE) vs. Cost Effectiveness**
>
> **The program administrator's cost of saved energy** is a useful metric for comparing the relative costs of efficiency programs and for comparing an energy efficiency option to other demand and supply choices for serving energy needs. The CSE is comparable to the levelized cost of energy (LCOE), which represents the per-kilowatt hour cost (in real dollars) of building and operating a generating plant over an assumed financial life and duty cycle.
>
> The cost of saved energy is not a direct test of cost effectiveness, however, and is not a benefit-cost analysis, like the Program Administrator's Cost Test or Utility Cost Test, because it does not purport to capture the monetized value of efficiency to utility customers and shareholders.

This study is the first technical report of the LBNL CSE Project and provides an overview of the project scope, approach, and initial findings, including:

- Providing a *proof of concept* that the program-level cost and savings data can be collected, organized, and analyzed in a systematic fashion;
- Presenting initial program, sector, and portfolio level results for the program administrator CSE for a recent time period (2009-2011); and
- Encouraging state and regional entities to establish common reporting definitions and formats that would make the collection and comparison of CSE data more reliable.

The LBNL DSM Program Impacts Database includes the program results reported to state regulators by more than 100 program administrators in 31 states, primarily for the years 2009–2011. In total, we have compiled cost and energy savings data on more than 1,700 programs over one or more program-years for a total of more than 4,000 program-years' worth of data, providing a rich dataset for analyses. We use the information to report costs-per-unit of electricity and natural gas savings for utility customer-funded, end-use energy efficiency programs. The program administrator CSE values are presented at national, state, and regional levels by market sector (e.g., commercial, industrial, residential) and by program type (e.g., residential whole home programs, commercial new construction, commercial/industrial custom rebate programs).

In this report, the focus is on gross energy savings and the costs borne by the program administrator—including administration, payments to implementation contractors, marketing, incentives to program participants (end users) and both midstream and upstream trade allies, and evaluation costs.[1] We collected data on net savings and costs incurred by program participants. However, there were insufficient data on participant cost contributions, and uncertainty and variability in the ways in which net savings were reported and defined across states (and program administrators). As a result, they were not used extensively in this report. It is also important to note that savings metrics reported by program administrators draw heavily from estimated values.[2]

Key Definitions

Program administrator costs include administrative, education, marketing and outreach, and evaluation, measurement and verification (EM&V) costs as well as financial incentives paid to customers or contractors. The CSE values exclude participant costs, and program administrator performance incentives, and, thus, do not represent the total resource cost unless indicated otherwise.

Program savings are based on **claimed gross savings** reported by the program administrator unless indicated otherwise. For program administrators that only reported net savings values, we calculated gross savings values using net-to-gross ratios if those were available from the program administrator.

Savings values are also based on **savings at the end-use site** and not at the power plant or natural gas pumping station and thus do not account for transmission and distribution losses.

Lifetime energy savings, when not reported by the program administrator, were calculated per the protocol described in Chapter 2.

Cost of First-Year Energy Savings (First-Year CSE): The cost of acquiring a single year of annualized incremental energy savings through actions taken through a program/sector/portfolio. The cost of efficiency as a function of first-year energy savings may be useful for program design or budgeting to meet incremental annual savings targets.

Levelized Cost of Lifetime Energy Savings (Levelized CSE): The cost of acquiring energy savings that accrue over the economic lifetime of the actions taken through a program/sector/portfolio, amortized over that lifetime and discounted back to the year in which the costs are paid and the actions are taken.

[1] Researchers who have estimated the cost of saved energy for efficiency programs have typically focused on the program administrator's costs because data on participant costs are often not available (Friedrich et al. 2009). Gross savings are those associated with the program participants' efficiency actions, irrespective of the cause of those actions. Net savings is defined as the total change in energy use that is attributable to a program (for both program participants and non-participants).

[2] Savings metrics rely heavily on estimated values because "….energy and demand savings as well as non-energy benefits resulting from efficiency actions cannot be directly measured. Instead, savings and benefits are based on counterfactual assumptions. Using counterfactual assumptions implies that savings are estimated to varying degrees of accuracy by comparing the situation (e.g., energy consumption) after a program is implemented (the reporting period) to what is assumed to have been the situation in the absence of the program (the "counterfactual" scenario, known as the baseline). For energy impacts, the baseline and reporting period energy use are compared, while controlling (making adjustments) for factors unrelated to energy efficiency actions, such as weather or building occupancy. These adjustments are a major part of the evaluation process; how they are determined can vary from one program type to another and from one evaluation approach to another. " (SEE Action Network 2012)

Results

The CSE values presented in this study are retrospective and may not necessarily reflect future CSE for specific programs, particularly given updated appliance and lighting standards. The CSE values are presented as either (a) the savings-weighted average values; (b) as an inter-quartile range with median[3] values across the sample of programs; or (c) both.

Table ES-1 provides an overall indication of national, savings-weighted average program administrator CSE values by sector using two indicators (e.g., levelized CSE 6% real discount rate and first-year CSE).[4] Figure ES-1 indicates the savings-weighted averages, medians and inter-quartile ranges for levelized CSE values using a 6% discount rate.

Table ES-1. The program administrator CSE for electricity efficiency programs for 2009-2011 data in the LBNL DSM Program Impacts Database (2012$/kWh)

Sector	Levelized CSE ($/kwh; 6% discount rate)	First-Year CSE ($/kwh)
Commercial & Industrial (C&I)	$ 0.021	$ 0.188
Residential	$ 0.018	$ 0.116
Low Income	$ 0.070	$ 0.569
Cross Sectoral/Other	$ 0.017	$ 0.120
National CSE	**$ 0.021**	**$ 0.162**

Values in this table are based on the 2009-2011 data in the LBNL DSM Program Impacts Database. CSE values are for ***program*** *administrator costs and based on gross savings.*

[3] The *inter-quartile range* is the middle 50 percent of the range of program CSE values. The *median* is the numerical value separating the upper half of a data sample from the lower half.

[4] We calculated a levelized CSE using two discount rates that are rough proxies for different perspectives on energy efficiency investments: a 6% real discount rate that can reflect the utility weighted average cost of capital (WACC) and a 3% real discount rate that can be a proxy for a societal perspective.

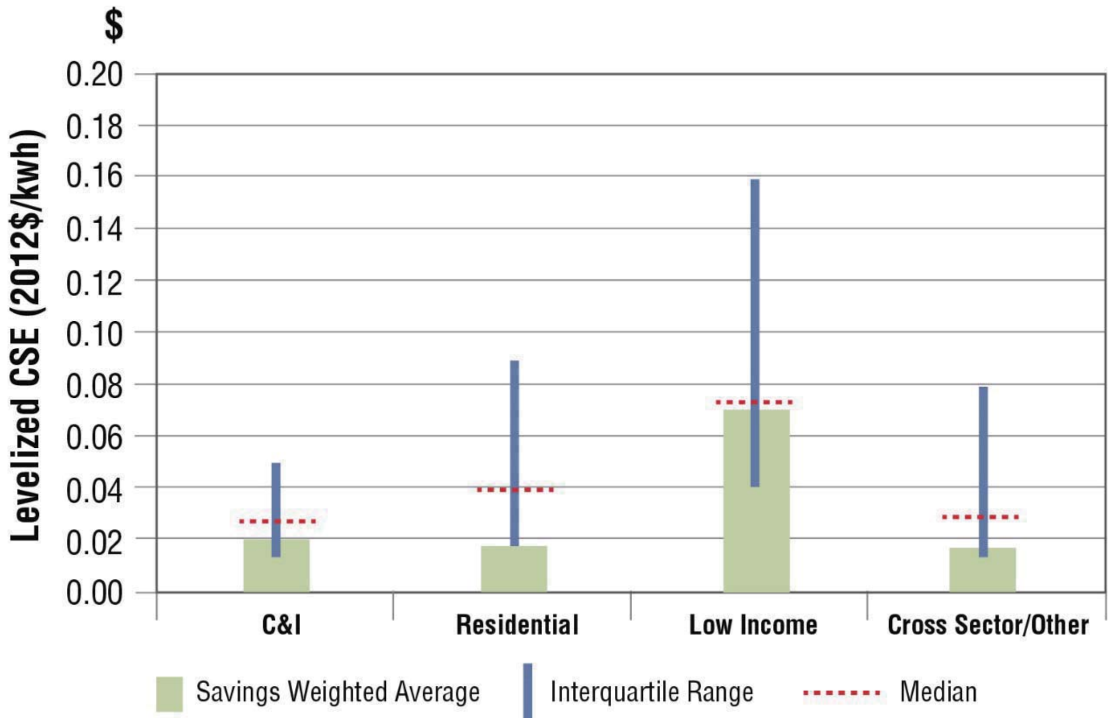

Figure ES-1. CSE for electricity efficiency programs by sector for 2009-2011 data in the LBNL DSM Program Impacts Database

Our key national and regional findings are:[5]

- The U.S. average levelized CSE was slightly more than two cents per kilowatt-hour when gross savings and spending is aggregated at the national level and the CSE is weighted by savings.
- Residential electricity efficiency programs had the lowest average levelized CSE at \$0.018/kWh. Lighting rebate programs accounted for at least 44% of total residential lifetime savings with a savings-weighted average levelized CSE of \$0.007/kWh. The residential CSE, when the lighting programs were removed, was \$0.028/kWh. Low-income programs have an average levelized CSE at \$0.070/kWh.
- Commercial, industrial and agricultural (C&I) programs had an average levelized CSE of \$0.021/kWh.
- Not surprisingly, the levelized CSE varies widely, both among and within program types. We find that the median value is typically higher than the savings-weighted average for nearly all types of programs. One possible explanation is that our sample includes a number of very large programs and for any given program type, larger efficiency programs have lower CSE than smaller programs because administrative costs are spread over more projects (e.g., economies of scale).
- In reviewing regional results, efficiency programs in the Midwest had the lowest average levelized CSE (\$0.014/kWh), while programs in northeast states had a higher

[5] Key findings in this section use savings-weighted average CSE values that include program administrator costs (in 2012$) and reported gross savings, which are levelized using a 6% real discount rate.

average CSE value ($0.033/kWh). Programs in western states are at $0.023/kWh and for the southern states included in the database, the comparable program CSE was $0.028/kWh.

- Natural gas efficiency programs had a national, program administrator savings-weighted average CSE of $0.38 per therm, with significant differences between the C&I and residential sectors (average values of $0.17 vs. $0.56 per therm, respectively).
- The cost of saved energy may vary across program administrator portfolios for reasons that have little to do with programmatic efficiency. In some jurisdictions, a policy mandate of acquiring all reasonably available cost-effective energy efficiency can lead to a focus on more comprehensive programs which will tend to have a higher CSE because they are serving more diverse constituencies and technologies. In other jurisdictions, the focus may be on acquiring the cheapest savings possible.

Program-level results

We also examined the cost of saved energy by program type for both residential and C&I programs (see Chapter 3). Figure ES-2 shows an example for the C&I programs, including savings-weighted average (pale green bar) CSE values, the inter-quartile ranges (blue line) and median (red dotted line) CSE values. The median value and inter-quartile ranges for CSE are based on calculations for each individual program and gives equal weighting to programs irrespective of their relative size in terms of either savings or costs.

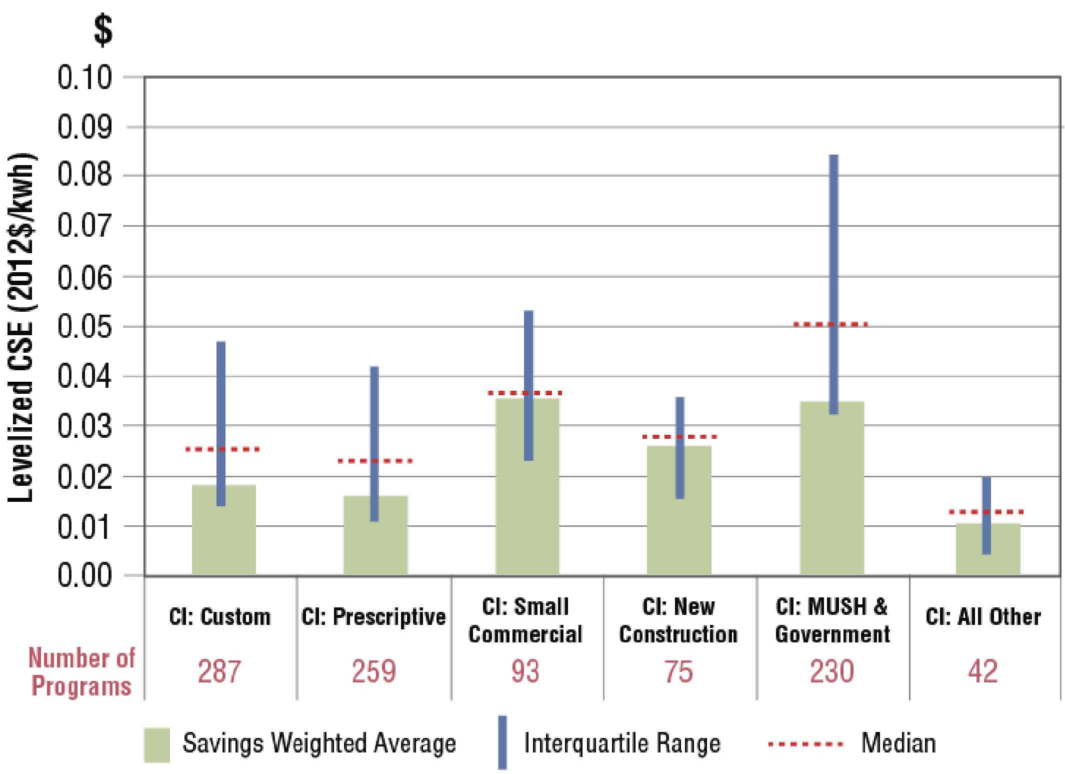

Figure ES-2. National levelized CSE for C&I sector simplified program categories

The simplified C&I programs have median values for program administrator CSE that range from \$0.01/kWh to \$0.05/kWh. It is worth noting that the savings-weighted average CSE values for custom and prescriptive rebate program categories are \$0.018/kWh and \$0.015/kWh, respectively. Since these two program categories account for almost 70% of C&I sector savings, they tend to drive the overall CSE results for the C&I sector (less than \$0.02/kWh).

For the residential programs, several program categories have a relatively tight range of program CSE values (see Figure ES-3). For example, Consumer Product Rebate programs have an inter-quartile range of \$0.01/kWh to \$0.04/kWh and a low savings-weighted average (~\$0.01/kWh). However, the residential prescriptive (\$0.03/kWh to \$0.11/kWh), new construction (\$0.03/kWh to \$0.11/kWh) and whole-home upgrade (\$0.03/kWh to \$0.21/kWh) program types have significantly larger ranges. There are several possible reasons for the range of CSE values in each of these program categories. The prescriptive simplified program category includes detailed program types that implement a wide variety of measures (e.g., HVAC, insulation, windows, pool pumps) as well as some generic "prescriptive" programs[6] that often include measures also found in the consumer product rebate category. This broad measure mix—and the variation in costs and measure lifetimes associated with those measures—are possible drivers for the wide range of CSE values for the prescriptive category.

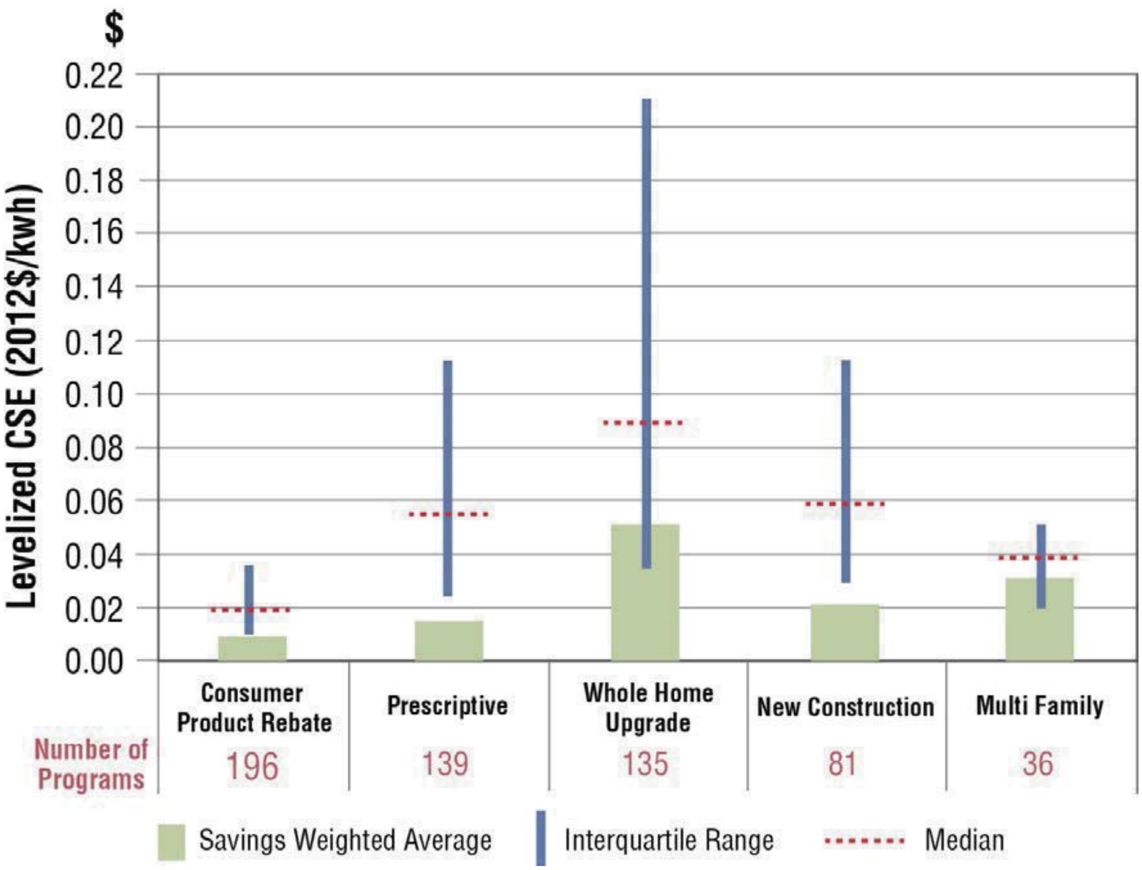

Figure ES-3. National levelized CSE for residential sector simplified program categories

[6] Some programs include all their rebated measures under the same program title and it is not possible to determine where the majority of the savings is coming from. In these cases, the programs were categorized as "Residential Prescriptive."

For the Whole-Home Upgrade program category, the broad range of program designs and delivery mechanisms (this category includes audit, direct install, and retrofit/upgrade programs) may help explain the relatively wide range of CSE values. Overall, most C&I program categories have a relatively smaller inter-quartile range of CSE values compared to residential program categories.

Total resource cost of saved energy

Although we focus on program administrator costs in this report, it is important to note that these metrics do not reflect a total cost perspective since program administrators infrequently report participant costs. We were able to collect participant cost data from a handful of program administrators. However, given small sample size and uncertainty in how participant costs were derived, it is difficult to confidently assess the "all-in" or total resource cost of efficiency or analyze potential influences on the total cost of the efficiency resource. For these reasons, in Figure ES-4, we compare the program administrator's levelized CSE vs. a total resource levelized CSE for illustrative purposes only. We calculate this total resource CSE for the simplified program categories where both program administrator and participant costs are available for more than 18 program years.[7]

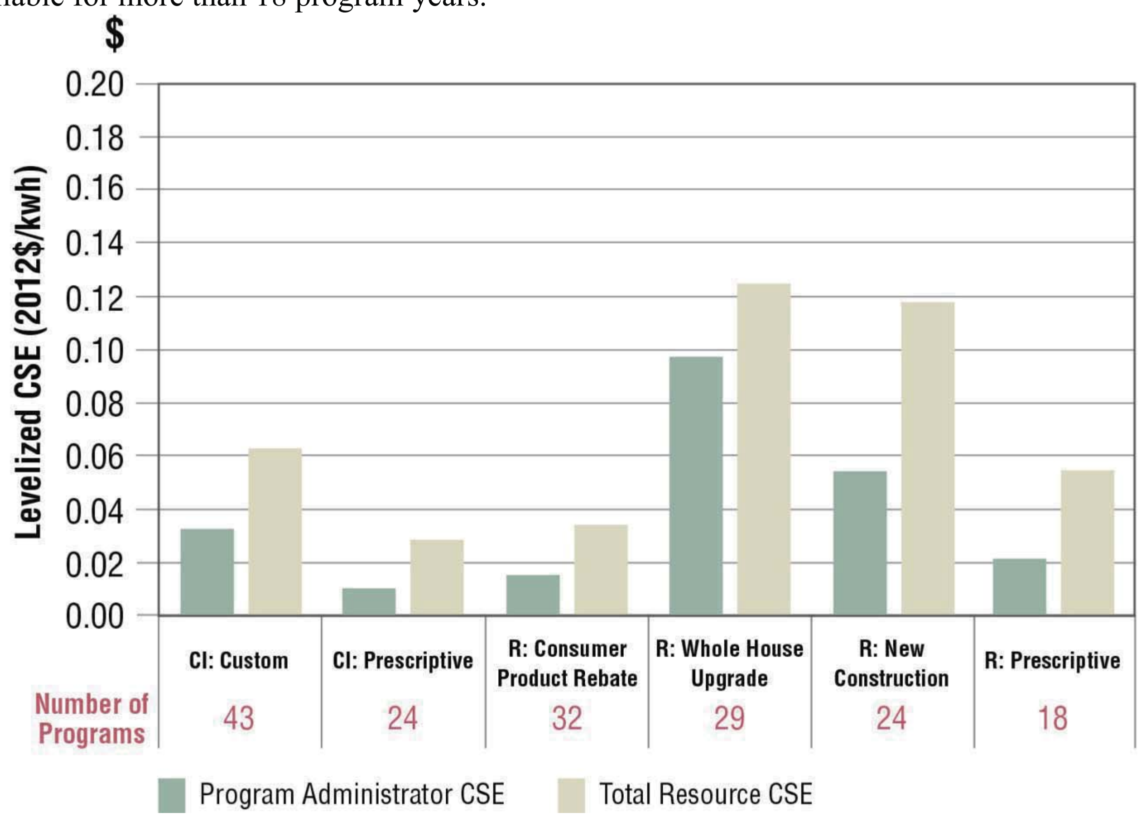

Figure ES-4. Levelized savings-weighted average CSE for electricity efficiency programs that include program administrator costs vs. total resource costs for select program categories[8]

[7] The "n" of 18 was selected because there was a natural break in the data and there were a meaningful number of programs from which to calculate average values.
[8] This chart includes a very small sample of programs from 11 states; thus, results may not reflect current practices in many jurisdictions.

For this small sample of programs, we found that the levelized total resource CSE values are typically double the program administrator CSE with the exception of the Residential Whole Home Upgrade program category (which has a savings-weighted total resource CSE that is about 25-30% higher than the program administrator CSE). Further data collection and analyses could better characterize the way in which the ratio of program administrator costs to participant costs varies as a function of sector, measure types, and market maturity; and how incentives and direct support might be optimized to pay no more than is necessary to meet a state's efficiency policy objectives.

Observations and Recommendations on Reporting

In calculating the CSE, we utilized information on program administrator costs, annual energy savings, estimated lifetime of measures installed in a program, and an assumed discount rate. However, with respect to current program reporting practices, we observed several challenges to the collection of this data for the purposes of calculating the CSE:

- Inconsistencies in the quality and quantity of the costs and savings data led LBNL to develop and attempt to apply consistent data definitions in reviewing and entering program data:
    - Program administrators in different states did not define savings metrics (e.g., varying definitions of net savings) and program costs consistently; and
    - Market sectors and program types were not characterized in a consistent fashion among program administrators.
- Many program administrators did not provide the basic data needed to calculate CSE values at the program level (i.e., program administrator costs, lifetime savings, or program-average measure lifetimes), which can introduce uncertainties into the calculation of CSE values (as we developed and utilized methods to impute missing values in some cases).

As a practical matter, the quality and quantity of program data reported by program administrators is an important factor in assessing energy efficiency as a resource in the utility sector. Additional rigor, completeness, standard terms, and consensus on at least essential elements of reporting could pay significant dividends for program administrators and increase confidence in energy efficiency savings among policymakers and other stakeholders—particularly in situations where efficiency is treated as a resource in utility procurement decisions, ISO/RTO forward capacity markets, or as an environmental compliance or mitigation option by state or federal environmental agencies.

Of the 45 states currently running utility-customer funded efficiency programs (Barbose et al. 2013), only 31 states provided reporting with sufficient transparency to complete a program-level CSE analysis, and almost all of the 31 states' data required some interpretation for purposes of regional or national comparison. With more consistent and comprehensive reporting of program results, additional insights can quite possibly be obtained on trends in the costs of energy efficiency as a resource as program administrators scale up efforts, what saving energy costs among an array of strategies, and what and how cost efficiencies might be achieved.

Therefore, we urge state regulators and program administrators to consider annually reporting certain essential data fields at a portfolio level and more comprehensive reporting of program-level data in order to facilitate the comparison of efficiency program results at state, regional, and national levels. A diagram illustrating this reporting hierarchy approach can be found in Chapter 5, Figure 5-1.

As part of the LBNL CSE Project, we intend to continue collecting energy efficiency program data and analyzing and reporting the CSE for efficiency actions funded by utility customers. We also plan to:

- Work with state, regional, and national stakeholders to encourage the collection of program cost and impact data using a common terminology and program typology as defined in this report and a companion policy brief (Hoffman et al. 2013). This is important for organizing program data into appropriate and consistent categories so that programmatic energy efficiency, as a regional and national resource, can be reliably assessed.
- Annually compile data reported by program administrators and state agencies from across the United States.
- Conduct additional analyses to help increase understanding of factors that influence EE program impacts, costs and the cost of saved energy.

1. Introduction

Demand side management (DSM), and end-use energy efficiency specifically, is increasingly being relied upon as a resource for meeting electricity and natural gas system needs within the United States, often because efficiency is quite cost-effective compared to other resource options. For example, 15 states have enacted long-term, binding energy savings targets, often called Energy Efficiency Resource Standards (EERS), and another five states have mandates that program administrators must acquire "all cost-effective energy efficiency."[9] In 2011, U.S. energy efficiency program administrators that manage utility customer-funded efficiency programs spent about $5.4 billion on electric and gas energy efficiency programs (CEE 2013), with spending projected to possibly more than double by 2025 (Barbose et al. 2013).

Electric and natural gas energy efficiency in the United States is pursued through a diverse mix of policies and programmatic efforts, which support and supplement private investments by individuals and businesses. These efforts include federal and state minimum efficiency standards for electric and gas end-use products; state building energy codes; a national efficiency labeling program (ENERGY STAR®); tax credits; and a broad array of largely incentive-based programs for consumers, funded primarily by electric and natural gas utility customers (Dixon et al. 2010) (Barbose et al. 2013).[10]

These utility customer-funded efficiency programs are overseen by state regulators and administered by more than 100 different entities (e.g., utilities, state energy agencies, non-profit and for-profit third parties) and are the focus of this study. Policymakers, regulators, program administrators and implementers rely on information about lifetime costs and savings of these customer-funded efficiency programs to assess efficiency's potential, to design and implement programs in a cost-effective manner or to improve program cost effectiveness. Given the expected growth in efficiency funding and the importance of understanding the cost of saved energy (CSE), we initiated this LBNL Cost of Saved Energy Project (CSE Project) to provide a resource for policy makers, regulators and the efficiency industry as a whole.

1.1 Assessing Energy Efficiency as a Resource

The cost and cost effectiveness of utility-customer funded end-use efficiency programs depend on perspective. From the perspective of a participant in a program, their cost is the cost of an efficiency project net of any incentives or support that might be provided by a program administrator. From the program administrator's perspective, it is the cost of planning, designing, and implementing a program and providing incentives to market allies and end users to take actions that result in energy savings; costs incurred by participants are not considered as part of the program administrator's costs. The total resource or societal cost perspective takes into

[9] States with an EERS as of the date of this report are: AZ, CA, CO, HI, IL, IN, MD, MI, MN, MO, NM, NY, OH, PA, and TX. Six states have a mandate to achieve all cost-effective savings: CA, CT, MA, RI, VT, and WA.
[10] For additional energy efficiency market background, please see: The Future of Utility Customer-Funded Energy Efficiency Programs in the United States: Projected Spending and Savings to 2025. http://emp.lbl.gov/publications/future-utility-customer-funded-energy-efficiency-programs-united-states-projected-spend

account the costs paid by both the program administrator and the participant to implement the efficiency action.

Numerous researchers have estimated the CSE for efficiency programs funded by utility customers (see Appendix A for a description of past and current efforts). These researchers have typically focused on the program administrator perspective (i.e., the program administrator CSE), for two primary reasons. First, in some cases, participant costs are often not collected or reported by program administrators in annual reports (see Chapter 2). Second, when comparing efficiency with supply side resources, some consider that the proper metric is the money paid to obtain the resource by the program administrator as supply-side resources do not consider, or have, participant costs. For this report, primarily because of the first reason, we present program administrator CSE data and analyses.

Another consideration for assessing efficiency as a resource is whether CSE values are based on net or gross savings. Net savings are those attributed to a program (for both program participants and non-participants). Gross savings are those associated with the program participants' efficiency actions, irrespective of the cause of those actions. There is debate about the proper use of net and gross savings in CSE calculations (SEE Action 2012); however, since there is neither sufficient nor consistent data available on net savings, we present CSE values based on gross savings in this study.

1.2 Objectives and Scope

This CSE Project presents and analyzes the costs of acquiring energy savings for different efficiency program types and in different market sectors across the United States. Our objectives are to provide insight into the costs associated with saving a unit of energy and the potential factors that influence those costs. To this end, we hope our work will:

- Benefit policy makers, system planners and other stakeholders by providing continually improving CSE indicators that enable projections of future spending and savings.
- Enable more cost-effective efficiency programs by:
  - Benchmarking and comparing program implementation approaches across different markets (e.g., industrial, commercial, small commercial), delivery mechanisms (e.g., direct install versus do it yourself), and design approaches (e.g., prescriptive versus custom rebates);
  - Analyzing contextual factors that affect CSE, such as types of programs, measures, program administrator experience, changes in building energy codes and standards, labor costs, climate, state-level policies, and the scale of efficiency investments.

This study is the first technical report of the LBNL CSE Project and provides an overview of project scope, approach and initial findings, including:

- Providing a *proof of concept* that the program-level cost and savings data can be collected, organized and analyzed in a systematic fashion;

- Presenting initial program, sector and portfolio level results for the cost of saved energy for a recent time period (2009-2011); and
- Encouraging state and regional entities to establish common reporting definitions and formats that would make the collection and comparison of CSE data more reliable.

Specifically, this report includes and discusses elements of our approach, including the following:

- Developing the data collection, documentation, and analyses procedures LBNL used to calculate the CSE (Chapter 2);
- Defining program categories as well as cost and savings definitions that allow for consistent, standardized entry of program administrator data into a CSE database (Chapter 2);
- Developing a database of program-level data on energy efficiency program impacts and costs from states with significant utility customer-funded energy efficiency programs (Chapter 2);
- Presenting the range of regional-, state-, sector-, and portfolio-level energy-efficiency program administrator CSE and program-level CSE for a defined set of over 60 program categories (Chapter 3);
- Exploring potential relationships between the program administrator costs of saved energy for specific types of programs and climate zones and adopted building energy codes (Chapter 3);
- Conduct a preliminary statistical analysis that explores factors that may be associated with and influence the cost of saved energy at the portfolio or program level and set the stage for future analyses that will assess additional hypotheses and a broader, more refined range of factors (Chapter 4); and
- Present recommendations for future data collection and analyses (Chapter 5).

1.3 Report Organization

The remainder of this report is organized as follows. Chapter 2 provides an overview of approach used to collect data in the LBNL DSM Program Impacts Database and the challenges associated with collecting, organizing and analyzing the data in a consistent fashion. In Chapter 3, we present descriptive statistics on efficiency program costs and savings followed by presentation of CSE statistics at a national, sector, regional, and state level and for certain program types and in relation to climate zones and building code status. In Chapter 4, we discuss our efforts to define and statistically test some factors that may influence the CSE. Chapter 5 presents a discussion of the key findings and recommendations for regulators and program administrators to consider with respect to CSE-related data collection and reporting.

The appendices contain documentation on topics covered in the chapters, including tables of CSE metrics by region, sectors, and program types in Appendix E.

2. Approach

The state-by-state evolution of utility customer-funded energy efficiency programs has fostered diversity in these programs' oversight, design, administration and evaluation. Thus, not surprisingly, information provided to state regulators by program administrators on the impacts and costs of efficiency programs is diverse with respect to the level of specificity and detail required as well as terms and definitions used to describe the costs and impacts of individual programs. In this chapter, we summarize our assembled program data, discuss our approach to compiling, organizing and analyzing the data in a manner that addresses the diversity in reporting practices yet allows for consistent reporting on the cost of saved energy across the country and on the basis of region, market sector, and type of program. This approach included developing an energy efficiency program typology and adopting standard definitions for program characteristics, cost and savings data. We also discuss several major challenges associated with collecting and analyzing program cost and impact data and calculating CSE values given data quality issues.

2.1 Data Summary

The data for this study were drawn from annual reports, mostly for the years 2009–2011, which were prepared by program administrators of efficiency programs funded by the customers of U.S. investor-owned utilities in 31 states. Our energy efficiency program data set comprises expenditure, energy savings and program participation data (where available) reported by 107 program administrators, for a total of 4,184 program records (see Table 2-1).

We relied primarily on annual DSM or efficiency reports filed by program administrators with state regulatory agencies because they both typically include data for a portfolio of programs and are publicly available from state regulatory commission filings.[11] In some cases, when data were not found or were ambiguous in annual reports, we consulted other reports (e.g., other performance metrics reports filed by investor-owned utilities in California) or solicited additional information directly from the program administrator or regulatory staff. Where required data were not provided in a program administrator's filed annual report, but provided in third-party program evaluation reports that were included as attachments to the program administrator annual reports, we used data from both to populate what we are calling the LBNL DSM Program Impacts Database (database).[12,13]

[11] The states included in this analysis were selected based on the availability and transparency of program cost and savings data at the individual program level as identified by LBNL researchers in a recent review of customer-funded energy-efficiency programs (Barbose et al. 2013). To the extent that reports were accessible, we collected data for all investor-owned utilities (IOUs) in the target states. Many program administrators had not yet released 2012 program year results during the data collection period for this study; thus our analysis focuses on the 2009-2011 period. We did not include program data from publicly-owned electric utilities and rural electric cooperatives because these utilities often do not report program level data that is publicly available. Future efforts may include data collected from public utilities.

[12] We did not rely on individual impact evaluation studies of efficiency programs because the data of interest to this project are usually reported in relatively easily accessible summary form and per program in the annual reports filed with regulators. Moreover, evaluations of individual programs are not always publicly available nor do they always include program or portfolio-related costs.

[13] Appendix C describes data that was collected for this research effort, the database configuration, and the data quality assurance/quality control process and procedures.

Table 2-1. Summary of energy efficiency program data in LBNL DSM Program Impacts Database[14]

State	First Year of Data	Last Year of Data	Total # of Years	Number of Program Administrators*	Number of Program Records
AZ	2010	2011	2	3	65
CA	2010	2012	3	4	1210
CO	2009	2011	3	1	110
CT	2009	2011	3	4	60
FL	2011	2011	1	5	88
HI	2009	2011	3	1	21
IA	2009	2011	3	3	171
ID	2010	2011	2	1	40
IL	2008	2011	4	2	85
IN	2009	2012	4	5	244
MA	2009	2011	3	11	403
MD	2010	2011	2	4	126
ME	2009	2011	3	2	22
MI	2009	2011	3	2	81
MN	2009	2011	3	2	141
MT	2011	2011	1	1	19
NC	2009	2011	3	2	37
NH	2009	2011	3	4	90
NJ	2009	2011	3	1	40
NM	2010	2011	2	4	101
NV	2009	2011	3	3	209
NY	2009	2011	3	11	111
OH	2009	2011	3	7	170
OR	2009	2011	3	2	16
PA	2009	2010	2	6	143
RI	2010	2011	2	2	36
TX	2010	2011	2	10	202

[14] "Number of Program Records" includes programs that produced energy savings (e.g., residential or commercial rebate programs), programs for which the program administrator did not claim savings (e.g., education and outreach programs or pilot programs), and, in some cases, sector- or portfolio-wide activities (e.g., marketing or internal program evaluation activities).

State	First Year of Data	Last Year of Data	Total # of Years	Number of Program Administrators*	Number of Program Records
UT	2009	2011	3	1	41
VT	2009	2011	3	1	18
WA	2010	2011	2	1	42
WI	2009	2011	3	1	42
	Totals			**107**	**4184**

** In some cases, program administrators who run both gas and electric programs are counted twice for the purposes of separating the reported effects of each program.*

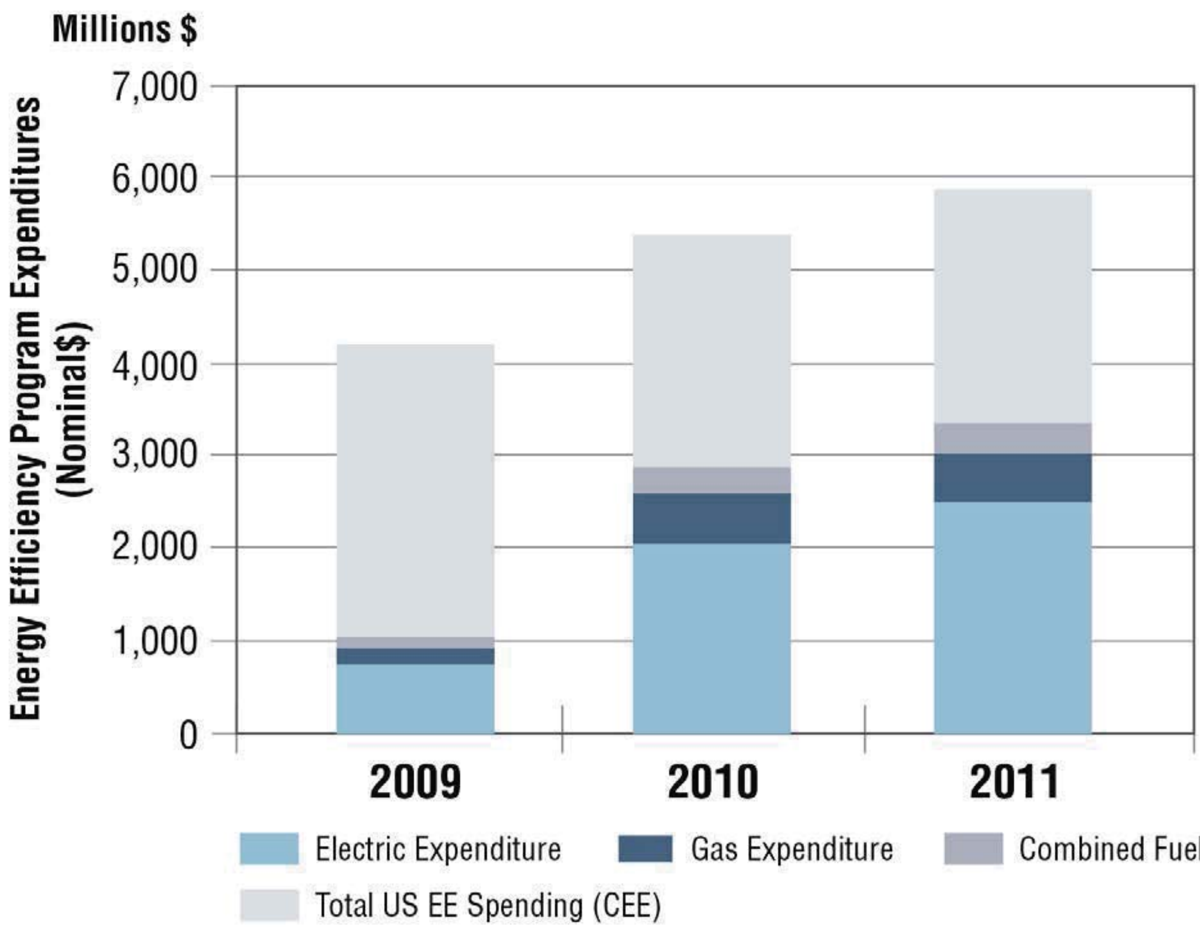

Figure 2-1. LBNL DSM Program Impacts Database coverage as compared to national efficiency spending reported by Consortium for Energy Efficiency (CEE)[15]

[15] CEE Annual Industry Reports can be found here: http://www.cee1.org/annual-industry-reports

The efficiency program data that were compiled by LBNL staff into the database represent a significant share of all efficiency programs funded by utility customers in the United States. The database contains programs with total program administrator expenditures of about $7.6 billion (see light and dark blue shading in Figure 2-1). Programs in the LBNL database represent about 25% ($1.1 billion) of 2009 national program expenditures by gas and electric utilities and about 50% of program expenditures in 2010 and 2011 ($2.9B in 2010 and $3.2B in 2011), compared to national efficiency spending as reported by the Consortium for Energy Efficiency (CEE) (see Figure 2-1).[16]

2.2 Program Typology and Standardized Definitions

We developed program categories in order to characterize and analyze similar types of efficiency program types, as defined by market sector and technology, action, delivery approach, or other common themes. Examples of program categories include commercial prescriptive HVAC programs, low-income programs, and residential whole home direct-install programs. Some program categories are relatively well defined and include a narrow set of technologies (e.g., high-efficiency windows or pool pumps), while other categories are cross-cutting, may span a wide variety of activities (e.g., statewide marketing, take-home energy efficiency kits), and/or target several market sectors (e.g., in-school education programs, lighting technology market transformation programs).

The typology grouped and classified energy efficiency programs into three tiers: (1) sector; (2) simplified program categories; and (3) detailed program categories. Figure 2-2 provides a partial snapshot of this three-tiered program typology approach: seven sectors (including one for demand response programs, which are not addressed in this report), 31 simplified efficiency program categories (27 for efficiency programs) and 66 detailed categories (62 for efficiency).[17] LBNL has prepared a policy brief that describes the typology in more detail as well as the standardized definitions (Hoffman et al 2013). Appendix B also includes the complete typology and set of definitions.

We determined that a three-tiered hierarchy was appropriate because it allowed for flexibility in grouping programs for comparison (e.g., single-measure versus comprehensive whole-building programs or by technology such as lighting vs. HVAC programs) and provides options for different levels of analysis. Moreover, in some cases, the detailed program category tier narrowed the range of installed measures for a program type, thus reducing the uncertainty in derivation of measure savings and lifetime savings across measures installed in that program. For example, we defined three detailed program categories that fall under the simplified program

[16] However, as noted below and in Chapter 3, some of the data were not utilized for the data presentations, CSE metrics and analyses due to missing data. For example, the programs indicated as Combined Fuel in this figure were not included in the cost of saved energy analyses, because the costs borne by electricity and gas utility customers could not be determined for this subset of programs. Without the useable data, the database still contains about 45-50% of the national spending estimate.

[17] The relatively large number of simplified and detailed categories was necessary to capture the wide range of common program offerings throughout the country. We also included some program types in the detailed typology because they have regional significance (e.g., pool pump programs in the Southwest, data center programs in New York, Washington and California), or the program types appear to be emergent (e.g., financing programs, residential behavior-based efficiency programs).

category of "Whole Home Upgrades": Whole Home Audit Programs; Whole Home Direct-Install Programs; and Whole Home Retrofit Programs.[18]

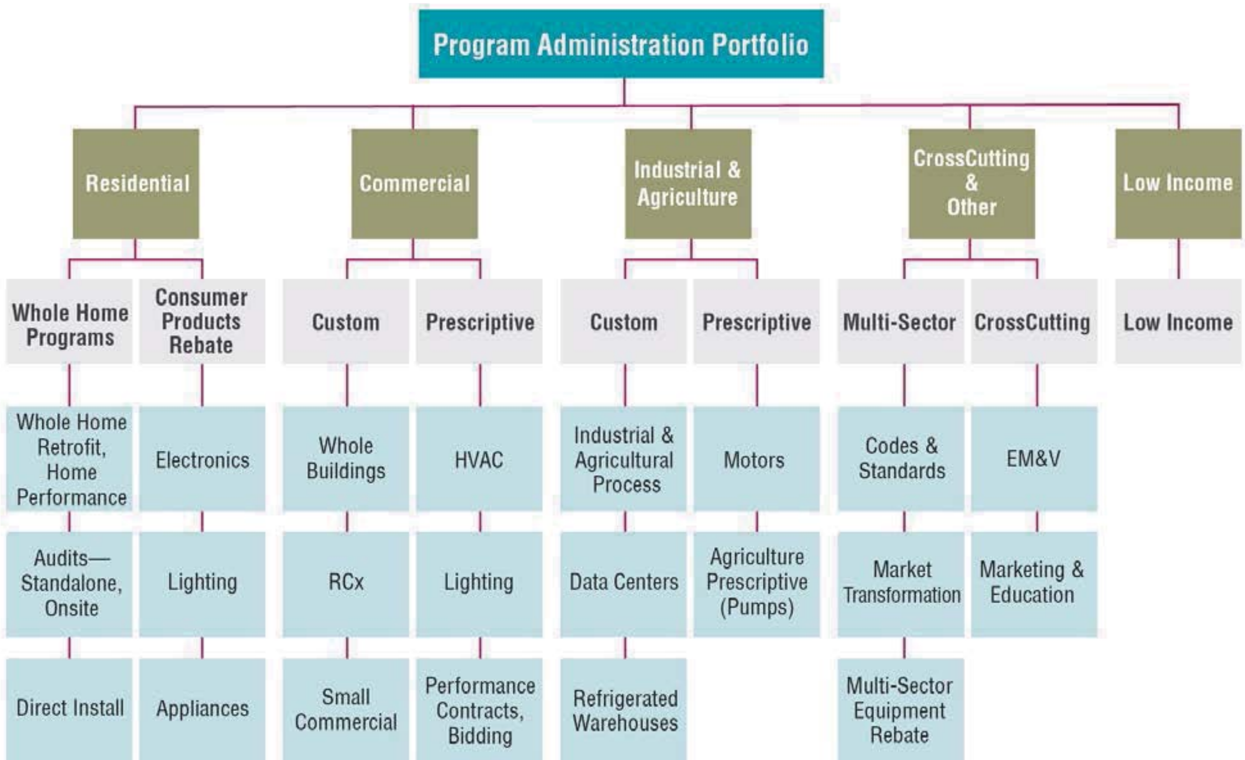

Figure 2-2. Selected program types in the LBNL program typology
Note: Not all sectors and simplified and detailed program categories are shown

We have relatively high confidence in the categorization of most programs. However, there are some programs where we were either not able to obtain much information about the measures offered under that program or where there was a wide array of measures offered under a single umbrella program. In both situations, programs were generally categorized under "prescriptive" or "other" categories. The mix of programs and measures in these two types of categories are likely to be less consistent than in other program categories.

The data fields and specification for the database and program categories were developed through an iterative process which included review of program administrator annual reports and review of several other sources that contain typologies and/or definitions, including the State and Local Energy Efficiency Action Network (SEE Action 2012), the Consortium for Energy Efficiency (CEE 2012), the Regional EM&V Forum of the Northeast Energy Efficiency

[18] We found that program names were not always indicative of the appropriate program category. Thus, in many cases, we reviewed program information as part of the process of classifying programs into program category. We defined a specific set of guidelines for classifying programs by type. For example, when the program name was ambiguous (e.g., EnergySaver) or when the program description indicated savings could fall into more than one detailed or simplified category (e.g., a single program that offered both prescriptive and custom rebates), we looked at the measure-level savings reported for that program (if available) and categorized the program according to the reported measure mix.

Partnerships (NEEP 2011), and the NEEP Regional Energy Efficiency Database (REED 2013). We shared a draft of our categories and definitions and had several discussions with representatives from CEE, NEEP and the American Council for an Energy-Efficient Economy (ACEEE); and made revisions based on their input. For the demand-response program categories, we relied on program categories defined by the Federal Energy Regulatory Commission (FERC) for its national surveys (FERC 2012), although demand-response program data are not included in this study.

We also defined program cost and energy savings (impacts) data fields as part of our effort to classify and report program information in a consistent fashion across program administrators and states.[19]

- **Program Administrator Costs:** The primary cost data used in this report are the *program administrator costs* which include: (1) program administration planning and delivery; (2) engineering or technical support; (3) services provided by implementation contractors; (4) marketing, education and outreach; (5) direct rebates or financial incentives to program participants; and (6) evaluation, measurement and verification costs (see Table 2-1).[20] Program administrator costs exclude participant costs and performance incentives for program administrators (e.g., utility shareholder incentives).[21] For each program we collected from one to four years of data.[22] We made inflation adjustments to the program cost data provided by program administrators so that all cost data are reported in 2012$.[23] We chose to use 2012 as our base year because 2012 is the most recent year for which an annual implicit price deflator for GDP is available from the U.S. Bureau of Economic Analysis. We would have preferred to also report CSE values based on participant, as well as program administrator, costs; however, we found that few program administrators reported participant costs in their annual reports (see Appendix C).
- **Program Savings:** The State and Local Energy Efficiency Action Network's Energy Efficiency Program Impact Evaluation Guide (SEE Action 2012) was the primary source used to describe and define the program energy savings indicators in a consistent fashion.[24] The SEE Action Guide was particularly important for providing

[19] Program cost and savings definitions tend to be consistent within a state, even if there are multiple program administrators.
[20] Some program administrators did not include program-level costs for activities such as marketing/outreach, education, and evaluation, but instead accounted for those expenditures at the sector or portfolio level.
[21] We did not report program administrator performance incentives because actual awards of performance incentives are not often included in annual reports filed by program administrators, and are frequently awarded at a significantly later date.
[22] Some program administrators included prior years' data in their reports in addition to the 2009–2011 period.
[23] Costs can be presented in nominal (or current) or real (or constant) dollar terms. Nominal values are economic units measured in terms of purchasing power of the date in question. Real dollar values are economic units measured in terms of constant purchasing power. A real value is not affected by general price inflation and can be estimated by deflating nominal values with a general price index, such as the implicit deflator for gross domestic product or the Consumer Price Index. From OMB *Circular A-94 Guidelines And Discount Rates For Benefit-Cost Analysis of Federal Programs.* We used the GDP implicit price deflator published regularly by the U.S. Bureau of Economic Analysis.
[24] The SEE Action Guide describes common terminology, structures, and approaches used for determining savings from energy efficiency programs guide. The definitions in the SEE Action Guide incorporated input from program

data definitions for net and gross energy savings and lifetime energy savings, which for this report are assumed to take place at the end-use site where the efficiency actions were implemented.

Table 2-2 provides abridged definitions for key program data in the Database (see Appendix B for the complete glossary of energy efficiency program data fields).

Table 2-2. Abridged definitions for selected program cost and savings data

Term	Definition
Program Administrator Costs	Program administrator costs include the costs of designing programs and portfolios; directing, managing and paying implementation contractors; marketing, education and outreach (ME&O); program and portfolio evaluations; and incentives to both program participants (or end users) and to both mid-stream and upstream allies in the market (e.g., financing and services such as installations or free audits).
Program Average Measure Lifetime	Weighted average economic lifetime (years) of all measures installed in a program year in a specified program.
Annual Gross Savings	Gross annual incremental savings (kWh or therm) as reported by the program administrator using their own staff or evaluation firm, after the subject energy efficiency activities have been completed. Gross savings are the change in energy consumption resulting from program-related actions taken by program participants regardless of why they participated. Note that these are annualized "full-year" savings, regardless of when measures were installed during the program year. Per the SEE Action reference (SEE Action 2012) these may be Claimed or Evaluated Savings.
Lifetime Gross Savings	The expected gross savings (GWh or therm) over the lifetime of the measures installed under the subject program. For our analysis, where available, we relied on lifetime savings reported by the program administrator.

The detailed program categories and data definitions described in this section have been adapted by CEE for its own 2013 annual surveys of the efficiency program industry.[25] We hope that other entities will consider using them as well and to support that objective, as part of the CSE Project, LBNL plans to gather feedback from stakeholders via an annual or biennial process to modify, add or subtract program categories as program offerings change or to address potentially needed clarifications in the definitions and categories.

administrators, state regulators, and other stakeholders from a number of states and regions and included a review and synthesis of definitions used in a broad set of energy efficiency glossaries.

[25] As part of its 2013 annual "State of the Industry" survey, CEE is collecting program-level energy efficiency and demand response program data from program administrators using the LBNL program categories described in this report as well as the definitions from the SEE Action guide.

2.3 Challenges in Consistent and Standardized Reporting of Program Data

When data are compiled from multiple states and program administrators, terminology differences can potentially make it difficult to conduct comparative analysis across states or program administrators. This was a primary rationale underlying our effort to develop a program typology and standardized definitions so that we could conduct a comparative analysis of energy efficiency program impacts and costs. However, even with the typology and definitions, there are two key data challenges.

First, we assume that all expenditure, savings and participation data reported by a program administrator are accurate. Given our time and resources, this is a reasonable starting assumption; however, it should be noted that the range of effort placed into documenting impacts by program administrators varies significantly among states (SEE Action 2012).

Second, in reviewing information on efficiency programs funded by U.S. utility customers, we found that program data are often not defined and reported consistently among states. Specifically, we identified three key concerns in compiling and analyzing program information on a regional or national basis, some of which are addressed by the common typology and standardized definitions:

1. ***Energy savings and program costs are not defined consistently.*** The most common discrepancies can be found in the definitions of net energy savings. Examples of other program data where differences are found across states include:
    - The term "annual energy savings" typically is understood as shorthand for annualized incremental energy savings, but some entities—including resource planners—apply a different meaning that includes savings resulting from prior years' activities.
    - The definition of measure lifetime, how a program's average measure lifetime is determined, and the estimated measure lifetime values for the same measures or program types varies among states.
    - Some program administrators report end-use site savings and others report savings at the power plant bus bar (for electricity efficiency programs).
    - Most program administrators do not count their own performance incentives among program costs, although some do. The definitions of other cost categories (e.g., marketing costs, general consumer education, and evaluation) also vary among states.
2. ***Program data are not reported consistently across states.*** For example, some states report just gross or net energy savings; others report both. Similarly, many efficiency annual reports only include first-year savings and not lifetime savings.[26] With respect to cost data, program administrators often classify costs differently among administration, marketing and outreach, incentives and participant costs. Some program administrators

[26] We found that only about a quarter of the program reports that were reviewed included information on measure lifetimes or lifetime savings, although this information is required to assess program cost effectiveness. See below, in the section on adjustments for missing data, for discussion of how measure lifetime variation creates uncertainty in the calculation of CSE.

also report certain costs (e.g., marketing, evaluation) at the portfolio or sector level, while others account for those costs at the program level.

3. ***Programs and sectors are not characterized in a standardized fashion.*** Programs targeting specific building types or consumers can be included under different sectors from state to state (e.g., multi-family residential structures are sometimes categorized as commercial programs). Moreover, the types of activities and measures that are included under the same program title (e.g., custom vs. combination custom/prescriptive programs) also vary.

We suggest that readers consider these above issues when utilizing the information in this report for their own uses and understanding of the cost of saved energy.

2.4 Calculating and Using the Cost of Saved Energy

The program administrator's CSE is a useful metric for comparing the relative costs of efficiency programs and for comparing an energy efficiency option to other demand and supply choices for serving electricity and natural gas needs[27]. However, the cost of saved energy is not a test of cost effectiveness (e.g., one of the screening tests used by program administrators) because: (1) it does not capture the full benefits to utility customers and shareholders (e.g., avoided generation capacity, avoided transmission and distribution investments, avoided environmental compliance costs); (2) benefits are not monetized but reflected simply in energy units of kilowatt hours or therms, the cost of which will vary by utility; and (3) energy is saved at the end use, not the power plant.[28]

In this report, we use gross energy savings (rather than net savings) in the CSE calculations primarily because of data availability and comparability reasons: (1) more administrators reported gross savings than net; and (2) net savings are defined relatively inconsistently, as compared to gross savings, among program administrators and states.
We also report savings at the end-user level (and not at the busbar or power plant source), because this is what most program administrators report. It is important to note that savings from electricity efficiency programs reported at the busbar would be higher than at the end-use level because we are accounting for distribution and transmission losses (losses also occur in the natural gas network as well).[29]

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[27] According to the Energy Information Administration, "levelized cost is often cited as a convenient summary measure of the overall competiveness of different generating technologies. It represents the per-kilowatt hour cost (in real dollars) of building and operating a generating plant over an assumed financial life and duty cycle. Key inputs… include overnight capital costs, fuel costs, fixed and variable operations and maintenance (O&M) costs, financing costs, and an assumed utilization rate for each plant type.
http://www.eia.gov/forecasts/aeo/electricity_generation.cfm

[28] The equation also is inverted, with costs in the numerator and benefits (in energy units) in the denominator—the reverse of the benefit/cost ratios that are a key determinant of cost effectiveness.

[29] This is an important consideration if the CSE values were to be compared with costs of electricity generation resources, which typically are indicated as busbar values.

We calculate the cost of saved energy (CSE) metrics in three ways: (1) a cost of lifetime saved energy; (2) a levelized cost of energy savings using two discount rates (3% and 6% real); and (3) a cost of first-year energy savings. See Table 2-3 for definitions of these CSE metrics and their common uses.

Table 2-3. Program administrator cost of saved energy metrics: definitions and potential uses

Program Administrator Cost Metric	Shortened Term	What is Measured	Potential Uses
Cost of Lifetime Energy Savings	Lifetime CSE	The cost of acquiring energy savings that accrues over the economic lifetime of the actions taken through a program/sector/portfolio. Calculated by dividing program administrators' costs by the gross savings.	• Used by program administrators for designing programs and portfolios, e.g., for depth of savings and cost effectiveness • Used by planners and other stakeholders to project efficiency as a resource, develop load forecasts, etc.
Levelized Cost of Energy Savings	Levelized CSE	The cost of acquiring energy savings that accrue over the economic lifetime of the actions taken through a program/sector/portfolio, amortized over that lifetime and discounted back to the year in which the costs are paid and the actions are taken	• Same uses as lifetime savings • Useful to program administrators, regulators and other stakeholders who want to compare particular demand-side options with other demand, and supply-side, resources
Cost of First-Year Energy Savings	First-Year CSE	The cost of acquiring a single year of annualized incremental energy savings through actions taken through a program/sector/portfolio. Calculated by dividing the program administrators' costs by the first year incremental savings.	• Useful for program administrators in program design

The cost of saved energy can be useful to various stakeholders. For example, state regulators can use both first-year and lifetime CSE values as quick metrics for assessing whether a program or portfolio looks like a reasonable expenditure of utility customer funds. A program administrator that is considering offering a comprehensive residential energy upgrade program may want to compare that program's estimated per-unit cost performance against average costs and the range of costs for similar programs. Based on the comparison, the program administrator may want to look at the design of comparable programs for potential cost efficiencies. Regulators and resource planners can use the levelized CSE in the initial screening analysis of various supply- and demand-side resources. Resource planners also can use the lifetime CSE to convert approved budgets for demand-side management plans into energy savings estimates that then can be used in scenario or sensitivity analysis of future load forecasts.

Finally, based on the limited participant cost data reported by program administrators, we calculate a total resource CSE for illustrative purposes in Chapter 3. This calculation presents the net total costs, including both program and participant costs, for the efficiency resource. A levelized total resource CSE might also be useful to program administrators, regulators and other stakeholders who want to compare particular demand-side options with other demand and supply-side resources.

2.4.1 Levelized Cost of Saved Energy

The lifetime cost of energy savings metric is a simple, straight-forward calculation although it ignores changes in the value of money between an initial investment and future energy savings. Meier (1982) included the time value of money (discount rate) to calculate the "cost of conserved energy" (CCE) or what we are calling the "levelized cost of saved energy". Meier found that inclusion of the discount rate raises the CCE because of discounting future benefits, yet provides a basis for comparing the CCE for measures that have different lifetimes and can be compared to retail rates and levelized costs of supply-side resources.[30] A similar accounting framework, the levelized cost of energy (LCOE), often is applied to assessing the economic competitiveness of diverse generation sources (U.S. Energy Information Administration 2013).

We calculated a levelized CSE using two discount rates[31] that are rough proxies for different perspectives on energy efficiency investments: a 6% real discount rate that can reflect the utility weighted average cost of capital (WACC) at present and a 3% real discount rate that can be a proxy for a societal perspective. The levelized CSE calculation is as follows:

$$\begin{aligned} &Levelized\ CSE\ (in\ \$/unit\ energy, e.g., kWh, therm, Btu) \\ &\qquad = (C\ x\ (Capital\ Recovery\ Factor))/(D) \end{aligned}$$

$$Capital\ Recovery\ Factor\ =\ [A * (1 + A)\string^B]/[(1 + A)\string^B - 1]$$

Where:

A = Discount rate

[30] See Appendix A for further discussion of the history of efficiency CSE analyses

[31] Discount Rate: An interest rate applied to a stream of future costs and/or monetized benefits to convert those values to a common period, typically the current or near-term year, to measure and reflect the time value of money. It is used in benefit-cost analysis to determine the economic merits of proceeding with a proposed project, and in cost-effectiveness analysis to compare the value of projects. The discount rate for any analysis is either a nominal or a real discount rate. A nominal discount rate is used in analytic situations when the values are in then-current or nominal dollars (reflecting anticipated inflation rates). A real discount rate is used when the future values are in constant dollars and can be approximated by subtracting expected inflation from a nominal discount rate (SEE Action Network 2012).

B = Estimated program measure life in years

C = Total program cost in 2012$

D =Annual kWh saved that year by the energy efficiency program

This formula is the classic definition of a compound interest calculation used to calculate equivalent annual net disbursements.

The discount rate can have a significant impact on the calculated CSE. For example, for a program with an average measure lifetime of 20 years, a discount rate of 6% will indicate a levelized CSE that is about 30% higher than the same program if a discount rate of 3% were used. See Appendix D for further discussion of the factors considered in choosing these two illustrative interest rates.

2.5 Treatment and Adjustments for Missing Data

In calculating CSE for efficiency programs, we encountered several data completeness issues that needed to be resolved:

- Many programs' data included neither program measure lifetime nor gross lifetime savings. This information is necessary to calculate lifetime and levelized CSE;
- Some combined gas and electric program administrators reported separate savings for their electric and gas programs but did not separate their electric and gas program costs; and,
- Most program administrators reported end-use energy efficiency savings while others reported savings at the source of the electricity (generation or busbar savings). Natural gas savings are usually considered the same at the end-use site and at points along the gas distribution, although there is the potential for per unit losses from the natural gas source to the end user.

In addition, for the few program administrators that reported only net savings, we calculated gross savings by dividing reported net savings by a net-to-gross ratio[32] when this ratio was provided in related references for the subject programs.[33] Furthermore, some program reports provided no cost data and others provided no savings data; these programs were excluded from the CSE analysis. These adjustments resulted in program data from 100 program administrators in the database being utilized in calculating CSE values in this study.[34]

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[32] The net-to-gross ratio is the net program impact (energy savings) divided by the gross program impact.

[33] In Massachusetts and New York, program administrators reported net savings and did not provide net-to-gross ratios in their annual efficiency reports. In these cases, we applied net-to-gross ratios reported in the 2011 REED database and applied the program level ratios to the previous two years included in this analysis (2009-2010). New Hampshire program administrators reported net lifetime savings for 2009-2010. We were not able to generate a gross lifetime or annual incremental savings values needed to calculate the CSE and therefore those years were dropped from the analysis.

[34] Data from 100 of the 107 program administrators whose data are in the LBNL DSM Program Impacts Database are included in this Chapter. The seven program administrators that were excluded represent about eight percent of the total costs for programs in the Database. Three program administrators are excluded because their combined gas and electric program costs could not be separated out by fuel type, three program administrators were excluded because they did not report expenditures at the program level, and one program administrator was excluded because it reported net savings in a manner that did not allow determination of gross savings. Two years of program data

2.5.1 Program Average Measure Lifetime

The CSE calculation takes into account the costs incurred to implement the measures, which in the database all occur during the program year,[35] and the savings that occur over the lifetime of the implemented measures. However, program administrators reported lifetime savings for only about 44% of the programs years in the collected annual reports (see Appendix C).[36] Another way to calculate the lifetime savings is to multiply the first-year savings by the program average measure lifetime (program lifetime)[37], which we interpret as the lifetimes of the various measures installed through a program weighted by their respective savings.

However, even fewer program administrators reported any form of a program lifetime—about 26% of electric and 30% of gas programs for the 2009–2011 period (see Appendix C). For the programs that did report a lifetime value, program average measure lifetimes varied widely within many of the detailed program categories.[38] For example, the median program lifetime for residential new construction programs is 18 years, with a program life of 14 and 25 years at the 25th and 75th percentile for programs in the database. Figure 2-3 shows the range, inter-quartile range, and median program lifetime values reported for a selected sample of detailed program categories.

Given the limited availability of lifetime savings and program lifetime values, we developed the following set of decision rules, or protocol, for defining lifetime savings for each program in the database:

1. When available, use the program lifetime savings reported for the program by the program administrator;
2. When program administrator did not report program lifetime savings, but did report program average lifetime value, we multiplied this value by the reported first-year savings to calculate the program's lifetime savings;[39]

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from three other program administrators were not used in the CSE analysis because these program administrators reported net savings in a manner that did not allow determination of gross savings; however, the third year of data for those three program administrators was used.

[35] Some project installations may be completed after the end of the program year but are accrued to the program year in which the project was initiated (e.g., customer has signed up, equipment installation has been scheduled, equipment installation has begun but not been completed). Some energy efficiency actions also may require ongoing, incremental operations and maintenance expenditures (compared to the baseline equipment), which are not considered in this study, which is consistent with most energy efficiency program assessments.

[36] There are more than 4,000 program years in the database, where we count each program in each year of implementation separately.

[37] Measure lifetime, also called effective useful life (EUL), is based on the lifetime of equipment installed or measures implemented and measure persistence (as opposed to savings persistence). In many energy efficiency programs, the estimated EUL takes into account both the expected remaining life of the measure being replaced and the expected changes in operational baselines over time (Mass Save 2011, SEE Action 2012).

[38] A number of factors may contribute to the variation in reported measure lifetimes including the unique mix of measures implemented for a program (particularly for programs that contain a wide range of longer- and shorter-lived measures) and different assumptions and/or methodologies used to determine measure lifetime used by program administrators.

[39] Some program administrators document the average measure lifetime for programs that installed a mix of measures. The most common approach used by program administrators is to weight the program average measure lifetime by respective measure savings. We applied this approach for all of the reported program measure lifetimes.

3. For programs where we did not have lifetime savings or measure lifetime data, we calculated a program average measure lifetime for similar programs in the database and used that imputed value along with the program's first-year savings to calculate program lifetime savings.[40]

For program categories that contained a broad unspecified mix of activities or too few data points to calculate a national program average measure lifetime values, we reviewed technical reference manual lifetime values for specific measures to generate a "national program average measure lifetime" value for that program.[41] Given the wide variation in reported measure lifetimes, our method of calculating a national program average measure lifetime and applying it to programs for which that data are not available introduces uncertainty into the final CSE calculation, particularly for program categories that contain mixes of measures with wide-ranging measure lifetimes. In Chapter 3, we include results of a sensitivity analysis that illustrates the impact of varying measure lifetime assumptions on CSE calculations.

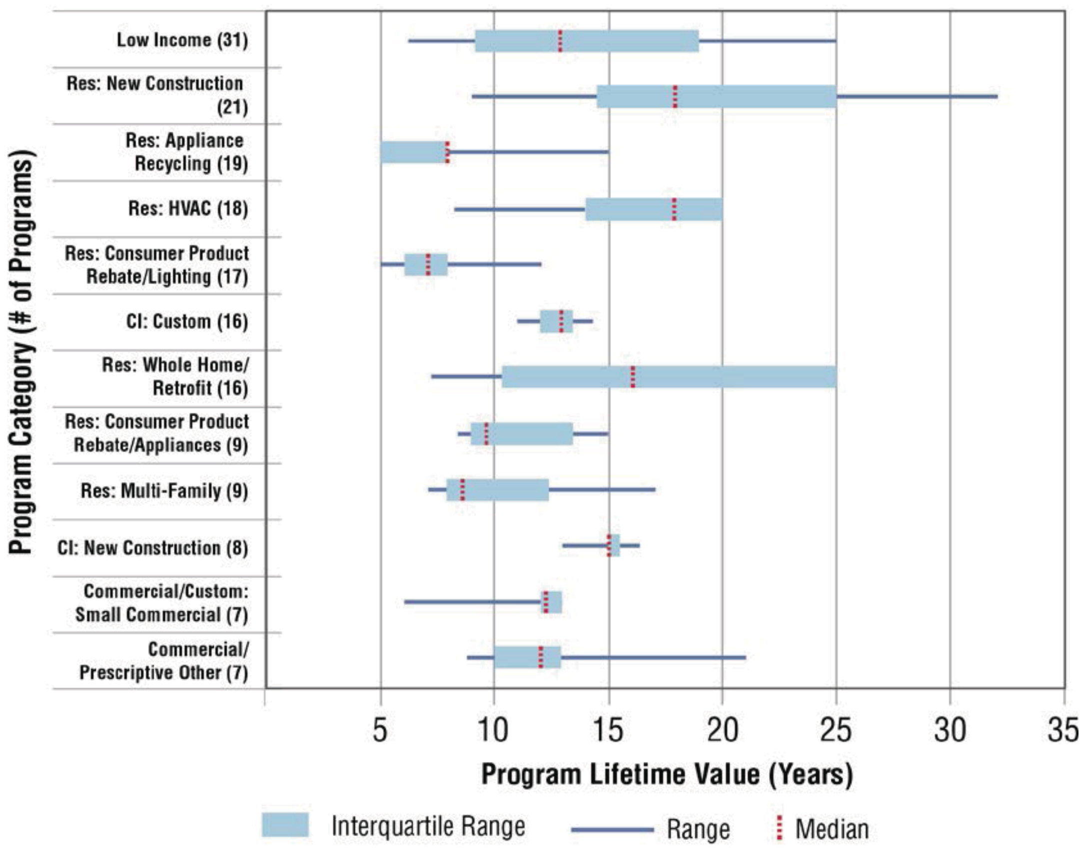

Figure 2-3. Range of reported program average measure lifetime values for select detailed program categories

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The authors' experience indicates that the way in which measure lifetimes are defined, determined and reported are not consistent among program administrators.

[40] We calculated a national program average measure lifetime as follows: divide reported lifetime savings by first-year savings values for each program in the database that reported this information in order to generate a national (un-weighted) program average measure lifetime by program type.

[41] See Table C-3 in Appendix C for the national program average measure lifetime values calculated for each of the detailed program categories.

2.5.2 Cost Data for Combined-Fuel Programs

Some program administrators of combined-fuel programs reported separate electric and gas savings values but did not report separate costs for electric and gas programs or measures. For those program administrators where we could not reliably calculate the per-kWh and per-therm CSE from the reported data, we obtained additional information that enabled us to calculate reasonable estimates of the disaggregated electric and gas expenditures for the following combined fuel utility cases:

- The California combined-fuel utilities did not provide separate electric and gas cost data. However, one of the utilities provided program-level data on the net monetized benefits of the programs, allocated by fuel. We were then able to estimate that utility's combined electric and gas program costs by fuel (electricity and natural gas) based on the program's share of savings allocated to each fuel.
- A New England combined-fuel utility that had not reported separate gas and electric cost data later provided estimates of the ratio of gas and electric costs which were applied to that utility's data.

Other program data from program administrators for which we could not disaggregate electric and gas program costs were included in the overview of program spending and savings presented at the beginning of Chapter 2, but excluded from the dataset used to calculate CSE.[42]

2.5.3 End-Use versus Source and Busbar Energy Savings

Most state program administrators reported end-use energy efficiency savings; however, there were a few program administrators that reported both end-use and busbar, and a handful that only reported busbar savings. For the purposes of this report, we followed the following decision rules:

- Where program administrators reported both end-use and busbar savings, we used end-use savings;
- Where program administrators are not clear, or do not explicitly state that the savings is end-use, we treat the savings values as end-use savings;

  Where program administrators only reported a busbar savings value, we identified a line loss estimate and calculated that end-use savings.[43]

[42] Wisconsin's single statewide program administrator was included in the program spending and savings overview but excluded from the CSE results because the program administrator did not provide disaggregated electric and gas program expenditures data.
[43] For a discussion on line losses, please see: http://www.raponline.org/ document/download/id/4537

3. Results—Utility Customer-Funded Programs: Costs and Savings

In this chapter, we first present a national overview of electric and gas energy end-use efficiency program administrator expenditures and savings, including summaries by market sector and region for the programs in the LBNL DSM Program Impacts Database (database). We then present ranges of program administrator cost of saved energy (CSE) values, mostly for electricity efficiency programs (as they represent about 80% of program expenditures), on a national, regional, and state basis. Some CSE values are presented at the sector and program level as well. We also include sensitivity analyses on the impact of assumed measure lifetimes on the CSE (one of the data issues raised in Chapter 2). Finally, we present CSE results for those programs where program administrators reported program administrator costs and participant costs (what some refer to as the total resource cost).

Attributes of Information Reported in this Chapter

Costs refer to **program administrator costs** only; the CSE values exclude participant costs unless specifically indicated otherwise.

Savings are based on **gross savings** reported by the program administrator unless specifically indicated otherwise. For program administrators that only reported net savings values, we calculated gross savings values using net-to-gross ratios. Savings values are also based on **savings at the end-use site** and not at the power plant or natural gas pumping station and thus do not account for transmission and distribution losses. See Chapter 2 for more detailed explanation.

Lifetime energy savings, when not reported by the program administrator (which was the case for about 50% of the programs), were calculated per the protocol described in Chapter 2.

The results presented in this chapter represent a significant portion of the efficiency programs funded by customers of U.S. investor-owned utilities during 2009, 2010, and 2011. However, when using the information, the reader should recognize that they are not necessarily a representative sample, particularly for some regions of the country where annual reporting is not prevalent.

3.1 Energy Efficiency Program Administrator Expenditures and Savings

3.1.1 Electric Programs

Program administrator expenditures for identifiable electricity efficiency programs[44] in the database, for the years 2009–2011, totaled just under $5.3 billion (in 2012$) with commercial/industrial programs (C&I) programs representing about 60% of expenditures and residential programs comprising about 30% of the expenditures (see Table 3-1).

In terms of how electricity savings vary by sector for the programs in the database, the answer depends on whether first year or lifetime savings are considered (see Figure 3-1). The savings accruing from C&I sector programs accounted for 53% of the aggregate first-year savings and 62% of the aggregate lifetime savings. Residential programs' share of first-year savings was higher than their share of expenditures; residential programs made up 29% of expenditures but garnered 40% of first-year savings and 31% of lifetime savings. On the other hand, low-income programs represent 6% of the total expenditures and 2% of first-year and lifetime savings.

[44] Eighty-eight program administrators reported electric program data.

Table 3-1. Program administrator expenditures for 2009–2011 electricity efficiency programs

Market Sector	Share of Total Program Administrator Expenditures	Total Program Administrator Expenditures (million 2012$)
C&I	61%	$3,214
Residential	29%	$1,515
Low Income	6%	$332
Cross Sector/Other	4%	$213
TOTAL	**100%**	**$5,274**

We also examined residential expenditure and savings data by simplified program type and found that consumer product rebate programs,[45] prescriptive rebate programs[46] and whole home programs[47] were the top three contributors to expenditures and lifetime electricity savings in the LBNL DSM Program Impacts Database. Combined, these three programs represented 84% of total expenditures and 90% of the lifetime savings for residential programs in our database (see Figure 3-2).

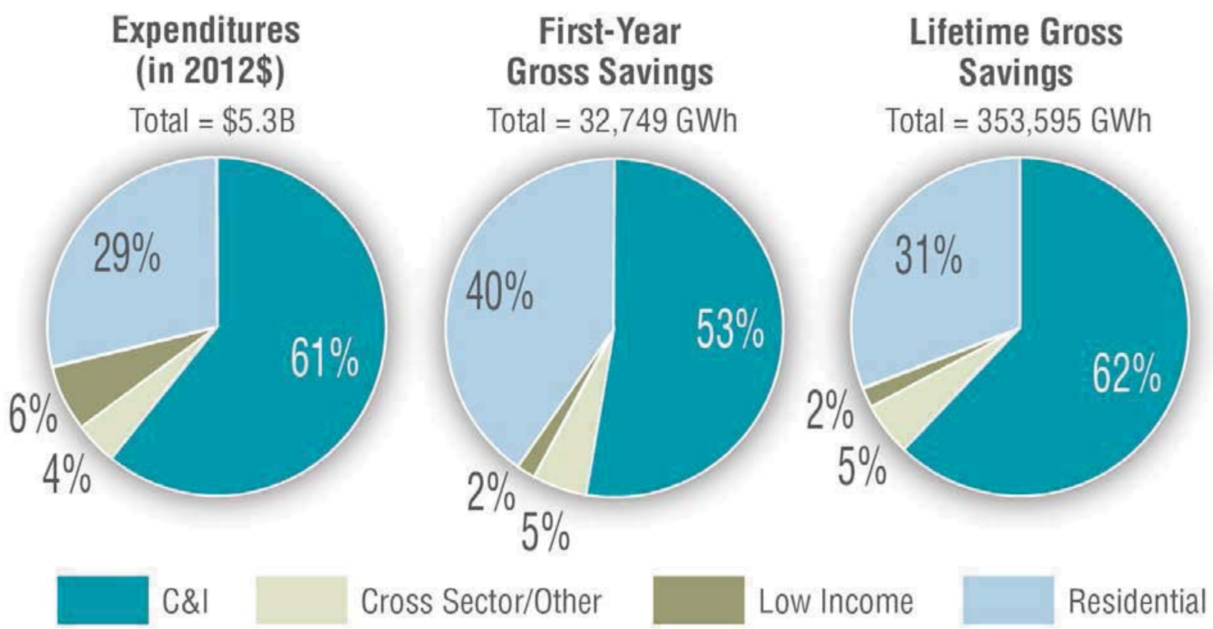

Figure 3-1. Program administrator expenditures, first year and lifetime gross savings for 2009–2011 electricity efficiency programs

[45] Programs that encourage use of more efficiency products such as appliances, electronics, lighting products, etc.
[46] Programs that provide pre-defined incentives for installation of cost efficient products such as insulation, windows, water heaters, etc.
[47] Programs that offer direct install services, audits or incentives for comprehensive packages of efficient products.

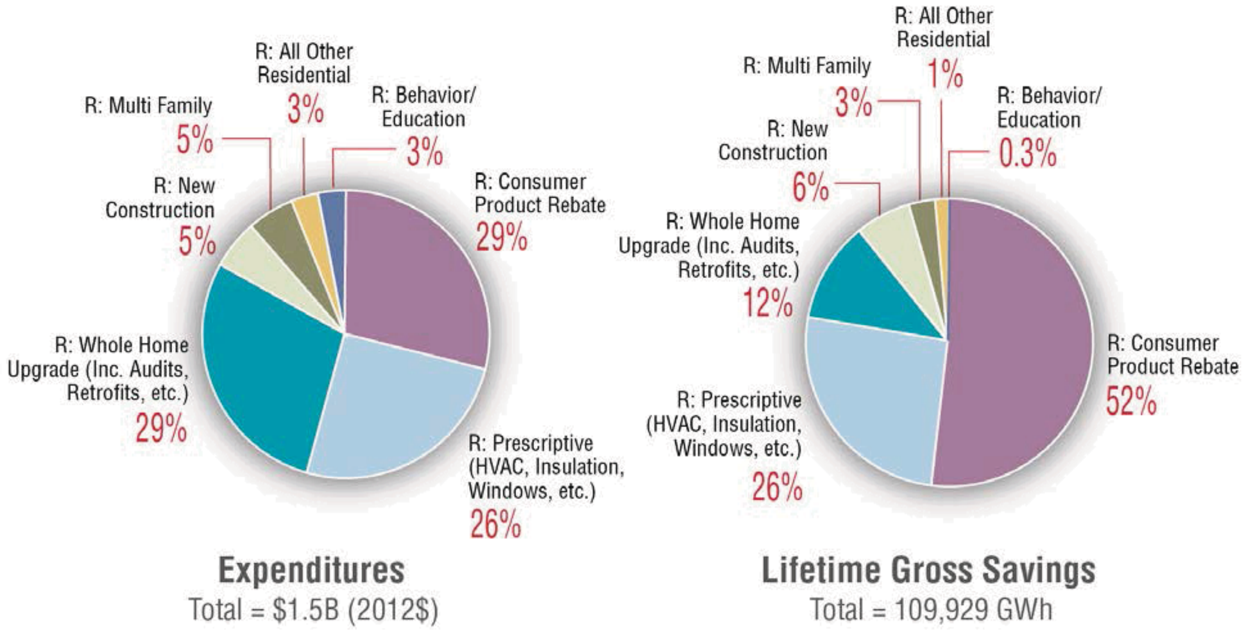

Figure 3-2. Program administrator expenditures and lifetime gross savings by simplified program category for 2009–2011 residential electricity efficiency programs

Other observations from the database's residential electricity program data, as shown in Figure 3-2, are:

- Consumer Product Rebates accounted for about 29% of total residential program expenditures, but over half of the lifetime savings;
- Residential Prescriptive programs accounted for similar percentages of expenditures and lifetime savings, both 26%;
- Whole Home Upgrade programs represented about 29% of aggregated expenditures and12% of the lifetime electricity savings;
- New Construction programs accounted for 5% of residential program expenditures and 6% of the sector's lifetime savings,
- Multifamily programs accounted for 5% of expenditures and 3% of lifetime savings, and
- Behavior and Education programs make up 3% of expenditures but less than 1% of lifetime savings.

To illustrate the power of a program-level database, we analyzed the four detailed program types that are included in the residential Consumer Product Rebate program category that covers 52% of the residential lifetime electricity savings (see Figure 3-3). This analysis indicated that lighting rebate programs accounted for over 80% of all gross electricity savings attributed to the consumer product rebates in the program administrator program reports we compiled. This means that lighting rebates represent at least 44% of total residential lifetime savings.[48] Appliance Recycling programs (which we also included in the product rebate category)

[48] We indicate at least 44% because other program types also can, and often do, include lighting related products.

accounted for 6% and appliance rebates made up 2% respectively of all residential sector lifetime gross savings. Consumer Electronics programs, the fourth detailed program type in the consumer product rebate category, garnered less than 1% of residential sector savings.

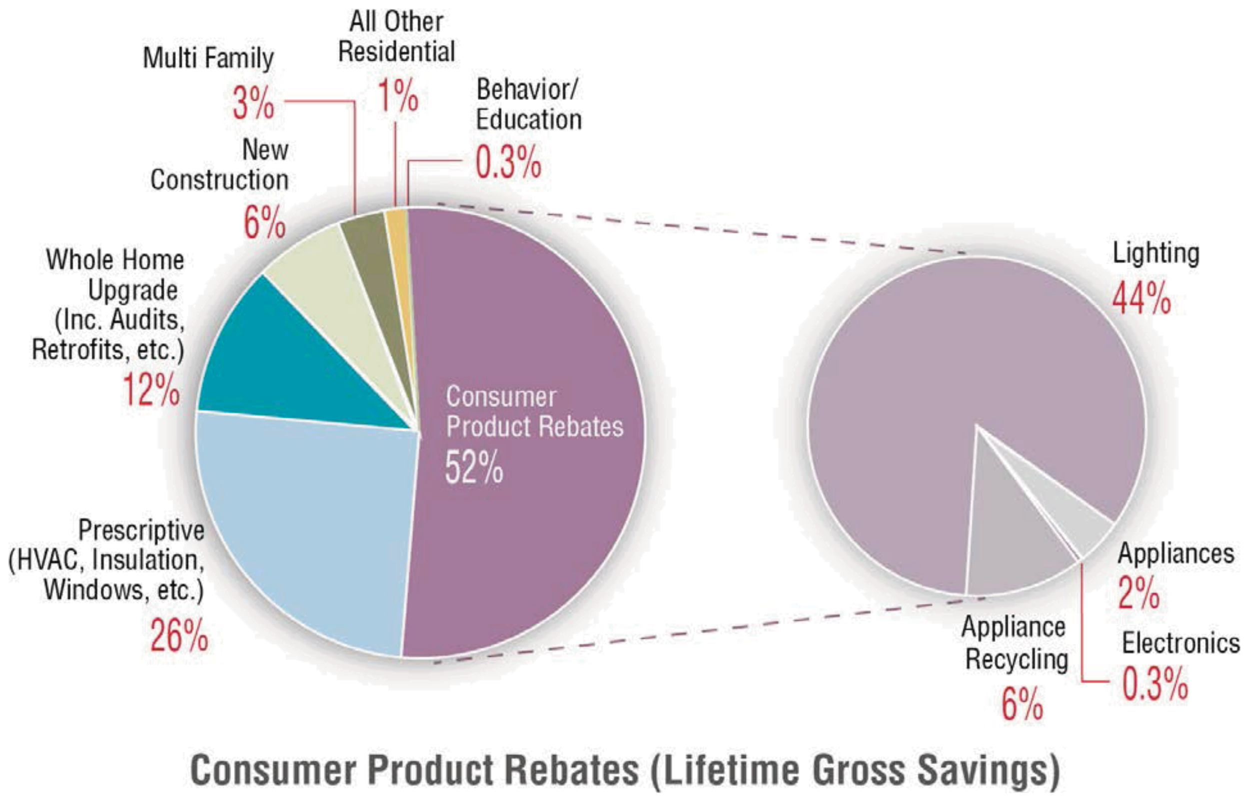

Figure 3-3. Lifetime gross electricity savings for 2009-2011 residential consumer product rebate programs

We also analyzed C&I sector expenditure and savings data by simplified program type (see Figure 3-4) and found the following:

- At 36%, custom programs represented the largest share of all C&I expenditures as well as the largest share of all C&I total lifetime savings at 38%.
- Prescriptive and small commercial programs accounted for comparable shares of C&I expenditures at about 21% each; although reported lifetime savings were much greater for prescriptive programs (30% of all savings) compared to small commercial programs (11% of all C&I savings).
- Commercial new construction programs accounted for 12% of C&I expenditures and 10% of the sector's savings.
- Programs specifically targeting the institutional market (municipal and state governments, universities, colleges, K-12 schools and hospital/healthcare facilities, also collectively known as the MUSH market) made up 7% of total C&I program expenditures and 4% of the savings, although it should be noted that institutional sector customers can and do participate in many other types of C&I programs as well.

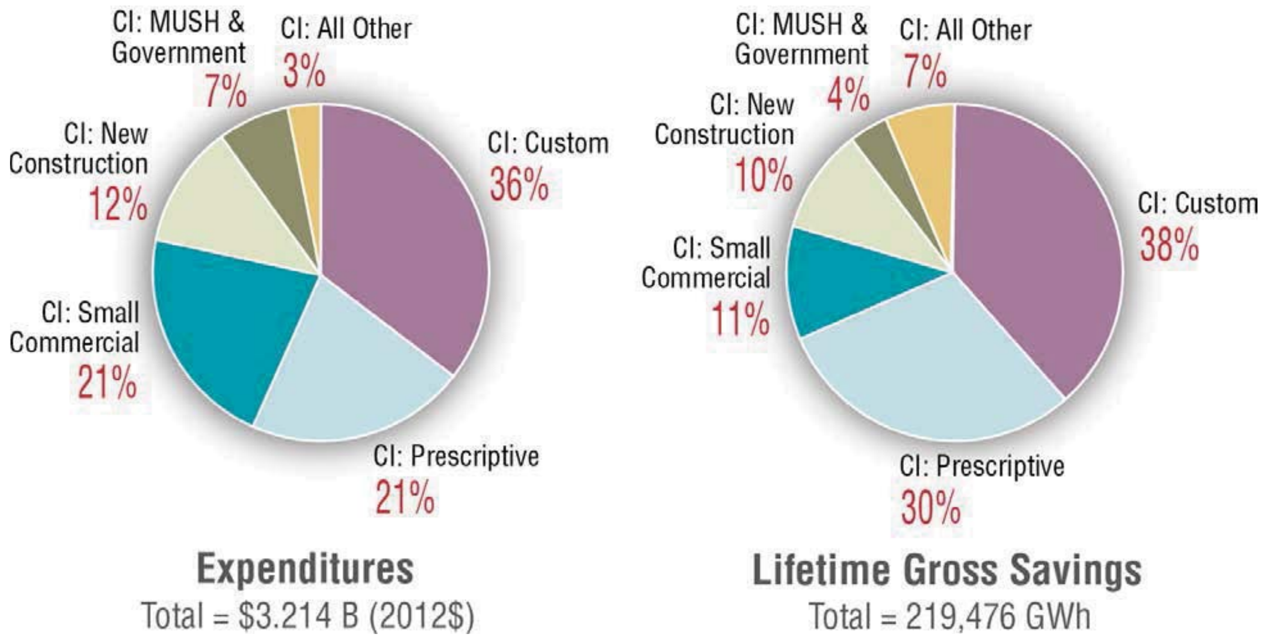

Figure 3-4. Program administrator expenditures and gross lifetime savings for 2009-2011 commercial and industrial electricity efficiency programs

We also created a region data field and coded efficiency program data provided by program administrators into the appropriate region, using U.S. Census region definitions (see Table 3-2). As can be seen from Table 3-2, we have a limited number of states (four) with program-level data from the South region as well as a relatively limited number of efficiency programs in total from southern states in the database.

Table 3-2. U.S. Census Regions and states in the LBNL DSM Program Impacts Database[49]

Region	States in the LBNL DSM Program Impacts Database
Midwest	MI, MN, IL, IA, OH, WI, IN
Northeast	PA, VT, CT, ME, NH, NY, RI, NJ, MA
South	MD, NC, FL, TX
West	CA, WA, MT, ID, OR, HI, CO, NV, UT, AZ, NM

For the programs in the database, program administrator costs for electricity programs were highest for the West at $2.0 billion, followed closely by the Northeast at just over $1.9 billion.

[49] U.S. Region Definitions may be found at: http://www.census.gov/econ/census07/www/geography/regions_and_divisions.html

Program administrator expenditures totaled just under $1 billion in the Midwest and about $505 million in the South (see Figure 3-5).

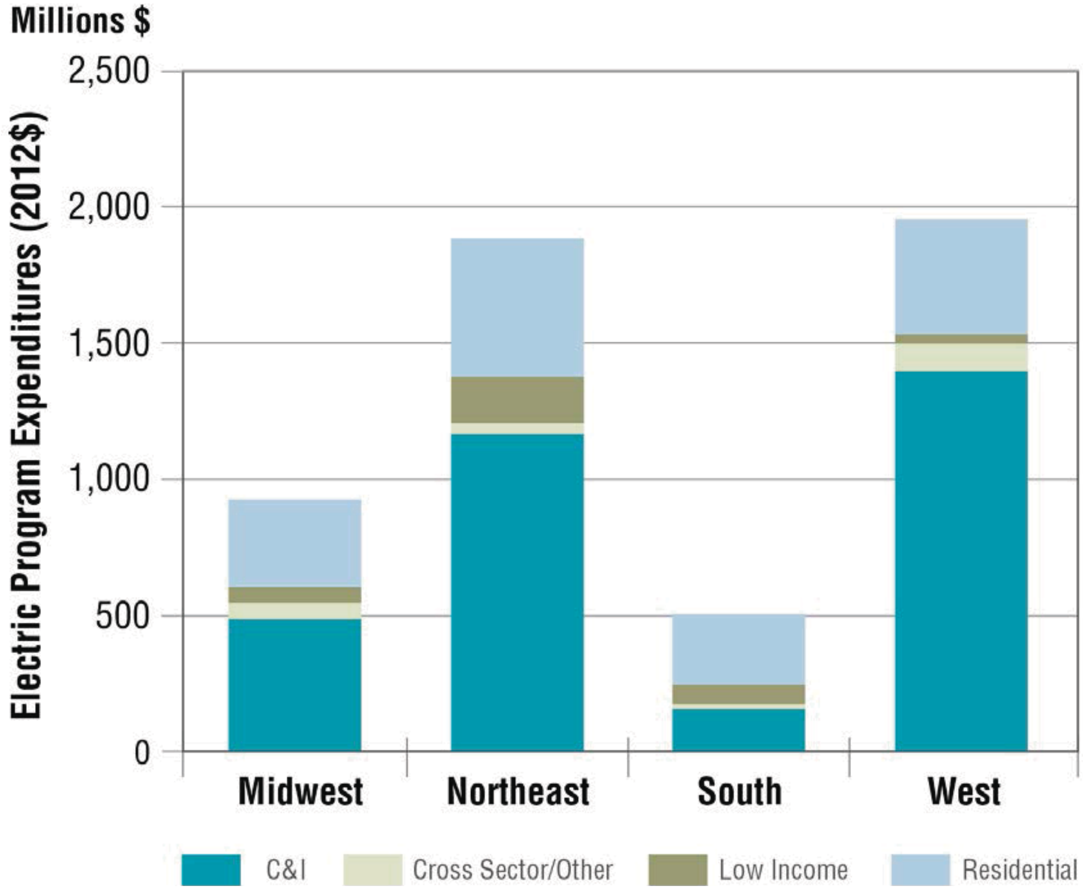

Figure 3-5. Program administrator expenditures by region for 2009-2011 electricity efficiency programs

The regional breakdown of lifetime savings for programs in the database looks much different compared to expenditures (see Figure 3-6). Program administrators in the Midwest reported about 20% more lifetime electricity savings than program administrators in the Northeast and about 75% of the savings for program administrators in the West, although expenditures in the Midwest were less than half of those in the West or Northeast.

As can be seen from Figure 3-5 and Figure 3-6, savings reported by program administrators come predominantly from the C&I sector, except for the South where residential and C&I program savings are more balanced. In the Midwest, C&I programs accounted for a little more than half of the region's total expenditures, but C&I programs accounted for nearly 70% of the savings. In the West, the expenditure and savings proportions were more comparable; C&I programs accounted for about 60% of total expenditures and about 65% of the savings, while 27% of expenditures and 21% of savings occurred in the residential sector. Low-income program expenditures were significantly higher in the Northeast than in the other regions.

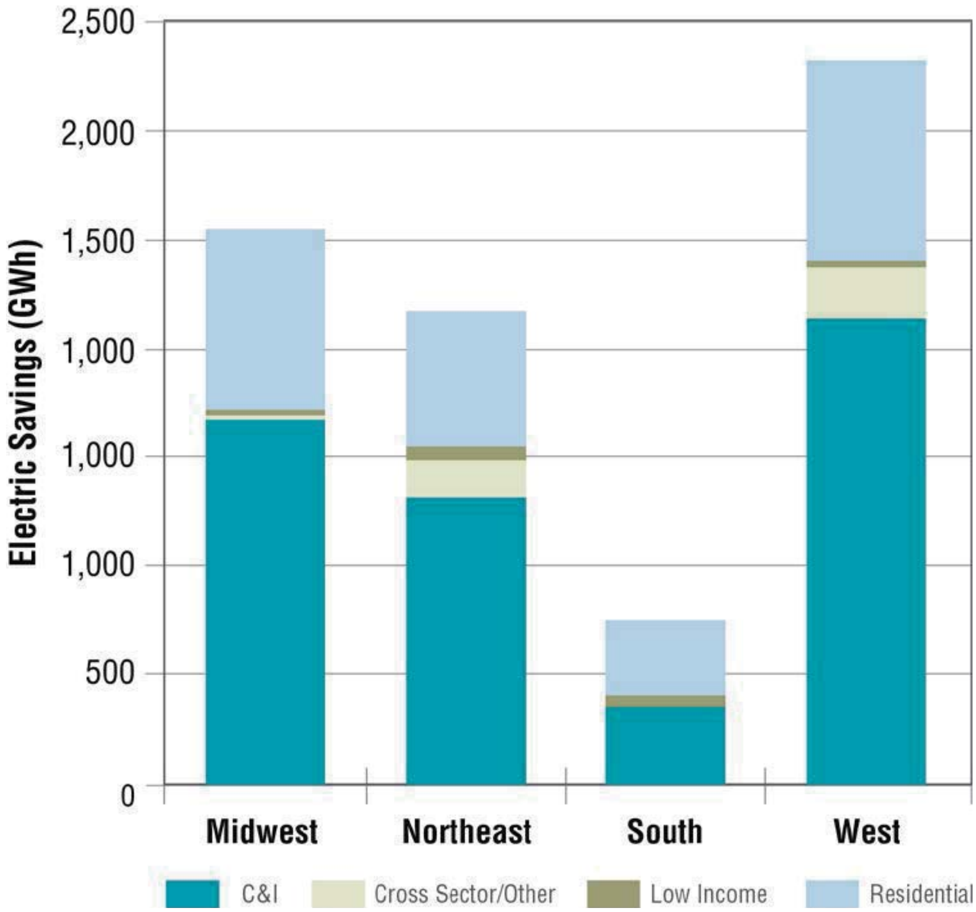

Figure 3-6. Program administrator lifetime savings by region for 2009-2011 electricity efficiency

3.1.2 Gas Program Expenditures and Savings

Program administrator expenditures for identifiable natural gas programs[50] in the LBNL DSM Program Impacts database for the years 2009–2011 totaled just under $1.3 billion, about 20% of program administrator expenditures for electric programs (see Table 3-3). Residential programs accounted for about 60% of aggregated gas program expenditures, while C&I programs accounted for about a quarter of total program expenditures, which is the converse of spending breakdown in electric efficiency programs (i.e., C&I programs account for 60% and residential programs about 30% of total spending).

[50] Fifty program administrators reported natural gas program data.

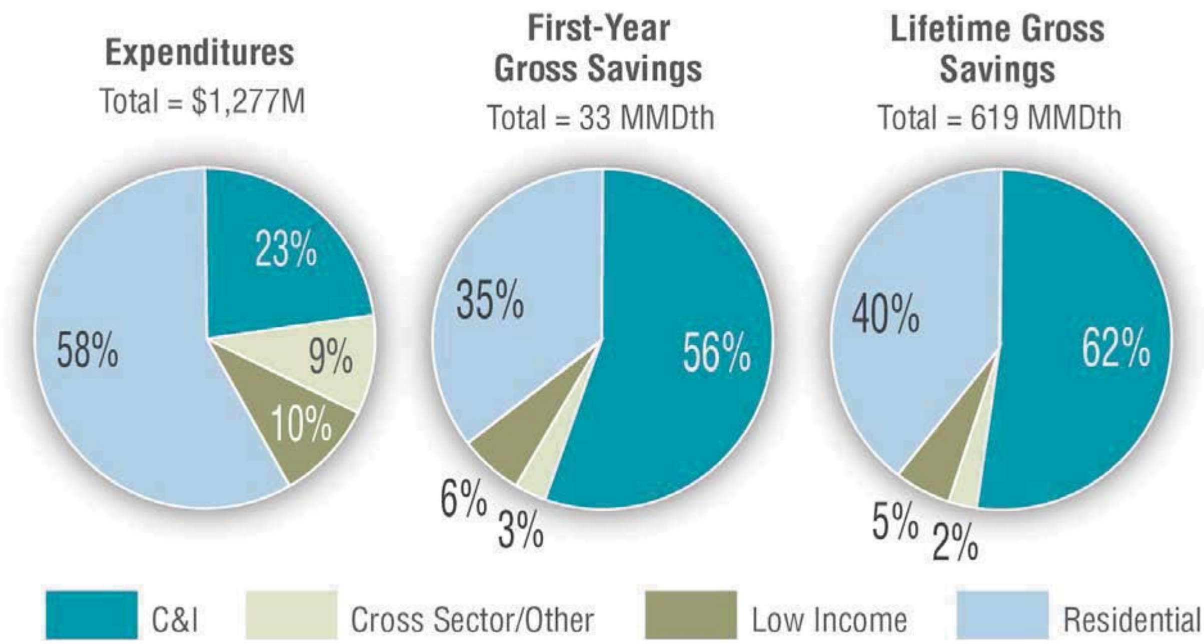

Figure 3-7. Program administrator expenditures, first- year and lifetime gross savings for 2009–2011 natural gas efficiency programs

As with the residential sector programs, we compared the share of total program administrator expenditures with the share of first-year and lifetime savings for each market sector (see Figure 3-7). Expenditures for the C&I sector accounted for about a quarter of total gas program expenditures, yet C&I programs generated more than half of total gas program savings (56% of first-year savings and 62% of the lifetime gross savings), indicating the importance of this sector for natural gas energy efficiency.

Table 3-3. Program administrator expenditures for 2009-2011 natural gas efficiency programs

Market Sector	Share of Total Program Administrator Expenditures	Total Program Administrator Expenditures (million 2012$)
Residential	58%	$742
C&I	23%	$291
Low Income	10%	$123
Cross Sector/Other	9%	$121
TOTAL	**100%**	**$1,277**

On the other hand, while residential programs made up about 60% of total gas program expenditures, they garnered 35% of first-year savings and 40% of the total lifetime savings for all programs. Low income gas programs follow a similar pattern as low-income electricity efficiency programs, accounting for 10% of total expenditures and 6% of first-year and 5% lifetime savings.

3.2 Observations on the Cost of Saved Energy

3.2.1 National Observations

CSE values are presented as either (a) savings-weighted average values; (b) as an inter-quartile range with median[51] values; or (c) both.[52] The savings-weighted average CSE is calculated using all savings and expenditures at the level of analysis (e.g., region, sector, program category).[53] For example, the national savings-weighted average CSE for the residential sector includes all the residential program portfolio costs in the database (even for programs without reported savings) divided by all the savings reported for the residential sector; thus "weighting" the CSE of larger programs more than small programs. The inter-quartile range and median CSE values are based on calculations for each individual program; thus giving equal weighting to all programs irrespective of their relative size (either in terms of savings or costs). The inter-quartile range and median CSE values exclude programs where a CSE cannot be calculated.[54]

CSE values are reported using three different metrics: a cost of lifetime saved energy, a levelized cost of energy savings using two discount rates (3% and 6% real), and a cost of first-year energy savings (see Table 2-2 for definitions of these CSE metrics). Appendix E contains detailed national and regional levelized CSE values by sector, simplified program type and detailed program type; tables in Appendix E show the savings-weighted average CSE, the first quartile, the median, and the third quartile levelized CSE values and the total number of programs for each category.

Table 3-4 shows national saving-weighted average CSE values for the identifiable electricity efficiency programs[55] in the database. Figure 3-8 depicts the lifetime and levelized CSE values ($/kWh) by sector. The national CSE values for electricity efficiency programs rounds to approximately $0.02/kWh for the levelized CSE using both the 3% and 6% real discount rates and a lifetime CSE (without discounting) of $0.015/kWh.

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[51] The *inter-quartile range* is the middle 50 percent of the range of program CSE values. The *median* is the numerical value separating the higher half of a data sample from the lower half.

[52] The CSE values in this section are based on *program administrator costs* and *gross energy savings*. When used, the lifetime energy savings may be based on reported values or values derived from estimates of program average measure lifetime. See Chapter 2 for a discussion of the basis for using program administrator costs and gross savings, the protocol for calculating lifetime energy savings, and discussion of the limitations in the efficiency program data used to calculate CSE values.

[53] We have observed that program administrators are not consistent in how they report program support costs (i.e. administration, EM&V, marketing & education, etc.). Some program administrators reported those costs at the program level, others reported those costs at the sector or portfolio level, and several reported those costs as, effectively, separate programs. For the purposes of this report, costs associated with specific programs stay associated with those programs. Costs that occur at the portfolio or sector levels are included in the analysis as separate programs. This allows us to account for those costs at the sector and portfolio levels but may appear as though individual programs within the same category cost less than their counterparts who report costs at the program level.

[54] Some programs did not report savings (e.g., education/information programs) and others were not designed to achieve savings (i.e. programmatic support programs including EM&V, marketing). Where savings are not reported, it was not possible to calculate a CSE for that particular program.

[55] Eighty-eight program administrators reported electric program data.

Table 3-4. The program administrator CSE for electricity efficiency programs by sector: national savings-weighted averages

Sector	Levelized CSE (6% Discount) ($/kwh)	Levelized CSE (3% Discount) ($/kwh)	Lifetime CSE ($/kwh)	First Year CSE ($/kwh)
Commercial & Industrial (C&I)	$ 0.021	$ 0.018	$ 0.015	$ 0.188
Residential	$ 0.018	$ 0.016	$ 0.014	$ 0.116
Low Income	$ 0.070	$ 0.059	$ 0.049	$ 0.569
Cross Sectoral/Other	$ 0.017	$ 0.014	$ 0.012	$ 0.120
National CSE	**$ 0.021**	**$ 0.018**	**$ 0.015**	**$ 0.162**

Values in this table are based on the 2009-2011 data in the LBNL DSM Program Impacts Database. CSE values are for program administrator costs and based on gross savings. Values are savings-weighted average CSE calculated using all savings and expenditures at the level of analysis.

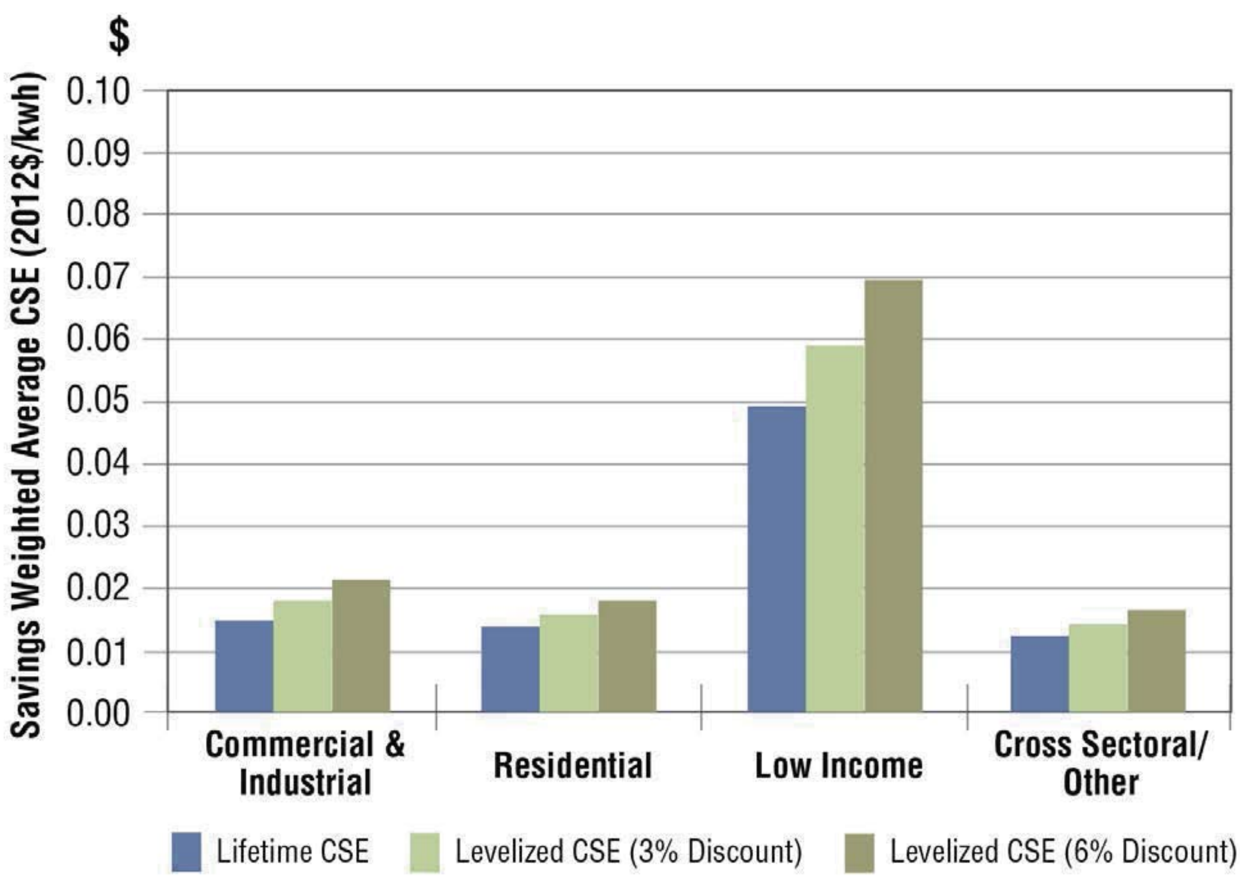

Figure 3-8. National savings-weighted average CSE for electricity efficiency programs by sector

Table 3-5 shows national saving-weighted average CSE values for the natural gas efficiency programs in the LBNL DSM Program Impacts Database. Figure 3-9 depicts the lifetime and levelized CSE values ($/therm) for gas efficiency programs by sector.[56,57] Gas efficiency programs targeted at C&I customers had a significantly lower CSE ($0.17/therm; 6% discount rate) than programs targeting residential ($0.56/therm) and low-income ($0.59/therm) customers, indicating the importance of the C&I sector for natural gas programs.

Table 3-5. The program administrator CSE for gas efficiency programs by sector: national savings-weighted averages ($/therm)

Sector (Natural Gas)	Levelized CSE (6% discount) ($/therm)	Levelized CSE (3% discount) ($/therm)	Lifetime CSE ($/therm)	First Year CSE ($/therm)
C&I	$ 0.17	$ 0.14	$ 0.11	$ 1.61
Residential	$ 0.56	$ 0.43	$ 0.32	$ 6.44
Low Income	$ 0.59	$ 0.47	$ 0.36	$ 6.26
Cross Sectoral/Other	$ 1.78	$ 1.55	$ 1.34	$ 12.37
National CSE	**$ 0.38**	**$ 0.31**	**$ 0.24**	**$ 3.93**

Values in this table are based on the 2009-2011 data in the LBNL DSM Program Impacts Database. CSE values are for program administrator costs and based on gross savings. Values are savings-weighted average CSE calculated using all savings and expenditures at the level of analysis.

[56] Fifty program administrators reported natural gas program data.
[57] There are a number of combined fuel programs that have reported interactive effects on natural gas. These impacts are not included in program level CSE calculations; however, they are included in portfolio and sector level calculations.

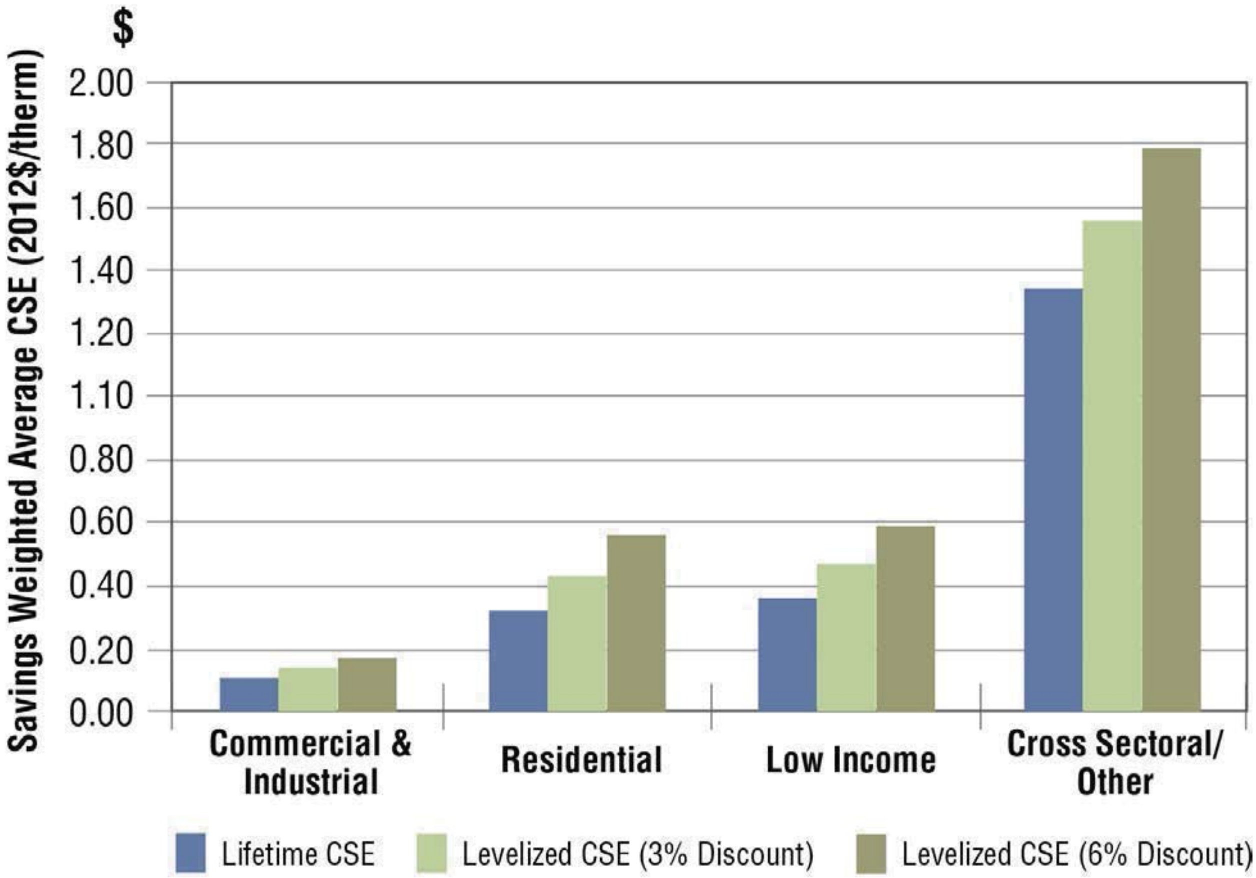

Figure 3-9. CSE for natural gas efficiency programs by sector

3.2.2 Sector and Program Level Observations for Electricity Efficiency Programs

We present CSE values at the sector and program level in this section. For simplicity, the remainder of this chapter presents CSE values using the levelized CSE for a 6% (real) discount rate (except where otherwise indicated).[58]

Figure 3-10 presents the levelized CSE results on a national basis, depicting the savings-weighted average, median and inter-quartile range for each sector. We found that both C&I and residential electricity efficiency programs included in our database had an average levelized CSE of about \$0.02/kWh. Looking at these sectors in more detail shows that the residential sector had a slightly lower weighted-average CSE than the commercial sector but a higher median CSE (~\$0.04/kWh). The CSE values for residential sector programs also had a larger inter-quartile range than commercial sector programs (e.g., inter-quartile range of CSE values ran from just

[58] We use a levelized CSE because we believe it is technically more appropriate for comparing resources. The 6% real discount rate is representative of a typical utility cost of capital. Lower discount rates result in lower CSE values. For example, for a program with an average measure life of 10 years for installed measures, a 6% discount rate results in a CSE that is about 15% higher than a 3% discount rate. There is significant interaction between discount rates and assumed measure lives. For example, the CSE value is 50% lower if we assume a 10 year measure life and 6% discount rate compared to a 20 year measure life and a 3% discount rate. See Appendix D for additional discussion of this issue.

under $0.02 to $0.09/kWh for residential programs vs. $0.015 to $0.05/kWh for commercial programs). We suspect that this is due to the very wide range of program types in the residential sector.

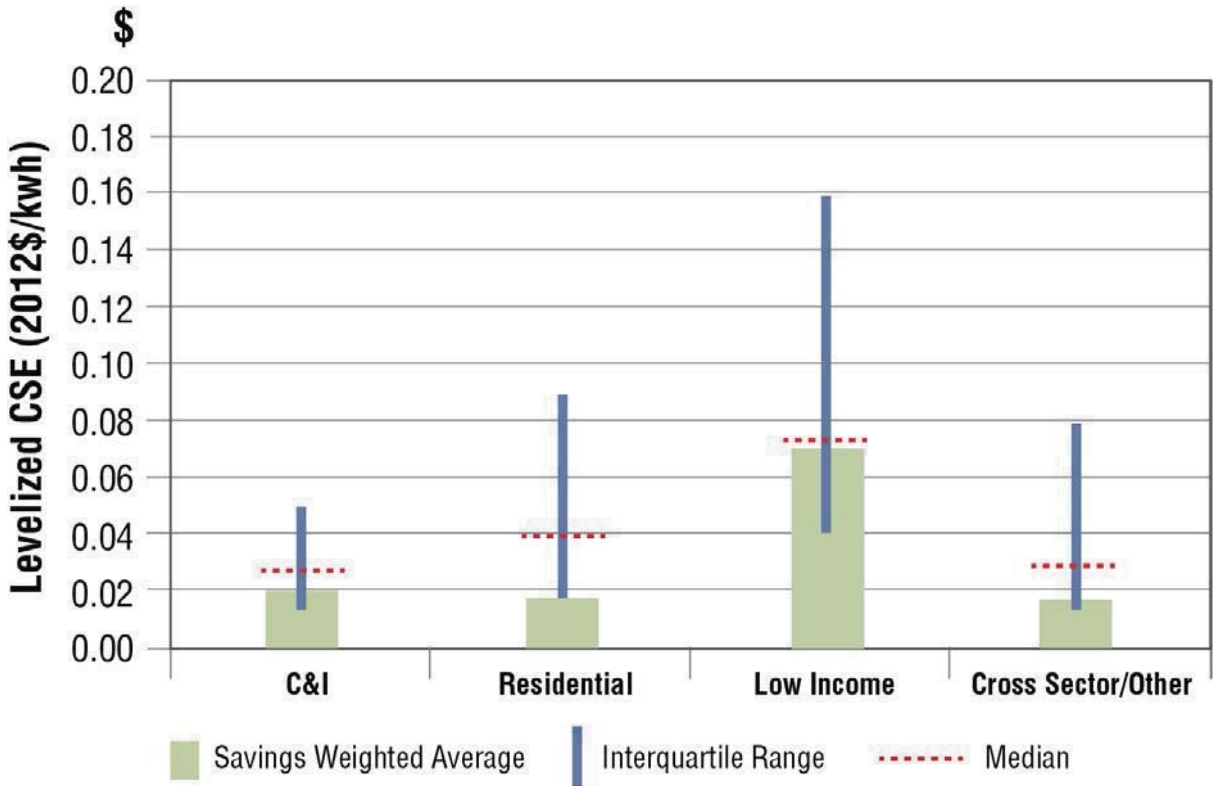

Figure 3-10. National levelized CSE for electricity efficiency programs by sector

Low-income programs have much higher savings-weighted average and median values for the program administrator CSE (on the order of $0.07 to $0.08/kWh). Low-income programs typically have a higher program administrator CSE for several reasons. Most notably, these programs are designed to achieve specific social policy objectives in addition to energy resource acquisition goals. These programs can include a variety of health and safety actions (correct structural issues, window replacement, mold removal, etc.) that need to be completed prior to completing any efficiency upgrades, adding to the program costs. Finally, low-income programs are often delivered at little or no cost to participants; thus the CSE for low-income programs is more comparable to an all-in or total resource cost perspective (i.e., including both program administrator and participant costs).

The cross sector/other program category, illustrated in Figure 3-10, is quite broad and includes a diverse mix of program types (e.g., equipment rebate programs that include both residential and non-residential customers, workforce development and training programs). Thus, at a high level, it is difficult to draw conclusions for the sample of programs included in this category.

At a national level, we observe a wide variation in CSE values for programs in most sectors (e.g., CSE values for programs in a sector have an inter-quartile range that varies by a factor of three to five). We also find that the savings-weighted average CSE was typically lower than the median value for CSE for a sector or program category (see Figure 3-11 and Figure 3-12). This suggests that much of the savings for each sector is coming from programs or program types on the low end of the CSE range for that program or sector.

Figure 3-11 and Figure 3-12 show levelized CSE values for the simplified program categories for C&I and residential sectors, respectively.[59]

The simplified C&I program categories had median values for the program administrator's CSE that range from $0.01/kWh to $0.05/kWh. It is worth noting that the savings-weighted average CSE for custom and prescriptive rebate program categories were $0.018/kWh and $0.015/kWh, respectively. Since these two program categories accounted for almost 70% of C&I sector savings (see Figure 3-4), they tended to drive the overall CSE results for the C&I sector: program administrators had an average levelized CSE of less than $0.02/kWh in the C&I sector. The C&I programs (Figure 3-11) also had a relatively smaller inter-quartile range of CSE values compared to the residential program categories (Figure 3-12).

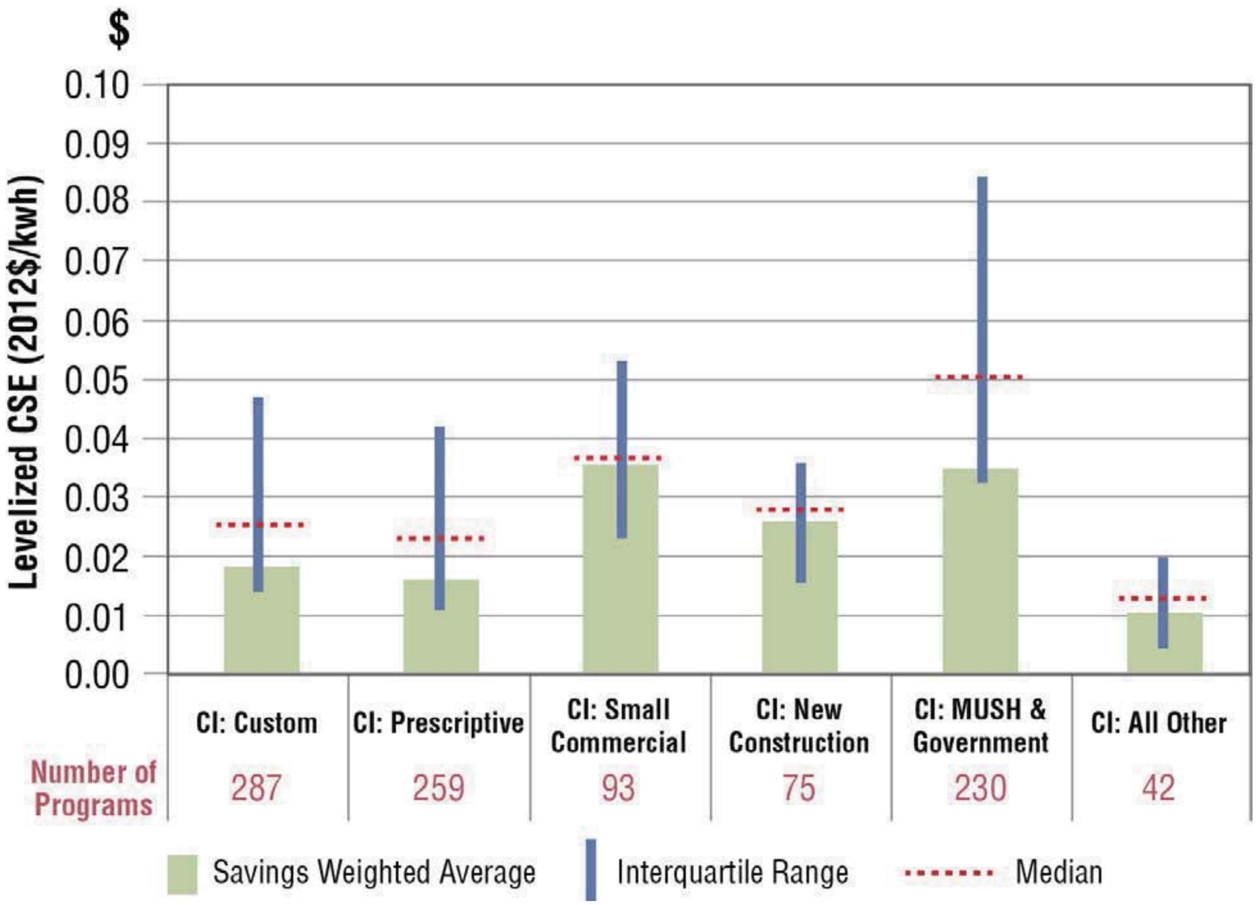

Figure 3-11. National levelized CSE for commercial and industrial sector simplified program categories

[59] Note that the y-axis scales for CSE are different in Figures 3-11 and 3-12, illustrating differences in the range of CSE values in C&I and residential sector programs.

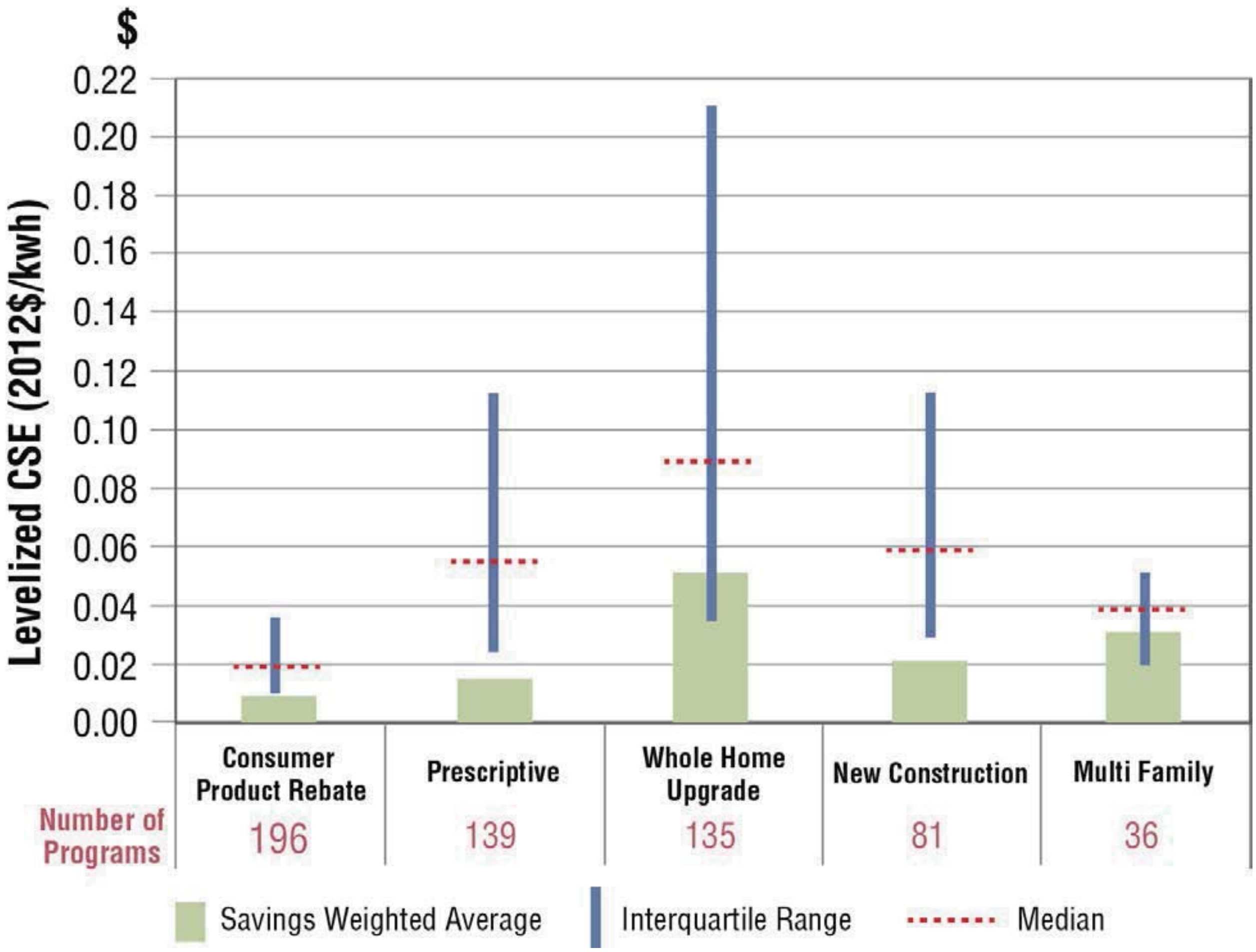

Figure 3-12. National levelized CSE for residential sector simplified program categories

For the residential programs, several program categories had a relatively tight range of program administrator CSE values. For example, Consumer Product Rebate programs had an inter-quartile range of $0.01/kWh to nearly $0.04/kWh and a low savings-weighted average (~$0.01/kWh). However, the Residential Prescriptive ($0.03/kWh to $0.11/kWh), New Construction ($0.03/kWh to $0.11/kWh) and Whole-Home Upgrade (slightly more than $0.03/kWh to $0.21/kWh) program types had significantly larger ranges. There are several possible reasons for the larger range of CSE values in each of these program categories. The prescriptive simplified program category includes detailed program types that implement a wide variety of measures (e.g., HVAC, insulation, windows, pool pumps) as well as some generic "prescriptive" programs[60] that often include measures also found in the Consumer Product Rebate category. This broad measure mix and the variation in costs and measure lifetimes associated with those measures are possible drivers for the wide range of CSE values for the prescriptive category.

[60] Some programs include all their rebated measures under the same program title and it is not possible to determine where the majority of the savings is coming from. In these cases, the programs were categorized as "Residential Prescriptive."

For the Whole-Home Upgrade program category, the broad range of program designs and delivery mechanisms (this category includes audit, direct install, and retrofit/upgrade programs) may help explain the relatively wide range of CSE values. Figure 3-13[61] shows program administrator CSE values for detailed program categories under the Whole-Home Upgrade program category. We observe that the inter-quartile range of CSE values for both direct install and whole-home upgrade programs ranged from about \$0.03/kWh to about \$0.26/kWh, with median values of \$0.06/kWh and \$0.12/kWh, respectively. Whole home audit programs have a much smaller inter-quartile range, from \$0.03/kWh to \$0.11/kWh, and a median value of \$0.07/kWh.

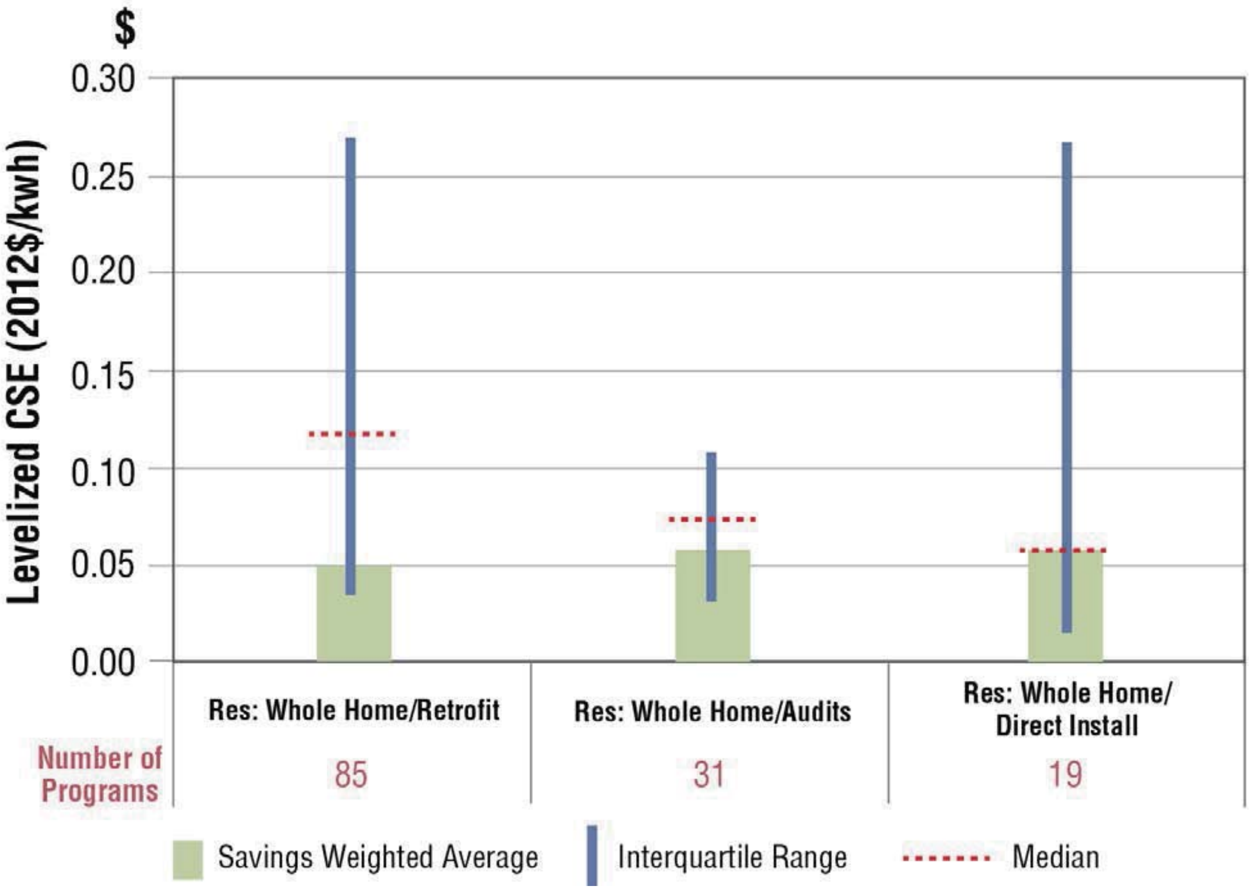

Figure 3-13. National levelized CSE for residential whole home detailed program category

Recall that about 44% of the residential sector lifetime gross savings came from lighting rebate programs that are part of the Consumer Product Rebate simplified program category (see Figure 3-13). Thus, we took a closer look at the CSE results for the four detailed program types within this category (see Figure 3-14).

The median and average levelized CSE values for lighting rebate programs were quite low (about \$0.01/kWh) with a small inter-quartile range (see Figure 3-14). Future investigation of these programs' CSE values, savings estimates, and drivers is probably warranted given that a

[61] Note that the y-axis scale in Figure 3-13 has higher CSE values than other figures in this chapter.

large percentage of savings came from lighting measures and that lighting CSE may rise as baselines (and thus perhaps savings) are lowered for many of these measures given implementation of more aggressive lighting equipment standards.

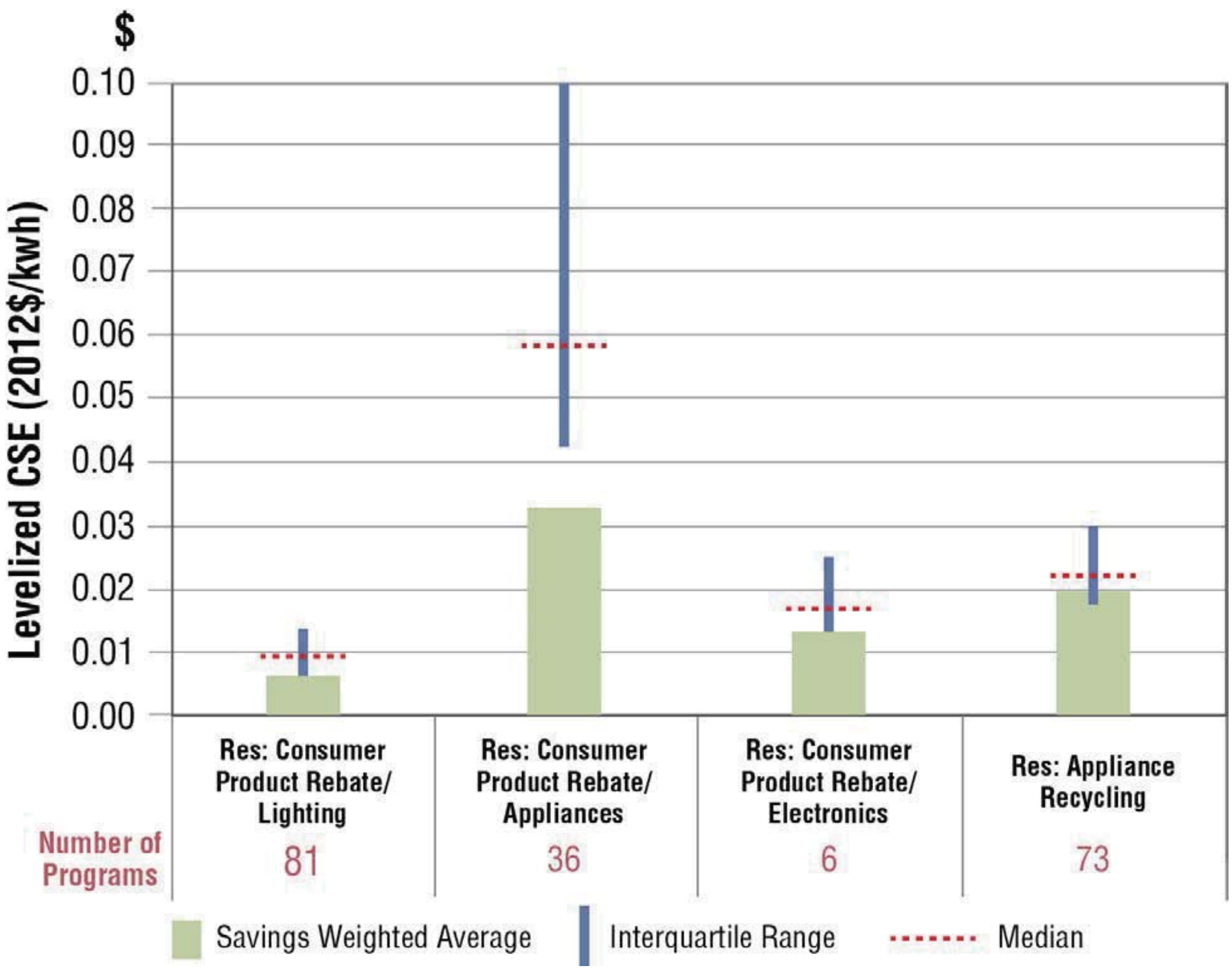

Figure 3-14. National levelized CSE for residential consumer product rebate detailed program categories

3.2.3 Regional Observations in Electricity Efficiency Programs

In this section, we examine some of the potential underlying drivers of CSE, including region (i.e., geographic location), climate, and baseline building efficiency requirements. Figure 3-15 presents regional CSE values for programs in the database (see Table 3-2 for assignment of states to region).

Across all programs, the savings-weighted average CSE ($0.014/kWh) and median CSE ($0.019/kWh) values were lowest in the Midwest. This is consistent with the information in Figure 3-5 and Figure 3-6, which shows that program administrators in the Midwest in aggregate reported relatively low expenditures and relatively high savings (compared to other regions). Possible explanations for this phenomenon include the relative “newness” of the Midwest energy efficiency programs and savings targets. Most of the states in this region enacted their first EERS targets in the late 2000s (Barbose et al. 2013). As a result, most of these states are perhaps still able to achieve significant savings from programs targeting low cost measures (i.e., lighting rebate programs). Another possible explanation is that gross savings values and/or measure lifetimes are higher because of baseline conditions or because EM&V practices are less mature in some states.

In contrast, many states in the Northeast region have consistently been running efficiency programs for many years, have much higher savings targets (e.g., "all cost effective" efficiency mandates) and relatively well established and rigorous savings evaluation requirements. In aggregate, program administrators in the Northeast have a higher savings-weighted CSE ($0.033/kWh) and a much wider range of CSE values among types of programs, which possibly indicates that there was a broader mix of program designs and delivery mechanisms, as well as desire to achieve more comprehensive savings driven by state policy objectives (e.g., regulatory decisions or legislation that directs program administrators to achieve all cost-effective efficiency).

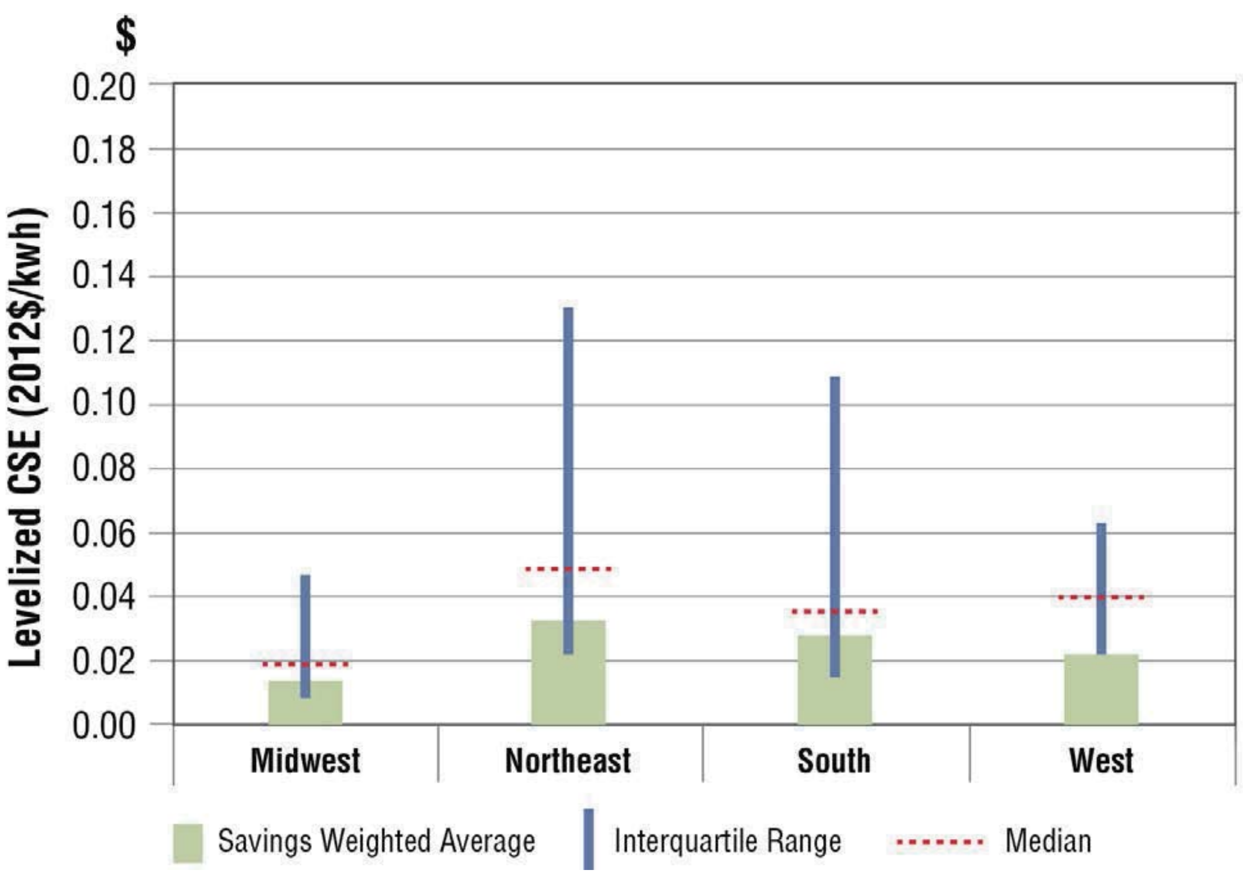

Figure 3-15. Levelized CSE for electricity efficiency programs by region

We also looked at average CSE values for all C&I and residential programs (excluding low-income programs) among program administrators in states (see Figure 3-16). Low-income programs were excluded for several reasons: (1) not all states either offer or reported information on their low-income programs; (2) the policy rationale(s) for low-income efficiency programs differs among states: some states require low-income programs to pass cost-effectiveness screening tests while other states use multiple criteria to assess budgets and design of low-income programs (e.g., equity reasons, cost-effectiveness); and (3) the scale of low-income programs varies significantly among states. Thus, including low-income program data has the potential to skew state by state observations in CSE.

With several exceptions, we observe some clustering of average CSE values for efficiency programs for states in a region (see Figure 3-16) with several exceptions (e.g., FL, PA, NJ). It is worth noting that Massachusetts and Vermont have all cost-effective efficiency mandates and both of those states had a savings-weighted average CSE over $0.04. Conversely, Pennsylvania has many characteristics that are typical of other states in the Midwest (e.g., relatively new efficiency programs, similar climate, economies) and had an average savings-weighted CSE more similar to program administrators in the Midwest than the Northeast. At this time, we cannot definitively explain the higher savings-weighted average CSE for program administrators in Florida.

one of the lowest costs of saved energy (CSE)

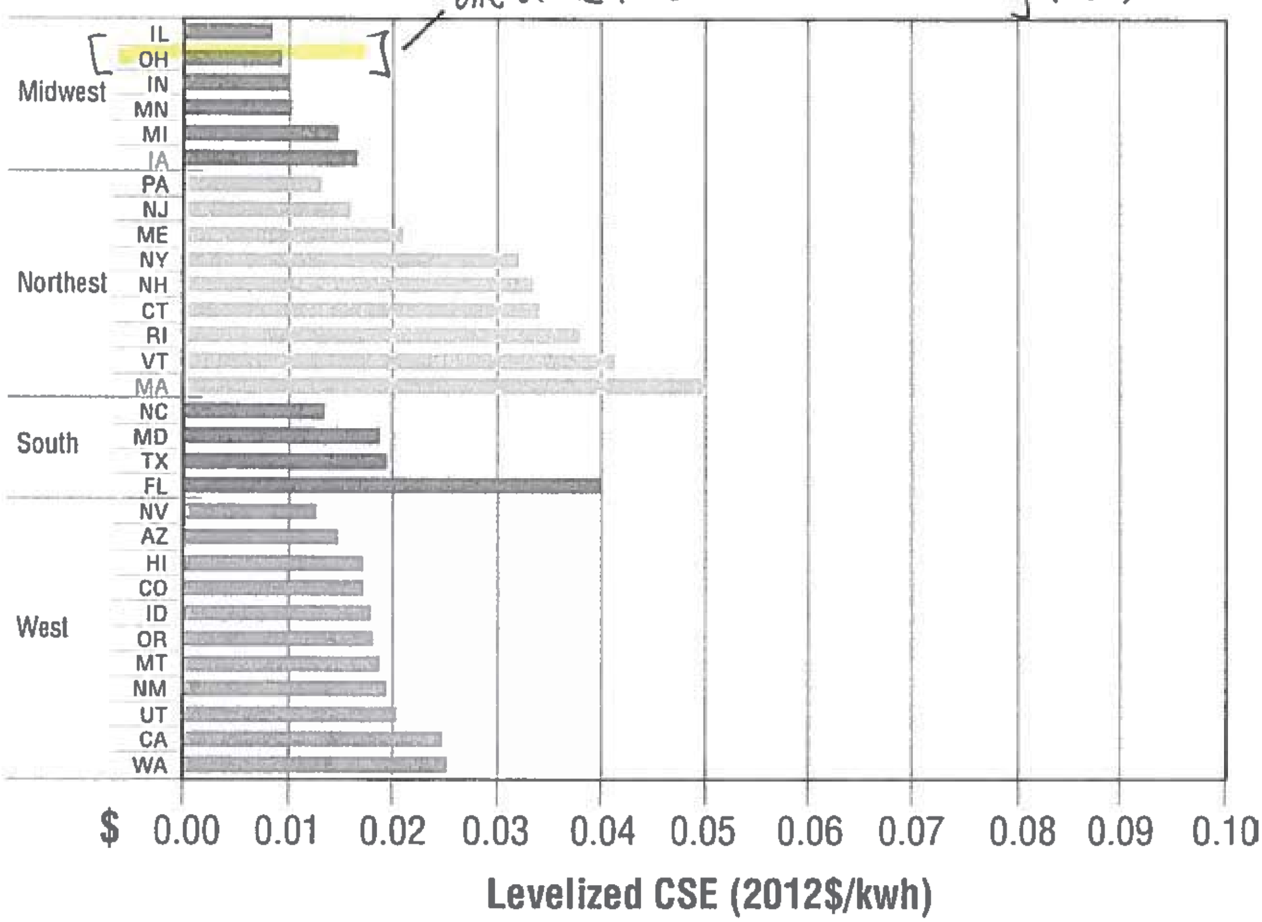

Figure 3-16. CSE values by state for electricity efficiency programs (excluding low-income programs)

A number of factors may influence the observed variation in the program-level CSE, including those that program administrators can influence (e.g., how program administrators report program costs, program design, incentive levels, and measure mix) and those largely outside of program administrator control (e.g., climate, area labor rates, building stock, regulatory requirements). We conducted exploratory analysis that examined two potential factors that may influence program-level CSE values: climate and building codes. First, we calculated the percentage of each region's lifetime gross savings by savings-weighted program administrator CSE and climate zone for all program categories in the database (see Figure 3-16). The size of the bubbles in Figure 3-17 represents the percentage of the total regional lifetime savings that falls within the respective climate zone in which the program was administered. For example, for the West, there are more savings in the database in the warm climate zone that includes much of California.

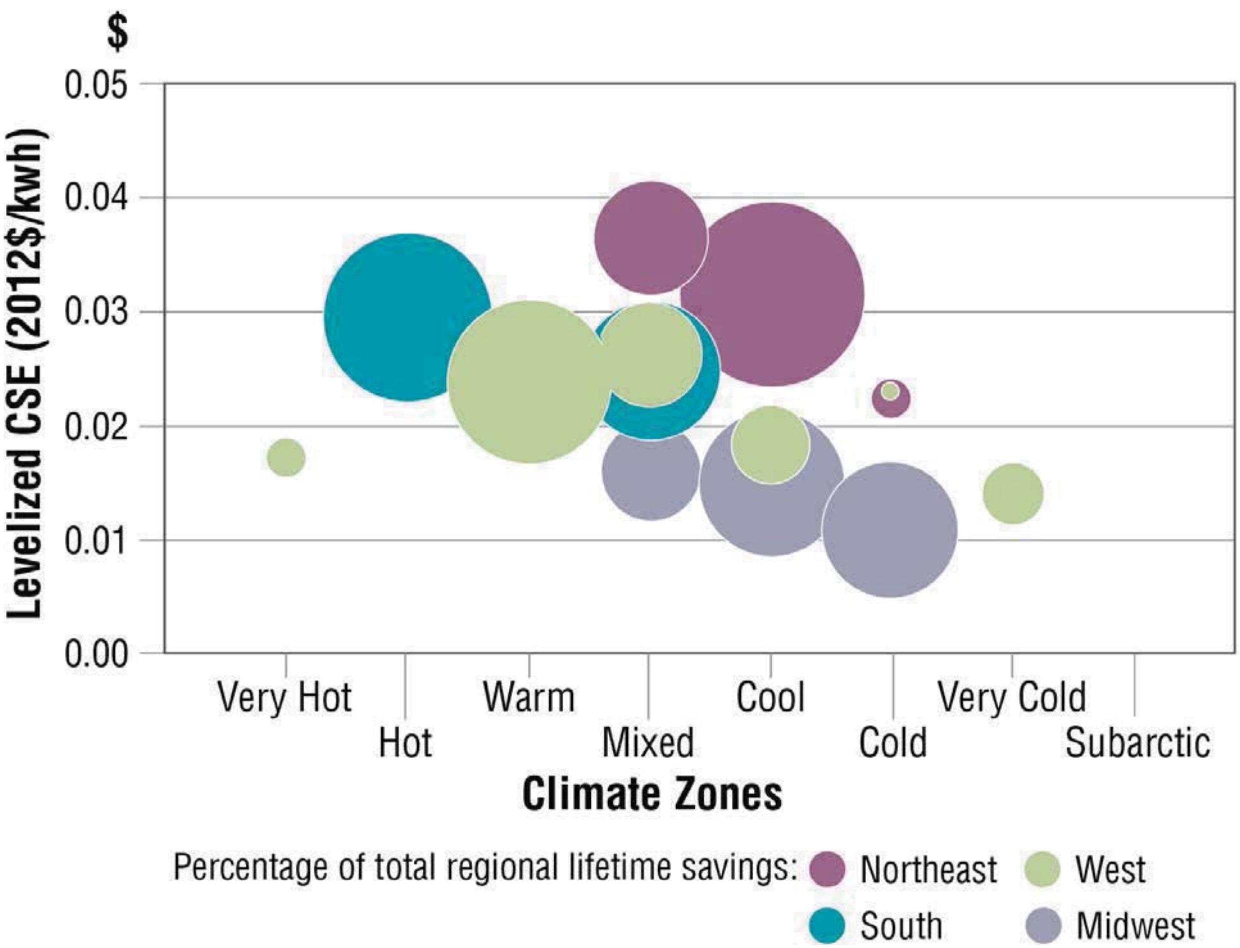

Figure 3-17. Percent of regional lifetime savings by climate zone and levelized CSE for electricity efficiency programs[62]

[62] States were assigned to climate zones adopted for the International Energy Conservation Code (IECC), in which the climate zones are delineated geographically as regions defined by certain historical averages for temperature, humidity and precipitation. A single zone was assigned to each state based on where the majority of the state's population—and presumably load—is concentrated. This method is imperfect but useful as a proof-of-concept test for an approximate relationship with levelized CSE. A description for the climate zones was adapted from the

In each region, we observe a pattern that as the climate gets cooler, the savings-weighted average CSE decreases for electricity efficiency programs. However, we also see that the savings-weighted average CSE varied significantly within a climate zone (see mixed and cool). Had climate been a significant driver for CSE, we would expect to see more agreement on the CSE by climate zone, even in different regions. This indicates that there are probably other factors that have more impact on the regional CSEs than climate zone. Additional analyses may be required to focus only on program types with climate dependent measures (e.g., cooling and heating system retrofits) or conduct more detailed analysis of participant costs and incentives which can vary by climate zone as cost effectiveness varies (e.g., a cooling system retrofit would be more cost-effective in a very hot climate than a cool one, possibly justifying higher incentives, but also perhaps not requiring them since the participant benefit to cost ratio would also be higher).

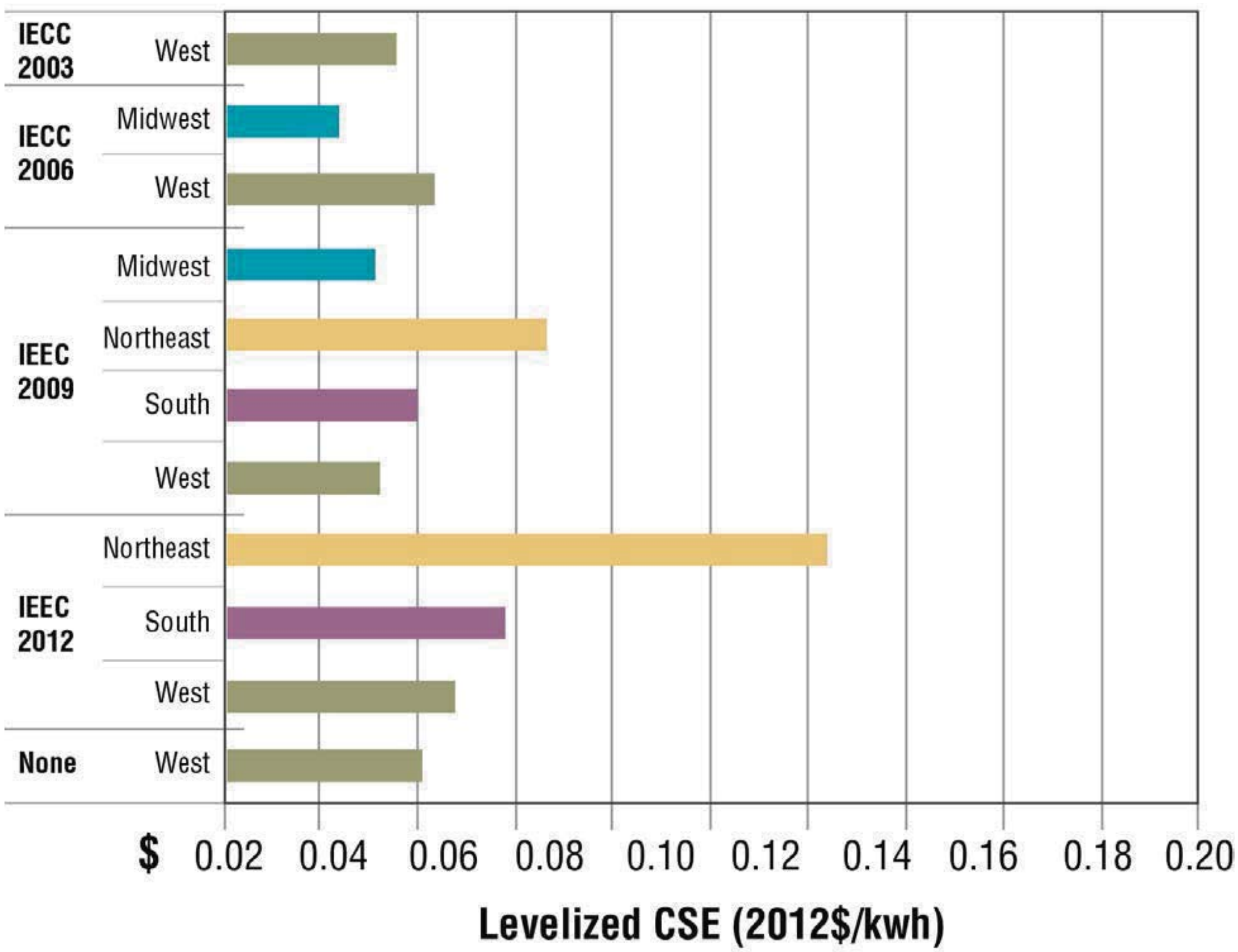

Figure 3-18. Levelized CSE for residential new construction programs compared to residential building energy codes adopted by states in each region[63]

Building America discussion of IECC and Building America climate zones found here: http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/ba_climateguide_7_1.pdf

[63] U.S. DOE. 2013. Building Energy Codes Program. Washington, DC. Accessed at: http://www.energycodes.gov/status-state-energy-code-adoption in September 2013.

Another potential influence on CSE values is differences in baseline building efficiency across states and regions. In Figure 3-18 and Figure 3-19, we examine the savings-weighted average CSE for new construction programs in the residential and commercial sectors, respectively. For the residential programs, we calculate the savings-weighted average electric levelized CSE for new construction programs in each region plotted against each state's current International Energy Conservation Code (IECC) status.[64,65] The newer the adopted code, the lower the assumed baseline energy consumption, which tends to reduce the incremental electricity savings for any given efficiency action. For example, the gross savings calculated for a fixed set of measures for a building than meets the 2006 IECC code would be greater than for the same set of measures for a building that meets the 2012 IECC code. Note that the West, as a region, has the most diversity among states in terms of building energy code requirements.

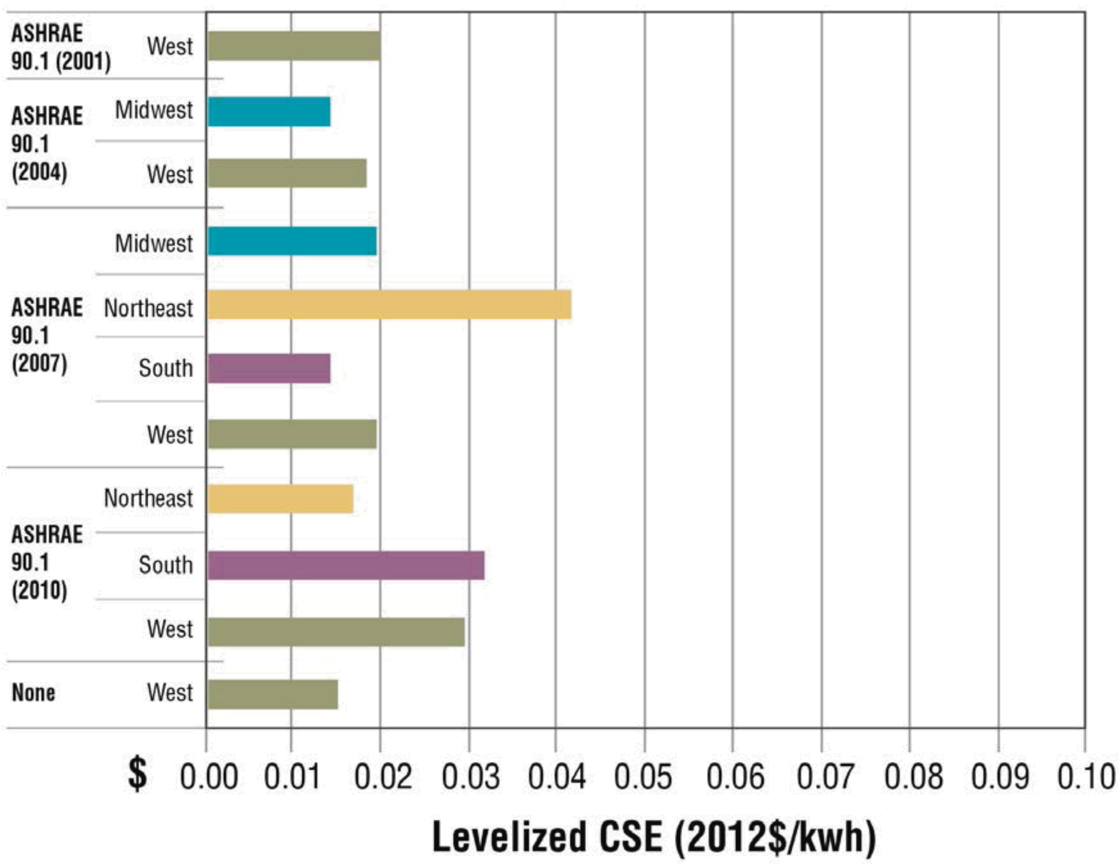

Figure 3-19. Regional levelized CSEs for commercial new construction programs compared to commercial building energy codes adopted by states in each region[66]

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[64] The IECC (http://www.iccsafe.org/gr/Pages/IECC-Resource.aspx) is a national model energy code for the United States. It sets minimum requirements for energy efficiency that new buildings—as well as additions and renovations to existing buildings—must meet wherever the code has been adopted into law, usually on state-by-state basis. The IECC is updated on a 3-year cycle, and the most recent version is 2012.

[65] By using current (2103) IECC code adoption status, we do not directly reflect the baseline status at time of program implementation (2009-2011). However, we expect that this approach may still be indicative of relative baseline status while not requiring state-by-state, year-by-year analysis of code status.

[66] U.S. DOE. 2013. Building Energy Codes Program. Washington, DC. Accessed at: http://www.energycodes.gov/status-state-energy-code-adoption in September 2013.

It might be reasonable to expect that the CSE would increase as the codes for new buildings set more stringent baseline efficiency requirements (e.g., incremental savings opportunities are less for any given investment). Some evidence for this pattern can be observed in the average CSE values for Midwest, Northeast and South residential programs segmented by the year of the building energy codes. However, the expected pattern in average CSE values does not readily emerge for states in the West that offer residential new construction programs.

The picture is even less clear when looking at the savings-weighted CSE for commercial new construction programs plotted against commercial codes (see Figure 3-19). CSE values do not follow the expected pattern for states in either the West or Midwest. The savings-weighted average CSE values for states in the Northeast seems to have been lower where more stringent codes exist, although there are a limited range of code requirements among states in the Northeast. Thus, the effects of code status on CSE values require further inquiry.

3.2.4 Sensitivity Analysis: Impact of Measure Lifetime

In Chapter 2, we discussed data gaps and inconsistent criteria for reporting lifetime energy savings (and by extension efficiency measure lifetimes), noting that lifetime savings (or program average measure lifetime) were not reported for about 50% of the program years in the database.[67] In this section, we illustrate and discuss results of a sensitivity analysis that explores the impact of varying assumptions regarding program measure lifetime on CSE values reported by program administrators.

Figure 3-20 compares the “LBNL approach” used to estimate lifetime savings for those programs that did not report this information to two other potential approaches in which we apply the minimum and maximum reported program average lifetimes for each detailed program type to all programs of that type.

The minimum and maximum values for each program type (see the light and dark green bars in Figure 3-20) dramatize the impact on levelized CSE values of varying assumptions for the average measure lifetime of efficiency programs. For five of the 12 reported program categories, if we use the minimum reported program average lifetime (and apply it to all other programs in that category), the levelized CSE values more than doubles compared to the CSE values using the LBNL measure lifetime approach. This underscores the importance of understanding and accurately reporting the average measure lifetime of measures installed in programs since it significantly impacts the cost of saved energy (and the underlying cost-effectiveness of efficiency actions).

[67] For those programs, we calculated a program-average measure lifetime by detailed program category and applied those values to the reported gross first-year savings to calculate lifetime savings.

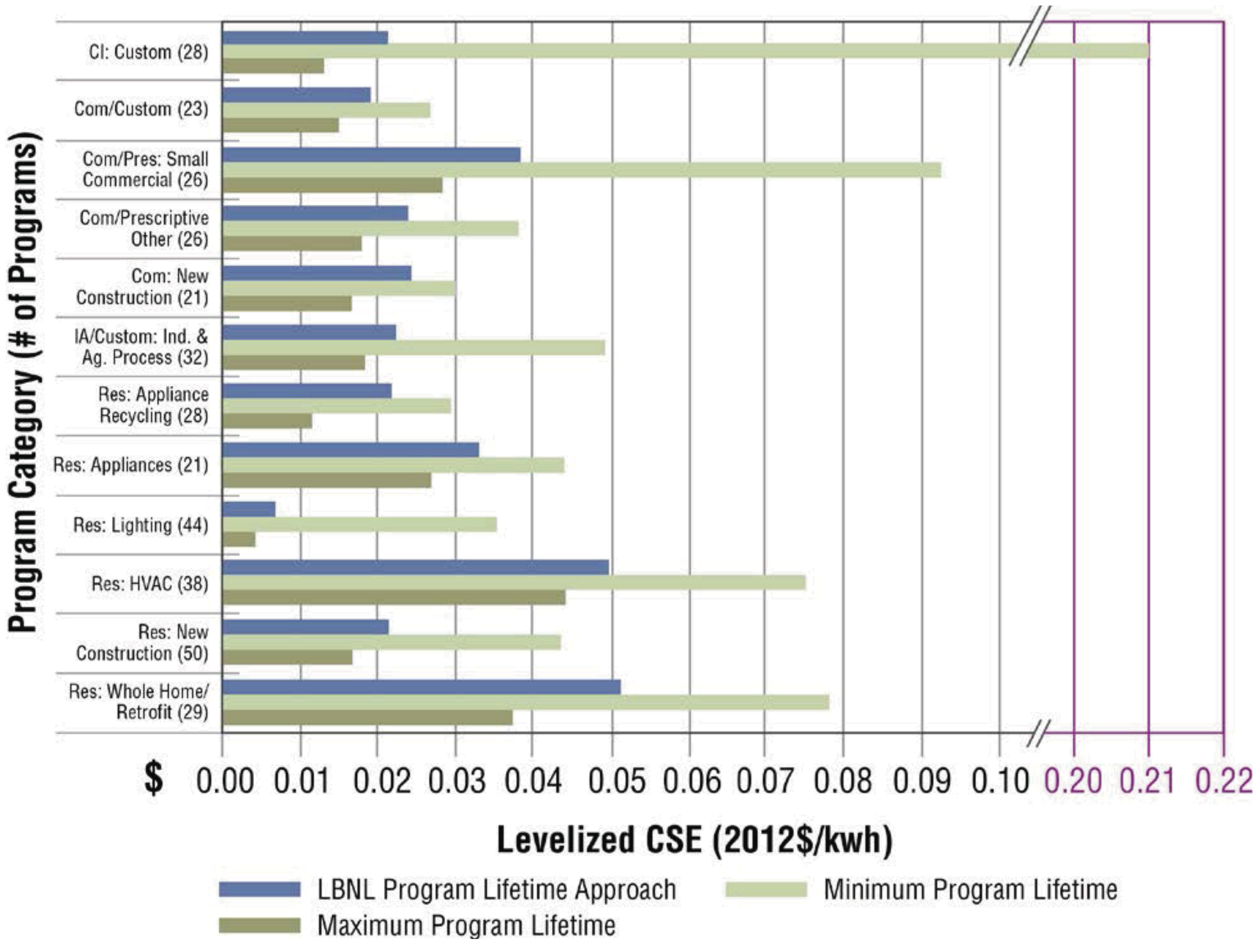

Figure 3-20. Impact of different program average measure lifetime assumptions on the levelized CSE for electricity efficiency programs

3.2.5 Program Administrator and Participant Cost Analysis: The Total Resource Cost of Saved Energy

This study focuses primarily on the program administrator CSE because participant costs were not consistently reported. We collected participant costs at the program level when reported, although this information was available for only 265 electric programs years (less than 10% of the programs in the database) in 11 states.[68] When reported, participant costs are subject to at least two additional sources of uncertainty: (1) whether the participant costs are based upon full program measure costs or incremental program measure costs; and (2) whether participant costs are based upon customer receipts and/or supplier invoices (i.e., actual participants paid those full costs) or whether incremental participant costs are based upon deemed values drawn from various sources (e.g., supplier surveys).

[68] In some of the 11 states, participant costs are only reported for select programs and not the entire portfolio.

Given small sample size and uncertain reporting of participant costs, it is difficult to assess the "all-in" or total resource cost of efficiency or analyze potential influences on the total cost of the efficiency resource. For these reasons, in Figure 3-21, we compare the program administrator's levelized CSE vs. a total resource CSE for illustrative purposes only. We calculate this total resource CSE for the simplified program categories where both program administrator and participant costs were available for more than 18 program years.[69]

For the small sample of programs, we found that the levelized total resource CSE values are typically double for most program types with the exception of the Residential Whole Home Upgrade program category (where the total resource CSE is about 25%–30% higher than the program administrator CSE). Further data collection and analyses could help understand how the ratio of program administrator to participant costs varies as a function of sector, measure types, and market maturity; and how incentives and direct support might be optimized to pay no more than is necessary to meet efficiency uptake objectives.

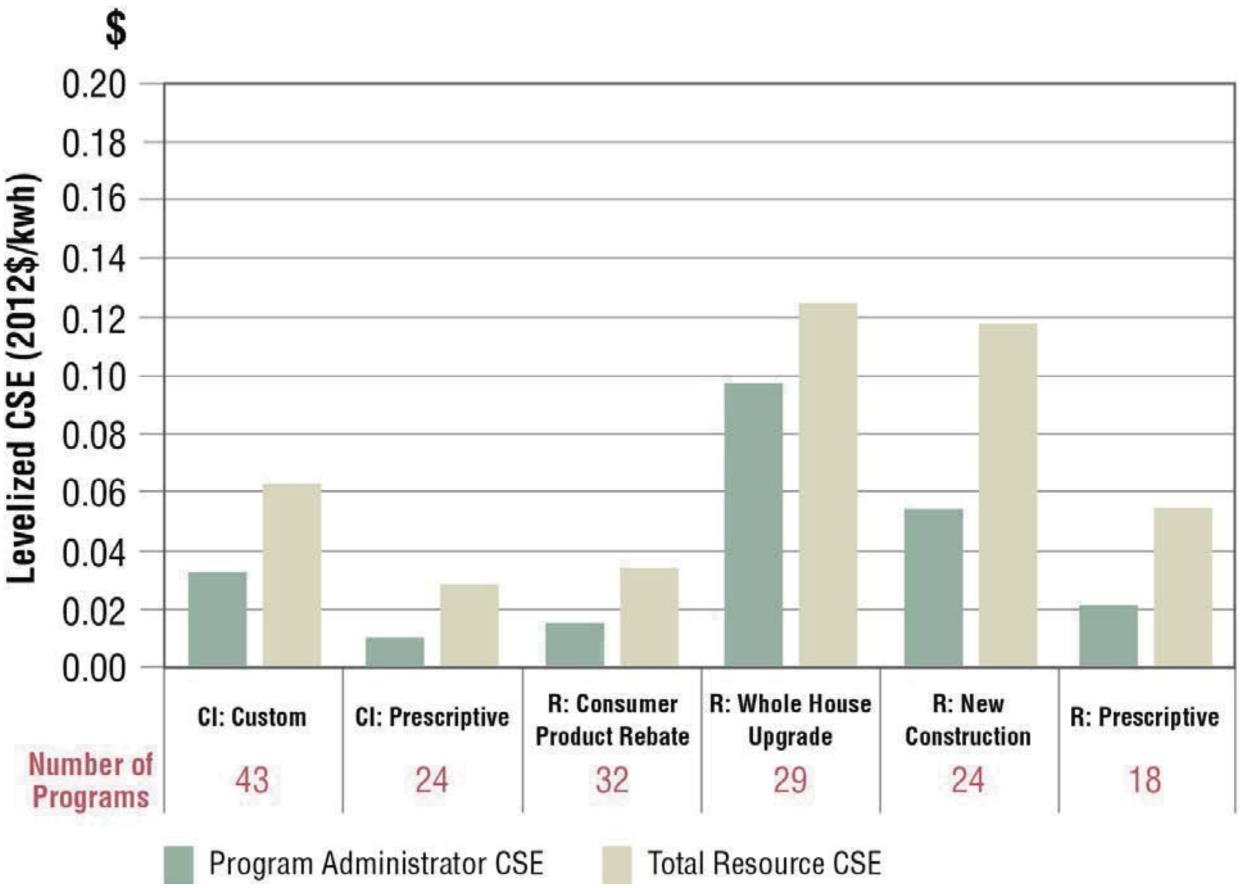

Figure 3-21. Levelized savings-weighted average CSE for electricity efficiency programs that include program administrator costs vs. total resource costs for select program categories[70]

[69] The "n" of 18 was selected because there was a natural break in the data and also that criteria resulted in only including results for which there was a meaningful number of programs from which to calculate average values.
[70] This chart includes a very small sample of programs from 11 states; thus, results may not reflect current practices in many jurisdictions.

4. Testing Influences on the Costs of Saved Energy

As shown in Chapter 3, we observe a wide range of values for the program administrator CSE from virtually every perspective—nationally, and across regions, states, portfolios, and sectors. Moreover, we find significant variability within the different types of programs. The inter-quartile range of CSE values (the "middle" 50% of programs) for the first-year CSE can vary by a factor of 10 or more within a program category. In this chapter, we explore some factors that may be associated with this variability in the CSE. We describe the results of statistical analyses aimed at quantifying the relationship of CSE and a few, selected independent variables.

To initiate these analyses, we postulated three sets of potential explanations for these ranges of CSE values:

- Differences internal to the programs themselves and over which program administrators have at least some influence (e.g., the mix of measures in programs and thus the adoption patterns of consumers, the scale of programs, the maturity of the programs, program design, and program implementation);
- Differences external to the programs and over which program administrators have very little or no influence (e.g., climate, labor costs, and the policy framework within which programs operate).
- Incorrect information arising from problems with the primary data or faulty categorization of programs, or both (e.g., if gross energy savings are inaccurately reported in the source reports).[71]

We suspect that most or all of these factors influence the CSE values, interacting in ways that can be difficult to disentangle. In this chapter, we focus on the first two explanations (i.e., potential internal and external program influences) in order to see if their hypothesized influences on CSE are observed or not, using the programs in the database.[72]

In the long run, we hope the collected data and this type of statistical analyses can:

- Inform policymakers and other stakeholders about the variability of the CSE to distinguish between controllable and uncontrollable sources of variability and, ideally, to identify ways of reducing costs or otherwise improving program design and delivery; and
- Lead to predictive models that specify and quantify major influences on CSE values and thus could inform cost or savings projections for use by portfolio planners, regulators, and resource planners.

[71] See Chapter 2 for a discussion of data issues and Appendix C for a description of the quality control procedures implemented for this project.
[72] As noted in Chapter 3, CSE values are derived as follows: Program costs refer to program administrator costs only; the CSE values exclude participant costs. Savings are *gross savings* as reported by the program administrator. When program administrators only reported net savings values and we either had or could derive program-specific net-to-gross ratios, we used those ratios to calculate gross savings values from reported net savings. Savings values are based on savings at the end-use site and not at the power plant or natural gas pumping station and thus do not account for transmission and distribution losses.

4.1 Hypotheses

Table 4-1 indicates five hypotheses postulated as part of this research effort. We present results for three of these hypotheses in this report (shown in black).[73] Future reports may provide more in-depth results for these hypotheses and analyses of other hypotheses (shown in gray), both indicated in Table 4-1 and under development.

Table 4-1. Factors that may influence the cost of saved energy

Factors that May Influence the Cost of Saved Energy	Hypotheses	Proxy Variables	Level at which Variable Was Tested	Sources for Proxy Variable Data
Program Administrator Experience	**Program administrators with more experience learn to deliver programs more effectively and efficiently, with resulting lower CSE**	**Years of energy efficiency program spending from 1999-2012[74] above a *de minimis* threshold**	**Portfolio and sector levels**	**U.S. Energy Information Administration Form 861 survey[75] data, 1999-2012**
Scale of Program	**Larger programs reap economies of scale and thus have lower CSE**	**Number of program participants**	**Sector and simplified and detailed program level**	**LBNL DSM Program Impacts Database**
Labor Costs	**Areas with higher labor costs have higher CSE because labor is a significant component of both administrative and (indirectly) incentive costs.**	**State average wages for the construction industry**	**Portfolio, sector, and simplified and detailed program levels**	**U.S. Bureau of Labor Statistics**
State Policy Environment	Strong efficiency policies can both raise the baseline for energy savings potential and drive program administrators to reach deeper into the economy for savings; over time, both factors	Estimated statewide savings targets, as a percent of retail sales	Portfolio, sector, and program levels	Various reports by LBNL and ACEEE State Scorecards

[73] We plan to explore other hypotheses in future reports.
[74] This period was chosen largely because reporting of energy efficiency program spending and savings to EIA was less consistent in the early 1990s. See subsection on preliminary findings on program administrator experience for a discussion of the implications of selecting this period.
[75] We measured experience as the number of years that each program administrator has funded program portfolios at 0.1 percent of retail revenues for that program administrator or for utilities in that program administrator's territory. Where a time series of program funding could not be obtained (e.g., through gaps in reporting or delayed recognition of a non-utility program administrator in the survey data), we used the launch date for a multi-sector portfolio by that program administrator or, in a few cases, relied upon in-house knowledge of the level of energy-efficiency activity by that program administrator.

	are likely to result in higher CSE.			
Retail Rate Environment	Higher retail energy costs result in lower CSE because the higher energy costs encourage more customers to invest in energy savings, thus lowering the program administrator's costs of securing participation and savings	Residential, commercial and industrial retail rates	Commercial and Industrial (C&I) and residential sectors	U.S. EIA 826 and 861 reports (the Monthly Electric Sales and Revenue Report with State Distributions Report and the Annual Electric Power Industry Report)

Through the exercise of developing the hypotheses and identifying associated independent variables, it became clear that several of our theorized influences on the CSE interact in complex ways. Several variables operate in synergistic or countervailing ways. For example, some policies that are generally supportive of saving energy (e.g., energy savings targets) may dampen the costs of saving energy for program administrators in some circumstances and yet increase those costs under other circumstances. Further, the resulting effects may not operate uniformly or in the same direction from one market sector to another or across program types. Thus, the identification of potential influences on the CSEs, development of testable hypotheses and identification of valid independent variables is an iterative process, the early phases of which are described below.

4.2 Approach

For our dependent variable, we chose the first-year electric CSE, which is simply the program administrator cost (2012$) divided by first-year gross electricity savings (in kWh). The primary advantage of using first-year savings (versus lifetime savings) is eliminating uncertainties associated with the measure lifetime data; see Chapters 2 and 3 for discussion of limitations of lifetime energy savings data.

The disadvantage of using first-year savings is the inability to examine the ways that potential influences on CSEs vary for shorter- versus longer-lived efficiency measures, as using a levelized or lifetime CSE might allow. Since energy resources are generally evaluated over their economic lifetime, we anticipate analyzing factors that may be associated with levelized CSE values.

Statistical Regressions

Statistical regressions do not necessarily imply causality. Regressions can establish correlation or a probability that changing one or more independent variables is significantly associated with a quantifiable change in the dependent variable (e.g., the CSE).

We identified and collected data on the independent variables as proxies for the factors chosen to represent the potential influences over CSE. We then performed single-variable ordinary least squares regressions to screen independent variables, followed by a limited number of multivariate regressions to test the correlation between variables and the relative contributions of the variables. Appendix F describes our data collection procedures for the independent variables, the statistical analysis process and contains a table of these preliminary regression results.

4.3 Preliminary Results: Analysis of Factors that May Influence the Cost of Saved Energy

Our preliminary results to date suggest that many factors influence the CSE, and the degree of those influences varies across market sectors and programs. In the following subsections, we present an illustrative sampling of preliminary results and also discuss some of the challenges in identifying valid independent variables and interpreting results.

4.3.1 Program Administrator Experience

We hypothesized that program administrators with more experience would, to some demonstrable degree, have optimized the efficacy of program implementation and thus have lower CSE values for their portfolio of programs after an initial period. Experienced program administrators might realize these cost savings by one or more mechanisms, including having already established the necessary program infrastructure and trade alliances, identifying cost efficiencies in overhead expenses, and learning what measures and marketing approaches tend to elicit more customer participation or deeper savings.

We defined the program administrator experience variable as follows: each year of spending above a minimum program spending threshold (0.1% of revenues) as reported to the Energy Information Administration counted as a year of experience administering efficiency programs.[76] Years of experience were summed up for all years where spending exceeded the threshold to the program year for the data being tested. For example, utility X offered an informational energy audit program to customers in 2004 and expanded their programs in subsequent years such that spending exceeded 0.1% of revenues in 2006. Thus, we assumed that this utility had four years of experience for their 2010 programs and five years of experience for their 2011 programs.

The nature of the relationship between first-year CSE values and program administrator experience is depicted in Figure 4-1. The blue dots in Figure 4-1 represent CSE values for the portfolio of programs offered each year by individual program administrators**.** The cost of first-year gross electricity savings is plotted on the y-axis, the years of program administrator experience are shown on the x-axis.

There may be a quadratic relationship, such that program administrator experience and the cost of first-year savings may trace a curve in which first-year CSE declines as program administrators gain experience and then, beyond a certain number of years, costs increase, as

[76] See Appendix F for a more detailed explanation of the basis for determining program administrator years of experience. Response rates vary among program administrators from year to year in providing EIA Form-861 information. Third-party program administrators were not included in the EIA datasets until very recently. The names and parent companies for some program administrators changed over time. Some EIA survey data terms and definitions have changed over time and program administrators may have interpreted those terms (e.g., direct vs. indirect spending) in different ways. These limitations increase as the data reaches back to the early years of the EIA survey. We therefore chose to limit the count of years above the spending threshold to a period from 1999 to 2012. We recognize that bounding our metric for program administrator experience to this 14-year period imposes an artificial ceiling on the level of experience for the most mature program administrators. This may affect the correlation between program administrator maturity and the cost of saved energy. However, this impact is likely to be limited because 80% of the program administrator s in our dataset have spent above the designated spending threshold for 10 or fewer years.

saturation of low cost measures increases and program administrators offer programs that include more costly measures or target harder to reach market segments. However, a regression analysis with a quadratic specification using the first-year CSE values at the portfolio level does not show a statistically significant relationship,[77] and the magnitude of the effect, if it exists, is small (see a table of regression results in Appendix F). We plan to gather additional data, refine our method to estimate program administrator experience variable, and re-examine evidence for this relationship.

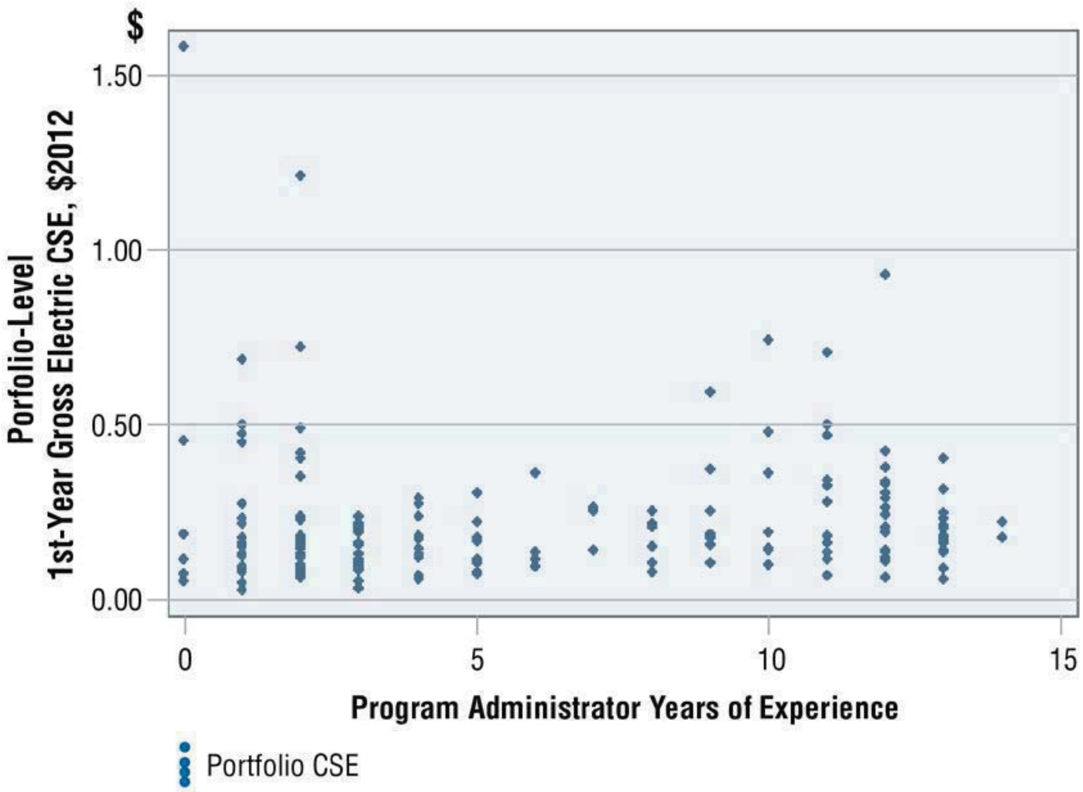

Figure 4-1. First-year portfolio-level CSE and program administrator experience, as measured by years of program spending above a minimal level.

4.3.2 Scale of Program

Based on economic theory, we would expect to see increasing economies of scale (i.e., lower CSE values as program fixed overhead costs are spread among more participant projects) at least up to a certain point. We found that the size of a program, as measured by number of participants, is often, but not always, indirectly associated with a decline in costs for some program types. This result is statistically significant for only certain program types. More reporting of participation levels could help determine, for different program types, when scaling up a program is likely to reduce the cost of saved energy.

As an example, Figure 4-2 depicts the relationship of participant count to first-year CSE for residential appliance recycling programs. The blue dots in Figure 4-2 represent first-year CSEs

[77] We use a 5% level as a threshold for statistical significance.

and reported participation for individual program years for appliance recycling programs. The red line is a linear fit across the data points, with the slope of the line indicating the predicted relationship between first-year cost performance and participation. For appliance recycling programs in our database, a doubling, or 100% increase, in the number of participants would, on average, be associated with about 0.01% of a reduction in the first-year CSE. This effect is statistically significant at the 5% level.

However, we also found that this effect is not statistically significant[78] for many other program types.

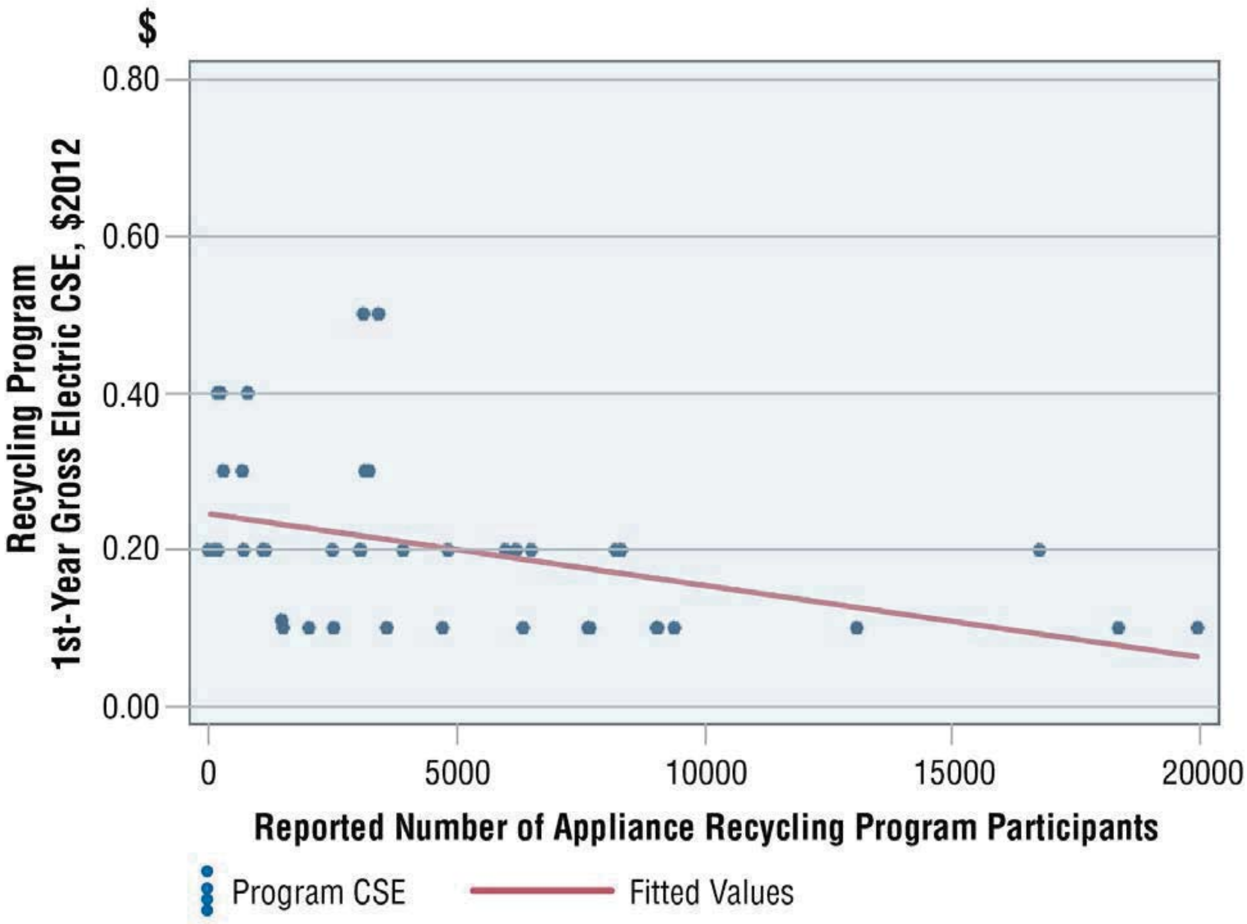

Figure 4-2. First-year CSE for appliance recycling programs and the reported number of recycling program participants

[78] The relationship between participation and first-year gross CSE for some other residential programs is statistically significant at the 20% level.

4.3.3 Labor Costs

We also theorized that higher labor costs result in higher CSE values (see Table 4-1). We present portfolio-wide CSE values as a function of state average hourly wages for construction industry employees in Figure 4-3. The blue dots represent CSE values for individual program administrator portfolios with the cost of first-year gross electricity savings plotted on the y-axis and the average hourly construction wages for the state in which the portfolios are administered on the x-axis.

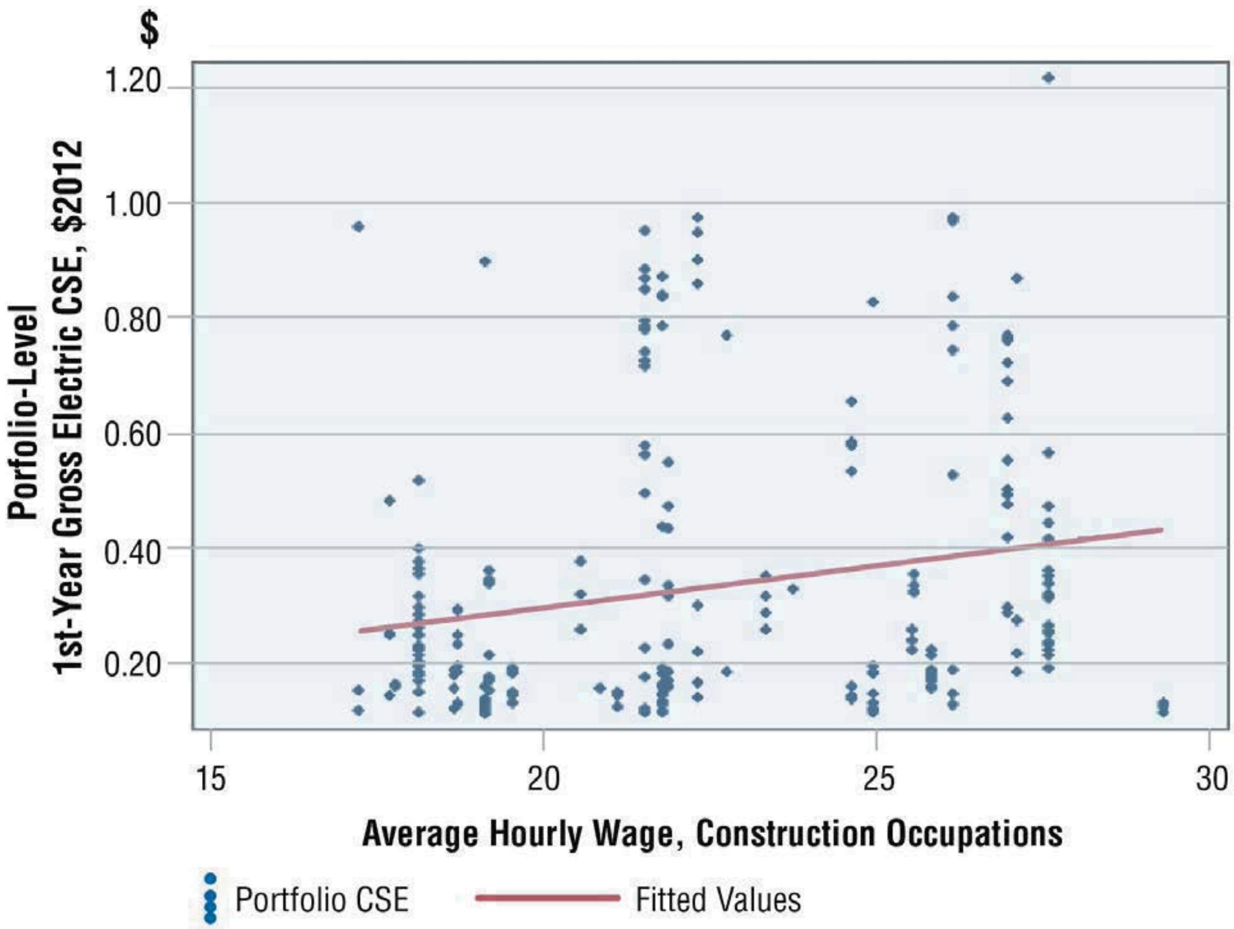

Figure 4-3. First-year portfolio-level CSE values and state average wages for construction industry employees ($/hour)

We selected construction hourly wages at the state level as our independent variable because research on the makeup of the energy-efficiency program workforce suggests that the construction industry is generally representative of that workforce (Goldman et al., 2010; Carol Zabin, UC-Berkeley Labor Center, personal communication). Our analysis shows that there is a positive correlation between construction wages and portfolio-level first-year gross CSEs. This result is statistically significant at a 5% level. However, the demonstrated effect is generally small, as can be seen from the fairly shallow slope of the fitted line in Figure 4-3. The effect is also neither uniform nor statistically significant across individual program types. As an aside, we also tried state average per capita income as the independent variable and found that the results are similar to those using construction hourly wages; this seems to indicate that labor costs are likely to play some role in the cost of saving energy.

4.4 Analytical Challenges

We also conducted exploratory analysis of other hypotheses (e.g., policy and retail price environments in which programs operate) and found that results varied substantially by market sector and program type. Many of these theorized relationships with the CSE are significant only at the 10%-15% level; further study is warranted.

The statistical analysis results described in this chapter depend critically on defining valid independent variables as well as the quality and quantity of the primary data underlying both the independent and dependent variables. Some of the difficulty in parsing these effects is a function of limitations in the underlying data for the independent variables. Drawing on an example noted earlier, we used data that program administrators voluntarily reported to the Energy Information Agency (EIA) to develop proxies for years of administrator experience. Program administrators sometimes do not report spending for every year or have interpreted EIA survey questions in different ways. More work is needed to minimize these and other sources of error or uncertainty in values for the independent variables.

Another challenge is specifying independent variables that are not highly correlated with other variables, that is, some proxies for influences on CSE can be overlapping in effect. For example, program administrators with more experience usually are required to achieve higher levels of savings. States that have higher labor costs also often have higher retail rates.

Likewise, it can be difficult to examine economies-of-scale questions when participation data are not provided. No participation data are reported for more than two-thirds of the program years in the database. In other cases, the data may be incorrect (numbers identified as participants are actually units sold or assumed installed) or ambiguous (unit and participant numbers are co-mingled or undifferentiated). Finally, many other questions pertinent to program design and delivery could be tested if spending breakdowns were available by program (i.e., program expenditures disaggregated into customer incentives, various categories of administration, marketing and outreach, and evaluation).

The primary data contained in the database have limitations, as discussed earlier. For the regression analysis, our total sample size was 2,035 data points. Many of the program years in the database are for gas-only programs, which are not included in an analysis of electricity program CSEs. Moreover, for some programs, the administrator did not report a key value (e.g., did not include program-level spending or allocate program costs by fuel for combination electric-gas programs).

5. Discussion of Key Findings and Recommendations

In this chapter, we summarize key findings from this initial report of the LBNL CSE Project and discuss opportunities for improving information provided by program administrators on the costs and impacts of efficiency programs.

5.1 Key Findings

We calculated the administrator costs of saving a unit of natural gas or electricity and reported the CSE in several ways, through first-year savings, lifetime savings and levelized savings. It is important to note that the CSE values presented in this report are retrospective and may not necessarily reflect future CSE for specific programs, particularly given updated appliance and lighting standards. The cost of efficiency as a function of first-year energy savings may be useful for budgeting to meet incremental annual savings targets. The cost of lifetime energy savings captures the efficiency that accrues throughout the effective lifetime of the implemented measures and therefore is more broadly applicable in designing programs and portfolios. In this study, we focused more attention on the program administrators' levelized cost of energy savings based on gross savings because relatively few program administrators reported the cost contributions of participants (or incremental measure costs) or net savings values. In future reports, our goals are to also provide the "all-in" or total resource CSE and to include CSE values based on net savings as well.

Key findings from this study are:[79]

- The U.S. average electricity CSE was slightly more than two cents per kilowatt-hour in the period 2009-2011 when gross savings and spending are aggregated at the national level and the CSE is weighted by savings.[80] This levelized CSE is somewhat lower than reported by other previous studies. In a 2009 study, for example, Friedrich et al. found an average program administrator levelized CSE of $0.025/kWh in constant 2007 dollars or $0.027/kWh in constant 2012 dollars—about 29% higher than is reported here.[81] The LBNL DSM Program Impacts Database contains a larger sample of program administrators, many of whom may have used longer program measure lifetimes that could affect CSE values. Moreover, nearly 40% of the program administrators in the database that administer electric efficiency programs have offered programs for less than four years and so may be early in accessing energy savings in their respective state economies or be targeting the least costly savings opportunities first.[82]
- Other findings for electricity efficiency programs include:

[79] All values reported here are program administrator CSEs for gross energy savings, levelized at a 6% real discount rate and given in constant 2012 dollars.

[80] This average value is based on the efficiency program portfolios of 100 electric and electric-gas program administrators that represent just less than half of the program spending in the United States during 2009 through 2011. These PAs are a large and diverse group in terms of geography, baseline efficiency, and historic levels of program activity.

[81] Friedrich et al. used a slightly lower discount rate (5 percent vs. 6 percent used in this report), so that the actual difference is larger.

[82] See Appendix A for summary of current and previous CSE research.

- Residential electricity efficiency programs had the lowest average levelized CSE at \$0.018/kWh. Commercial, industrial and agricultural (C&I) programs had a slightly higher average levelized CSE at \$0.021/kWh. Low-income programs show an average levelized CSE at \$0.070/kWh.
- In reviewing regional results, the Midwest programs had the lowest average levelized CSE (\$0.014/kWh) and the Northeast programs the highest (\$0.033/kWh). The average levelized CSE values for programs in the West and South, to the extent sufficient reporting was found, were \$0.023/kWh and \$0.028/kWh, respectively.
- The database provides a valuable resource for understanding the composition and the CSE for various efficiency measures and program types. For example, at least 44% of the reported gross savings in the residential sector came from dedicated lighting programs and lighting rebate programs had a savings-weighted average CSE of \$0.007/kWh with a small inter-quartile range.

* Natural gas efficiency programs had a national, program administrator savings weighted CSE range of \$0.24 (lifetime CSE) to \$0.38 per therm (levelized CSE, 6% discount rate), with significant differences between the commercial/industrial and residential sectors (\$0.11–\$0.17 vs. \$0.32–\$0.56 per therm respectively).
* Not surprisingly, the levelized CSE varied widely both among program types and within program types. We found that the median value was typically higher than the savings-weighted average for nearly all types of programs. One possible explanation is that our sample includes a number of very large programs and for any given program type, larger efficiency programs have lower CSE than smaller programs because administrative costs are spread over more projects (e.g., economies of scale). Some of our statistical analyses tend to demonstrate this relationship; however, other factors are probably at work as well.
* The "all-in" or total resource cost of energy savings is subject to the uncertainties and very limited availability of information on participant costs. Based on our small sample of programs that reported participant costs, we found that the program administrator costs account for about a third to a half of the total CSE (including program administrator and participant costs). One exception is residential Whole-Home Upgrade programs in our database, for which the median value for the program administrator's CSE is closer to three-quarters of the median CSE value that includes both program administrator and participant costs.
* We developed several hypotheses regarding factors that may influence the variability in the cost of saved energy. Preliminary statistical analyses of cost of first year energy savings suggest that myriad factors both internal and external to program design and implementation play some role in influencing the CSE:
    - Program administrator experience and the cost of first-year savings may show a curve where first-year CSE declines as new program administrators gain experience and then, beyond a certain number of years, costs increase, consistent with administration of portfolios that have matured beyond acquiring the least expensive resources. However, the demonstrated effect is generally small and not statistically significant at this time.

- Higher construction labor costs are associated with higher costs of energy savings at the portfolio level. However, the demonstrated effect is generally small and is not uniform (or statistically significant) across all types of programs.
- The size of a program, as measured by the number of participants, is associated with a decline in costs for some types of programs, suggesting that certain programs (e.g., Appliance Recycling programs) can achieve economies of scale by spreading fixed overhead across more projects. However, we also found that this result is not statistically significant for many other types of efficiency programs. More reporting of participation data could help determine when scaling up a program is likely to reduce costs and for what program types.

5.2 Discussion: Program Data Collection and Reporting

Program administrator annual reports are typically the product of state regulatory requirements or traditional practices that have evolved over time. In compiling and analyzing more than 4,000 program-years of data, we discovered a wide spectrum in the level of detail and completeness in annual program reporting. Barbose et al. (2013) found that over 45 states are running utility customer-funded efficiency programs. Many program administrators report program-level data at a very high level of completeness and transparency. However, we also found many examples of annual reports from program administrators that do not provide a complete picture of the impacts or costs of the efficiency investments at the program level. Although these reports may meet regulatory requirements in their state, they were not sufficient for the purposes of CSE analysis and therefore we were not able to include results from program administrators in many states.

With respect to current program reporting practices, we found:

- Inconsistencies in the quality and quantity of the costs and savings data which led LBNL to develop and attempt to apply consistent data definitions in reviewing and entering program data:
  - Program administrators in different states did not define savings metrics (e.g., varying definitions of net savings) and program costs consistently; and
  - Market sectors and program types were not characterized in a consistent fashion among program administrators.
- Many program administrators did not provide the basic data needed to calculate a CSE at the program level (i.e., program administrator costs and annual and lifetime savings), which introduced uncertainties into the calculation of CSE values.

This project brought into sharp relief the challenges of creating a program spending and savings database and calculating reliable, internally consistent metrics for assessing programmatic energy efficiency. For example, program measure lifetimes are essential for converting annual to lifetime savings while participant costs are essential for calculating the total resource costs of energy savings. We believe that nearly all program administrators must collect this information in order to satisfy cost-effectiveness screening requirements, yet many program administrators did not include this information in their annual efficiency reports:

- Less than 45% of electric program administrators reported lifetime savings;
- About 25% of electric program administrators reported program measure lifetimes;

- Only about half of electric program administrators reported both net and gross annual savings; and
- Less than a third of electric program administrators reported participant costs.

As a practical matter, the quality and quantity of program data reported by program administrators is an important factor in assessing energy efficiency as a resource in the utility sector. Therefore, we encourage further efforts to improve consistency in program administrator reporting of this information.

Regional and national policymakers have also expressed increasing interest in integrating energy efficiency as a resource and the value of transparent and complete reporting of program metrics as a foundation for increasing their confidence in this resource.[83] For example, ISO-New England, New York ISO and PJM Interconnection are collecting, or are considering collecting, demand-side spending and savings data from program administrators.[84] One objective is to develop better load forecasts in order to inform transmission planning, market development and operations. A second objective is to gain visibility into the future for wholesale energy and capacity markets. More rigorous and consistent reporting can help energy markets count and confidently value energy efficiency resources. Finally, all stakeholders that are engaged in any aspect of the efficiency effort share an interest in making energy-efficiency portfolios as cost effective as possible; consistent and more standardized reporting of efficiency program data and metrics are a prerequisite for this to occur.

We believe that there is a direct connection between the maturation of energy efficiency as a utility and national resource and increased consistency in periodic reporting of efficiency program costs and impacts. Additional rigor, completeness, standard terms, and consensus on at least essential elements of reporting could pay significant dividends for program administrators and increase confidence among policymakers and other stakeholders. With more consistent and comprehensive reporting of program results, we may obtain additional insights on trends in the costs of energy efficiency as a resource as program administrators scale up efforts, why those costs might vary from place to place and year to year, what saving energy costs among an array of strategies and what cost efficiencies might be achieved.

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[83] The Northeast Energy Efficiency Partnerships' (NEEP) Regional Evaluation, Measurement and Verification Forum (EM&V Forum) supports the development and use of common, consistent protocols to evaluate, measure, verify, and report the savings, costs, and emission impacts of energy efficiency. The EM&V Forum has developed the Regional Energy Efficiency Database (REED), launched in early 2013, which includes data from eight states, soon to be nine states and the District of Columbia. REED was informed by the Forum's "Common Statewide Energy Efficiency Reporting Guidelines," which were adopted by the Forum's Steering Committee in 2010. See http://neep.org/emv-forum/about-the-emv-forum/index.

[84] The NY ISO and ISO NE develop projections on efficiency program impacts based on future program budgets and cost information about past program performance. See, e.g., the NY ISO 2013 Gold Book (http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Documents_and_Resources/Planning_Data_and_Reference_Docs/Data_and_Reference_Docs/2013_GoldBook.pdf) and the 2014 Energy-Efficiency Data Review by the ISO NE Energy-Efficiency Working Group at http://www.iso-ne.com/committees/comm_wkgrps/othr/enrgy_effncy_frcst/2014mtrls/final_2014_eefwg_data_review.pdf

Therefore, we urge state regulators and program administrators to consider annually reporting certain essential data fields at a portfolio level and more comprehensive reporting of program-level data in order to facilitate benchmarking of efficiency program results at state, regional, and national levels. The reporting hierarchy in Figure 5-1 illustrates this approach.

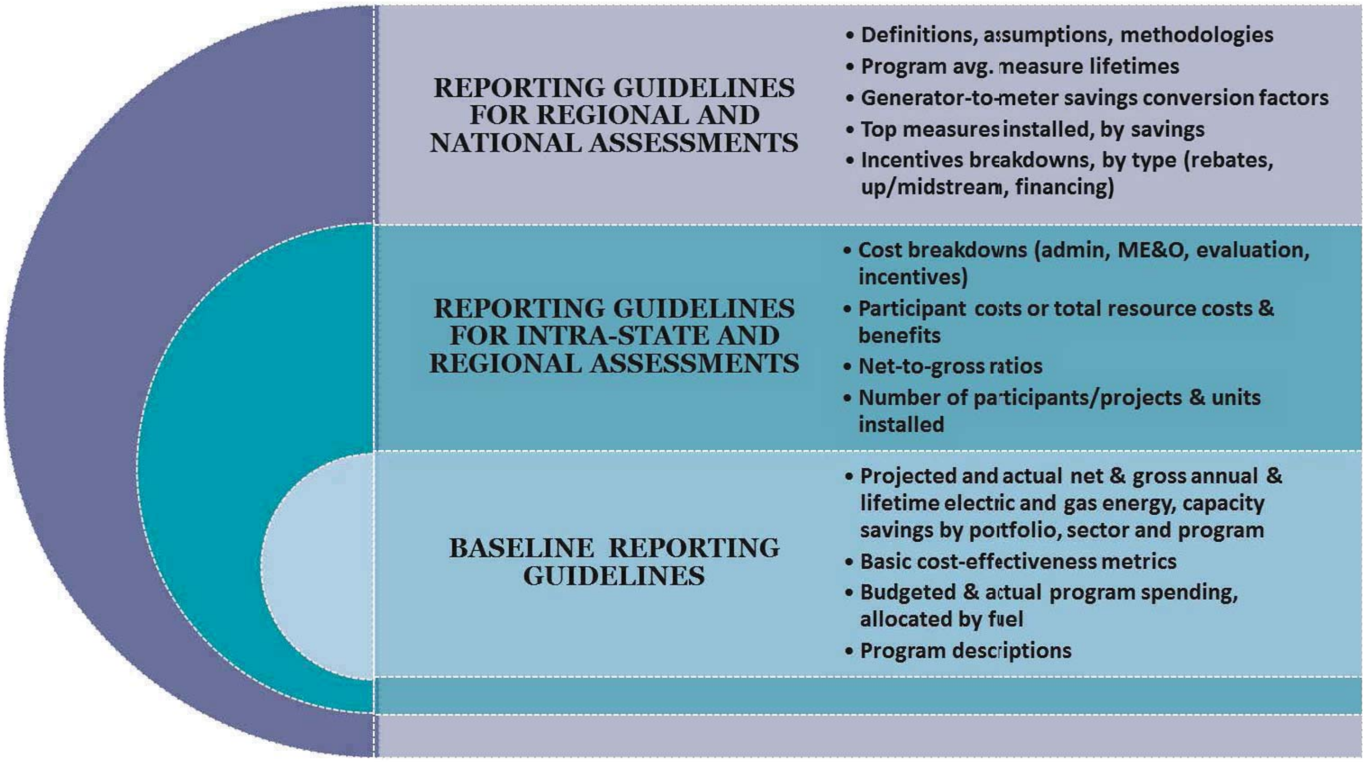

Figure 5-1. Components of annual energy efficiency program reporting

The program information included in each circle above correspond to gradually increasing visibility into program performance, increasing confidence in the reported values and potential relevance to policymakers and more stakeholders across broader geographic areas. The most basic level of reporting (light blue background) provides information that state regulators can use to ensure that programs are available to all customer classes and are cost-effective as implemented. The next level of reporting (teal background) provides critical information for calculating the CSE, assessing program efficacy and market penetration, and ensuring savings are attributable to program activities. The third level of reporting (purple background) enables comparisons of programs and cost performance in different states, reinforces assessments of program efficacy, and allows visibility into key assumptions to ensure those assumptions are valid and comparable to those used by other program administrators.[85]

[85] The components of annual reporting in Figure 5-1 are not exclusive. A number of states require significantly more, including indicators of performance on multiple fronts. Examples include estimates of market penetration; estimates of economic impacts; and cost breakdowns by internal spending, payments to or for external evaluations, payments to implementation contractors, payments to installation contractors, etc.

If program administrators were to report, at a minimum, the data under the baseline guidelines, this analysis would include nine additional program administrators among the 31 states included in this study, and programs from at least an additional 14 states. This would facilitate a more comprehensive national analysis of the impact of utility-customer funded energy efficiency.

We also encourage program administrators, regulators and other stakeholders to provide feedback on our efforts to encourage consistent reporting of efficiency program results, particularly the program typology and data definitions. We will be soliciting input more formally as we move forward with the next phases of this project. Given sufficient interest and resources, it is our hope to update the LBNL DSM Program Impacts Database on a periodic basis and prepare comprehensive reports and policy briefs that are publicly available that explore key issues in energy efficiency programs.

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4928.64 Electric distribution utility to provide electricity from alternative energy resources.

(A)

(1) As used in this section, " qualifying renewable energy resource" means a renewable energy resource, as defined in section 4928.01 of the Revised Code that has a placed-in-service date on or after January 1, 1998, or with respect to any run-of-the-river hydroelectric facility, an in-service date on or after January 1, 1980; a renewable energy resource created on or after January 1, 1998, by the modification or retrofit of any facility placed in service prior to January 1, 1998; or a mercantile customer-sited renewable energy resource, whether new or existing, that the mercantile customer commits for integration into the electric distribution utility's demand-response, energy efficiency, or peak demand reduction programs as provided under division (A)(2)(c) of section 4928.66 of the Revised Code, including, but not limited to, any of the following:

(a) A resource that has the effect of improving the relationship between real and reactive power;

(b) A resource that makes efficient use of waste heat or other thermal capabilities owned or controlled by a mercantile customer;

(c) Storage technology that allows a mercantile customer more flexibility to modify its demand or load and usage characteristics;

(d) Electric generation equipment owned or controlled by a mercantile customer that uses a renewable energy resource

.

(2) For the purpose of this section and as it considers appropriate, the public utilities commission may classify any new technology as such a qualifying renewable energy resource.

(B)

(1) By 2027 and thereafter, an electric distribution utility shall provide from qualifying renewable energy resources, including, at its discretion, qualifying renewable energy resources obtained pursuant to an electricity supply contract, a portion of the electricity supply required for its standard service offer under section 4928.141 of the Revised Code, and an electric services company shall provide a portion of its electricity supply for retail consumers in this state from qualifying renewable energy resources, including, at its discretion, qualifying renewable energy resources obtained pursuant to an electricity supply contract. That portion shall equal twelve and one-half per cent of the total number of kilowatt hours of electricity sold by the subject utility or company to any and all retail electric consumers whose electric load centers are served by that utility and are located within the utility's certified territory or, in the case of an electric services company, are served by the company and are located within this state. However, nothing in this section precludes a utility or company from providing a greater percentage.

(2) The portion required under division (B)(1) of this section shall be generated from renewable energy resources, including one-half per cent from solar energy resources, in accordance with the following benchmarks:

By end of year	Renewable energy resources	Solar energy resources
2009	0.25%	0.004%
2010	0.50%	0.010%
2011	1%	0.030%
2012	1.5%	0.060%
2013	2%	0.090%
2014	2.5%	0.12%
2015	2.5%	0.12%
2016	2.5%	0.12%
2017	3.5%	0.15%
2018	4.5%	0.18%
2019	5.5%	0.22%
2020	6.5%	0.26%
2021	7.5%	0.3%
2022	8.5%	0.34%
2023	9.5%	0.38%
2024	10.5%	0.42%
2025	11.5%	0.46%
2026 and each calendar year thereafter	12.5%	0.5%.

(3) The qualifying renewable energy resources implemented by the utility or company shall be met either:

(a) Through facilities located in this state; or

(b) With resources that can be shown to be deliverable into this state.

(C)

(1) The commission annually shall review an electric distribution utility's or electric services company's compliance with the most recent applicable benchmark under division (B)(2) of this section and, in the course of that review, shall identify any undercompliance or noncompliance of the utility or company that it determines is weather-related, related to equipment or resource shortages for qualifying renewable energy resources as applicable, or is otherwise outside the utility's or company's control.

(2) Subject to the cost cap provisions of division (C)(3) of this section, if the commission determines, after notice and opportunity for hearing, and based upon its findings in that review regarding avoidable undercompliance or noncompliance, but subject to division (C)(4) of this section, that the utility or company has failed to comply with any such benchmark, the commission shall impose a renewable energy compliance payment on the utility or company.

(a) The compliance payment pertaining to the solar energy resource benchmarks under division (B)(2) of this section shall be an amount per megawatt hour of undercompliance or noncompliance in the period under review, as follows:

(i) Three hundred dollars for 2014, 2015, and 2016;

(ii) Two hundred fifty dollars for 2017 and 2018;

(iii) Two hundred dollars for 2019 and 2020;

(iv) Similarly reduced every two years thereafter through 2026 by fifty dollars, to a minimum of fifty dollars.

(b) The compliance payment pertaining to the renewable energy resource benchmarks under division (B)(2) of this section shall equal the number of additional renewable energy credits that the electric distribution utility or electric services company would have needed to comply with the applicable benchmark in the period under review times an amount that shall begin at forty-five dollars and shall be adjusted annually by the commission to reflect any change in the consumer price index as defined in section 101.27 of the Revised Code, but shall not be less than forty-five dollars.

(c) The compliance payment shall not be passed through by the electric distribution utility or electric services company to consumers. The compliance payment shall be remitted to the commission, for deposit to the credit of the advanced energy fund created under section 4928.61 of the Revised Code. Payment of the compliance payment shall be subject to such collection and enforcement procedures as apply to the collection of a forfeiture under sections 4905.55 to 4905.60 and 4905.64 of the Revised Code.

(3) An electric distribution utility or an electric services company need not comply with a benchmark under division (B) (2) of this section to the extent that its reasonably expected cost of that compliance exceeds its reasonably expected cost of otherwise producing or acquiring the requisite electricity by

three per cent or more. The cost of compliance shall be calculated as though any exemption from taxes and assessments had not been granted under section 5727.75 of the Revised Code.

(4)

(a) An electric distribution utility or electric services company may request the commission to make a force majeure determination pursuant to this division regarding all or part of the utility's or company's compliance with any minimum benchmark under division (B)(2) of this section during the period of review occurring pursuant to division (C)(2) of this section. The commission may require the electric distribution utility or electric services company to make solicitations for renewable energy resource credits as part of its default service before the utility's or company's request of force majeure under this division can be made.

(b) Within ninety days after the filing of a request by an electric distribution utility or electric services company under division (C)(4)(a) of this section, the commission shall determine if qualifying renewable energy resources are reasonably available in the marketplace in sufficient quantities for the utility or company to comply with the subject minimum benchmark during the review period. In making this determination, the commission shall consider whether the electric distribution utility or electric services company has made a good faith effort to acquire sufficient qualifying renewable energy or, as applicable, solar energy resources to so comply, including, but not limited to, by banking or seeking renewable energy resource credits or by seeking the resources through long-term contracts. Additionally, the commission shall consider the availability of qualifying renewable energy or solar energy resources in this state and other jurisdictions in the PJM interconnection regional transmission organization, L.L.C., or its successor and the midcontinent independent system operator or its successor.

(c) If, pursuant to division (C)(4)(b) of this section, the commission determines that qualifying renewable energy or solar energy resources are not reasonably available to permit the electric distribution utility or electric services company to comply, during the period of review, with the subject minimum benchmark prescribed under division (B)(2) of this section, the commission shall modify that compliance obligation of the utility or company as it determines appropriate to accommodate the finding. Commission modification shall not automatically reduce the obligation for the electric distribution utility's or electric services company's compliance in subsequent years. If it modifies the electric distribution utility or electric services company obligation under division (C)(4)(c) of this section, the commission may require the utility or company, if sufficient renewable energy resource credits exist in the marketplace, to acquire additional renewable energy resource credits in subsequent years equivalent to the utility's or company's modified obligation under division (C)(4)(c) of this section.

(5) The commission shall establish a process to provide for at least an annual review of the renewable energy resource market in this state and in the service territories of the regional transmission organizations that manage transmission systems located in this state. The commission shall use the results of this study to identify any needed changes to the amount of the renewable energy compliance payment specified under divisions (C)(2)(a) and (b) of this section. Specifically, the commission may increase the amount to ensure that payment of compliance payments is not used to achieve compliance with this section in lieu of actually acquiring or realizing energy derived from qualifying renewable energy resources. However, if the commission finds that the amount of the compliance payment should be otherwise changed, the commission shall present this finding to the general assembly for legislative enactment.

(D) The commission annually shall submit to the general assembly in accordance with section 101.68 of the Revised Code a report describing all of the following:

(1) The compliance of electric distribution utilities and electric services companies with division (B) of this section;

(2) The average annual cost of renewable energy credits purchased by utilities and companies for the year covered in the report;

(3) Any strategy for utility and company compliance or for encouraging the use of qualifying renewable energy resources in supplying this state's electricity needs in a manner that considers available technology, costs, job creation, and economic impacts.

The commission shall begin providing the information described in division (D) (2) of this section in each report submitted after September 10, 2012. The commission shall allow and consider public comments on the report prior to its submission to the general assembly. Nothing in the report shall be binding on any person, including any utility or company for the purpose of its compliance with any benchmark under division (B) of this section, or the enforcement of that provision under division (C) of this section.

(E) All costs incurred by an electric distribution utility in complying with the requirements of this section shall be bypassable by any consumer that has exercised choice of supplier under section 4928.03 of the Revised Code.

Amended by 130th General Assembly File No. TBD, SB 310, §1, eff. 9/12/2014.

Amended by 129th General AssemblyFile No.125, SB 315, §101.01, eff. 9/10/2012.

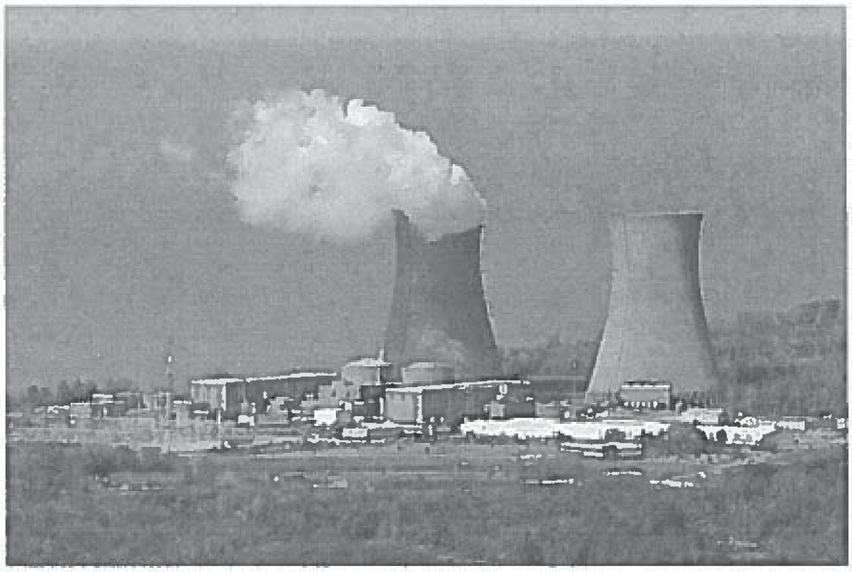
Amended by 128th General AssemblyFile No.48, SB 232, §1, eff. 6/17/2010.

Amended by 128th General Assemblych.48, HB 2, §101.01, eff. 7/1/2009.

Effective Date: 2008 SB221 07-31-200.

Related Legislative Provision: *See 129th General AssemblyFile No.39, SB 171, §4 .*

FirstEnergy Corp. to sell or close its nuclear power plants



The Perry nuclear power plant east of Cleveland is one of four reactors that FirstEnergy is preparing to sell or shut down because atomic energy, once "too cheap to meter," is often now more expensive that power generated by high-tech combined-cycle gas turbines. The FirstEnergy subsidiary which owns the power plants is today worth less than its combined long-term debt *(Plain Dealer file)*

By John Funk, The Plain Dealer
Follow on Twitter
on February 22, 2017 at 2:51 PM, updated February 23, 2017 at 7:22 AM

AKRON, Ohio -- FirstEnergy made it clear Wednesday that it is leaving the competitive power plant business, closing or selling all of its plants, including its nuclear plants, by the middle of next year.

The sale of the nuclear plants to another company would have little immediate impact on customer bills.

Closing the plants, which would probably take several years, would also have little impact on customer bills or power supplies.

Here's why:

Because Ohio has deregulated electric markets, the Illuminating Co., Ohio Edison and Toledo Edison buy the power they deliver through an ongoing series of state-monitored auctions designed to obtain the lowest wholesale price.

FirstEnergy Solutions, the unregulated subsidiary of FirstEnergy which owns the power plants, competes in these state-monitored auctions. Sometimes it doesn't win even a portion of what the three delivery companies think they will need because of the heavy competition.

Additional power, if required, is also purchased from wholesale markets where day-ahead and hour-ahead competition determine the price.

Not all of FirstEnergy's customers buy power from the local delivery companies. Customers who have signed power contracts with outside suppliers, some many states away, would not be affected if a nearby FirstEnergy Solutions plant were closed.

In other words the power flowing second-by-second into homes and businesses here could have been generated anywhere in the region by any number of power companies.

We are going to do it for all the right reasons, though it's not going to have any impact on shareholder value."

Finally, there is PJM Interconnection.

PJM is the non-profit company charged with keeping the high-voltage grid stable and with making sure there is enough power minute-by-minute in Ohio and 12 other states from Illinois to New Jersey, Maryland and Washington, D.C.

PJM has a lot to say about power plant closures.

PJM can ask a company to continue to operate a power plant if it concludes the closing would jeopardize grid stability. The company can then go to the Federal Energy Regulatory Commission to ask for extra payments to continue operating.

In such cases, PJM provides the extra payments to the power plant owner as it did in 2012 when FirstEnergy announced that it would close a series of power plants on the lake, including the Eastlake plant. Customers paid those extra charges on the delivery side of their bills.

PJM required FirstEnergy to build a new transmission line from the Ohio River to Cleveland before it would approve the closings. Eastlake finally closed in 2015.

Closing any power plant means the layoff of employees and a loss of property taxes to local schools, and FirstEnergy is expected to make these kinds of arguments when it appeals to state lawmakers for a new kind of subsidy.

The company's acknowledgement Wednesday **during a teleconference** with financial analysts that it plans to sell or close its three nuclear plants came 24 hours after an **Ohio lawmaker revealed** that the FirstEnergy is seeking what amounts to additional and unprecedented rate increases.

The money from these first-of-a-kind charges would be earmarked for Davis-Besse, located east of Toledo, Perry, located east of Cleveland, and Beaver Valley, northwest of Pittsburgh.

FirstEnergy is proposing that the state create a program awarding "Zero Emission Credits" to the three plants because nuclear reactors do not produce carbon dioxide or other combustion pollutants.

In other words, the state would give zero carbon emissions a financial value, just as it previously enacted laws giving a financial value to wind and solar power by creating renewable energy credits, or RECs, which power companies could buy if they did not own their own wind and solar farms.

But in this case, customers would pay directly for those credits -- called Zecs -- on the delivery side of their monthly bills.

5-9%

If lawmakers approve the plan, consumers would see an estimated 5 percent increase in their monthly bills. Commercial and industrial customers would see bills increase by 5-to-9 percent to reflect the value of the millions of megawatts the nuclear plants generate.

The Zec program would give the company's nuclear fleet an increase of about $300 million a year, maybe enough to offset the losses competitors running gas turbine power plants have inflicted.

The gas units have driven down prices in competitive markets where The Illuminating Co., Ohio Edison and Toledo Edison buy power, the same markets the FirstEnergy Solutions power plants must sell into. In Ohio alone there are currently four large gas turbine plants under construction. Another seven or eight are seeking permits.

Even if the state creates a Zec program to subsidize FirstEnergy's nuclear plants, the company acknowledges that it intends to try to sell them because it no longer wants to operate in competitive markets.

"We are going to work hard on this [Zec] legislation because I believe it is the right thing to do for the state of Ohio," said Charles Jones, CEO, in answer to a number of questions from financial analysts during a teleconference to discuss the company's sales and profits in 2016 and the fate of its four nuclear plants.

"I believe it is the right thing to do for these [power plants] ... for our employees who work at these facilities...[and] for these communities," Jones continued to explain why FirstEnergy is seeking the ZECs.

"We are going to do it for all the right reasons, even though it is ultimately not going to have any impact to the shareholder value of FirstEnergy over the long haul," Jones said.

Jones last November told investors and analysts that the company wanted to operate as a regulated utility -- with guaranteed rates of return for improving or expanding its local wires and distant high-voltage transmission line.

He made it clear then that unless Ohio would consider re-regulating, FirstEnergy would sell or close its old power plants and become a delivery-only company. Lawmakers have not shown any desire to tackle re-regulating the state. Such a legislative move would take years, say analysts, not the 18 months the FirstEnergy wants.

The company's background materials accompanying Wednesday's financial report show that FirstEnergy Solutions has a total value of $1.6 billion But the subsidiary carries a long-term debt of $3 billion.

The nuclear power plants are now valued at $900 million -- with a debt of about $1.3 billion, the documents show.

"I cannot speak for prospective new owners of these four nuclear units, but I can tell you this: Running nuclear reactors isn't something that just anybody can do. There is a significant amount of ...risk," Jones told an analyst who wanted to know whether FirstEnergy would change course and operate the reactors if they could somehow be put back under regulation.

"I don't think there is any guarantee -- absent some other support for these units -- that they are going to keep running far into the future," Jones said.

The new charges would be "non-bypassable," meaning a customer could not avoid the ZEC charges by purchasing power from another supplier.

The Ohio Zecs would be similar to a program Illinois created last fall to assist nuclear plant owners there. Opponents immediately sued in federal court, claiming an unconstitutional subsidy because the state is deregulated and power prices are set on competitive markets.

A piecemeal state-by-state Zec program to bail out nuclear plants could pose a problem for PJM, said PJM's top executive **in an interview** earlier this week. Andrew Ott, CEO, said such a program would be more cost effective if done on a regional basis rather than one state at a time or one plant at a time. It would also spread out the costs.

The company's decision to sell or close its plants in Ohio and Pennsylvania leaves power plant operations intact in West Virginia, which is not deregulated, and the cost of the power from the coal-burning power plants in that state reflects the what it cost to generate.